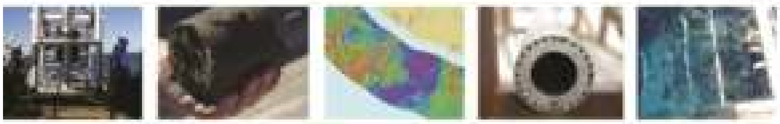
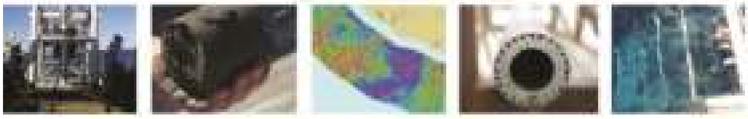


PRE-FEASABILITY STUDY

OFFSHORE IRON SANDS PROJECT

July 10th 2013	PFS	ST/TC/MB/AS/DD/RT/MK	ASt	TC
Date	Designation	Writers	Checked by	Approved
Revision		2		
Document Number		TTR-01-REP-001		



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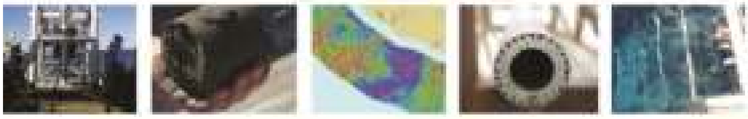

Glossary of Terms

AHT: Anchor-Handling Tug

AHV: Anchor Handling Vessel

BFS: Bankable Feasibility Study

BML: Below Mud Line

CAPEX: Capital Expenditure

CD: Constant Density

CMA: Crown`s Minerals Act 1991

CMS: Cleaner Magnetic Separation

DEME: Dredging, Environmental and Marine Engineering Limited

DTM: Decision to Mine

DTR/DTC: Davis Tube Recovery

DTW: Davis Tube Wash

EEZA: Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012

FMP: Flow Moisture Point

FOOS: First Ore on Ship

FPSO: Floating Production, Storage and Offloading Vessel

FSO: Floating Storage and Offloading Vessel

HAZOP: Hazard and Operability Study

HFO: Heavy Fuel Oil

HPF: Hyperbaric Pressure Filter

IMS: Intermediate Magnetic Separation

IMS: Intermediate Magnetic Separators

ITP: Inspection and Test Plan

JORC: Joint Ore Reserves Committee Code

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LARS: Launch and Recovery System (for SMT)

LIMS: Low Intensity Magnetic Separator

MIMS: Medium Intensity Magnetic Separator

MCC: Motor Control Centre

NPV: Net Present Value

NZDS: New Zealand Diving and Salvage Limited

OGV: Ocean Going Vessel

OPEX: Operating Expenditure

PFD: Process Flow Diagram

PFS: Preliminary Feasibility Study

PID: Piping and Instrumentation Diagram

PSD: Particle Size Distribution

QEMSCAN: Quantitative Evaluation of Minerals by Scanning Electron Microscopy

RAS: Replenishment at Sea

RFQ: Request for Quotation

RMA: Resource Management Act 1991

RMS: Rougher Magnetic Separation

RO: Reverse Osmosis

ROM: Run Of Mine

RORO: Roll on roll off

SAL: Single Anchor Leg

SMT: Sea floor Mining Tool

SOLAS: Safety of Life at Sea

SONAR: Sound Navigation and Ranging

SOP`s: Standard Operating Procedures

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TSHD: Trailer Suction Hopper Dredge

TTR: Trans-Tasman Resources Limited

VTM: Vanadium Titano-magnetite

VTS: Vertical Transport System (ROM Hoses to SMT)

WBS: Work Breakdown Structure

STB: South Taranaki Bight

SSC: Suspended Sand Concentration

SSED: Submerged Sediment Extraction Device

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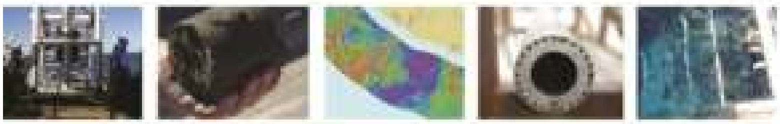

1. EXECUTIVE SUMMARY

The technical and financial evaluation in this Preliminary Feasibility Study ("PFS") has concluded, based on the information currently available, that the project is economically viable and robust and that further project development is justified. The current set of current productivity assumptions, (Module 1), deliver a project post-tax Net Present Value ("NPV") of US$339 million at a 10% discount rate, based on a discounted cash flow model. Trans-Tasman Resources Limited (TTR) is currently working with its technology provider IHC to improve these assumptions and take new higher productivity assumptions as the basis of design for the Bankable feasibility Study (BFS). Should these assumptions be realised the NPV could increase to US$582-632 million for module 1.

The project is potentially highly profitable with a discounted payback (based on NPV) in approximately 6.5 years.

The financial analysis, (Module 1), of the project yields the following[1]:

- Project capital cost of US$576 million;
- Operating costs estimated at approximately US$35/t (rounded, excluding freight costs) on average over first 10 years of operations;
- Total revenue estimated at US$3.1 billion (rounded) in the first 10 years;
- Total direct operating costs (including overheads but excluding marketing costs, royalties and freight costs) are estimated at US$1.2 billion(rounded) in the first 10 years;
- EBITDA estimated at US$1.38 billion (rounded) in the first 10 years; and
- Net Profit after Tax estimated at US$519 million (rounded) in the first 10 years.

The financial outcomes detailed above reflect the results of the implementation of a single integrated vessel. The project solution detailed within this PFS has the potential to be scaled by adding additional integrated vessels.

[1] The PFS results are based on existing resource estimates, broker consensus, mid-point iron ore pricing (Section 15) and market conditions and consequently, market fluctuations, varied logistics or production costs or recovery rates may render the results of past and future project studies uneconomic and may ultimately result in a future study being very different.

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2. INTRODUCTION

This Pre-Feasibility Report has been compiled by a select TTR team presenting a viable option for a project accomplishing the extraction and processing of iron ore deposits in tenements located off the West coast of New Zealand's North Island. This report details the technical and economic evaluation of an integrated mining solution over the existing multiple vessel solution as presented by Technip in an earlier report. In order to maintain continuity and consistency this report uses and refers to information within the submitted Technip PFS report. The Executive Summary of the previous Technip report has been included as Appendix 19.1 of this report.

2.1 Purpose of the report

In April 2013 TTR, after the receipt of increased indicative Capex and Opex costs, concluded that the multi vessel solution as presented by Technip did not constitute a viable project. It became apparent that an integrated solution whereby the mining or extraction component together with the tailings management solution had to be incorporated into a single processing platform. TTR then embarked on an intense, focussed assessment of mature feasible extraction technologies and after a structured evaluation procedure decided on the IHC crawler technology as employed by De Beers Mining off the coast of Namibia.

This report has been prepared to outline the key technical and economic findings of the Pre-Feasibility Study work (PFS) undertaken directly by TTR in the evaluation of the integrated vessel solution. The PFS report has been prepared in recognition of the Australasian Code for reporting of Exploration Results, Mineral resources and Ore Reserves, The JORC Code 2012 Edition. In addition, the reporting requirements pursuant to the listing rules of the ASX and Regulatory Guidelines of the Australian Securities and Investments Commission (ASIC) require mining companies comply with JORC.

2.2 Sources of information

The sources for the information contained within this report have been extracted from equipment designers and manufacturers, internationally recognised independent consulting and local engineering companies as engaged by TTR. The integrity and quality of the previous Technip study is recognised and as such relevant, verified information has also been retained and used from the previous Technip PFS report.

A full listing of the principal sources of information used in both this version and previous versions of the PFS report is available and a summary of the sources is provided below:

- Amdel-Bureau Veritas Australia – Metallurgical laboratory test work
- ASR – Environmental Study and Opinion letter
- Beca – Engineering Design and Verification Services.
- Canadian Shipping Lines (CSL) – Trans-Shipping Proposal
- DEME
- Fugro – Aeromagnetic Survey
- Golders Associates – Mineral Resource and Geology

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- IHC Merwede – Mining Technology Design Support
- MTI – Dredging and Tailings Management
- Principia – Mooring Stability Study (Contracted directly by TPM)
- Sea Transport – Naval Architects - Engineering Design and Verification Services.
- Seabulk – Transhipment, Warehousing and De-watering
- Technip – Previous PFS Report
- Tennant Metals Pty. Ltd. – Marketing Report
- Transfield Worley – Risk Management and cost controlling

TTR has made all reasonable effort to verify and establish the completeness, accuracy and authenticity of the information provided and where appropriate identify potential risks or uncertainties that would affect either technical or economic models. Please see appendix 19.2– Verification Report.

All resource estimates and statements have been prepared by employees of Golder Associates Pty Ltd., who are totally independent of TTR.

2.3 Qualification and Experience

For this study, which crosses several technological areas including subsea engineering, vessel mooring systems and beneficiation, subject matter experts and experienced resources from various consultants have been integrated to form the study team.

The key members were:

- Tim Crossley, CEO TTR,
- Andrew Stewart, CFO TTR,
- Shawn Thompson, Project Director TTR,
- Matt Brown, General Manager Exploration TTR,
- Andy Sommerville, General Manager - Environment and Approvals TTR,
- Rhys Thomas, Offshore Operations Manager TTR,
- Andre Mouton, Process Metallurgist TTR,
- Mahesh Khupse, Project Research Assistant TTR,
- Alvin Hung, Juniper Capital Partners
- Dr. John Feenan, Director IHC Mining,
- Laurens de Jonge, Manager IHC Mining,
- Ross Ballantyne, Manager Naval Architect Sea Transport,
- Albert Sedlmeyer, Senior Naval Architect Sea Transport
- Dave Debney, Capital Risk Specialist Transfield Worley,
- Chris Lee, Senior Process Engineer Beca.

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Curriculum Vitae of the above personnel are provided in Section 19.3 of this report.

2.4 Key Findings

The following key findings have been identified; these findings are subject to the stated risks and assumptions detailed in Section 16 and 3.14 respectively:

- The proposed integrated mining methodology and technical aspects of the project are technically sound and appropriate for the project,
- The CAPEX and OPEX estimates (within +/-30% accuracy) are based on appropriate and reasonable assumptions,
- It is reasonable to expect that the proposed mining method is suitable for the geological characteristics of the resource (as reported by Golders Associates),
- It is reasonable to expect that the stated metallurgical yield can be achieved using the proposed mining method and process,
- It is reasonable to expect that if implemented, the proposed mining method has the capability of mining 39Mtpa of sediment (dry basis),
- It is reasonable to assume that if expected yields are achieved, the proposed processing facility is expected to produce 4Mtpa of iron ore concentrate, taking into account mining losses and dilutions,
- The basic schedule covering further studies and development of the project as outlined is reasonable,
- Results of the metallurgical test work undertaken by Amdel Bureau Veritas appear to be reasonable and have been prepared using appropriate techniques and in accordance with applicable industry standards, and
- For the base case of approximately 4Mtpa production of concentrate grading 56% to 57% Fe, the estimated NPV is US$339 million for a Capex of US$576 million. The projected average FOB cash cost average over the first 10 years is estimated at approximately US$35/t of concentrate.

3. PROJECT SUMMARY

3.1 Project Description

TTR (TTR) is a privately owned New Zealand company, established in September 2007 to explore assess and uncover the potential of the rich offshore iron ore deposits off the west coast of the North Island of New Zealand. TTR's ambition is to provide Asian markets with a reliable supply of low cost iron ore and build mutually beneficial strategic long term partnerships with steel manufacturers. TTR is committed to conduct all its activities in a safe and environmentally sustainable manner and to proactively engage with the local communities on all relevant economic, environmental and social issues.

The aim of this pre-feasibility study is to estimate and economically evaluate selected techniques and methods for:

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- The mining and processing of the offshore iron ore which could feed multiple blast furnaces to produce a Vanadium Titano-magnetite (VTM) concentrate at 56-57% Fe.
- The shipment to world markets of this VTM concentrate.
- Provision of a Capex estimate at +/- 30% accuracy.

3.2 Option Overview

In addition to the dredging option review commissioned during the initial PFS study (see appendix 19.17) that evaluated different dredging options, different extraction/mining system options were evaluated during the later IHC workshop in order to identify the most suitable solution for TTR's activities. Mining systems were weighted on a system level not on specific included equipment. Mining systems evaluated include: crawler, trailer suction hopper dredge (TSHD), drill, Ro-Ro, and point suction dredge and measured against mining efficiency, depth from 30-45 m, capacity, mining flexibility, logistic complexity, and tailings dispersal parameterss.

Parameterss	Weight Factor	Crawler	TSHD	Drill	Ro-Ro	PSD
Mining Efficiency	7	9	8	5	4	6
Depth (30-45 m)	10	10	10	0	8	10
Capacity	10	9	10	4	8	10
Mining Flexibility (sediment thickness, direction, location, depth soil conditions, etc.)	8	9	9	9	7	5
Logistic Complexity Integrated vessel multi system	7	9	5	9	5	8
Tailings	10	9	5	9	5	9
Total (Sum of Rating x Factor)		478	413	300	329	428

Table 3-1 Option Decision Analysis

Results from the structured decision analysis indicated that the drill, Ro-Ro, and PSD were not viable options.

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The TSHD, as detailed within the initial version of the PFS report and the integrated crawler as detailed within this latest version of the PFS were found to be the best two options for TTR's mining operations. Main differences between the two systems include: scalability, tailing dispersal, operation logistics, and mineral processing. The TSHD is easily scalable, whereas, the crawler is reaching its limits with regards to operational size. In regards to tailings dispersal, a TSHD system cannot control the tailings dispersion and has the ability to generate large plumes. On the other hand, crawlers, by their intensive extraction will allow the return of the tailings material back to the original location in a controlled way. Operation logistics between the two systems are also different; the TSHD system must have the processing plant located on another vessel, whereas, the crawler can be incorporated into an integrated production vessel.

It is TTR's conclusion that an integrated sediment extraction device, i.e. a crawler system, provides the best overall mining solution particularly because it facilitates an acceptable tailings management strategy.

An integrated sediment extraction system such as the assessed sea bed crawler will be lowered to the sea bed and controlled remotely from the surface support vessel. The crawler is typically fitted with highly accurate acoustic sea bed navigation and imaging system, and extracts sediment by systematically advancing along a pre-determined 'lane'. Unconsolidated surface sediment is pumped to the vessel for further processing or beneficiation. These extraction devices are capable of achieving a more thorough coverage of the target area, thus avoiding the need for re-mining. The integrated mining vessel will employ a dynamic mooring system, i.e. using multi-anchor systems to locate itself precisely over a specified extraction area.

3.3 Project Geology

Titano-magnetite iron sand forms Quaternary[2] onshore beach and dune deposits and offshore marine deposits along 480 km of coastline from Kaipara Harbour south to Wanganui on the west coast of the North Island, New Zealand. The onshore deposits include the present beach and dune sand, and older coastal sand deposits that have been preserved by uplift due to faulting and/or lowering of sea level.

The titano-magnetite mineral is sourced from the Quaternary volcanic rocks of western Taranaki and the volcanic rocks of the Taupo Volcanic Zone, transported to the coast by rivers, along the coast by shallow marine long shore currents, and subsequently concentrated by wave and wind action into beach and dune lag deposits.

From the interpretation of the exploration information, the geological model of the offshore iron sand deposits can be represented as areas, consisting of remnant coastal dunes that were constructed at a time of lower sea level. These paleo-dune features where part of an ancient river system in which dunes formed contemporaneous at the mouth of the river(s) and the coast line. The rivers are locally controlled by active faulting with the iron sands within the river channels and dunes partially reworked by currents and long shore drift and are re-deposited along the shore lines of the transgressing sea.

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[2] The **Quaternary Period** is the most recent of the three periods of the Cenozoic Era in the geologic time scale, and spans from 2.588 ± 0.005 million years ago to the present. This relatively short period is characterized by a series of glaciations.

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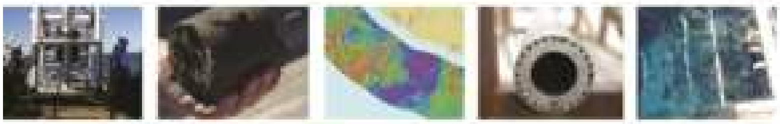

3.4 Exploration Summary

TTR have undertaken extensive exploration activities within its tenement areas, and in particular within the identified mining area. Exploration activities included, aeromagnetic surveying, 2D seismic surveying, multiple programmes of shallow and deep drilling, and bulk metallurgical sampling. From these exploration activities TTR has been able to delineate a JORC compliant resource, using drilling methods that have been independently technically verified to enable representative sampling at depth of the titano-magnetite resource.

	Head Analysis		DTR Analysis	
	Drill Holes	Samples	Drill Holes	Samples
Area 2	497	2620		
Koitiata	44	205		
Proposed Mine Area			83	643

Table 3-2 Resource Model Area Data

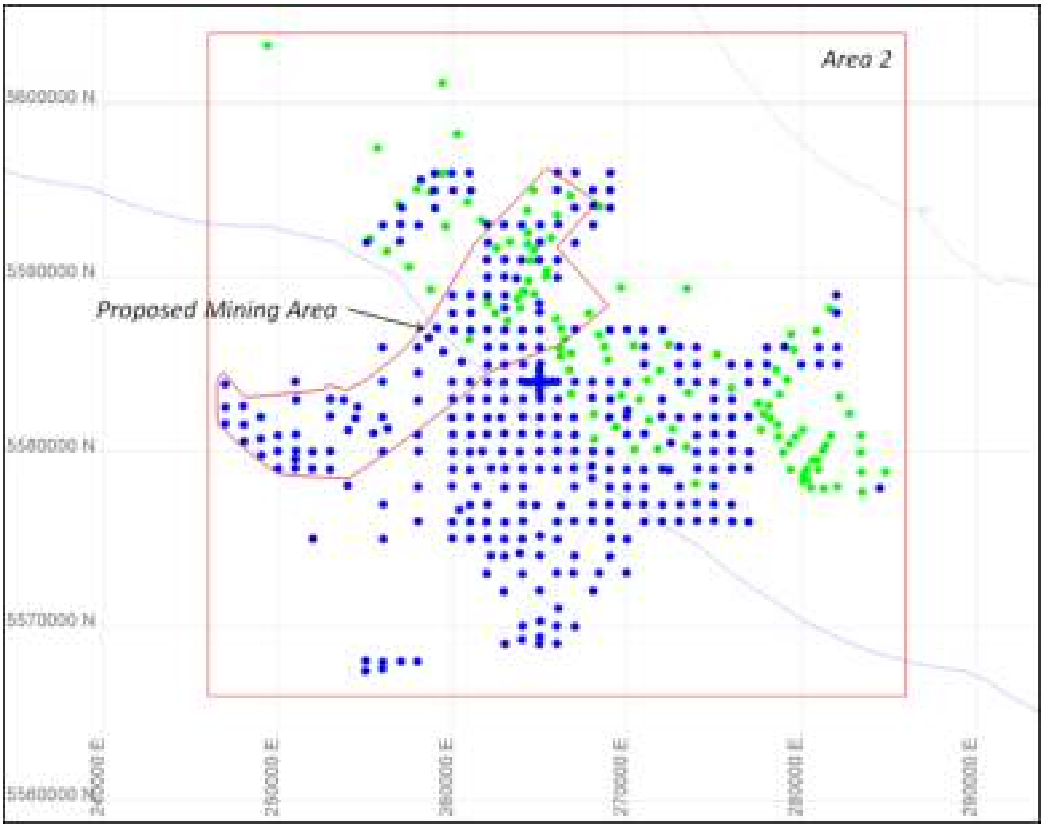

Figure 3-1 Drilling Locations

3.5 Mineral Resource Definition

Golder Associates Pty Ltd (Golder) was initially commissioned by TTR assist with the development of TTR's iron sand project in New Zealand in 2009. In November 2009 an in-

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situ maiden resource of 1040 Mt at 5.88% Fe was defined. Golder (2009) In July 2011, after additional drilling, the resource was updated to 2121 Mt at 5.64% Fe (Golder, 2011).

The TTR resource estimates were classified in accordance with the Australasian Code for Reporting of Identified Mineral Resources and Ore Reserves (JORC, 2012) as Indicated and Inferred based on drill holes available as of 20 November 2012 and:

- The physical recovery has been applied to the models;
- Head grades and tonnages are for all material less than 2 mm in diaMetre;
- Concentrate grades are for the magnetically recoverable portion of the sample;
- Concentrate tonnage is calculated from the head tonnage and DTR;
- The *in situ* resource model has been reported at a 3.5% DTR cut-off grade where DTR analyses are available within the proposed mining area. Outside this area a cut-off grade of 7.5% Fe_2O_3 has been used based on the statistical relationship between Fe_2O_3 and DTR.

TTR's Mineral Resource estimate is presented below in Table 3-3. The Mineral Resource is not believed to be materially affected by any known environmental, permitting, legal, title, taxation, socio-economic, marketing, political or other relevant factors.

Category	***In situ* Concentrate Tonnes**	**Fe%**	**P%**	**SiO_2%**	**Al_2O_3%**	**Ti**
Indicated	47.4	57.35	0.108	3.46	3.64	5.10
Inferred	32.5	57.00	0.111	3.85	3.68	5.08
Total	**79.9**	**57.21**	**0.109**	**3.62**	**3.65**	**5.09**

Table 3-3 Summary of the JORC *in situ* mineral resource at a cut-off grade of 3.5% DTR

At time of the PFS write up a review of the "*in situ*" bulk density[3] was undertaken. TTR believes that the "*in situ*" bulk density used to estimate the mineral resource has potentially under estimated the bulk density by approximately 8% to 10%. This updated assumption on density will be assessed and if ascertained will be corrected and reported in late Q3 as part of the company releasing a new JORC compliant Resource Statement and Ore Reserve.

3.6 Metallurgical Test work

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[3] Bulk density implies the density of extractable volumes of sediment inclusive of voids. The in-situ density includes the void and grain boundary water present in the sediment in its natural state. Whilst the latter is important for estimation of the tonnage of material to be moved during mining, for resource estimates, however, dry bulk density is required, Lipton, I. T. 2001, Measuring of Bulk Density for Resource Estimation, Aus MIM

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The metallurgical test work was conducted in two phases:

- Stage 1 – Preliminary test work
- Stage 2 – Pilot plant test work

The purpose of the preliminary test work was to investigate the viability of upgrading the ore using conventional mineral sands processing methods and to determine the base parameterss required for the design of the process flow sheet. The purpose of the test work was to design a process flow sheet that is capable of producing a saleable iron ore concentrate whilst maximising recovery of the valuable component in the ore.

