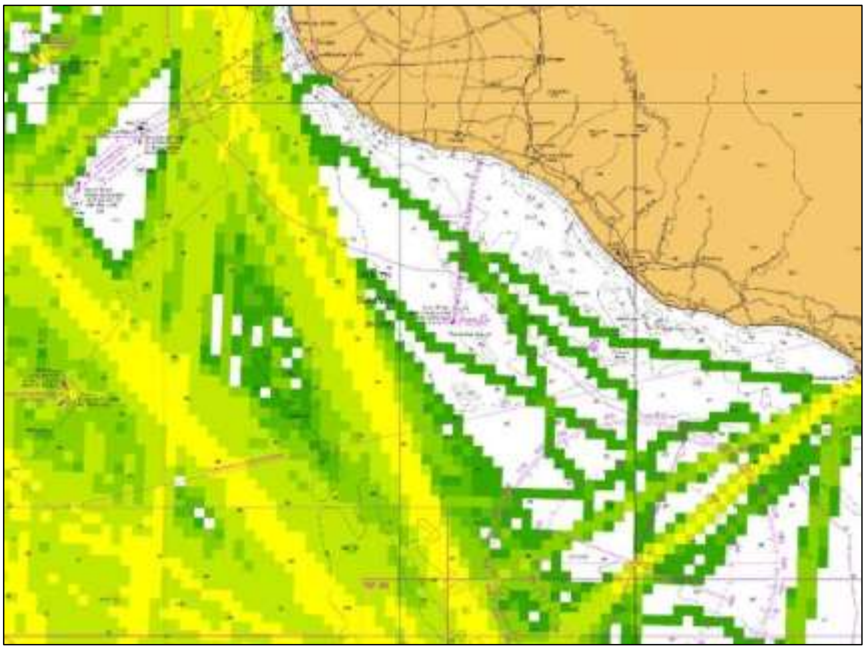
TRANS-TASMAN RESOURCES LIMITED

SOUTH TARANAKI BIGHT MARINE TRAFFIC STUDY



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MARICO MARINE NZ LTD / MARINE AND RISK CONSULTANTS LTD

Trans-Tasman Resources Limited

South Taranaki Bight Marine Traffic Study

Prepared for: Trans-Tasman Resources Limited

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CONTENTS

FIGURES

TABLES

EXECUTIVE SUMMARY

This report details a comprehensive study into marine traffic movements and navigational safety within the South Taranaki Bight region of New Zealand to establish the impact of shipping on the proposed development of an offshore iron ore extraction operation.

This report was originally prepared in 2013 for TTR. The traffic volumes both in the area of interest to TTR, and in the wider Taranaki Byte area have not increased or reduced measurably. This is both in the frequency and type of transits made, as well as the routes taken. Recent traffic extracts of the Taranaki Byte area associated with other projects have confirmed this. Further, a modified plume calculation is going to have no material effect on the navigational risk assessment. On this basis, the traffic risk work undertaken for the original TTR application remains valid in 2015, in our view.

Twelve months (April 2012 to March 2013) of vessel movements recorded by the Marico Marine NZ AIS data recording system were extracted and analysed as part of this study. This is a significant pool of ship traffic data and fully representative of the seasonal variation of water resource use in the area[1]. A number of analytical and statistical techniques are employed in this assessment to provide conclusions clearly supported by data.

The results show considerable variability in marine activity within the South Taranaki region, but that the proposed area for dredging has low levels of existing transit activity. There are very well demarcated shipping routes between major nodes, which contain the majority of dry cargo and liquid tanker traffic. This is particularly so between New Plymouth, Nelson and the Cook Strait and these routes are well away from the proposed area of dredging operations. The activity of fishing vessels around the centre of the South Taranaki Bight is far more dispersed and accounts for a large

[1] 12months of data analysis is more than the UK offshore requirement for resource consent applications (e.g. offshore windfarms), where 2 weeks of summer and 2 weeks of winter vessel traffic records are recommended.

proportion of the non-transit movements. There is a natural focus of offshore services around the oil and gas installations to the south west of the Taranaki Bight.

Near to the proposed extraction site the traffic density was generally low to very low, with only a handful of vessels transiting through the site in the 12 month period of the data. A majority of vessels operating adjacent to the mining site were engaged in servicing the Kupe Gas Rig operation. A single shipping route between the Cook Strait and the Taranaki Bight was identified as adjacent to the proposed site, but was at a distance of five nautical miles. The disposition of traffic in that route was defined. Within this five mile distance, only 58 vessel movements were recorded in the 12 month period (approximately 1 movement every 6 days). Most of these transits were small dry cargo ships. There was shown to be both a low number of vessel encounters and vessel exposure, indicating a low risk of collision and plenty of sea room for vessels to navigate around the proposed operations.

Table 1: Vessels Transiting near Study Site within 12 months.

Vessels within site	4	Vessels servicing Kupe Rig and occasional transiting vessels
Vessels within 5nm	58	Cargo/Tankers transiting between Cook Strait and Taranaki Bight
Vessels within 20nm	544	Large Commercial Trawlers; Cargo/Tankers transiting between Cook Strait and Taranaki Bight; Vessels servicing oil/gas rigs

The results show that the proposed South Taranaki mining site is located in an area of a very low traffic density and the development would have very little impact, if any, on the safety of navigation in the adjacent areas.

Given the low level of traffic, the operation could use standard marine watch-keeping systems to interface with other vessel traffic and based on the data, there is no need for any remote management of vessel traffic through the proposed site. The only vessels missing from this data set will be small vessels not fitted with AIS transponders. All vessels involved in the proposed iron ore extract operation are recommended to be fitted with AIS data transponders.

1 INTRODUCTION

This study provides a comprehensive analysis of shipping transits through the South Taranaki Bight to support the deployment of iron ore extraction and production vessels. It is of principal importance that the effect on navigational safety is assessed as part of any resource consent application for an offshore activity. It is also important to demonstrate that any significant additional risk to navigation is capable of being effectively managed back to residual levels. This report was reviewed in December 2015 and reissued after confirming that the risk assessment remains valid for the area of the proposed development.

This report analyses twelve months of traffic movements through the entire South Taranaki Bight to establish the baseline traffic profile in the area. This is a significant data period, allowing assessment of seasonal variability. The types, frequency and interactions between these vessels are commented upon in order to inform decision makers on the degree to which the safety of navigation is affected by this development.

The study is set out in three sections as follows:

- **Section 1** is introductory and background information (this section);
- **Section** 2 and **Section** 3 outline the study design and area, general navigational situation. They also reference the data inputs and data quality used in the analysis;
- **Section 4** and **Section** 5 provide a synoptic picture of traffic through the South Taranaki Bight to establish the dominant shipping routes; and
- **Section** 6 and **Section** 7 provide more detailed analysis of traffic in the area adjacent to the proposed mining site.

The site of the proposed mining area is presented in **Figure 1**.

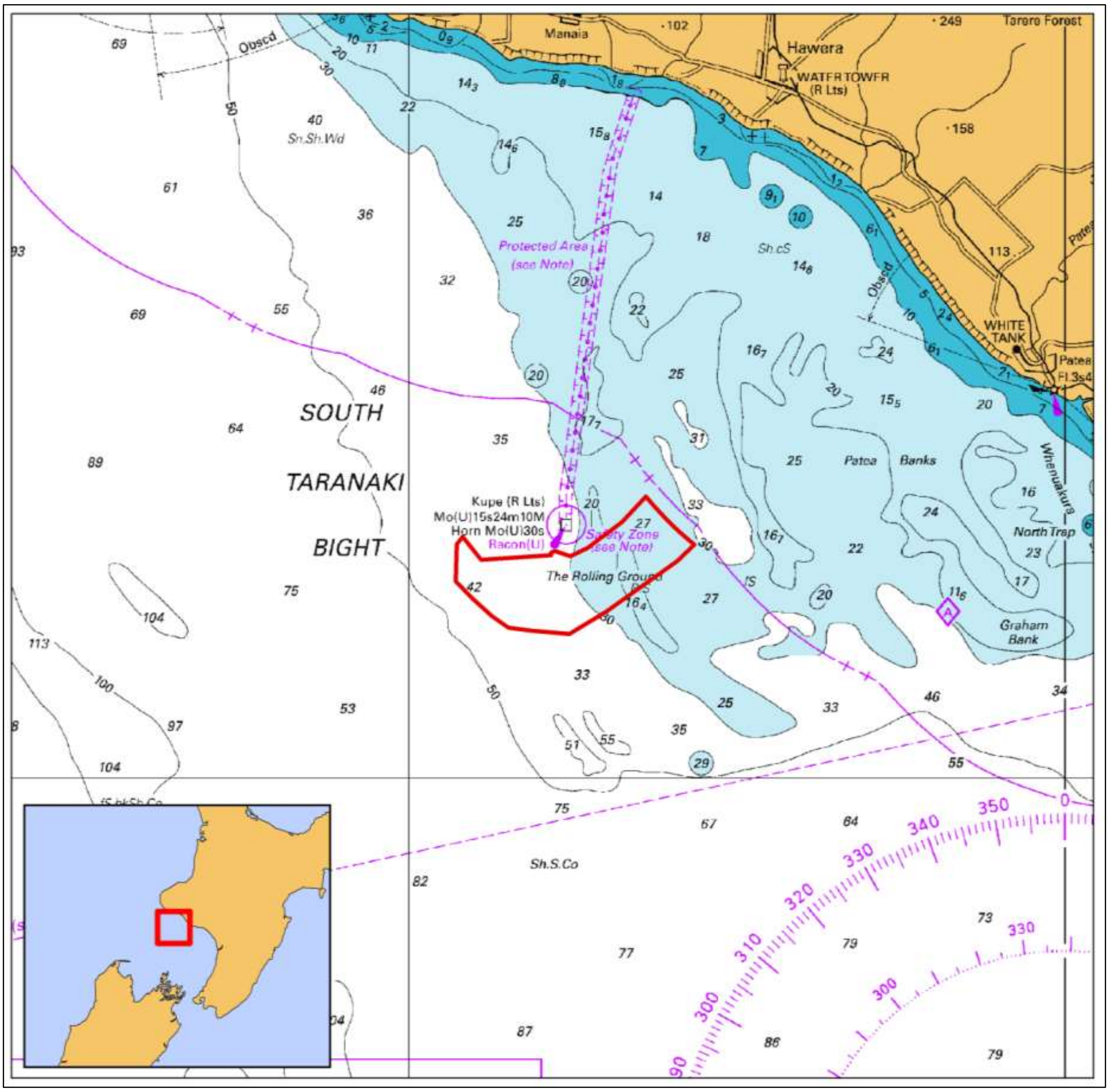


Figure 1: Proposed Mining Site.

1.1 STUDY OBJECTIVES

The objectives of this study are to:

- Produce a comprehensive assessment of shipping activity throughout the South Taranaki Bight;
- Provide a detailed breakdown of all traffic transiting near to the proposed mining site;
- Assess any incremental change of navigational risk associated with the proposed dredging activities; and
- Provide operational recommendations and highlight any navigational constraints.

2 STUDY AREA

The traffic study area analysed in this report represents a 150nm^2 region, as shown in **Figure 2**. The area is limited to the south by the Cook Strait between Wellington and the South Island and to the north by the Taranaki Bight. The western sea limit includes both Tasman Bay and Golden Bay of the South Island as well as a large part of the Tasman Sea.

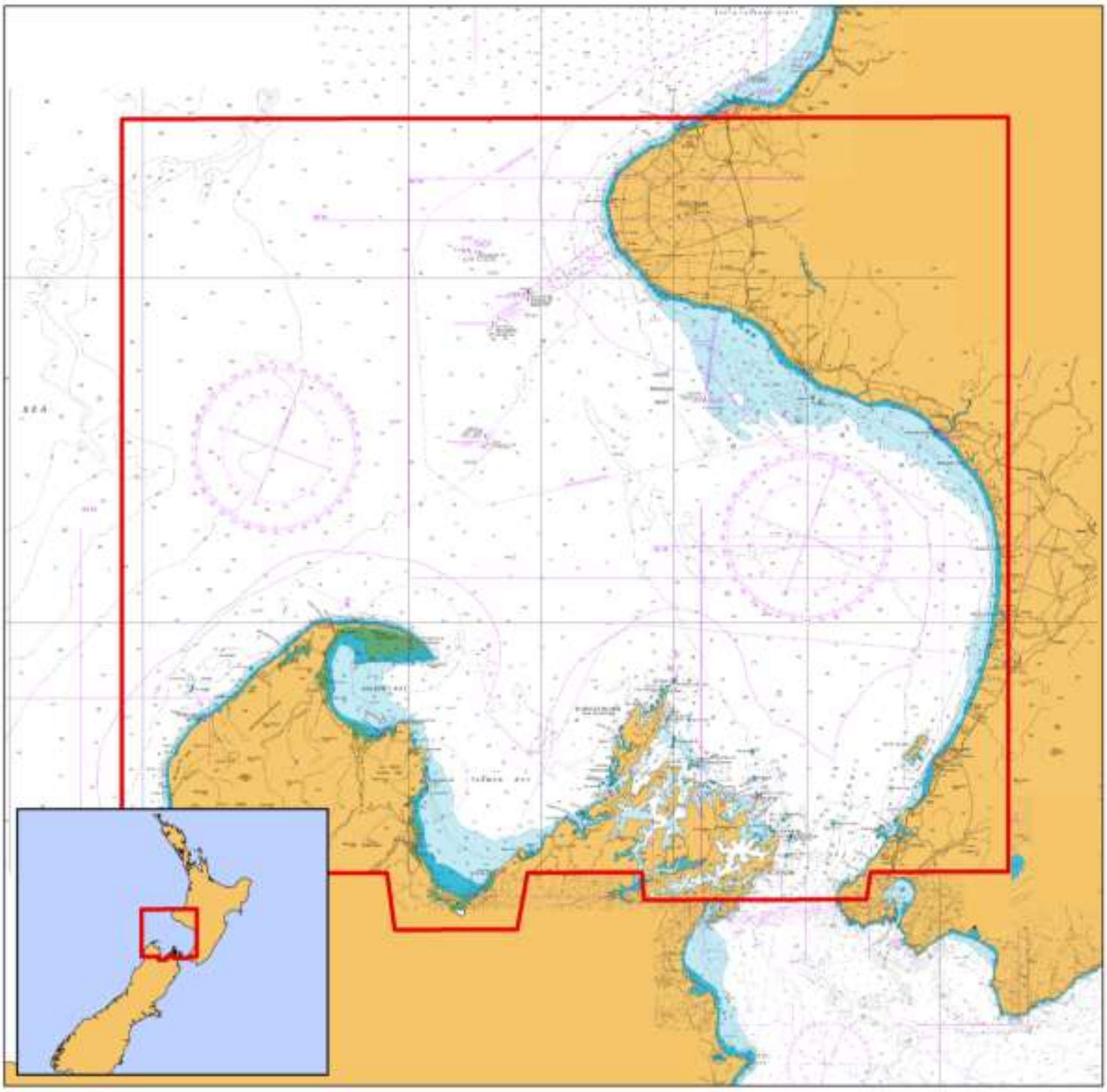


Figure 2: Study Area.

2.1 PREVAILING CONDITIONS

The prevailing winds in these latitudes are westerly with a succession of high and low pressure systems dominating the meteorological conditions. Furthermore New Zealand's topography, with unbroken mountain chains, produces considerable local accelerations and gusts that can produce localised swell, which is especially steep when wind is against tidal current. When the prevailing conditions and tidal stream combine, these interact to produce heavy seas in offshore areas that can potentially lead to dangerous environmental conditions[2].

The tidal stream is broadly north-west to south-east with water funnelled through the Cook Strait. Spring rates vary between half a knot near the Taranaki Bight to at least one knot by Queen Charlotte Sound and far greater in the Cook Strait itself. When combined with strong winds the surface current can be considerably increased.

2.2 LOCAL NAVIGATIONAL CONSTRAINTS

2.2.1 Oil and Gas

The South Taranaki Bight region is host to a number of offshore oil and gas installations, which are marked in **Figure 3**.

- 1: Floating Production Storage and Offloading (FPSO) Umuroa;
- 2: Maui A and Maui B production platforms;
- 3: Kupe production platform;
- 4: Maari production platform and FPSO Raroa; and
- Pohokura well head platform is not shown but is located to the north of the Taranaki Bight.

All of these installations are well charted, lit and carry AIS transmitters, and therefore visible to passing shipping. A 500m exclusion zone exists around all of these sites for which unauthorised entry of any vessel is prohibited.

[2] Bowman et al. (1983). Circulation and mixing in greater Cook Strait, New Zealand. *Oceanologica Acta 1983*, 6(4).

Furthermore, vessels are prohibited from anchoring or fishing within the Protected Area surrounding the gas pipelines.[3]

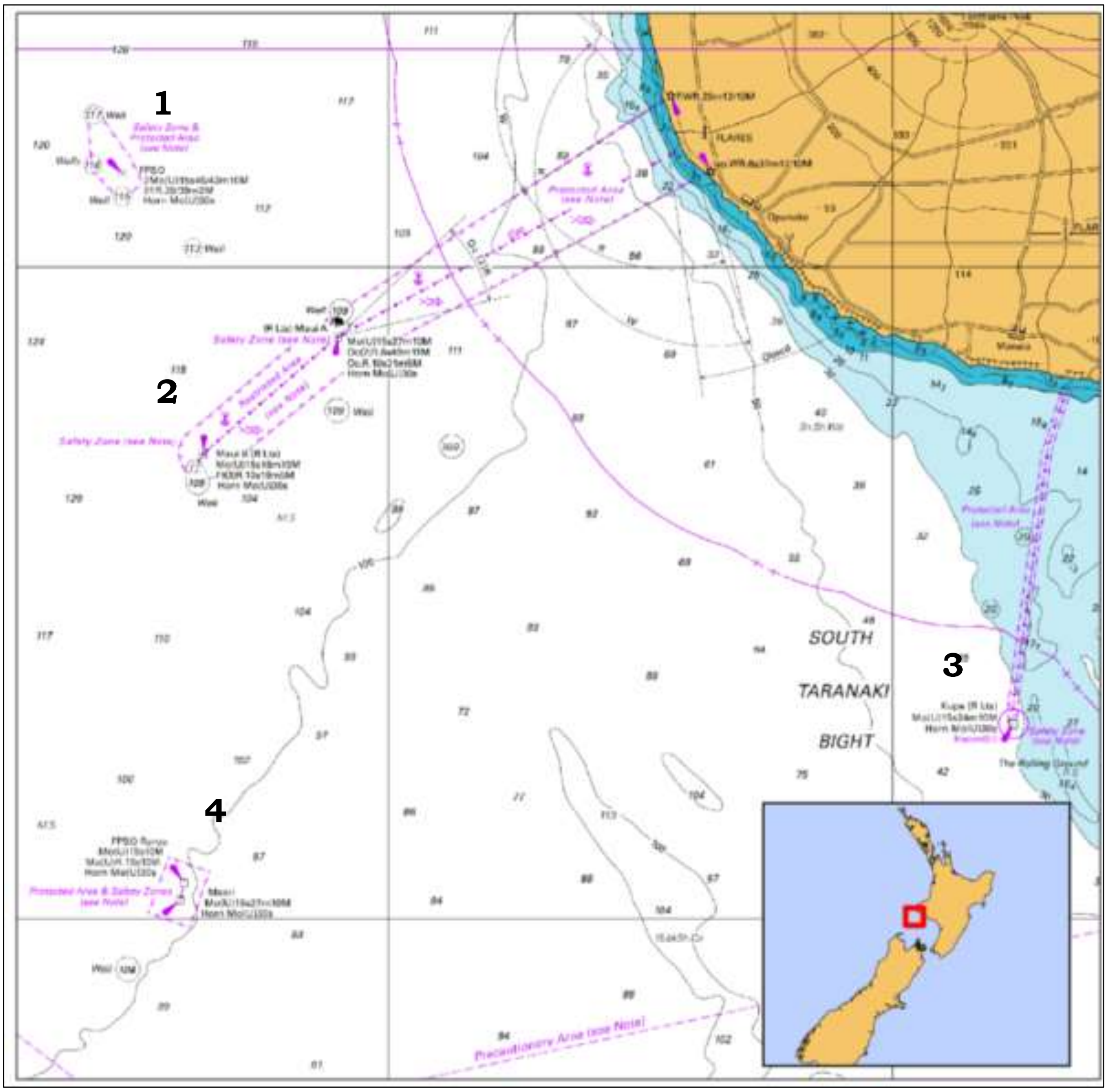


Figure 3: Oil and Gas Installations.

3 Beyond the Territorial Sea Outer Limit these areas are "Restricted" and New Zealand vessels are prohibited from, whilst other flagged vessels are warned against, fishing or anchoring

2.2.2 Precautionary Area

A 'Precautionary Area' is marked around the Taranaki Bight and oil and gas installations and is shown in **Figure 4**. Chart NZ 48, Western Approaches to Cook Strait states that:

"All ships should navigate with particular caution in order to reduce the risk of a maritime casualty and resulting marine pollution in the precautionary area."

