6. **DESCRIPTION OF THE PROJECT AREA**

6.1 **Introduction**

The EEZ Act\(^{32}\) requires a description of "the current state of the area where it is proposed that the activity will be undertaken and the environment surrounding the area."

The area of interest in relation to the TTR project is the northern part of the South Taranaki Bight. Descriptive information on the existing environment in TTR’s area of interest is summarised in the following sections. Detailed information is contained in the Technical Reports cited for each subsection.

6.2 **Geology**

| Technical report reference | NIWA (2013c) “Geological Desktop Summary Active Permit Areas 50753 (55581), 54068 and 54272, South Taranaki Bight” |

6.2.1 **Iron sands resource - general**

Iron sands are the largest known reserve of metalliferous ore in New Zealand. Iron sand is a general term for sand-sized grains of iron-rich minerals, principally magnetite (Fe\(_3\)O\(_4\)), titano-magnetite (Fe\(_2\)TiO\(_3\)), and ilmenite (FeTiO\(_3\)). New Zealand’s iron sands occur extensively in coastal dunes and on the adjacent continental shelf of the western North Island, and have been successfully mined onshore for over 35 years.

Offshore deposits of iron sand have been known since the early 1960s, but early estimates of their reserves were poorly constrained, and to date offshore deposits remain unexploited. With the growing demand for raw materials on international markets, there has been increasing interest in the feasibility of exploiting beach, shoreface and submarine iron sand deposits. Since 2005, there has been significant interest in offshore prospecting permits in New Zealand.

In addition to TTR, other mining companies that have also initiated exploration programmes include Rio Tinto/Iron Ore New Zealand, Sinosteel Australia, FMG Pacific, Iron sands Offshore Mining, and Sericho Developments. Many have undertaken offshore sediment coring and drilling campaigns, aeromagnetic surveys, and marine geophysical surveys to better identify and quantify potential shelf and nearshore iron sand deposits. Geographically, active and applied permits cover almost the entire west coast of the North Island north of the Wanganui Bight (Figure 36).

6.2.2 **Current iron sand mining projects**

New Zealand’s largest onshore iron sand mines occur on land in coastal dune fields along the northern Taranaki coast, which locally form a strip a few kilometres wide. Concentrations of titano-magnetite can locally reach 70% by weight in the youngest aeolian deposits and form the main ore resource. The largest iron sand mine at Taharoa opened in 1972, with 215 million tonnes of Proved and Probable Ore Reserves (as of 2002). Since then, New Zealand Steel Mining has provided continuous supply to its North Asian customer base, with peak annual exports of two million tonnes in the late 1970s. In 2008, 563,000 tonnes of iron sand was mined from Taharoa.

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\(^{32}\) EEZ Act, section 39(1)(b)
Figure 36: Map of active minerals permits for the North Island of New Zealand
Source: NZPM website, Aug 2013. The dashed blue line is the 12 NM limit. (Data and image modified from NZPM permits portal). TTR’s mining permit application relates only to sub-area 55581 within 50753.
At the Waikato North Head mine, near the Waikato River mouth, figures published by Crown Minerals and New Zealand Steel Ltd indicate that 1.160 million tonnes of sand were mined in 2008. The deposit reportedly contains around 107 million tonnes of Proved and Probable Ore Reserves (as of 2004).

The Waikato North Head and the Taharoa mines occur in large basement depressions that have provided significant accommodation space to develop thick iron sand deposits. The former occurs in a subsided graben (fault-bound valley) immediately north of the Waikato River, and the latter partly in fills a river valley.

6.2.3 Southern Taranaki Bight Sea-floor sediments (Hawera to Tangimoana)

Sediment deposition on the seafloor of the South Taranaki and Whanganui bights since the last-glacial maximum has been controlled primarily by patterns of sea-level rise. Other contributing drivers have been the quantity and nature of the landward-derived sediment supply and the evolving hydraulic regime of the shelf, from initially tide-dominated to storm-dominated as sea level rose and the Cook Strait opened. The last glaciation reached its maximum in New Zealand approximately 18,000 years ago, when sea level was about 120 m lower than today. The subsequent post-glacial sea-level rise occurred episodically, as a series of rapid transgressions punctuated by stillstands, or even minor regressions, which lasted up to two thousand years. Modern sea level (±1 m) was attained ~6,500 years ago.

6.2.4 Origin of offshore iron sand deposits

The coastal iron sands of the central North Island west coast are primarily derived from andesites from the Taranaki volcanics, as strongly suggested by their mineral assemblages, and by the dispersal trends in iron sand concentration. Iron sands on the continental shelf also display a strong Taranaki volcanic provenance, as shown by the concentrations immediately north and south of Cape Egmont. Local fluxes of iron sand, for example off the Mokau River, suggest input from other sources, such as recycling of older, onshore sand deposits.

6.2.5 Surficial distribution

Iron sand concentration maps show the distribution of iron sand along the North Island west coast with sediments containing >5% iron sand spatially restricted to the inner and middle shelves off Auckland, Taranaki and Whanganui. Elsewhere, iron sand contents are low (<2%), with a slight increase in concentration to 2-4% off Kawhia Harbour. A narrow belt extends from the mouth of the Waikato River to just south of Kaipara Harbour, in water depths of 20-40 m. The highest iron sand concentration of 39% was recorded near the Waikato River mouth with a gradual decrease to the northwest. In contrast, concentration gradients to the southeast and offshore are steep, and the iron-rich belt is strongly delineated.

A second prominent coast-parallel belt exists in the North Taranaki Bight, from Cape Egmont to Tirua Point in depths of 40 m and shallower. Locally, iron sand concentrations reach maximum values off New Plymouth (65%) and the Mokau River (36%), from which concentrations gradually diminish northward.

A third southern belt occurs in the South Taranaki Bight, offshore of Patea, reaching a maximum concentration of 22%, but iron sand concentrations >5% persist south-eastward along the coast to offshore Whanganui. An offshore belt, with lower iron sand concentrations (1-5%), extends from Cape Egmont to Auckland in depths of 75-100 m.

Recent NIWA analyses broadly confirm previous indications that the inner shelf off Hawera shows high concentrations of iron, with several surface sediments returning values >10%. This is likely a function of the close proximity of iron sand-rich source
rocks, delivered to the coast by the multitude of rivers that drain the Mt Taranaki volcanic complex and iron sand-rich, coastal sedimentary deposits. Bathymetric gradients steepen westward approaching Cape Egmont, which may limit the ability to develop beach-face sand deposits that pro-grade onto the shelf and will limit the breadth of sediment supply by littoral transport. Lahars associated with Mt Taranaki also extend out onto the inner-shelf south of the mountain’s flanks.

6.2.6 Aerial magnetic survey

Fugro Airborne Surveys Pty Ltd was commissioned by TTR in 2010 to acquire, interpret and model new airborne geophysical data over the prospect permit areas in the northern and southern Taranaki bights. Interpretation and inversion modelling of resultant data assist focusing of subsequent iron sands exploration, with particular attention paid to the potential development of meandering lowstand river channels and contemporaneous iron sand-rich aeolian dunes offshore of Patea (Figure 37).

Figure 37: Aerial magnetic survey results for STB annotated to highlight magnetic anomalies

6.2.7 Depositional Model

A depositional model, showing how the offshore high grade deposits formed and were subsequently preserved and reworked, was developed for the area, is set out in Figure 38.

Figure 39 illustrates a typical present day South Taranaki coastline with iron sand concentrate at a stream mouth, with tidal, wave and longshore drift enhancing the concentration of the beach deposit. These same processes occurred historically as sea levels rose and fell, resulting in the present-day situation where there are offshore examples of remnant coastal dune features (paleo-dune features) formed at the mouths of ancient river systems. The rivers were locally controlled by active faulting with the iron sands within the river channels and dunes being partially reworked by currents and long shore drift and were subsequently preserved and re-worked.
**Figure 38:** Geological model of offshore titano-magnetite mineral resource within the mining area

**Figure 39:** Present-day South Taranaki coastline
6.3 Physical Oceanography

6.3.1 General Description


6.3.2 Scope of Investigation

A comprehensive set of current, wave and suspended-sediment measurements was collected during the approximate 7-month period from 09 September 2011 to 01 July 2012 (excluding gaps between deployments). The range of winds experienced during the field programme was typical of the long-term wind climate and included a more extreme “weather-bomb” event (3 March 2012).

A wide range of oceanographic investigations was undertaken at sites shown in Figure 40.

![Figure 40: Oceanographic investigation sites](image)

6.3.3 Bathymetry

TTR commissioned NIWA to undertake extensive multibeam bathymetry surveys covering the STB in relation to the Project. Results of this survey have been incorporated into the detailed bathymetry map set out in Figure 41.
Figure 41: South Taranaki Bight - Bathymetry
6.3.4 Currents

Current velocities were measured at five sites in the STB. The data show the prevailing patterns of water movements in the STB, with tides and winds being the main contributors. Tidal currents account for 40-78% of the measured currents at all sites, with wind driven current accounting for the remainder. The peak ebb or flood current speed of the main twice-daily lunar (M2) tide, ranged between 0.13 m/s and 0.25 m/s for an average tide. Somewhat higher and lower tidal speeds occur on spring and neap tides respectively. At all sites the M2 tide is oriented in the SE-NW direction (parallel with the coastline). The presence of such tidal current speeds well offshore in the STB arises from the alternate flow of water over the extensive, relatively-shallow, shoals off Hawera and Patea.

Currents in the STB are also substantially affected by wind conditions. Large current speeds of around 1 m/s were measured on a number of occasions during periods of high winds. Winds blowing from the W and the SE sectors had the most pronounced influence on currents (see Figure 42).

Moderate to strong winds not only increased current speeds but also greatly altered current direction. During strong winds, currents could set in a constant direction for more than 24 hours; during calm conditions, currents reversed approximately every 6.2 hours with the tides re-asserting dominance.
At most sites during periods of light winds the prevailing current drift was towards the SE, which is consistent with the influence of the d’Urville Current, which sweeps past Farewell Spit and turns around in the STB to head south. However, current drift directions were significantly altered by moderate to strong SE winds which reversed the drift towards the NW. During moderate to strong W-NW winds, the prevailing SE drift was considerably enhanced.

When there was any sand in suspension, suspended sand concentration close to the seabed was typically much greater than the suspended fine-sediment concentration. The largest suspended-sand concentration very close to the seabed was 1,900 mg/l. At all sites, periods of increased sand concentration coincided with periods of large waves, thus highlighting the importance of waves in re-suspending sand from the seabed in the STB. During calm periods, no sand was found to be in suspension.

Over the duration of the largest sediment-transport event, 3,355 kg of sand per metre width of seabed was transported in suspension by currents. This equates to a volume of 2.1 m$^3$ of sand transported per metre width of seabed (gross transport rates in any direction).

Overall, the field dataset provides a coherent picture of currents, waves and suspended-sediment concentrations in the STB. The datasets, which have been carefully calibrated to produce accurate measures, can be used with confidence in the development of numerical models of current flows, waves and suspended-sediment plume dispersion in the STB.

### 6.3.5 Wave Characteristics

|----------------------------|---------------------------------------------------------------------------------------------------------|

Waves are a major driver of sediment transport, particularly in the nearshore and surf zone. Most wave energy in the South Taranaki Bight comes from large southwest swells from the Southern Ocean and locally generated wind waves from the Tasman Sea that vary in size and direction with season. On the shelf and in the extraction area seabed stirring by waves entrains seabed sediments that can then be advected by currents. In the nearshore and surf zone sand transport along and across the shore is driven primarily by the waves arriving at an angle to the shore.

NIWA developed a numerical model, verified against records from wave buoys and satellite altimeters, which details a 20-year hindcast of wave conditions for the South Taranaki Bight. The model simulations provide records of wave statistics along the 50 m isobath at 43 output locations, including significant wave height, mean and peak wave period, mean and peak wave direction, wave energy flux, as well as associated wind speed and direction.

The 20-year average significant wave height for all output locations is plotted in Figure 43 (Left). This shows that the largest wave heights are found off the western end of the Taranaki Peninsula, decreasing further south with increasing shelter from prevailing SW swell.

This pattern is also seen in the corresponding average of wave energy flux (Figure 43 Right), which is a vector quantity reflecting the magnitude and direction of energy transfer by the waves. Figure 43 shows relatively strong energy transfer, principally
from the WSW, at the northern end of the South Taranaki Bight, while further south, the more southerly energy components become blocked. Note that the magnitude of the vector mean energy flux will always be somewhat less than the mean of the magnitude of the energy flux vector. The orientation of energy flux relative to the coast is also significant, as wave energy reaching the coast at an oblique angle (i.e., not perpendicular to the coast) will drive longshore sediment transport.

Inshore of the 50 m isobath the incident wave direction is affected by quite complex bathymetry. In the nearshore, wave and breaking angle (relative to the shore) are further affected by shore platforms and rock reefs. These effects, and the resulting detailed patterns of longshore sediment transport, are addressed by nearshore wave modelling as described in Section 11.1 of this IA. The mean wave energy transport seen offshore tends to favour wave-driven longshore transport towards the southeast in the northern part of the Bight, from Opunake to south of the Whanganui River, beyond which northward transport would be more favoured.

The model predictions show a seasonal cycle with mean wave heights reaching a maximum in late winter and a minimum in late summer. At site 15 (off Patea), for example, the 20-year mean significant wave height is 1.9 m, but with monthly means varying between 1.5 m in February and 2.2 m in August. In comparison the wave period varies little, the 20-year mean of the peak wave period is 11.2 sec, but with monthly means varying between 10.3 sec in January and 11.9 sec in August. At site 20 (off Waitotara), the 20-year mean significant wave height is 1.8 m, with monthly means varying between 1.4 m in February and 2.1 m in August. Here as well the wave period shows little seasonal variation: the 20-year mean of the peak wave period is 11.4 sec, but with monthly means varying between 10.4 sec in January and 12.0 sec in August.

Data indicate that at site 15 (off Patea), the most frequently occurring significant wave height is approximately 1.5 m (somewhat below the mean value of 1.9 m), but that the distribution has quite a long tail, up to a maximum of 8.0 m. Peak wave period (usually reflecting the swell component of the spectrum is typically around 12 seconds, while the second moment mean period (more influenced by short wind/sea) is spread through the range 5-10 seconds with values around 7 seconds predominating. There is a predominance of waves from the southwest through westerly sectors, with a strong seasonality in the likelihood of energetic wave conditions.

6.3.5.1 Effect of climate change on wave conditions

In the next 50 years climate change is predicted to cause a rise in sea level (by 25 cm) and changes to the wave climate. In this study, the wave modelling undertaken to predict the effect of modifications in seabed bathymetry (pits and mounds) due to sand extraction has been carried out using present day wave climate statistics. If the wave climate was to change significantly with future climate change then those predictions would be less accurate. The time frame under consideration is at least 20 years (the possible duration of a mining permit) or longer if the pits and mounds formed on the seabed were to remain unaltered by natural processes of infilling and scour.

To address this issue NIWA developed a ‘futurecasts’ of the effects of climate change on sea conditions and wave climate which demonstrates that the changes in wave climate due to climate change are very small and will not alter the natural wave processes significantly in the next 20 years. Therefore, these changes will not alter predictions of the impacts of extraction on coastal stability presented elsewhere in this IA.
**Figure 43: Wave Data**

**Left:** Spatial distribution along the 50 m isobaths of mean significant wave height averaged over a 20 yr hindcast record.

**Right:** Spatial distribution along the 50 m isobaths of mean wave energy flux, averaged over a 20 yr hindcast record. Colour scale shows the mean of the magnitude of the energy flux, while the arrows show the vector averaged flux.
### 6.4 Coastal Physical Characteristics


The coast adjacent to the TTR Project area lies on the southern flank of the Cape Egmont ‘mega-headland’, on a very exposed and energetic coast. This coast has seen continual tectonic uplift and erosion over the past 15,000 years or so, producing almost continuous near-vertical, 30 - 50 m tall cliffs along about 70% of the coast. As the cliffs retreated they left behind a hard shore platform on which sandy beaches developed at the base of the cliffs (Figure 44).

![Figure 44: Hawera Beach showing high cliffs and typical profile](image)

Beaches have formed in places where shallow embayments in the coast and headlands provide shelter from waves. Along the section of coast without cliffs (from the Patea River to about Waihau), the beaches are backed by foredunes, landward of which transgressive dunes, now stabilised by farm pasture, have formed where sand picked-up from the beach by strong winds is blown far inland to smother low lying topography and rising ground.

Erosion of coastal cliffs supplies sediment to the beaches. Sand is also transported into and through the area from alongshore by waves. Transport can be particularly large at times of storms when large waves create a surf zone and corridor for sand transport more than 500 m wide. Under these conditions sand is moved in pulses or slugs along the shore, which are visible in beach profile records (illustration in Figure 45).

The net change in beach volume varies greatly, from erosion at some sites to accretion at others. There is no pattern of change in erosion and accretion along the shore. The overall picture seen for the South Taranaki Bight is one of high variability in beach morphology, erosion and accretion throughout the year, small net storage of sand on the beaches and large quantities of sand passing through the beach systems. With the exception of the sand stored in the transgressive dunes, the sand storage on beaches is rather transient in a system of highly connected sand storage units.
Regional trends in coastal stability are, at least partly, explainable by regional trends in wave height as shown in Figure 46.
6.5 Sediment Movement


6.5.1 Introduction

TTR commissioned NIWA to give consideration to nearshore and offshore sediment movement with findings summarised below.

As noted in Section 6.4, there is considerable sand movement across the beaches along the STB, with sand moving back and forth in swash bars between the nearshore bars and the beach, and alongshore as slugs of sediment in low broad shore normal bars.

Storms do not always result in erosion on all parts of the beach, as a consequence of these pulses of sand moving along the shore. This highly variable geomorphology is driven by the large waves on this coast that run to the top of the beach in storms and high tides.

Changes in sand volumes measured by beach profile surveys at the eight sites between Ohawe and Kai Iwi over the period June 2011 to April 2012 show that the net change in beach volume and sand storage varies from erosion at some sites to accretion at others (Table 17). The 11 months of profile data show no spatial or temporal pattern of change in erosion and accretion along the shore, just considerable change. The total movements of sand on and off the beach over the year were of the order of at least 6-times to 39-times greater than the net change in sand storage. The beaches are continually changing as large volumes of sand enter and leave and are redistributed in the beach system.

<table>
<thead>
<tr>
<th>Site</th>
<th>Length of beach spanned by profiles (m)</th>
<th>Net change in beach volume (m³/km of shoreline)</th>
<th>Total amount of sand moving on and off the beach (m³/km of shoreline)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ohawe</td>
<td>500</td>
<td>+23,200</td>
<td>137,000</td>
</tr>
<tr>
<td>Hawera</td>
<td>530</td>
<td>-7,300</td>
<td>67,000</td>
</tr>
<tr>
<td>Manawapou</td>
<td>680</td>
<td>+25,700</td>
<td>247,000</td>
</tr>
<tr>
<td>Patea</td>
<td>360</td>
<td>-15,900</td>
<td>169,500</td>
</tr>
<tr>
<td>Waverley</td>
<td>400</td>
<td>+4,700</td>
<td>109,600</td>
</tr>
<tr>
<td>Wainu</td>
<td>400</td>
<td>-10,100</td>
<td>100,500</td>
</tr>
<tr>
<td>Ototoka</td>
<td>630</td>
<td>-6,100</td>
<td>205,100</td>
</tr>
<tr>
<td>Kai Iwi</td>
<td>420</td>
<td>-5,300</td>
<td>203,300</td>
</tr>
</tbody>
</table>

Table 17: Sand volume changes from beach profile data - June 2011 to April 2012

6.5.2 Littoral processes and sediment budget

In the context of predicting the impacts of offshore sand extraction on the shoreline it is important to consider sediment transfers in the coastal sand system. For example, sand extraction offshore may, for instance, significantly reduce the supply of sand to the beach and cause a sediment deficit in the littoral cell resulting in beach erosion.

The STB coastal sand system is large, extending over 200 km from Cape Egmont in the north to about Kapiti Island in the south. The seaward boundary is more diffuse and some distance offshore where cross shore sand transfers between the beach and the seabed become insignificant.

Sediment transfers along the coast are driven primarily by waves. With the exception of the sand stored in the transgressive dunes, the sand storage on beaches in the STB is rather transient in a system of highly connected sand storage units. Sand is exchanged on and off the shore between the beaches and the nearshore bars. Sand is driven to the NW and SE along the shore depending on the wave direction, but primarily to the SE. Big waves and a surf zone 100s of metres wide provide a highway for sand to move from re-entrant (embayment) to re-entrant along the shore and to bypass the river mouths.
The coastal sediment budget in the South Taranaki Bight is primarily made up of inputs from longshore transport into the area, onshore transport, river transport and seacliff erosion. Sediment is lost through longshore transport out of the area, wind transport away from the beach, offshore transport and solution and abrasion. While it is easy to identify the inputs and outputs of sediment they are much more difficult to quantify.

In the STB, the longshore sediment transport potential is large and of the order of 20 million m³/yr in the NW at Ohawe. It reduces south-eastward along the shore to about 2 million m³/yr at Kai Iwi. The onshore wave energy flux is also large. However, longshore and cross shore transport into the area is difficult to estimate and does not supply reliable numbers for a sediment budget.

6.5.3 River Inputs

Rivers along the project shore deliver sediment derived primarily from erosion of sedimentary and volcanic rocks in their catchments. These sediment inputs are visible as nearshore plumes of muddy water extending several kilometres offshore and along the coast from the river mouths after flood events.

Estimates of the suspended sediment yield from the major rivers are given in Table 18. Most sediment derives from the Patea, Whenuakura, Waitotara and Whanganui Rivers. The total annual yield from the rivers is of the order of 2,930,600 m³/yr (or 5,861,200 tonnes/yr), however it is unclear what proportion of the input from each of these rivers is beach grade material and therefore this is an unreliable estimate for the budget.

<table>
<thead>
<tr>
<th>River</th>
<th>Upstream area (km²)</th>
<th>Mean flow (m/s)</th>
<th>Sediment yield (tonnes/yr)</th>
<th>Sediment yield (m³/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waiaua River (Opunake)</td>
<td>46.4</td>
<td>3.6</td>
<td>4900</td>
<td>2450</td>
</tr>
<tr>
<td>Kaupokonui Stream</td>
<td>146.3</td>
<td>8.6</td>
<td>9700</td>
<td>4850</td>
</tr>
<tr>
<td>Waingongoro R (Ohawe)</td>
<td>233.1</td>
<td>7.8</td>
<td>9100</td>
<td>4550</td>
</tr>
<tr>
<td>Tangahoe River</td>
<td>285.1</td>
<td>4.2</td>
<td>43900</td>
<td>21950</td>
</tr>
<tr>
<td>Manawapou River</td>
<td>120.9</td>
<td>1.9</td>
<td>15000</td>
<td>7500</td>
</tr>
<tr>
<td>Patea River</td>
<td>1048.5</td>
<td>30.4</td>
<td>310600</td>
<td>155300</td>
</tr>
<tr>
<td>Whenuakura River</td>
<td>465.3</td>
<td>9.9</td>
<td>275900</td>
<td>137950</td>
</tr>
<tr>
<td>Waitotara River</td>
<td>1162.0</td>
<td>23.3</td>
<td>475400</td>
<td>237700</td>
</tr>
<tr>
<td>Kai Iwi Stream</td>
<td>191.0</td>
<td>1.8</td>
<td>16900</td>
<td>8450</td>
</tr>
<tr>
<td>Whanganui River</td>
<td>7113.8</td>
<td>229.0</td>
<td>4699800</td>
<td>2349900</td>
</tr>
</tbody>
</table>

Table 18: Suspended sediment inputs from the rivers flowing into the study area.