Initial test work focused on gravity separation as is commonly used at many existing mineral and iron sands operations. This initial test work proved that this approach was not viable and steered the process flow sheet design towards conventional magnetite processing which is based primarily on magnetic separation.

The pilot plant test work concentrated on investigating the beneficiation of the ore using this magnetic separation approach. This report will focus on the test work conducted on the pilot plant.

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3.7 Operational Description

3.7.1 Integrated System

The selected integrated solution is based on a single FPSO, (Floating, Production, Storage and Offloading vessel) that will contain the mining, processing and tailings deposition mechanisms and a single Floating Storage and Offloading Vessel (FSO) that will trans-ship the concentrate from the FPSO onto standard commercial bulk cape-size vessels for delivery to end users.

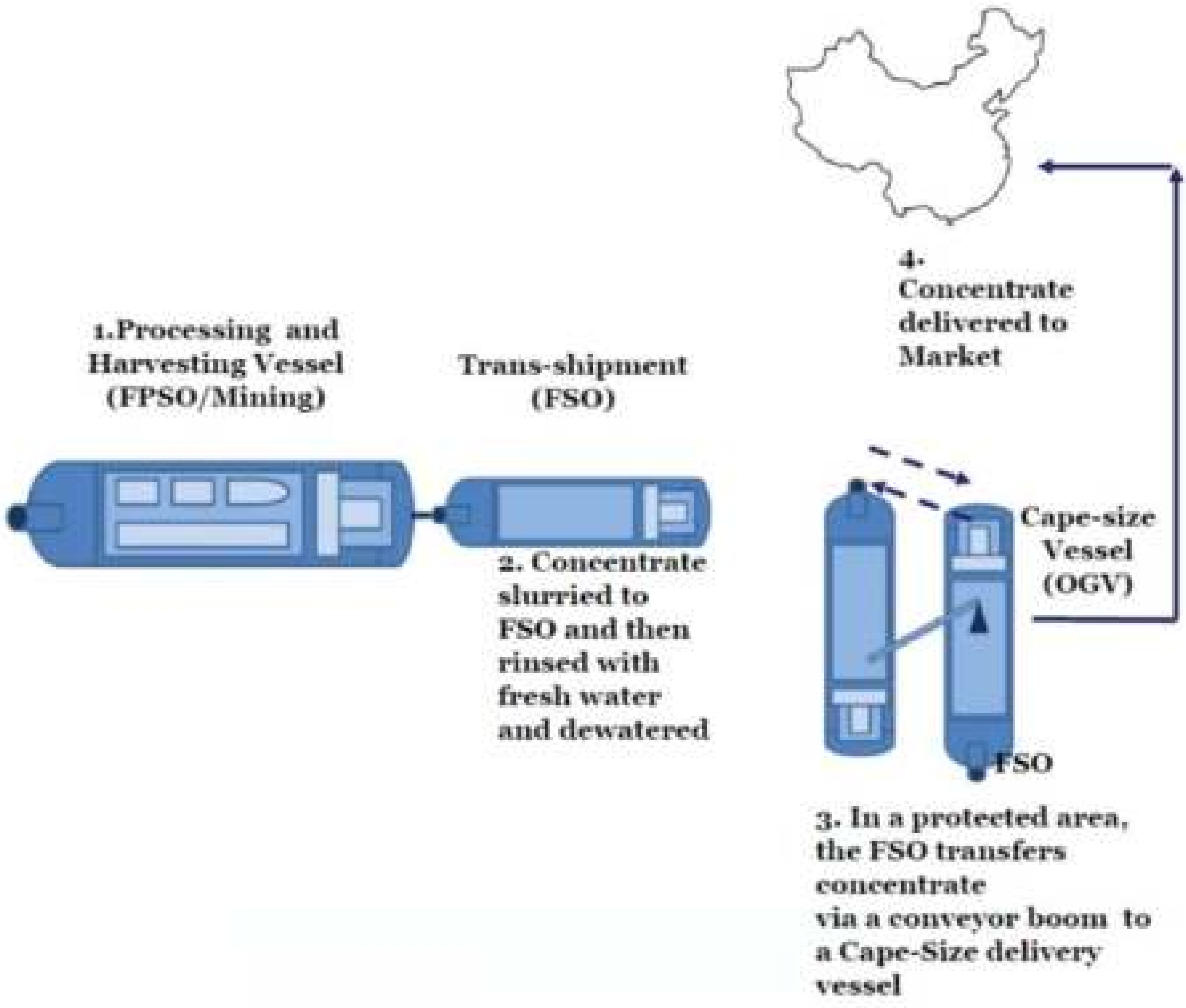

Figure 3-2 Offshore Operations

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3.7.2 Sediment Extraction

A mobile subsea sediment extraction device (SSED) was selected as the preferred sediment extraction methodology to be integrated into the FPSO vessel.

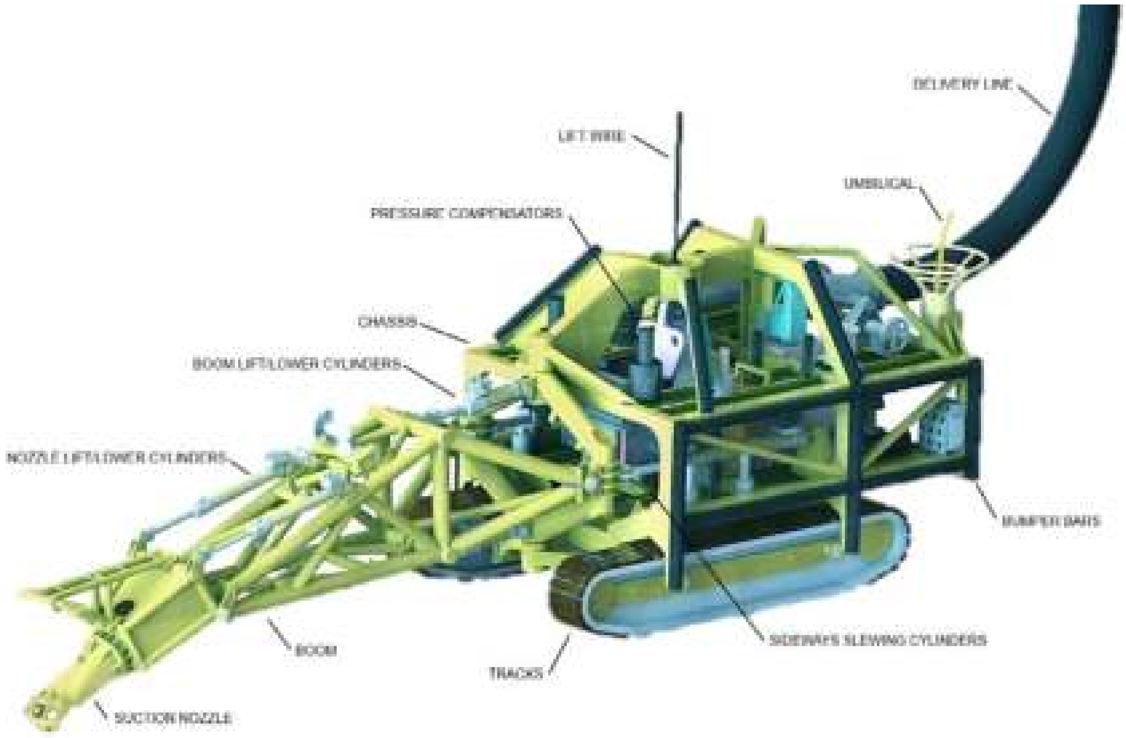

Figure 3-3 Subsea Sediment Extraction Device

During extraction operations the SSED is lowered onto the sea bed by the launch and recovery system (LARS), together with the discharge hose and umbilical. Around 2-3 sections of the discharge hose will be floating on the water allowing for flexibility in the movement of the subsea device.

To accommodate the deposition of the tailings into an already depleted area, because of the location of the tailings deposition pipe on the bow of the vessel, the length of each extraction run will be a function of the vessel length, e.g. 300 m. At the end of each run the SSED will turn 180° and work the adjacent run, see Figure 3-4 below. The total width of the planned run of the SSED boom is 10 Metre wide allowing for a 1 Metre overlap on both sides of the run to minimize spill (losses).

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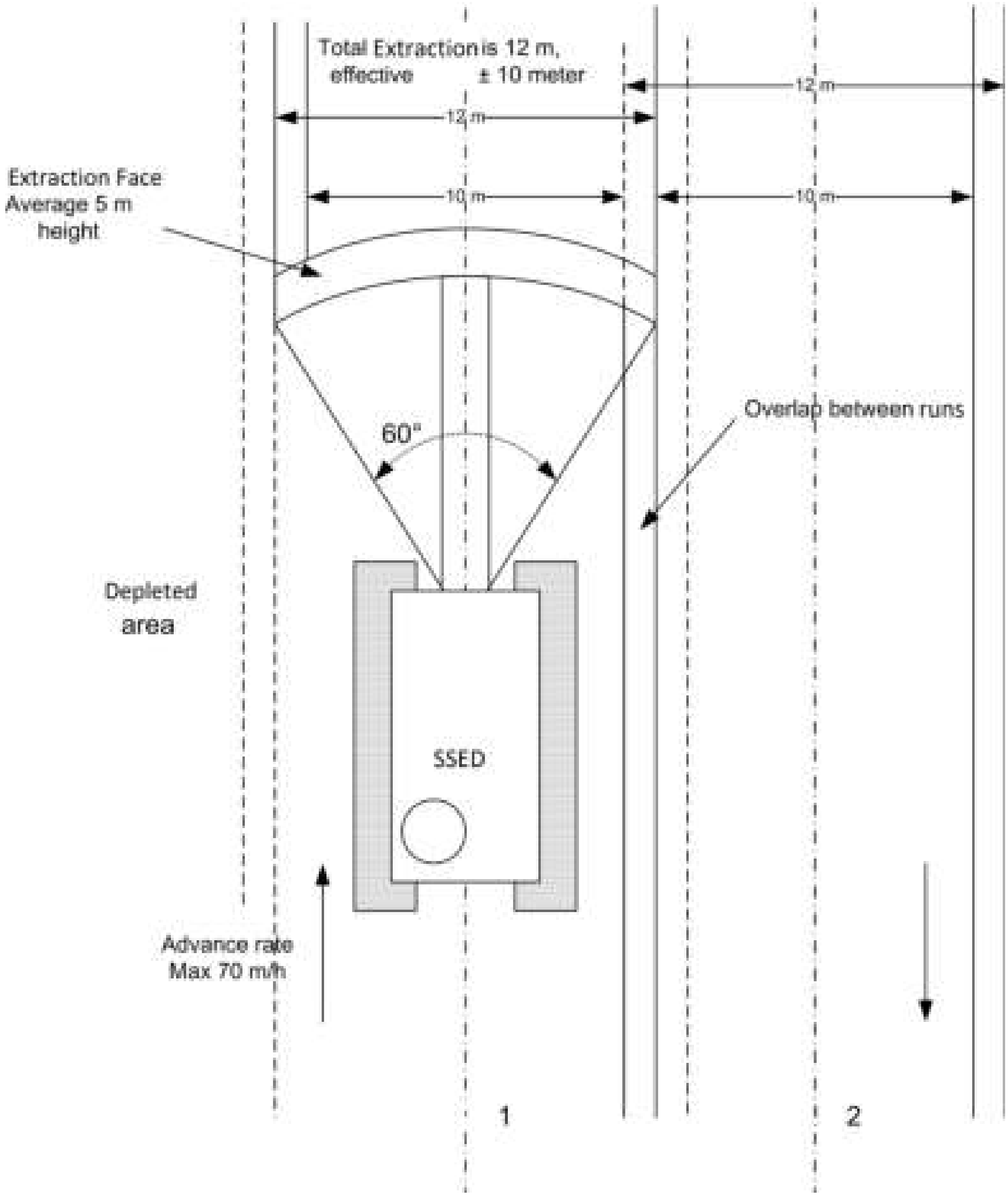

Figure 3-4 Typical SSED Run

The FPSO will follow the SSED at the advance rate of 70 m/hr, a 300x300 m block will typically be depleted in around 5 days, and thus the mooring system will normally span a 600x300m area, see Figure 3-5, allowing a period of 10 days between each mooring move.

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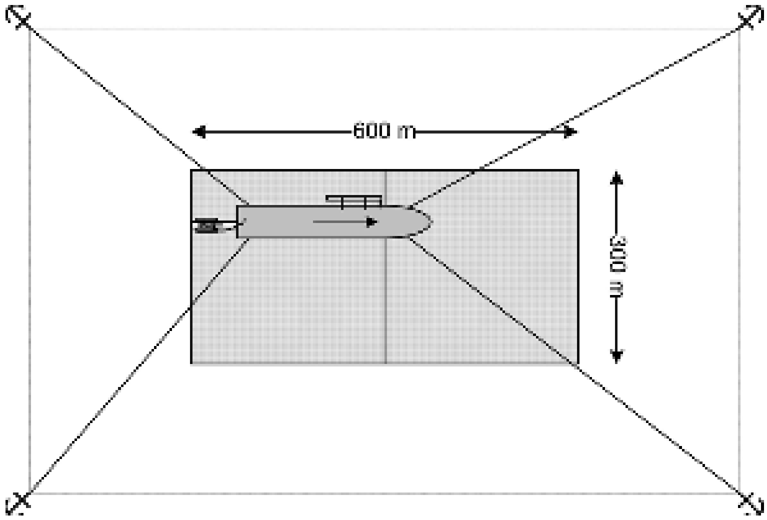

Figure 3-5 Mooring Layout

3.7.3 Processing Module

The metallurgical test work programmes demonstrated that the TTR Project deposits are required to be beneficiated using conventional classification, i.e. magnetic separation followed by grinding and a final magnetic separation to produce a 56-57%Fe product (typically 75µm) with mass yields in the order of 10%.

A summary of the proposed processing facility is detailed in the Process Flow Diagram detailed in Section 7 of this report and is broadly described as follows:

- Extracted sediment will be delivered to the FPSO via an 800 mm ID rubber hose connected to the SSED. The design delivery rate of the SSED is 6,500 t/h solids. The run of mine (ROM), ore will be directed into a boil box from where it will be directed into two intermediate distribution sumps. Process water will then be added to reduce the slurry density to approximately 31.5% solids by weight before the slurry is fed to 10 trommel screens at main deck level. The screen aperture will be 4 mm such that the effective screen size of the ROM will be ~2 mm. Spray water on the screens will reduce the slurry density further to approximately 30% solids. The screen undersize is fed under gravity to 10 water agitated storage tanks directly below the screen area. The oversize will be fed via a chute to the tailings handling area.
- The -2 mm ore will then be pumped from the agitated storage tanks to the first stages of magnetic separation. The purpose of the rougher magnetic separation (RMS) will be to capture both the liberated and locked magnetic particles whilst rejecting the majority of the gangue[4].

[4] Gangue is the commercially worthless material that surrounds, or is closely mixed with, a wanted mineral.

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- First Stage Grinding. The feed to the first stage (~1,420 t/h) will be ground to a P80 of nominally 130 µm, requiring a grinding energy of 15 kWh/t. It is envisaged that the first stage grinding duty will be accomplished using six 3 MW IsaMills™.
- Intermediate Magnetic Separation (IMS). The IMS section will comprise of 12 units arranged into two clusters of six separators each. Approximately 30% of the IMS feed will be rejected to tailings. The IMS concentrate will be gravity fed to the second stage grind feed tanks and the tailings will be gravity fed via a chute to the tailings handling area.
- Second Stage Grinding. In the second stage grind the feed to the IsaMills™ will be ground from 130 µm to 75 µm in order to liberate the titano-magnetite sufficiently to achieve the final product specification on a consistent basis.
- Cleaner Magnetic Separation. The cleaner magnetic separation (CMS) section will consist of eight triple drum co-current magnetic separators at an intensity of 950 gauss, arranged in two clusters of four each. The CMS concentrate will then be gravity fed to a set of dewatering drum magnets to reduce the concentrate moisture to ~10%.
- Final Concentrate Handling. The dewatered concentrate will be stored in two hoppers. The hoppers were sized for a buffer capacity of 40h or approximately 32,000 t. This will allow enough time for the FSO to sail a distance of maximum 70 nautical miles to a sheltered area (if required by weather conditions), offload its entire load of 60,000 t concentrate and return to the FPSO. Once the FSO is on station, it will connect to the FPSO via a floating slurry line.
- On-board the FPSO dewatered concentrate will be extracted from the bottom of the storage hoppers onto a conveyor belt. It will be elevated to the top of a constant density (CD) agitator tank with a sandwich conveyor. In the CD tank the concentrate will be slurried with fresh water from the desalination plant (from two intermediate fresh water tanks) to form a 50% by solids slurry. The fresh water is required to wash the concentrate, i.e. to reduce the chloride level of the product. The slurry will then be pumped to the FSO and filtered to a low moisture content of less than 6.5% using four hyperbaric pressure filters.
- During offloading of concentrate the process plant will continue to operate to produce the balance of the 60,000 t FSO cargo. Offloading to the FSO therefore will occur at double the production rate of the process plant (~1600 t/h).
- Tailings Handling. In order to minimise the environmental impact of the tailings, it will be dewatered before disposal via a set of hydro-cyclones. The coarse and fine tailings will be dewatered separately to approximately 75 to 80% solids before being discharged under gravity via the tailings deposition pipe. The deposition pipe will be controlled using sonar such that the discharge occurs at a constant height from the sea bed. The tailings waste water will be discharged via a second pipe along the tailings deposition pipe slightly higher than the solids discharge.

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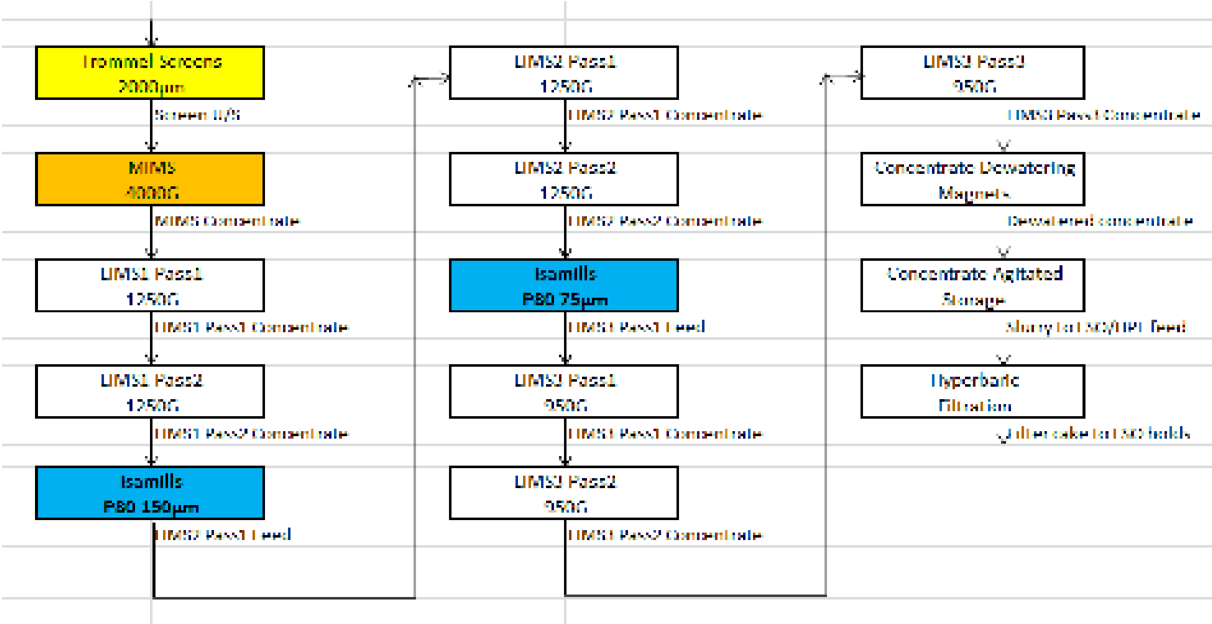

Table 3-4 Process Description

3.8 Auxiliary Services

3.8.1 Power Generation

The TTR project has specified four (4) Siemens SGT-500 gas turbine generator sets for a total installed power capability of 80MW.

The SGT-500 set was selected because of its multi fuel capability on a range of gas and liquid fuels specifically that of Heavy Fuel Oil (HFO).

The units also have:

- The Ability to accept a wide range of load application / rejection
- The Ability to accept a 6 MW step load increase in a single step
- The Ability to shed load from 11 MW to zero in a single step
- The Ability to shed load from full load to 2 MW in a single step
- The Ability for on-line turbine washing
- Low NOx emissions – 350 ppmv without water injection, 50 ppmv with water injection
- Low noise emissions – 85 dB(A) @ 1m
- Low lube oil consumption
- Low footprint and weight

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Figure 3-6 FPSO Example

This vessel shown above in Figure 3-9 is a typical oil and gas FPSO (Floating Production, Storage and Offloading) vessel. The power on board is provided by two SGT-500 gas turbines.

The SGT-500 is regarded in industry as a light-weight, high-efficiency, heavy-duty industrial gas turbine. Its special design features are high reliability and fuel flexibility. It is also designed for single lift, which makes the unit suitable for all offshore applications.

The modular, compact design of the units also facilitates onsite modular exchange. (Source: Siemens Westinghouse)

The power generation component for the TTR project is detailed further in section 8.1 of this report.

3.8.2 Sea Water Desalination

The TTR project has specified 10 separate containerised Reverse Osmosis plants, each with a production capacity of three thousand (3000) cubic Metres per day.

Splitting the plant up in this way reduces risk as in the case of a breakdown in one plant, nine others are still available. It is also advantageous from a maintenance downtime perspective: with only 10% capacity offline at any one time, production is hardly interrupted for scheduled servicing. Spare parts are common across all plants, further reducing costs of stocking critical parts and components.

The sea water desalination component for the TTR project is detailed further in section 8.2 of this report.

3.9 Environmental

Before TTR can remove any material for any of its activities it will require authorisation from both the relevant legislation i.e. EEZ and Crown Minerals Act. TTR has exploration permits (as at the time of writing, one granted and three under application) to give it access to iron-

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sand within NZ's territorial waters and one licence to prospect in NZ's exclusive economic zone (EEZ). These are all now managed under the Crown Minerals Act.

TTR's initial proposed mining area straddles the 12nm territorial boundary.