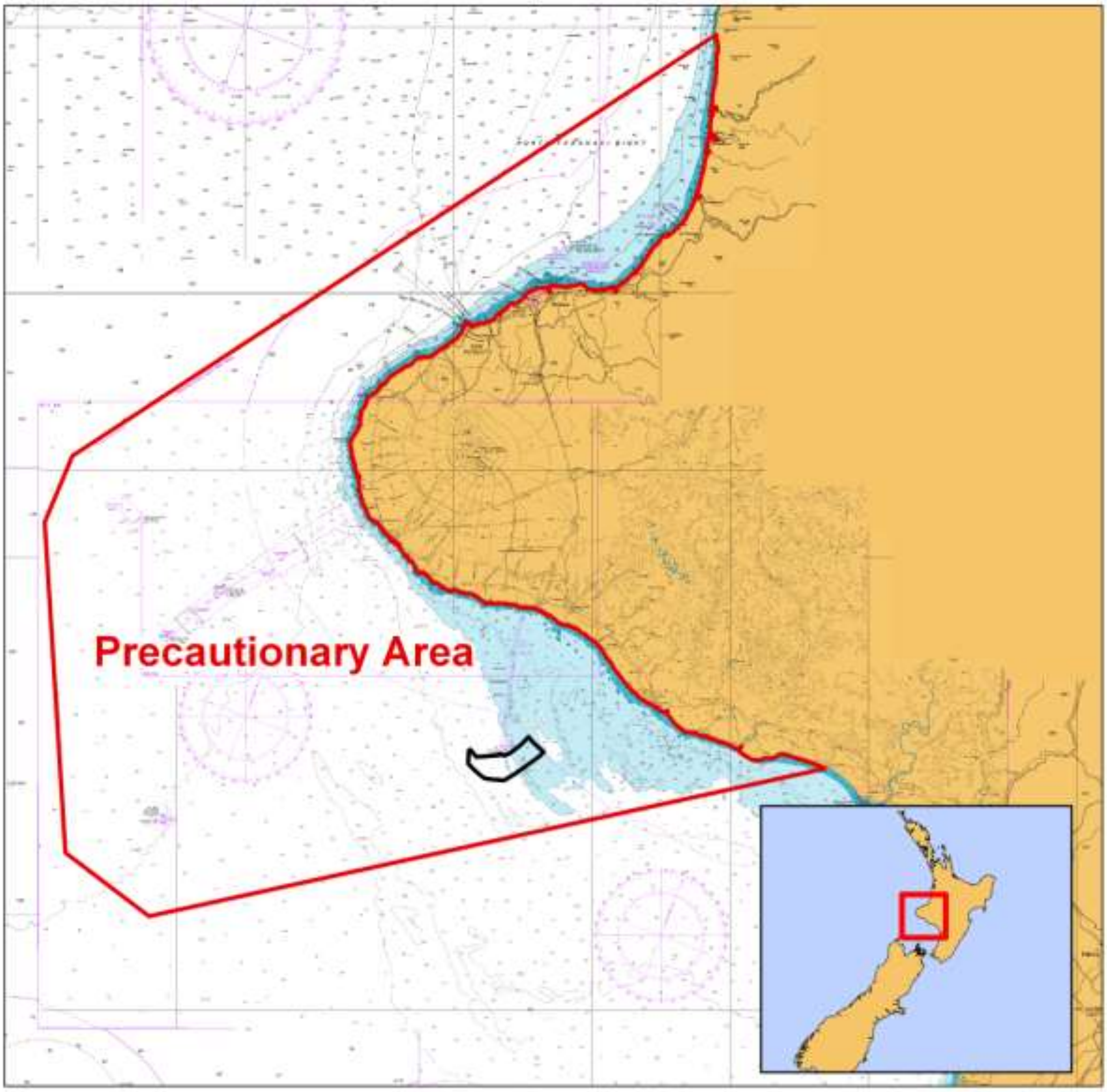


Figure 4: Taranaki Bight Precautionary Area.

2.2.3 Buoyage and Lighting

There is no offshore buoyage or lighting in the South Taranaki Bight study area, with the exception of the oil and gas installations. A number of lights exist along the New Zealand coast and the visible range of selected lights are marked below in **Figure 5**.

Near to the proposed iron ore extract site only one light would be visible (on the Kupe Well head Platform, a Morse code "U" all round red light visible for 10 nautical miles. The platform is also fitted with a Racon and horn, both of which also signal "U".

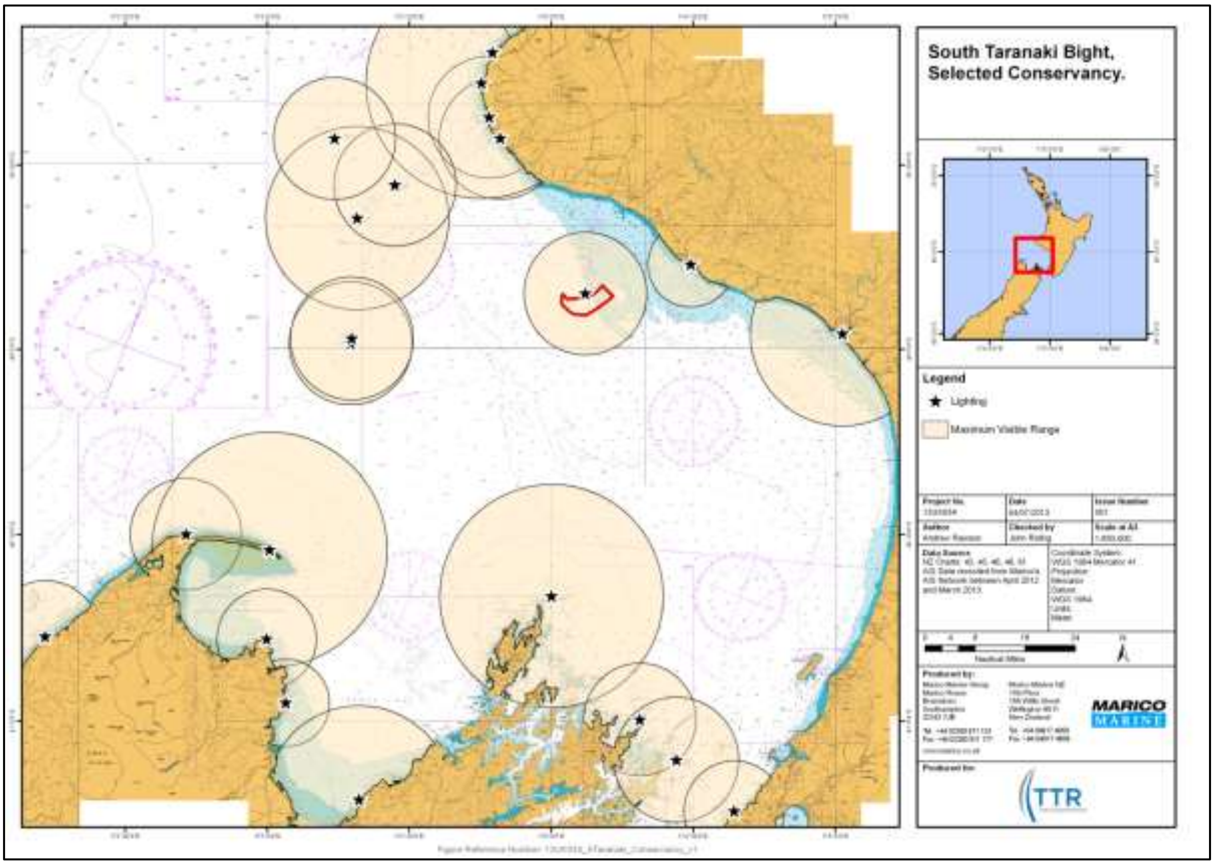


Figure 5: Selected Conservancy in South Taranaki Bight.

3 DATA SOURCES

The majority of data used in the analysis presented in this report has been produced from Automatic Identification System (AIS) data. An outline description of this dataset is presented in **Section 3.1**.

The following nautical charts of Land Information New Zealand (LINZ) are used in the plots generated in this analysis:

- NZ43;
- NZ443;
- NZ45;
- NZ46;
- NZ48;
- NZ58; and
- NZ61.

3.1 THE AUTOMATIC IDENTIFICATION SYSTEM

In 2000, IMO adopted a new requirement (as part of a revised Chapter V of SOLAS) for ships to be fitted with Automatic Identification System (AIS).

AIS was developed primarily as a collision avoidance tool. Vessels that carry an AIS transponder broadcast at regular intervals key information such as their position, identity, type, speed, course, etc. AIS exists in two forms, Class A and Class B: the former is fitted in all vessels so mandated by IMO; the latter on a voluntary basis by non-SOLAS vessels such as recreational craft.

Regulation 19 of Safety of Life at Sea (SOLAS) Chapter V[4] - sets out the navigational equipment to be carried on board ships according to ship type. AIS is required to be carried on:

- All ships of 300 and greater gross tonnage and engaged on international voyages;

4 IMO, (2002). *SOLAS Chapter V: Safety of Navigation.*

- Cargo ships of 500 and greater gross tonnage not engaged on international voyages; and
- All passenger vessels irrespective of size.

AIS uses one of two VHF frequencies, namely: [5]

- AIS 1: 161.975 MHz; and
- AIS 2: 162.025 MHz.

Vessels transmit packets of dynamic and static information in 26 millisecond time-slots of which there are 2,250 each minute. Static data i.e. that defining the unchanging description of a vessel, e.g. its identity, type, etc. is broadcast every 6 minutes. Dynamic information giving details of the vessels passage and actions, e.g. course, speed, heading, etc. is broadcast at intervals dependent on the speed and type of vessel. The normal reporting interval for Class A AIS[6] is:

- 3 minutes for a vessel at anchor (speed of less than 3 knots);
- 10 seconds for a vessel in transit (speed less than 14 knots);
- 4 seconds for a vessel in transit and altering course;
- 6 seconds for a vessel in transit (speed between 14 and 23 knots); and
- 2 seconds for a vessel in transit (speed greater than 23 knots) or altering course (speed greater than 14 knots).

For AIS Class B installations, the reporting intervals are:

- 3 minutes for a vessel at anchor (speed of less than 2 knots); and
- 30 seconds for a vessel underway (speed greater than 2 knots).

5 IALA (2011). IALA Guideline No. 182: On an overview of AIS.

6 IMO (1998). Resolution MSC.74(69) Adoption of New and Amended Performance Standards.

3.2 STUDY AIS DATASET

This study utilises a year of AIS data recorded by Marico Marine's AIS recording network in New Zealand. AIS receivers in various locations around the New Zealand coastline record any raw encoded AIS data which is then sent to a central database where it is decoded using Marico's specialist algorithms and then stored.

The data extent used in this study is from April 2012 to March 2013 within the extents laid out below (see **Figure 2**). Given the high density of shipping activity within Wellington Harbour, no data analysis was undertaken for this area as it was superfluous to the study objectives.

- North: 39˚ 2' S;
- East:175˚ 15' E;
- South: 41˚ 23' S (excluding Wellington Harbour); and
- West: 171˚ 55.2'

3.3 DATA QUALITY

AIS operates on VHF band communications and is therefore limited in its accuracy in relation to distance from the receiving station. The principal factor dictating recording range is the relative heights of the receiving and transmitting antennas, though adverse weather conditions and atmospheric pressure limit VHF wave propagation. A standard IALA (2002) formula for estimating range is given as:

$$Effective\ Range = 2.23\left(\sqrt{H} + \sqrt{h}\right)$$

Where:

- Range in nautical miles;
- H = Receiving station height in metres; and
- h = Transmitting station height in metres.

Therefore an inverse relationship exists between distance from the shore and data accuracy. As the range from the shore increases, smaller vessels with lower antennas are lost before larger commercial vessels. Where necessary this phenomenon will be referred to in the presented analysis, however it should be expected that sea areas greater than 60nm from shore will have incomplete data coverage.

The coverage for this project was determined by analysing the reception of a single stable target in the project area that would be representative of the dataset as a whole, for which the Kupe well head platform was chosen. The number of transmission received from the Kupe Platform per day is shown in **Figure 6**. The graph shows generally a high level of coverage for the structure with a few minor days of poor coverage for the project site.

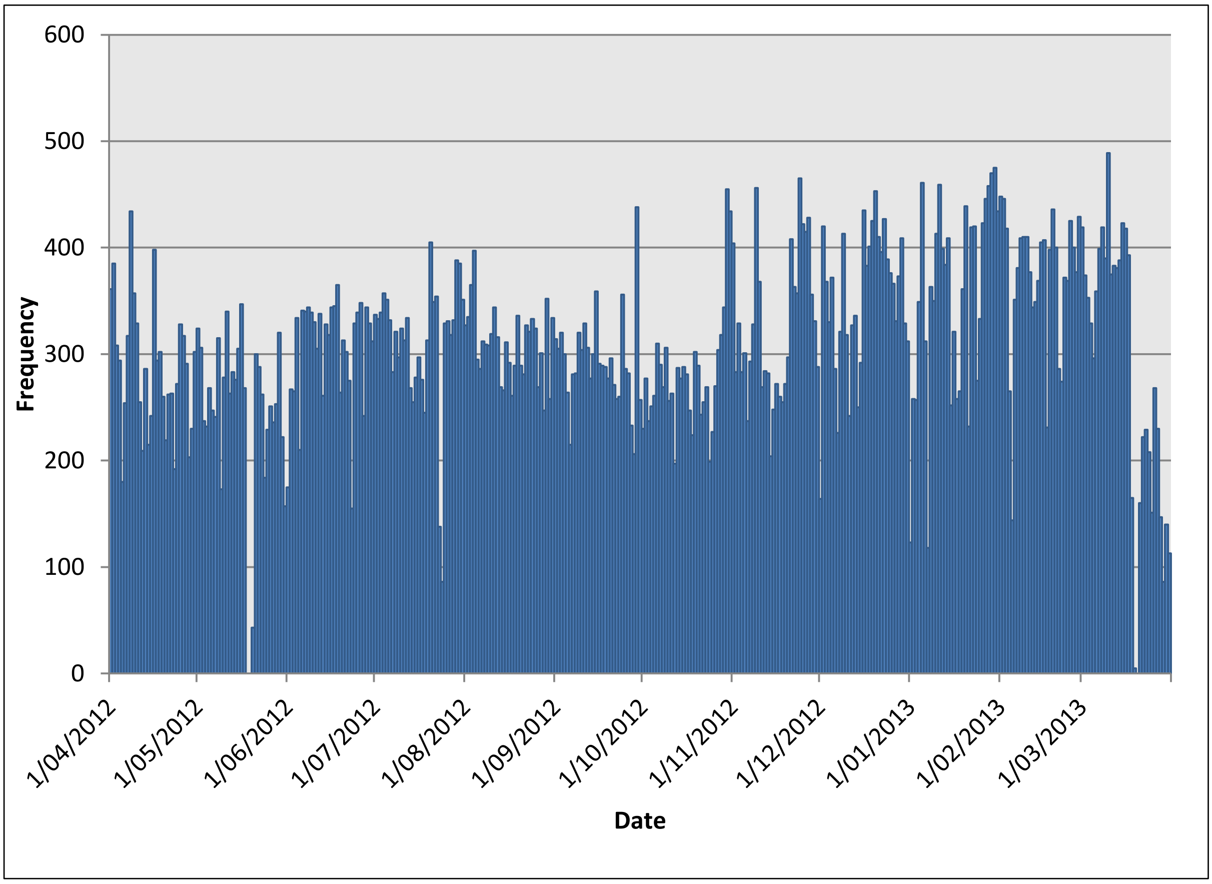


Figure 6: Kupe Well Head Platform AIS Transmissions.

4 TRAFFIC OVERVIEW

The recorded AIS transmissions were decoded by Marico's specialist algorithms to form a sequential database. The latitude and longitude attributes were used to create a series of ordered points inside of a Geographical Information System (GIS)[7]. Subsequent points between vessels were connected to form vessel tracks so long as the interval did not exceed a threshold value.

In total, 6 million ship positions over a twelve month period were analysed in this assessment.

4.1 COMBINED VESSEL TRACKS

All vessel tracks produced are displayed below in **Figure 7**. In total 926 ship stations were recorded by AIS, a breakdown of the total dataset is included in **Table 2** and **Figure 8** below. The plot shows the dominant traffic patterns through the South Taranaki Bight study area. The broad traffic pattern is one of divergence/convergence of traffic that is transiting through the Cook Strait, a 23km wide passage that funnels and concentrates vessel traffic. A similar but lesser effect is visible around Cape Egmont with vessels approaching New Plymouth and Port Taranaki. The Port of Nelson to the exhibits distinct NW and NE approach patterns. Clusters of activity are also visible around the offshore installations of maintenance vessels.

7 A GIS is specialist computer software used to handle, analyse and display spatial datasets.

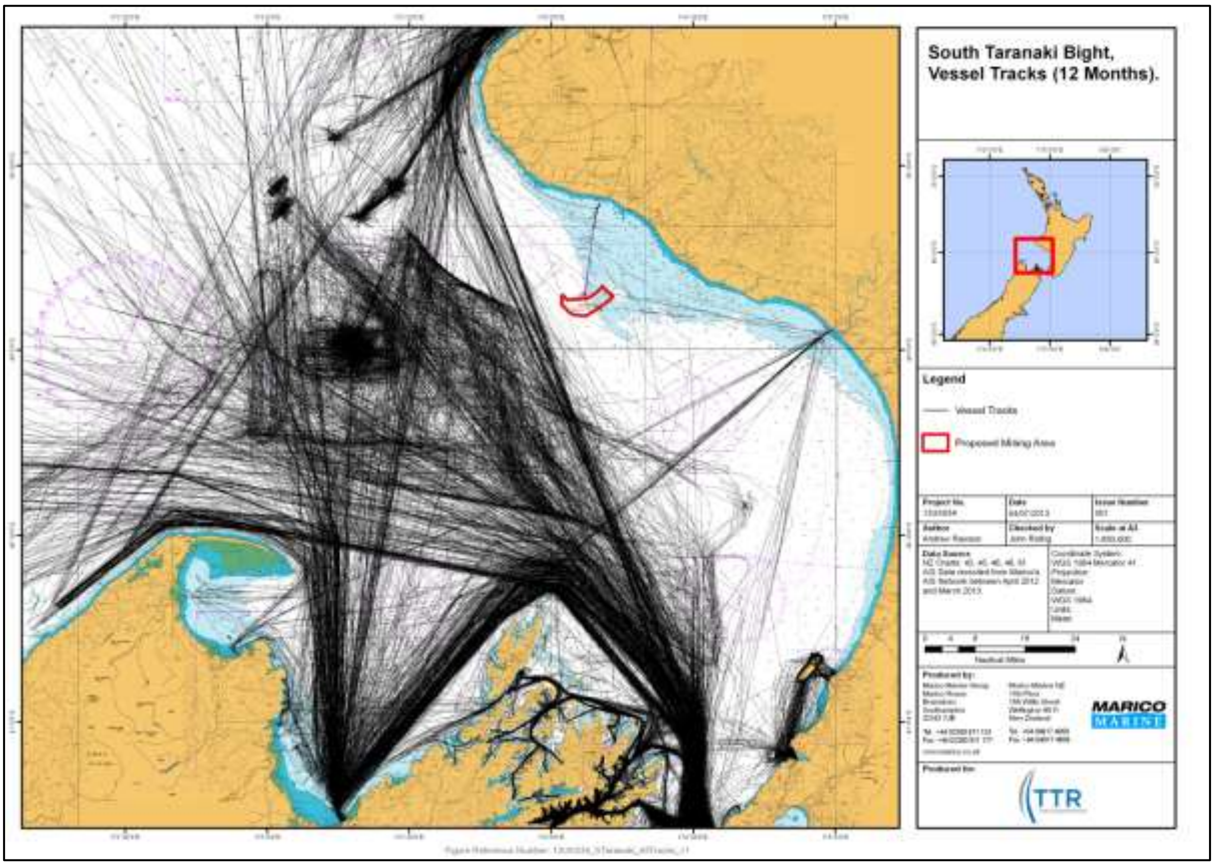


Figure 7: Combined Vessel Tracks.

Table 2: Total Numbers of Ship Stations in South Taranaki Bight for Study Period

Vessel Type	Unique Stations	Percentage
Anchor Handlers	4	0.4%
Buoys/Navigational Marks	6	0.6%
Dry Cargo Ship (All Sub Types)	375	40.5%
Dredgers	3	0.3%
Fishing	37	4.0%
Naval	6	0.6%
Passenger/Cruise Ship	35	3.8%
Pilot Vessels	5	0.5%
Recreational Craft	39	4.2%
Research/Survey	13	1.4%

Vessel Type	Unique Stations	Percentage
Tankers	87	9.4%
Tugs/Towing	20	2.2%
Other Types	296	32.0%
Totals	**926**	**100%**

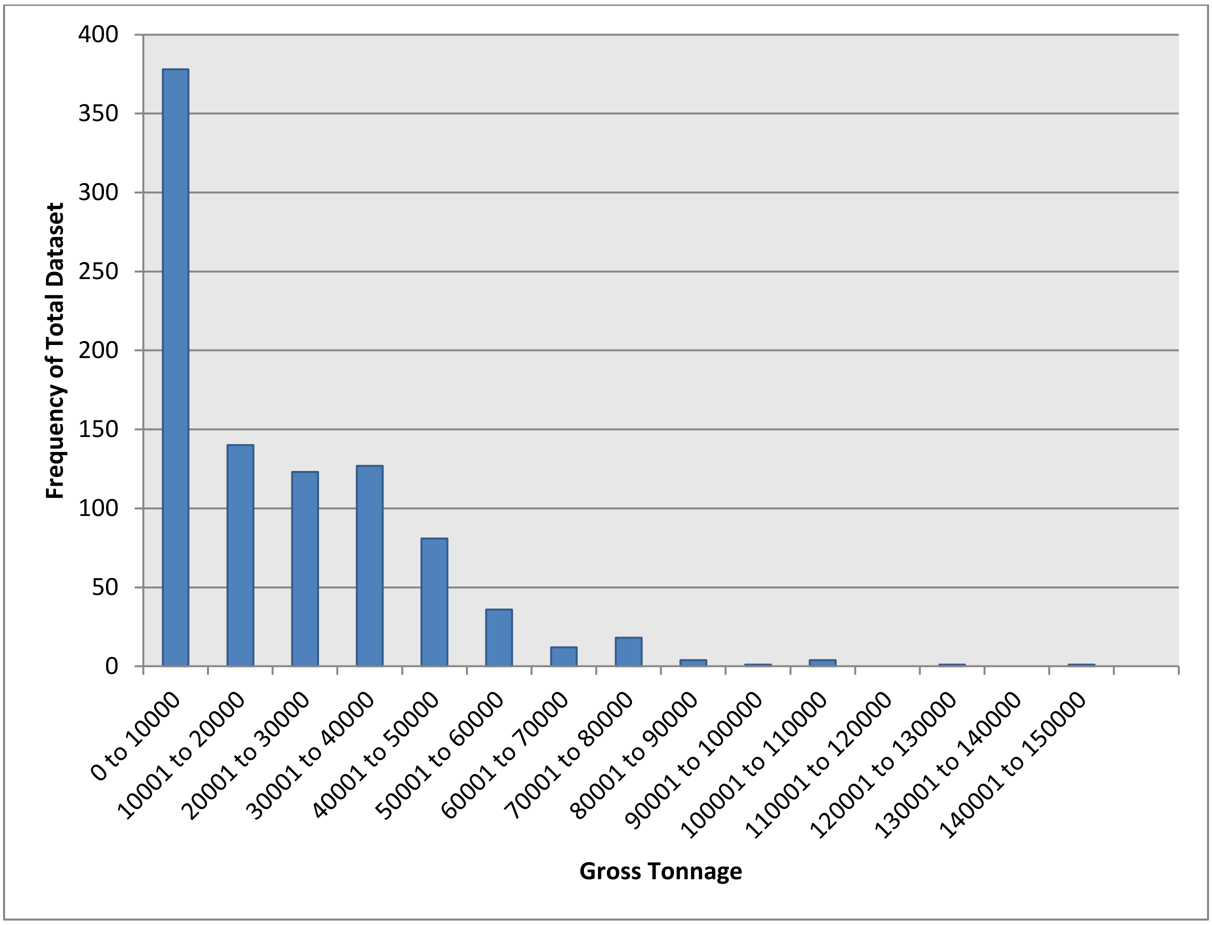


Figure 8: Vessel Dataset by Gross Tonnage

4.2 VESSEL TRACKS BY TYPE

The tracks produced in **Section 4.1** have been differentiated by the vessel type. The vessel type broadcast as part of AIS messages was cross referenced with Marico's databases and any identified conflicts were rectified manually.