Note: The mean flow is a cumulative catchment average. The data is sourced from NIWA’s WRENZ model (http://wrenz.niwa.co.nz/webmodel/), and has been compiled in a manner described in Hicks et al. 2011). A factor of 2 has been used to convert sediment yield in tonnes/yr to cubic metres/yr.

6.5.4 Shoreline erosion

Seacliff erosion supplies sand to the beaches and nearshore seabed, by waves and currents. The cliffs that comprise 70% of the shoreline are composed of soft sedimentary material, largely Pliocene Wanganui Series mudstones, sandstones, shell beds, limestone and conglomerates. In places this is capped with Pleistocene conglomerates, marine sand, dune sand, volcanic sand and lignite bands. The cliff face erodes catastrophically by slumping, also aided by groundwater seepage though the strata and joints in the cliffs, large waves undercutting the base and removing slumped material and perhaps tectonic activity such as earthquakes. Slumped sediment and rock protects the cliff base until wave action removes the debris. NIWA field observations suggest that the soft sedimentary sandstone and mudstone components of this material break down rapidly. Slumped deposits seen at the toe of the cliffs on one survey may have been partially
washed away by waves on a subsequent visit. The total supply of sandy and gravelly material to the beaches has been estimated by assuming that if cliffs averaging 30 m tall were eroding at 0.3 m/yr over 70% of the 100 km of coast between Ohawe and Whanganui, then the supply of sediment to the coast would be around 630,000 m$^3$/yr (acknowledging there is considerable uncertainty about the absolute value, as this figure is derived from limited data). Along the non-cliffed shore, the sand dunes are cut back and build forward again in cycles of erosion and accretion exchanging sand with the nearshore.

6.5.5 Net sediment transport from model runs

Numerical modelling was used to simulate the transport and deposition of seabed sediment in the extraction area (NIWA 2013). A simulation was run to predict the suspended sediment transport associated with 2 years of currents and waves over a patch of seabed in the extraction area of dimensions 2 km x 3 km, representing one year's worth of iron sand extraction. The patch was represented by 4 classes of sediment, namely: coarse sand (> 500 µm, 14.3%), medium-fine sand (150–500 µm, 80.7%), very fine sand (90–150 µm, 4.2%), and very coarse silt/very fine sand (38–90 µm, 0.8%).

Time-lapse imagery from the model simulations shows that sand in the lower 1 m of the water column at the extraction site gets lifted into suspension reasonably often, but doesn't travel far before it is deposited again. After 730 days, patch material is found on the surrounding seabed at thicknesses of 0.2 - 0.3 mm up to 3 km from the patch boundary and >0.1 mm up to 6 km from the patch boundary (Figure 47). The maximum thickness outside the patch boundary is 18 mm. The patch material has been transported in all directions away from the patch but with a bias to the southeast and in the direction of the prevailing current. The patterns of distribution of both the suspended sediment concentration and deposition indicate that sediment is not distributed far from the site, and that the transport of sand to the shore from this site (or a deficit therein) will take a lot more than 2 years. There is no significant connection between seabed sediment at the extraction site and that at the shore.

Figure 47: Simulated net accumulation of sediment around seabed patch in extraction area

Notes: (1) Figure shows result at end of model simulation of 700 days of wave and current forcings. The yellow area bounded by a black rectangle is the patch sediment. (Source NIWA 2013)); (2) Figure shows the 99$^{th}$ percentile of values over the last 365 days of a model simulation of 700 days of wave and current forcings.
6.6 **Seabed morphology and sediments**

The inner continental shelf out to 50 m depth is about 30 km wide off Hawera, widens to about 40 km off Patea, and then narrows immediately south of this to about 20 km wide to as far south as Whanganui. Its topography between about 10 and 50 m depth is characterised by banks and shoals and ridges off Patea and Waitotara. These features extend seawards from about the 20 m isobaths, making angles of c.110 to 170 degrees to the shore. At their seaward end in 30 to 40 m water depth they curve in a SE to E direction. These features tend to be aligned with the net (or mean) current which flows NW to SE through the region. They can be large in size with individual features offshore from Patea more than 20 km long and 5 to 10 m in elevation.

Bedforms in the STB generally form two basic types: those in the nearshore zone are mainly erosional; and those offshore are depositional. Erosional bedforms occur at <30 m water depth, and comprise elements such as rock outcrops and ancient buried river valleys from differential weathering of the underlying Plio-Pleistocene mudstone. In contrast, at >30 m water depth storm-generated depositional bedforms occur, including dunes and ridges, sand ribbons, symmetrical megaripples and sand waves.

The largest sediment bodies are situated immediately southeast of the mouth of the Whanganui River. These deposits are 4-12 m high, several hundred metres wide, several kilometres long, and aligned sub-parallel to the coastline. Their surface is composed of iron sand and volcanic pebbles, interpreted to be sourced from Mt Taranaki. These sand ridges are located on relatively flat seafloor.

An analysis of the hydrodynamic motions required to create bedforms of this size at 30-50 m water depth inferred that they are more likely to be formed 9,000-12,000 years ago as shore-connected shoals. Their location and orientation on the shelf is consistent with the estimated position of the transgressive shoreline at that time. Their formation appears to have ceased about 9,000 years ago with rising sea level, when Plio-Pleistocene rock promontories around 25 km west of Whanganui began to act as natural barriers to the supply of iron sand within the littoral drift system. As the sea transgressed the inner shelf, these outcrops of shelly sandstone formed headlands and reefs that dammed the eastward, longshore supply of iron sand. Supply was not re-initiated until present-day sea level was attained c. 6,500 years ago and headlands were eroded back to allow longshore drift to develop once again. Iron sand shoals of similar size and morphology have not been described on the modern shoreface.

Within the intervening troughs, between large iron sand ridges, are a complex array of smaller active bedforms, including sand ribbons, ripples (0.1-0.5 m wavelength), symmetrical megaripples (1-3 m wavelength) and sand waves. These bedforms persist to depths of >50 m water depth, and were presumably formed by strong oscillatory currents, approaching 1 m/s, which occur during the passage of large storms.

Sand ridges and dunes, 3–12 m in height, occur in two large zones around 100 km² in size off Whanganui, and as isolated patches <20 km² in the area of The Rolling Ground off Patea. Data indicate that the bottom topography is a series of northwest-southeast trending, submarine ridges and troughs, composed of coarse sand-gravel, but with a thin, patchy veneer of fine sand. Similar to the iron sand ridges observed off Patea, the coarse deposits are believed to have formed during the last phase of the sea level transgression around 8,000-10,000 years ago, whereas the fine-sand cover is probably a modern deposit at the seaward edge of the shore-attached sediment prism.

Seabed sediment sediments vary from fine sands to gravelly fine sands, although sediments are mostly fine to medium sands, with a general trend of more fine sand to the north and west of the study site and a greater proportion of coarse sand and gravel/shell to the south and west (Figure 48). The gravel fraction is mostly comprised of shell fragments.
6.7 Seabed Sediment Characteristics


6.7.1 Surface Sediments

Seabed sediment sediments vary from fine sands to gravelly fine sands, although sediments are mostly fine to medium sands, with a general trend of more fine sand to the north and west of the study site and a greater proportion of coarse sand and gravel/shell to the south and west (Figure 48). The gravel fraction is mostly comprised of shell fragments.

6.7.2 Deeper Sediments

Sediment characterisation undertaken by NIWA for TTR on RC core STH004 in Sept 2011 showed that a major textural change occurred below 5 m core depth from primarily moderately-sorted fine sand to 38% mud, and 83% in the core section 7-8 m below the surface. Preliminary hydrodynamic modelling indicated that this mud component could be readily dispersed once disaggregated and re-suspended. For this reason further sediment characterisation work was undertaken to refine on-going modelling efforts and guide planned iron sand extraction logistics.

TTR provided homogenised subsamples from two new cores, STH010RC and STH012RC. Laboratory protocols were maintained from NIWA’s earlier characterisation analyses to ensure consistent results that followed standard laboratory best practice. Similarly, sample duplicates (supplied by TTR), replicate laboratory subsamples, and repeat analyses were used to assess the repeatability of the sub-sampling and potential variability in homogenisation of the methodology. Compiled laser particle-size data (Appendix 2) indicate low variability, suggesting that the methodology was internally consistent.

The particle size data from the cores indicates that the major grain-size component in the upper sections is well to moderately-well sorted medium sand. However, significant textural changes occur down core.

In STH010RC the mud content increased from <4% to around 37-43% below 10 m core depth, then became the dominant component at 84% in the section 11-12 m.

Similarly, in STH012RC the mud content increased dramatically from <3% to 58% below 6 m core depth, then became the dominant component at 82% in the section 7-8 m. Below 9 m the mud content in STH012RC became a minor component.

The silt content of the muddy fractions could be readily dispersed once disaggregated and re-suspended. These data informed plume modelling discussed in Section 11.5 of this IA.
Figure 48: Grain size of seabed sediments in the South Taranaki Bight

Note: data shown as percentages in different size classes. PCT_PEB: pebbles, PCT_GRA: gravel, PCT_CS: coarse sand (500 μm – 1.6 mm), PCT_MS: medium sand (250 μm – 500 μm), PCT_FS: fine sand (125 μm – 250 μm), PCT_VFS: very fine sand (63 μm – 125 μm), PCT_M: mud (<63 μm)
6.8 Seabed Sediment Chemistry

<table>
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TTR engaged Auckland University of Technology (“AUT”) to address the potential for TTR’s operations to displace, modify and suspend deep anoxic sediment and potentially make sediment-bound contaminants available to pelagic and benthic biota. In particular TTR contracted AUT to:

(1) investigate if and how the sediment contents of trace metals and trace metal binding sulphides change with sediment depth;

(2) investigate the release of trace metals from suspensions of this sediment, and

(3) investigate the release of trace metals from suspensions of processed iron sand, (iron sand that has been modified by magnetic separation and milling).

AUT found no evidence of increases in sediment organic matter and acid volatile sulphides (AVS) content with increased sediment depth.

The concentrations of cadmium, chromium, copper, lead, nickel, and zinc in sediment from 0–5 m depth were below the upper ANZECC & ARMCANZ33 interim sediment quality guidelines concentrations (ISQG-high values, ANZECC & ARMCANZ 2000). With the exception of nickel in two of 23 sediment core samples, these concentrations were also below the lower ANZECC & ARMCANZ guideline concentrations (ISQG-low values). AUT inferred a low probability of adverse effects of these trace metals on the functioning of the South Taranaki Bight benthic ecosystem.

Analysis of Sediment Elutriate Extracts

For all trace metals (except nickel) the concentrations in standard elutriate extracts of sediment core samples (to determine metals likely to be bioavailable) were either below the detection limits of the analysis (as for chromium, copper, lead, zinc) or, if the metal was detected (as for cadmium, zinc), concentrations were below the ANZECC & ARMCANZ water quality trigger value for the protection of 99% of species. For chromium, copper, lead, zinc, AUT infer a low probability of adverse effects of sediment re-suspension on pelagic biota (Note that for copper, the detection limit was below the trigger values for the protection of 95% of species).

Elutriate extracts of deeper and surface sediments from three of the five sites contained nickel at concentrations that exceeded the ANZECC & ARMCANZ water quality trigger values for the protection of 99% of species. The release of nickel from surface sediment likely represents a natural process because wave-driven currents suspend surface sediment. Note, however, that the concentrations of nickel in the elutriate extracts did not exceed the ANZECC & ARMCANZ water quality trigger concentrations for the protection of 95% of species.

Sediment concentrations of chromium and nickel increased from the sediment surface to a depth of 5 m, the maximum depth measured at all sites except one. If this trend continued into deeper sediments, it was determined that mobilisation of this sediment could result in seawater concentrations of chromium and nickel that exceed ANZECC & ARMCANZ water quality trigger concentrations.

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33 ANZECC (Australian and New Zealand Environment and Conservation Council) and ARMCANZ (Agriculture and Resources Management Council of Australia and New Zealand) were tasked with developing guidelines to provide an authoritative reference for water and sediment quality management in New Zealand (and Australia) which provide methods for setting limits on pollutant concentrations in freshwater, coastal and marine environments.
Additional analyses of sediment slurries collected at one-metre increments to a maximum sediment depth of 18 m in mining areas Diana and Christina, however, did not show evidence for such a trend. AUT found no consistent increase with depth in the concentrations of dissolved nickel. The concentrations of chromium were below the detection limits of the analysis.

**Impact Assessment**

**North Taranaki Bight Iron Sand Extraction Project**

**Trans-Tasman Resources Limited**

**October 2013**

**Marine Consent Application**

**Analysis of Processed Sediments**

Processing of ROM sediment by magnetic separation and milling increased the acid-extractable zinc and copper concentrations. The extracts from this iron sand contained two orders of magnitude higher concentrations of zinc and copper than the extracts from sediment core samples.

Elutriate testing confirmed these results. For zinc, the elutriate concentrations exceeded ANZECC & ARMCANZ trigger values for the protection of 99% of species in three of 20 samples. For copper, the concentrations in elutriates of as-received (magnetically enriched iron sand) and coarse (first grind) iron sand exceeded the ANZECC & ARMCANZ trigger values for the protection of 99 and 95% of species. Copper concentrations in elutriates of medium and fine iron sand (second and third grind) exceeded the ANZECC & ARMCANZ trigger values for the protection of 80% of species. Iron sand particles size and elutriate copper concentrations were negatively linearly correlated. That is, the concentration of copper in iron sand elutriates increased with decreasing particle size.

The highest measured average copper concentration (0.0081 g m\(^{-3}\) or 8.1 ppb) would be reduced by at least 50% through dilution with internal process streams (de-ored sand discharge stream on the FPSO or the HPF filtrate stream on the FSO) before being discharged to the receiving environment. Assuming that South Taranaki Bight seawater contains copper at a concentration of around 0.00025 g m\(^{-3}\) (0.25 ppb) an 85-fold dilution would decrease the residual concentration to below the guideline concentration limit for the protection of 99% of species.

AUT recommended that TTR takes a precautionary approach in regard to routinely monitoring seawater concentrations of copper and other trace metals in the vicinity of their beneficiation plants to ensure compliance with ANZECC & ARMCANZ guidelines.

**6.9 Water Quality**

**6.9.1 General**


TTR commissioned a range of water quality investigations in the STB in relation to TTR’s area of interest. Principal findings are as follows:

- Temperature and salinity measurements show that the water column in the STB is generally well mixed with only small vertical differences in temperature and salinity.
- Slightly lower salinity is likely to be found in the vicinity of major rivers in the STB (e.g., Patea, Waitotara and Whanganui).
- In the near-surface waters, the maximum measured suspended-fine-sediment concentration was 25 mg/litre.
- At some sites the suspended-fine-sediment concentration varied over the deployment period, with peaks tending to occur during or just after periods of significant rainfall. At these times it is likely that rivers are discharging fine sediments into the STB, which were then being transported in suspension through the measurement site.
- Some of the peaks in suspended-fine-sediment concentration also coincided with times of large waves.
- For most of the time, the near-surface background suspended-fine-sediment concentration is typically less than 10 mg/litre.
Near the seabed, the maximum recorded suspended-fine-sediment concentration was 80 mg/litre, and peaks in concentration near the bed did not always coincide with peaks in wave height. This implies that increases in concentration were not always driven by re-suspension of local bed sediments. Instead, fine suspended sediment may have been advected through the measurement site from some “upstream” location. During calm periods, background suspended-fine-sediment concentration at the seabed was similar to the background concentration at the surface (~10 mg/litre).

When there is any sand in suspension, suspended-sand concentration close to the seabed are typically much greater than suspended-fine-sediment concentrations.

The largest suspended-sand concentration very close to the seabed was 1,900 mg/litre.

At all sites, periods of increased sand concentration coincided with periods of large waves, thus highlighting the importance of waves in resuspending sand from the seabed in the STB.

During calm periods, no sand was found to be in suspension.

Over the duration of the largest sediment-transport event, 3,355 kg of sand per metre width of seabed was transported in suspension by currents. This equates to a volume of 2.1 m$^3$ of sand transported per metre width of seabed.

6.9.2 South Taranaki Bight - Satellite Imagery Study


TTR commissioned an investigation using a combination of field sampling and satellite imagery to assess the distribution over the past decade of a range of water quality variables including total suspended matter (“TSM”) and chlorophyll-a in the coastal waters of the South Taranaki Bight.

Key findings of this study are:

- The STB region is a dynamic and optically-complex environment.
- The annual mean concentration of TSM between the coast and 10 km offshore in the STB is 3.0 g m$^{-3}$, decreasing rapidly with distance offshore (see Figure 49).
- There is an annual cycle in TSM, with highest concentrations in August and lowest concentrations in February.
- Between the coast and 10 km offshore, TSM was greater than 3 g/m$^3$ (a nominal turbid value) about 39% of the time, over the course of a year.
- Between 10 and 40 km offshore, the annual average TSM concentration was 0.8 g/m$^3$ and TSM was greater than 3 g/m$^3$ rarely (<9% of the time).
- There is a substantial small-area and short term variability in TSM from satellite maps that is associated with river plumes, local re-suspension of sediment and/or coastal erosion.
- There is evidence in individual satellite images of plumes with relatively high concentrations of sediment (>4 g/m$^3$) being transported more than 30 km offshore.
- Based on the satellite data, at 6 selected sites there has been no long-term increase or decrease in total suspended matter or chlorophyll-a (“chl-a”), during the period 2002 to 2012.
- The mean euphotic zone depth during the biogeo-optical sampling was ~25 m. This represents the depth above which addition of sediments would impact upon the underwater light climate and therefore potentially affect phytoplankton productivity.
In considering the foregoing, some important limitations of the satellite-based approach were noted:

- Ocean colour sensors only see material in the upper water column, typically from a few cm to a few metres of depth, depending on the turbidity of the water. In highly turbid waters, the satellite may only see material in upper few centimetres, whereas in offshore waters with lower turbidity, the satellite may see material in the upper tens of metres. Deeper suspended sediment and that near the seabed will usually not be seen in satellite data.

- Satellite observations of TSM, chl-a and absorption by non-algal particles, and Coloured Dissolved Organic Material are inherently less accurate than in situ measurements. In particular, estimates of chl-a in the presence of moderate concentrations of sediment are uncertain because the subtle effect of chl-a on ocean colour is masked by the stronger effect of sediment.

- Ocean colour satellite data is not obtained when clouds are present, and this is the case most of the time in the STB. In our data analysis, about 13% of the satellite observations were cloud free. As concentrations of optically active material in the water column are related to the probability of cloud present/absence, there is a bias in climatologies based on satellite data. For example, concentrations of suspended sediment in the coastal zone are likely to be highest just after high rainfall events (elevated land-run off) and/or when high winds/high waves are present (higher coastal erosion and sediment re-suspension). These situations are likely to occur when clouds prevent ocean colour satellites seeing the water surface. Hence, climatologies of TSM based on satellite data are likely to underestimate the actual long-term mean concentrations.

Notwithstanding these caveats, satellite observation of ocean colour is an effective tool over large-areas (100s of km) and over long-terms (years to decades) for making observations of coloured material in coastal zones. Water sampling from vessels or
moorings, though providing more accurate data, has limited ability to assess or monitor these large-scale patterns over long periods.

In broad terms, the satellite data corroborate the field measurement data (Section 6.9.1), indicating that background suspended-fine-sediment concentration levels in the STB, in the area potentially affected by TTR’s operation, are of the order of 10 mg/l during average conditions.

6.9.3 Nearshore Measurements of Optics and Suspended Sediment Concentrations

TTR commissioned NIWA to undertake a field programme to measure background optical water quality and suspended sediment concentrations (SSC) in the nearshore region (within 2.5 km of the shore) of the STB. These field studies were undertaken to provide background details to help assess the potential effects of offshore sand extraction on the surrounding environment, in particular the effect of sediment plume dispersal.

Investigations involved:

- Two boat surveys (S1 on 11-12 March 2013; S2 on 1-2 May 2013) to measure vertical profiles of optical variables and SSC, in order to assess spatial variability.
- A 6-week deployment of moored instruments at 6 nearshore sites (~10 m water depth) to access temporal variability and to establish relationships between measured near-surface optical backscatter and certain optical variables; and
- The collection of water samples from the surf-zone region at 11 sites along the STB. The water samples were analysed to determine variables relating to optical water quality and SSC.

Measurements from both boat surveys showed that SSC and optical variables vary significantly with distance offshore, with SSC and diffuse light attenuation being greatest closest to the shore, and visual clarity (as indexed by the horizontal black disc visibility) increasing rapidly with distance offshore. Both coloured dissolved organic matter (CDOM) and chlorophyll-a concentration also decrease with distance offshore.

Both boat surveys suggest a reduction in SSC (and hence an increase in visual clarity and a decrease in light attenuation) moving down the coast in a SSE direction. Measured SSC greater was following higher river flows (and sediment loads). The maximum (averaged over the water column) SSC measured during S2 was 68 mg/L near Hawera. During the second boat run, in the waters ~500 m offshore, the horizontal black disc visibility was less than 1 m along the entire length of the STB, which is a rather low visual clarity.

Measurements and assessment of turbidity, optical backscatter, diffuse light attenuation and horizontal black disc visibility from the six moored instrument sites all showed considerable temporal variability. During the last two weeks of the deployment period there was a significant increase in SSC, coinciding with increased river flows. At these times it is likely that the rivers were discharging fine sediments into the STB, which were then being transported in suspension through the measurement site. Some of the peaks in SSC also coincided with times of high wind speed but low river flows. These peaks in SSC are most likely wave-driven. At these times, wave stirring is entraining fine sediments from the sea floor, which are subsequently mixed into the water column.

During river and wave events, the euphotic depth is less than the mean water depth at the instrument sites. This is significant, as it means that less than 1% of the ambient light is reaching the benthos at these times.

Rainfall data showed that the deployment took place during a period of lower than expected rainfall for that time of year, and consequently during a period of low river flows. Since rivers are a major source of fine sediments into the STB, it is likely that the data are representative of conditions with clearer water.
6.10 Ecology

6.10.1 Offshore Benthic Ecology


NIWA was contracted by TTR to survey and describe the benthic (seafloor) flora and fauna on and in the sediments of the broader Patea Shoals region, and to compare the application area with adjacent mid-shelf, inner shelf and deeper offshore areas.

Seabed sampling of the broader Patea Shoals region was conducted between September 2011 and May 2012. Sampling sites were allocated within TTR’s operational area, and across the broader Patea shoals region cover the inner shelf, mid-shelf and deeper offshore areas. Seabed habitats and macrobenthos were visually characterised at 144 sites using underwater video footage and still photographs. Surficial sediments and associated infauna were collected from 331 samples from 103 sites (~3 replicates cores per site), while benthic macrofauna and macroflora specimens were collected from 116 sites using a benthic dredge.

Video observations of the seabed identified the following seven major habitat types (Figure 50):

- **Sand ripples**: Occurring across most of the inner to mid-shelf areas in depths of 15-50 m, including inside and adjacent to TTR’s operational area.
- **Sand waves**: Dynamic sand-wave bedforms.
- **Rock outcrop**: Comparatively diverse epibenthic assemblage on small and scattered inner shelf rocky outcrops.
- **Suspension Feeders**: Large areas of the seabed within and adjacent to the Extraction Area - variably dense populations of the infaunal tubeworm, *Euchone* sp A. These worms bind sediments together to form their tubes, and can occur in extremely high densities. (see section 6.10.2 for discussion of polychaete worms).
- **Tucetona (NR)**: Mid shelf Live *T. laticostata* with no rubble or shell debris.
- **Bivalve Rubble**: Deeper areas offshore - characterised by the large robust dog cockle, *Tucetona laticostata*, both living buried in the sediments and with relict shells that have accumulated on the surface of the seabed. Live *T. laticostata* were recorded in water depths of 26-84 m, while the shell debris of this species - that formed the dominant biogenic structure in deeper offshore areas - occurred within a much narrow depth contour (44-69 m depths). Typically diverse benthic assemblages [as for Bryozoan areas noted below], dominated by sessile suspension-feeding taxa (e.g. bryozoans, sponges, colonial ascidians, brachiopods and epiphytic bivalves), and a range of motile species (e.g. crabs, ophiuroids, holothurians, gastropods, and nudibranchs).
- **Bryozoan area**: In deeper zones (>60 m), bryozoan rubble combined with more generic shell debris become the dominant habitat type. Typically diverse benthic assemblages dominated by sessile suspension-feeding taxa (e.g. bryozoans, sponges, colonial ascidians, brachiopods and epiphytic bivalves), and a range of motile species (e.g. crabs, ophiuroids, holothurians, gastropods, and nudibranchs).
NIWA investigations indicated that the Project Area (proposed extraction and de-ored sand deposit areas) and adjacent mid and inner shelf habitats supported low numbers of organisms and species, with no significant differences between the Project Area and these adjacent-shelf habitats. This pattern of low abundance and species richness is typical of highly disturbed shelf sediments.