Any party wishing to undertake an activity within the territorial boundary requires environmental 'consents' under the Resource Management Act (**RMA**); and for activities outside the territorial boundary will require 'marine consents' under the Exclusive Economic and Continental Shelf (Environmental Effects) Act (**EEZA**). It is probable that initially TTR will only obtain environmental consents for activities in the EEZ. In that case there will be no activities within NZ's territory so there will be no requirement for RMA consents.

Both the RMA and EEZA are 'effects based' pieces of legislation. Effects based legislation requires that applicants for consents demonstrate that the activities will have low level of effect on the environment.

In order to be able to predict the effects of TTR's initial mining activities on the environment, it has had the environment in the South Taranaki Bight extensively studied. This work was designed to fill in the gaps of the existing knowledge. This work has entailed benthic, pore water chemistry, beach profile, noise, marine mammal aerial and visual sediment plume studies and also wave, current and sediment transport measurement. In order to establish the actual effects computer models of sediment plumes and waves have been built. Put together these will enable appropriate experts to determine the effects of the proposed activities on waves, shoreline erosion and the area's ecology, and determine the visual effects.

The timeframe for the consenting processes includes approximately 2 years of field work and reporting, of which the majority is already complete, followed by 7 to 12 months of consent processing work depending on the pathway followed.

3.10 Capital Costs

Capital costs were estimated by TTR supported by various technical consultants and equipment providers. The estimates are summarised in Table 14-2CAPEX Breakdown and should be considered to be ±30% order of accuracy current at the second quarter of 2013.

Opportunities to reduce TTR's capital outlay through contracting with third parties to provide key elements of the project include potentially the project water supply and power infrastructure and auxiliary services will be evaluated during the BFS phase.

The following key assumptions have been made in regards to the capital cost.

- Contracted transfer and marine support operations;
- Owner processing;
- No capital allowance has been made for on-shore facilities as these are assumed to be covered by the respective entities providing services to the project as an operating cost; and
- The processing plant capital estimate has been based on suitable equipment sized from preliminary metallurgical test-work and flow sheet development. The processing plant is also based on a modularised construction strategy allowing (where practical) assembly and testing off site with reduced on-site construction effort.

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3.11 Operational Costs

Operating costs have been estimated on the basis that all primary mining operations will be carried out by TTR. All transfer and support operation will be contracted out to third parties. Average operating cost (excluding freight) is estimated to be approximately US$35 per tonne to produce 57% Fe saleable product delivered FOB. A summary of operating costs elements are shown below under section 15.

3.12 Project Schedule

It is estimated that the project duration will be 22 months from project decision to mine (DTM). The major key elements of the project schedule are tabled below.

Task Name	Start	Duration	Finish
TTR-01-SS-001-R1 (WBS 130508)	**Wed 6/02/13**	**825 days**	**Mon 4/04/16**
Project Management	Mon 3/06/13	741 days	Mon 4/04/16
Project Management And Control	Mon 3/06/13	741 days	Mon 4/04/16
Project Operations	Mon 3/06/13	240 days	Fri 2/05/14
Maritime Operations & Licensing	Mon 3/06/13	220 days	Fri 4/04/14
Project Artefacts/Documents	Mon 3/06/13	320 days	Fri 22/08/14
Basis of Design (Early Confirmation)	Mon 3/06/13	81 days	Mon 23/09/13
BFS Report	**Thu 26/06/14**	[redacted]	**Thu 26/06/14**
Decision to Mine	**Fri 25/07/14**	[redacted]	**Fri 25/07/14**
Execution	**Mon 28/07/14**	**441 days**	**Mon 4/04/16**
Procurement	Mon 28/07/14	441 days	Mon 4/04/16
FSO Supply	Mon 20/10/14	12 mo	Fri 18/09/15
AHT Supply	Mon 20/10/14	12 mo	Fri 18/09/15
FPSO - Hull/Plant	Thu 5/02/15	81 days	Thu 28/05/15
Mining ROM	Mon 3/11/14	231 days	Mon 21/09/15
Process Plant	Fri 10/10/14	267 days	Mon 19/10/15
Power generation	Mon 28/07/14	261 days	Mon 27/07/15
Desalination	Thu 8/01/15	203 days	Mon 19/10/15
HDF - Concentrate Onloading	Mon 4/05/15	241 days	Mon 4/04/16
Construction	**Fri 6/03/15**	**282 days**	**Mon 4/04/16**
FPSO - Hull/Plant	Fri 6/03/15	190 days	Thu 26/11/15
FPSO Integration	Wed 1/04/15	264 days	Mon 4/04/16
Handover	**Mon 4/04/16**	[redacted]	**Mon 4/04/16**

Table 3-5 Project Schedule

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3.13 Financial Analysis

The evaluation of the TTR Offshore Project was completed using discounted cash flow analysis with a discount rate of 10%.

The base-case key economic outcomes were:

- A NPV estimate of US$339 million;
- Total operating costs of approximately US$35/tonne (excluding freight costs) of product grading 57% Fe delivered free on board (“FOB”); and
- Capital discounted payback of approximately 6.5 years.

The financial outcomes from the studies of the TTR Offshore Project are shown below under section 15.

3.14 Pre-Feasibility Assumptions

In the frame of this Preliminary Feasibility Study, the following main assumptions have been made in order to determine the most appropriate offshore scheme with regards to the logistical aspects:

- All equipment cost estimate accuracy is +/-30%.
- The FSO sizing has been based on a 60kt “Panamax” sized vessel.
- Flow-sheet has been compiled from laboratory test data and shall be confirmed by pilot plant testing in the BFS phase,
- Assumed that the target specification for residual moisture of the final product is minimum 9%, to be confirmed by filtration test and FMP (Flow Moisture Point) for transportation of the iron concentrate.
- Preliminary grinding test results have to be confirmed by additional tests especially for the closed circuit mill control (future consideration) and IsaMills™. designs.
- IsaMil™l grinding media assumption 330 g/t.

3.15 Forward Work Program

There are several areas that will require additional focus during the next phase (BFS) of the Project. These works are summarised below:

3.15.1 Bulk Test Works

A larger representative bulk sample in the order of 1500kg is required to undertake additional test works to confirm process equipment and PFDs and evaluate the concentrate product’s sintering and pelletizing properties.

A total of approximately 20 t bulk sample is available for further test work. Supervised trials will be conducted on the pilot plant with sample analysis carried out in local laboratories and in Australia. The following test work is planned for the BFS phase:

3.15.2 Minerals Processing Test Works

In addition to the minor recommendations contained within each of the PFS verification reports the following activities will be included within the next phase test work:

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- Confirmation of optimum grind size for each grinding stage;
- Grinding circuit optimisation: The potential for reduction of the grinding duty by closing the grinding circuit and having material at the target product size bypass the grinding will be investigated. This will include both laboratory sighter test work and pilot plant trials. The impact on product grade will be closely monitored. Also included under this program will be further grindability test work in order to provide accurate data for grinding mill sizing and Project power consumption;
- Once the grinding and magnetic separation circuits are optimised, the balance of the bulk samples will be processed according to the final flow sheet. A pilot scale IsaMill™ will be used for this purpose. The final concentrate produced will be provided to potential customers for sintering pot test work.
- Magnetic separation circuit optimisation: The potential to reduce the number of MIMS units will be investigated. The impact on overall Fe recovery, Mag Fe recovery and product grade will be closely monitored;
- A mathematical concentrate grade from the Davis Tube Recovery (DTR) on each sample should be done and then compared to the DTR of the sample and also compare this with actual pilot run results; and
- A continuous pilot run with representative ore and a pilot plant configuration similar to the proposed flow-sheet will be scheduled, including the use of sea water that will be used throughout the process plant.

In order to optimize the current flow-sheet TTR will:

- Evaluate options to determine if it will be viable to install separation equipment on the LIMS 1 concentrate to remove the target size material in the feed to the first grinding stage and similarly on LIMS 2 concentrate. This could have a positive impact on the grinding circuit by removing feed tonnage to the mills;
- Evaluate the merits of installing a screen to scalp out the oversize (+300 µm) material from the IsaMill™ feed;
- Investigate different separation options for removing of the +2mm fraction;
- Materials handling test work: Samples will be collected at various stages of the pilot flow sheet for materials handling test work (TUNRA test work), including hydraulic conveying testing (slurry parameterss), and material flow property and related tests. This work is needed to determine the key slurry parameterss such as settling velocity, yield stress and viscosity. Wear rate of slurry pipeline materials will also be determined. The material flow properties of the final concentrate at the moisture level stored on the FPSO as well as the FSO will be tested to provide critical data for bin and conveyor design. The transportable moisture limit will also be determined;
- Sea water trial: All pilot plant test work to date has been carried out using potable water. A trial will be conducted to compare the pilot plant operation with sea water as opposed to freshwater to determine the extent of the influence of sea water on the process;
- Determine the dilution method, factor and effect of the process water (e.g. sea water);

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- Develop a water management strategy that includes possible recycling of the filtrate from the FSO system helping in the dilution of the high TDS and other elements in the concentrator plant;
- In addition to the test work above, a continuous pilot plant run will be considered in order to de-risk the final process flow sheet. Additional bulk sample will be required for a continuous run. This material could potentially be collected during tests to determine the free flowing properties of the in situ ore; and
- TTR has engaged LFJ Consulting to undertake a “Value in use Model” for the concentrate produced from the bulk sampling test works.

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4. GEOLOGY

4.1 Geological Setting

New Zealand lies in the southwest of the Pacific Ocean astride a distinct belt of volcanic and earthquake activity that surrounds the Pacific Ocean. This is the Pacific Mobile Belt or "Ring of Fire" and the activity results from the structure of the Earth's crust. New Zealand straddles the boundary between the Pacific and Indian-Australian plates. To the north of New Zealand and beneath the eastern North Island, the thin, dense, Pacific plate moves down beneath the thicker, lighter Indian-Australian plate in a process known as subduction; within the South Island the plate margin is marked by the Alpine Fault and here the plates rub past each other horizontally; while south of New Zealand the Indian-Australian plate is forced below the Pacific plate. Plate movement results in volcanic activity in the North Island and in earthquakes that are felt throughout the country.

To understand New Zealand’s current geological setting and geographical features the past is the key to appreciate how this occurred and how the land and sea has diverged greatly during the geological past. The present-day shape of New Zealand is well recognised, however millions of years ago the relative positions of land and sea were quite different. Some hundreds of millions of years ago a super-continent (Gondwanaland), which included the present-day continents of South America, Africa, Australia, India, and Antarctica, existed in the southern hemisphere surrounded by sea. The New Zealand area was situated on the edge of Gondwanaland. Since that time, movements from within the Earth have caused the constituent continents to break away from one another and move to their present positions - a process which is still continuing. The original super-continent was not stationary; it too responded to forces from within the Earth so that it was in different positions with respect to the Earth's poles at different times. Thus at various times the fossil record and the rocks may show evidence of cold, temperate, or tropical climate.

The very oldest sedimentary rocks in New Zealand were deposited in basins lying offshore from the landmass of Gondwanaland. Subsequently the sediments were disrupted by tectonic movements and pushed up to form land that eventually became parts of Australia, Antarctica, and New Zealand. Later, an extensive series of depositional troughs developed off-shore, which collected sediment eroded from adjacent continents for nearly two hundred million years. Here the "greywacke" rocks that now make up the main ranges of New Zealand were formed. This era came to a close about 110-120 million years ago when tectonic plate movements uplifted the sediments to form new land. A period of quiescence followed when erosion reduced much of the mountainous land to a low-lying, almost level plain. It was during this time that the split between Australia and New Zealand occurred.

As the land was reduced in height, low-lying swampy areas developed, which are now the sites of major coalfields. Eventually the sea started to cover the land, firstly depositing sediments in marginal basins, and later over most of the New Zealand area. Then, about 15 million years ago, the mainly quiet period ended, and New Zealand once again experienced tectonic activity, mountain building and widespread volcanic activity. In more recent geological times, the effects of rises and falls of sea level, due to alternating glaciations and warmer intervals, were superimposed on the tectonic events.

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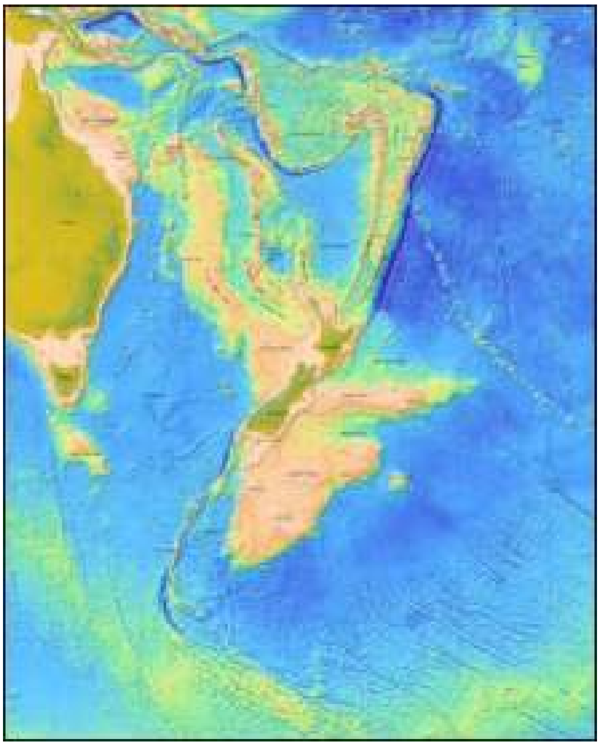

Figure 4-1New Zealand's continental shelf and tectonic setting within the Australian and Pacific Plate

4.1.1 Iron sands deposits

The nature, extent and provenance of New Zealand's onshore iron sand deposits have been well researched and investigated. Titano-magnetite iron sand forms Quaternary onshore beach and dune deposits and offshore marine deposits along 480 km of coastline from Kaipara Harbour south to Wanganui on the west coast of the North Island. The onshore deposits include the present beach and dune sand, and older coastal sand deposits that have been preserved by uplift due to faulting and/or lowering of sea level. This is evident with black sand beaches and dune systems along this coastline. The deposits have been well defined and in recent years attention has been given to the nature and extent of the offshore iron sand resource potential.

4.1.2 Source of Iron sands

The liberated titano-magnetite mineral contained in iron sand deposits has been eroded from the Quaternary andesitic volcanic rocks of western Taranaki and, to a lesser degree from the rhyolitic volcanic rocks of the Taupo Volcanic Zone, transported to the coast by rivers, along the coast by shallow-marine long shore currents, and subsequently concentrated by wave and wind action into beach and dune lag deposits.

Laurent (2000) investigated the dispersal and origin of the iron sands along the North Island's western coast using petrographic techniques. Shallow core samples were taken from multiple locations along the western coast in which the key tracer minerals analysed

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were titano-magnetite, orthopyroxene[5], clinopyroxene, horneblende[6] and volcanic lithics. It was ascertained that the main provenance was from the Taranaki volcanics, with the Taupo Volcanic Zone, providing a secondary input. A limited amount of material contributed also from localized, generally older volcanic outcrops and sediments. From the south to the north of Mt Taranaki, the primary variation was reflected by a decrease in the abundance of rock fragments, and an increase in the abundance of titano-magnetite, clinopyroxene and horneblende minerals. Winnowing of individual minerals was noted to happen over a short distance with a fining of grain size north and south of the primary source.

Figure 4-2Mt Taranaki volcano, the most recent feature of the Taranaki volcanics.

[5] The **pyroxenes** are a group of important rock-forming minerals found in many igneous and metamorphic rocks.

[6] Hornblende is a common constituent of many igneous and metamorphic rocks. Very dark brown to black hornblendes that contain titanium are ordinarily called basaltic hornblende

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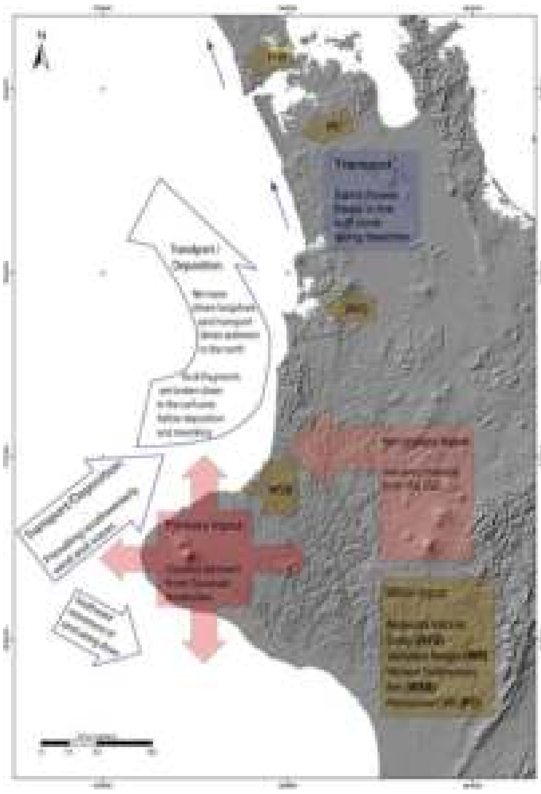

Figure 4-3The dominant controls on western coastal beach sand provenance and dispersal off the North Island (after Laurent, 2000).

The New Zealand offshore occurrence of iron sand have been known since the early 1960's, but estimates of the mineral resource are poorly constrained and to date remain unexploited.Scientific investigations have obtained a general understanding of the concentration and distribution of the offshore iron sand, through surface sampling. In 1980 Dr Lionel Carter presented iron sand concentration maps that show sediments containing >5% iron sand which are spatially restricted to the inner and middle shelves off Auckland, Taranaki and Whanganui. Elsewhere the iron sand concentrations are low, with the sediments concentrated under littoral (coastal) conditions that existed on the continental shelf during the Holocene transgression.

4.1.3 Iron sand Distribution

The highest reported surficial marine iron sand concentrations are typically associated with the inner shelf, shore-connected, Holocene muddy sand wedge that tapers seaward. This wedge offlaps onto an older gravelly sand unit, which is interpreted as a coarse grained transgressive lag deposit that ranges in thickness from about 2 to 5 m. The coarse grain sediments were deposited during the last marine transgression as the shoreface connected wave abrasion zone swept landwards during rising sea level. This unit has not been covered everywhere by Holocene sediment, but is subject to sediment reworking under the present wave climate. The shore connected sand wedge has accumulated largely since the stabilis

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ation of post glacial sea level some 7000 years ago. This unit is strongly influenced by waves and currents in the present littoral zone. Dr Alan Orpin and others describes, in a paper " Resource evaluation, exploration and current prospecting interests of west coast iron sands, North Island, New Zealand" the Whanganui Bight area as an area where active faults have created localized sea floor deformation and synsedimentary coarse grained post glacial infill of up to 20m think. Generally the distribution of the subsurface iron sands along the west coast of New Zealand is defined and their distribution and concentration influenced by a number of factors, such as current and littoral conditions, bathymetric relief and distance from the primary source.

4.1.4 Geological Model of Iron sand Concentration within TTR Mining Area

Initial exploration targets were defined by concentrating on the higher magnetic anomaly areas and establishing the *in situ* Fe grades through shallow and deep drilling. Drilling to date over the entire permit area has shown that the occurrence of higher grade (with an average 10% Fe head grade) iron sand to be patchy, and that a significant part of the permit area is generally covered by a "blanket" of lower grade sediment. This blanket is a combination of reworked titano-magnetite and Holocene marine sands and muds. However within areas of the mining area there are occurrences of iron sand which has higher concentrations from the sea floor to depths of up to 11 Metres.

From the interpretation of the exploration information, the geological model can be represented as an area, consisting of remnant coastal dunes that were constructed at a time of lower sea level. These paleo-dune features are part of an ancient river system in which dunes formed contemporaneous at the mouth of the river(s) and the coast line. The rivers are locally controlled by active faulting with the iron sands within the river channels and dunes partially reworked by currents and long shore drift and are re-deposited along the shore lines of the transgressing sea. Figure 4-4 shows a schematic of how the offshore high grade deposits formed and subsequently were preserved and reworked.

Figure 4-4The south Taranaki coastline with iron sand concentrate at river / stream mouth. Tidal, wave and longshore drift enhancing the concentration of the beach deposit.

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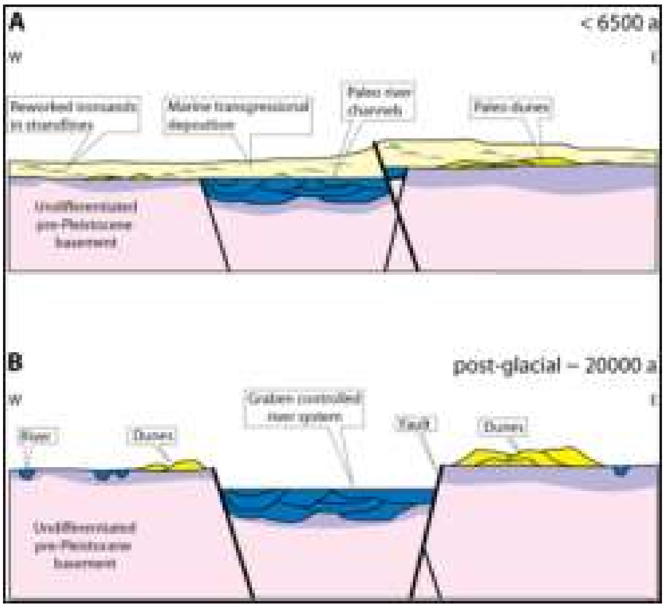

Figure 4-5Geological model of the offshore Titano-Magnetite mineral resource within the mining area

4.2 Tenements

TTR tenements are located on the west coast of the North Island of New Zealand to the north and south of Cape Egmont. TTR has been granted Exploration Permit *(EP) 54068* which covers part of the previous Prospecting Permit *(PP) 50383* off shore from Wanganui. The remainder of *(PP) 50383* is now covered by *(EP) 54270*, *(EP) 54271* and *(EP) 54272* currently awaiting approval by the New Zealand Petroleum and Minerals.

New Zealand approvals for the Prospecting, Exploration and Mining of Crown owned minerals resources is administered by New Zealand Petroleum and Minerals, (Ministry of Business, Innovation and Employment). TTR's mineral rights are assessed and granted under the Crown Minerals Act 1991, for the areas within the offshore 12 nautical mile limit, and the Continental Shelf Act 1964, which is outside the 12 nautical mile limit.