Vessels can broadly be categorised into the following types:

- Dry cargo (**Section 4.2.1**);
- Liquid tanker (**Section 4.2.2**);
- Passenger (**Section 4.2.3**);
- Fishing (**Section 4.2.4**);
- Recreational (**Section 4.2.5**); and
- Other (**Section 4.2.6**).

A cumulative plot of all vessel types is shown in **Figure 9**.

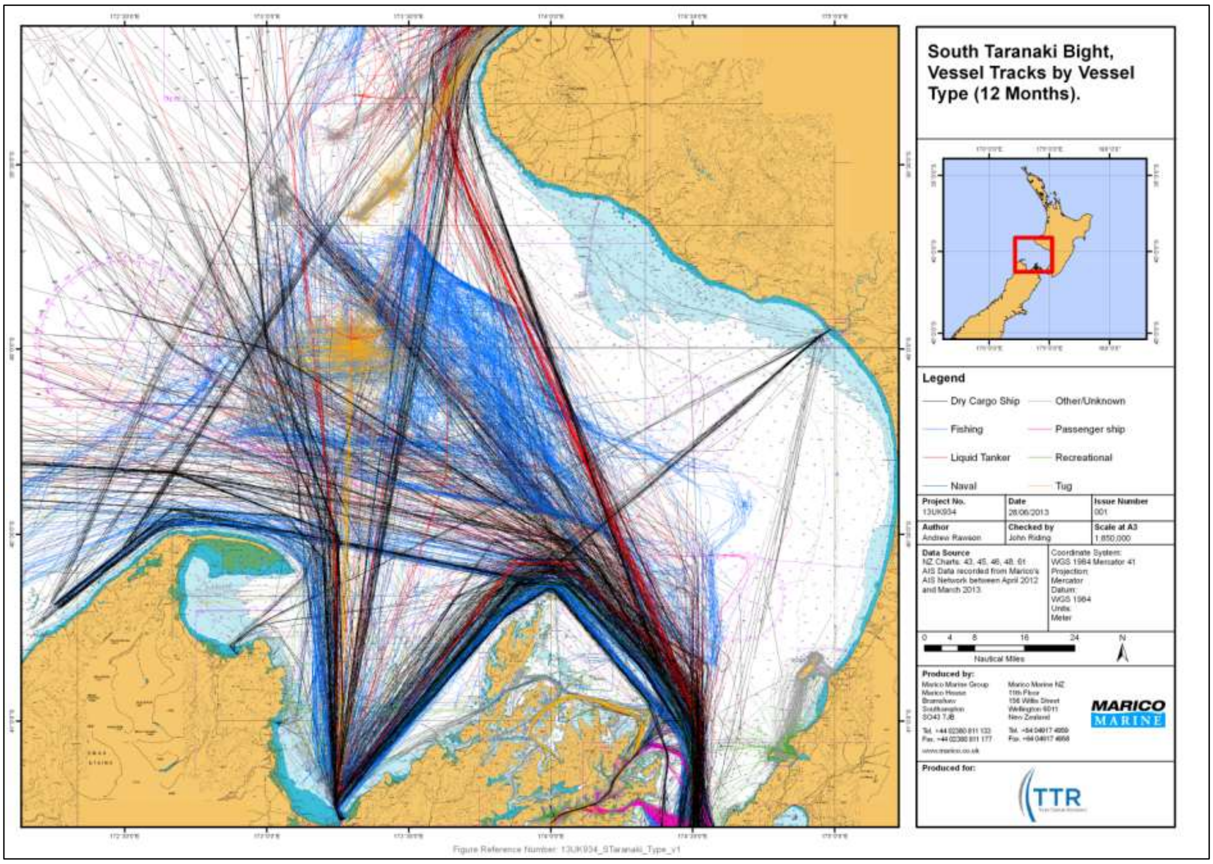


Figure 9: Vessel Tracks by Type.

4.2.1 Dry Cargo Vessels

Dry cargo vessels is a category that describes container, bulk carrier, refrigerated (Reefers), roll-on roll-off (RoRo) and general cargo vessels. **Figure 10** shows the tracks of all dry cargo vessels over the year of analysis. The routes taken by these vessels are delineated into principal shipping routes and further analysis is undertaken in **Section** 5 in order to define them. In particular the traffic is concentrated in the Cook Strait, the port of Nelson and rounding Cape Egmont.

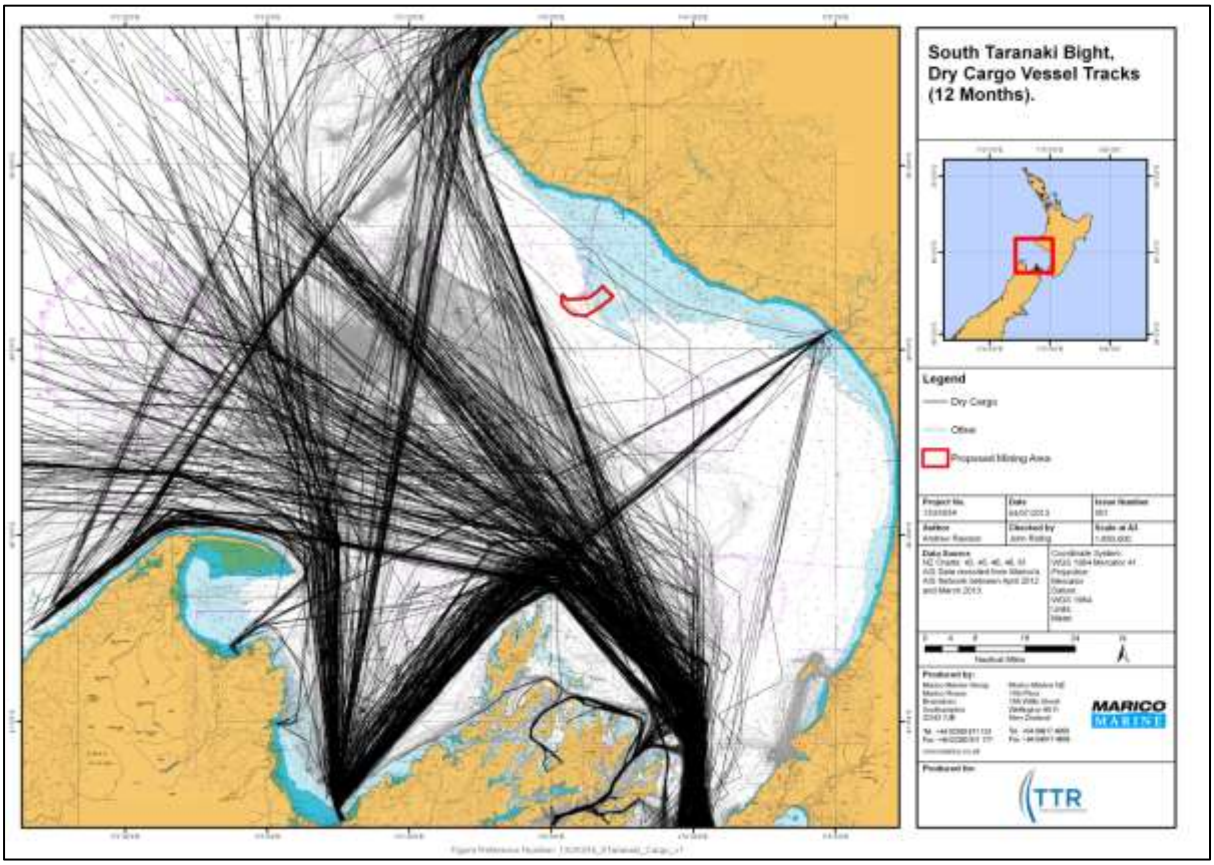


Figure 10: Dry Cargo Vessel Tracks

4.2.2 Liquid Tanker Vessels

Liquid tankers are vessels designed for the carriage of 'wet' cargo such as oil, gas and chemicals and are therefore distinguished from 'dry' cargo vessels shown in **Section 4.2.2**. **Figure 11** shows a very similar pattern to that of dry cargo vessels with, however considerably less total movements.

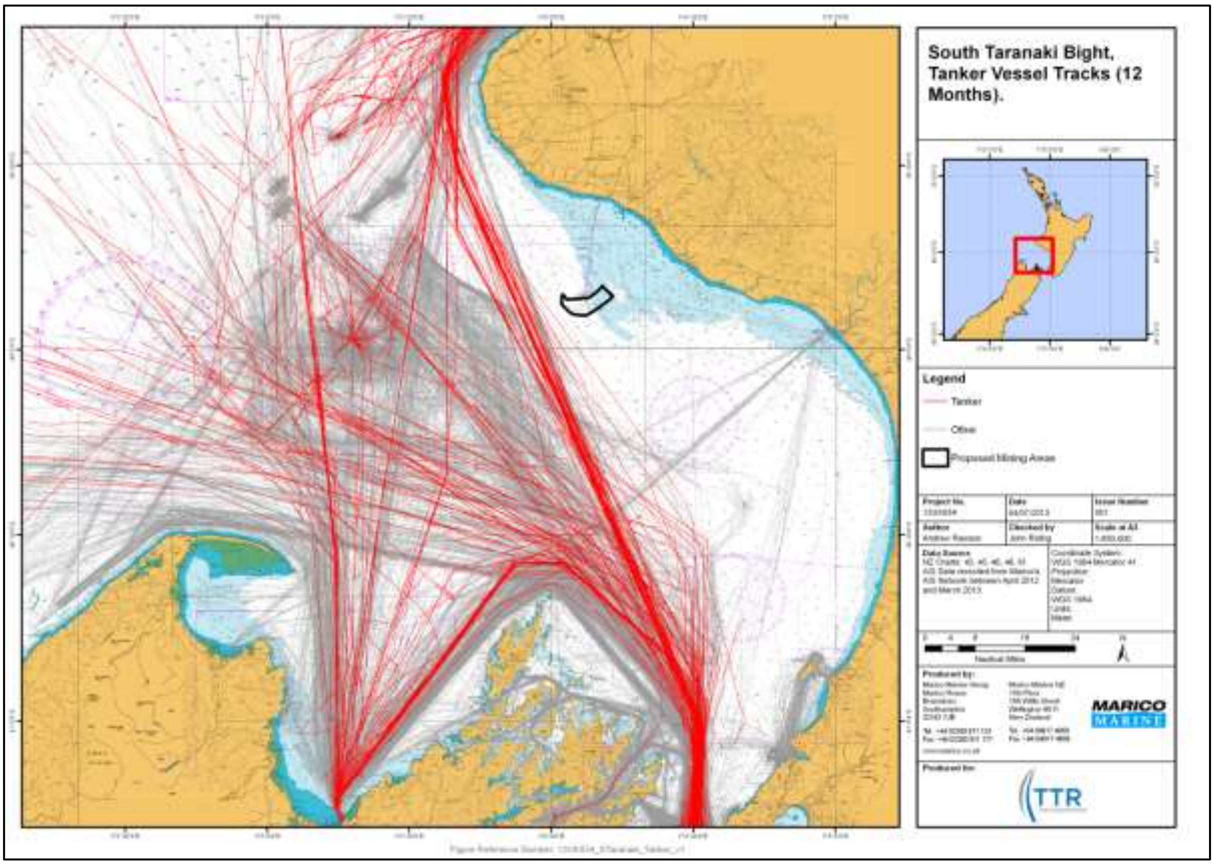


Figure 11: Liquid Tanker Vessel Tracks.

4.2.3 Passenger Vessels

A passenger vessel describes a vessel that is carrying members of the public for commercial gain. Therefore both ferries and cruise ships are included in this category. All passenger vessels are required to carry AIS and therefore the plot of passenger vessel activity shown below includes all related vessels. It shows the regular interisland ferry traffic across the Cook Strait between Wellington and Picton. There are also a number of large cruise ships that transited to and from Wellington and passed through the Cook Strait and the South Taranaki study site.

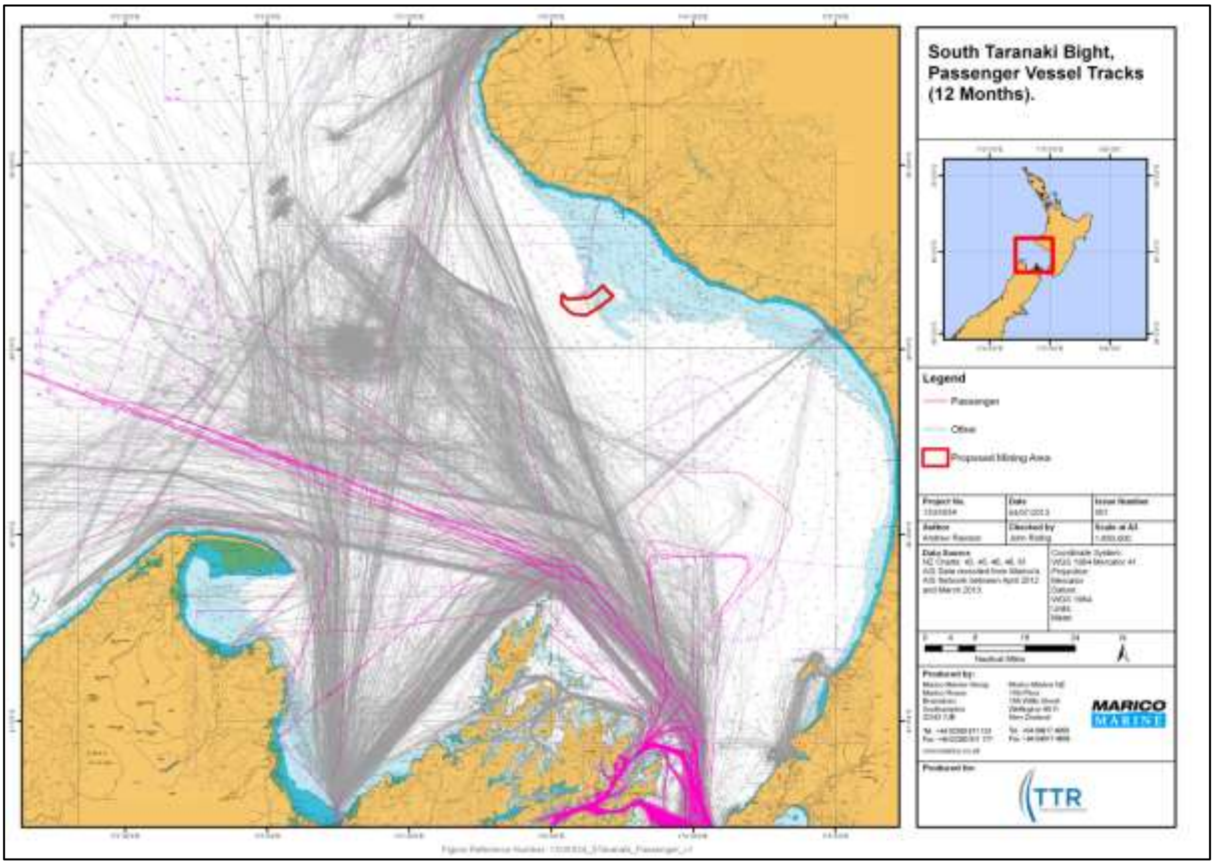


Figure 12: Passenger Vessel Tracks.

4.2.4 Fishing Vessels[8]

Fishing vessels are not required to carry AIS under IMO regulations and a number will actively turn off AIS to hide their preferred fishing grounds. Therefore a complete picture of fishing activity is unattainable. The activity of these vessels carrying AIS is shown below in **Figure 13**.

The plot shows a number of fishing vessels transiting through the Cook Strait and from the Port of Nelson, many of which continue on to the west of South Island. The importance of Nelson as a fishing centre is clearly evident with two of New Zealand's largest fishing operators based here. A concentration of fishing activity is notable in the centre of the Taranaki Bight. However, there are gaps near to the offshore installations. Much of the traffic shown in **Figure 13** is constituted of large commercial trawlers, upwards of 100 metres LOA.

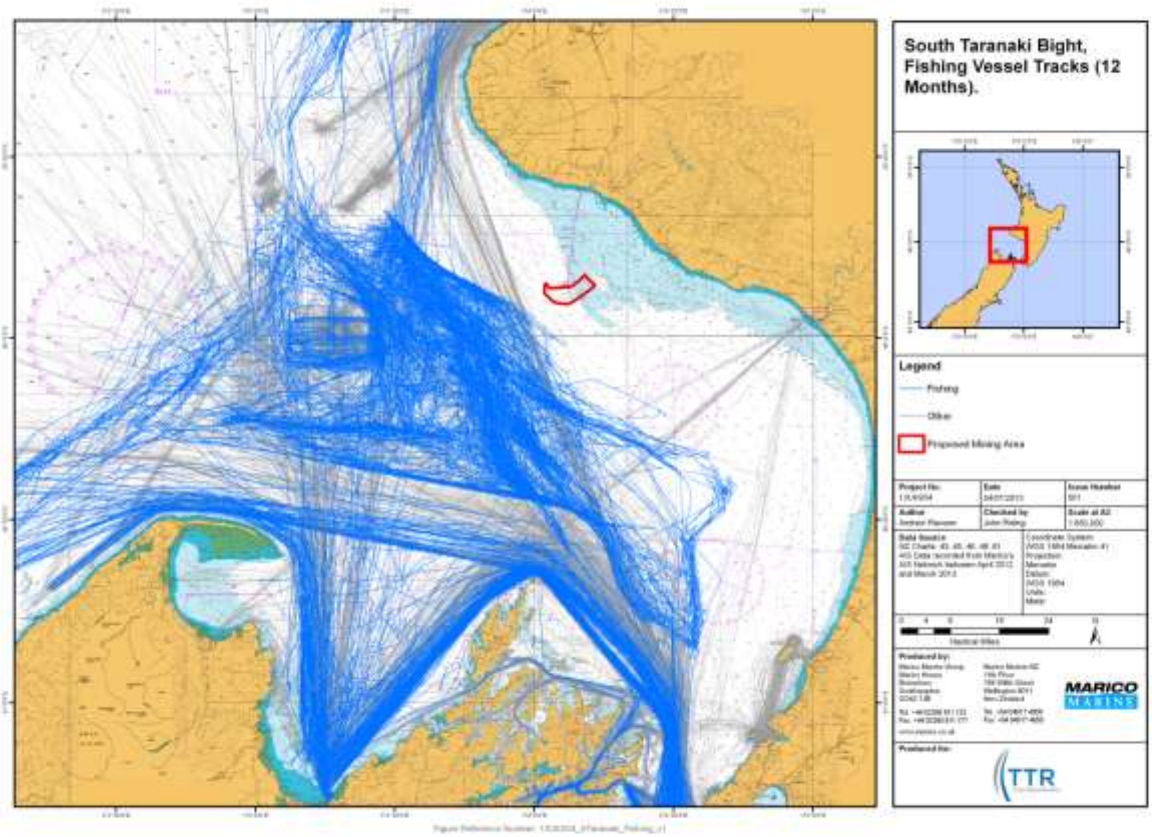


Figure 13: Fishing Vessel Tracks.

8 Fishing describes both trawling and fishing, of all types and is henceforth described as "fishing".

4.2.5 Recreational Craft

Recreational craft are also not required to carry AIS although many of the larger craft, as well as those on long distance voyages, may choose to. **Figure 14** shows the tracks of recreational craft carrying AIS through the South Taranaki Bight. The plot demonstrates that the majority of craft are centred around Nelson, the Marlborough Sound and the Cook Strait with comparatively few venturing further north. It should be noted however that the relative sizes of these craft inhibits long range tracking with AIS as compared to the other vessel types.