Although the Project Area supported patchily abundant polychaete worm communities, the worms were more abundant in sediments outside of the Project Area, particularly in mid-shelf areas to the north. Overall, there was no evidence to suggest that the Project Area was “unique” with respect to benthic epifauna or infauna collected from or observed on the seabed during this survey.

The Project Area and adjacent-shelf habitats supports comparatively depauperate epifaunal assemblages compared to the diverse and abundant epifaunal assemblages recorded from the deeper offshore bivalve rubble and bryozoan rubble habitats. These offshore biogenic habitats support abundant and diverse assemblages dominated by suspension feeding taxa.

The shallower bivalve rubble habitat support early successional species, dominated by encrusting coralline algae and small encrusting invertebrates. The deeper bryozoan rubble habitats support later stage successional species, dominated by small branching and foliose bryozoans, sponges, and higher mean densities of small motile species.

Bryozoan rubble habitats also supported significantly higher abundances of infauna, although both habitats were dominated by the foraminifer, *Miniacina miniacina*, with much lower numbers of all other infaunal taxa.

Overall NIWA concluded that there was no evidence within the data to suggest that the proposed extraction or de-ored sand re-deposition areas are “unique” with respect to macrofauna collected/observed during the survey. Importantly, neither the video observations, dredges, sediment cores (macro or meiofauna), nor the recolonisation
experiment showed a significant relationship between iron concentration and community structure.

### 6.10.2 Polychaete Worm Communities

In this study, polychaetes represented 90% of all worms found. Most of these polychaetes are poorly known in New Zealand and therefore were not identified to species level. Polychaete abundance was highest inside and to the north of the Project area, including sites along the Kupe Pipeline\(^{34}\) (Figure 51a). In contrast, the rippled sediments in the southern mid-shelf supports much lower abundances of worms (Figure 51a). Species richness, however, was more evenly distributed across the region (Figure 51b).

*Euchone* sp A was the most polychaete worm present and occurred in patchy abundance at most of the sites sampled within the Project Area (Figure 51c). The paraonid polychaete *Aricidea* sp was also, patchily abundant within the Project Area, comprising 22% of the total abundance. Unlike *Euchone* sp A, *Aricidea* is a mobile species, capable of burrowing into or ‘rowing’ through the surface of the substrate. This species feeds on organic material on the seabed (a ‘deposit’ feeder) and thus plays a role in turnover of the seafloor; the genus is known to occasionally suspension feed as well.

Although densities of both these taxa were variable between replicates and sites within these areas, there was no significant difference in total infaunal abundance or species richness between the Project area and northern mid-shelf zones. Southern mid-shelf sites supported similar species richness, but significantly lower infaunal abundances due mostly to the absence of *Euchone* sp A. and *Aricidea* sp. Shallow sites in the Project area (water depths < 30 m) which had fewer or no *Euchone* sp A, are characterised by coarser sands and have an infaunal assemblage more similar to the southern mid-shelf.

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Figure 51: Spatial distribution of polychaete worms/site for top 0-5 cm section of sediment.

Notes: a) The green bars represent the mean number of individuals (N) collected; b) The light brown bars represent the mean number of species/OTU’s (S) collected. c-f) Mean numbers p/site of: c) *Euchone* sp A; d) Syllid spp; e) Aricidae spp; and f) *Pisione oerstedii*, per site. Relative scale bars are provided in the legend of each graph.
6.10.3 Nearshore Epibenthos/Shallow Infauna

| Technical report reference | NIWA (2013b) “Benthic habitats, macrobenthos and surficial sediments of the nearshore South Taranaki Bight” |

Sampling to characterise the seabed habitat of the nearshore region of the STB was conducted during late February and early March 2013.

A number of soft-sediment and rocky outcrop habitats were recorded within the nearshore region of STB. Exposed areas in the north and central regions are characterised by well-sorted fine sands in dynamic rippled bedforms, while the more protected southern sites are characterised by flat or subtly rippled bedforms with higher proportions of mud.

Rocky outcrops occurred at five of the 36 sites surveyed, with rocky outcrops occurring as hard rock outcrops of low to moderate and mudstone outcrops.

Video observations of the seabed along with epibenthic collections at representative sites found that most soft-sediment sites supported very low numbers of epibenthic organisms, and were characterised by deposit feeders, predators/scavengers and suspension feeders.

Rocky outcrops, although much rarer in spatial extent, supported more abundant and diverse epibenthic assemblages characterised by bryozoans, macroalgae and sponges, as well as more motile species, such as crabs, amphipods, starfish, brittle stars, gastropods and polychaete worms. Hard rock outcrops accounted for more than 25% of all specimens and 61% of all species collected during the survey. Mudstone outcrops supported low or negligible amounts of epibenthos (<2.5% of specimens).

Most species recorded during this survey have been reported previously from the broader Patea Shoals or STB region, with six of these species purported as common. No records of new species were found.

Soft-sediment sites were characterised by fine rippled sands with low and variable numbers of small motile epifauna - mostly hermit crabs, gastropods, and a few suspension-feeding bivalves. These species are presently subjected to regular sediment disturbances from storm events and river runoff and are likely to be tolerant to deposition of sediments. The mudstone outcrop present in the nearshore area potentially influenced by the sand extraction operation is draped in fine silt with few epibenthic organisms. Other habitats and organisms likely to be affected by the sand extraction operation are macroalgal and suspension-feeding species associated with hard rock outcrops, particularly their diverse bryozoan and sponge dominated assemblages.

Key findings from the nearshore epibenthic survey were:

- Area typified by extensive areas of soft-sediments that support few macrobenthic organisms
- Mudstone outcrops support low or negligible amounts of macrobenthos
- Hard rock outcrops support abundant and diverse assemblages

6.10.4 Crayfish

| Technical report reference | NIWA (2013g) “South Taranaki Bight Fish and Fisheries” October 2013 |

Red rock lobsters are typically the largest and most abundant invertebrate predator on coastal rocky reefs throughout New Zealand. At certain times of the year, particularly immediately after the mating and moulting in winter and summer respectively larger males may migrate offshore across sand flats to feed on shellfish. Egg-brooding females may also form offshore aggregations in areas of high water current in spring at the time of larval hatching. Available data from the STB (albeit limited) suggests that lobsters do not migrate as far offshore as the proposed sand extraction areas.
The STB lobster population is most likely dependent on larval supply from lobster stocks living around Fiordland, Southland and Stewart Island with only a minor component (17%) originating from adult lobsters in the Westland/Taranaki Fisheries Management Region (CRA9) region of which the STB comprises about 10%. Although, the lobster stock in CRA 9 makes a very significant contribution of larvae to lobsters stocks in the Northland Fisheries Management Region (CRA 1), along the east and west coasts of the Northland peninsular, possibly only about 10% comes from the STB region.

6.10.5 Phytoplankton


NIWA’s 2011 Baseline survey reviewed published information and concluded that the complex optical conditions prevalent in the broader South and North Taranaki Bights, make the quantification of chlorophyll from remotely sensed ocean colour data extremely difficult. Particulate and dissolved terrigenous (derived from land) material is frequently advected into the region from the Marlborough Sounds, west coast of the South Island and from Cook Strait.

Phytoplankton blooms appear to peak in springtime, with an origin offshore to the west of the study region, and apparent advection of the bloom through the study region and into the Cook Strait. River inputs of terrigenous material along the Taranaki coastline are frequent but sporadic.

Massive re-suspension of bottom sediments, presumably wind-driven, occasionally causes the entire region to appear bright and turbid. Chlorophyll values at those sites deemed to be least compromised by terrigenous inputs range from 0.02 to 4.4 mg m$^{-3}$, with blooms occurring regularly during October, and no significant autumn bloom. Apparent median chlorophyll values are relatively high throughout the year all across the broad STB, with an overall range of 0.02 to 32 and median 0.57 mg m$^{-3}$. This compares to values typically < 0.1 mg m$^{-3}$ in clear blue waters. No significant decadal trends were observed in apparent chlorophyll concentration.

Conclusions are broadly consistent with the satellite imagery report (Section 6.9.2). A region of upwelling approximately 80 km to the west of TTR’s extraction area typically contains high levels of phytoplankton.

6.10.6 Zooplankton


NIWA’s 2011 Baseline survey concluded that based on studies undertaken over the past 20 years, the ecology of STB zooplankton was strongly influenced by the upwelling events that persist off Kahurangi Shoals and Cape Farewell, at the north western corner of the South Island.

NIWA’s 2013 Zooplankton report reviewed in more detail available information about the zooplankton, and the processes supporting it, in the Greater Western Cook Straight (including the STB, Tasman and Golden Bays, and bounded by Cook Strait Narrows), as this larger area influences zooplankton populations in the STB. The 2013 review indicates the following:

- Zooplankton species composition in the STB is typical of coastal waters found around the North Island, New Zealand.
Four major classes of pelagic water occur in the Greater Western Cook Strait region:\(^{35}\)
- Class 124 - very shallow nearshore waters (mean depth of 8 m) where orbital velocities are high;
- Class 64 - coastal waters with mean depth of 38 m where orbital velocities are moderately high and the annual amplitude of sea surface temperature (SST) is high;
- Class 60 - these waters comprise the bulk of Greater Western Cook Strait with mean depth of 112 m, moderate annual solar radiation, and moderate winter SST; and
- Class 58 - the Cook Strait Narrows where strong tidal currents dominate.

The STB comprises mainly Class 124 and Class 64 waters and the eastern fringes of Class 60 waters.

Zooplankton has been sampled at 90 stations in the STB over a period of 13 years in the 1970s and 1980s. Zooplankton biomass data were collected at 62 stations and zooplankton species composition data were collected at 79 stations. Most of the sampling stations (83%) were in Class 60 waters in depths >50 m. About 17% of zooplankton sampling stations were in Class 64 waters and none were in Class 124 waters.

Little is known of the seasonal cycle or inter-annual variability of plankton. The existing data has been mainly collected in summer.

The Greater Western Cook Strait region is impacted by several large-scale, highly variable, physical phenomena that structure the distribution and biomass of zooplankton, mediated by the pattern of distribution of phytoplankton biomass and its primary production. These large-scale physical processes include the Kahurangi/Cape Farewell upwelling plume, tidal mixing, river plumes and surf beach processes. Of these the Kahurangi/Cape Farewell upwelling plume is the best understood in terms of plant nutrient renewal which impacts primary production and dynamics and its downstream impact on the zooplankton.

Upstream in the Kahurangi/Cape Farewell upwelling plume, near Cape Farewell, although nutrients are high there is evidence of low breeding activity among copepods and zooplankton food requirements are not being met. Omnivorous copepods are numerically dominant. But the reverse applies downstream, extending towards the STB. There, nitrate levels decrease, ammonia levels increase, and concentrations of copepod nauplii, herbivorous copepods, and developmental stages of krill Nyctiphanes australis are much higher than at the plume origin.

As this assemblage is transported north-eastwards, further oceanic copepod species are entrained which produce high species richness, but two omnivorous copepods Acartia ensifera and Oithona similis are present in very large numbers. Further east the proportion of herbivorous copepods, species diversity and zooplankton biomass increases. These are the populations that extend into MEC Class 64 waters in the STB.

The zooplankton populations of Class 64 water in the STB, when not dominated by salps, are likely to be dominated numerically by the copepod Oithona similis, and moderately large numbers of Acartia ensifera, Clausocalanus jobei, Paracalanus c.f. indicus and copepod nauplii. That is, omnivorous copepods should dominate (66%) with 34% herbivores and 0.1% carnivores.

The Manawatu River appears to impact phytoplankton biomass and production near shore. Nutrient recycling on Waitarere Beach, south of the Manawatu River, is probably related to the measured high productivity of surf diatoms.

No information is available on zooplankton assemblages close to shore in Class 124 waters that have a mean depth of 8 m and are dominated by very high orbital velocities.

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\(^{35}\) New Zealand Marine Environment Classification: Ministry for the Environment 2005.
6.10.7 Marine Fish

| Technical report reference | NIWA (2013g) “South Taranaki Bight Fish and Fisheries” |

### 6.10.7.1 General

A range of marine habitats occur in the STB that support a variety of organisms including reef fish and invertebrates, crayfish, demersal fish and pelagic fish species. The species richness of the reef fish, demersal fish and pelagic fish assemblages is moderate on a national scale.

None of the species reviewed in NIWA’s STB Fisheries report are nationally rare or threatened. Some of the identified fish and invertebrate species support locally important commercial and customary fisheries. Recreational fisheries are addressed elsewhere in this IA (refer Section 6.18).

Demersal and pelagic fish species with predicted distributions in the STB that particularly coincide with areas potentially affected by iron sand extraction operations include barracouta, blue cod, carpet shark, eagle rays, John dory, golden mackerel, kahawai, leather jacket, lemon sole, red cod, red gurnard, rig, school shark, snapper, spiny dogfish, tarakihi, trevally, common warehou, and witch.

Species that are predicted to be particularly abundant in the areas of iron sand extraction operations include barracouta, red gurnard, leather jacket, school shark, snapper, spiny dogfish, rig, tarakihi, and trevally.

The demersal and pelagic fisheries potentially most affected by sand extraction operations are the commercial set-net fisheries for rig, warehou, and school shark, and customary fisheries for rig and leather jacket, located to the south and east of the banks where the sand extraction is proposed to take place.

Marine fisheries have traditionally been a source of cultural and economic wealth for Māori. At least forty species of invertebrates and fish are customarily gathered or fished from the STB. Harvesting sites vary from intertidal reefs to deep offshore areas and methods of collection vary from hand picking or gathering to specialised hook and line and potting techniques.

Customary species occurring on inshore reefs that are potentially the most vulnerable to the effects of offshore sand extraction are sedentary species that cannot move sufficiently far or fast to avoid sediment deposition. The offshore customary fisheries most vulnerable to the effects of iron sand extraction are those for species such as rig and leatherjacket which are abundant in the vicinity of the mining area.

### 6.10.7.2 Spawning and Juvenile fish - General

NIWA (2013g) cites a comprehensive study by NIWA (Hurst et al. 2000)\(^{36}\) which indicates good evidence of spawning, pupping or egg-laying by the following six species along the shelf in the south-west of the North Island: lemon sole, New Zealand sole, rig, sand flounder, yellow-belly flounder, and yellow-eyed mullet. Probable spawning by golden mackerel is evidenced by the common occurrence in the region of fish with running-ripe gonads. Blue mackerel with spent gonads also occur. Hurst et al. (2000) also suggested the possible breeding of a further five species based on the presence of small juveniles in the region. These species included blue cod, John Dory, kahawai, kingfish, and sea perch.

Hurst et al. (2000) report the relative abundance of larger juveniles along the shelf in the south-west of the North Island based on catches by the RV Kaharoa during research trawl surveys conducted in some years between 1992-2000. Low abundances of juveniles of the following species were present; arrow squid (*Nototodarus sp*.), barracouta, blue warehou, giant stargazer, Jack mackerel, John dory, kahawai, kingfish, red gurnard, rig, sea perch, school shark, snapper, spiny dogfish, terakihi, and trevally. Juveniles of eight other species are listed by Hurst et al. (2000) but no abundance estimate is provided because of insufficient data. These species included blue cod, grey mullet, horse mackerel, New Zealand sole, red cod, silver warehou, yellowbelly flounder, and yellow-eyed mullet.

### 6.10.7.3 Snapper

Figure 52 shows the distribution of spawning snapper (*Pagurus auratus*) in Northern New Zealand. This map was generated by Nabis (the National Aquatic Biodiversity Information System)\(^\text{37}\).

Snapper spawning occurs from the northern North Island to the top of the South Island, and throughout northern New Zealand. Snapper spawn mainly between depths of 20 and 70 m. Spawning hotspots are largely seasonal, occurring in spring and early summer. The distribution of spawning hotspots is difficult to determine because of a paucity of data from most of the population range, but there is an important spawning ground located the Hauraki Gulf. Specific spawning sites include Rangaunu Bay, Doubtless Bay, Bay of Islands, Bream Head, Hauraki Gulf, Bay of Plenty, East Cape to Gisborne, Hawke Bay, Tasman Bay, Golden Bay, North Taranaki Bight, and off the main harbours of the Manukau and Kaipara harbours. Particular spawning grounds in the South Taranaki Bight are unknown, but notably snapper was not cited in Hurst *et al.* (2000).

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6.10.8 Freshwater Migratory (Diadromous) Fish

New Zealand has about 35 species of freshwater fish (McDowall 1990). Most are endemic and almost half are diadromous, spending part of their life cycle in the sea. Depending on the species, the marine component of the life cycle may be eggs and larvae, juveniles, or adults. Important customary fisheries exist for a number of diadromous fish including lampreys, short and long finned eels and whitebait (Galaxids). Information relevant to these species in the South Taranaki Bight is set out in the following sections.

Few details are known about the marine phase of any diadromous fish such as lampreys, freshwater eels or galaxids, so it is not known whether any of these species occur in the vicinity of the proposed extraction site.

6.10.8.1 Lampreys – piharau

New Zealand’s one species of lamprey, Geotria australis which is also found in Australia and southern South America, is widely distributed in New Zealand.

The marine phase of this fish spends 3-4 years in the open ocean where it uses a circular sucker to attach itself to other animals and feeds by rasping a hole in their flesh. Lampreys then enter freshwater and spend up to 16 months reaching sexual maturity and migrating upstream to small, shady, hard-bottomed streams where they spawn and die. Larvae spend around 4 years as filter feeders in freshwater buried in fine sediments before metamorphosing into miniatures of the marine phase that then migrate downstream to begin their 3-4 years of life in the ocean. Little is known of G. australis once it enters the ocean.

6.10.8.2 Freshwater eels - tuna

New Zealand has two species, the shortfin (Anguilla australis) and longfin eel (Anguilla dieffenbachii). The shortfin eel occurs throughout the South Pacific while the longfin eel is endemic to New Zealand.

Adult eels are thought to breed in the deep ocean trenches north-east of New Zealand, near Tonga though the migration routes are not understood. The transparent leaf-like larvae, the leptocephalus, drift on ocean currents for over a year before reaching New Zealand coasts. Before entering freshwater the leptocephalus changes into the more familiar eel shape although they remain transparent for up to a week after leaving the ocean. The two species frequently coexist, but the shortfin is principally a lowland species, dominating populations in lowland lakes, estuaries and the lower reaches of rivers, while longfins prefer flowing water and hence are found extensively in mainstem rivers, penetrating long distances upstream. Eels spend many years in stream, rivers and lakes (14-25 for male and female shortfins respectively; 25-40+ years for male and female longfins respectively) before migrating downstream to make their way their tropical spawning sites.

6.10.8.3 Whitebait - inanga

Whitebait or inanga is a general term applied to juvenile Galaxids of five different species; Galaxias argenteus, G. brevipinnis, G. fasciatus, G. maculatus, and G. postvectis. All five species occur in the south Taranaki region and have a similar life cycle. Newly hatched larvae are swept down river and out to sea where they spend their first six months feeding and growing. Where they live during this phase is unknown. Juvenile galaxids re-enter streams and rivers in spring where they are harvested.

6.10.9 Birds


The STB supports a relatively modest seabird assemblage. Many of the species occurring in the area are relatively coastal in their distributions. Such species include...
blue penguin, shags, gulls and terns, although these latter taxa can extend to more offshore areas. By contrast, and although some species have been observed from and relatively close to the coast, albatross and petrel species tend to be more pelagic and wide-ranging in their distributions and will likely occur anywhere throughout the area.

The area does not support large breeding colonies for any species but a number of estuarine sites are of significant value to coastal, shore, wading, and migratory bird species. These include the Waikirikiri Lagoon, and the Whanganui, Whangaehu, Turakina, Manawatu and Rangitikei river estuaries.

6.11 Marine Mammals

6.11.1 General Description

The marine waters off NZ support a diverse community of marine mammals. Forty-one species of cetaceans (whales, dolphins, and porpoises) and nine species of pinnipeds (seals and sea lions) are known from NZ waters. NIWA 2011 evaluated existing data on observations of marine mammals in the Southern and Northern Taranaki Bight region (extending out to 100 km offshore from the Patea coastline, 150 km to the south, and northwards around the coast past New Plymouth). This review identified the sighting records set out in Table 19.

<table>
<thead>
<tr>
<th>Species</th>
<th>Threat Classification</th>
<th>Spring</th>
<th>Autumn</th>
<th>Summer</th>
<th>Winter</th>
<th>Unknown</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue whale (Balaenoptera musculus)</td>
<td>Migrant</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Bottlenose dolphin (Tursiops truncatus)</td>
<td>Range restricted</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Common dolphin (Delphinus spp.)</td>
<td>Not threatened</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>Dusky dolphin (Lagenorhynchus obscurus)</td>
<td>Not threatened</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>False killer whale (Pseudorca crassidens)</td>
<td>Not threatened</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Fin whale (Balaenoptera physalus)</td>
<td>Migrant</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Humpback whale (Megaptera novaeangliae)</td>
<td>Migrant</td>
<td>3</td>
<td>2</td>
<td>10</td>
<td>1</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>Killer whale (Orcinus orca)</td>
<td>Nationally critical</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Maui’s dolphin (Cephalorhynchus hectori maul)</td>
<td>Nationally critical</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Not threatened</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td></td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Sei whale (Balaenoptera borealis)</td>
<td>Migrant</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Southern right whale (Eubalaena australis)</td>
<td>Nationally endangered</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Sperm whale (Physeter macrocephalus)</td>
<td>Migrant</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>12</td>
<td>6</td>
<td>25</td>
<td>16</td>
<td>5</td>
<td>64</td>
</tr>
</tbody>
</table>

Table 19: Sighting records by season from DOC and Cawthorn datasets of 13 cetacean species observed along the southern and northern Taranaki bights. NIWA (2011)
NIWA’s evaluation identified three nationally critical or endangered species with the potential to occur in the South Taranaki Bight region. These were the Southern right whale (*Eubalaena australis*), Maui’s dolphin (*Cephalorhynchus hectori maui*) and Orca or Killer whale (*Orcinus orca*). Key population characteristics of each are discussed as follows:

**Southern right whale (*Eubalaena australis*)**

Southern right whales in the New Zealand are considered nationally endangered due mainly to whaling that reduced the population from about 17,000 animals to just 1,000 today. Southern right whales follow traditional annual migration routes between southern ocean summer feeding areas and their nearshore calving grounds. Right whales are frequently found in sheltered coastal waters close to shore to give birth, nurse calves, and avoid predators during migrations. During the breeding season in winter months, they are mostly found in the waters around the sub-Antarctic Auckland and Campbell Islands but there are occasional sightings around mainland New Zealand, which may represent recolonization of breeding grounds largely unused since the 1830s.