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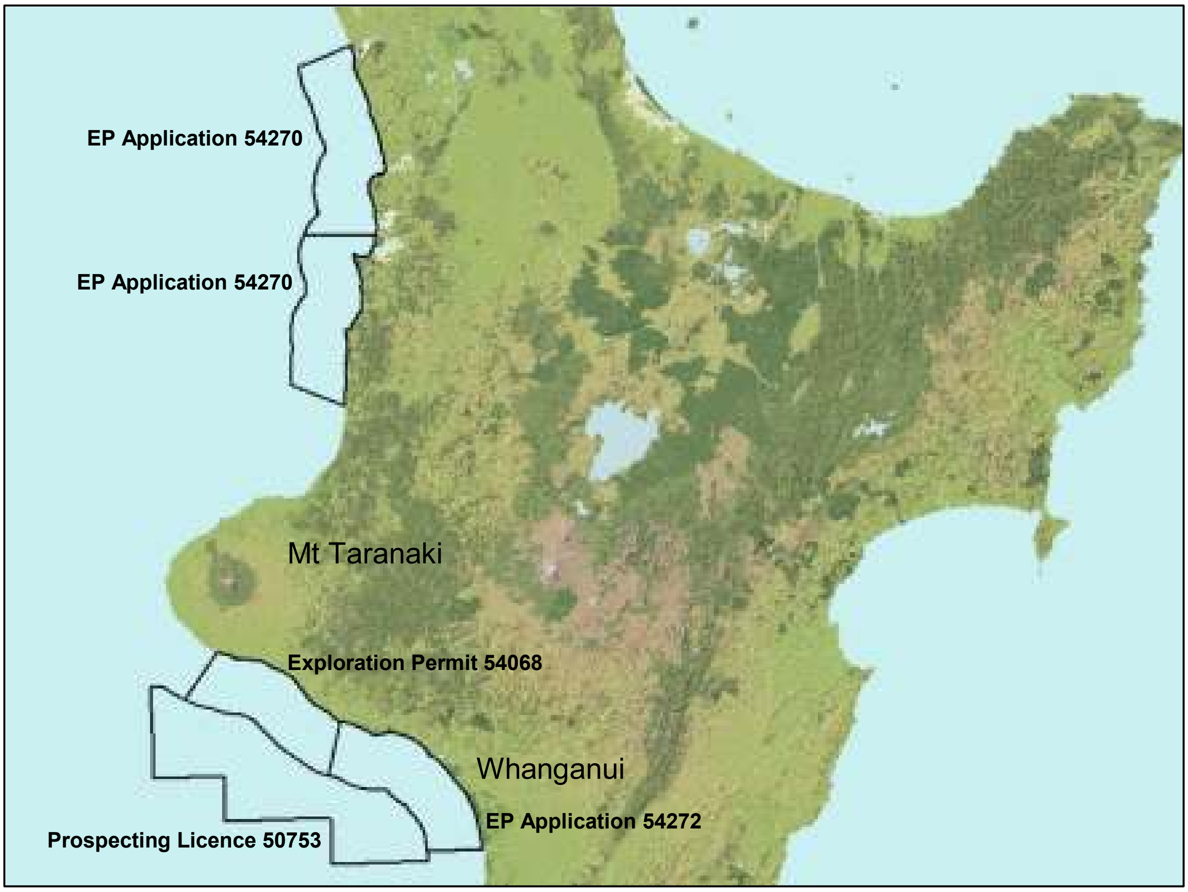

Figure 4-6Location of TTRs mineral exploration permits and licence

Prospecting Permits allow for more detailed investigation of the tenements to be undertaken. They are only applicable within the 12 nautical mile limit around New Zealand. Beyond this limit the Continental Shelf Act applies and a different licence must be applied for. TTR holds Continental Shelf License 50753 immediately south of *(EP) 54068* and *(EP) 54272*.

The table below lists the details held for each permit. The areas relating to the Pre-Feasibility Study relates to exploration permit *54068* and Continental Shelf Licence *50753*. Full license / permit documents for

CSA 50753 and *(EP) 54068* are appended. An overview of New Zealand's regulatory regime is included within Approvals Section of this study.

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Number:	50753	54068	54270	54271	54272
Commodity:	MINERALS	MINERALS	MINERALS	MINERALS	MINERALS
Type:	Continental Shelf Licence	Exploration Permit	Exploration Permit	Exploration Permit	Exploration Permit
Owners:	TTR	TTR	TTR	TTR	TTR
Location:	Taranaki	Taranaki	Waikato	Waikato	Taranaki
Operation Name:	Offshore Taranaki	Patea	Waikato North	Taharoa South Offshore	Koitiata
Status:	GRANTED	GRANTED	SUBMITTED	SUBMITTED	SUBMITTED
Granted:	17-12-10	19-12-12			
Commenced:	17-12-10	19-12-12			
Received:			12-03-12	12-03-12	12-03-12
Duration:	4 years	5 years	5 years	5 years	5 years
Expires:	16-12-14	18-12-17			
Area:	3314 SQKM	143070 HECTARE	176770 HECTARE	156320 HECTARE	158760 HECTARE

Table 4-1 Permit Details from New Zealand Petroleum and Minerals (NZ Gov.) website

4.3 Mineral Resource Exploration

4.3.1 Airborne Magnetic Survey

Fugro Airborne Services were commissioned by TTR to undertake an extensive airborne magnetic survey. From this survey, over 55,000 line kilometres of aerial magnetic data was acquired. Fugro Airborne Geo-services then undertook filtering and interpretation of this data to target sub-surface sampling locations.

The aeromagnetic data clearly shows paleo-geomorphological features, such as channel, river mouth, beach dune deposits and possibly river deltas. From this data it is modelled that during the period of low sea levels, ancient river channel and river mouth systems were the locality for iron sand concentration. Further concentration occurred in this setting through long shore drift and tidal action, with dunes placed and potentially sorted through aeolian accumulation. With the marine transgression, the encroaching surf zone would

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have partially destroyed these dune systems. Eventually silt, sand and reworked iron sand was deposited on these features. The sub surface iron sands located further offshore are that of discrete locations that coincide with the paleo shorelines (during periods of stand still circa 7k yBP and 9K yBP) and the migration of the shoreline, due to marine transgression to the current sea level.

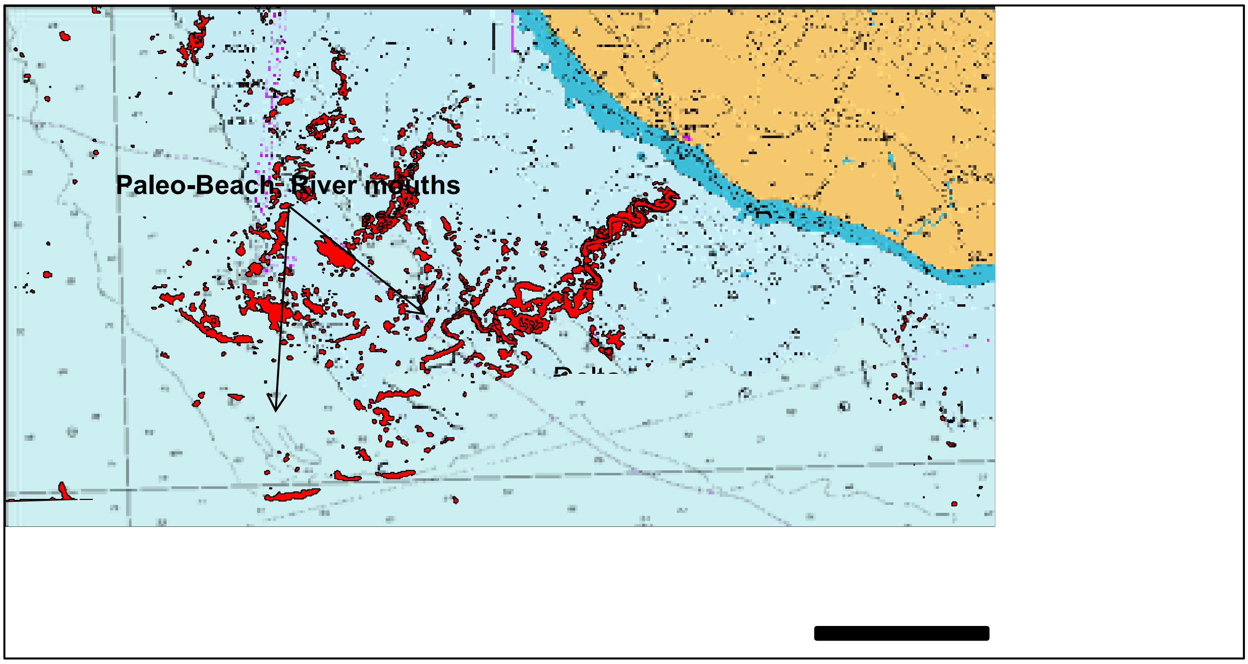

Table 4-2. The red areas highlight the magnetic anomalies over the South Taranaki Bight.

4.3.2 Drilling

Early in the company's life, TTR investigated different drilling and sampling methods. Globally nothing was considered to be a cost effective drilling technology that could meet all of TTR requirements. TTR therefore, began a long and innovative process of design, construction and development of proprietary drilling technology. With the input from an experienced offshore drilling contractor, TTR now has the technology to rapidly obtain cost effective and representative samples at depth. This has enabled a JORC resource to be defined within TTR's permits.

Two different submersible rigs have been developed to obtain the sample, a shallow system (<9 m drill string) and a deep drilling system (up to 42 m) with their applications depending on the number of holes required, water depth, and desired target depth. Both drilling rigs have a purpose built LARS (Launch and Recovery System) to ensure safe launching and retrieval of the rig.

4.3.3 Shallow Drilling

The shallow drilling rig is controlled remotely from a vessel using a system of electric and hydraulics. The shallow drill system utilises a passive (non-mechanical cutting drill head)

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Reverse Circulation (RC) drilling as the preferred method of recovering representative samples from below the sea floor. Samples are taken as composites over 1 m intervals.

A hydraulic ram is used to control the descent of the drill string and again to pull the drill string from the hole. The whole process is monitored by two cameras stationed on the rig. As this rig does not require diver support it can be deployed it in water depth of up to 60 m (with the ability to go deeper if necessary). This is a single pass drilling system, so the maximum penetration depth is 11m below the sea floor.

The drill works using a triple tube system, with high pressure water, up to 500psi, pumped down the outer tube, which jets out of the end disturbing the sand and creating slurry. High pressure air between up to 220psi (350cfm) is pumped down the 2nd tube, which in turn creates a venturi effect. The venturi lifts the slurry up the centre tube and into a cyclone diffuser on the deck of the vessel, where it is collected in marked poly-weave bags.

The driller watches the drill penetrating the sea floor, and directs the crew collecting the sample when to change bags (as each Metre mark passes by).

This rig is extremely fast and cost-effective on a shallow resource, consistently drilling up to 8 holes to 9m depth in a 12 hour day. The rig also provides an effective bulk-sampling tool (<3 tonnes), having the capacity to collect several tonnes in a matter of hours.

Figure 4-7Trans-Tasman Resources 11m shallow rig on display at the sample warehouse

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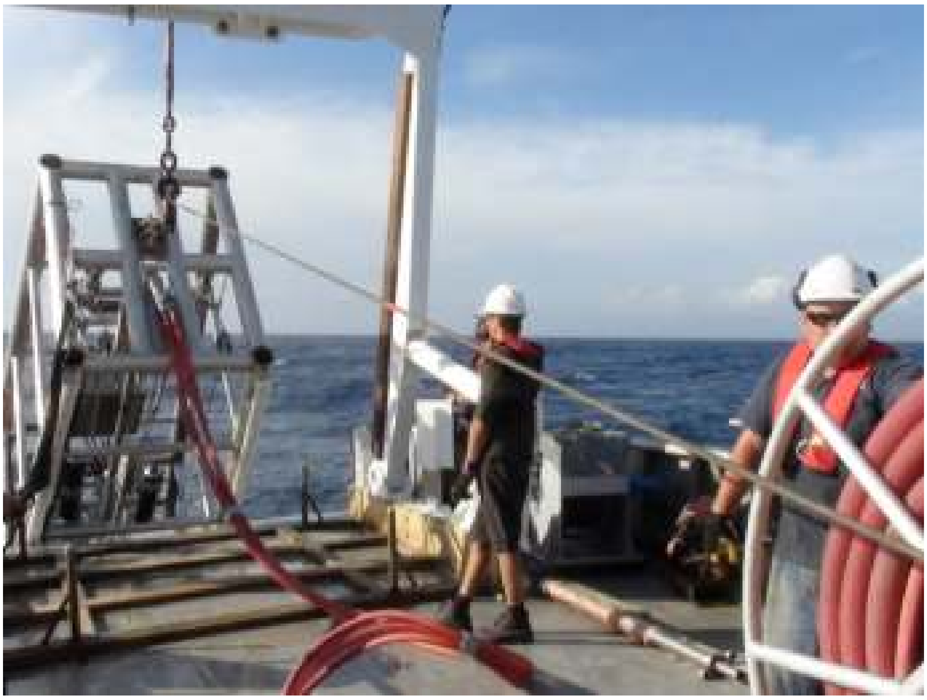

Figure 4-8Launching of the 11m shallow drill rig from the Island Leader II (2011 shallow drilling programme)

4.3.4 Deep Drilling

As with the shallow drilling, the deep drilling rig has also been built as a Reverse Circulation (RC) drill. RC is the preferred drilling method, as this method can be carried out more effectively and potentially quicker than other drilling methods.

The deep drilling rig uses a combination of compressed air, drill fluid injection, rotation and downward pressure to retrieve slurry of sample from below mud line (BML). The bottom hole assembly (BHA) is a tri-cone roller bit, which allows penetration through alternating layers of sediment. The slurry sample travels from the rig to a cyclone diffuser on the vessel, via a return sample hose. The depth BML is monitored by the diver and the expert driller on the vessel with samples taken at 1 Metre intervals.

The drilling is physically controlled by a diver on the drill platform who is directed by an expert drill supervisor located on the vessel, watching and communicating with them through standard SSBA communication equipment. Drilling is limited to dive time, which can be increased if decompression chambers are used.

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Figure 4-9Deep drilling rig and LARS on the PMG Pride during the 2013 deep drilling programme.

Figure 4-10Raising of the LARS off the PMG Pride during the 2013 deep drilling programme

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Figure 4-11Collection of drill samples from deep drilling

Figure 4-12Diver preparing for deep drilling

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4.3.5 2D seismic survey

TTR sought to gain better understanding of the geometry and geology of the sedimentary wedge within which iron sand-rich deposits occur. This sediment wedge overlies the massive siltstone/bioclastic, limestone and pebble sandstone unit of the Whenakura Group (locally called *papa* or basement). The basal contact of the sedimentary wedge with this massive mud/siltstone is a critical contact and was believed to be a strong reflector which would allow TTR to determine the true thickness of the sand wedge, allowing a more definitive volumetric assessment of any potential resource.

Two surveys have taken place, the first in August 2011 on NIWA's 14 m catamaran, RV *Ikatere*. This boomer study consisted of 20 seismic profiles, cumulating to total length of approximately 140-line kilometres, acquired over 28 hours of survey time. The water depth across the survey area ranged between ~30–55m. The data acquisition for the second seismic survey was completed on the 28th of February 2013, for an additional 20 lines at a total of approximately 140 line kilometres.

For both surveys the seismic source was a 300 Joule Applied Acoustics AA201 Boomer plate mounted on a CAT200 catamaran. For completeness, two receiver arrays were used: a Geoeel digital streamer and a Benthos analogue streamer. The Geoeel consists of 16 channels with a 1.5625m group interval, and 2 hydrophones per group. The horizontal offset between source and the Geoeel first channel was set to 10m. The Benthos 15/10S single-channel array was towed 4-5m directly behind the boomer source. The Benthos array consists of 8 hydrophones with a 300mm spacing connected in series.

Seismic processing was undertaken using Globe Claritas software. The processing routine included trace editing, quality control, source-receiver geometry setting, de-convolution, de-spiking, swell and band-pass filtering, staking, and post-stack de-convolution

The data was not tide corrected. Tide correction is usually only required when true depth below the sea surface is needed and was not required for this pilot study.

Swell filters were applied to all profiles following a protocol developed in house, as follows:

- Reflector was digitised on screen. Overall, the seismic surveys have successfully demonstrated the potential of high resolution boomer seismic to provide valuable geological information, such as the sub-sea floor geometry of sedimentary units and the spatial extent of deposits.
- A 1-D time-series filter was applied using a window of 35–55 traces (equivalent to 25-40m filter length) to the digitised sea floor function. Different filter lengths were tested.
- The residual function generated was applied as a static shift to each trace.

In some cases swell corrections were applied twice when deemed necessary. Rare spikes and extremely high amplitude, low-frequency noise, in seemingly random places of the time section, required the application of a de-spiking algorithm to all shots. This is common practise and proved efficient. The final processed data were saved in standard SEG-Y format, with the trace relative position expressed as shop-peg in position 17-20 in the 240 bytes trace header.

Processing was extremely beneficial to the quality of the seismic sections. The raw data are dominated by a very high frequency content that masks some useful signal indicative

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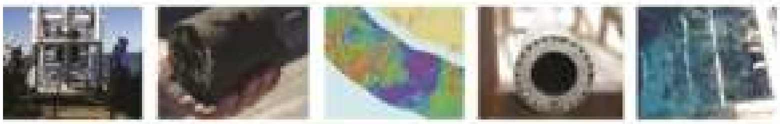

of geological reflectors. Although the processed data did not show better penetration, the overall resolution, coherence and clarity of the seismic profiles are vastly improved after processing, as can be seen in the figure 4.13.

On some profiles, the processing resolved seismic horizons below the primary multiple. The first 5-8 ms immediately below the sea floor are often masked by the seismic-source signature, evident as a very-high amplitude and low frequency sea-bottom reflector. A ghost reflection also occurred within the first 10 m.

Penetration (resolution at depth) and resolution of geological reflectors is usually very good down to the primary sea floor multiple, i.e. approximately 40ms below sea floor for most lines (which equates to approximately 30-35 m).

Typically, seismic resolution of coherent reflection is often masked by the apparition of the very strong primary sea floor multiple within the first 40ms below the sea bottom reflection, depending on the water depth. However, for the current survey some lines (107, 117, and 118) yielded better resolution below the primary multiple, which indicates that strong coherent reflectors immediately below the primary multiple can be resolved with the present acquisition/processing settings. Some of these deeper reflectors could be geologically useful.

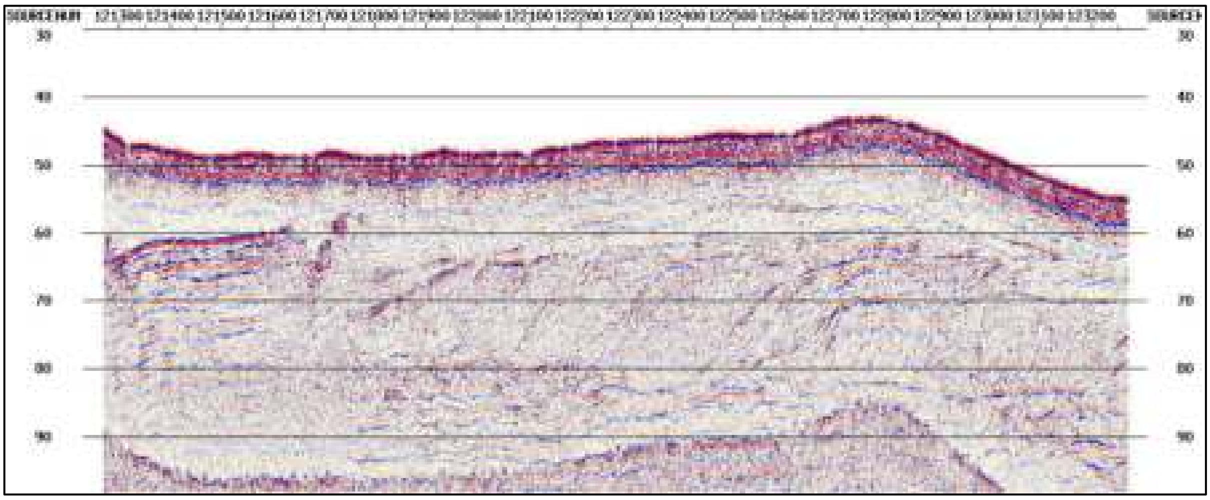

Figure 4-13Processed seismic line 107 profile showing sub-surface infilling of a paleochannel

4.4 Mineral Resource Estimation

Golder Associates Pty Ltd (Golder) was initially commissioned by TTR (TTR) to assist with the development of TTR's iron sand project in New Zealand in 2009. In November 2009 an *in situ* maiden resource of 1040 Mt at 5.88% Fe was defined. Golder (2009) details the data analysis and geological interpretation supporting the resource. In July 2011, after additional drilling, the resource was updated to 2121 Mt at 5.64% Fe (Golder, 2011).

Appended to this study is the current resource estimation report which details the latest update of the resource and includes drilling results, QAQC and statistical analysis of the drill data reported by Golder Associates. Only a few additional drill holes have been added to the resource model area since the previous estimate. The main update to the data set is the

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addition of Davis Tube Recovery results and concentrate assays for the proposed mining area.

Golder has been delivering technical solutions to the global mining sector for over 50 years, providing a comprehensive suite of integrated mining services, from concept study to mine closure. Golder has extensive practical experience in all aspects of design, planning and operation of open pit, underground and strip mines, enabling clients to realise the maximum value from mining projects.

4.4.1 Analytical Reporting

The TTR resource is a titano-magnetite iron sand deposit. Titano-magnetite is $Fe^{2+}(Fe^{3+},Ti)_2O_4$, pure magnetite is Fe_3O_4. The analysis process reduces all compounds to oxides and reports these. For head samples standard analyses return iron results as Fe_2O_3 (Hematite), Fe is calculated from the stoichiometric ratios of Fe to O in the Fe_2O_3. For Davis Tube Concentrate sample analysis iron grades are reported as Fe.

Golder has estimated and reported the Fe_2O_3 content for the head grades and Fe for the concentrate grades of the deposit based on the analytical results.

In historical documentation TTR have reported TiFe. The TiFe ("Titano-magnetite") content of the deposit can be back calculated from the Fe_2O_3 content based on the assumptions and stoichiometric formula.

Site Visits

Representatives from Golder Associates visited the TTR project from 28 to 31 January, 2010 and in July 2011. The purpose of the visits was to review the project status, audit the analytical laboratory and review the pilot plant operation.