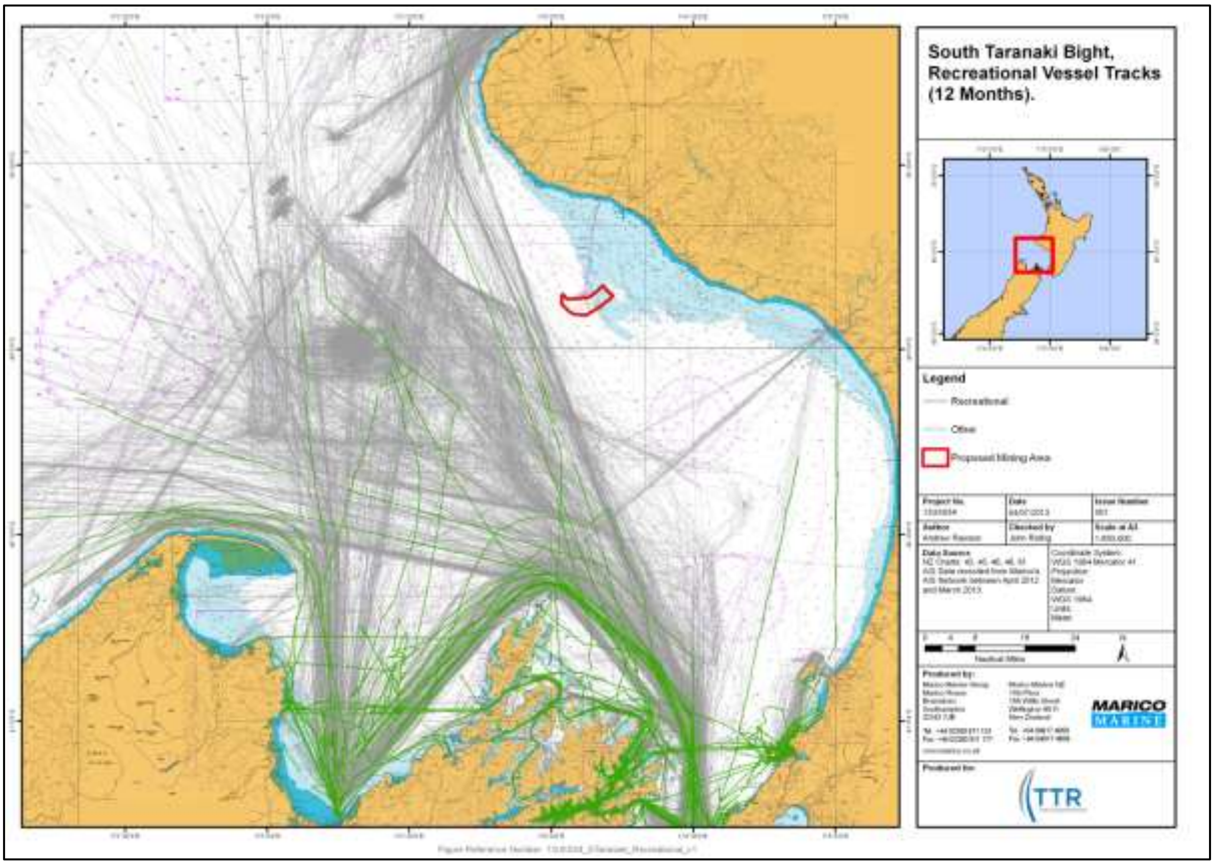


Figure 14: Recreational Vessel Tracks.

4.2.6 Other Craft

There are number of other vessel types whose tracks are of special interest. In particular a number of movements are associated with the offshore installations south west of the Taranaki Bight (**Section 2.2.1**). **Figure 15** provides the tracks of three vessel types associated with these categories; tugs, anchor handlers and offshore supply vessels. The plot demonstrates the concentration of activities around these structures but also the routes used to the vessel base. The port at New Plymouth is the main regional offshore service base with some tug activities also based out of Nelson.

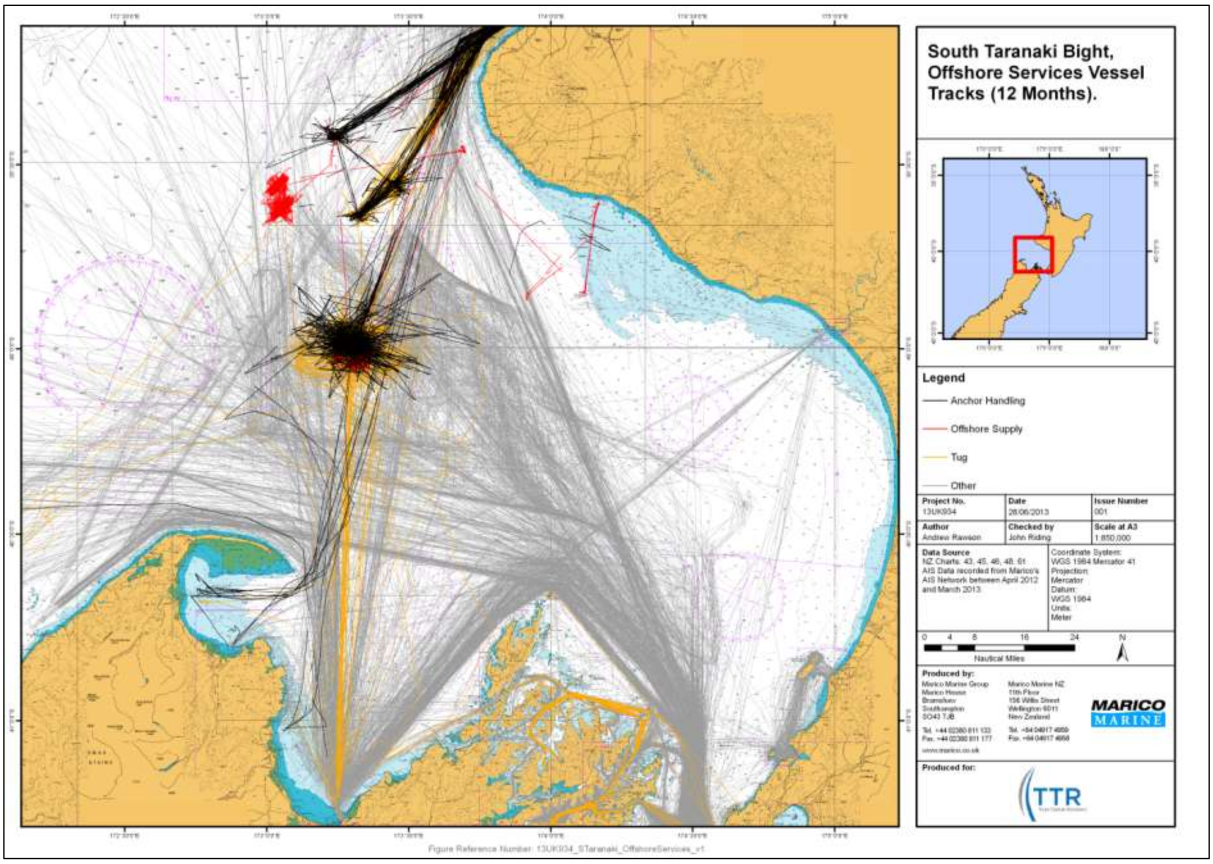


Figure 15: Vessels Supporting Oil installations.

Most naval vessels carry AIS as a tool for collision avoidance but will not generally activate it unless they are engaged in coastal navigation within territorial waters. **Figure 16** shows the tracks of the four identified naval vessels, namely:

- *Warship Warramunga* (184m LOA);
- *Warship Newcastle* (138m LOA);
- *HNBZS Taupo* (55m LOA);
- *HMNZS Rotiti* (55m LOA).

The identified tracks of all four of these vessels are well to the south of the South Taranaki region and are mostly engaged in coastal navigation around the Marlborough Sounds.

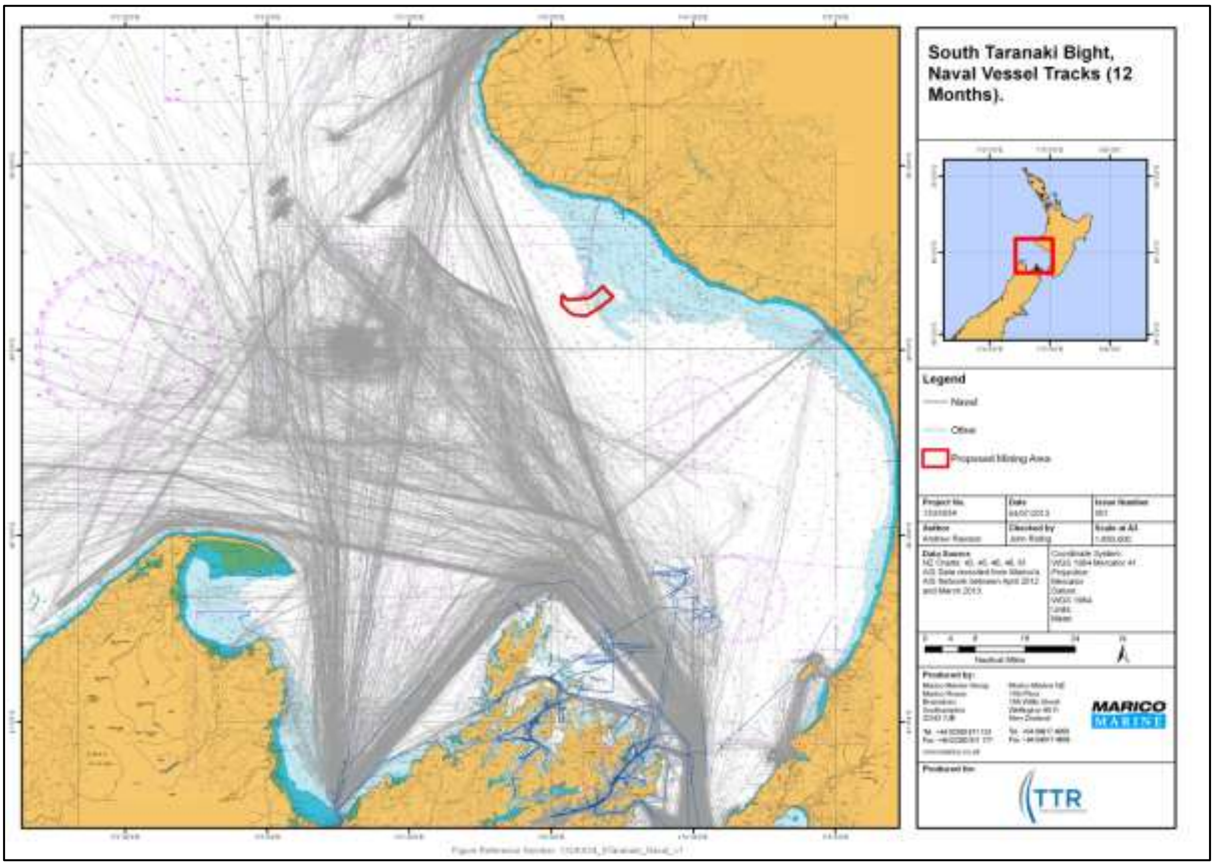


Figure 16: Naval Vessel Tracks

4.3 VESSEL TRACKS BY SIZE

Given the wide range of vessel types that utilise the South Taranaki region it is necessary that the relative sizes of these vessels are distinguished. The size of a vessel can be determined by several factors, however two particular measures are; length over all and gross tonnage.

4.3.1 Length Over-All

The length over-all (LOA), measured in metres, describes the maximum length of a vessel's hull measured parallel to the waterline. **Figure 17** shows a full year of vessel tracks differentiated by LOA. The background of small fishing vessels and fish processing vessels is clearly distinct from the commercial traffic of between 150m and 250m LOA. The cruise ship *Voyager of the Seas*, was the only recorded vessel that was greater than 300m LOA.

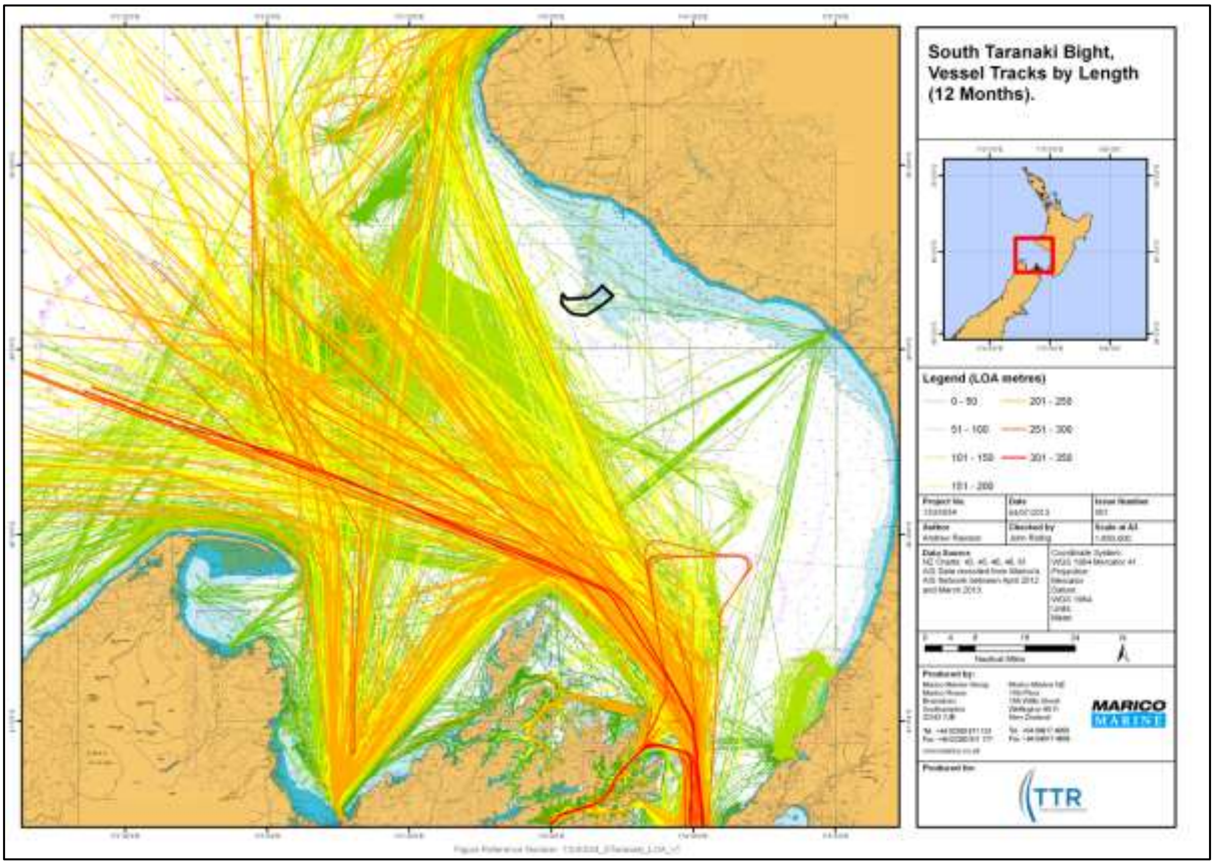


Figure 17: Vessel Tracks by Length Over-All (LOA)

A breakdown of each unique vessel's length is shown in **Figure 18**. The majority of vessels recorded are commercial dry cargo and liquid tanker vessels between 151m and 200m LOA.

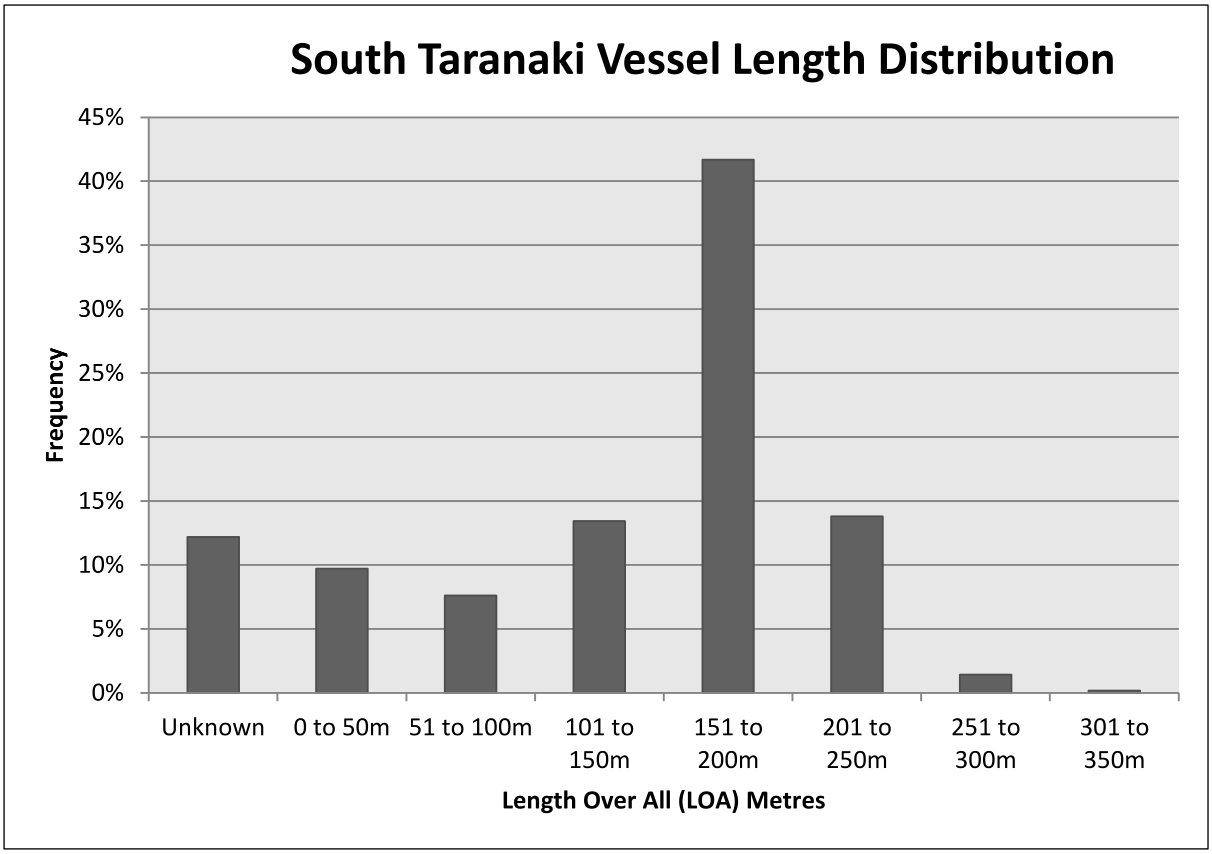


Figure 18: Vessel Length Distribution

4.3.2 Gross Tonnage

Gross Tonnage is a measure of a ship's internal volume and provides an alternative measure of a vessel's size to LOA. **Figure 19** shows a similar pattern of transit to that of **Figure 17** with the largest vessels transiting through the Cook Strait and then onto either Nelson or to international destinations.

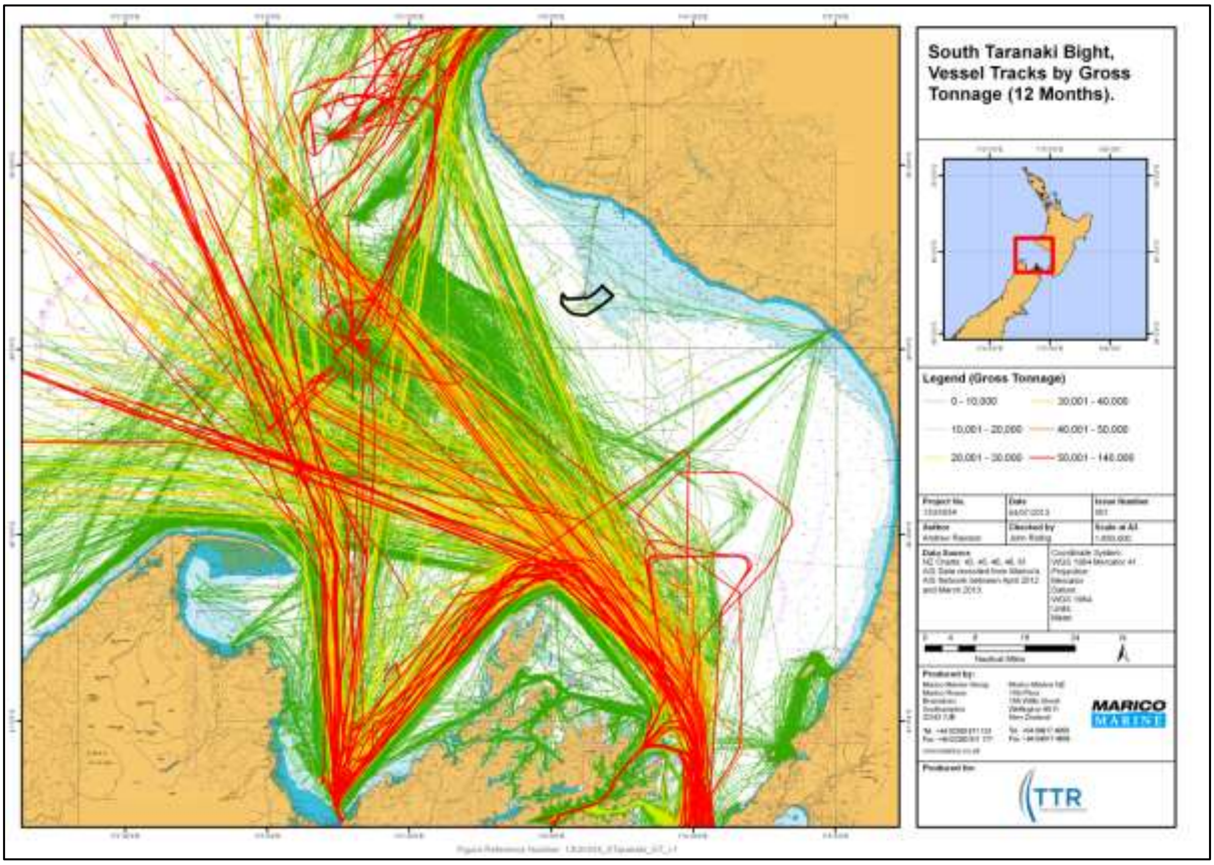
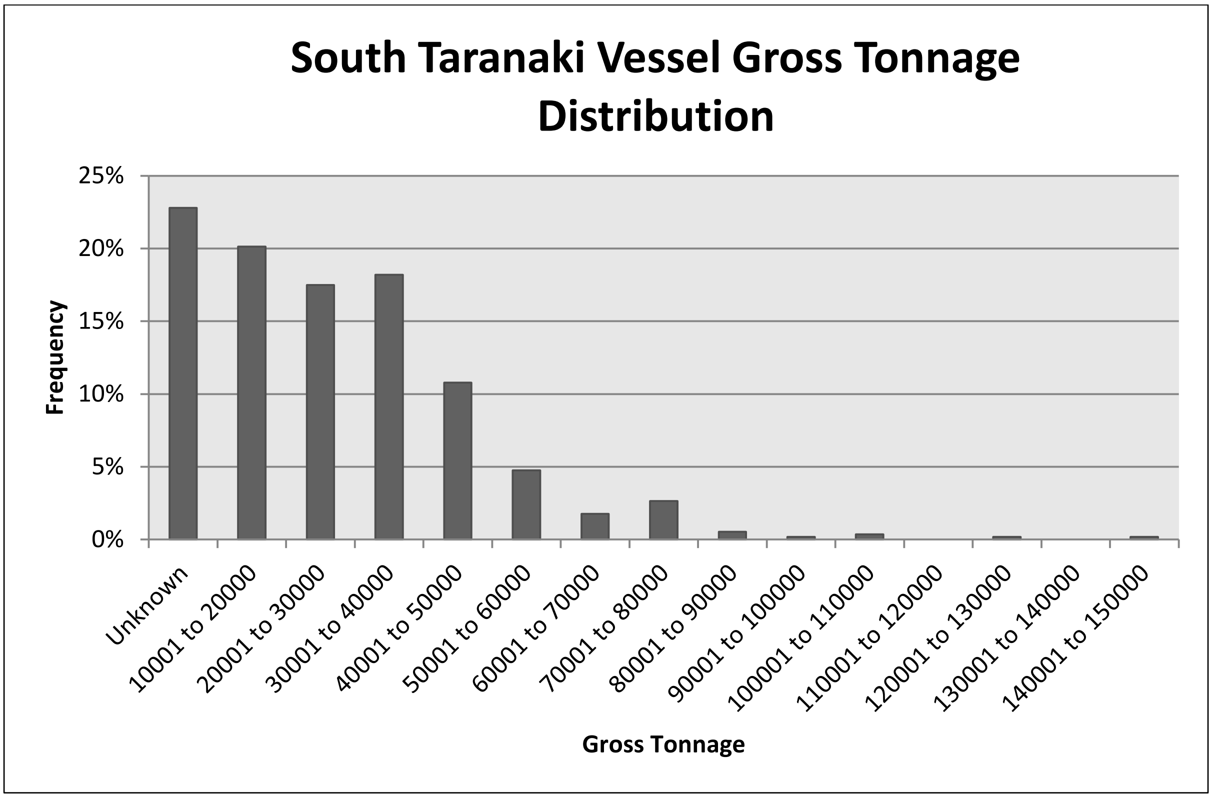


Figure 19: Vessel Tracks by Gross Tonnage (GT)


South Taranaki Vessel Gross Tonnage Distribution
Frequency
25%
20%
15%
10%
5%
0%
Unknown
10001 to 20000
20001 to 30000
30001 to 40000
40001 to 50000
50001 to 60000
60001 to 70000
70001 to 80000
80001 to 90000
90001 to 100000
100001 to 110000
110001 to 120000
120001 to 130000
130001 to 140000
140001 to 150000
Gross Tonnage

4.4 VESSEL TRACKS BY TRANSIT SPEED

Each vessel's Speed over Ground (SOG), as commutated by the vessel's GPS, is extracted and displayed below in **Figure 20**. The plot shows a high variance in speed within the South Taranaki Bight region. The movements of non-transit vessels such as vessels engaged in fishing and trawling as well as offshore vessels operating in areas around offshore installations is visible within the central region as markedly slower speeds. Transiting commercial vessels have typical speeds of between 11 and 20 knots.