Two sightings of southern right whales were recorded in the STB region. One of these sightings occurred during the spring of 1983 and consisted of a cow/calf pair. The other sighting recorded a solitary animal in the winter of 2004.

Estimated total population size as of 1997 was 7,500 animals (of which 1,600 were mature females).

**Maui’s dolphin (*Cephalorhynchus hectori maui*)**

Hector’s dolphin, and its subspecies the Maui’s dolphin, are endemic and iconic species of New Zealand. Due to small population sizes, limited genetic exchange, and threats from fisheries and habitat destruction, the Hector’s dolphin is listed as nationally endangered and the Maui’s dolphin is listed as nationally critical (Suisted & Neale 2004).

The Hector’s dolphin population in New Zealand is composed of four sub-populations, due to little or no female dispersal: North Island, East Coast South Island, West Coast South Island, and South Coast South Island. The North Island subpopulation of Hector’s Dolphin was subsequently recognised as a subspecies, *C. h. maui*.

Estimate population size of the Maui’s Dolphin is reported at around 55, with distribution as set out in Figure 53. From this distribution map it can be seen that the TTR Project area is of very low probability for occurrence of Maui’s Dolphins.

**Killer whale (*Orcinus orca*)**

Killer whales are classified as a nationally critical threatened species in New Zealand waters. Between 1980 and 2005, 3 sightings of killer whales were recorded within the STB region. The entire New Zealand killer whale population is small (less than 200) with broad distribution patterns around both North and South islands. Killer whales may be transiting through the broader STB or use the area to forage for prey including fish, other marine mammals, and sharks and rays.

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As noted above, the NIWA baseline study\textsuperscript{39} identified the presence of three endangered species potentially located in the South Taranaki Bight ("STB"): southern right whales (*Eubalaena australis*), Hector’s dolphins (*Cephalorhynchus hectori* and the sub-species Maui’s dolphin (*C.H. maui*), and killer whales (*Orcinus orca*). Only very limited sighting data were available in the STB in relation to these species, and therefore TTR commissioned species distribution models for these three species for the area, covering a distance of 22-40 km offshore in water depths of 25-45 m, to help understand the suitability of habitat in the STB for each of these endangered species.

Distribution models of the three species around New Zealand were generated using incidental presence-only sightings data referenced against various environmental variables including bathymetry, dissolved organic matter, winter sea surface

\textsuperscript{39} NIWA 2011 South Taranaki Bight Factual Baseline Environmental Report IWA Client Report: WLG2011-43 September 2011
temperature, sea surface temperature gradient, suspended particulate matter, primary productivity, tidal current, and the 95th percentile of wave height (representing extreme wave/storm events). Distribution models were created for habitat within the 350 m isobath of the New Zealand mainland coast for southern right whales and Hector’s dolphins as a function of coastal distribution patterns. The killer whale model included the NZ extended continental shelf due to the broad distribution of this species. Seasonality was not incorporated into these models due to lack of sufficient data across seasons, so results represent a yearly average for Hector’s dolphins and killer whales. The southern right whale model was limited to winter when this species uses coastal habitats.

The spatial predictions of southern right whale habitat based on this model identified sheltered coastal habitats as having the highest habitat suitability during winter. Low habitat suitability for southern right whales was predicted at and adjacent to TTR’s proposed project area. A coastal strip within 5 km of the shoreline had low to moderate suitability for this species suggesting that individuals may use this area as a migration corridor (see Figure 54).

![Figure 54: Habitat suitability predictions for southern right whales in STB. TTR proposed project area outlined in black.](image)

The Hector’s dolphin model (Figure 55) identified suspended particulate matter, dissolved organic matter, 95th percentile of wave height, and winter sea surface temperature were the most important predictors habitat use patterns. Spatial predictions of Hector’s dolphin distribution based on model results demonstrated a relatively good match with known areas of sub-population distributions and identified one area from which Hector’s dolphins may have been historically extirpated. The modelling established that habitat suitability for Hector’s dolphins in the proposed project area was low. However, coastal areas inshore of the TTR area were predicted to have average to above average suitability as habitat for Hector’s dolphin.
**Figure 55:** Prediction of habitat suitability for Hector’s dolphin in the South Taranaki Bight. TTR proposed project area outlined in black.
The model of killer whale habitat use patterns (Figure 56) determined that sea surface temperature gradient was the most influential determinant of distribution, followed by primary productivity, dissolved organic matter, and suspended particulate matter. Low habitat suitability for killer whales was predicted in the proposed TTR project area. A band of average to above average habitat suitability for killer whales, corresponding to an area of increased sea surface temperature gradient, begins approximately 8 km seaward of the proposed project area.

Figure 56: Habitat suitability predictions for killer whales in the North and South Taranaki Bights. TTR’s proposed project area is outlined in black.

In summary, the proposed project area in the STB appears to be of low suitability for all three species of threatened cetaceans. Areas of increased habitat suitability for Hector’s dolphins and southern right whales lie close inshore and may be increasingly used as the New Zealand populations of these species recover. An area of average to above average habitat suitability for killer whales is indicated to begin approximately 8 km seaward of the proposed project area.
6.11.3 Blue Whale Foraging Area

A recent paper (Torres 2013) has described an apparent Blue whale (Balaeonoptera musculus) foraging ground in the South Taranaki Bight (Figure 57). TTR’s area of interest is some 50 km to the east of the centre of this indicated foraging area.

Figure 57: Distribution of blue whale sightings and strandings within the South Taranaki Bight (STB), NZ (Torres 2013).

Notes for Figure 57:
- Incidental, survey and anecdotal sightings are symbolised by source.
- Black lines indicate 50-m bathymetry isobaths.
- The centre of upwelling off Kahurangi Point is demarcated in grey; tongues of upwelled water extend as a plume to the north and northeast.
- The ellipses indicate the approximate areas of increased Nyctiphanes australis density sampled in March and April 1983 (green ellipses; Bradford & Chapman 1988; James & Wilkinson 1988) and February 1981 (blue ellipse; Foster & Battaerd 1985).

6.11.4 Marine Mammal Aerial Observations

Historically, very few sightings of cetaceans have been reported within the broad STB or in the TTR Project area. As noted in Section 5.3.3 TTR commissioned Cawthorn & Associates Ltd to undertake a series of aerial surveys of the offshore Project area, extending from approximately Manaia in the north-west to between Patea and Waverley in the south-east. A total of approximately 4,550 nm (or 8,426 km) of

40 LG Torres (2013): Evidence for an unrecognised blue whale foraging ground in New Zealand, New Zealand Journal of Marine and Freshwater Research, DOI:10.1080/00288330.2013.773919
transect was flown which equates to approximately 7,300 square nautical miles (or 25,040 sq. km.).

Table 20 presents a summary of the key findings:

- A pod of common dolphin (6-8) was observed in the October 2012 survey on Transect 11 located inside the Project Area.
- Very low densities of fur seals were observed between July 2011 and June 2013. All outside of the Project Area, closer to shore.
- A variety of other fauna were also observed including seabirds, fish (usually mullet or kahawai) and sharks.

<table>
<thead>
<tr>
<th>Species</th>
<th>Number</th>
<th>Waypoint / Transect Location</th>
<th>Survey Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common dolphin</td>
<td>6-8</td>
<td>22-21 (T11)</td>
<td>October 2012</td>
</tr>
<tr>
<td>Fur seal</td>
<td>2</td>
<td>NR</td>
<td>July 2011</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>4-3 (T2)</td>
<td>October 2011</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>10-9 (T5)</td>
<td>October 2012</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>14-13 (T7)</td>
<td>June 2013</td>
</tr>
</tbody>
</table>

Table 20: Summary of key marine species observed during aerial surveys

Overall, it was concluded that the abundance of marine cetaceans and mammals within the area surveyed is very low. These findings are consistent with observations from TTR workboats operating on the STB over the last 3 years.

Fur seals breed on the Sugar Loaf Islands off New Plymouth approximately 120 km around the coast to the north of Cape Egmont, and their scarcity in the survey area is not surprising given the lack of suitable haulout sites ashore and lack of demersal fish life. Fur seals are reported as common on many of the offshore oil structures in the Taranaki Bight.

The low densities of cetaceans observed in surveys was attributed to a number of factors including the limited benthic fauna present which would otherwise provide an attraction for higher order marine life; the homogenous habitat present across the seabed shelf in this location providing no refuge or features of interest to hold transitory cetaceans; and the harsh nature of the prevailing environment conditions.

6.12 Seascape and Visual Environment

6.12.1 Seascape Character Types

The South Taranaki Bight seascape was classified into the following three broad regional seascape character types based on the nature of the coastal margin and their associated beach sediment characteristics:

- **Dunes and Low Cliffs**
  Referred to as Rising Ground in NIWA’s Coastal Explorer, this character type has sandy beaches and associated sand dunes and/or low landforms and sea cliffs. The two coastal areas where this occurs are located between the Whanganui River mouth and the Patea River mouth. The larger of the areas occurs at Waiinu Beach and extends north to the Patea River mouth, with the smaller area being to the south along the Castlecliff foreshore. (Figure 58 and Figure 59)
Fossil Sea Cliffs
This relatively small area extends for approximately 1.5 km to the north of Castlecliff near the mouth of the Whanganui River and is characterised by stable hard rock cliffs backing sandy beaches. (Figure 60)

Eroding Sea Cliffs
These extensive areas extend from north of the fossil cliffs near Castlecliff to a point south of Wainui Beach and from the mouth of the Patea River to Ohawe and beyond. These actively eroding steep sea cliffs, which extend along 70% of the study area coastline, contain narrow beaches where the sediment material comprises a mixture of sand and gravel with areas of soil deposited from the actively eroding escarpment face. (Figure 61)

The defining elements and features for the regional seascape types have been primarily influenced by the nature and character of the visually prominent coastal margin. The coastal escarpment, dune systems and associated beaches which have been sculptured and shaped by past and ongoing erosion processes, clearly display very high and near pristine levels of natural character throughout most of the South Taranaki/North Whanganui coastal environment.

6.12.2 Seascape Character Areas

Based on the 2004 Inventory of Regional and Locally Significant Coastal Areas prepared by the Taranaki Regional Council, and the Landscape Character Areas defined in the 1996 Whanganui District Landscape and Ecology Report, 20 seascape character areas have been identified in the coastal environment between Mania and Whanganui. The spatial relationship between the national, regional and district seascape scales defined for this assessment are illustrated in Figure 62.
Figure 58: Sand Dune and Low Cliffs Seascape Character Type - Waipipi Beach 12 March 2013

Figure 59: Sand Dune and Low Cliffs Seascape Character Type - Waiinui Beach 11 February 2013
Figure 60: Fossil Cliffs Seascape Character Type - North Castlecliff Beach (source Lloyd Homer c1995)

Figure 61: Eroding Sea Cliffs Seascape Character Type - Hawera Coast 12 March 2013
Figure 62: Seascape Character Classifications
6.12.3 Natural Sediment Plumes

In addition to the distinctive coastline features that define and characterise the Seascape Character Types and Character Areas, a particularly distinctive feature of the nearshore seascape (up to 5 km offshore) is the appearance of suspended sediment plumes. While the appearance, extent and pattern of these plumes vary considerably, they are a characteristic feature of the South Taranaki Bight seascape. The sediment plumes are largely derived from river and stream deposited material, active shoreline erosion processes and the re-suspension of bottom sediments as a consequence of sea current and wave action. Figure 63 to Figure 67 illustrate the general appearance and pattern of natural sediment plumes along the South Taranaki Bight.

As part of the biogeophysical investigations commissioned by TTR, NIWA measured the natural suspended sediment concentrations (“SSC”) at six inshore locations along the coast between Whanganui and Hawera41. SSC readings were taken every 15 minutes during the entire period of deployment (up to nine weeks). The period over which the NIWA measuring instruments were deployed was unusually dry, with low river flows and low river sediment inputs to the coast, which would have coincided with low natural turbidity inputs.

During the deployment period, a series of aerial and land based photographs of the instrument locations were taken to provide a visual basis for the assessment of the visual effects of the existing natural and the proposed mining generated plumes in the inshore seascape. Photographs of the instrument sites and the SSC readings for these areas at specified dates and times are shown in Figures 5.1-5.26 of the Graphic Supplement attached to the “Seascape, Natural Character and Visual Effects Assessment (Boffa Miskell 2013b)”. In addition to the static instrument site observations, where obtainable, additional data from NIWA’s synoptic boat surveys carried out on March 11 and 12 are included and are illustrated in Figures 5.12 and 5.13 in the Graphic Supplement.

Based on the SSC measurements, the instrument photography, and field observations made over a number of occasions during the early part of 2013 in the South Taranaki Bight area, the appearance, pattern and extent of the naturally derived SSC plumes vary considerably within and between sites on a daily basis and over varying periods of time.

These plume patterns generally relate to natural processes such as would be expected at river mouths, in the vicinity of eroding sea cliffs and the patterns associated with tides, currents, wave and weather conditions. Notwithstanding these variations, the natural sediment plumes within the Character Type and Character Areas are distinctive features that contribute to the high visual, recreational and amenity values of the South Taranaki Bight seascape.

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Figure 63: Natural suspended sediment plumes off Patea Beach (12 March 2013)

Figure 64: Natural suspended sediment plumes off Waihi Beach (12 March 2013)
Figure 65: Natural suspended sediment plumes Patea River Mouth (12 March 2013)

Figure 66: Natural suspended sediment plumes adjacent Hawera Golf Course (12 March 2013)
Due to adverse weather conditions no reliable measurements have been able to be undertaken in regard to baseline “quiet” conditions at the Project site. However, a measurement undertaken in a harbour mouth situation in calm conditions and no shipping in the area is shown in Figure 68. This illustrates an example of calm sea conditions. When measured over a 15 minute period the $L_{eq}$ level was 129 dB re 1μPa with a waterfall sound spectrum.

Measurements undertaken at Lyttelton Port with cargo ships arriving and departing showed sound peaks at approximately 158 dB re 1μPa as the ship passes at low speed within 100 m of the receiver position within the harbour.
As shown on Figure 69 there is a significant number of ship movements within 10 nm of the proposed extraction site. These ships will be having an effect on the existing noise environment with levels of up to 13.2 dB as a ship passes.

Figure 68: Ambient Sound Spectrum

Figure 69: Vessel Tracks by Length Over All (LOA)

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42 Marico (2103) “South Taranaki Bight Shipping Study” report prepared for TTR by Marine and Risk Consultants Ltd, July 2013”
Table 21 and Table 22 set out background noise levels generated by natural underwater sources and from shipping activities. Many of these levels would be expected in the STB.

<table>
<thead>
<tr>
<th>Source</th>
<th>Broadband Source Level (dB re 1μPa at 1 m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sperm Whale Clicks</td>
<td>163 - 223</td>
</tr>
<tr>
<td>White-beaked Dolphin Echolocation Clicks</td>
<td>194 - 219 (peak-to-peak)</td>
</tr>
<tr>
<td>Spinner Dolphin Pulse Bursts</td>
<td>108 - 115</td>
</tr>
<tr>
<td>Bottlenose Dolphin Whistles</td>
<td>125 - 173</td>
</tr>
<tr>
<td>Fin Whale Moans</td>
<td>155 - 186</td>
</tr>
<tr>
<td>Blue Whale Moans</td>
<td>155 - 188</td>
</tr>
<tr>
<td>Gray Whale Moans</td>
<td>142 - 185</td>
</tr>
<tr>
<td>Bowhead Whale Tonals, Moans and Song</td>
<td>128 - 189</td>
</tr>
<tr>
<td>Humpback Whale Song</td>
<td>144 - 174</td>
</tr>
<tr>
<td>Humpback Whale Fluke and Flipper Slap</td>
<td>183 - 192</td>
</tr>
<tr>
<td>Right Whale</td>
<td>172 - 175</td>
</tr>
<tr>
<td>Southern Right Whale Pulsive Call</td>
<td>172 - 187</td>
</tr>
<tr>
<td>Snapping Shrimp</td>
<td>183 - 189 (peak-to-peak)</td>
</tr>
</tbody>
</table>

Table 21: Natural Underwater Sounds

<table>
<thead>
<tr>
<th>Type of vessel</th>
<th>Frequency (kHz)</th>
<th>Source level dB re 1μPa</th>
<th>Reference from Hegley (2013)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rigid inflatable (rescue craft)</td>
<td>6.3</td>
<td>152</td>
<td>Malme et al. 1989</td>
</tr>
<tr>
<td>7 m outboard motor boat</td>
<td>0.63</td>
<td>156</td>
<td>Malme et al. 1989</td>
</tr>
<tr>
<td>Tug pulling empty barge</td>
<td>0.037, 1.0, 5.0</td>
<td>166, 164, 145</td>
<td>Buck &amp; Chalfant 1972; Miles et al. 1989</td>
</tr>
<tr>
<td>Tug pulling loaded barge</td>
<td>1.0, 5.0</td>
<td>170, 161</td>
<td>Miles et al. 1989</td>
</tr>
<tr>
<td>34 m (twin diesel engine) workboat</td>
<td>0.63</td>
<td>159</td>
<td>Malme et al. 1989</td>
</tr>
<tr>
<td>Tanker (135 m)</td>
<td>0.43</td>
<td>169</td>
<td>Buck &amp; Chalfant 1972</td>
</tr>
<tr>
<td>Tanker (179 m)</td>
<td>0.06</td>
<td>180</td>
<td>Ross 1976</td>
</tr>
<tr>
<td>Super tanker (266 m)</td>
<td>0.008</td>
<td>187</td>
<td>Thiele and Odengaaard 1983</td>
</tr>
<tr>
<td>Container ship (219 m)</td>
<td>0.033</td>
<td>181</td>
<td>Buck &amp; Chalfant 1972</td>
</tr>
<tr>
<td>Container ship (274 m)</td>
<td>0.008</td>
<td>181</td>
<td>Ross 1975</td>
</tr>
<tr>
<td>Freighter (135 m)</td>
<td>0.041</td>
<td>172</td>
<td>Thiele &amp; Odengaard 1983</td>
</tr>
</tbody>
</table>

Table 22: Summary of sound frequencies produced by shipping traffic and their source levels.
Figure 70: Typical Sound Levels of Ocean Background Noises (from Wenz (1962), in Hegely (2013)
6.14 Commercial Fishing

|----------------------------|------------------------------------------------------------------------|

The South Taranaki Bight is an exposed and weather-beaten area which nevertheless supports a productive and diverse range of valuable inshore fisheries. The main commercial fisheries in the immediate area of the mining operation are a mixed bottom trawl fishery for trevally, leatherjacket, gurnard and snapper, and a set net fishery targeting school shark, rig and blue warehou. Nearby fisheries include a coastal rock lobster fishery and, on the seaward side of the mining site, a mid-water trawl fishery for jack mackerel and a small bottom longline fishery.

The bottom trawl fishery occurs over a particularly productive area known as “the rolling grounds.” The area is fished by one trawler based in New Plymouth and around a dozen from the top of the South Island which visit on an occasional basis a part of their annual fishing plans. Although trawling effort occurs year round, the species taken show a distinct seasonality, with catches of many species peaking during the summer months.

The set net fishery has three main components: rig is targeted in shallow waters within 4 nm of the coast, school shark is targeted further out in waters around 50 m deep, and blue warehou is targeted in shallow waters around Cape Egmont. Four set net vessels fish out of New Plymouth, often operating in all three target fisheries at different times of year, and several other vessels travel up from the South Island. The rig fishery in particular has been subject to significant spatial displacement over recent years as a result of regulations put in place to protect Maui’s dolphins.

Quota ownership in both the trawl and set net fisheries is dominated by the large seafood companies Talley’s and Sanford. Te Ohu Kaimoana Trustee is also a major quota owner on behalf of Māori, and several other iwi-owned companies feature in the top 10 quota owners for stocks in this area.

6.15 Social Environment - Existing Communities

|----------------------------|---------------------------------------------------------------------------------------------------|

6.15.1 Introduction

TTR commissioned Corydon Consulting Limited to assess the social impacts of the Project on local communities and identify possible mitigation measures.

Effects on the Social Environment are evaluated in Section 13.

TTR’s operations will predominantly be undertaken in the coastal waters of South Taranaki, 22-36 km offshore from Patea. These operations will be supported by onshore services operating from Port Taranaki and Port of Whanganui, and offices in New Plymouth and Wellington. The communities potentially affected by the proposed project are therefore spread across a large geographic area, with different communities and groups potentially affected in different ways.

For the purposes of this IA, the potentially “affected area” is defined at two scales.

- The “local area” covers the coastal communities from Opunake in the north to Whanganui city in the south (in South Taranaki District and Whanganui District). This is the area that has the closest association with the coastal environment in which the
The proposal is based, and contains eight main coastal communities: Opunake, Manaia, Ohawe, Hawera, Patea, Waverley, Waitotara and Kai Iwi.

- The “wider area” covers the districts of New Plymouth, South Taranaki and Whanganui. This is the area that is most likely to experience employment-related effects of the proposal.

The paragraphs set out below describe to existing social environment in respect of the “local area” and the “wider area” as described above.

### 6.15.2 Profiles

The communities in the local area differ to New Zealand as a whole, with the main differences being:

- all communities had a declining resident population between 1996 and 2006, in comparison to population growth in New Zealand as a whole. Some communities had a significant decline in population (particularly Waitotara, Patea, Manaia, Opunake and Waverley).
- the communities are generally not as ethnically diverse as New Zealand as a whole. All communities have a significantly greater percentage of the population with Māori ethnicity.
- the age profile of all communities indicates that there are fewer residents in the early and mid-stages of their careers (15-44 years of age) and more residents of retirement age (65 years and older)
- there are significantly lower household incomes in Patea, Waverley, Opunake and Manaia than New Zealand as a whole.
- with the exception of Hawera, there is a significantly higher percentage of residents earning an income from some form of government benefit (such as unemployment, sickness, domestic purposes or invalids benefit)
- the manufacturing sector is the largest employer in each community, and the percentage of the workforce in this sector is significantly great than for New Zealand as a whole.

Appendix 3 sets out information on the existing social environment for each of the “local area” communities.

### 6.16 Archaeology


TTR commissioned Clough & Associates Ltd to provide archaeological advice on the potential for the discovery of historic shipwreck sites within the area of operations as part of the assessment of effects for the project.

The assessments undertaken consisted of a review of previous research, including a multibeam bathymetry survey of the proposed area of operations commissioned from NIWA by TTR. A desk-based review of the literature relevant to shipwrecks on the South Taranaki Coast was also carried out to provide background historical detail and supplement the results of that survey.

There are at least 126 documented shipwrecks in the Taranaki region, of which 64 pre-date 1900. The remains of the majority are in unconfirmed locations and only 11 of these wrecks have been successfully relocated in recent times. Twenty-three vessels are recorded to have been lost on the South Taranaki coast at or near Patea, and 28 on the coast at or near Whanganui. These include 14 near Patea and 20 near Whanganui that were wrecked before 1900.
No shipwrecks are known to be present within the project area. The potential for encountering shipwrecks in the STB Exclusive Economic Zone (EEZ) is low, but cannot be discounted entirely. A review of NIWA’s multibeam sonar data suggests that there is no significant wreckage exposed above the seabed in the project area; however, it is still possible that wreckage could be encountered buried beneath the seabed.

Any shipwrecks pre-dating 1900 have statutory protection under the Historic Places Act 1993 and cannot be modified or destroyed unless an Authority has first been obtained from the New Zealand Historic Places Trust (NZHPT). To provide for the possibility that a shipwreck may be encountered, TTR will adopt a ‘Discovery Protocol for Shipwreck Finds’ to ensure that statutory requirements and processes are followed in the event that nineteenth century wreckage is encountered. Any information recovered from a previously unidentified shipwreck (whether pre- or post-1900) could add significantly to our knowledge of New Zealand’s history.

6.17 Maritime and Navigation

TTR commissioned Marico Marine NZ Limited to investigate vessel movements in the South Taranaki Bight to provide a basis to establish the impact of the proposed mining project on vessel activity in the area.