In 2012 Stephen Godfrey and James Farrell (Associate, Senior Geologist) visited the TTR Wellington office and Porirua warehouse from 24 to 27 July.

4.4.2 Drilling

TTR has undertaken a program of offshore sampling using the services of New Zealand Diving and Salvage (NZDS). The sampling program has included sediment sampling onshore and offshore. Preliminary investigation commonly involved lowering a magnet to the sea floor to identify the presence of magnetic minerals. Within the Permit areas the return of magnetic sands from this process is almost ubiquitous. These grab samples; however, are non-representative of the deposit and so they have not been used in any analyses or estimations.

In partnership with NZDS, TTR developed a drill sampling system capable of sampling the first 6 m of the sea bed. The drill rig was diver operated on the sea floor. The drilling employs a passive triple tube reverse circulation system. In December 2010 the system was upgraded enabling it to be hydraulically controlled from the surface with diver support if necessary. In September 2011 the system was upgraded and can now drill to a maximum depth of 9 m, and most recently to 11m. The drilling rig is transported to the drill site by service vessel and lowered to the sea floor.

The original system was diver operated and restricted to operating in less than 25 m of water. Below this depth decompression is required for the diver to return to the surface. The service vessels do not carry decompression chambers. The upgraded system can operate in deeper water, with the deepest hole to date at 65 m water depth.

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The original diver supported 6 m system was used to drill the first 148 holes. A further 364 holes have been drilled with the diver-less system. The remaining drill holes in 2011 were drilled with the upgraded 9 m system.

In 2012 a new rig was developed and deployed with the ability to drill up to 42 m. This rig is diver operated on the sea floor. The rig uses a similar system to a land based RC drilling rig carrying six removable drill rods in a carousel. Six holes have been drilled with this system.

The drill rig and divers are connected to the service vessel by umbilicals. The drill rig compressor and pump are on the service vessel and all samples are returned by bull hose to a cyclone on the deck. The system includes full video contact between the sea floor rig and the boat. Divers also have video and audio contact with the surface crew. Drilling is monitored by a drill supervisor on the boat.

Drilling is weather dependant. The tenements are exposed to the storms of the ‘roaring forties’ that come across the Tasman. During the worst storms even Wanganui harbour is unsafe.

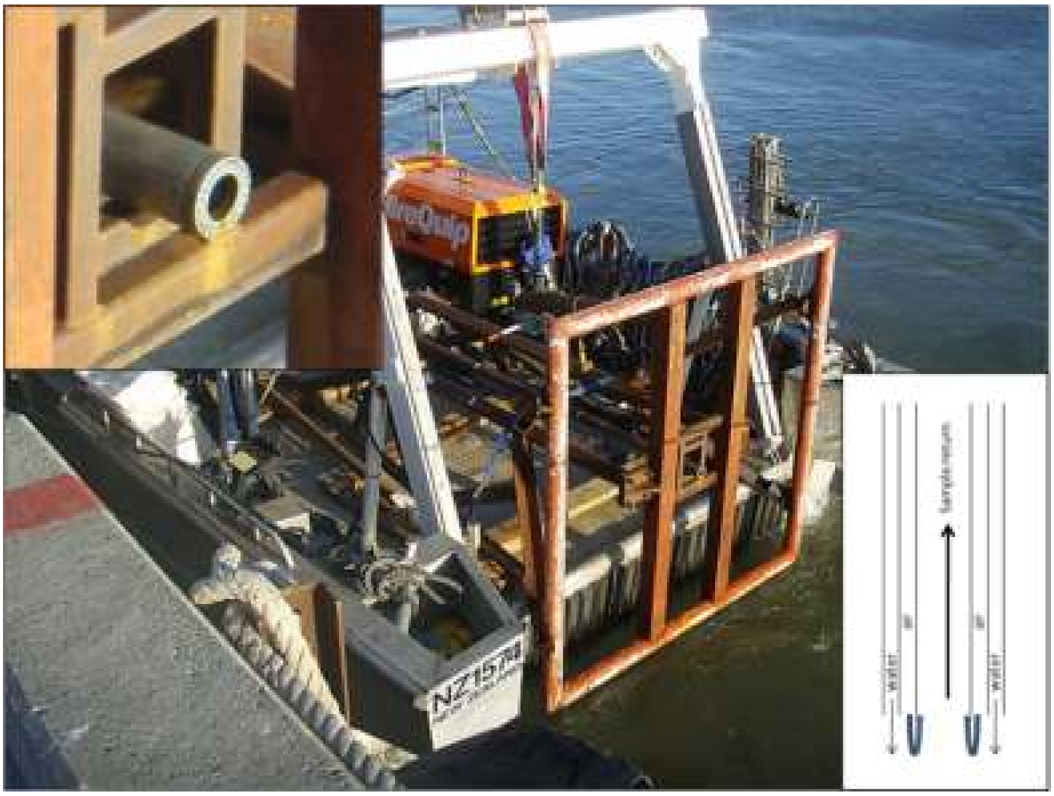

Figure 4-14 Drill Rig on The Shoman. Inset - Bit Detail and Circulation Diagram

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Figure 4-15 Drilling is Diver Operated and Monitored from the Boat

Figure 4-16 Cyclone and Sample Collection

4.4.3 Site Visit

The complete drilling and sampling system has been constructed by NZDS. In order to ensure the effectiveness of the drill system and the veracity of the samples, in 2010 a Golder representative spent a day on the service vessel the *Shoman* and observed the drilling of three holes in the Graham Banks area.

The drill system uses a 75.75 mm OD bit and 75 mm OD pipe (approximately NQ). The drill used a single rod with a 6 m stroke. On the sea floor the diver releases the drill rod which penetrates under its own weight with most of the work being done by the hydraulic cutting action of the bit. Water is pumped down the outer tube and air down the inner tube with angled jets creating both a cutting and venturi-type effect to raise the sample. Drilling

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through sands is quite smooth and effective. If the drill encounters shell beds penetration may be physically stopped. Originally, a blast of air was used to get through shell beds; however this resulted in abnormally large samples as the blast created a cavity which then collapsed.

Golder advised that these air blast samples should be flagged in the database and not used for any resource analysis work. The system later employed a hand operated winch and now uses a hydraulic system to exert down force on the drill rod to assist in penetrating shell beds.

The returned samples were collected from the base of a cyclonic separator. The size of the samples is normally consistent with the size of hole being drilled. When the downward progress of the drill is stopped the system returns clean water to the cyclone indicating there is no contamination from material inflow and that the drill is returning only material from the drill hole.

The drill system will have some issues with larger particles not returning in the system as there is no cutting bit to break them up. These larger particles make up a very small proportion of the material being sampled and not should have a significant impact on the resource. The envisaged dredging/processing system that would mine a deposit like this would screen out anything larger than 2 mm, so any contained mineralisation has no material impact on the resource.

The Spectrachem laboratory was visited in 2010 and 2012. The sample processing and analysis system was inspected during both visits, with the 2012 visit focussing on the DTR samples. In both instances the laboratory was observed by Golder to be performing as expected.

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Figure 4-17 Deep Drill Rig TTR Yard Porirua

4.4.4 Sampling

Samples are bagged, labelled clearly and stored on deck until the return to harbour. A preliminary log of the samples is made while at sea and a magnetic susceptibility reading taken.

All samples are temporarily stored in Wanganui Port before being transported to the TTR Porirua warehouse. At the warehouse the samples are dried and split into eight. One split is sent for chemical analysis and another for geological logging. A field magnetic susceptibility reading is taken from chemical analysis sample. The remaining splits are re-bagged and stored.

Chemical analysis (head sample) is sent to Spectrachem for XRF analysis and returns the analysed suite to TTR. For the 2010-2011 drilling the logging sample was sent to the National Institute of Water and Atmospheric Research (NIWA). Samples are now logged by TTR geologists.

The laboratory screens the sample to remove all material greater than 2 mm in diametre and records the percent recovery. This material is predominantly shells and pebbles and is regarded as barren. The laboratory analysis is performed on the sub-2 mm material. The final model results need to take this into account. The model estimates the full volume and tonnes of the deposit so the estimated grades need to be diluted by the recovery.

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In 2012 selected samples were sent for Davis Tube Recovery (DTR) Analysis. The selected samples were from existing and any new drill holes in the proposed mining area. DTR analysis determines the magnetically recoverable portion of the sample by passing the sample through a high intensity magnetic field.The recovery is sensitive to the equipment set-up including particle size and magnetic intensity. The overall set-up is designed to emulate the eventual processing plant recovery but is at a laboratory scale. Some scale up factor may eventually be required in estimating an ore reserve. The recovered magnetic concentrate undergoes XRF analysis and returns the analyte suite as listed in the resource estimation tables. Note that the concentrate iron analysis returns Fe and the head analysis Fe_2O_3.

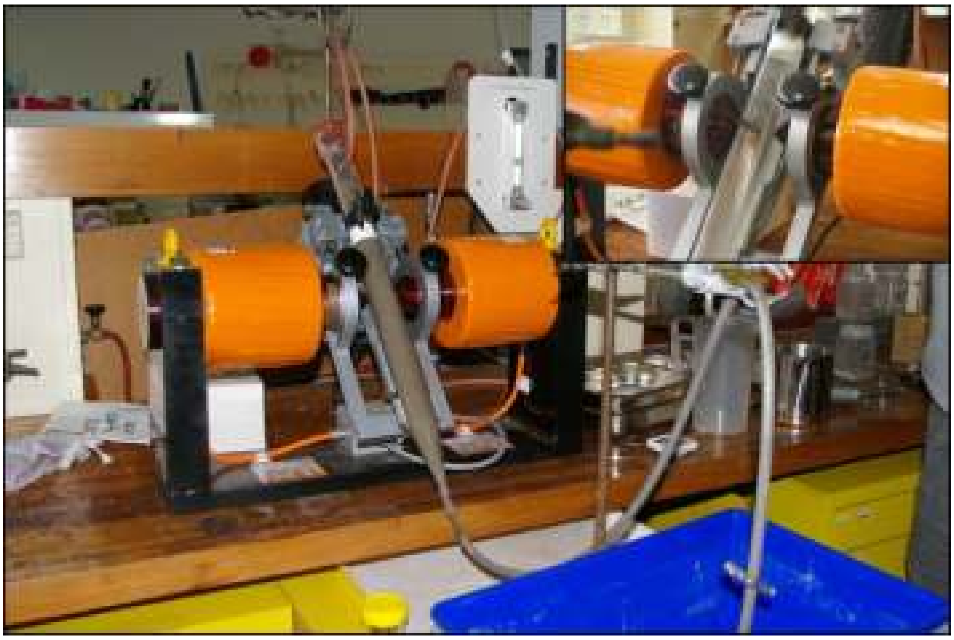

Figure 4-18 Davis Tube

4.4.5 Pilot Plant

As part of the resource validation process the metallurgical pilot plant was observed operating during Golder's 2012 site visit. The pilot plant, a scaled down version of the anticipated final processing plant, is located at the Porirua warehouse. Multiple bulk samples have been collected from the proposed mining area for the pilot plant test work. The sample was obtained using the exploration drill rig. The pilot plant screens the sample at +20 mm then +2 mm with the sub-2 mm fraction going through a first pass Medium Intensity Magnetic Separation (MIMS) and Low Intensity Magnetic Separation (LIMS).

The recovered concentrate is ground by ball mill to 53 µm (P80) and run through LIMS three times producing a final concentrate. JORC (2004) in defining a Mineral Resource requires that "there are reasonable prospects for eventual economic extraction". The successful production of concentrate by the pilot plant demonstrates that it is possible to recover titano-magnetite from the TTR iron sand deposits. Golder was provided with a

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comprehensive GIS data set and the geological drill hole database. Topographic and bathymetric data was extracted from the GIS data set along with miscellaneous geographical information, e.g. coastlines, rivers and place names. The GIS data set also included magnetic geophysical imagery. TTR also provided documentation for their drilling, sampling and database procedures.

4.4.6 Drilling for Mineral Resource Estimation

The November 2012 resource update is based on 606 drill holes containing valid analytical results for 3284 samples representing 3296 m of drilled material. The diagram below illustrates the locations of all drilling used in the resource estimate highlighted by drilling season. Holes drilled during the recent 2013 drilling programme and the 2012 programme in the northern tenement are not shown.

Within the proposed mining area 83 drill holes have had samples re-analysed for Davis Tube Recovery and the recovered concentrate analysed by XRF. The table below summarises the number of drill holes and samples available to each resource model estimate.

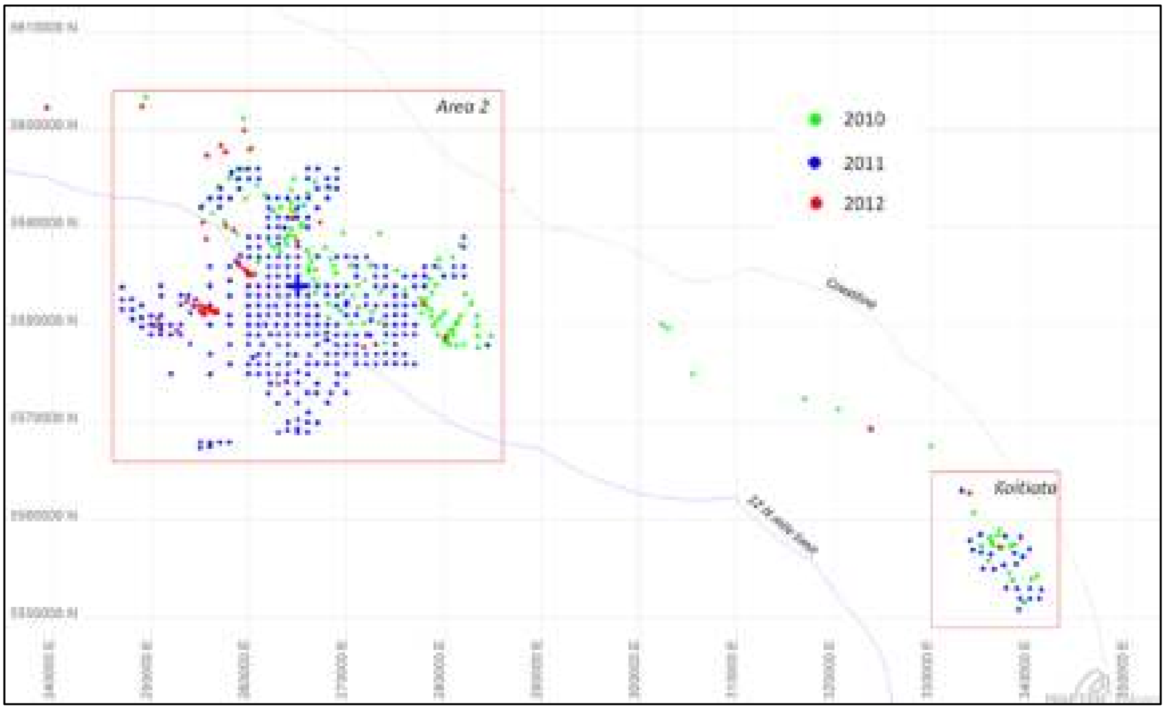

Figure 4-19Drilling Locations - TTRs Iron sand Deposit

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	Head Analysis		DTR/DTC Analysis	
	Drill Holes	Samples	Drill Holes	Samples
Area 2	497	2620		
Koitiata	44	205		
Proposed Mine Area			83	643

Table 4-3Model Area Data

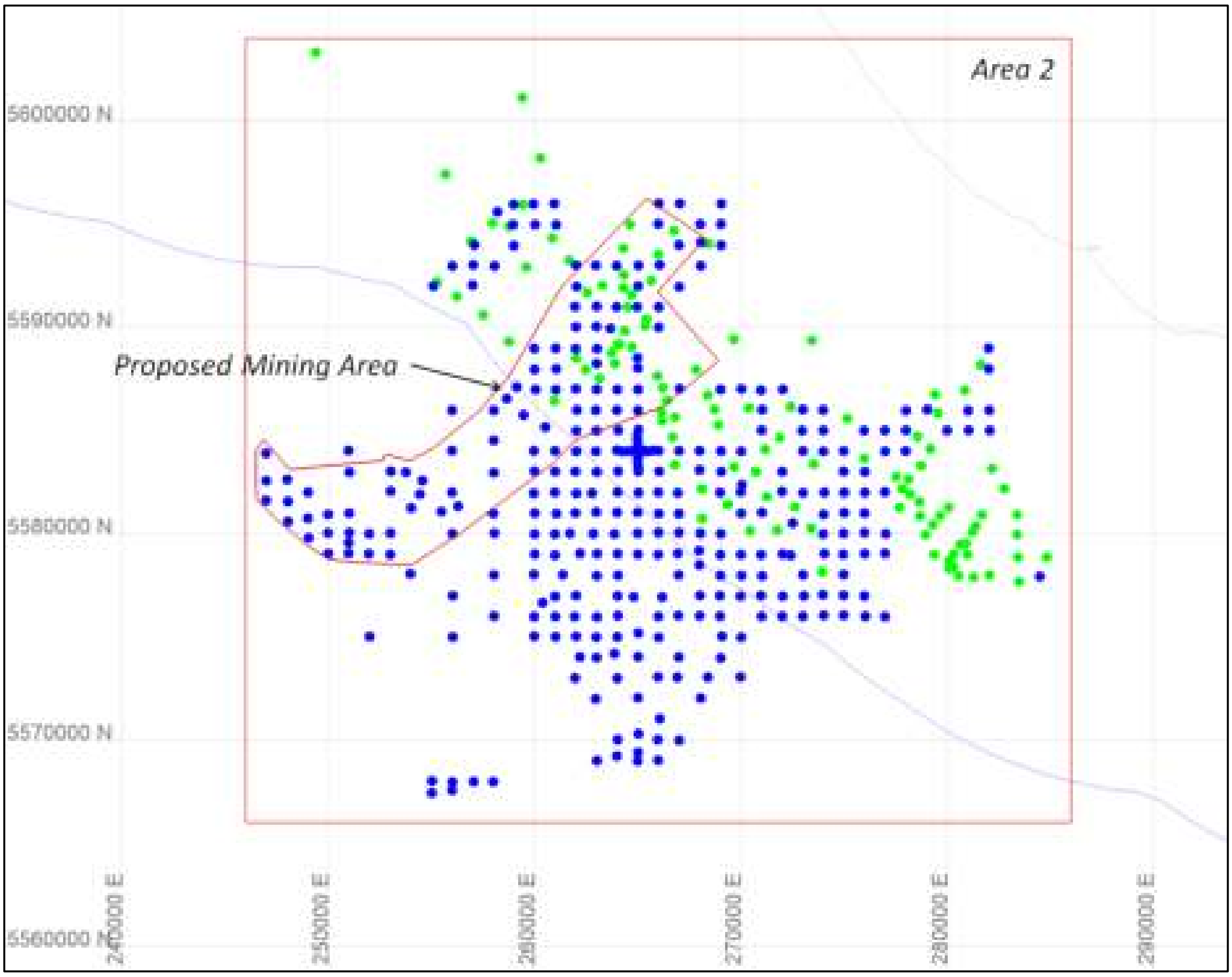

Figure 4-20Drill Holes in the Proposed Mining Area

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4.4.7 Density

Mineral Resource and Ore Reserves, although typically stated in terms of grade and tonnage, are estimated in terms of three parameterss: grade, volume and density. Tonnes are the product of volume and density so for good estimation of the resource tonnes a reliable density value must be used for the deposit being evaluated. For a resource estimate the *in situ* dry bulk density is required to estimate the *in situ* tonnage of the deposit.

A detailed analysis of the available density data was undertaken previously by Golder in 2010. From this work the *in situ* bulk density was defined using the Fe regression developed from the calculated theoretical bulk density corrected for measured results. The dry bulk density is calculated by the formula ((Fe_2O_3 *0.6994)+81.191)/51.064 where Fe_2O_3 is 69.94% Fe.

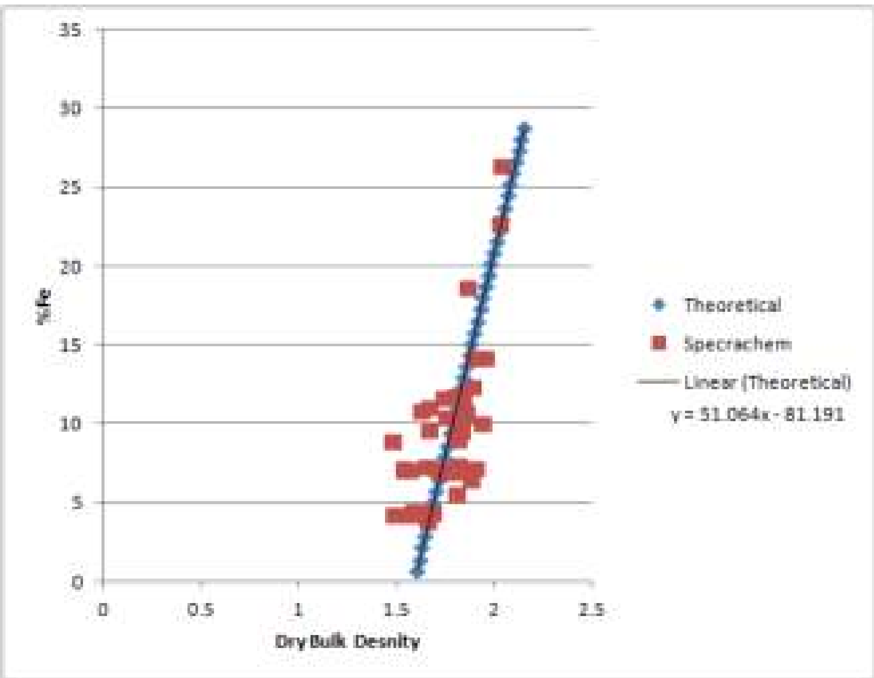

Figure 4-21 Dry Bulk Density Regression against Fe

With consideration of the potential compaction of the sand and minerals other than quartz making up the non-magnetic portion of the sand Golder considers these bulk densities are likely to be slightly conservative. At time of the PFS write up a review of the *in situ* bulk density was undertaken. TTR believes that the *in situ* bulk density used to estimate the mineral resource has potentially under estimated the bulk density by approximately 8% to 10%. This updated assumption on density will be assessed and if ascertained will be corrected and reported in late Q3 as part of the company releasing a new JORC compliant Resource Statement and Ore Reserve.