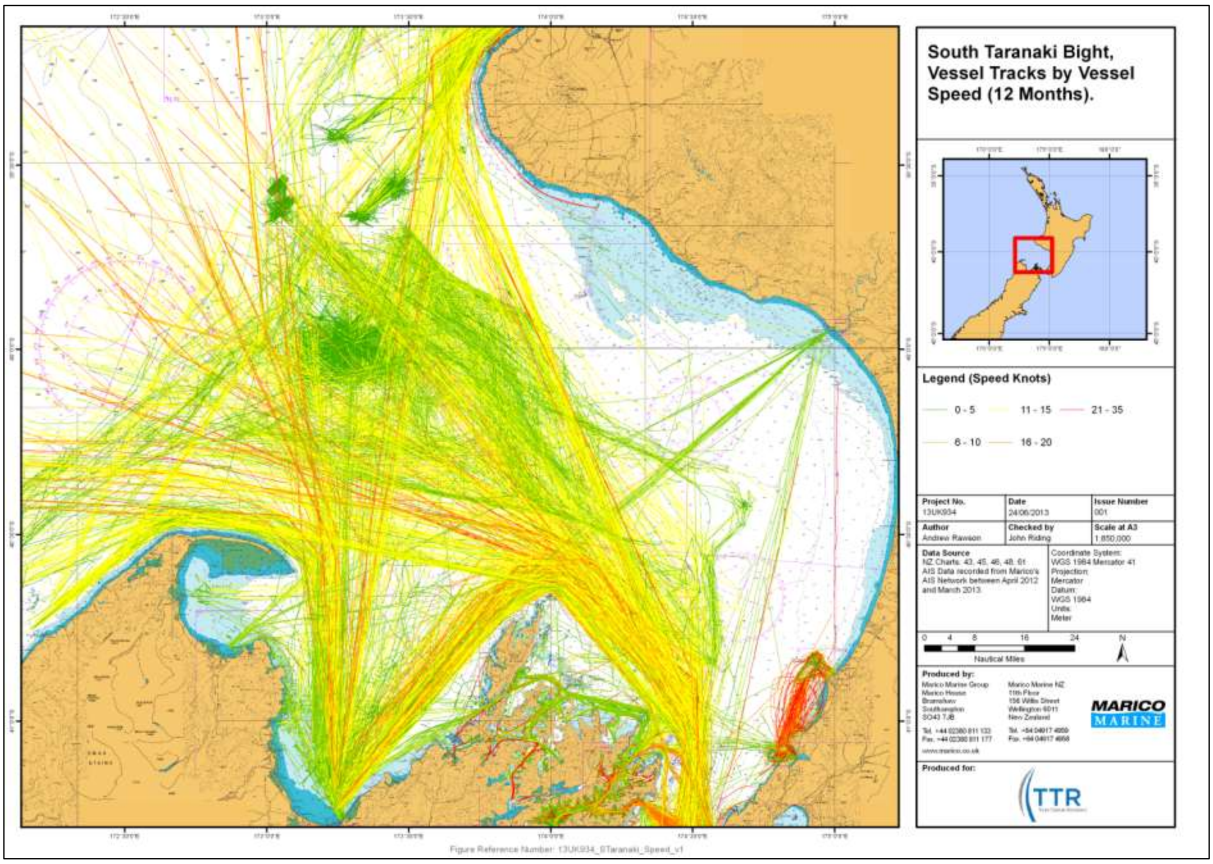


Figure 20: Vessel Tracks by Transit Speed

4.5 SEASONAL COMPARISON

In order to account for any seasonal differences in shipping routes within the study area the tracks of vessels during the months of December, January and February (summer) were compared to those of June, July and August (winter). **Figure 21** overlays the winter traffic on the summer traffic.

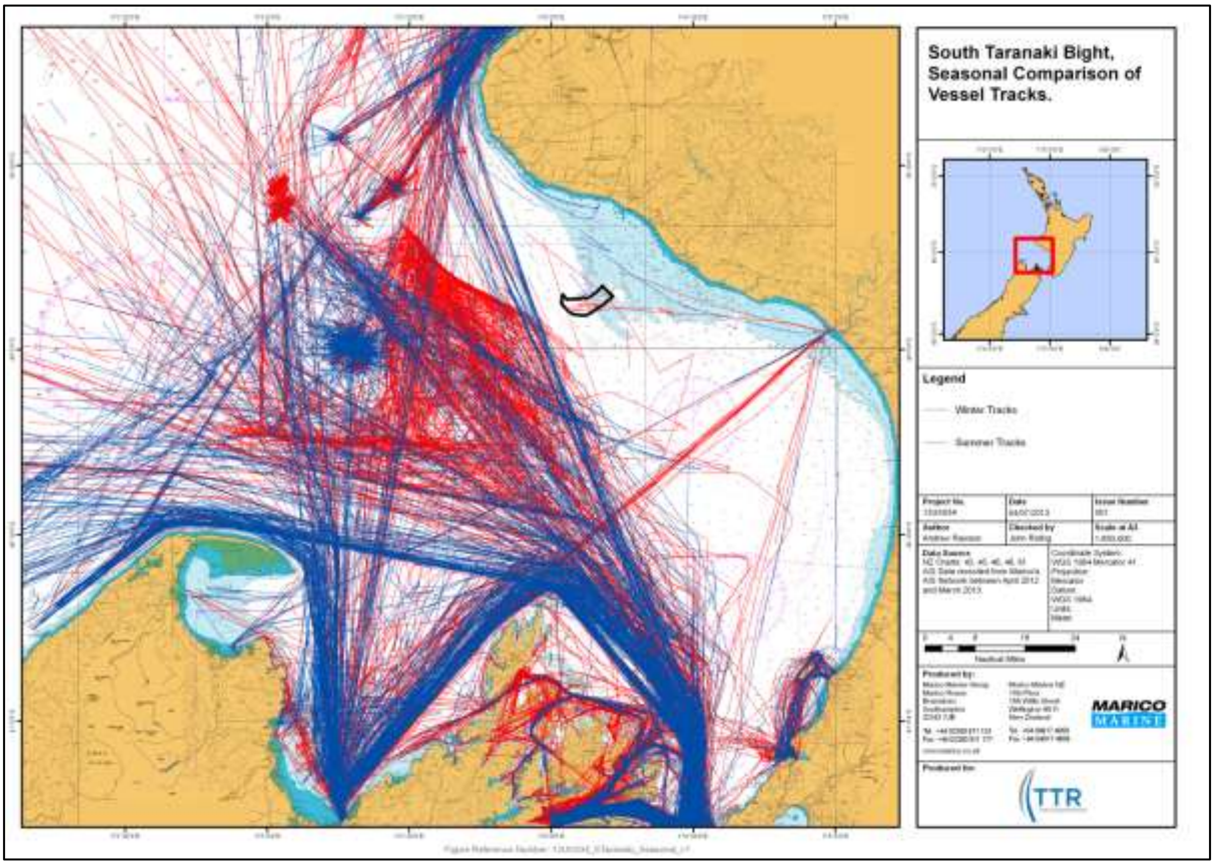


Figure 21: Seasonal Comparison of Vessel Tracks

Figure 22 and **Figure 23** divide these seasons into their constituent vessel types. The profile of dry cargo, liquid tanker and offshore services is broadly similar between the two time extents however there are notable differences in the activity of fishing vessels and passenger craft. The majority of fishing activity is seen during the summer months only. As would be expected passenger vessel movements are also far greater during the summer months, with only the *Straitsman* bound for Brisbane observed during the winter period.

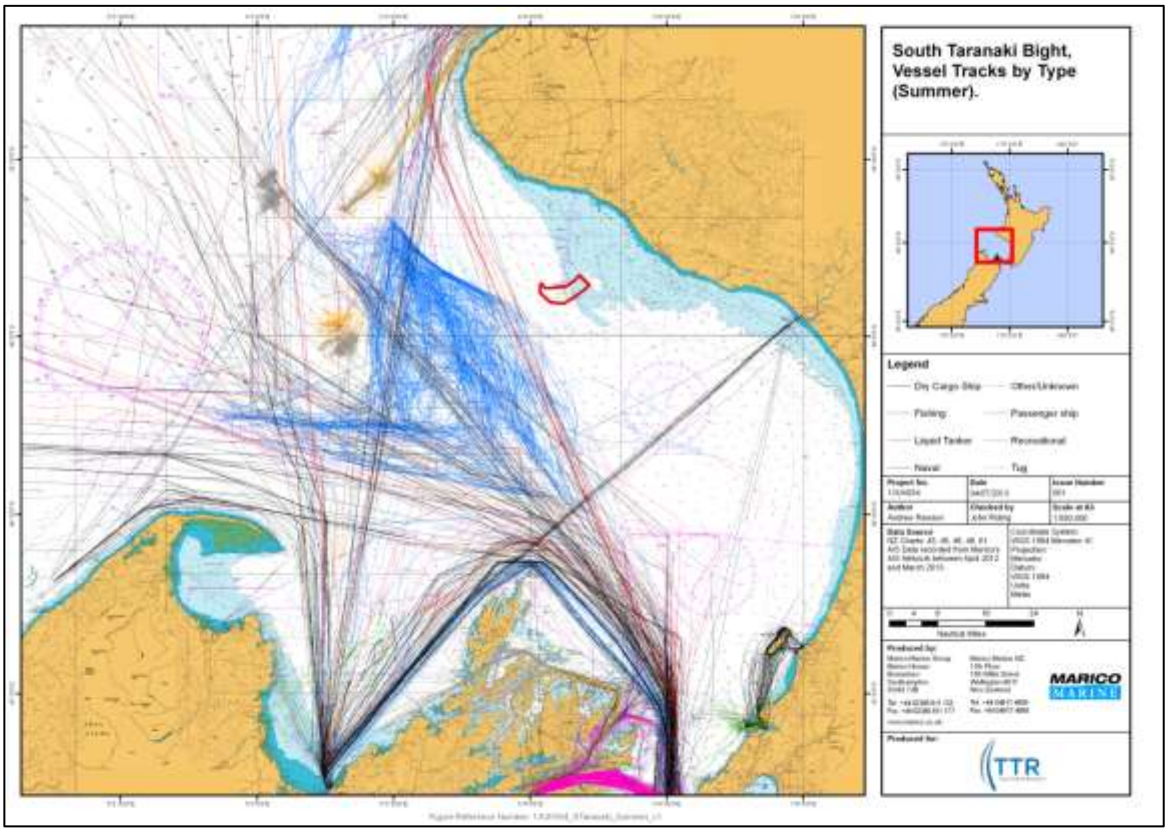


Figure 22: Vessel Tracks by Type during Summer

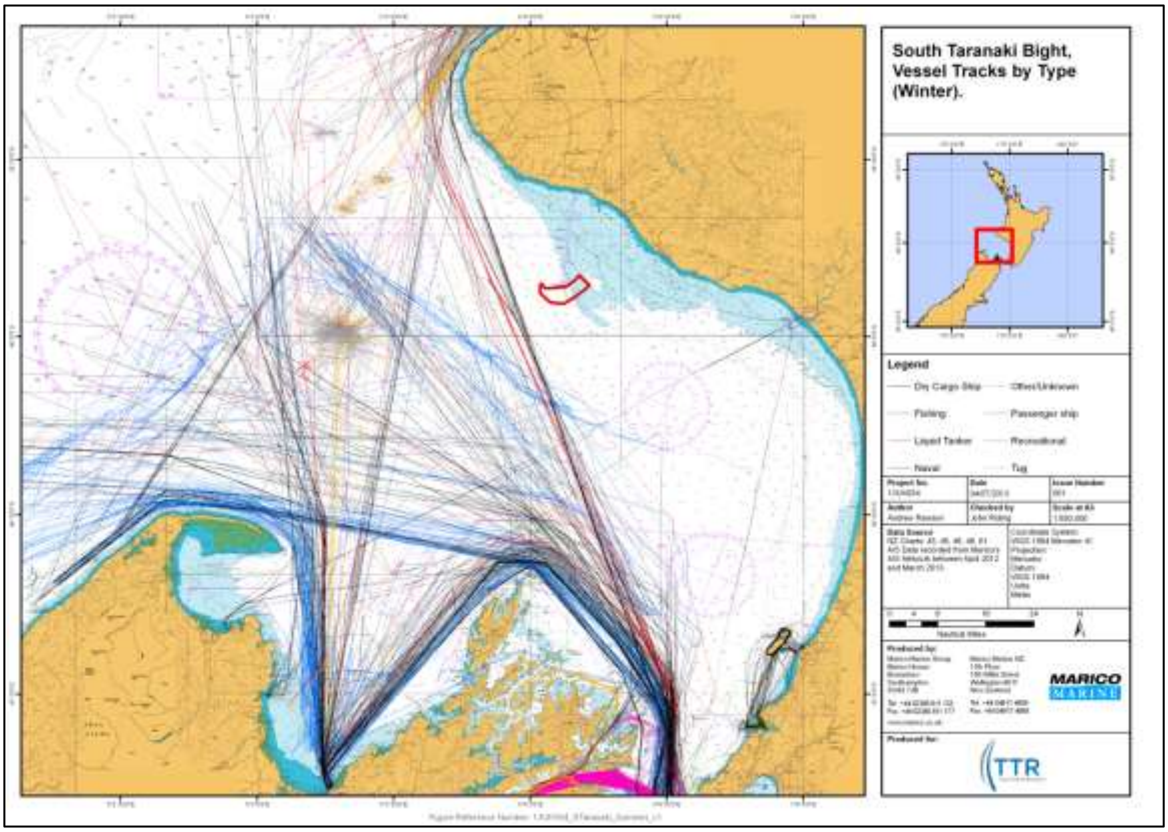


Figure 23: Vessel Tracks by Type during Winter

5 SHIPPING ROUTES

Utilising the vessel tracks presented in **Section** 4 the dominant shipping routes can be extracted. This section utilises a transit density algorithm in order to identify localised concentrations of shipping movements and produce a network of shipping routes.

5.1 TRAFFIC DENSITY

Vessel transit density is a measure of the number of vessel transits that intersect a defined geographical grid (**Figure 24**). A vessel transit is defined as the route taken by a vessel from the moment she departs a berth or mooring until her arrival at her destination berth or mooring. Any cells she intersects during this period is given a count of one, even if she passes through the same cell multiple times.

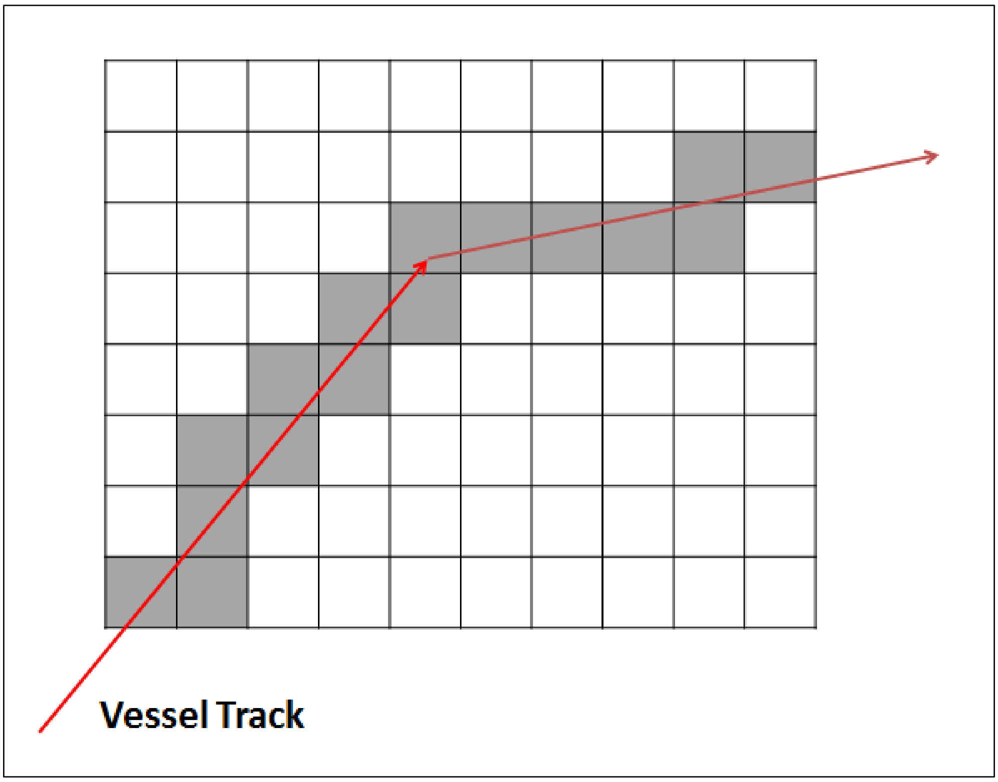


Figure 24: Vessel Transit Density Methodology

The results of the vessel transit density analysis with one nautical mile grid squares are displayed in **Figure 25** below. The highest concentrations are shown in the Marlborough Sounds and are the result of the Interisland

Ferries transiting between Picton and Wellington through a restricted waterway. There is also a clearly evident funnelling effect of traffic through the Cook Strait and around Cape Egmont to the north. A number of routes converge at Nelson with a northerly and north-easterly approach route evident.

Three localised concentrations of activity are evident around the oil and gas installations at Maui A/B, FPSO Raroa and production installation Maari, and FPSO Umuroa.