The study analysed 12 months of Automatic Identification System (AIS) data for the area extending from Cook Strait to Kahurangi Point and Cape Egmont including Tasman Bay. Findings are summarised in Figure 71. The study concluded that, the Project area is well separated from the regular shipping routes and commercial fishing grounds.

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Figure 71: South Taranaki Bight – Vessel Tracks past 12 Months

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43 Marico (2103) “South Taranaki Bight Shipping Study” report prepared for TTR by Marico Marine NZ Limited, July 2013
6.18 Recreation


TTR commissioned Rob Greenaway & Associates to identify recreation and tourism activities which occur in the area that is potentially affected by this activity, defined as the coastal and offshore area extending 25 nautical miles (nm) (46.4 km) out to sea from mean high water springs (MHWS), between Hawera and Whanganui. Ohawe Beach has been defined as the northern-most extent of the ‘study area’ for recreation and tourism purposes.

Regionally important coastal marine recreation settings are based at the main public access and activity points:

- Ohawe Beach
- Waihi Beach,
- the mouths of the Tangahoe and Manawapou Rivers,
- Patea,
- Waipipi,
- Waiinu,
- Kai Iwi
- Castlecliff, and
- the fishing and crayfishing resource up to 20 km offshore.

The level of shellfish gathering along the coast is unclear but is a locally important activity.

Fishing from beaches and river mouths (surfcasting, whitebaiting and shellfish gathering) and cliff tops is noted at many locations. Fishing from boats is popular, particularly at Four Mile Reef and the North and South Traps. The areas most commonly fished occur within 10 kilometres from the shore.

The section of coast extending from Patea north to Cape Egmont is relatively lightly fished in comparison with the coast south of Patea and in North Taranaki.

Very little recreational fishing occurs more than 20 km offshore along the entire west coast of the North Island in general with a similar pattern shown in the STB. In 2011 the Ministry of Fisheries published data on aerial survey of recreational fishing effort and take on the West Coast of the North Island (referred to in Greenaway 2013). ‘Offshore fishing’ in the South and North Taranaki Bights was not analysed in the Ministry of Fisheries study, and the focus was on the area out to several kilometres from the coast, with the flight path generally 1 km from the shoreline with an ability to see vessels up to 3 km away. There were some exceptions, including by coincidence the proposed mining activity area (Figure 72).

The pilot study indicated that 79% of anglers in the area spanning Ohawe to Titahi Bay were boat-based, 2% were using shore-based long lines and 19% were surfcasters. The flight data from the 2006-07 study showed sparse boat fishing activity from Cape Egmont to north of Patea, with more boats sighted south of Patea and around

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44 The main locations from the shore are Patea (fishing), Arawhata Beach (fishing), Puketapu (surfcasting, fishing), Oeo Cliffs (surfcasting, shellfish gathering), Otakeho Beach (fishing), Rawa Stream mouth (surfcasting, shellfish gathering), Kaupokonui Beach and river mouth (fishing and whitebaiting), Ohawe beach (fishing, whitebaiting, seafood gathering), Inaha beach (fishing), Waihi Beach (fishing), Manawapou-Tangahoe River mouths and cliff tops (fishing), Kakaramea cliff tops (fishing), Waipipi dune lands (fishing), Waverley Beach (fishing), Waitotara Estuary (whitebaiting), Waiinui Beach (fishing).
Whanganui. The flight path indicates the survey area in the proposed mining area and that most offshore fishing activity is near the coast at that site.

![Diagram of the South Taranaki Bight Iron Sand Extraction Project](image)

**Figure 72:** Inshore boat angling activity, Tongaporutu to Tangimoana (in Greenaway 2013)

Tourism activity in the study area is largely limited to the six beach camp sites and three fishing charter operations - two operating from Pate and one from Whanganui.

The mining site is a very low use recreation setting which may be used only rarely for marine fishing. Sites of interest to this assessment of effects are the inshore recreation setting, the near-coast diving sites and the marine fishing opportunity within 20 km of the coast. At a national level, the scale of recreation activity in the relevant coastal setting is relatively slight, with higher levels of activity north of Cape Egmont and south of Patea.
7. EXISTING INTERESTS CONSULTATION

7.1 Introduction

Section 39(1)(d) of the Act requires the IA to identify persons whose existing interests are likely to be adversely affected by the activity. Section 39(1)(d) of the Act requires that an impact assessment describe any consultation undertaken with those existing interests which are likely to be adversely affected by the activity.

These matters are discussed in this section of the IA in relation to relevant “existing interests” associated with TTR’s Project which have been identified largely on the basis of consultation undertaken as discussed.

TTR’s engagement and consultation commenced before all of the environmental effects were known, and as such TTR decided to consult with some existing interests who may be affected by the Project. As a result of consultation and research into potential environmental effects, it was found that some groups, such as surfers, are not likely to be adversely affected by the Project; however they are still listed as an existing interest in this section.

7.2 Identification of Existing Interests

The Act defines existing interests as:

existing interest means, in relation to New Zealand, the exclusive economic zone, or the continental shelf (as applicable), the interest a person has in—

(a) any lawfully established existing activity, whether or not authorised by or under any Act or regulations, including rights of access, navigation, and fishing:
(b) any activity that may be undertaken under the authority of an existing marine consent granted under section 62:
(c) any activity that may be undertaken under the authority of an existing resource consent granted under the Resource Management Act 1991:
(d) the settlement of a historical claim under the Treaty of Waitangi Act 1975:
(e) the settlement of a contemporary claim under the Treaty of Waitangi as provided for in an Act, including the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992:
(f) a protected customary right or customary marine title recognised under the Marine and Coastal Area (Takutai Moana) Act 2011

“Existing interests” as defined under the Act and associated with TTR’s Project are described as follows:

7.2.1 Lawfully Established Existing Activity

The following groups are existing interests by virtue of them having a lawfully established activity in the territorial sea and/or exclusive economic zone including rights of navigation, access and fishing, which may be adversely affected by TTR’s activity. Groups and organisations have been identified based on pre-existing relationships, discussions with representative bodies and regulators, and the South Taranaki District Council’s database of recreational clubs.

Recreational fishing groups

- New Plymouth Sportfishing and Underwater Club
- Wanganui Manawatu Sea Fishing Club
- Patea Fishing Club
- Opunake Surfcasting/Angling Opunake
- Kaponga Fishing Club
- Patea Surfcasters Club

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45 EEZ Act, section 4
46 http://www.southtaranaki.com/Live/Clubs-and-Organisations/
Diving and Boating clubs
- Patea and District Boating
- Cape Egmont Boat Club
- Ohawe Boating and Angling Club
- Opunake Boat and Underwater Club Inc.

Charter operators
- South Taranaki Fishing Charters
- Hy-jinks Charters
- Ron Opie Diving
- Fluffy Duck Fishing Charters

Surfing clubs
While surfing occurs near the shoreline, there was a perception among the community that TTR’s activity may negatively affect surfing within the coastal and marine area. The modelling has demonstrated that the activity is not likely to have any adverse activity on surfing but because of the widespread concern, TTR treated surfing as an existing interest for the purposes of this IA.

- New Plymouth Surf Riders Club
- Surfing Taranaki
- Patea Board Riders Club
- Opunake Boardriders Inc

Commercial fishing operators/representative bodies
- Seafood New Zealand
- Egmont Seafoods
- Fisheries Inshore New Zealand
- Deepwater Group
- Southern Inshore Fisheries Management Company
- NZ Rock Lobster Industry Council
- Trawlers:
  - Ian Brown
  - Nelson vessels
- Set netters:
  - Ian McDougall
  - Lyle Jenkins
- Mid water trawling (jack mackerel etc)
  - Sealord
  - Talley’s, Nelson
- Te Taihauāuru Iwi Fisheries Forum
- Te Ohu Kaimoana

Commercial operators under Continental Shelf Act and the Crown Minerals Act
- Origin Energy (Kupe Platform and Pipeline operator)

Marine traffic
As discussed in Section 6.17, marine traffic in and around the project area is scarce. The main marine traffic consists of smaller fishing vessels and vessels carrying out exploration activities for TTR. It is on this basis that TTR does not consider that marine traffic constitute an existing interest that may be affected by the Project.

7.2.2 Existing Marine Consents
There are currently no activities authorised by an existing marine consents granted under section 62 of the Act with interests in or near the Project area.

7.2.3 Existing Resource Consents
Under the Act, TTR must consider any activity that may be undertaken under the authority of an existing resource consent granted under the Resource Management Act 1991. TTR reviewed existing resource consents granted by Taranaki Regional Council and Horizons Regional Council in the South Taranaki Bight. None of the consented activities or permitted activities are considered to be affected by TTR’s Project. A list of existing resource consents for the South Taranaki Bight is attached as Appendix 4.

A question was raised during consultation regarding the potential for synergistic and/or cumulative effects between TTR’s Project and Fonterra’s milk processing wastewater from the Whareroa Plant near Hawera. TTR discussed the matter with BTW Company, which has been contracted by Fonterra for the renewal of the resource consent. Based on those conversations and evidence regarding met-ocean conditions, TTR is satisfied there is little to no risk of interaction between Fonterra’s discharges, which occur approximately 2 km offshore and TTR’s activities more than 22 km offshore.

**7.2.4 Settlement of Historical Claims under the Treaty of Waitangi Act**

TTR has interpreted the settlement of a historical claim under the Treaty of Waitangi Act 1975 provision above to include potential future settlement of historical claims in addition to settlements which have been enacted by legislation. To date no historical settlements have included provisions covering the EEZ within the South Taranaki Bight. Based on plume modelling there is the potential for the sediment plume to migrate into the coastal and marine area, over which iwi may have a Treaty interest through a statutory acknowledgement.

The status of historical Treaty settlements for iwi in the South Taranaki Bight are detailed in Table 23.

<table>
<thead>
<tr>
<th>Iwi organisation</th>
<th>Existing interest</th>
<th>Additional comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Te Runanga o Ngāti Ruanui</td>
<td>Ngāti Ruanui Claims Settlement Act 2003  Mandated iwi organisation Māori Fisheries Act 2004</td>
<td>Project area is within Ngāti Ruanui’s rohe, as such Ngāti Ruanui is considered to be the tangata whenua of the project. Ngāti Ruanui has a statutory acknowledgement over the coastal and marine area within their area of interest.</td>
</tr>
<tr>
<td>Te Kaahui o Rauru</td>
<td>Ngaa Rauru Kiltahi Claims Settlement Act 2005  Mandated iwi organisation Māori Fisheries Act 2004</td>
<td>Project area is near Ngaa Rauru’s area of interest and the coastal statutory acknowledgement which extends west to the Patea River. Ngaa Rauru rohe moana boundary extends out 200 nm from Kai-Iwi Beach and Kaitoke Stream. Environmental modelling suggests that the effects are likely to impact the Ngaa Rauru rohe.</td>
</tr>
<tr>
<td>Whanganui River Māori Trust Board (WRMTB)</td>
<td>Te Whiringa Muka Trust (part of WRMTB) is the mandated iwi organisation Māori Fisheries Act 2004</td>
<td>Represents Te Atihauaui a Pāpārangi (Whanganui iwi) in Treaty settlements for Whanganui River settlement. Letter of Agreement signed August 2013. The Waitangi Tribunal has not yet reported on historical land claims. Te Atihauaui a Pāpārangi rohe moana boundary extends out 200 nm from Kai-Iwi Beach and Kaitoke Stream. Modelling of the plume suggests it may flow into Whanganui rohe and mix with the sediment of the Whanganui River.</td>
</tr>
</tbody>
</table>
### Table 23: Status of historical Treaty settlements and existing interests for iwi in the South Taranaki Bight

<table>
<thead>
<tr>
<th>Iwi organisation</th>
<th>Existing interest</th>
<th>Additional comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Te Runanga o Ngāti Apa Trust</td>
<td>Ngāti Apa (North Island) Claims Settlement Act 2004</td>
<td>Modelling of the plume suggests it may flow into the area over which Ngāti Apa has a coastal statutory acknowledgement.</td>
</tr>
<tr>
<td></td>
<td>Mandated iwi organisation Māori Fisheries Act 2004</td>
<td></td>
</tr>
<tr>
<td>Ngāti Raukawa ki te Tonga Trust</td>
<td>Mandated iwi organisation Māori Fisheries Act 2004</td>
<td>Claims being heard by the Porirua ki Manawatu District Inquiry. Modelling of the plume suggests it may flow into Ngāti Raukawa ki te Tonga coastal rohe.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Te Ohu Tiaki o Rangitāne Te Ika a Māui Trust</td>
<td>Mandated iwi organisation Māori Fisheries Act 2004</td>
<td>Rangitāne o Manawatu, mandated by Tanenuiarangi Manawatu Incorporated, is in direct negotiations with the Crown. Heads of Agreement signed 1999. Modelling of the plume suggests it may flow into the Rangitāne coastal rohe off the Manawatu coast.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ngā Hapū o Ngāruahine Iwi Inc</td>
<td>Mandated iwi organisation Māori Fisheries Act 2004</td>
<td>Ngāruahine is in negotiations with the Crown to settle historical Treaty claims. Agreement in Principle signed in 2012. The Project area is near Ngāruahine’s area of interest, over which the Crown has agreed in principle to a coastal statutory acknowledgement. Ngā Hapū o Ngāruahine and individuals have applied for customary marine title within the Ngāruahine area of interest. These have not yet been granted. On advice from Ngā Hapū o Ngāruahine Iwi Inc representatives, TTR also tried to engage with individual hapū of Ngāruahine.</td>
</tr>
<tr>
<td>Taranaki Iwi Trust</td>
<td>Mandated iwi organisation Māori Fisheries Act 2004</td>
<td>Taranaki Iwi is in negotiations with the Crown to settle their historical Treaty claims. Letter of Agreement signed in 2012. The south eastern boundary of the Taranaki Iwi area of interest is Ouri Stream.</td>
</tr>
</tbody>
</table>

#### 7.2.5 Settlement of Contemporary Claim under Treaty of Waitangi

All of the iwi organisations detailed in Table 23 are mandated iwi organisations under the Māori Fisheries Act 2004 which implemented the agreements made under the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992. In addition Te Ohu Kaimoana has an existing interest in the Project based on their statutory role as defined in the Māori Fisheries Act 2004. This Act implements the agreement made in the Deed of Settlement dated 23 September 1992 and the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992.

The Māori Commercial Aquaculture Claims Settlement Act 2004 provides for the settlement of contemporary Treaty of Waitangi claims to commercial aquaculture. Within the South Taranaki Bight no aquaculture settlement areas have been Gazetted, therefore the Māori Commercial Aquaculture Claims Settlement Act 2004 creates no further existing interests with respect to the Project. Protected Customary Right or Customary Marine Title
There are no customary right or customary marine titles, which have been recognised under the Marine and Coastal Area (Takutai Moana) Act 2011. TTR notes that Ngāruahine has lodged an application for customary title for the coastal marine area between the Taungatara and Waihi Rivers.

7.3 Consultation with existing interests

7.3.1 Introduction

Section 39(1)(d) of the Act requires that an impact assessment describe any consultation undertaken with those existing interests which are likely to be adversely affected by the activity. This section sets out details on TTR’s consultation programme with existing interests including iwi.

7.3.2 TTR Community Engagement

Effective engagement and consultation with key stakeholders and existing interests has been priority for TTR since its inception in 2007. TTR has put significant time and resources in understanding the needs and concerns of key stakeholders. As much as possible TTR has undertaken its own engagement and consultation, with the aim of establishing meaningful relationships between the company and the community. To that end an Iwi and Community Relations Manager was appointed in June 2013.

For the purpose of this IA, this section focuses on consultation as required under the Act for this project, rather than generic community/stakeholder engagement TTR has undertaken.

7.3.3 Consultation Programme

TTR’s consultation programme included the following steps:

- Identify existing interests as defined by the Act
- Brief existing interests on the nature, scale and location of the project. Distribute information on the proposed project
- Discuss and identify possible effects of the proposal with existing interests and obtain feedback
- Identify possible methods of avoiding, remediying or mitigating adverse effects and provide feedback
- Provide a forum for the wider community to learn about the project and ask questions

Existing interests were identified based ongoing engagement since 2007, marine recreational clubs listed on the South Taranaki District Council website, discussions with representative bodies such as Seafood New Zealand, and regulators, for example, Taranaki Regional Council.

Between June 2013 and October 2013, TTR sent email invites and met with existing interests and key stakeholders to brief them on the project and the consultation timeline. Information provided included a PowerPoint presentation about the project including the area, extraction methodology, potential environmental effects and the expected economic benefits. During these initial meetings the existing interests expressed their initial concerns and areas of interest with regard to the Project.

Consultation is continuing, and below is a summary of the consultation to date.

http://www.southtaranaki.com/Live/Clubs-and-Organisations/
7.3.4 Commercial Fishing Consultation

In July 2013, TTR representatives met with Seafood New Zealand, which is the national representative organisation, to brief them on the Project. Seafood New Zealand provided a list of key stakeholders and operators who would be interested in the Project. The list provided aligned closely with the list of commercial fishing operators identified in the Commercial Fishing Assessment (Fathom 2013).

TTR has met with some of the operators (Egmont Seafoods and Ian McDougall) based in New Plymouth, who had canvassed the views of other operators in the region.

TTR has also met with representative groups including the Deepwater Group, Inshore Fishing Group, Te Ohu Kaimoana, Southern Inshore Group representing many of the operators in Nelson, and the Te Taihauāuru Iwi Fisheries Forum, to discuss the Project, potential effects and to identify potential existing interests.

TTR has provided the organisations with a copy of the Commercial Fishing Assessment (Fathom 2013), along with access to the suite of relevant draft NIWA reports.

7.3.5 Recreational Users Consultation

Recreational users include recreational fishing groups, boat clubs, surfers and divers. On 5 August 2013 TTR emailed all of the recreational groups along with charter operators in the South Taranaki Bight, inviting them to a meeting in Hawera to learn about TTR’s proposed project. The meeting was held on 13 August 2013 at the Hawera Community Centre. TTR was represented by the CEO, Executive Manager - Environmental and Approvals, Iwi and Community Relations Manager, and TTR’s Environmental Advisor. Rob Greenaway, who was completing the assessment of the effect on recreation and tourism also attended. 38 stakeholders representing a range of the recreational users attended the meeting.

During the meeting TTR provided a presentation about the project, including consultation, the location, extraction methodology, the environmental effects research and potential economic and community benefits. TTR staff answered participants’ questions about the project and listened to the participants concerns which included:

- short and long term environmental effects
- plume effects, smothering of fishing reefs and adversely affecting diving quality in the region
- recolonisation rates
- impact on surfbreaks
- development of natural resources
- job opportunities including foreign workers
- the impact on local communities

Some of the participants at the meeting said that they oppose all extraction of all natural resources and some declined to provide their contact details for further correspondence.

The database of recreational groups and charter operators were also invited to the public information expo held on 13 September 2013 in Hawera, as described in section 7.4.

TTR also met with the CEO of Surfing Taranaki and some of the charter operators separately to discuss possible effects the TTR Project may have on their activities.
### Iwi Consultation Plan

TTR had established relationships with most of the iwi with existing interests but still wanted to adopt a formal consultation process differentiated from day to day relationship building and engagement. TTR developed a draft consultation plan based on the HSNO Best Practice Guidelines Tangata Whenua Effects Assessment May 2010 and Alberta’s First Nations Consultation Guidelines on Land Management and Resource Development November 2007.

The key components of the consultation plan and implementation are detailed in Table 24.

<table>
<thead>
<tr>
<th>Adapted Guideline</th>
<th>TTR approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Establish a relationship with the applicant and agree a consultation process.</td>
<td>TTR has spent several years developing relationships with most of the iwi in the South Taranaki Bight. Following plume modelling and discussions with New Zealand Petroleum Minerals, Ngāti Raukawa ki te Tonga, Rangitāne o Manawatu and Taranaki iwi were added to the list of potential existing interests. TTR developed and sent out a draft consultation plan and timetable to each iwi in June 2013.</td>
</tr>
<tr>
<td>2. Understand the proposed activity, by reviewing the draft application and/or all supporting information (such as technical reports) and through workshops with the applicant and their advisors/consultants.</td>
<td>During June and July 2013 TTR provided iwi with a presentation about the proposed project including changes made to the project. TTR supplied each iwi with a copy of TTR’s Crown Minerals mining permit application supporting information document, which included information about the geology, resource, mining method and TTR technical capability. On 26 July TTR presented the project overview to the Te Taihauāuru Iwi Fisheries Forum. In July TTR provided iwi with draft NIWA reports on the environmental baseline and effects modelling in late July 2013. In August 2013 TTR organised NIWA scientists to present their key findings to the iwi in Hawera and Whanganui and answer questions they had. The Te Taihauāuru Iwi Fisheries Forum has undertaken to review the environmental reports on behalf of various iwi and will work with environmental units to assess the effects and make recommendations about possible mitigation. TTR has agreed to contribute funding to that process. The final report of that study will likely be provided to the EPA as part of the public submission process or as evidence.</td>
</tr>
<tr>
<td>3. Identify the relations of the tangata whenua/iwi with the taonga and environment. Identify the effects of the proposed activity on tangata whenua and their values and assess the magnitude of the effects identified.</td>
<td>TTR assessment of relations and associations is based on consultation and the desktop study. Individual iwi, such as Ngāti Ruanui have undertaken to complete an independent cultural impact assessment as a separate process, which will likely be provided as part of the public submission process. TTR has shared NIWA reports</td>
</tr>
</tbody>
</table>
4. Assess the level of risk associated with the effects identified. Where significant adverse effects on tangata whenua or their values are identified, assess whether these can be avoided, remedied or mitigated.

Develop the measures that are proposed to reduce the extent or impact of those effects. To date most of the discussions with iwi have centred on understanding the environmental effects, with some preliminary discussions about the potential for iwi to be involved in monitoring of the environmental effects, and the development of a detailed environmental management plan in conjunction with iwi and other stakeholders.

5. Report back to the tangata whenua on the results of the assessment in a clear and transparent manner.

TTR shared draft information as it has become available, including a draft version of the IA.

Table 24: Iwi consultation plan

7.3.7 Desktop Study on Iwi Interests in South Taranaki

In addition to consulting with iwi, TTR compiled a desktop study of the publicly available information relating to the cultural associations with each of the iwi with the South Taranaki Bight to inform TTR with a preliminary assessment of some of the potential interests various iwi may have and to provide background to TTR staff. The desktop study focused on associations with the coastal and the marine environment.

In completing the desktop study the following resources were used, where available:

- Waitangi Tribunal Reports, including District and Generic Reports
- Treaty of Waitangi Deeds of Settlement
- Iwi Management Plans
- Iwi Fisheries Plans
- Submissions on Petroleum Block Offers
- Select Committee submissions
- Regional Plans

Each iwi was informed of the desktop study and asked if there was any information they would like to provide towards the desktop, such as draft statements of association for coastal plans or Treaty settlements still under negotiation.

7.4 Community Engagement

In addition to consulting with potential existing interests, TTR has met with representatives of the local councils:

- Taranaki Regional Council
- South Taranaki District Council
- New Plymouth District Council
- Wanganui District Council
- Horizons Regional Council

These meetings have assisted by increasing TTR’s understanding some of the community concerns about the Project and providing contacts of potential existing interests. TTR has also met with representatives from Venture Taranaki, Wanganui Development Agency, Port Taranaki and Port of Nelson to discuss the project.
On 10 September 2013 TTR hosted a public information session in Hawera. This was an expo-styled event, where members of the public could come and learn about the Project at their leisure. Invitations to this expo were sent to iwi, existing interests, local councils, local Members of Parliament and local media. Public notices, advertising the event, were placed in the Taranaki Daily News and the Wanganui Chronicle. During the expo TTR staff and advisors were able answer questions and listen to concerns. Approximately 25 people attended the information expo. TTR proposes to hold another information expo in Hawera ahead of the public submission period.