4.4.8 Metallurgical Recovery

In the mineral sand industry the mineralogy and quality can be secondary considerations to the recoverable percentage of heavy mineral. Magnetite and mineral sand deposits are commonly reported with a recovery. For deposits containing magnetically recoverable minerals DTR analysis provides this information. The recent DTR analyses by TTR now

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provide recoverable resource figures for the proposed mining area. The pilot plant work, when complete will provide plant recovery and efficiency figures.

4.5 Mineralisation

Iron sand deposits of New Zealand are comprised principally of silica sand with minor dark green clinopyroxene, black orthopyroxenes, hornblende and titano-magnetite (Orpin, 2010). In addition to the sands the samples commonly contain up to 15% shells and pebbles. Work to date has indicated that the only magnetic mineral present is titano-magnetite.

The mineralogy and chemical analysis suggest that most of the Fe content of the sands is in the titano-magnetite. FeO, Fe_2O_3 and TiO_2 are only available for a limited number of samples. Plotting the FeO:Fe_2O_3:TiO_2 ratios identifies the mineral species as a titanium enriched magnetite.

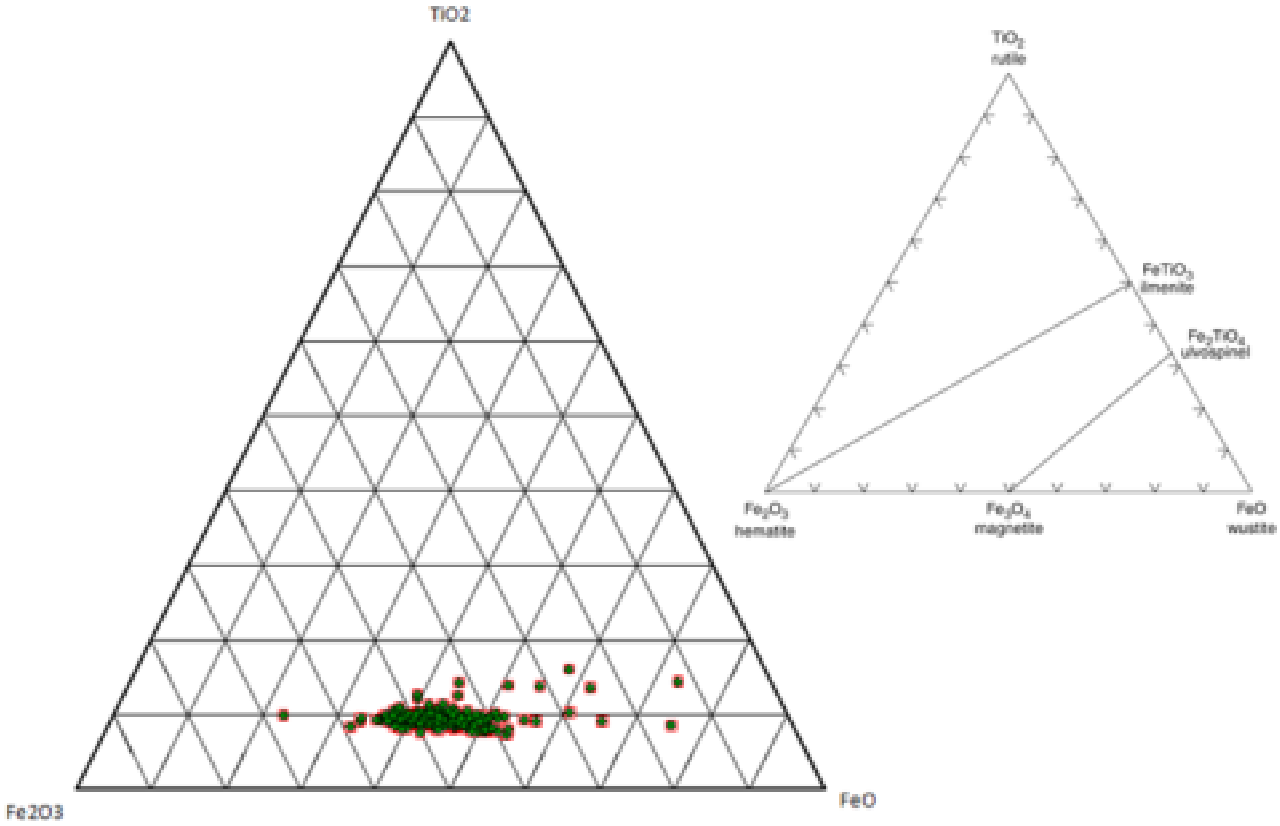

Figure 4-22: Fe_2O_3-Feo-TiO_2 Ternary Plot

4.5.1 Geological Model

The original geological model used to target drilling assumed higher grade material would be intersected where the geophysics showed a higher magnetic response.

Statistical and visual analysis of the drill hole sample data showed that the samples were relatively consistent across most locations with only a small high grade population. This conflicted with the anticipated result of getting higher grade samples where the geophysical survey showed higher magnetic values.

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The geological model was revised to include a layer of overburden covering the features being seen in the geophysical survey imagery. A blanket of reworked sands explains the relatively consistent results from the shallow drilling.

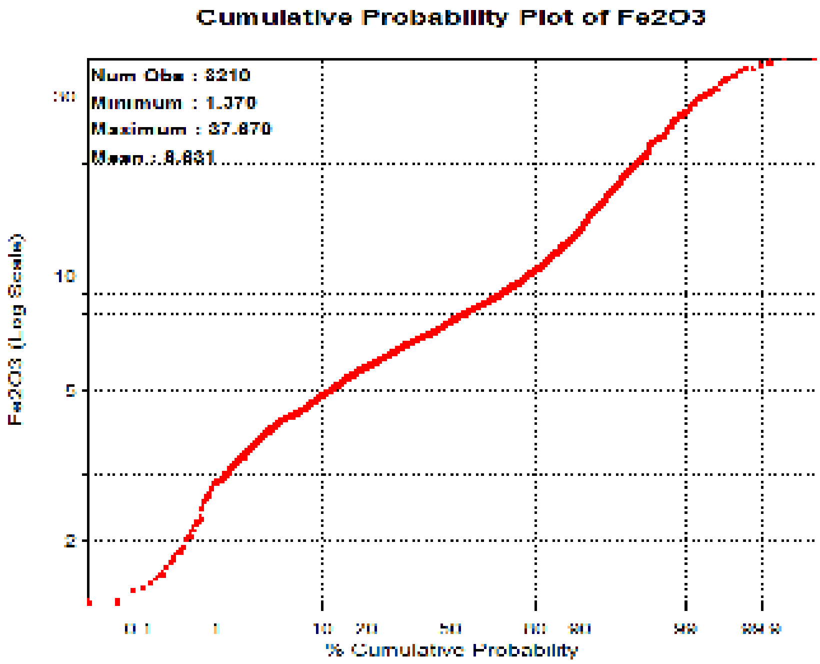

Figure 4-23 Fe2O3 - All Drill Holes

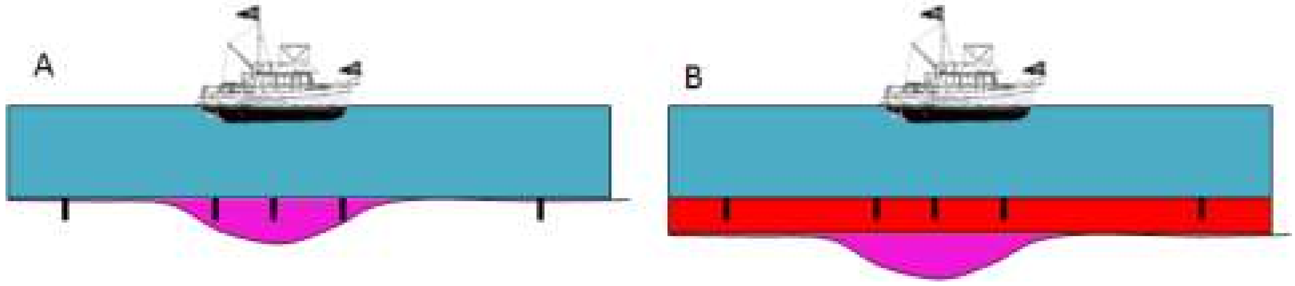

Figure 4-24 Geological Model

Statistical analysis also showed that the total population had an average grade in excess of that defined by TTR as the minimum grade required by the preliminary business model. This being the case a resource model was constructed to determine quantitatively the potential of the 'overburden'.

The recent deep drilling has shown the sands to be up to 30 m thick but the limited dataset does not assist with the geological modelling.

4.5.2 Domains

The geological model has defined an overburden layer of sand which is different to the underlying geomorphological features. However, these overburden sands are reworked from the material making up these underlying features. Based on this, a series of broad domains were defined over the area sampled by the drilling. These are illustrated below. The old river channels are defined as fluvial zones, Graham Banks is defined as dunes

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and the linear features further off shore in Domain 9 are interpreted as slumps. The remaining northern areas are defined as deltas and Koitiata as paleo beach.

The domains were further refined to limit the extent of the influence of any particular drill hole to approximately 1000 m horizontally. This was done in order to stop an unreasonable volume of material receiving an estimated grade in the block model. The 1000 m extrapolation is based on the drill spacing of 2000 m required for an Inferred Resource in this deposit.

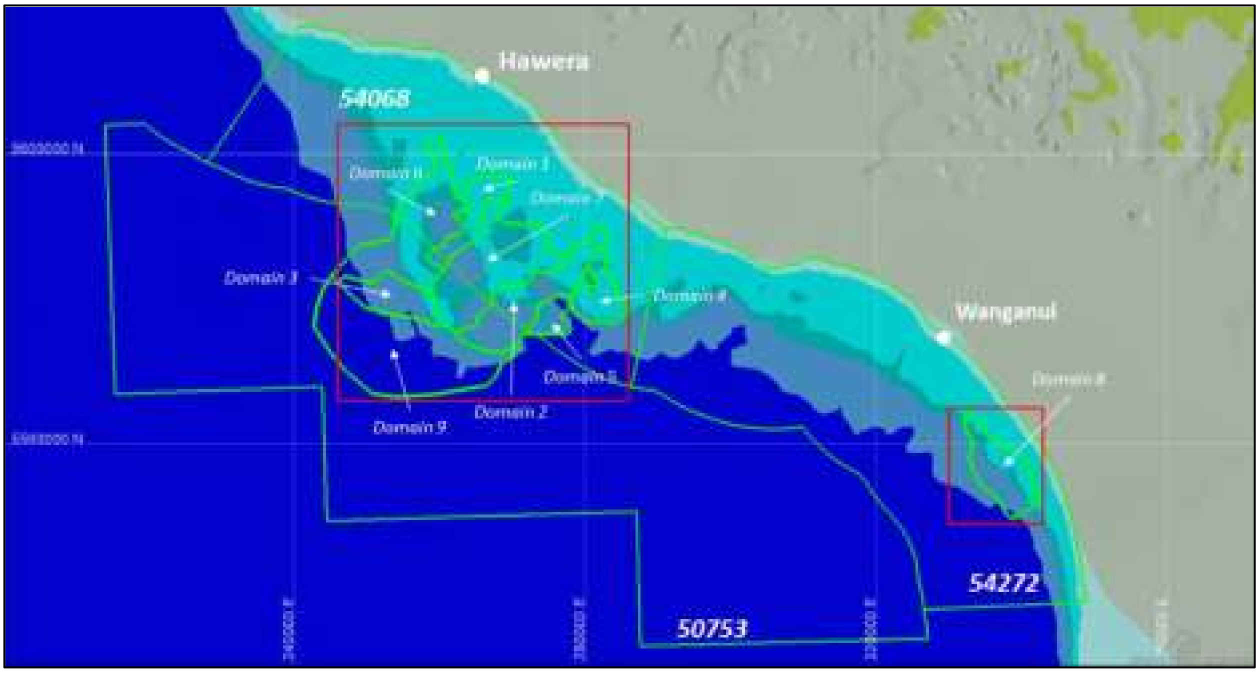

Figure 4-25 Domains of the offshore titano-magnetite Mineral Resource

The cumulative log probability plots for domains in the Area 2 (the larger red box) in the deposit and shows that there are statistical differences between the domains supporting the approach taken. Koitiata (Domain 8) is a single geographically separated from the Area 2 domains.

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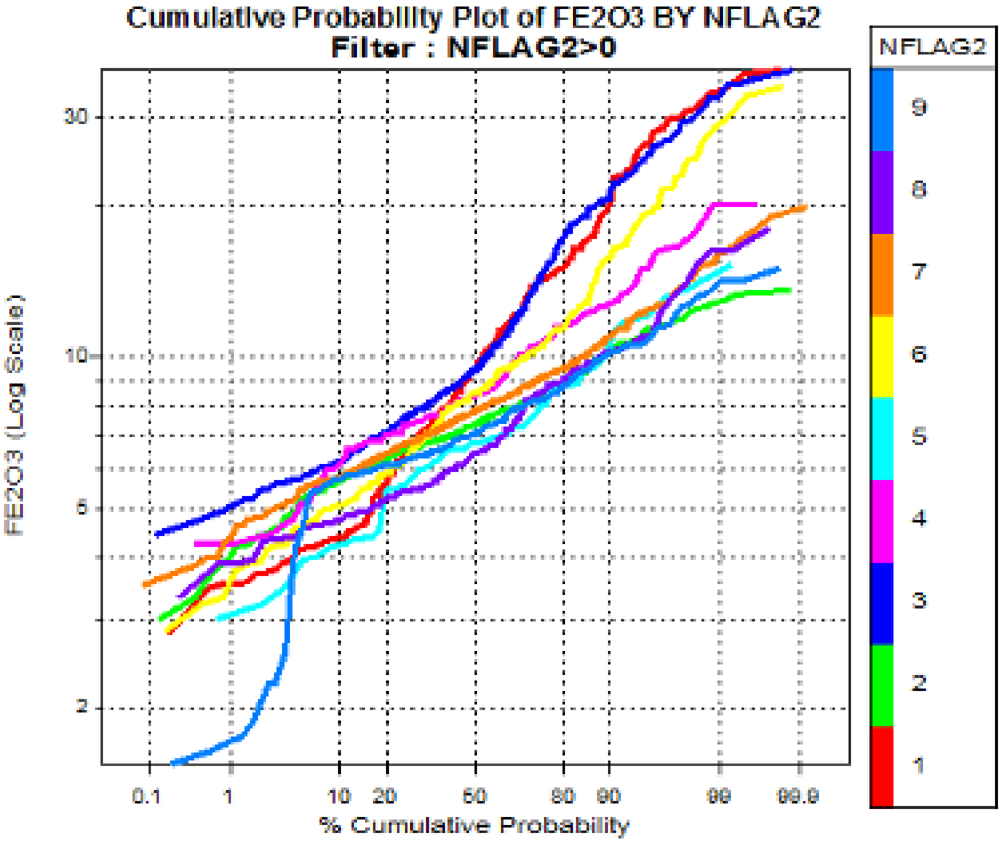

Figure 4-26 Cumulative Probability for Fe203 by Domains for the Area 2 and Koitiata Deposits.

In addition to the geomorphological (spatial) domains, a mineralised zone was applied where all samples greater than or equal to 4% Fe_2O_3 were included in the mineralised zone. The break in the population at 4% can be seen in the above graph. To define the lower boundary of the mineralisation an intersection selection method was used to generate composites of the drill hole sample database using a 4% target with a maximum of 2 m internal waste. As the proposed mining method of dredging will not be removing waste separately overburden was blended into the selection. Multiple intersections were manually assessed to determine where to define the base of mineralisation by either incorporating the subgrade material or raising the base of mineralisation.

4.5.3 Resource Estimation

The TTR offshore iron sand resource estimates are reported in accordance with the Australasian Code for Reporting of Identified Mineral Resources and Ore Reserves (JORC, 2004). The resource estimates have been prepared by employees of Golder Associates Pty Ltd. Golder and its employees are independent of TTR.

The resource estimates were classified in accordance with the Australasian Code for Reporting of Identified Mineral Resources and Ore Reserves (JORC, 2004) as Indicated and Inferred based on drill holes available as of 20 November 2012.

The physical recovery has been applied to the models. Head grades and tonnages are for all material less than 2 mm in diaMetre. Concentrate grades are for the magnetically

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recoverable portion of the sample. Concentrate tonnage is calculated from the head tonnage and DTR.

The resource model has been reported at a 3.5% DTR cut-off grade where DTR analyses are available within the proposed mining area. Outside this area a cut-off grade of 7.5% Fe_2O_3 has been used based on the statistical relationship between Fe_2O_3 and DTR.

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Table 4-4: Head Grades (%) - Proposed Mine Area - 3.5% DTR Cut-Off Grade

Class	Domain	Mt	Fe_2O_3	Al_2O_3	SiO_2	TiO_2	P_2O_5	CaO	K_2O	MgO	MnO	LOI	DTR	REC
Indicated	1	98.9	10.54	10.50	55.41	1.07	0.177	10.46	1.08	5.14	0.18	3.08	7.10	93.24
	3	358.2	12.82	12.28	50.49	1.29	0.263	11.06	1.10	5.59	0.22	2.03	8.96	98.27
	6	81.8	10.67	11.46	55.84	1.10	0.200	9.49	1.19	4.48	0.17	2.59	7.16	95.46
	7	41.6	9.25	12.51	51.68	0.93	0.231	12.28	1.14	5.24	0.18	3.57	5.43	89.92
	9	3.6	8.23	14.16	53.71	0.82	0.232	11.18	1.20	4.60	0.17	2.55	4.10	98.25
Total Indicated		584.1	11.85	11.89	52.18	1.20	0.237	10.83	1.11	5.33	0.20	2.40	8.11	96.43
Inferred	1	93.3	16.68	10.27	47.42	1.69	0.276	10.88	0.99	6.34	0.25	2.63	8.27	94.67
	3	111.6	11.33	13.11	51.13	1.14	0.261	11.04	1.17	5.19	0.20	2.36	8.75	97.23
	6	192.6	10.14	13.34	52.26	1.03	0.241	11.09	1.16	4.89	0.18	2.46	6.21	95.01
	7	49.5	12.45	9.07	45.56	1.20	0.234	16.30	0.75	7.18	0.24	4.86	6.18	86.64
Total Inferred		447.0	12.06	12.17	50.22	1.21	0.253	11.61	1.08	5.52	0.21	2.74	7.27	94.56
Indicated + Inferred		1031.1	11.94	12.01	51.33	1.20	0.244	11.17	1.10	5.41	0.21	2.54	7.75	95.62

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Table 4-5: Concentrate Grades (%) - Proposed Mine Area - 3.5% DTR Cut-Off Grade

Class	Zone	Mt	Fe	Al_2O_3	SiO_2	Ti	P	CaO	K_2O	MgO	Mn	LOI
Indicated	1	7.0	58.42	3.57	2.48	5.06	0.096	0.80	0.07	3.18	0.52	-3.21
	3	32.1	57.09	3.65	3.69	5.12	0.112	1.00	0.11	3.25	0.51	-3.05
	6	5.9	57.76	3.61	3.09	5.10	0.104	0.88	0.09	3.19	0.51	-3.14
	7	2.3	56.83	3.73	4.01	5.05	0.103	1.07	0.12	3.32	0.51	-3.07
	9	0.1	54.95	3.77	6.04	5.03	0.120	1.36	0.19	3.40	0.51	-2.90
Total Indicated		47.4	57.35	3.64	3.46	5.10	0.108	0.96	0.10	3.24	0.51	-3.08
Inferred	1	7.7	57.29	3.71	3.60	5.06	0.106	0.95	0.12	3.24	0.51	-3.10
	3	9.8	56.97	3.66	3.85	5.12	0.115	1.01	0.12	3.24	0.51	-3.03
	6	12.0	56.60	3.70	4.27	5.07	0.113	1.08	0.13	3.24	0.51	-3.01
	7	3.1	57.93	3.61	2.91	5.04	0.099	0.89	0.08	3.23	0.52	-3.17
Total Inferred		32.5	57.00	3.68	3.85	5.08	0.111	1.01	0.12	3.24	0.51	-3.05
Indicated + Inferred		79.9	57.21	3.65	3.62	5.09	0.109	0.98	0.11	3.24	0.51	-3.07

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5. MINE PLAN

TTR have identified an initial mining area, which contains four areas of higher grade iron sand. These areas were identified and delineated by aeromagnetic data and subsequent shallow and deep drilling. These high grade areas are identified as Xantia, Xantia Extension (X2), Christine and Dianne and are located within an area of 130.5 square kilometres, extending from 13 km to 35 km off the South Taranaki coastline. The mining area encapsulates the high grade areas both inside and outside the 12 nautical mile limit and can be described as an offshore submarine aeolian/alluvial/marine accumulation of iron sand in paleo channels, strandlines and dunes.

In determining the recoverable material form the *in situ* resource TTR undertook a testing programme of the drill hole samples obtained within the identified mining area and involved samples tested using DTR, which therefore has permitted the modelling of the recoverable concentrate and associated grades. This was then used as the basis of the mine schedule.

5.1 Definition of initial mining area

In May 2013 Golder Associates, updated the mineral resource model and completed a resource estimate, which was based on the drilling results up to 20 November 2012. From this a mining model regularised to a consistent block size of 250 m × 250 m × 1 m was developed. This model was used as the basis for the mine schedule created by Golder Associates Mine Engineer.

When delineating the mining area a number of factors such as, but not limited to, *in situ* head grade, bulk density, Davis Tube Recovery, metallurgy, depth of mineralization, mining method, water depth, regulatory consideration, meteorological and ocean conditions, tailings disposal, environmental effects and mine scheduling are key considerations and inputs.

The nature of the resource dictated how to effectively extract the iron sand resource, with TTR identifying two options that are considered technically feasible. The mining method options reviewed include the use of a TSHD (Trailer Suction Hopper Dredge) and a sea floor crawler or SSED (Subsea Sediment Extraction Device), similar to that used offshore in Namibia for marine diamond mining. The methods have been reviewed and described within this study, but in terms of the effect the two mining methods have on the overall area and the mining blocks, this is considered minimal.

5.2 Mine Blocks Overview

Mining blocks have been calculated and positioned within the minable resource within areas of the cut-off grade (as described in Section 5.9) with iron sand concentration varying in thinkness from two to ten metres below the ocean floor. Two scenarios have been studied, one the TSHD option the other is the sea floor crawler.

The only major difference of the mining blocks in relation to the different mining method is that of the orientation of the Christina Block. The orientation of the mining

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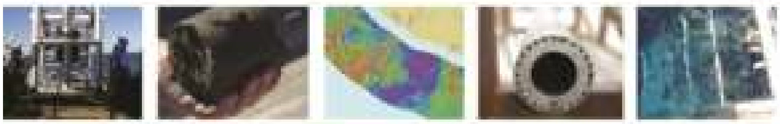

blocks take into consideration prevailing environmental constraints such as current and wind direction.