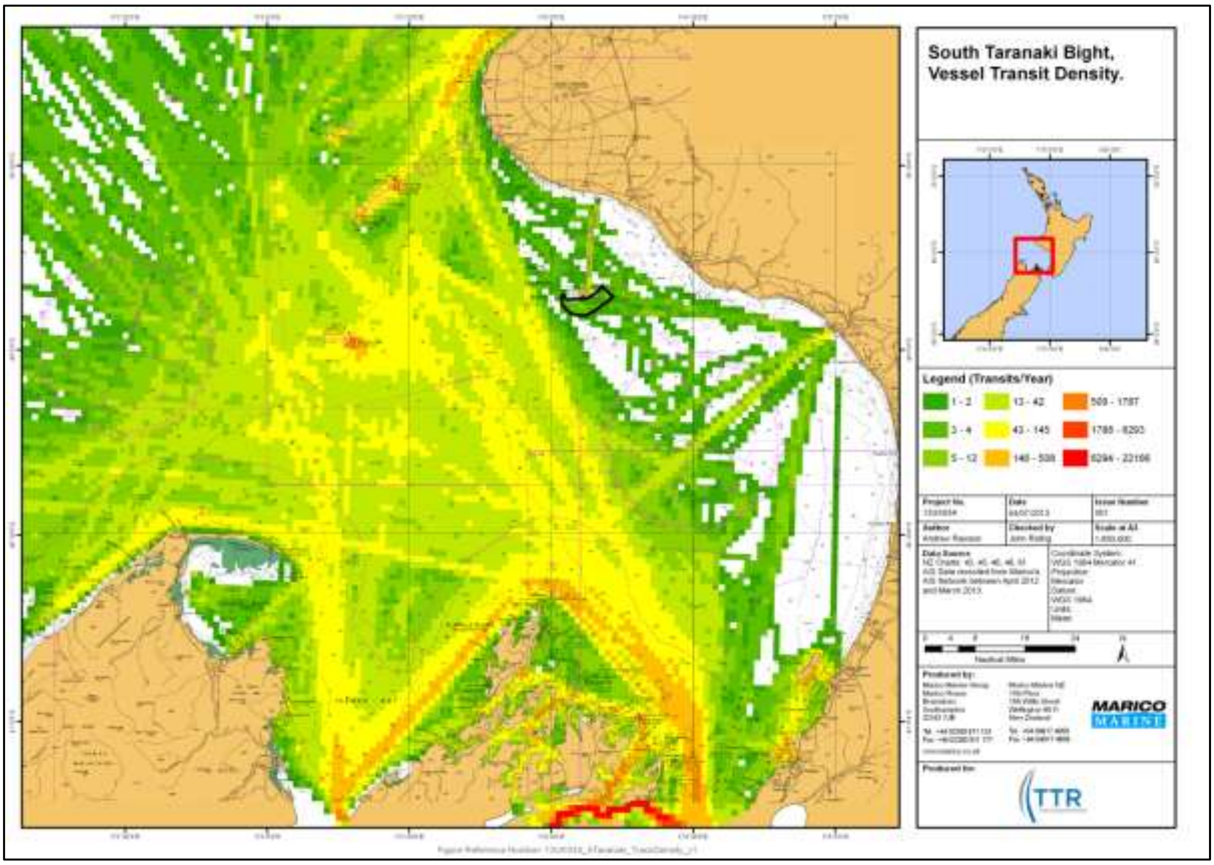


Figure 25: Vessel Track Density

Offshore towards the centre of the study area, these routes start to diverge and the demarcation is less clear. Furthermore the non-transit activity of fishing vessels and offshore energy vessels in this area hides transit routes. The analysis was repeated in **Figure 26** utilising only dry cargo, liquid tanker and passenger vessels such that the main transit routes are emphasised.

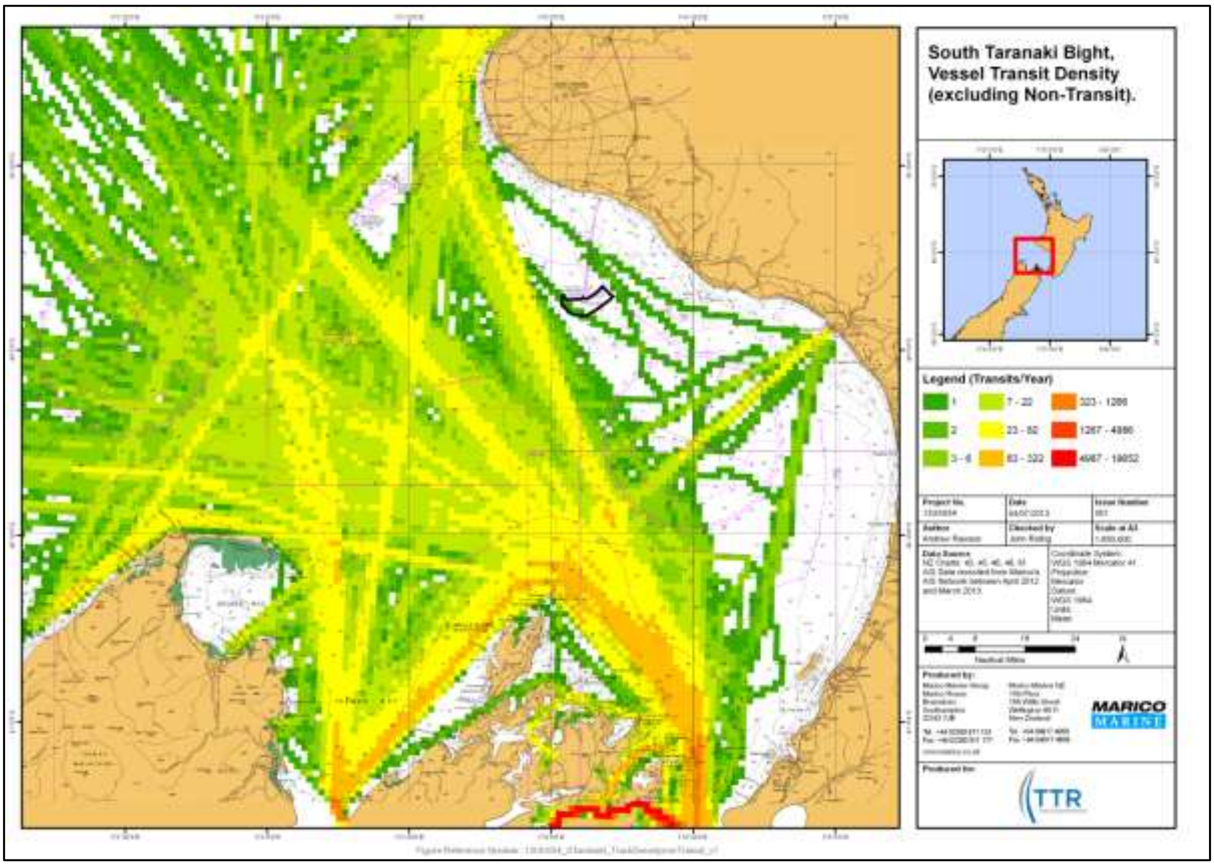


Figure 26: Vessel Track Density with Non-Transit Vessels Excluded

5.2 SHIPPING ROUTES

The vessel transit density analysis in **Section 5.1** was used to extract the principal shipping routes. A shipping route is defined as a demarcated linear region of water through which vessels transit from one destination to another. Therefore non-transit vessels such as vessels engaged in fishing, trawling or survey work are not included.

The analysis identified 18 principal routes which are shown in **Figure 27**. A brief summary of these routes is provided in **Table 3**. Two groups of routes are defined as non-transit. Route 10 is associated with a research vessel moving regularly between Kapiti Island and mainland North Island. Routes 15, 16, 17 and 18 are offshore vessels (i.e. tugs, anchor handlers and FPSO) servicing the installations.

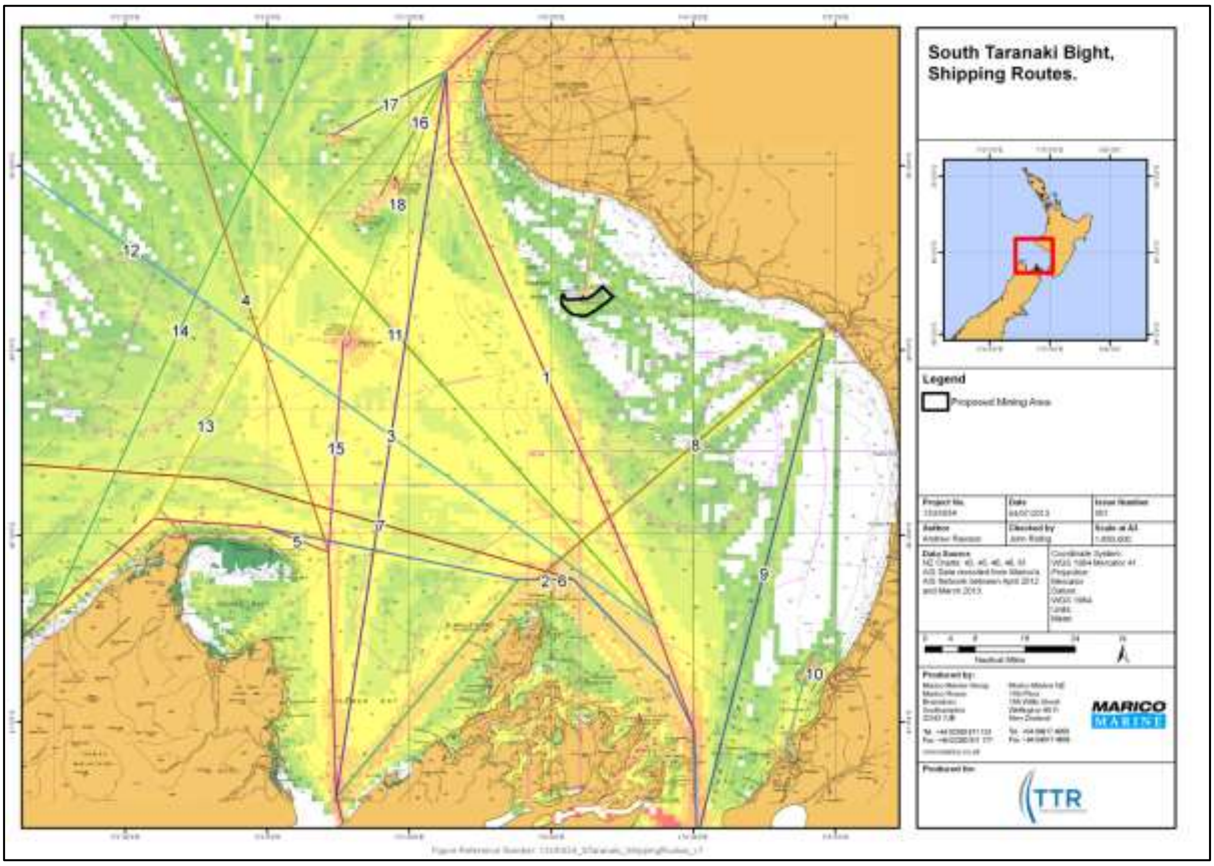


Figure 27: Identified Shipping Routes in Study Area

Analysis of the shipping route network reveals three major nodes in the South Taranaki Bight region.

The first major node is the Cook Strait to the south of the study area. The narrow passage funnels 6 routes into a high density area. After traffic has passed through the Cook Strait the routes diverge towards their destinations; including Nelson, New Plymouth as well as international destinations in Australia and South East Asia.

Secondly vessel traffic is concentrated as it transits around the Cape Egmont. In particular a large proportion of this traffic is associated with New Plymouth's Port Taranaki which acts as both a major offshore energy centre and a dry and liquid cargo handler. A small minority of vessels continue up the North Island coast to Auckland through Onehunga.

Thirdly, five of the routes are focused on the Port of Nelson. The port handled 2.65 million tonnes of cargo in 2011-2012 and 733 vessels visited.[9] The port also hosts some offshore energy activity, however to a lesser extent than at New Plymouth. Nelson is also host to the region's main fishing fleet with the two largest New Zealand companies based here (see **Section 4.2.4**).

Vessel routes diverge considerably to the west of the South Taranaki Bight study area. Westport on the South Island is the only national port to attract vessels on these routes, however internationally these routes lead to Australia and South East Asia. As a proportion of the total number of vessels transiting south west, fishing vessels based out of Nelson are the greatest category of vessel.

9 http://www.portnelson.co.nz/about-the-port/fast-facts/

Table 3: Principal Routes through South Taranaki Bight.

Route	Name	Freq.*	Description
1	Cook Strait to Cape Egmont	M	Cargo and Tankers between Lyttelton, New Plymouth, Bluff and Wellington.
2	Cook Strait to Nelson	H	Cargo, Fishing and Tankers (Nelson, Lyttleton, Tauranga, Picton, Wanganui, Westport)
3	Nelson to Cape Egmont	M	Cargo and Tankers between Nelson and New Plymouth.
4	Nelson to Japan	L	Cargo vessels between Nelson and Japan
5	Nelson to western South Island	M	Cargo and Fishing between Nelson, Westport and Australia)
6	Cook Strait to western South Island	M	Cargo and Fishing (Westport, Wellington, Lyttleton, Dunedin)
7	Cook Strait to Southern Australia	M	Cargo Vessels bound for Nelson, Melbourne.
8	Nelson to Wanganui	L	Single small cargo vessel running between Nelson and Wanganui
9	Cook Strait to Wanganui	L	Single small cargo vessel running between Wanganui and Tauranga/Napier
10*	Porirua to Kapiti Island	H	Mataara II research craft makes regular trips, along with recreational craft.

Route	Name	Freq.*	Description
11	Cook Strait to north of Papua New Guinea	**L**	Cargo and Tankers bound for W Australia and Torres Strait (Gladstone, Japan, Korea, Singapore, Malaysia. Philippines, Brazil)
12	Cook Strait to W. Australia and Torres Strait	**L**	Cargo and Tankers bound for W Australia and Torres Strait (Gladstone, Japan, Korea, Singapore, Malaysia, Brazil)
13	Taranaki Bight to western South Island	**L**	Cargo vessels between Westport, New Plymouth and Auckland
14	Western South Island to Western North Island	**L**	Small cargo vessels bound for Westport, Auckland
15**	Nelson to Maari Production Platform	**M**	Tug, FPSO and Anchor Handler transiting between Maari Production Platform and Nelson
16**	New Plymouth to Maui A/Maui B	**L**	Tug, Anchor Handler, Offshore Supply servicing field
17**	New Plymouth to FPSO Umuroa	**M**	Anchor Handler servicing FPSO
18**	New Plymouth to Maari Production Platform	**L**	Anchor Handler and Tugs Servicing Maari Production Platform

* *Frequency of Transits marked as High/Medium/Low*

** *Routes 15 to 18 are movements associated with offshore installations.*

6 DISCUSSION

The following sections provide more detailed analysis of the area adjacent to the proposed mining sites by utilising advanced analytical techniques.

6.1 VESSELS TRANSITING NEAR PROJECT SITE

Figure 28 and **Figure 29** show the dominant shipping routes near to the proposed mining site. Route ‘1’ of **Section** 5 is the only route within 20 nautical miles and is used by shipping transiting directly between the Cook Strait and Cape Egmont. Much of this traffic is bound for the western coast of North Island and is commercial in nature. Inshore of Route 1 the traffic density is considerably lower with only occasional movements associated with the Kupe Well Head Platform. West of Route 1 commercial trawling operations take place and this raises the traffic density.

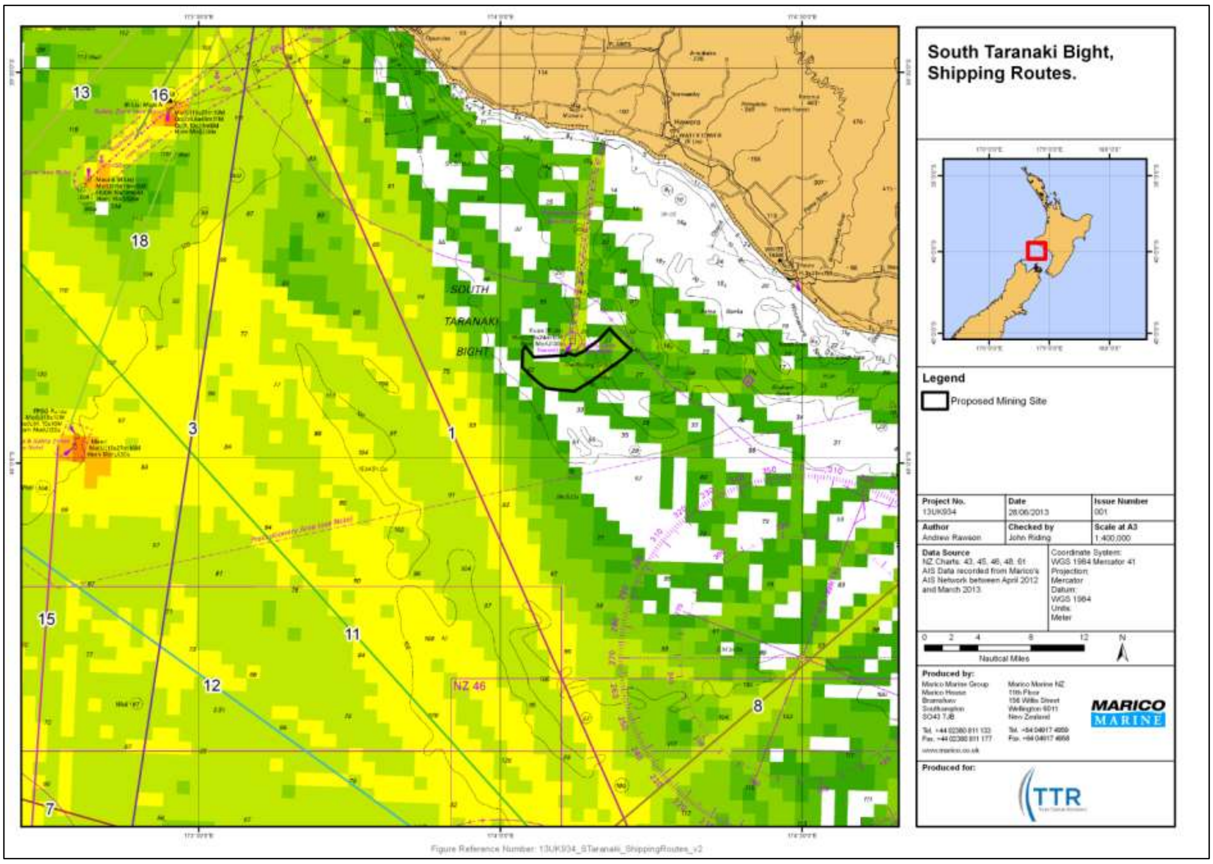


Figure 28: Shipping Routes near to Proposed Mining Site

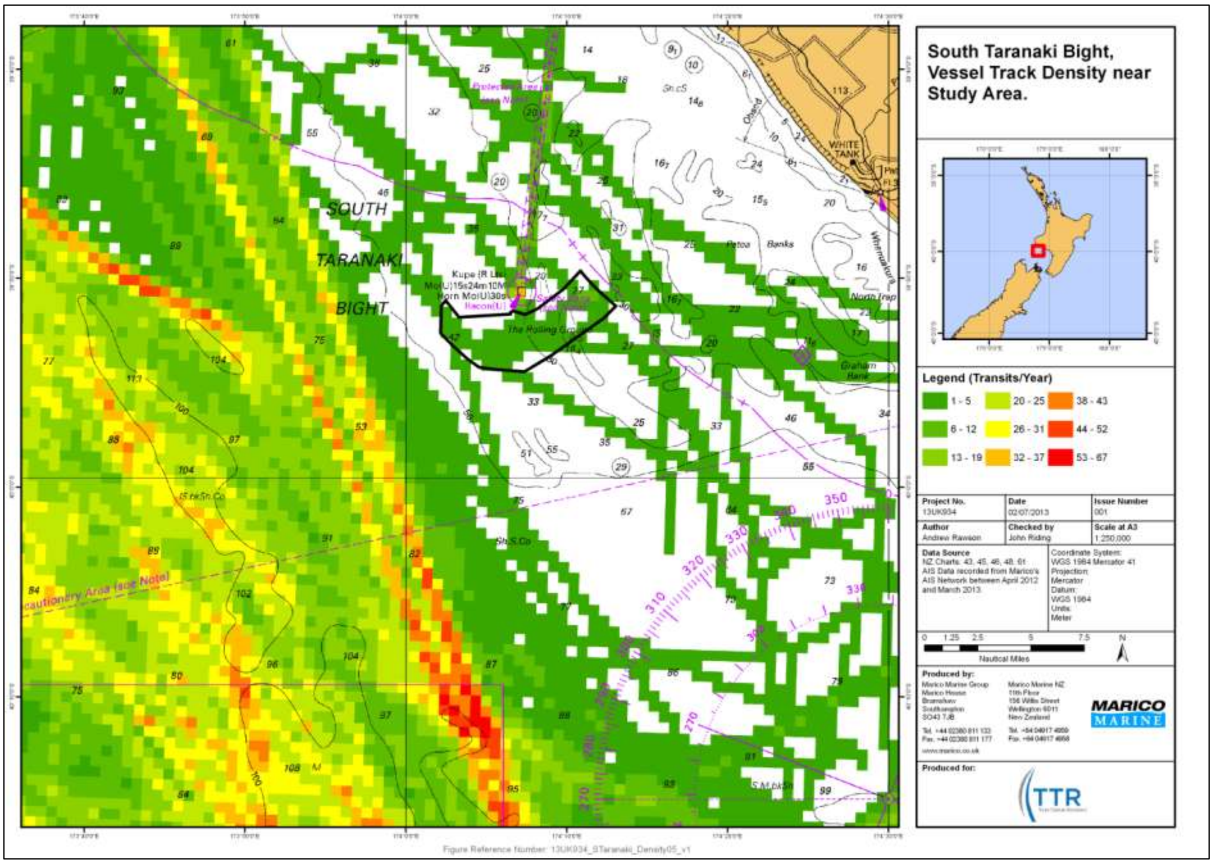


Figure 29: Vessel Transit Density near to Proposed Mining Site

6.1.1 Gate Analysis

A ‘gate’ is a linear transect line perpendicular to a traffic flow that is used to extract transit distribution and frequency as well as summary statistics. Gates are particularly useful when assessing the lateral traffic density and distribution in a shipping lane or route.

A gate was placed perpendicular to the traffic flow inshore of the South Taranaki Bight, directly intersecting the proposed mining area. **Figure 30** shows two permutations of this gate; with and without fishing vessels.[10] Both plots show the considerably greater number of transits greater than four nautical miles west of the mining site. With fishing vessels removed from the analysis the dominance of Route ‘1’ on the total frequency of transits is clear.

10 Fishing vessels are non-transit vessels that would frequently cross and re-cross the gate in a similar time frame, artificially increasing the total transit frequency.