Prior to submitting the IA, TTR updated its website with a presentation about the project and a preliminary summary of the project and the environmental effects so the general public could learn more about the project and the potential effects.
8. ECONOMIC BENEFITS

8.1 Introduction

One of the considerations for the EPA is to take into account the “economic benefit to New Zealand of allowing the application”. Economic considerations are also part of achieving sustainable management and therefore the purpose of the EEZ Act.

Information is presented here on the anticipated economic benefits, how these benefits have been characterised and assessed; and the level of confidence attached to predictions. Consideration has been given to alternative extraction methodologies and projected commodity prices.

8.2 Overview

The TTR iron sands project will make New Zealand fundamentally wealthier. TTR’s project will use a previously unused resource. When that resource is unlocked, New Zealand will enjoy a positive wealth shock.

TTR commissioned the New Zealand Institute of Economic Research (“NZIER”) to use a computable general equilibrium (“CGE”) model to estimate the likely long-run, annual impact of TTR’s operations on the New Zealand economy48. The benefit of a CGE model is that it considers both the first round effects of the project — increased production, returns to capital in the mining industry, royalties and taxes — as well as the impact that this first round effect has on other prices, and demand and production, in the rest of the New Zealand economy.

NZIER’s analysis is static. The estimated effect is an annual impact. It will persist as long as the TTR iron sands project is operational. Lifetime impacts can be estimated by calculating a net present value of the annual effects over the lifetime of the project.

8.3 The Economic Operation of the TTR Project

8.3.1 Production and Sales Projections

The following description of the direct impact of the TTR Project are drawn largely from TTR’s financial projections and related materials. NZIER has not verified the plausibility of the projections.

The expected production from the TTR Project is being continually refined, and is affected by the techniques and technologies that will be employed. NZIER relied on budgets that assume an average production of 4.4 million tons of iron ore concentrate per annum for export. This may change in the future as forecasts are refined.

TTR has assumed a price for its material of US$81.80/tonne. This figure is based on an estimated world price for iron ore of US$108.50/tonne, adjusted for the composition of the product TTR expects to produce. This price will generate annual revenues of US$357 million. Using an exchange rate of about US$0.80 per NZ$, that equates to approximately $446 million49. To put these numbers in context, a number of export categories are shown in Table 25. The proposed exports are more than pharmaceutical exports, and in the same range as plastics and plastic items.

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49 NZIER uses the convention that a bare dollar sign denotes New Zealand currency.
Export category | 2012 Value ($m) 
---|---
Wine | 1,202
Aluminium | 1,035
Wool | 797
Iron and steel | 595
Wood and paper pulp | 588
Optical and medical devices | 573
Paper | 511
Plastic items | 436
Pharmaceuticals | 258
Live animals | 249
Iron and steel items | 244

Source: Statistics NZ

Table 25: Assorted exports and values similar in value to projected TTR exports, 2012

NZIER assumed TTR will export all the iron ore at the world price, and that the extra production is not significant enough to impact the world price. Production is modelled as commencing in 2016 and continuing for 20 years.

8.3.2 Operational Expenditure Cost Structure

The operational expenditure of the TTR Iron Sands project (Table 26) is slightly unusual because TTR will lease storage and processing vessels from international firms. Consequently, around 18% of the inputs to production will be imported. Domestic intermediate purchases are dominated by power and professional services such as insurance, and account for 50% of total operational expenditure.

Also notable is the high shipping cost of iron ore. Being a bulky commodity, it has a high annual shipping cost of around US$44 million, 24% of operational costs.

<table>
<thead>
<tr>
<th>Cost category</th>
<th>Values</th>
<th>Shares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic intermediates</td>
<td>91</td>
<td>50%</td>
</tr>
<tr>
<td>Imported intermediates</td>
<td>34</td>
<td>18%</td>
</tr>
<tr>
<td>Labour</td>
<td>14</td>
<td>8%</td>
</tr>
<tr>
<td>Freight</td>
<td>44</td>
<td>24%</td>
</tr>
<tr>
<td>Total operational expenditure</td>
<td>184</td>
<td>100%</td>
</tr>
</tbody>
</table>

Estimated average annual costs of production (US$ m)

Table 26 Operational expenditure of the TTR Iron Sands project

8.3.3 Capital Expenditure

TTR suggest the project requires US$575 million capital investment that will largely be funded from offshore financing. NZIER assumes a financing cost of 8% that equates to US$46 million over the lifetime of the project or $4.6 million per annum. Depreciation costs on the capital assets of 20% add a further $11.6 million per annum, bringing total capital expenditure and financing to just over $16 million per annum.

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50 The TTR Iron Sands project is expected to increase the worldwide production of iron ore by 0.1%. 

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8.3.4 Royalties, taxes and profit

The Crown Minerals (Royalties for Minerals Other than Petroleum) Regulations 2013 sets royalties on Tier 1 minerals (which includes iron sands) at the higher of a 2% Ad Valorem Royalty or 10% Accounting Profit Royalty. TTR estimates annual average royalties of US$8 million, based on a rate of 10% of sales minus expenditure.

Taxes are calculated as 28% of assessable income (calculated as sales minus expenditure minus royalties minus deductions). TTR estimate annual average taxation payments of US$35 million. The remaining profit flows overseas.

8.4 National economic impacts

The economic impacts of the projects are provided in Table 27. They show the impacts estimated using the NZIER CGE model, given the details of the project and the expected output.

<table>
<thead>
<tr>
<th>Economic measure</th>
<th>(NZ$ m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exports</td>
<td>147</td>
</tr>
<tr>
<td>Gross Domestic Product</td>
<td>302</td>
</tr>
<tr>
<td>Government</td>
<td>71</td>
</tr>
<tr>
<td>Household consumption</td>
<td>104</td>
</tr>
</tbody>
</table>

Annual impacts; Source: NZIER

**Table 27: Economic impacts of TTR Iron Sands**

The results indicate that TTR iron sands will increase the size of the New Zealand economy. The specific results are as follows:

- it will raise the level of exports by $147 million per year
- the Gross Domestic Product will increase $302 million per year during the project, as a result of the increased exports and the flow-on effects through the economy
- included in this increased GDP are taxes and royalties to the New Zealand government from TTR, estimated at $54 million annually as discussed in Section 8.3
- overall, government expenditure is estimated to be $71 million greater per year as a result of the project, as a result of the direct contributions of TTR and the increased economic activity
- household consumption will increase by $104 million per year. This is a measure of the welfare benefits to New Zealand of the increased economic activity.

It may be helpful to place these numbers in the context of the New Zealand economy:

- the Gross Domestic Product was $212 billion\(^{51}\) in the year ending March 2013
- only 21 exports have values over $500 million annually, compared to TTR’s expected $446 million
- the Education Review Office spending in 2012/13 was $28 million, Vote Sports and Recreation spending was $80 million, and Vote Food Safety was $85 million\(^{52}\).

The figures for the economic impacts of the project are based on our assessment of the project description and financial information provided by TTR. They rely in part on assumptions of the capital costs of the project, the source of capital and how it is treated in the economic model. These assumptions were detailed in Section 8.3 of this report. If these assumptions are changed, they will affect the figures estimated.

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\(^{51}\) Statistics New Zealand Series SG02NAC00B15Z, ‘Expenditure on gross domestic product current price - annual value’.

\(^{52}\) The 2013 Budget from the New Zealand Government, Summary Tables.
8.5 Taranaki Region

8.5.1 Industrial structure of Taranaki

The Taranaki economy is more heavily based on the primary sector than the rest of New Zealand. In particular, mining has a larger presence in the region than most other parts of the country. Agriculture is also a significant part of the regional economy, as it is for rural areas of New Zealand generally.

Table 28 shows the breakdown by industry of the Taranaki economy for 2010 according to the latest available official Statistics New Zealand release. The forestry, fishing, mining, electricity, gas, water and waste group of industries are the most important to the Taranaki region, contributing $3.2 billion or 41% of regional GDP. Manufacturing is the second largest industrial sector (10% of Taranaki GDP), and is focused on food processing and engineering to support the primary industries. The third largest sector is agriculture at 9% of GDP.

<table>
<thead>
<tr>
<th>Industry</th>
<th>GDP ($m)</th>
<th>Share of Taranaki</th>
<th>Share of national</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forestry, Fishing, Mining, Electricity, Gas, Water and Waste Services</td>
<td>3,233</td>
<td>41%</td>
<td>7%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>798</td>
<td>10%</td>
<td>11%</td>
</tr>
<tr>
<td>Agriculture</td>
<td>725</td>
<td>9%</td>
<td>5%</td>
</tr>
<tr>
<td>Professional, Scientific, Technical, Administrative and Support Services</td>
<td>334</td>
<td>4%</td>
<td>9%</td>
</tr>
<tr>
<td>Construction</td>
<td>325</td>
<td>4%</td>
<td>5%</td>
</tr>
<tr>
<td>Health Care and Social Assistance</td>
<td>297</td>
<td>4%</td>
<td>6%</td>
</tr>
<tr>
<td>Rental, Hiring and Real Estate Services</td>
<td>239</td>
<td>3%</td>
<td>6%</td>
</tr>
<tr>
<td>Owner-Occupied Property Operation</td>
<td>209</td>
<td>3%</td>
<td>6%</td>
</tr>
<tr>
<td>Retail Trade</td>
<td>207</td>
<td>3%</td>
<td>5%</td>
</tr>
</tbody>
</table>

Source: Statistics NZ

Table 28 Industry contribution to the Taranaki economy (2010)

8.5.2 Employment in Taranaki

Employment in Taranaki is more heavily dependent on the primary and secondary sectors than the rest of New Zealand. The primary sector includes agriculture, forestry and mining, which accounted for 8% of employment in 2012. In New Zealand, the sectors accounted for only 6% of employment. The secondary industries, including manufacturing, construction, and electricity, gas and water supply, contributed 26% of employment. They contributed only 19% of employment nationwide. The tertiary sector - the services sector - was therefore a smaller portion of Taranaki’s employment than in the rest of New Zealand. The mix of industries in the tertiary sector - the spread across retail, transportation, education and government - is largely the same as the country as a whole; they simply make up a smaller portion of employment.

Figure 73 shows the share of employment by industry in the Taranaki region in 2012. Manufacturing is the most important employer for Taranaki with 17%, followed by health care and social assistance with 11%. Retail trade is the third largest industry by employment in Taranaki with 10% of total.
The mining industry in Taranaki employed 1,090 employees in 2012, out of the total New Zealand mining workforce of 6,760 employees.

Unemployment in Taranaki is somewhat lower than in the rest of the country. In 2011, the regional unemployment rate was 5%, compared to New Zealand’s rate of 7% (Infometrics, 2012).

### 8.5.3 Impacts of TTR Project

The proposed project involves growth in the mining industry. This is a relatively important sector for the Taranaki economy. The project would entail a noticeable growth in the number of people employed in mining and considerable expansion of output from the local mining sector.

In addition, the Taranaki Regional Council (2010) reports that manufacturing in the region is largely focused on supporting the primary sector. The mining activity would therefore be expected to affect manufacturing in the region. Finally, the tertiary sector - the services sector, representing over 60% of the local economy - should also benefit.

CGE modelling confirms these results. Specifically, the TTR Project will:

- raise Taranaki’s regional GDP by 3% or $240 million per year
- increase employment directly by around 200 jobs within the TTR Project, and by around 170 in jobs throughout the rest of Taranaki region
- benefit the wider regional economy: the gains are not confined to the mining sector by spill over to related sectors (electricity, business services) and sectors that benefit from a growing regional economy (retail and service sectors).

### 8.5.4 Regional data caveats

Statistics New Zealand’s official regional GDP data was released at the beginning of 2013. This data is highly aggregated but provides the latest official source of information about regional economic activity.
NZIER notes that Infometrics (2012) Taranaki profile suggests a smaller GDP than the official Statistics New Zealand numbers. Regional data tends to be more volatile than national data however the overall magnitude of the TTR Project impact remains robust to variations in the measurement of the regional GDP.
9. DESCRIPTION OF EFFECTS ON IWI

9.1 Introduction

Section 60 of the Act sets out matters the EPA must have regard to in considering the effects of an activity on existing interests under section 59(2)(a). These matters are:

a) the area that the activity would have in common with the existing interest; and
b) the degree to which both the activity and the existing interest must be carried out to the exclusion of other activities; and
c) whether the existing interest can be exercised only in the area to which the application relates; and
d) any other relevant matter.

This section of the IA describes the assessment of effects relating to each of the iwi within the South Taranaki Bight based on consultation undertaken to date and the desktop study completed by TTR. TTR is satisfied that this information represents the best available information. Some of the iwi have informed TTR that they plan to provide a cultural impact assessment during the public submission period.

One of the key concepts that were raised during consultation with iwi was kaitiakitanga and the important role iwi and hapū play in the management of resources as kaitiaki. TTR understands kaitiakitanga is a broad concept that has important cultural and spiritual dimensions. Kaitiakitanga ensures sustainability of resources, in a physical, spiritual, economic and political sense. The authority to protect a resource stems from the broader viewpoint of whakapapa with kaitiakitanga is an exercise of obligation, mana, of prestige, of hapū and iwi. The Te Taihauāuru Iwi Forum Fisheries Plan 2012-2017 makes the following statement about kaitiakitanga which summarises much of the concerns iwi have regarding the cultural impacts and the effect on iwi of the Project:

Without kaitiakitanga informing our decisions, our cultural identity and traditions become lost in modern society. Kaitiakitanga is based on mātauranga. Our mātauranga is founded on a holistic perspective; we are part of our environment. Our environment nurtures our mauri, and our mana remains powerful.

9.2 Description of Effects on Ngāti Ruanui

9.2.1 Consultation

TTR has met with Te Runanga o Ngāti Ruanui Trust representatives on several occasions to discuss the Project and effects. TTR provided Ngāti Ruanui with draft technical reports and a draft version of the IA. TTR also arranged for NIWA scientists to brief Ngāti Ruanui staff with the key findings from their research, including coastal stability, fisheries and sediment plume modelling.

Ngāti Ruanui has informed TTR and the EPA, that they will submit a cultural impact assessment as part of the public submissions process. The effects on Ngāti Ruanui detailed below have been drafted by TTR and are based on the best available information to TTR based on publicly available information and consultation to date.

9.2.2 Ngāti Ruanui Cultural Associations

The Ngāti Ruanui rohe extends from the Whenuakura River in the South and extends to the Waingongoro River in the West. Ngāti Ruanui is tangata whenua for the Project area.

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53 Te Taihauāuru Iwi Forum Fisheries Plan 2012-2017, pp. 6
In the twelfth century the people of the Aotea Waka arrived in the area of Patea after leaving the Pacific island of Rangiatea. The Arikinui of the waka was Turi who travelled with his wife Rongorongo. The waka originally made landfall at Kawhia whereby Turi and his people travelled over land until they came to Patea where they settled on the south bank of the Patea River.

Taneroroa, the daughter of Turi married Uenuku-Puanake of the Takatimu waka. The decedents of Ruanui are so named after their son, Ruanui. Ruanui was also the name given to an ancestor who resided in Rangiatea. Within a few generations, the descendants of Ruanui formed the main tribe in South Taranaki. Customary use of coastal waters and the wider oceans are evident in Ngāti Ruanui traditional song and stories. For example near Patea is Parara ki Te Uru, Patea Beach, a well-known site (recorded in the song ‘No Runga’) where ancestors Turi and Rongorongo sustained their hapū by growing gardens and gathering seafood including pupu in the mudflats. This beach and coastal waters has been valued for generations.

Further up the coast is Whitikau (a fishing village) where Turi and Rongorongo daughter Taneroroa lived sustaining the next generation of the hapū.

Manawapou, further along the coast is a significant wāhi tapū where the Wharenui Manawapou was built to host the meeting of the Rangatira from where the whakatauaki ‘Te Tangata Too Mua, Te Whenua Too Muri’ was derived.

As kaitiaki and Treaty of Waitangi partners, Ngāti Ruanui have a particular interest in ensuring appropriate delivery and integration of mātauranga Māori me ona tikanga into environmental sustainability. This integration must occur in a way that maintains the cultural integrity of Ngāti Ruanui knowledge systems and cultural practices.

**Figure 74: Statutory Acknowledgement Area for Te Moananui a Kupe o Ngāti Ruanui**

Ngāti Ruanui’s Deed of Settlement provided Ngāti Ruanui with a statutory acknowledgement over the coastal marine area with Ngāti Ruanui area of interest. The statement of association for the coastal area is as follows:

The area to which this statutory acknowledgement applies is the area known as Te Moananui A Kupe O Ngāti Ruanui (coastal area).

The resources found within Te Moananui A Kupe have, since time immemorial, provided the people of Ngāti Ruanui with a constant supply of food resources. The hidden reefs...
provided koura, paua, kina, pupu, papaka, pipi, tuatua, and many other species of reef inhabitants. Hapuka, moki, kanae, mako, and patiki swim freely between the many reefs that can be found stretching out into the spiritual waters of Te Moananui A Kupe and along the Ngāti Ruanui coastline.

Names such as Rangatapu, Ohawe Tokotoko, Waiali, Waokena, Tangahoe, Manawapou, Taumaha, Manutahi, Pipiri, Kaikura, Whitiikau, Kenepuru, Te Pou a Turi, Rangitawhi, and Whenuakura depict the whereabouts of either a fishing ground or fishing reef. All along the shoreline from Rangatapu to Whenuakura food can be gathered, depending on the tides, weather, and time of year.

Tragedies of the sea are also linked to these reefs. Ngāti Ruanui oral history records the sinking off Tangahoe of a Chinese trade ship that had just been loaded with a cargo of flax. When the bodies were recovered and brought to shore, none of them had any eyes.

The people of Ngāti Hine believe that they did something wrong and in turn were punished by the Ngāti Ruanui taniwha named Toi, kaitiaki (guardian) of the fishing reefs and grounds, who is renowned to this day to eat the eyes of his victims.54

The Deed of Settlement also provided for a Fisheries Protocol. The Protocol included the following provisions:

The Governance Entity is the body representative of the whanau, hapū and iwi of Ngāti Ruanui who have an interest in all species of fish, aquatic life and seaweed that exist within the Fisheries Protocol Area. Ngāti Ruanui also has a responsibility in relation to the preservation, protection and management of its customary non-commercial fisheries through its tino rangatiratanga and kaitiakitanga. This derives from Ngāti Ruanui’s status as tangata whenua in the Fisheries Protocol Area and is inextricably linked to whakapapa and has important cultural and spiritual dimensions.

The Crown, through the Minister and Chief Executive, recognised that Ngāti Ruanui have a customary non-commercial interest in, and a special relationship with, all species of fish, aquatic life and seaweed found within the Fisheries Protocol Area and managed by the Ministry under the Fisheries Legislation. The Ministry also recognises the particular customary non-commercial interest of Ngāti Ruanui in the Taonga Fish Species.55

9.2.3 Possible Effects on Ngāti Ruanui

Based on best available information and conversations with representatives from Te Runanga o Ngāti Ruanui, TTR has identified the following potential effects. TTR’s assessments of the risks of the effects are detailed in the right hand column.

<table>
<thead>
<tr>
<th>Potential effect</th>
<th>TTR risk assessment</th>
<th>Relevant section of the IA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ensure the physical and spiritual relationship of Ngāti Ruanui to their wāhi tapu is recognised, protected and provided for.</td>
<td>TTR understands there are a range of views with regard to resources and the extraction of resources from Tangaroa. TTR is keen to work with Ngāti Ruanui, as kaitiaki to understand hapū views on this matter. With regard to the effect on the taonga species and impacts inland see Table 29 and other relevant sections on coastal processes.</td>
<td>Table 29</td>
</tr>
<tr>
<td>Such an extraction process may give rise to the permanent destruction of sensitive marine environments which in turn</td>
<td>Cumulative effects are addressed in the Impact Assessment document, based on evaluation of all the relevant technical inputs. The broad conclusion is that given the relatively small scale of TTR’s operational activities in the context of the STB overall and the minor effects attributable to TTR’s</td>
<td>14.2.4, 12.4, 11.5</td>
</tr>
</tbody>
</table>

54 Ngāti Ruanui Deed of Settlement Coastal Statutory Acknowledgement statement of association
55 Ngāti Ruanui Deed of Settlement Fisheries Protocol
<table>
<thead>
<tr>
<th>Potential effect</th>
<th>TTR risk assessment</th>
<th>Relevant section of the IA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact on marine life and traditional food sources of iwi.</td>
<td>Activities, there will be no overall impact on the ecosystem of the STB. There will be an observable but minor change in water column suspended sediment levels, but within 5-10 km of the shoreline TTR’s effects will largely be indistinguishable from the effects of naturally occurring processes.</td>
<td></td>
</tr>
<tr>
<td>The environmental risks attached to iron sand mining due to the disturbance and destruction of coastal habitats as a result of the extraction techniques is potentially high. The risk of smothering of benthic communities by sedimentation and coastal erosion is also apparent.</td>
<td>NIWA’s investigations and modelling have demonstrated that there will be no change to wave climate, and consequently no change to the topography of the coastline or erosion characteristics.</td>
<td>11.4.8, 11.5</td>
</tr>
<tr>
<td>The migration of fish particularly inanga and whitebait.</td>
<td>Mature eels migrate out from rivers to the sea and then to the equatorial Pacific where they spawn. Larval eels float on ocean currents back to coastlines, where they turn into “glass eels” and migrate up rivers as evers. On the other hand, iنانga (which usually live for one year) spawn in estuaries around the high-water mark on very high spring tides. When the tide recedes, the eggs are exposed to the air for a number of weeks but remain moist among the vegetation. When another spring tide reaches the eggs, larvae hatch, and the falling tide carries them out to sea. The hatchlings spend the winter at sea, feeding on small plankton such as crustaceans. In the springtime, juvenile iنانga make their way upriver as whitebait stage. Those that reach fresh water remain there as adults for spring and summer and in autumn, adults make their way downstream to spawn in estuaries. TTR’s operations will potentially introduce suspended sediments into the water column, mainly around the extraction area. These suspended sediment levels would not adversely affect mature eels which are after all, accustomed to highly turbid river habitats. The larval stages of eels and iنانga are not expected to be adversely affected by TTR’s activities, which will only noticeably affect a relatively small area in the outer STB.</td>
<td>6.10.8</td>
</tr>
<tr>
<td>The potential to negative effect the amenity value of the coastline including water colour/typography/ cliff erosion.</td>
<td>NIWA’s investigations and modelling have demonstrated that there will be no change to wave climate, and consequently no change to the topography of the coastline or erosion characteristics. The coastal amenity has been assessed in relation to visible sediment plumes and water colour, with the conclusion that the level of any adverse effects will be minor, and will be largely indistinguishable from the effects of existing natural processes.</td>
<td>11.4, 11.5, 11.7</td>
</tr>
<tr>
<td>The impact on the fisheries and fisheries habitats.</td>
<td>Given the relatively small scale of TTR’s operational activities in the context of the STB, and the minor effects attributable to TTR’s activities, there will be no overall ecosystem impact.</td>
<td>12.4, 6.14</td>
</tr>
<tr>
<td>Potential effect</td>
<td>TTR risk assessment</td>
<td>Relevant section of the IA</td>
</tr>
<tr>
<td>------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td></td>
<td>There will be an observable but minor change in water column suspended sediment levels, but within 5-10 km of the shoreline TTR's effects will largely be indistinguishable from the effects of natural processes. The area most likely to be affected will be TTR's direct operational area in the vicinity of the extraction and deposition activities. However, the relatively small area affected over a 1-2 year period coupled with anticipated recolonisation over the same time frame will avoid adverse effects. The presence of the FPSO may act as a fish aggregation device in the area, with associated potential for enhanced localised fisheries abundance, however, direct access to this new resource will be limited by the navigational safety buffer zone. In an overall sense however, this may contribute to improved fisheries abundance in the STB.</td>
<td>3, 12.6</td>
</tr>
</tbody>
</table>
The following table is an assessment of the effects of the taonga species listed in the Ngāti Ruanui Deed of Settlement:

<table>
<thead>
<tr>
<th>Māori Name</th>
<th>Common Name</th>
<th>Formal Name</th>
<th>Habitat</th>
<th>Risk from TTR activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hapuka</td>
<td>Groper</td>
<td>Polypion oxygenios</td>
<td>Deeper water reefs</td>
<td>Nil –Low – occur around reefs - reef areas in STB will not be adversely affected by sediment deposition. Juvenile hapuku reported in STB area but abundance not known in detail.</td>
</tr>
<tr>
<td>Kaeo</td>
<td>Sea tulip</td>
<td>Pyura pachydermatum</td>
<td>Filter feeding tunicate ascidian attached to rocks in shallow, wave-swept areas around New Zealand.</td>
<td>Nil – Low - Not recorded in TTR biological surveys – risk relates to covering by suspended sediments – at shoreline TTR effects will be indistinguishable from natural processes.</td>
</tr>
<tr>
<td>Kahawai</td>
<td>Sea trout</td>
<td>Arripus trutta</td>
<td>Pelagic fish - shallow coastal zone to 15 m depth.</td>
<td>Low – occurs in moderate abundance on STB – in immediate vicinity of TTR extraction operations elevated suspended sediment levels may cause avoidance behaviour, but given localised influence of elevated turbidity, overall risk of adverse effect is low.</td>
</tr>
<tr>
<td>Kanae</td>
<td>Grey mullet</td>
<td>Mugil cephalus</td>
<td>Primarily a marine species, grey mullet will move considerable distances upstream. However they must return to the sea to spawn.</td>
<td>Low – not reported in NIWA fisheries report – species is adapted for elevated turbidity environments.</td>
</tr>
<tr>
<td>Koeke</td>
<td>Common shrimp</td>
<td>Palaemon affinis</td>
<td>Demersal – bottom dwelling</td>
<td>Low – reported in low densities in Project area – in the immediate extraction and deposition areas, localised losses will occur, but over the broader STB area, benthic organisms such as Palaemon will not be subject to excessive sedimentation and accordingly adversely affected.</td>
</tr>
<tr>
<td>Marari</td>
<td>Butterfish</td>
<td>Odax pullus</td>
<td>Reef fish occurring on subtidal reefs to 10 m depth.</td>
<td>Low – Reportedly widespread in the STB in NIWA fisheries report– likely to be found in nearshore reefs where TTR effects will be indistinguishable from natural processes.</td>
</tr>
<tr>
<td>Moki</td>
<td>Blue moki</td>
<td>Latridopsis ciliaris</td>
<td>Deeper water fish - mainly found around the South Island and east coast of the North Island down to depths of 100 m.</td>
<td>Low – reported as limited distribution in the STB in NIWA fisheries report– occurs in deeper water where TTR’s effects are no more than minor.</td>
</tr>
<tr>
<td>Paraki/ Ngaiorre</td>
<td>Common smelt</td>
<td>Retropinna retropinna</td>
<td>Mainly freshwater fish with some marine exposure for spawning.</td>
<td>TTR’s operations will potentially introduce suspended sediments into the water column, mainly around the extraction area. These suspended sediment levels would not adversely affect mature smelt which are accustomed to highly turbid river habitats. The larval stages of smelt are not expected to be adversely affected by TTR’s activities, which will only noticeably affect a relatively small area in the outer STB.</td>
</tr>
<tr>
<td>Para</td>
<td>Frostfish</td>
<td>Lepidopus caudatus</td>
<td>Offshore zone &gt; 100 m</td>
<td>Nil – occurrence will be in offshore water unaffected by TTR’s activities</td>
</tr>
<tr>
<td>Patiki mohoao</td>
<td>Black flounder</td>
<td>Rhombosolea retiaria</td>
<td>Inshore demersal– near coastal</td>
<td>Nil – occurrence in nearshore waters where TTR’s effects will be largely indistinguishable from natural processes.</td>
</tr>
<tr>
<td>Māori Name</td>
<td>Common Name</td>
<td>Formal Name</td>
<td>Habitat</td>
<td>Risk from TTR activities</td>
</tr>
<tr>
<td>------------</td>
<td>-------------</td>
<td>-------------</td>
<td>---------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Patiki rore</td>
<td>New Zealand sole</td>
<td>Peltorhamphus novaezeelandiae</td>
<td>Inshore demersal - generally at depths of less than 50 m.</td>
<td>Nil – not common in outer STB. Main occurrence in nearshore waters where TTR’s effects will be largely indistinguishable from natural processes.</td>
</tr>
<tr>
<td>Patiki tore</td>
<td>Lemon sole</td>
<td>Pelotretis flavilatus</td>
<td>Inshore demersal - generally at depths of less than 50 m – in the Coastal zone especially towards Whanganui.</td>
<td>Nil-low - Main occurrence in nearshore waters where TTR’s effects will be largely indistinguishable from natural processes</td>
</tr>
<tr>
<td>Patiki totara</td>
<td>Yellowbelly</td>
<td>Rhombosolea leporina</td>
<td>Inshore demersal - generally at shallow depths</td>
<td>Nil-low - Main occurrence in nearshore waters where TTR’s effects will be largely indistinguishable from natural processes</td>
</tr>
<tr>
<td>Patiki</td>
<td>Sand flounder</td>
<td>Rhombosolea plebeia</td>
<td>Inshore demersal - generally at depths of less than 50 m – in the Coastal zone</td>
<td>Low – are found in the STB in the vicinity of TTR’s operational area – however they are ubiquitous throughout the STB, mainly nearshore where TTR’s effects will be largely indistinguishable from natural processes</td>
</tr>
<tr>
<td>Patukituki</td>
<td>Rock Cod</td>
<td>Parapercis colias</td>
<td>Subtidal reefs and shallow coastal zone to 30 m widespread in STB, occurring at most reefs within the region</td>
<td>TTR notes that the common name for Parapercis colias is blue cod. Low- Blue Cod are found in low numbers across TTR’s operational area, but are more abundant on reefs. Given effects on reefs are considered to be minor, effects on this species are deemed to be low.</td>
</tr>
<tr>
<td>Pioke</td>
<td>School shark/rig</td>
<td>Galeorhinus galeus</td>
<td>Found through water column and throughout STB across range of depths.</td>
<td>Low – Whilst species will be present in the vicinity of TTR’s area of operations, it is widespread elsewhere throughout the STB, and will not be adversely affected by increased sedimentation outside of the immediate operational area.</td>
</tr>
<tr>
<td>Reperepe</td>
<td>Elephant fish</td>
<td>Callorhynchus millii</td>
<td>Small shark species, which is only found in New Zealand, most common on the east coast of the South Island to depths of 200 m.</td>
<td>Nil-Low – not reported in NIWA Fisheries report – same risk profile as other pelagic species.</td>
</tr>
<tr>
<td>Tuna heke</td>
<td>Eel – long finned</td>
<td>Anguilla dieffenbachii</td>
<td>Mature eels migrate out from rivers to the sea and then to the equatorial Pacific where they spawn. Larval eels float on ocean currents back to coastlines, where they turn into “glass eels” and migrate up rivers as elvers.</td>
<td>Nil-Low - TTR’s operations will potentially introduce suspended sediments into the water column, mainly around the extraction area. These suspended sediment levels would not adversely affect mature eels which are after all, accustomed to highly turbid river habitats. The larval stages of eels are not expected to be adversely affected by TTR’s activities, which will only noticeably affect a relatively small area in the outer STB.</td>
</tr>
<tr>
<td>Tuna roa</td>
<td>Eel – short finned</td>
<td>Anguilla australis</td>
<td>As for long finned eels above</td>
<td>Nil- low – see discussion for long finned eels – short finned eels migrate at earlier age than long finned eels so have shorter generation times.</td>
</tr>
<tr>
<td>Wheke</td>
<td>Octopus</td>
<td>Octopus maorum</td>
<td>In STB found primarily in vicinity of coastal reefs</td>
<td>Nil –low - reefs are mainly nearshore where TTR’s effects will be largely indistinguishable from natural processes.</td>
</tr>
<tr>
<td>Koiro, ngoiro, totoke, hao, ngoio, ngoingoi, putu</td>
<td>Conger eel</td>
<td>Conger verreauxi</td>
<td>Subtidal reefs</td>
<td>Nil-low - reefs are mainly nearshore where TTR’s effects will be largely indistinguishable from natural processes.</td>
</tr>
<tr>
<td>Māori Name</td>
<td>Common Name</td>
<td>Formal Name</td>
<td>Habitat</td>
<td>Risk from TTR activities</td>
</tr>
<tr>
<td>------------</td>
<td>-------------</td>
<td>-------------</td>
<td>---------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Koura</td>
<td>Rock lobster/Crayfish</td>
<td>Jasus edwardsii</td>
<td>Coastal rocky reefs through STB – migrate offshore at times.</td>
<td>Low – TTR effects on nearshore reefs will be indistinguishable from natural processes; available data from the STB (albeit limited) suggests that this migration does not carry lobsters as far offshore as the proposed sand extraction areas. In any event, the area of sand extraction is relatively minor in the context of the broader STB.</td>
</tr>
<tr>
<td>Kaunga</td>
<td>Hermit crab</td>
<td>Pagurus novaeseelandiae</td>
<td>Benthic crabs – occur throughout NZ.</td>
<td>Low - not recorded in TTR benthic surveys in STB. Other hermit crab species were recorded across the STB in relatively low densities. Direct loss will occur in TTR operational area but there is opportunity for recruitment from non-impacted areas over time.</td>
</tr>
<tr>
<td>Papaka parupatu</td>
<td>Mud crab</td>
<td>Helice sp.</td>
<td>Benthic crabs – occur throughout NZ.</td>
<td>Low - not recorded in TTR benthic surveys in STB. Other crab species were recorded across the STB in relatively low densities. If present, direct loss will occur in TTR operational area but there is opportunity for recruitment from non-impacted areas over time.</td>
</tr>
<tr>
<td>Papaka</td>
<td>Paddlecrab</td>
<td>Ovalipes catharus</td>
<td>Benthic crabs – occur throughout NZ – primarily recorded in inshore areas in STB.</td>
<td>Low - Recorded in TTR benthic surveys in STB, in low densities. If present in vicinity of TTR operational area, direct loss will occur but there is opportunity for recruitment from non-impacted areas over time.</td>
</tr>
<tr>
<td>Kotore, humenga</td>
<td>Sea anemone</td>
<td>Cnidaria group</td>
<td>Benthic species – located throughout STB – but not recorded in vicinity of TTR Project area.</td>
<td>Low - Not recorded in vicinity of TTR operational area. If present in vicinity of TTR operational area, direct loss will occur but there is opportunity for recruitment from non-impacted areas over time.</td>
</tr>
<tr>
<td>Rore, rori</td>
<td>Sea cucumber</td>
<td>Stichopus mollis</td>
<td>Benthic species – located throughout STB – but not recorded in vicinity of TTR Project area.</td>
<td>Low - Not recorded in vicinity of TTR operational area. If present in vicinity of TTR operational area, direct loss will occur but there is opportunity for recruitment from non-impacted areas over time.</td>
</tr>
<tr>
<td>Patangatana, patangaroa, pekapeka</td>
<td>Starfish</td>
<td>Echinoderms</td>
<td>Benthic species – located in low densities throughout STB</td>
<td>Low - direct loss will occur in TTR operational area, but there is opportunity for recruitment from non-impacted areas over time.</td>
</tr>
<tr>
<td>Kina</td>
<td>Sea urchin/kina</td>
<td>Evechinus chloroticus</td>
<td>Reef area – shallow water, nearshore</td>
<td>Nil - Low - Not recorded in NIWA TTR studies. TTR effects on nearshore reefs will be indistinguishable from natural processes.</td>
</tr>
<tr>
<td>Kutae/Kuku</td>
<td>Green lipped mussel</td>
<td>Perna canaliculus/mytilus edulis</td>
<td>Reef areas</td>
<td>Nil - Low - Not recorded in NIWA TTR studies. TTR effects on nearshore reefs will be indistinguishable from natural processes.</td>
</tr>
<tr>
<td>Kutae/Kuku</td>
<td>Blue mussel</td>
<td>Perna canaliculus/mytilus edulis</td>
<td>Reef areas</td>
<td>Nil - Low - Not recorded in NIWA TTR studies. TTR effects on nearshore reefs will be indistinguishable from natural processes.</td>
</tr>
<tr>
<td>Paua</td>
<td>Paua – black foot (Abalone)</td>
<td>Haliotis iris</td>
<td>Reef areas</td>
<td>Nil - Low - Not recorded in NIWA TTR studies. TTR effects on nearshore reefs will be indistinguishable from natural processes.</td>
</tr>
<tr>
<td>Hiihiwa</td>
<td>Paua – yellow foot</td>
<td>Haliotis australis</td>
<td>Rocky reef area – generally in shallower waters</td>
<td>Nil - Low - Not recorded in NIWA TTR studies. TTR effects on nearshore reefs will be indistinguishable from natural processes.</td>
</tr>
</tbody>
</table>
### Table 29: Ngāti Ruanui Taonga Species

<table>
<thead>
<tr>
<th>Māori Name</th>
<th>Common Name</th>
<th>Formal Name</th>
<th>Habitat</th>
<th>Risk from TTR activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipi/kakahi</td>
<td>Pipi</td>
<td><em>Paphies austral</em></td>
<td>Rocky reef area – generally in shallower waters</td>
<td>Nil - Low - Not recorded in NIWA TTR studies. TTR effects on nearshore habitats will be indistinguishable from natural processes.</td>
</tr>
<tr>
<td>Pupu</td>
<td>Pupu</td>
<td><em>Turbo smaragdus</em>/<em>zediloma spp</em></td>
<td>Shallow coastal</td>
<td>Nil - Low - Not recorded in NIWA TTR studies. TTR effects on nearshore habitats will be indistinguishable from natural processes.</td>
</tr>
<tr>
<td>Purimu</td>
<td>Surfclam</td>
<td><em>Dosinia anus, Paphies donacina, Mactra discor, Mactra murchsoni, Spisula aequilateralis, Basina yatei, or Dosinia subrosa</em></td>
<td>Shallow coastal</td>
<td>Nil - Low – Some species of bivalves (same genus to those noted) recorded in NIWA TTR studies. TTR effects on nearshore areas will be indistinguishable from natural processes. If present in vicinity of TTR operational area, direct loss will occur but there is opportunity for recruitment from non-impacted areas over time.</td>
</tr>
<tr>
<td>Rori</td>
<td>Seasnail</td>
<td><em>Scutus breviculus</em></td>
<td>Shallow coastal</td>
<td>Nil - Low - Not recorded in NIWA TTR studies. TTR effects on nearshore reefs and habitats will be indistinguishable from natural processes.</td>
</tr>
<tr>
<td>Tuangi</td>
<td>Cockle</td>
<td><em>Austrovenus stutchburgi</em></td>
<td>Shallow coastal</td>
<td>Nil - Low - Not recorded in NIWA TTR studies. TTR effects on nearshore habitats will be indistinguishable from natural processes.</td>
</tr>
<tr>
<td>Tuatu</td>
<td>Tuatua</td>
<td><em>Paphies subtriangulata, Paphies donacina</em></td>
<td>Shallow coastal</td>
<td>Nil - Low - Not recorded in NIWA TTR studies. TTR effects on nearshore habitats will be indistinguishable from natural processes.</td>
</tr>
<tr>
<td>Waharoa</td>
<td>Horse mussel</td>
<td><em>Atrina zelandica</em></td>
<td>Shallow coastal</td>
<td>Nil - Low - Not recorded in NIWA TTR studies. TTR effects on nearshore habitats will be indistinguishable from natural processes.</td>
</tr>
<tr>
<td>Waikaka</td>
<td>Mudsnail</td>
<td><em>Amphibola crenata, Turbo smaragdus, Zedilom spp.</em></td>
<td>Shallow coastal</td>
<td>Nil - Low - Not recorded in NIWA TTR studies. TTR effects on nearshore reefs will be indistinguishable from natural processes.</td>
</tr>
<tr>
<td>Karaura, ngakih, tio, repe</td>
<td>Rock oyster</td>
<td><em>Crassostrea glomerata</em></td>
<td>Demersal - across STB</td>
<td>Nil - Low - Not recorded in NIWA TTR studies. TTR effects on nearshore reefs will be indistinguishable from natural processes.</td>
</tr>
<tr>
<td>Kuakua, pure, tipa, tipai, kopa</td>
<td>Scallop</td>
<td><em>Pecten novaezelandiae</em></td>
<td>Demersal - across STB</td>
<td>Low – occasional individuals identified in NIWA study throughout STB, including some in TTR Project area. Some individuals may be able to move to avoid extraction. Effects deemed to be minor other than in immediate operational area. Recruitment from undisturbed areas will occur.</td>
</tr>
</tbody>
</table>
9.3 Ngaa Rauru Cultural Associations

The Ngaa Rauru Deed of Settlement provided a statutory acknowledgement over the coastal marine area with Ngaa Rauru rohe. The statement of association for the coastal statutory acknowledgement is as follows:

Ngaa Rauru Kiitahi emanated from the cosmogenic tree of the gods. It came by way of the legion of spirits who were not seen but heard, down through the generations of the Kahui Rere and the genealogies of the ‘immediate assembly of elders’. In this respect, Rauru is a progeny of both ‘divine and human parentage’ and, therefore, so is Ngaa Rauru Kiitahi. This divine origin is particular to the sacred, mystical and theological insight of the people of Ngaa Rauru Kiitahi. The esoteric nature of these claims is expressed through their own pertinent whakapapa link. It is through a knowledge and awareness of this whakapapa, that one is able to gain a perception of the attitudes of the tribe towards the almighty powers of the celestial realm, the cosmic emanations of the divine beginning, the world and its creation, and the evolution of earth and its people.

Ngaa Rauru Kiitahi makes a direct acclamation by stating its origins from the period of the Absolute Void to Rangi and Papa, to Rauru the man, and Ngaa Rauru Kiitahi the tribe. This claim draws together the spiritual and temporal manifestations of which Rauru is the central figure, it deals specifically with the origins of: the gods, man, vegetation and taonga. Ngaa Rauru Kiitahi has a spiritual and physical relationship through whakapapa to its Taonga. It is espoused within mana atua, mana whenua, and mana tangata. These Taonga encompass the expanses of Ranginui (sky), the vastness of Tangaroa (sea), and the immensity of Papa-tua-nuku (land), from the Te Awa nui o Taikehu Patea River inland to the Matemateaonga ranges, seaward to the river mouth of Whanganui to our furthermore fishing boundaries to the south, Te Moana o Raukawa, and across the western horizon then back inland to Te Awa nui a Taikehu Patea.

Ngaa Raurutanga has been exercised in relation to every Statutory Area in relation to which the Statutory Acknowledgement is provided. These values have been practised in the following ways:

• Te reo: Waiata and korero relating to a Statutory Area is preserved in te reo.

• Wairuatanga: The relationship between Ngaa Rauru Kiitahi and a Statutory Area is expressed in waiata, korero and karakia. Karakia, in particular, has always been used when harvesting kai. Wairua impacts upon the way in which individuals conduct themselves around kai, the harvesting of kai and the tikanga around the eating of kai.

• Mātauranga: Mātauranga was passed on from one generation to another through karakia, wananga and mihimihi. The knowledge that has been passed on includes the history of a Statutory Area and conservation methods exercised by Ngaa Rauru Kiitahi as kaitiaki of a Statutory Area.

• Kaitiakitanga: Kaitiakitanga has been continuously practised through sustainable land and resource management methods. It was the responsibility of the hapū to only harvest enough kai to sustain their own, and other Ngaa Rauru Kiitahi hapū, and ensure the ongoing health and sustainability of a Statutory Area.

• Waiora: Waiora manifests itself in individuals through the practice of te reo, wairuatanga, mātauranga, and kaitiakitanga, and in the fulfilment of an individual’s responsibilities in relation to both a Statutory Area and to all of Ngaa Rauru Kiitahi.

• Whakapapa: The relationship with a Statutory Area has been fostered through individuals’ knowledge of the use and occupation of a Statutory Area that has been passed on throughout the generations.

Cultural, Spiritual, Historic and Traditional Association of Ngaa Rauru Kiitahi with the Coastal Marine Area from the Patea River to the mouth of the Whanganui River

Within this coastal area between Rangitaawhi and Wai-o-Turi Marae is “Te Kiri o Rauru”, the skin of Rauru. Te Kiri o Rauru is an important life force that has contributed to physical and spiritual wellbeing of Ngaa Rauru Kiitahi.
Ngaa Rauru Kiitahi used the entire coastal area from Te Awanui o Taikehu (Patea River) to the mouth of the Whanganui River and inland for food gathering, and as a means of transport. The coastal area was a rich source of all kai moana. Ngaa Rauru Kiitahi exercised the values of Ngaa Raurutanga in both harvesting and conserving kai moana. Ngāti Hine Waitaia, and Ngāti Tai hapū of the Waipipi (Waverley) area gathered food according to the values of Ngaa Raurutanga and kawa along the coast from the Patea River to Waipipi. Along the wider coastal area Rangitaawhi, Pukorokoro, Ngāti Hine, Kairakau, Ngāti Maika and Manaiahapuu of the Patea area gathered food according to the values of Ngaa Raurutanga and kawa.

Ngā Rauru Kiitahi describes its association with water as inclusive of Mana Atua (its spiritual and cultural connections to water), Mana Whenua (its sea as an economic base) and Mana Tangata (its social organisation in relation to the sea). Those concepts are reinforced for Ngaa Rauru Kiitahi in its whakapapa which has origins in Io Matua Kore (Mana Atua), Kahui Rere/Kahui Maunga and Aotea Waka (Mana Tangata).

The Ministry recognises that Ngaa Rauru Kiitahi have a customary non-commercial interest in the tuna (eel) fishery within the Fisheries Protocol Area and in particular, the possibility of the enhancement of that fishery through the transfer of elvers and the possibility of farming tuna.
9.4 Whanganui Iwi Cultural Associations

Whanganui Iwi has not received a historical settlement for land claims, and the Waitangi Tribunal is yet to release its report into the land claims. In August 2013 the Whanganui River Māori Trust Board signed a letter of agreement with the Crown for the settlement of historical Treaty claims.

Whanganui Iwi has rights and interests in all land, water and resources within its area of interest which includes the coastal marine area from Kai Iwi River in the north to the Whangaehu River in the south. Whanganui Iwi assert they never relinquished its rights to the resources and has consistently maintained its mana in respect of the control, management, use and protection of its lands, waterways and marine environment according to core tribal values.

To Atihaunui, the tidal reaches of a river, not the sea. The river mauri proceeds into the sea even beyond the mouth, as can be seen in a view from a hill until its mana finally mingle with that of the ocean.

The Whanganui River and its tributaries were possessed by Te Atihaunui-a-Paparangi. The river system was possessed as a taonga of central significance to Atihaunui and was conceptualised as a whole and indivisible entity, and not separated into beds, banks, and water, or into tidal and non-tidal, navigable and non-navigable parts. Through creation beliefs, it is a living being, an ancestor with its own mauri, mana, and tapū. 56

The Whanganui River sustains a number of marine species:

- Species that spawn in freshwater but have marine larval development: the common bully, red-finned bully, torrentfish, and various whitebait, including the inanga;

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56 The Whanganui River Report, Waitangi Tribunal
- Marine species that feed in freshwater: the yellow eyed mullet, grey mullet, black flounder (found well upstream), yellow belly flounder, and kahawai;
- Marine species that also use the freshwater environment: the common smelt and the lamprey;
- Freshwater species that must spawn at sea: the short- and long-finned tuna (eel).  