For the dredging option, two large trailing suctions hopper dredges (TSHD) will extract the material from the sea floor to fill the hopper on the dredge. This material will then be transported to the Floating Production Storage and Offloading Vessel (FPSO), where it will be processed. Based on current estimates, each dredge will have an annual throughput capacity of 30-35 Mtpa. The dredging option, with two dredges scheduled, indicates annual tonnage movements of 60-69 Mtpa of *in situ* material with annual concentrate production of 3.7-7.4 Mtpa. The resources in the mining area are depleted in nine years.

For the SSED or Crawler option, the crawler will be located on the sea floor, connected to the FPSO via an umbilical delivery tube. A winching system will be used to locate the FPSO relative to the crawler which will be mining 300 m × 300 m blocks from the base of the mineralisation, in a predetermined sequence. Based on current estimates, a remote crawler unit will have an annual throughput capacity of about 41 Mtpa.

The crawler option indicates annual tonnage movements of 41 Mtpa of *in situ* material with annual concentrate production of 2.9-4.8 Mtpa. A ten year schedule was developed, however there are still resources available for mining by the crawler beyond 10 years.

Concentrate production in both scenarios varies with the feed grade and feed recovery factor. The FPSO plant will be required to cope with these variations.

The extent of the resource within the mining area is shallow but widely dispersed. Areas between the higher grade resources are retained within the mining area to ensure continuity between the areas for the purpose of maintaining this area as a single Mining Licence / Permit, and potentially enabling lower grade sediment (below current cut-off grade) to be mined in the future.

Mining Block Name	Area (sq km)	Average Fe Head Grade	Concentrate (MT)	Ave Mine Block Thickness (m)	Depth of Water (m)
Xantia	**14.98**	**9.75**	**10.8**	**3.3**	**17 - 32**
X2	**4.96**	**12.78**	**7.7**	**7.5**	**25 - 38**
Dianne	**15.53**	**10.41**	**19.9**	**8.4**	**21 -41**
Christina	**15.16**	**8.75**	**15**	**7.8**	**35 - 42**

Table 5-1Mining Blocks over a scheduled 10 year mining life

An overview of the mining area is outlined in the table above with the figures taken from Schedule Run 15 (Golder Associates**).**

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5.3 Mine Plan Schedule

TTR commissioned Golder Associates to undertake a mining schedule over the defined mining area using a regularised mining model. This model is based on the recent resource block model, also completed by Golder Associates. From the mining model, extraction schedules where generated, utilising assumptions and key inputs to derive the yearly run of mining and grades.

The schedule also identifies area where a “royalty” applies. This is used to distinguish the resource which is situated within the 12 nautical mile limit. This is only used to distinguish between resource that inside versus outside the 12 nautical mile boundary, as they operate under different mineral tenement regimes, not for the financial model.

The mining methods used to determine the schedule rates is that of trailing suction hopper dredges (TSHD) or a remote crawler system. The modelled mineralised zone varies from two to ten metres below the ocean floor. For this scheduling study, the regularised block model has been “flattened” by adjusting the model block centres to equate to the depth of the block centre below the ocean floor.

To minimise the dredging of the lower grade Fe material, higher grade areas in the proposed mining area were defined to target an average plant head-feed grade of 10-11% Fe.

For the dredging option, two large trailing suctions hopper dredges (30K m3 hopper capacity) will extract the material from the sea floor to fill the hopper on the dredge. This material will then be transported to the FPSO, where it will be processed. Based on current estimates, each dredge will have an annual throughput capacity of 30-35 Mtpa

For the dredging option, it is assumed that both of the waste fractions (+2 mm and -2 mm) will initially be pumped from the FPSO into a designated waste disposal area on the ocean floor adjacent to the FPSO. It may be possible for the FPSO to be relocated onto the mined out areas, to backfill these mined out areas when they become available.

For the remote crawler option, it is assumed that both of the waste fractions will be pumped from the FPSO into the mined out areas as part of the remote crawler/FPSO operating sequence.

Initial information SSED supplier indicated that the integrated FPSO system would require a minimum operational 30m depth of water. The total amount of minable resource reported from the model in 30m depth or more is 148.8 Mt or 27% of the scheduled tonnes. The sediment in the shallow areas could be extracted using a lower draft dredge system scheduled within relatively benign seasonal weather periods. The full Golder Associates scheduling report is appended to this report.

Note that the golders analysis and mine plan are based on employing existing technology. TTR plans to scale up that capacity to process up 8000 tph with an annual throughput capacity of up to 50 Mtpa, as discussed in section 7.

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Mining Block

For this study, a mining block model *north_acc_12_02_2013_min.bmf* was created from the updated geological model by;

- Deleting geological model fields not required by running a Vulcan script file (*delete_variable.csh)*
- Set default values to zero, except *dt_loi* field using Vulcan Script (*set_defaults.csh)*
- To calculate the density of all material in a block, a calculated *in situ* density (isg) field was added, using the formula: *isg* = (sg*rec/100) + 1.5*(1-rec/100)

The SG field in the geological model is the calculated density of the -2 mm or plant head feed material. The +2 mm fraction was discarded and a recovery field recorded. For this study, the density of the +2 mm oversize material is assumed to be 1.5 t/m^3.

This mining model is a sub-blocked model with the same block model dimensions and variables as the geological model.

5.4 Mining Model Regularisation

For this study, the mining model was regularised to a consistent block size of 250 m × 250 m × 1 m. Bench tonnages for the proposed mining areas will be calculated by summing the blocks that have the block centroid within an area.

- Vulcan reblocking definition file - *north_acc_2013_250.bdf*
- Vulcan regularised model -- *north_acc_2013_250.bmf*
- During the reblocking procedure, a new *fillpc* field is created. This field represents the proportion of the original blocks within the regularised model blocks. The *fillpc* field was used to adjust the *isg*, *sg* and *sg_rec* fields to correct the reported tonnages from the regularised model. Adjusted fields *isg_adj*, *sg_adj* and *sg_rec_adj* were added to the model, using the Vulcan script file - *adj_densities.csh.*
- The *Mine* field was updated by coding the area (Mine = 1) inside the revised mining boundary string file *Mining_Area_Rev02* supplied by TTR. The default code for areas outside the mining area was 0. Note Mining_Area_Rev1 was used for the Resource estimations.

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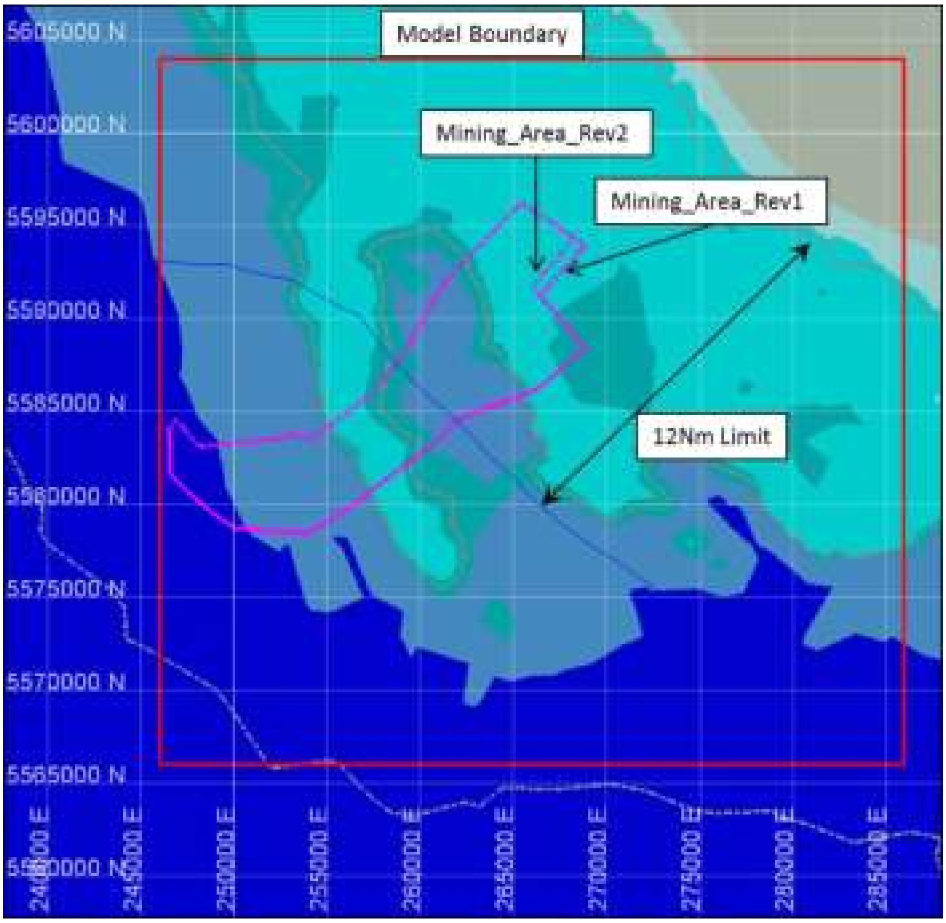

Figure 5-1 Proposed Mining Areas and the 12 Nm Limit

Below are the details of the position and dimensions of the regularised block model.

Area 2	Model Dimensions (m)						Block Dimensions (m)		
	x min	y min	z min	x max	y max	z max	x size	y size	z size
parent block	246 000	5 566 000	-110	286 000	5 604 000	0	250	250	1

Table 5-2Regularised Model Dimensions (north_acc_2013_250.bmf)

A summary of the *in situ* tonnage reported from the geological and the regularised mining models within the proposed mining boundary *Mining_Area_Rev02* are given in No cut-offs have been applied.

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	In Situ Tonnes	Fe_2O_3	AL_2O_3	SIO_2	TIO_2	P_2O_5	CaO	K_2O	MgO	MnO	LOI
	Mt	%	%	%	%	%	%	%	%	%	%
Geomodel	1471.5	10.69	12.30	52.82	1.09	0.23	10.78	1.17	5.02	0.19	2.7
Reblocked Model	1446.5	10.72	12.29	52.76	1.09	0.23	10.82	1.17	5.04	0.19	2.7
% Difference	(1.7)	0.3	(0.1)	(0.1)	(0.2)	(0.2)	(0.3)	(0.3)	(0.4)	(0.3)	(0.1)

Table 5-3 In Situ Tonnage and Grade Reports and the Effect of Model Regularisation

5.5 The Effect of Model Regularisation

Regularising the model has reduced the total reported tonnages by 1.7% with only minimal changes to the modelled grades. These changes are considered to within acceptable limits.

5.6 Scheduling Block Model

It is assumed that both the TSHD or a remote crawler system will be used to mine the material below the gently sloping ocean floor.

For this scheduling study, the regularised block model has been "flattened" by adjusting the model block centres to equate to the depth of the block centre below the ocean floor.

A *depth* field was added to the mining model, and a lava script (*rmg_block_depthbelsurf.lava)* run to calculate the depth of the block centre below the ocean floor. The model blocks were exported to a csv file, manipulated by transferring the block *zcentre* field to a new field *b_centriod_z*. The *depth* field was then copied to the *zcentre* field. The modified csv file was imported into the scheduling model *north_acc_2013_250_flat.bmf.* This model has the same block dimensions and parameterss as the regularised mining model.

An additional field *b12nm* was added to the model to code material within the 12 nautical mile limit as royalties are payable on products from within this zone..

This flattened scheduling model *north_acc_2013_250_flat.bmf* was used as the basis of the tonnages and grades for scheduling.

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5.7 Initial Dredging Areas

Initial dredging areas were defined covering most of the proposed mining area *Mining_Area_Rev02.* These initial areas are shown in the figure below and a summary of tonnages and grades reported from each area is shown in Table 5-4.

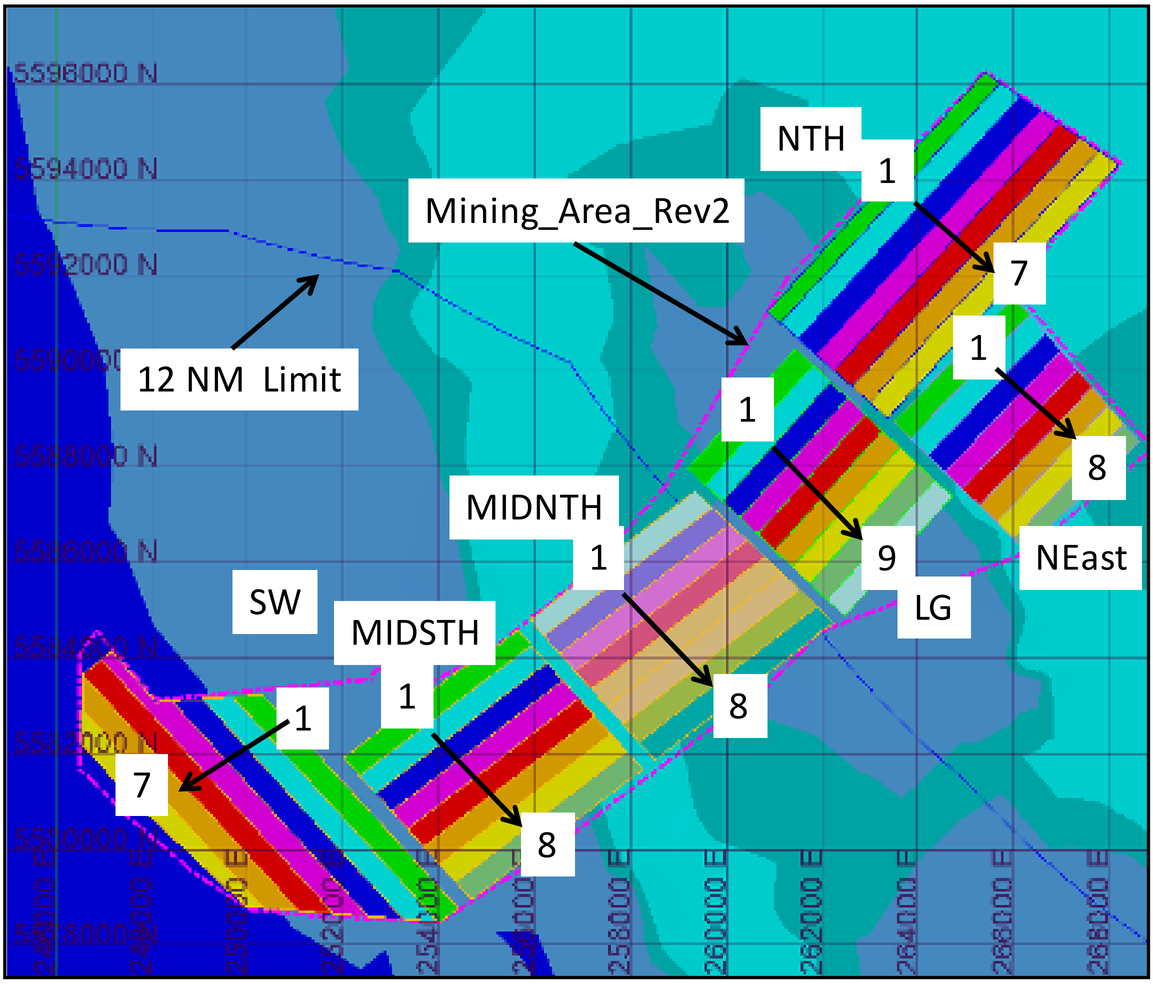

Figure 5-2Proposed Initial Dredging Areas

Initial scheduling of these areas indicated that there were a significant number of lower grade blocks within the defined areas. These lower grade blocks were having an effect on concentrate production and therefore increased the dredging capacities required to achieve TTR concentrate targets.

Feed tonnes are the plant feed tonnes after initial screening removes the +2 mm oversize material.

To minimise the dredging of the lower grades blocks Fe, it was proposed to dredge the higher grade areas in the proposed mining area with the aim of achieving an average plant head-feed grade of 10 to 11% Fe.

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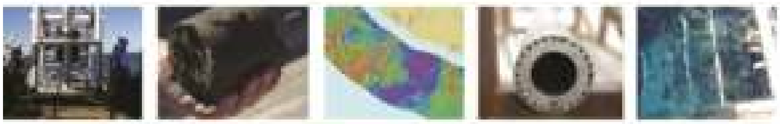
Table 5-4Initial Dredging Areas - Tonnages and Grades

Area	*In Situ* Tonnes	Feed Tonnes	F_Fe$_2$O$_3$	F_Al$_2$O$_3$	F_SiO$_2$	F_TiO$_2$	F_P$_2$O$_5$	F_CaO	F_k$_2$O	F_Mgo	F_Mno	F_LOI	F_dtr	F_rec	Conc Tonnes
	Mt	Mt	%	%	%	%	%	%	%	%	%	%	%	%	Mt
Nth	**148.6**	**139.9**	**11.10**	**10.23**	**56.82**	**1.15**	**0.16**	**8.88**	**1.12**	**4.77**	**0.18**	**3.02**	**7.17**	**93.96**	**10.0**
NEast	**89.1**	**77.2**	**12.20**	**9.31**	**48.08**	**1.19**	**0.22**	**14.83**	**0.80**	**6.75**	**0.23**	**4.31**	**7.12**	**86.64**	**5.5**
MidSth	**259.1**	**250.4**	**13.04**	**12.36**	**49.55**	**1.32**	**0.27**	**11.33**	**1.09**	**5.55**	**0.22**	**2.29**	**9.31**	**96.28**	**23.3**
MidNth	**266.7**	**251.0**	**10.86**	**13.38**	**52.09**	**1.11**	**0.26**	**10.55**	**1.25**	**4.95**	**0.19**	**2.27**	**6.66**	**94.23**	**16.7**
SW	**323.0**	**315.6**	**10.95**	**12.99**	**52.32**	**1.11**	**0.25**	**10.76**	**1.18**	**5.13**	**0.20**	**2.06**	**6.78**	**97.52**	**21.4**
LG	**105.1**	**92.6**	**6.31**	**11.20**	**59.38**	**0.65**	**0.15**	**10.02**	**1.30**	**3.86**	**0.13**	**4.26**	**2.23**	**88.27**	**2.1**
Grand Total	**1191.5**	**1126.8**	**11.12**	**12.19**	**52.50**	**1.13**	**0.23**	**10.82**	**1.15**	**5.14**	**0.19**	**2.61**	**7.01**	**94.56**	**79.0**



5.8 High Grade Areas

5.8.1 Grade Tonnage Analysis

To define these higher grades areas, a grade tonnage analysis of the blocks within the proposed mining area was done. The results, using DTR_Est grade as a cut-off is shown below.

DTR_Est	DTR_Est	Tonnes	Fe_2O_3	Fe
Cut-Off %	%	(Mt)	%	%
3	7.72	1103.6	11.81	8.26
4	8.51	928.6	12.61	8.82
5	9.65	723.4	13.69	9.57
6	10.84	563.7	14.81	10.36
7	11.76	465.9	15.66	10.95
8	12.73	380.2	16.54	11.57
9	13.48	323.1	17.27	12.08
10	14.38	263.9	18.09	12.65
11	15.33	211.9	19	13.29
12	16.45	164.3	20.07	14.04
13	17.5	130.1	20.96	14.66
14	18.31	108.3	21.72	15.19
15	19.4	84.0	22.71	15.88
16	20.64	63.6	23.67	16.55
17	21.56	52.1	24.62	17.22
18	22.17	45.3	25.16	17.60
19	23.14	35.5	25.97	18.16
20	24.06	28.6	27.01	18.89

Table 5-5 Grade Tonnage Report Based on Dtr_Est Cut-Off

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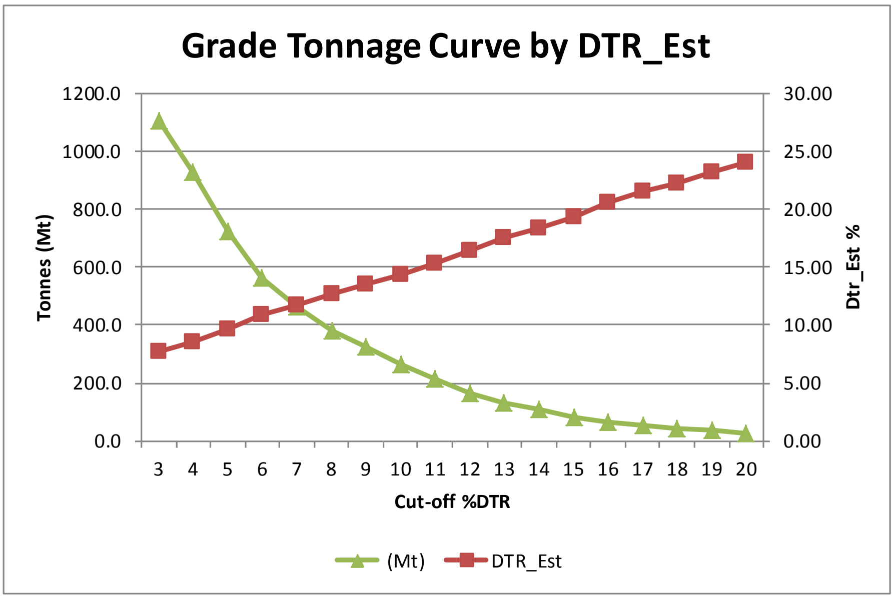

Figure 5-3 Grade Tonnage Curve - Based on DTR_Est%

This analysis indicates that a 7% DTR_Est grade cut-off would result in a plant head feed tonnage of 466 Mt with an average grade of 10.95% Fe. However it should be noted that the grade tonnage curve does show the best scenario as with any grade cut-off the curve assumes continuity of the concentration and every block is considered as equally available to be mined. That is why schedule planning was undertaken in this study to normalise the ROM grade and the tonnages expected within the mining blocks.

5.9 Dredging Option

For the initial dredging option, two large TSHD would extract the material from the sea floor to fill the hopper on the dredges. This material would then be transported to the FPSO where it would be offloaded for processing.

Based on estimates, each dredge would of had a capacity 30 to 35 Mtpa.

5.10 Dredge Scheduling Blocks

A grade shell of the block model was created in Vulcan to define the blocks above the 7% DTR_Est cut-off. This grade shell was then used to digitise the higher grade dredging strips on each bench. A bench height of one metre has been used.

The outline of the pit shell on the ocean floor, and the area/strip naming convention is shown below.

An *area* field was added to the scheduling model *north_acc_2013_250_flat.bmf.* This field was coded with the area name and strip number.