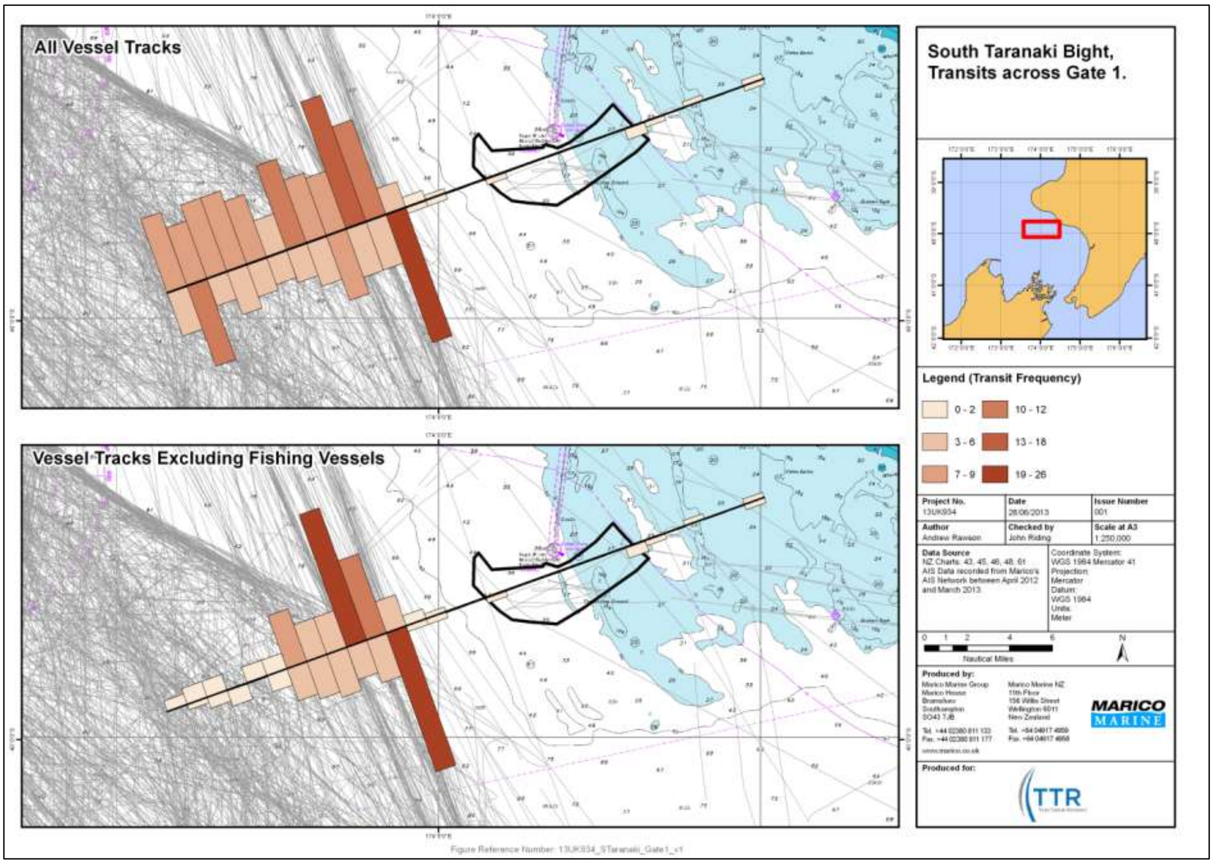


Figure 30: Vessel Transits through Gate

6.1.2 Vessels intersecting Project Site

Only four named vessels were recorded transiting through the proposed mining site. Three of these vessels were tugs or offshore supply vessels servicing the Kupe Gas Rig (*Tuakana*, *Skandi Singapore* and *PMG Pride*). These vessels transit from Wanganui and Port Taranaki.

A single 20,000 GT general cargo vessel was recorded transiting in the project site; however her track is atypical of the general traffic profile.

6.1.3 Vessels within 5 Nautical Miles

A five nautical mile area around the proposed mining site includes a segment of traffic utilising Route ‘1’ between Cape Egmont and the Cook Strait and therefore a far greater number of vessels are recorded. The *Skandi Singapore*, *PMG Pride* and *Tuakana* operating on the Kupe Platform constitute a large number of the movements.

Excluding vessels servicing the Kupe Well Head Platform, 58 vessel transits were recorded that passed within five nautical miles of the project site. The proportion of vessel types within five nautical miles of the proposed mining site is shown in **Figure 31**. The majority of these transits were dry cargo vessels. One regular runner was identified, a small general cargo vessel *'MV Spirit of Resolution'* (3,850 GT) that accounted for 25 of these transits. Some fishing vessels were also recorded operating within the five nautical mile radius.

Figure 32 and **Figure 33** breaks down these vessels by their size in both length over all and gross tonnage. Most vessels are relatively small compared to the sizes of vessels within the wider Taranaki Bight between 75m and 150m LOA and under 10,000 GT.

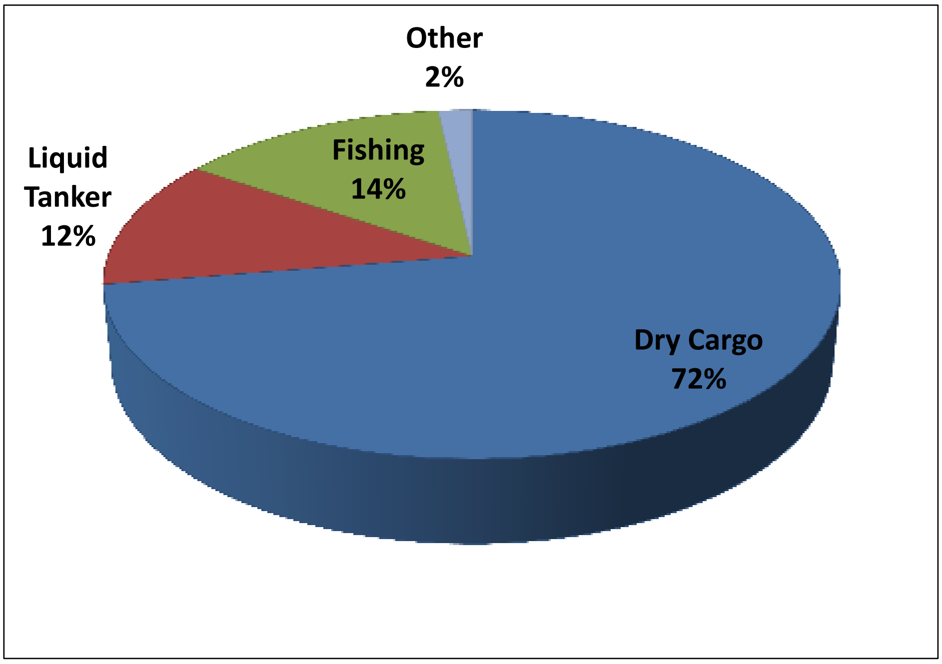


Figure 31: Proportion of Vessel Types within 5nm

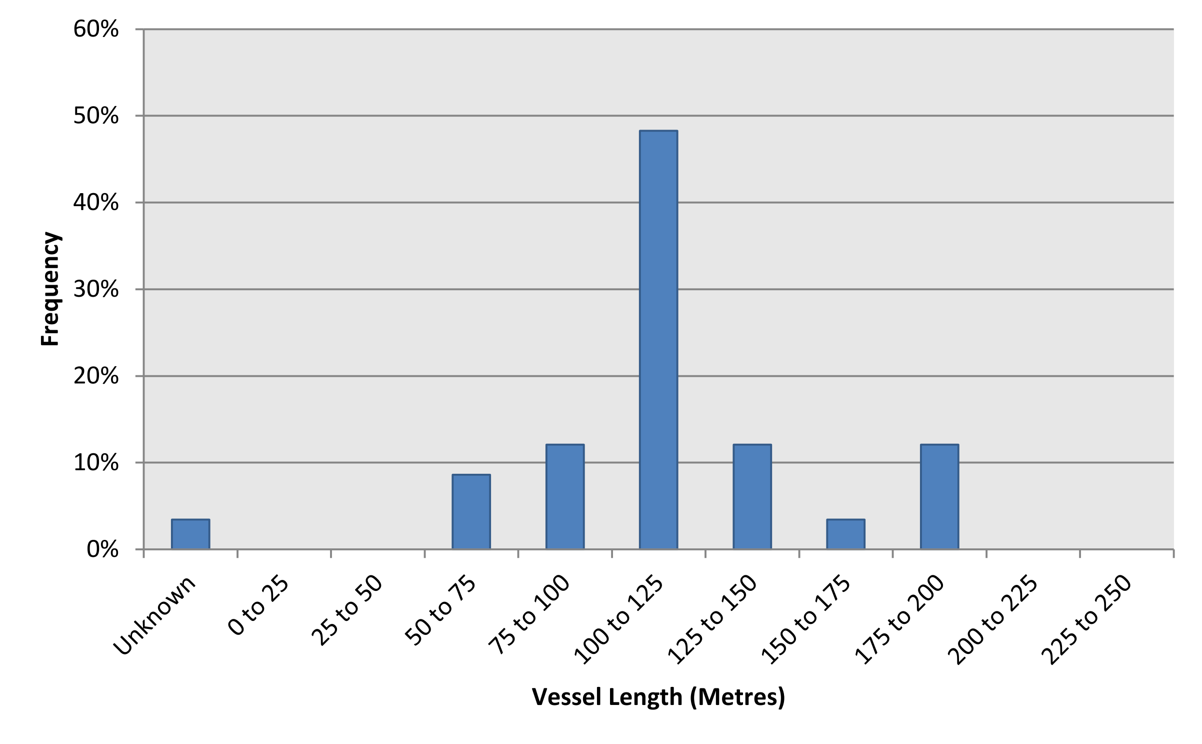


Figure 32: Proportion of Vessel Lengths within 5nm.

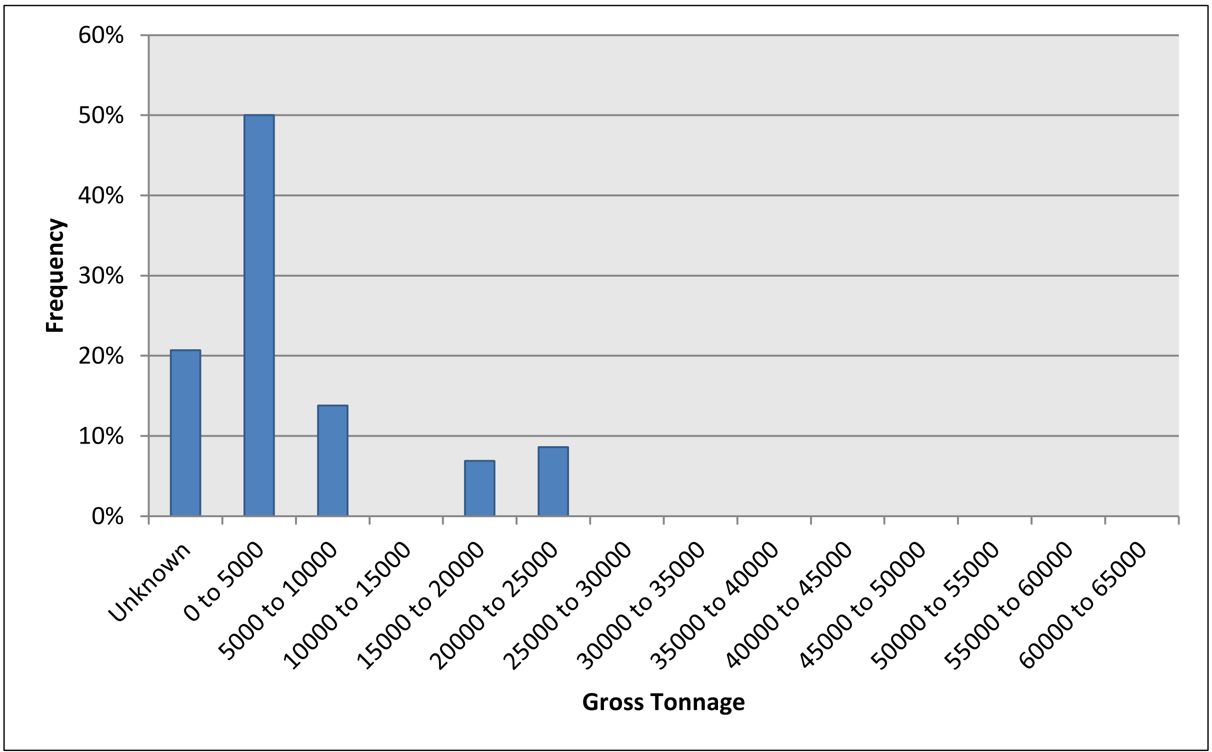


Figure 33: Proportion of Vessel GT within 5nm.

6.1.4 Vessel's within 20 Nautical Miles

Statistical analysis was undertaken on all vessels that transit within 20 nautical miles of the study site. Vessel type (**Figure 34**), length (**Figure 35**) and gross tonnage (**Figure 36**) were all examined. The results show that as the range extends the proportion of vessels that are fishing greatly increases. This is the result of the radius now including a high use fishing ground but also the radius not extending far enough to include another shipping route as identified in **Section 5.2**. No passenger vessels were recorded within 20nm of the proposed drilling site.

The vessel size distribution is broadly similar to that shown in **Section 6.1.3**.

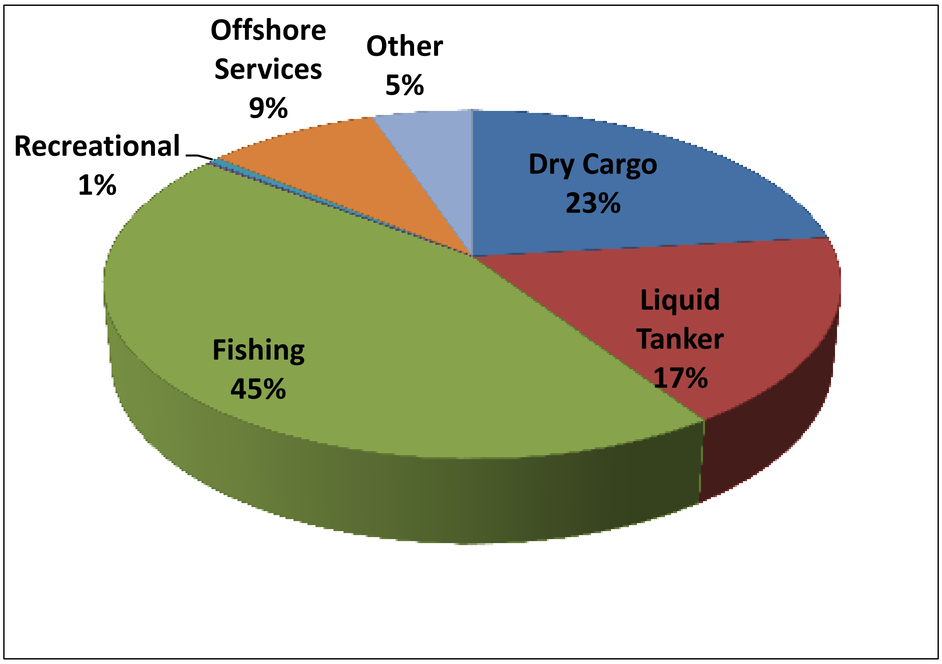


Figure 34: Proportion of Vessel Types within 20nm

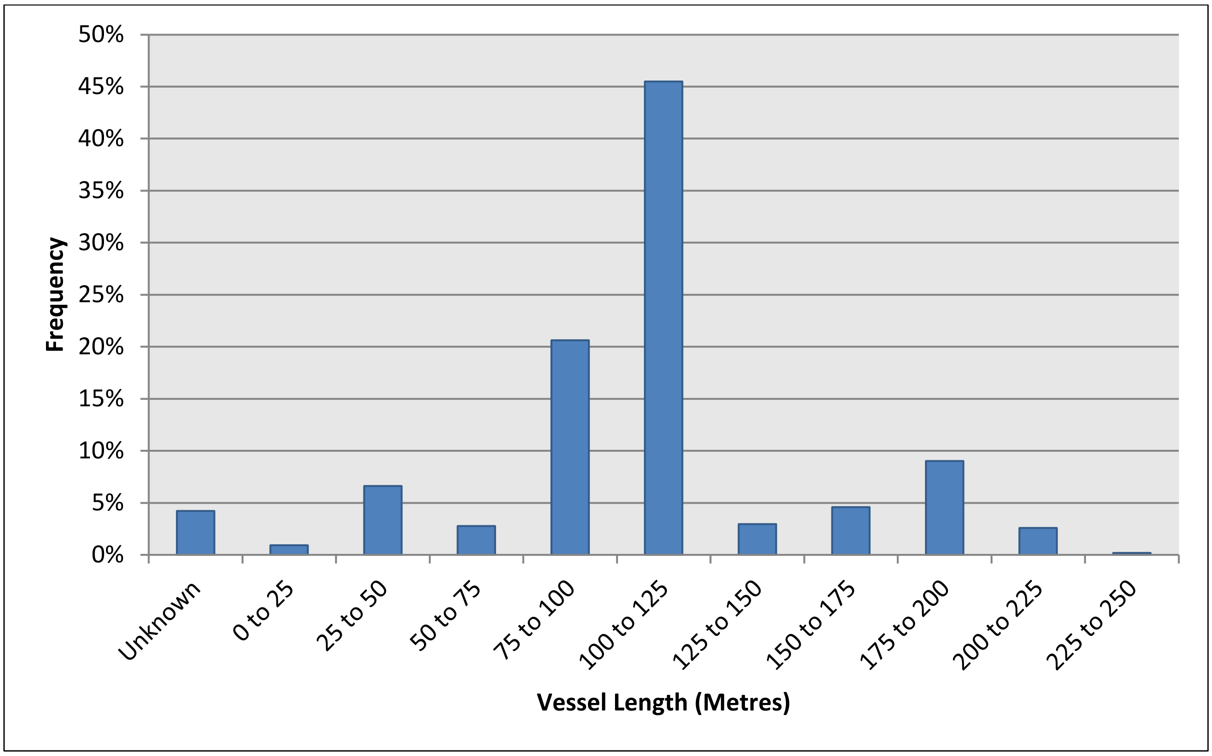


Figure 35: Proportion of Vessel Lengths within 20nm

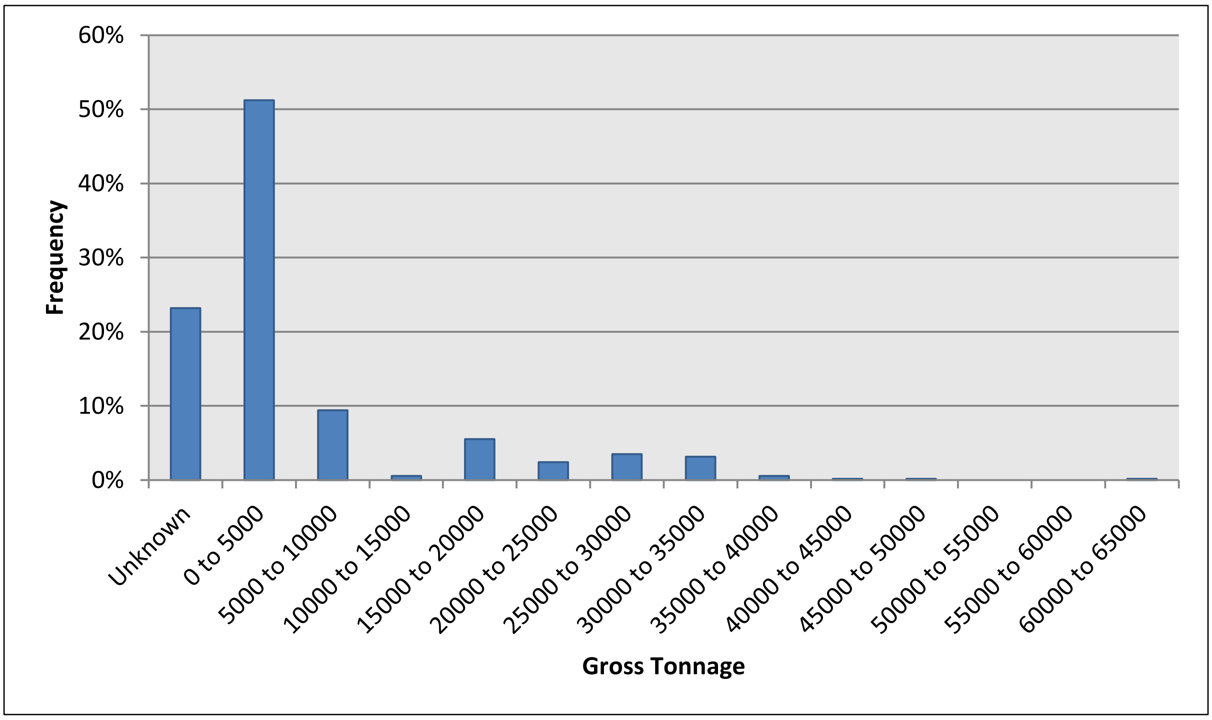


Figure 36: Proportion of Vessel GT within 20nm

6.2 VESSEL EXPOSURE

The exposure of a vessel is a measure that contrasts the transit density presented in **Section 5.1**. A vessel's exposure is a measure of the accumulated time a vessel spends in a defined geographical area, and describes the probability of finding a vessel in any given cell at any given time. Unlike transit density the speed of vessels is accounted for as one vessel of speed 6 knots will spend twice as long in a cell than a vessel whose speed is 12 knots.

Figure 37 shows the variation in vessel exposure across the study area.

Firstly, the plot shows the Kupe Well Head Platform, fitted with AIS, which is showing 365 days of exposure.

Secondly, a clear shipping lane is evident approximately 10 nautical miles to the west of the site. This route relates to Route 1 from **Section 5.2** and is of moderate use.

Thirdly, much of the less defined exposure to the west is the result of large trawlers conducting operations in their fishing grounds.

Finally, areas of increased exposure to the north and east of the study site relate to offshore supply vessels and tugs servicing the rig and neighbouring field.