9.5 Ngāti Apa Cultural Association

The Ngāti Apa (North Island) Deed of Settlement provides for a statutory acknowledgement over the coastal and marine area within Ngāti Apa’s area of interest. The statement of association for the statutory acknowledgement is as follows:

The coastline within the Ngāti Apa (North Island) area of interest is of historical, cultural, spiritual, and traditional significance to Ngāti Apa (North Island). The Ngāti Apa (North Island) coastline extends some 52 kilometres along the western edge of the Ngāti Apa (North Island) area of interest from Motu Karaka in the north to Omarupapako in the south.

The coastline was traditionally used as a highway for Ngāti Apa (North Island) hapū to travel to other areas within the rohe. Other iwi also used the coastline to pass through the Ngāti Apa rohe to other areas of the country. As recorded in the Oriori mo Wharaurangi composed by Te Rangitakorou of Ngāti Apa, Haunui a Nanaia journeyed along the coast naming the three major rivers of significance as he crossed them while in pursuit of his wife, Wairaka.

A major part of traditional life in Ngāti Apa (North Island) involved utilising the resources located within the coastal area. Sea fishing was a major activity, particularly in the summer months when hapū would gather near the mouths of three of the major rivers within Ngāti Apa (North Island) area of interest, namely the Whangaehu River, Turakina River and the Rangitikei River. Reupena Ngataieparino, a Chief of Ngāti Apa (North Island), quoted an old saying that when the weather was fine, ‘oh the Ngāti Tamawaina [a Ngāti Apa (North Island) hapū based near the mouth of the Turakina River] will be at the sea shore fishing.’

Sites of significance located along the coastline and at the mouths of three of the major rivers include:

- Whangaehu River - the tauranga waka named Harakeke where sea fishing waka landed and were launched and two fishing stations or camps named Maraeraute and Whitiau;
- Turakina River - fishing stations where seafaring waka were launched, namely at Te Ope o Te Wai, Takurangi, Taurangamana, and Te Papa. A sand bank near Te Papa was named Te Rangitukakaka as it extended across the Turakina River and so this had to be navigated when coming in from sea; and
- Rangitikei River - the fishing station and tauranga waka of Tawhirihoe and the Rangitikei Heads. The latter area was noted as the place that Rangipowhatu, an early ancestor of the Ngāti Tauira hapū of Ngāti Apa (North Island), first settled. From there, his descendants moved into the Rangitikei Valley and populated the area.

Other sea fishing sites of significance included Motu Karaka, a fishing boundary marker located to the north of the Whangaehu River mouth, Urutaukawe, a permanent sand hill used as a bearing point at sea, which was located at the Turakina River mouth, and Omarungehe, an inland marker for catching hapuka.

Two traditional sites of significance located on the coast include:

- Herewahine, which is a sand dune on the beach at the boundary between the Rakautaua and Waipu land blocks. Herewahine was named after a Ngāti Apa (North Island) ancestor who sighted beached sperm whales (paraoa) in the vicinity; and

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57 The Whanganui River Report, Waitangi Tribunal p. 61
• Pakauhau, a shag-breeding ground located near the Turakina River where shags were sometimes harvested by hapū.

Shellfish were also prevalent, and therefore gathered, along the coastline. While the coastline was not as abundant in shellfish as other areas of Aotearoa, there are some areas, particularly the beach near the Waipatiki Stream and Waikakahi Stream, where pipi, toheroa, and scallops can be found.

As a result of the early land transactions between the Crown and Ngāti Apa (North Island), access to many of the resources along the coastal area became very difficult and limited. Reserves were established around coastal lakes such as Kaikokopu, Pukepuke and the beach area between the Turakina River and the Whangaehu River, but no legal access was provided for these land areas. These barriers led to the traditional usage of the coastal area being marginalised. In the 1970s and early-1980s, the coastal waters were fished extensively by foreign fishing boats who were allowed to commercially fish in the area, which resulted in the depletion of the Ngāti Apa (North Island) fishery.

Summer fishing in the coastal lakes was also a traditional activity carried out by hapū such as Ngāti Tauira and Ngāti Kauae, who were located at the lower Rangitikei River. Many coastal lakes south of the Rangitikei River, including Puketotara, Rehurehu, Rotokokopu, Pupepuke, Whakarua, Wharekupenga, Oakura, Otahanga, Kaikokopu, Te Kariri, and Koputara, were accessed mainly for tuna, and also for kokopu, mudfish, inanga and kakahi. It is noted that Koputara was allocated to hapū of Ngāti Raukawa in the Rangitikei Manawatu transaction. These lake systems connect with the ocean through the Kaikokopu Stream and the stream connected to Pupepuke Lagoon crossing the coastal margin. The care and protection of these coastal margins was integral to the health of the fisheries at the coastal margin itself and further inland.

Between the Turakina River and the Rangitikei River there are many streams which were utilised for fishing. These include the Waipatiki, Waikakahi, Waimahora, and Koitiata Streams. The fisheries at the coastal margin were a significant part of the overall traditional usage of these streams due to migratory species being harvested in that section.

In recent times, the Manawatu-Wanganui Regional Council [sic] has cited the importance of the lower reaches of the Whangaehu, Turakina, and the Rangitikei Rivers native fish spawning. They also note the Koitiata Stream, Waimahora Stream, Waipatiki Stream, Kaikokopu Stream as well as the stream that connects to the Pupepuke Lagoon. They also note aquatic sites of significance for the brown mudfish at Omarupapakō, banded kokopu in the Waimahora Stream and an unnamed stream in the Santoft Forest which presumably would be the Waikakahi Stream and also Redfin Bullies in the Kaikokopu Stream. Due the migratory nature of these species the protection of the coastal margins of these water systems is important in retaining and further enhancing what remnant native fishery there is.

Within the advent of pastoral farming the nutrient levels in these vulnerable waterways has increased markedly. Many of them are treated as drains with the focus on keeping the drain clear and not developing them as natural areas. The consequences of these actions also affect these water systems in the coastal margin.
Taranaki Iwi Cultural Associations

Taranaki Iwi are still in negotiations with the Crown with regard to the settlement of historical claims, therefore they do not have a statutory acknowledgement over the coastal marine area within their rohe, although in the Letter of Agreement signed between Taranaki Iwi Trust and the Crown in December 2012 the parties agreed that the deed of settlement and the settlement legislation will provide for statutory acknowledgments to be made in relation to sites to be negotiated between Taranaki Iwi and the Crown prior to deed of settlement. Taranaki Iwi Trust does not have an environmental management plan.

Taranaki Iwi has undertaken to provide TTR with information concerning Taranaki Iwi’s association with the South Taranaki Bight on a confidential basis for the purpose of drafting this IA and for TTR’s assessment of impact on existing interests. Based on the agreement of Taranaki Iwi and TTR, only the summary of Taranaki Iwi’s association and cultural impact is included in this IA.

Taranaki Iwi rohe extends from New Plymouth around the coastal Taranaki to south of Opunake. Taranaki Iwi exercise mana whenua and mana moana within the Taranaki rohe (area of interest) and have been kaitiaki of the whenua and moana within the Taranaki role for generations.

Taranaki Iwi participate in a pataka system with other iwi in the region, where they put some of their customary fishing quota on local commercial fishing vessels. The operator’s process and freeze over-catch as customary fishing for the iwi allowing the iwi to have a source of kaimoana for tangi. Taranaki Iwi expressed concern that the TTR Project might impinge on the commercial fishing operators ability to fish the customary quota and supply kaimoana for tangi.

Taranaki Iwi Trust is a Mandated Iwi Organisation under the Fisheries Act 2004. Taranaki Iwi are concerned that the TTR Project may limit the ability of commercial fishing interests to operate in the South Taranaki Bight as a result of the navigational safety buffer zone and the ecological effects the Project may have on fishing stocks. Taranaki Iwi is concerned that the TTR project when combined with other restrictions commercial operators are facing such as the extension of set net bans may impede commercial operators to fish Taranaki Iwi’s quota. Taranaki Iwi argue that a restriction that prevents Taranaki Iwi from receiving their quota...
would breach the fisheries Deed of Settlement the Crown signed with iwi in 1992, which settled historical and contemporary Treaty of Waitangi claims relating to fisheries.

There are a number of Taranaki wāhi tapū located along the South Taranaki Bight. Based on the studies undertaken by NIWA, TTR does not believe any of the sites will be adversely affected by the Project. The Project will not have any significant impact on coastal processes, including erosion, sedimentation or amenity values with Taranaki Iwi’s rohe.

9.7 Ngāruahine Coastal Associations

Ngāruahine are still in negotiations with the Crown with regard to the settlement of historical claims, therefore they do not have a statutory acknowledgement over the coastal marine area within their rohe, although in the Agreement in Principle signed between Ngā Hapū o Ngāruahine and the Crown in December 2012 the parties agreed that the deed of settlement and the settlement legislation will provide for statutory acknowledgments over the coastal and marine area.

Ngāruahine traditional lands, as described in evidence to the Taranaki raupatū Tribunal and mapped in that Tribunal’s 1996 report, were bounded by the mouth of the Taungatara Stream to the top of Mount Taranaki, then to Tariki and following the Whakaahurangi track to Araukuku, then following the Waihi Stream to its mouth, and from there northwards along the coast of the mouth of the Taungatara Stream. For the purposes of the Wai 796 claim, the claimants describe the rohe as also including the seabed and continental shelf adjacent to that land area without seaward boundary. Within those boundaries is the offshore Kupe gas-condensate field.58

The Kaupokonui stream and beach has high cultural value for Ngāruahine (TRC, 2004). The land across the river from the car park at Kaupokonui Beach was an important early Māori village and has been the site of many significant archaeological finds. Many moa remains have been found near Kaupokonui.

The Waingongoro River Mouth and Ohawe Beach have high cultural/historic value (TRC, 2004). At the mouth of the Waingongoro River the first Māori settlers in Taranaki lived in small undefended settlements. The remains of moa have been found in cooking ovens around the edge of the present camping ground, and the remains of other native birds have been found in the area. In the 1940s a fortified pa stood where the car park is now located (Venture Taranaki). Four Mile Reef, offshore from Ohawe, is a traditional fishing reef of importance to iwi (TRC, 2004).

Ngāti Haua Piko have a kaitiaki in the form of a blue shark called Aho-Aho. Taniwha kaitiaki can take many forms, are usually descended from gods, and can have living descendants. They remain an essential feature of Māori beliefs and practices, and their role as guardians is no less important today than it was in traditional pre-European times.59

‘But despite all this Ngā Ruahinerangi is still strong. Our spirituality and our faith gives us strength. For my hapū of Ngāti Haua Piko and all other hapū of Ngā Ruahinerangi Iwi, spiritually comes from Mareikura (translated means a female guardian angel), and Whatikura (translated means a male talisman). Our entire being and surrounds are wāhi tapū, urupa, pa-pakanga, papakainga, awa, waipuna, roto, kaa kaimoana, moana ruku kai, moana hiinga ika, maunga, puke, papa-wanaga [sic], mauri, rakau, tauranga waka, wai-tohi, tuahu, whare tutahanga, wai-paru, paru kokowai, mahinga kai, whakaparupu, puharakeke, pu-pingao, pu-kiekie, pu-rakau, pu-oneone, takutai moana, rua-pito, urunga pito, rua-taniwha, ana taniwha, rua-pou-whenua, kohatu, ngahere, uru-rakau, wai-hohourongo, iringa-korero, marae.’ Thomas Ngatai60

Claimants to Wai 796 submitted that tangata whenua interests in the resources of the coastal and maritime areas of their rohe were devalued by the Crown’s limited control of the

environmental risks posed by oil companies which operate, with the Crown’s permission and to its financial benefit, more than 12 nautical miles from shore.61

TTR held a hui-a-iwi with the hapū of Ngāruahine on 28 July 2013. During this hui hapū members expressed their concern about the destruction of the seabed, recolonisation, and access to healthy kaimoana. Attendees also stated they oppose the extraction of natural resources, including oil, gas and iron sands.

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Figure 77: Ngāruahine area of interest

9.8 Ngāti Raukawa ki te Tonga Coastal Associations

TTR provided information to Ngāti Raukawa ki te Tonga Trust and requested meetings with Ngāti Raukawa ki te Tonga but was not able to meet with the iwi kanohi ki te kanohi. TTR will continue to engage with Ngāti Raukawa ki te Tonga.

Ngāti Raukawa ki te Tonga has previously stated they have an economic interest in the fisheries of Raukawa Moana and has for many years suffered the consequences of pollution of the waters by agricultural and municipal waste. A consequence has been severe restriction on the ability to harvest kaimoana from the shores of the moana.62

9.9 Rangitāne o Manawatu Coastal Associations

Rangitāne o Manawatu is in direct negotiations with the Crown with regard to the settlement of historical claims.

Rangitāne o Manawatu identifies its rohe as extending from the southern bank of the mouth of the Rangitikei River, inland to the Orangipango Trig, in the north east near Ohingaiti. From there in a straight line to Te Hekenga, following the summit along the Ruahine and Tararua

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Ranges across to the Taramea Trig. From this point it continues westward to the mouth of the Rangitikei River\textsuperscript{63}.

Shellfish beds along the Coast were of significant to Rangitāne o Manawatu tipuna, but have been in decline or have collapsed over recent years. Rangitāne o Manawatu has identified re-establishing shellfish beds as a priority\textsuperscript{64}.

During meetings with Rangitāne o Manawatu representatives, they have emphasised the importance of protecting fisheries, both customary and commercial fisheries.

9.10 Te Taihauāuru Iwi Fisheries Forum

In addition to consulting with individual iwi, TTR engaged with the Te Taihauāuru Iwi Fisheries Forum (the Forum). The Forum is made up of mandated iwi representatives from 14 iwi from the Mokau River in North Taranaki down the coast to Waikanae in the south.

TTR briefed the Forum on 26 July on the Project. The Forum has also been contracted to undertake a review of the environmental research completed by NIWA and others, with the aim of coordinating the environmental units of mandated iwi organisations to complete a report on the environmental effects of the Project and make recommendations for minimising and mitigating these effects, with particular reference to fisheries management. It is expected that the final report will be submitted during the public submission process or as evidence at a later date and will provide similar advice as a cultural impact assessment. Appendix 5 is a copy of the letter detailing the scope of this work stream from Te Taihauāuru Iwi Fisheries Forum.

9.10.1 Te Taihauāuru Iwi Forum Fisheries Plan 2012-2017

Although the scope of the Te Taihauāuru Iwi Forum Fisheries Plan (the Plan) is primarily directed at fisheries decisions, it is not restricted solely to this on the grounds that kaitiakitanga is practiced over all living things. Impacts of non-fishing activities on fisheries resources are outside the scope of the Fisheries Act 1996. However, iwi see opportunity to collectively address these activities that could adversely affect fisheries sustainability in the region such as farming, development and oil and mineral extraction\textsuperscript{65}.

One of the objectives of the Forum is that the mana and rangatiratanga over fisheries is restored, preserved and protected for future generations. The performance measures for this objective are:

- The health of known habitats of significance is protected, monitored regularly and stable or improving.
- Mātauranga Māori contributes to decision-making about fisheries and their habitats.
- Iwi are able to utilise tikanga in the management of the fisheries,

The commentary accompanying this objective notes the need for management arrangements to be integrated across all natural resources, and not only fisheries. “Combatting the risks associated with environmental degradation (for example seabed mining) should not be looked at separately to fisheries sustainability. Iwi understand it is not an effective approach to manage fish if the habitats they live in are polluted and not being considered as well.”

“To iwi, a holistic approach to managing all natural resources is preferred. It is about protecting and restoring the health of our fisheries, waterways and habitats whereby iwi have the ability to take steps that encourage this.”\textsuperscript{66}

\textsuperscript{63} Rangitaane o Manawatu Heads of Agreement, 1999 pp. 4

\textsuperscript{64} Rangitaane (North Island) Iwi Fisheries Plan 2012-2017

\textsuperscript{65} Te Taihauāuru Iwi Forum Fisheries Plan 2012-2017, pp. 14

\textsuperscript{66} Te Taihauāuru Iwi Forum Fisheries Plan 2012-2017, pp. 9
Fishing and the gathering of other kaimoana was, and remains today, a fundamental part of being Māori and living on the Taranaki coast with tangata whenua holding a very strong relationship with the sea. Traditional management entails a whole body of knowledge about the resource and how and when to access it. Customary knowledge is held sacred by tangata whenua and only passed onto those who will look after that knowledge.

Traditional management governing fishing practices within an area of significance to tangata whenua can be undertaken using the Fisheries (Kaimoana Customary Fishing) Regulations 1998. Customary rights provided for under these regulations allow tangata whenua to establish.

### 9.11 Potential Effects on Iwi

Based on the cultural associations above and discussions with the iwi TTR has identified the following effects on iwi within the South Taranaki Bight:

<table>
<thead>
<tr>
<th>Potential effect</th>
<th>TTR risk assessment</th>
<th>Relevant section of the IA</th>
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<tbody>
<tr>
<td>Negatively effect of the mauri of Tangaroa including pollution from the project.</td>
<td>TTR understands there are a range of views with regard to resources and the extraction of resources from Tangaroa. Overall, the environmental impact of the project is minor, with recolonisation occurring quickly after mining, and having a minimal impact on water quality as no heat or chemicals are used in the processing of the sediment. TTR is keen to work with iwi, as to their individual roles as kaitiaki to develop and implement an environmental management plan and establish a forum whereby TTR and iwi can monitor the environmental effects and the effects on the ocean.</td>
<td>12.11</td>
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<tr>
<td>Impact on customary and commercial fishing.</td>
<td>The extent of spatial displacement of the trawl fishery is likely to be minor as trawling effort is mainly concentrated beyond the 50 m depth contour seaward of the mining site. The proportion of trawl catch taken within the mining site is therefore likely to be minimal. The wide distribution of the fishery means that any displaced catch can be caught elsewhere in the area with minimal, if any, increase in the overall cost of fishing. The mining operation will also displace set net catch and effort for school shark. The overall proportion of school shark taken from the mining area is likely to be small. However, even a minimal amount of displacement may be considered significant by the affected fishers due to the history of spatial exclusion in the near-shore parts of the set net fishery where rig and blue warehou are targeted. Regulatory closures to protect dolphins have pushed additional set net effort south into the Taranaki Bight and outwards into deeper waters beyond 7 nm. These cumulative effects may leave some set net fishers with limited flexibility to respond to even small additional exclusions. This may have a flow-on effect for customary fishing as some of the commercial operators catch customary fisheries on behalf of iwi. TTR is working with the fishing industry and operators to decrease the spatial displacement and development a relationship agreement to mitigate these effects.</td>
<td>6.14, 13.4.3, 13.4.4</td>
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<td>Impact</td>
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<td>Adverse effect from the sediment plume and increased sedimentation.</td>
<td>Plumes from TTR Project activities extend to the east-southeast, reaching the coast between Patea and Whanganui and with a long tail of low concentrations following the coast towards Kapiti. For extraction at the 12 nm limit (inner boundary of application area) the highest surface concentrations occur at the source location and are 2.5–5 mg/L (median) and 10-20 mg/L (99th percentile). For extraction further offshore, the plume is located further offshore and the nearshore concentrations are somewhat lower. In both cases the mining-derived sediment plume contributes markedly to the total suspended sediment concentrations within a few kilometres of the source but is insignificant relative to the natural suspended sediment concentrations near the coast.</td>
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<td>Adverse effect on organisms in the Project area due to extraction and the rate of recolonisation.</td>
<td>The total mined area is around 66 square kilometres and extraction will take place over of duration of 16-20 years, resulting in an annual disturbance of around 4 square kilometres. The remainder of the extraction area will be undisturbed either until extraction is undertaken or once de-ored sand re-deposition has taken place. Based on the understanding of the existing ecology, TTR anticipates that recovery will commence relatively rapidly, and that recolonisation will have been well established within 1-2 years of disturbance ceasing.</td>
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<td>Impact on fisheries and life in the sea</td>
<td>The relatively small scale of TTR’s operational activities in the context of the STB overall, and the minor effects attributable to TTR’s activities are anticipated to result in no overall long term impact on the ecosystem and kaimoana stocks within the STB. The area most likely to be affected will be TTR’s direct operational area in the vicinity of the extraction and deposition activities. However, the relatively small area affected over a 1-2 year period coupled with anticipated recolonisation over the same time frame will avoid adverse effects.</td>
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<td>Adverse effect on tuna (eel) and whitebait</td>
<td>Mature eels migrate out from rivers to the sea and then to the equatorial Pacific where they spawn. Larval eels float on ocean currents back to coastlines, where they turn into “glass eels” and migrate up rivers as elvers. On the other hand, Īnanga (which usually live for one year) spawn in estuaries around the high-water mark on very high spring tides. When the tide recedes, the eggs are exposed to the air for a number of weeks but remain moist among the vegetation. When another spring tide reaches the eggs, larvae hatch, and the falling tide carries them out to sea. The hatchlings spend the winter at sea, feeding on small plankton such as crustaceans. In the springtime, juvenile Īnanga make their way upriver as whitebait stage. Those that reach fresh water remain there as adults for spring and summer and in autumn, adults make their way downstream to spawn in estuaries. TTR’s operations will potentially introduce suspended sediments into the water column, mainly around the extraction area. These suspended sediment levels would not adversely affect mature eels which are after all, accustomed to highly turbid river habitats. The larval stages of eels and Īnanga are not expected to be adversely affected by TTR’s activities, which will only noticeably affect a relatively small area in the outer STB.</td>
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<td>Long term environmental sustainability of the coastal area</td>
<td>The broad conclusion is that given the relatively small scale of TTR’s operational activities in the context of the STB, and the minor effects attributable to TTR’s activities, there will be no overall impact on the ecosystem of the STB. There will be an observable but minor change in water column suspended sediment levels, but within 5-10 km of the shoreline TTR’s effects will largely be indistinguishable from the effects of natural processes.</td>
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<td>The area most likely to be affected will be TTR’s direct operational area in the vicinity of the extraction and deposition activities. However, the relatively small area affected over a 1-2 year period coupled with anticipated recolonisation over the same time frame will avoid adverse effects. The presence of the FPSO may act as a fish aggregation device in the area, with associated potential for enhanced localised fisheries abundance, however, direct access to this new resource will be limited by the navigational safety buffer zone. In an overall sense however, this may contribute to improved fisheries abundance in the STB.</td>
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<td>The risk that NIWA’s modelling and research could be wrong</td>
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<td>TTR has selected NZ’s leading independent consultancies, and the methodology adopted by TTR’s consultants is based around accepted international best practice. In addition, TTR has had the major technical reports peer reviewed by independent external experts.</td>
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<td>Negative effect on coastal wāhi tapu</td>
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<td>NIWA’s investigations and modelling have demonstrated that there will be no change to wave climate, and consequently no change to the topography of the coastline or erosion characteristics, therefore the risk of erosion or increased sedimentation of wāhi tapu located on the coast is low.</td>
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<td>11.4</td>
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<tr>
<td>Effect of an unplanned event such as an oil spill on the environment</td>
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<tr>
<td>TTR will be developing emergency management plans to manage outcomes in the event of an emergency. Such events will include a full range of unplanned events ranging from oil spills, to vessel collisions, and weather-related adverse events. With precautionary measures put in place and adherence to international best practice the risk of an unplanned event is low.</td>
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<td>3, 12.6</td>
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</tbody>
</table>

TTR plans to continue to work with iwi to mitigate any adverse effects the project may have on iwi, through the development of the environmental management plan, emergency response plan and through the formation of a Kaitiakitanga Komiti as described in Section 16.3 of this IA.