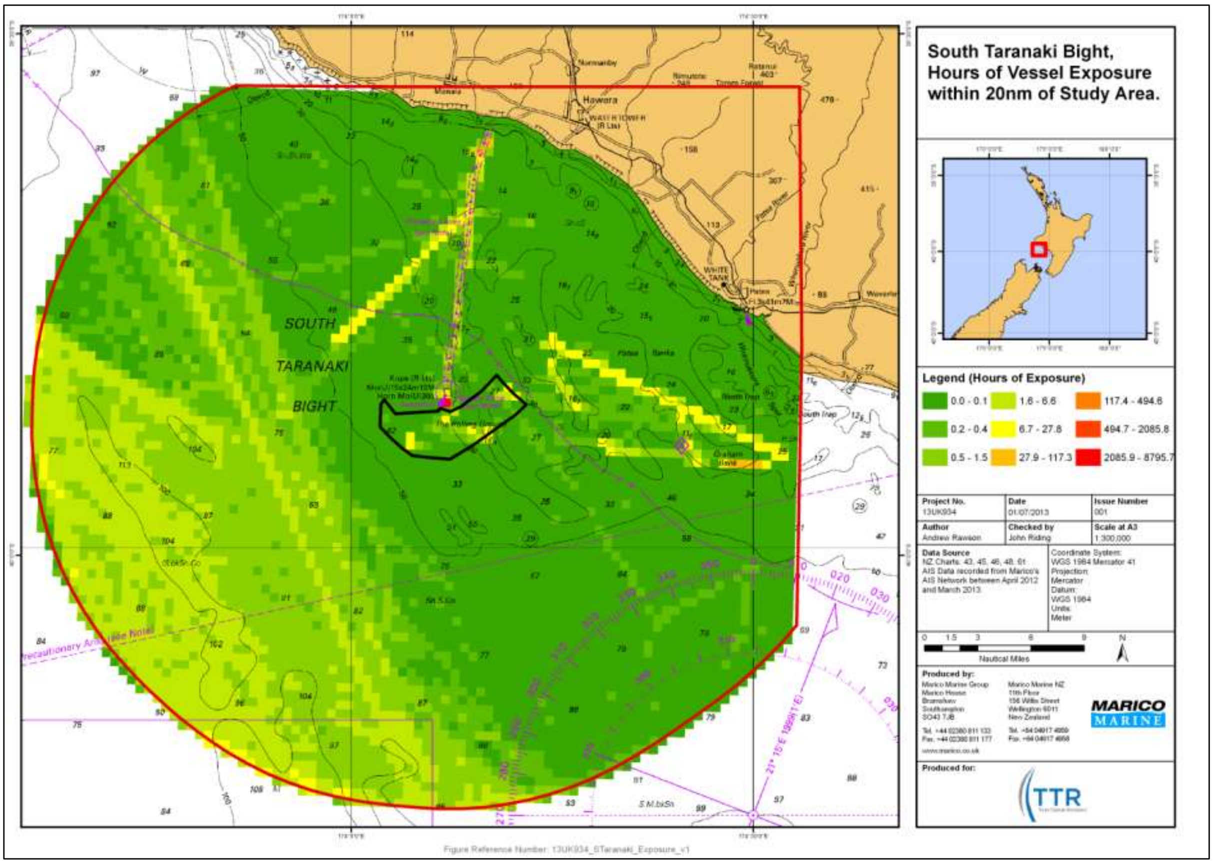


Figure 37: Vessel Exposure within 20nm of Study Area

Figure 38 presents the analysis in **Figure 37** as a graph over time.[11] This plot emphasises the contribution fishing vessels make to total exposure within 20nm of the study site. Occasional concentrations of exposure are evident when trawlers are operating to the western extent of the 20nm radius. The background level of exposure however is considerably less and generally less than 5 hours/day. During the first three months of 2013 the exposure is greater, largely as a result of the activity of the offshore supply vessel *Skandi Singapore* operating on the Kupe field.

11 The Kupe Gas Rig is not included in this analysis.

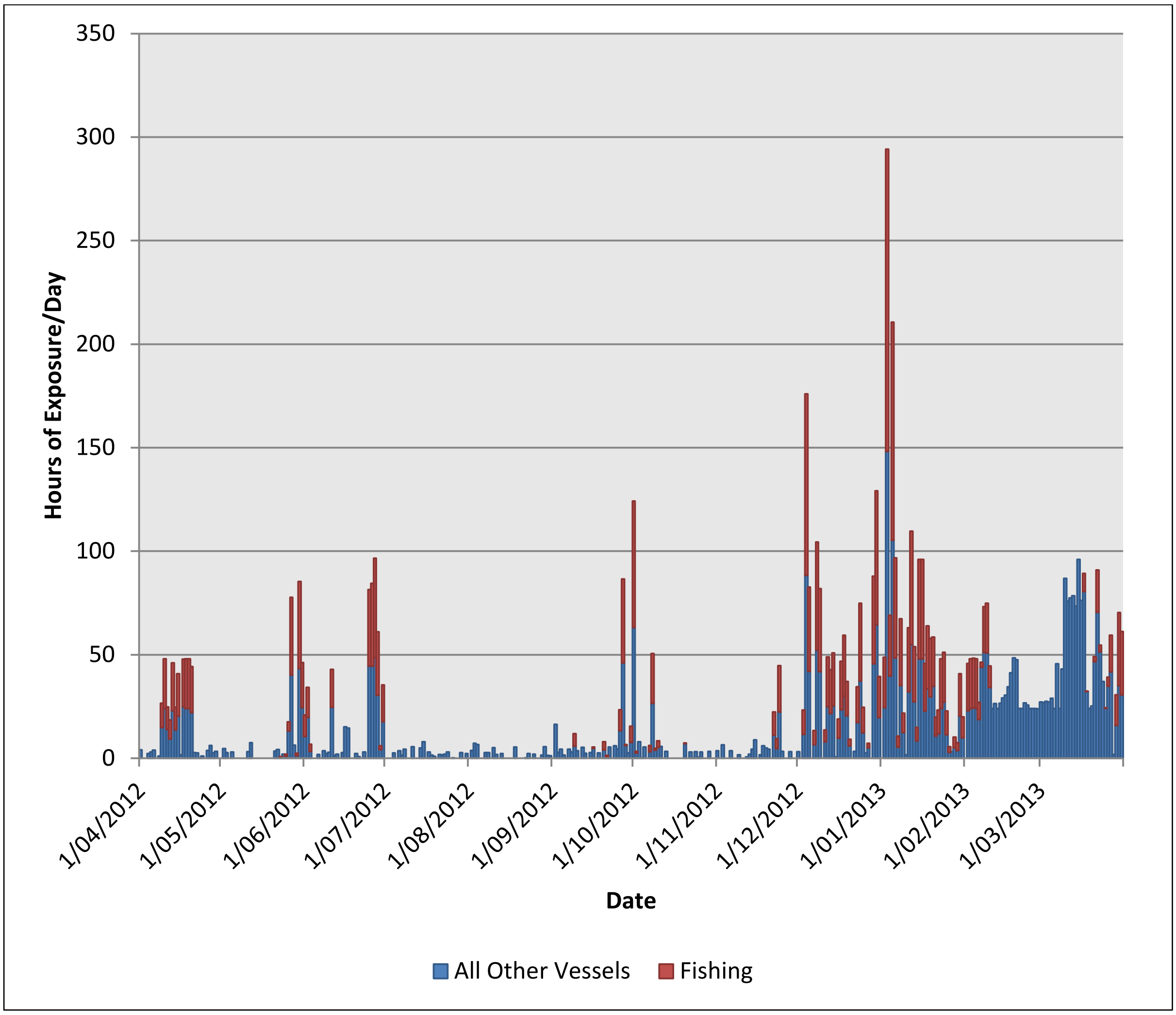


Figure 38: Vessel Exposure Within 20nm Over Time

6.3 VESSEL ENCOUNTER ANALYSIS

A comprehensive analysis was undertaken of the encounter frequency between vessels within 20 nautical miles of the study area. This provides both a temporal aspect to the analysis and a measure of congestion. An encounter is defined as the intersection of one ship's domain with that of another. A ship's domain can be defined as:

"The surrounding effective waters which the navigator wants to keep clear of other ships or fixed objects"[12].

Where two or more domains intersect the location and characteristics of the encounter are recorded;

"Any violation of the ship domain is interpreted as a threat to navigational safety"[13].

Domain analysis is a useful technique for assessing the encounters between vessels and therefore the collision risk. This technique builds on the analysis presented in the proceeding sections by accounting for temporal distribution and interactions of traffic as well as spatial distributions.

6.3.1 Methodology

The design of the vessel domains utilised in this study is shown in **Figure 39**. An elliptical domain off-centre forward of the vessel is used to extract instances where two vessels are within two minutes of meeting. A stationary vessel's position in two minutes is unchanged and therefore the domain will be a circle of radius twice the vessel's length.

Marico's algorithm was used to analyse the full dataset and record every instance where two vessels encountered. The time, location and characteristics of the encounter were extracted and included;

- Encounter Type (Head-On/Overtaking/Crossing);

12 Goodwin, E. (1975). A statistical study of ship domain. *The Journal of Navigation*, 28, pp.328-344.

13 Zbigniew Pietrzykowski and Janusz Uriasz (2009). The Ship Domain – A Criterion of Navigational Safety Assessment in an Open Sea Area. Journal of Navigation, 62 , pp 93-108.

- Closest Point of Encounter; and
- The details of the encountering vessels.

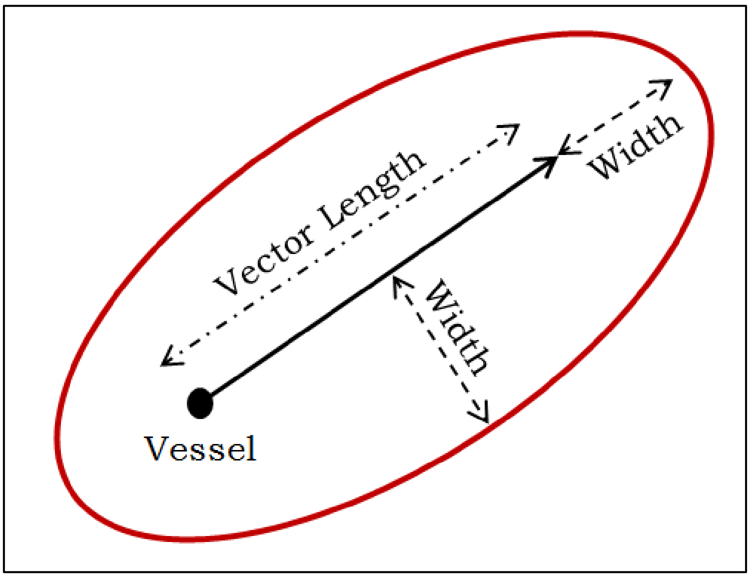


Figure 39: Vessel Encounter Analysis: Domain Design

Where:

- Vector Length: the distance vessel will travel in 2 minutes;
- Width: twice the vessel's length.

6.3.2 Results

Figure 40 shows all vessel encounters over the year of analysis.[14] No encounter was recorded within 10 nautical miles of the installation. 19 encountering situations were identified, all of which were between six trawlers operating to the south-west of the study area. These trawlers were:

- *Aleksandr Buryachenk*;
- *Aleksey Slobodchikov*;
- *Ivan Golubets;*
- *Mainstream*;
- *Meridian 1*; and
- *Profesor Aleksandrov.*

[14] The Kupe Rig was removed from this analysis; encounters between the rig and service vessels have been discounted as not navigationally significant.

The nature of these encounters, between vessels operating together and likely in continual contact, is such that they are low risk in the context of collision and not navigationally significant. Crucially these encounters occurred to the west of the shipping route that transects this area and no encounters were recorded between commercial shipping and fishing vessels. This suggests that there is little reason for commercial shipping on this route to deviate from their course or take evasive action to the east. Therefore, commercial shipping is highly likely to remain contained to this route.

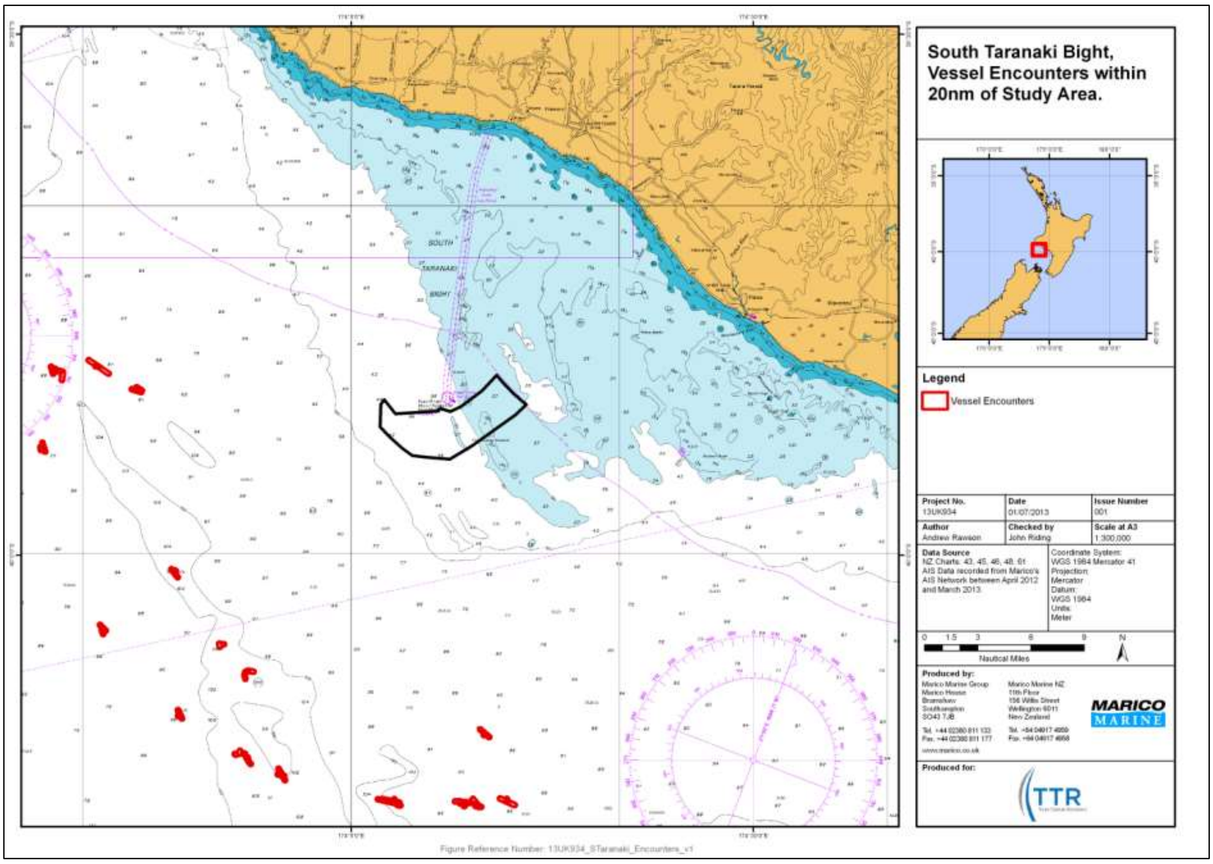


Figure 40: Vessel Encounters near Study Area

6.4 NAVIGATIONAL CONSTRAINTS MAPPING

This section synthesises the results of the preceding sections to provide a single all-encompassing plot of navigational constraints in the South Taranaki Bight region.

The following navigational constraints have been identified within 20nm of the proposed mining site (**Figure 41**).

- The location of a shipping route between the Cook Strait and Cape Egmont that passes five nautical miles to the west of the dredging site (**Section 5.2**). The estimated transit frequency of vessels on this route is once every six days;
- The fishing grounds of the largest trawlers are limited to an area at least four nautical miles to the west (**Section 4.2.4**);
- The location of the Kupe Well Head Platform and the activity of support craft that are servicing the rig (**Section 2.2.1** and **Section 4.2.6**);
- A single light would be visible for vessels with four nautical miles of the proposed mining site, the Kupe Rig's Morse Code "U" visible all round for 10nm (**Section 2.2.3**);
- No popular recreational areas, passenger ferry routes or naval practices grounds have been identified from the AIS data (**Section 4.2.5**, **Section 4.2.3** and **Section 4.2.6**); and
- The depth is greater than 15 metres chart datum and the waterway is not congested providing vessels with plenty of sea room to navigate.

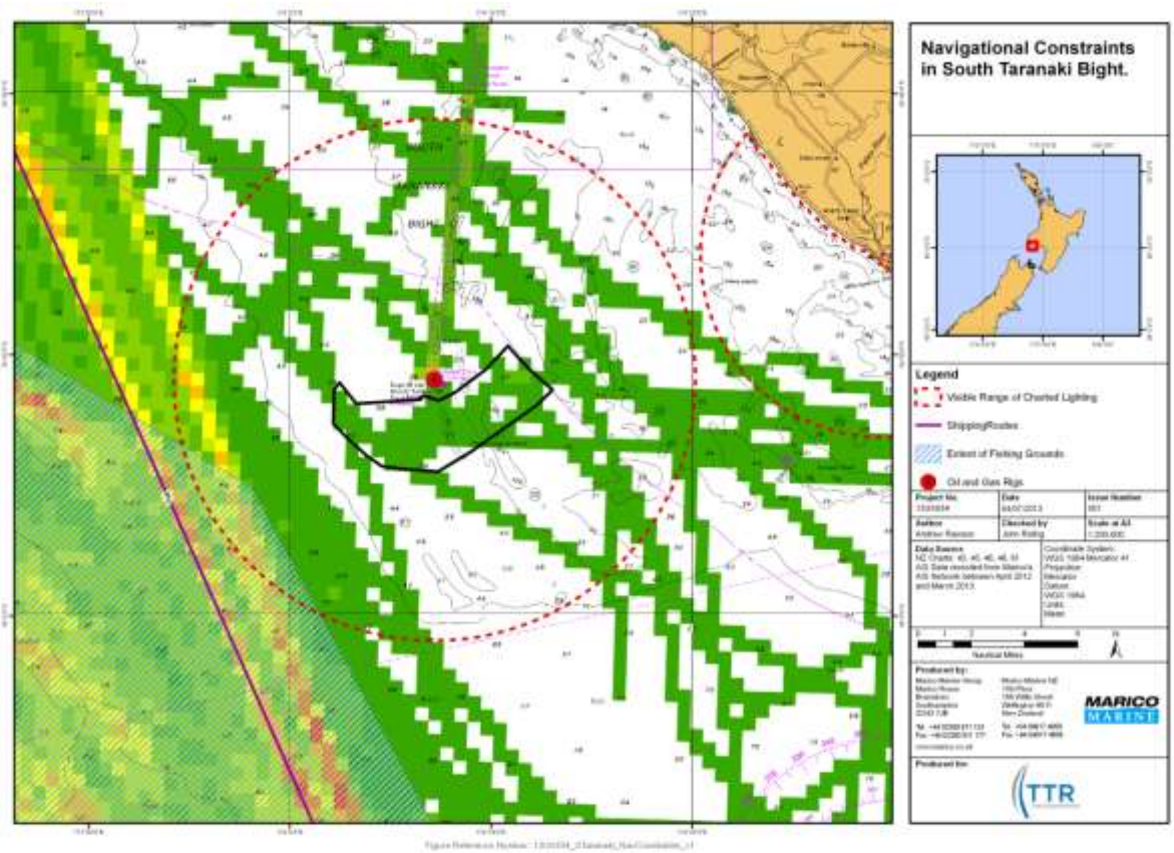


Figure 41: Navigational Constraints near Proposed Mining Site

7 CONCLUSIONS AND RECOMMENDATIONS

This report has provided a comprehensive assessment of shipping and navigation within the South Taranaki Bight region. The analysis has shown that the region is widely used by a number of different activities, including a number of significant NZ shipping routes and busy fishing grounds.

The analysis presented in this report has reached the following conclusions:-

i. The principal conclusion is that the iron sands dredging zone as proposed is located in an area of very low shipping density;
ii. Vessel traffic recorded in the study site are almost exclusively tugs and offshore supply vessels servicing the Kupe Well Head Platform;
iii. The nearest shipping route is five nautical miles away and is of moderate use by commercial shipping transiting directly between the Cook Strait and the Cape Egmont;
iv. 58 vessel transits were recorded within five nautical miles, mostly dry cargo vessels;
v. There is a tight distribution of traffic on this route and it is unlikely that any commercial traffic would deviate towards the mining area;
vi. Very few vessel encounters were recorded, and were exclusively limited to commercial trawlers operating together. The lack of encounters between commercial shipping indicates little congestion and a low collision risk;
vii. No anchorages were recorded in the analysis;
viii. Commercial trawling operations are not recorded as having taken place near to the mining site and are limited to an area greater than four nautical miles to the west; and
ix. The Precautionary Area, proximity of the Kupe well head platform, and the anchoring and fishing exclusion zone have likely had the effect of reducing the number of inshore vessel movements and reducing vessel density near to the proposed mining site.

A number of operational recommendations to ensure the safety of navigation can also be drawn:

1. Any mining operations should be well lit in accordance with the International Rules for the Prevention of Collisions at Sea (COLREGs);
2. Regular navigational safety alerts should be broadcast on Channel 16 whilst dredging and transfer operations are taking place;

3. The vessels involved in the activity should be fitted with “Class A” AIS transponders, thus removing any question of the need for shore based monitoring/management of vessel traffic in the area;
4. Continual contact should be established between the vessels engaged in mining and any craft servicing the Kupe well head platform control room to ensure both parties are aware of the others’ movements; and
5. Information about the scheduled movements of iron-sands dredging and extraction activities should be promulgated to interested bodies, including:
    - Maritime New Zealand (for Coastal Radio promulgation);
    - Local fishing operators;
    - Ports of Wellington Taranaki, Wanganui and Nelson to allow them to pass information onto shipping; and
    - Land Information New Zealand for updating charts and Notices to Mariners.

In conclusion the results show that the proposed South Taranaki mining site is located in an area of a very low traffic density and the development would have little impact (if any) on the safety of navigation.

GLOSSARY

AIS	Automatic Identification System
COLREGs	The International Regulations for Preventing Collisions at Sea 1972
dwt	Deadweight tonnes
GT	Gross Tonnage
HSC	High Speed Craft
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IMO	International Maritime Organisation
LOA	Length Over All
LINZ	Land Information New Zealand
m	Metre
mm	Millimetres
Marico Marine	Marico Marine NZ Ltd / Marine and Risk Consultants Ltd
MMSI	Maritime Mobile Service Identity
nm	Nautical Mile
NMEA	National Marine Electronic Association
SAR	Search and Rescue Operations
SOLAS	Safety of Life at Sea
TSS	Traffic Separation Scheme
VHF	Very High Frequency
WGS 1984	World Geodetic System 1984

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New Zealand Charts:

- NZ43;
- NZ443;
- NZ45;
- NZ46;
- NZ48;
- NZ58; and
- NZ61.