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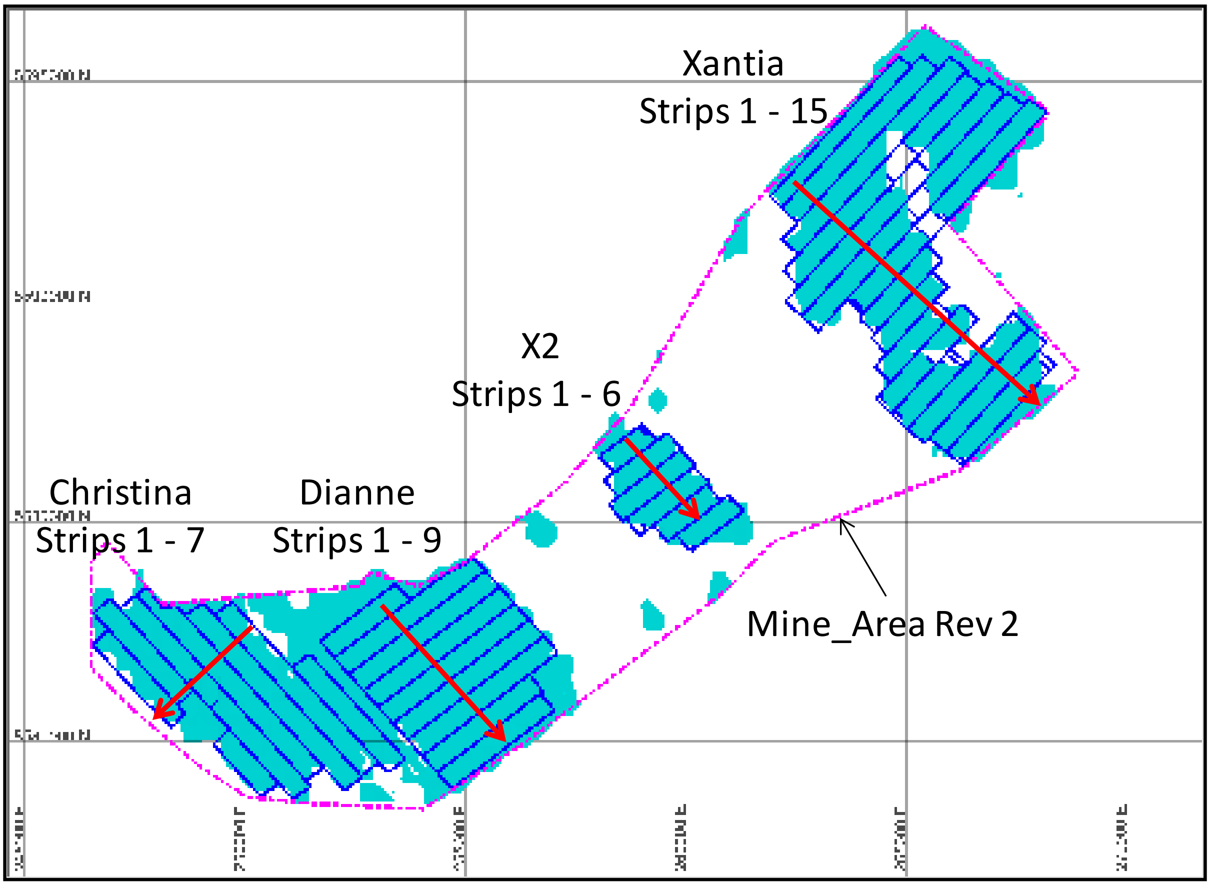

Figure 5-4Proposed High Grade Dredging Areas - 7% DTR_Est Pit Shell Outline and Strip Naming Convention

Dredging areas are generally aligned parallel to the SW - NE wave and wind direction for the area. This is the preferred alignment for directional control of the dredge. The Christina area is roughly perpendicular to the wave/wind direction and would have to be dredged in calm weather conditions. Generally, the prevailing tidal current is in SE-NW alignment. Current direction is also substantially affected by wind conditions.

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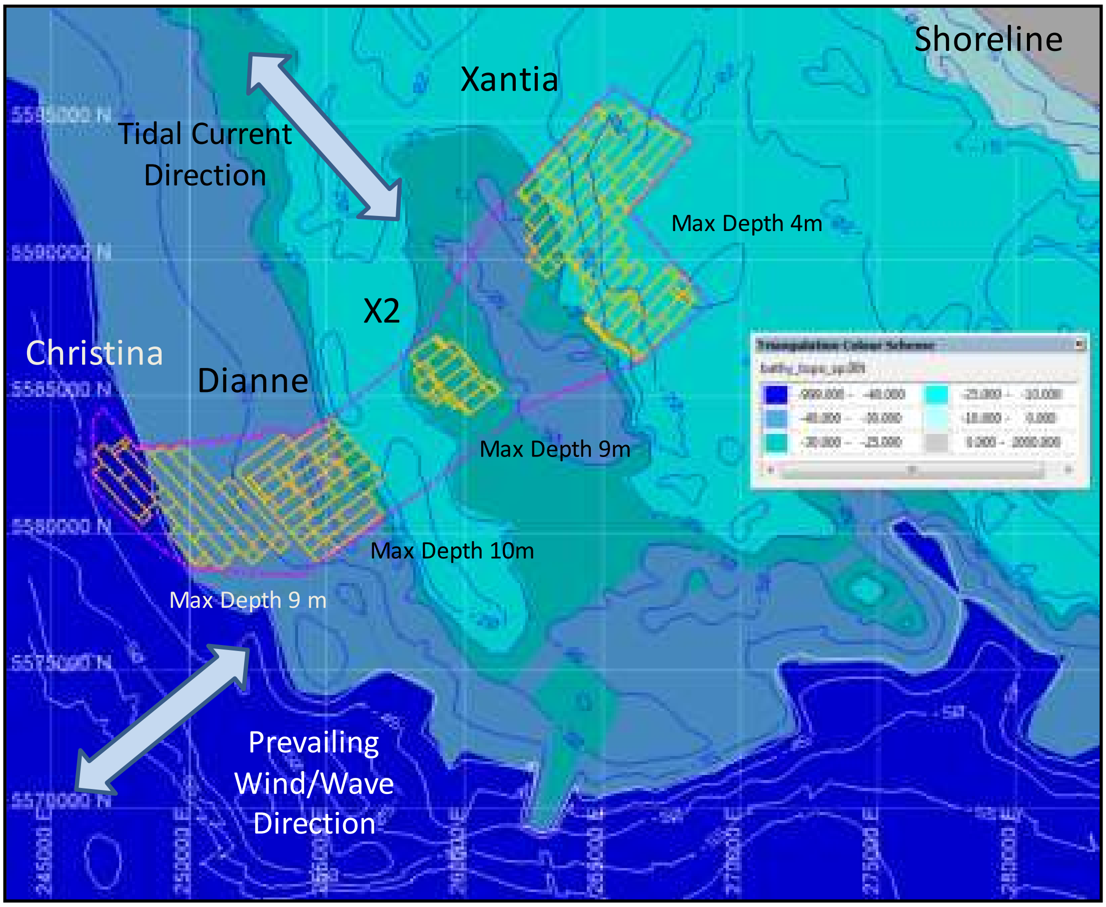

Figure 5-5 Dredging Option Areas - Wind and Tidal Directions

The Xantia area has up to 4 benches, while the other three areas are deeper and have 9 or 10 benches.

The north-eastern edge of the Xantia area has been excluded as there are no block concentrate grades for this area within the current model, due to lack of sample data.

Some low grade blocks are included in the digitised strips as these blocks will have to be dredged to access lower levels. The top 4 metres of Christina is mainly low grade material. This lower grade material will have to be dredged to access the deeper higher grade (HG) material.

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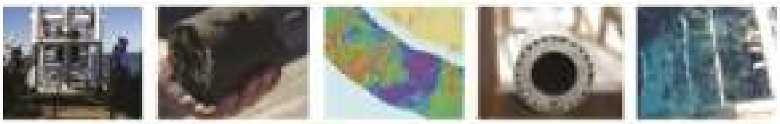

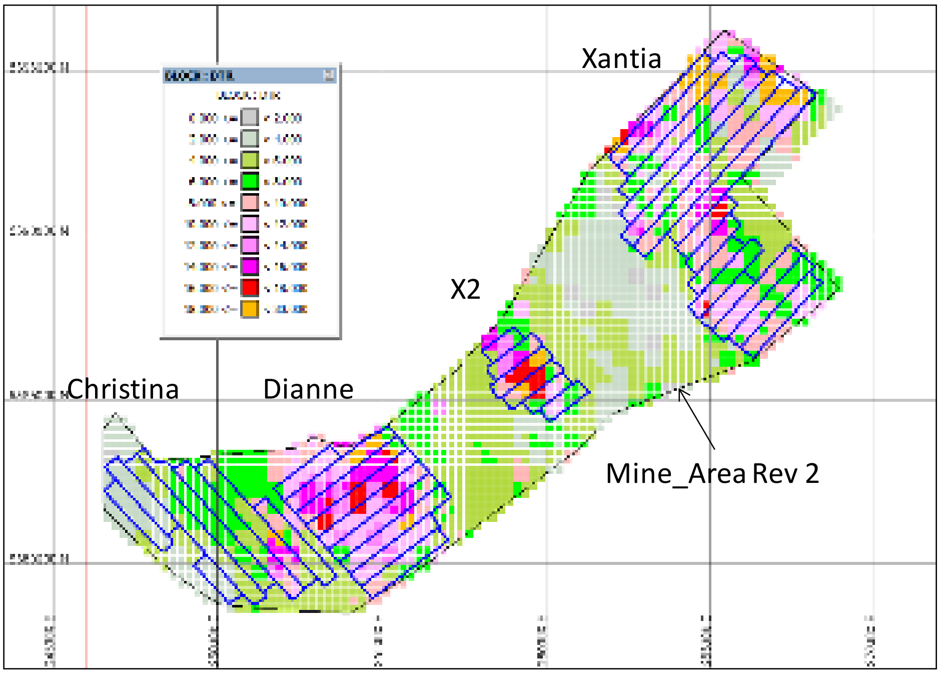

Figure 5-6HG Dredging Areas- Top Metre showing DTR_Est Grades

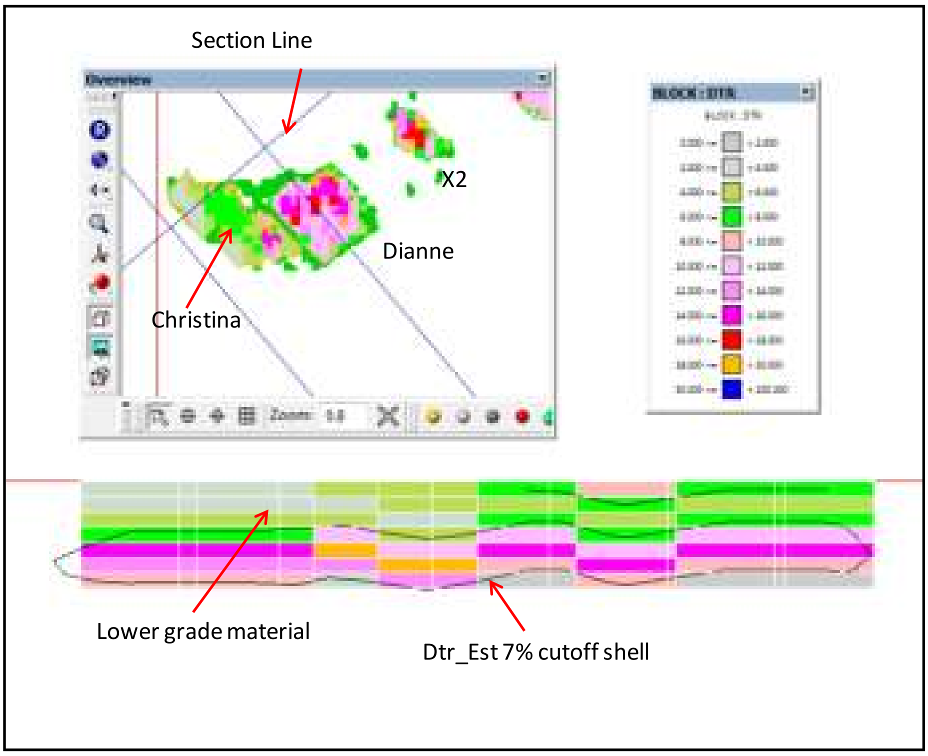

Figure 5-7Christina Section - Low Grade Material in Scheduled Blocks from Normalised Model

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Table 5-6HG Dredging Areas - Tonnages and Grades

Area	*In Situ* Tonnes	Feed Tonnes	F_Fe_2O_3	F_Al_2O_3	F_SiO_2	F_TiO_2	F_P_2O_5	F_CaO	F_K_2O	F_Mgo	F_Mno	F_LOI	F_dtr	F_REC	Conc Tonnes
	Mt	Mt	%	%	%	%	%	%	%	%	%	%	%	%	Mt
Xantia	122.9	113.5	13.94	9.27	50.37	1.39	0.20	12.03	0.88	6.13	0.23	3.54	9.54	92.55	10.8
X2	60.6	58.8	18.18	10.37	45.88	1.84	0.32	11.39	0.95	6.98	0.28	1.44	13.74	97.00	8.1
Dianne	180.9	176.3	14.88	11.84	48.48	1.50	0.28	11.13	1.04	5.70	0.23	2.09	11.30	97.07	19.9
Christina	199.4	195.8	12.25	12.31	50.80	1.22	0.26	11.36	1.06	5.66	0.22	1.99	7.99	98.00	15.7
Grand Total	563.8	544.4	14.09	11.31	49.43	1.41	0.26	11.43	1.00	5.91	0.23	2.28	10.01	96.46	54.5

5.11 Dredge Scheduling Parameterss

With regards to the previous version of the PFS report, advice from Technip Oceania Pty Ltd (Technip) the PFS Study Managers and dredging experts from the Dredging, Environmental and Marine Engineering Group (DEME), was that the dedicated processing FPSO could be located in a minimum of 50 m of water.

Other DEME provided assumptions (within the previous version of the PFS) were:

- Tailings were not to be handled by dredges,
- SPT 24 (Standard PenetroMetre Test) - i.e. free digging material
- Optimal overflow - minimum ore losses to fill the hopper
- Pumping distance from TSHD to FPSO would be 150 m
- 50 weeks/year, 90% operational workability, 81% weather workability
- Coupling/uncoupling time is 60 min/trip.

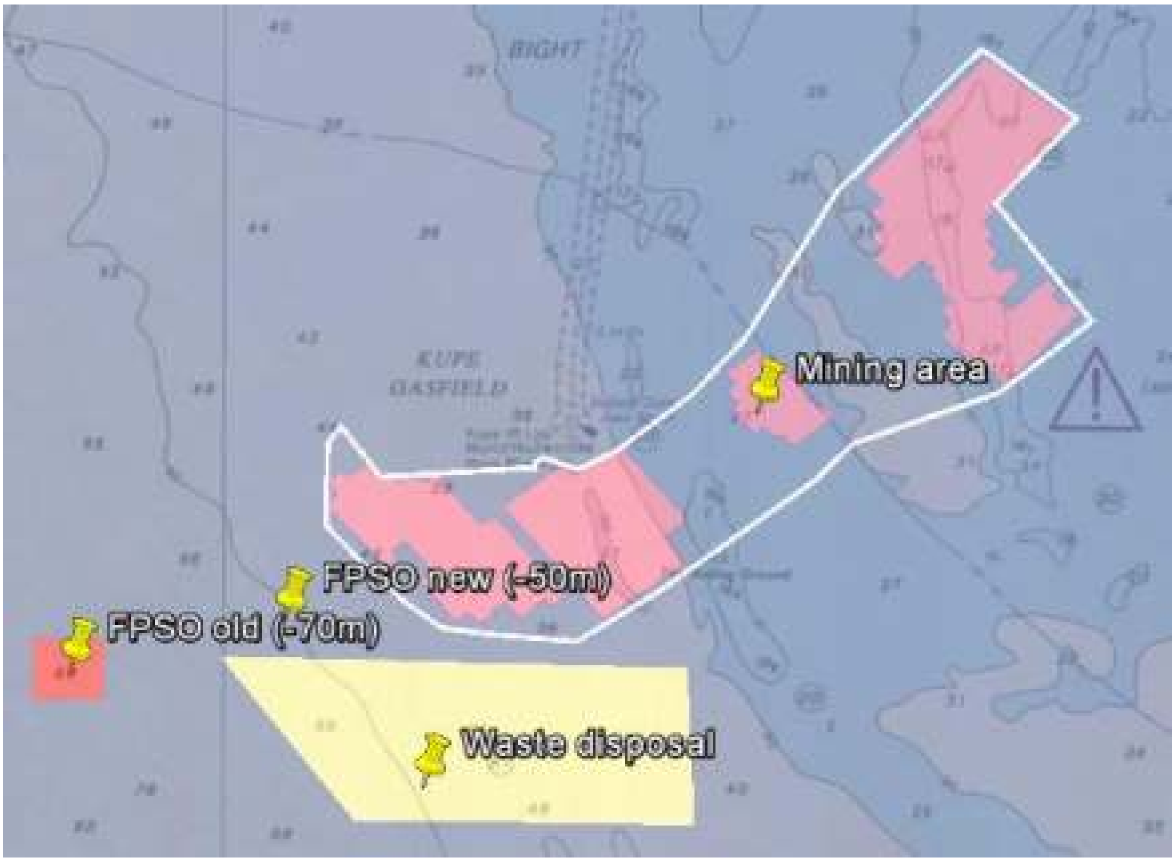

Figure 5-8 Proposed FPSO Location and Mining Area Layout

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Area	Sailing Distance	Av DTR	Annual Sediment TDS
	nm	%	Mt TDS/yr
Christina	3	6.74	33.2
Christina	3	11.50	33.5
Dianne	5.4	6.74	34.2
Dianne	5.4	11.50	34.6
X2	8.6	6.74	31.9
X2	8.6	11.50	31.8
Xantia	12.5	6.74	29.8
Xantia	12.5	11.50	30.4

Table 5-7Dredge Scheduling Parameterss Provided by DEME

Note: TDS = Tonnes of Dry Sediment

Golder used the higher annual sediment estimates for this study.

5.12 Dredge Assumptions and Scheduling Parameter's

For the initial dredge scheduling study, it was assumed that:

- TTR would source two trailing hopper suction dredges and a FPSO capable of achieving the above production rates after initial ramp up periods;
- First 3 years were scheduled in 6 month periods, then annual scheduling periods;
- Recovery of the sediment < 2 mm was based on the modelled field “rec”;
- Fe% = Fe_2O_3% × 0.6994;
- Mining recovery of *in situ* tonnages and Feed tonnages = 100% (TTR request);
- Typical Process Recovery = 92%;
- Concentrate tonnage = Feed tonnage × DTR_EST% × Process Recovery;
- Indicated and Inferred resource classes have been used in the scheduling block tonnages and a Fe_2O_3 grade cut-off has not been applied;
- In general each area was scheduled on an area/bench sequence, with strips being mined from the NW to the SE. This mining direction was not strictly applied when two dredges were scheduled in the same area at the same time.

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- Scheduling Rates
    - Dianne = 34.6 Mtpa
    - X2 = 31.8 Mtpa
    - Xantia = 30.4 Mtpa
    - Christina = 33.5 Mtpa

Note: These rates were averaged when multiple areas were scheduled in one period.

5.13 Dredge Scheduling Results

The dredge scenario scheduled was that of one dredge for 6 months, with a second dredge starting in the second half of Year 1.Both dredges at maximum capacity, with one large plant.

The scenario was developed using an Excel spreadsheet template.

On advice from DEME, it was assumed both dredges were able to operate within one area at the same time.

Period	Dredge 1	Dredge 2
Y1	Dianne	Dianne
Y2	Dianne	Dianne
Y3	Dianne	Dianne+ X2
Y4	Xantia	X2 + Xantia
Y5	Xantia	X2 + Xantia
Y6	X2 + Xantia	X2 + Xantia + Christina
Y7	X2 + Christina	Christina
Y8	Christina	Christina
Y9	Christina	Christina

Table 5-8Dredging Scenario - Areas as Scheduled

The dredging, Processing Plant Feed and Concentrate Product Tonnages and grades are summarised below.

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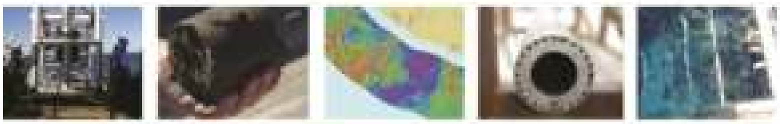

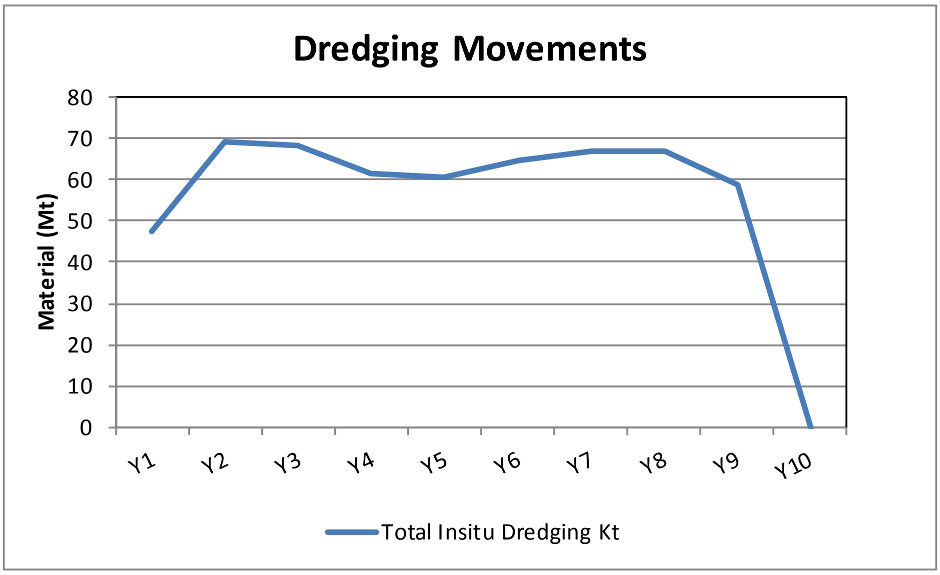

Figure 5-9 Dredging Schedule - Dredging Tonnage

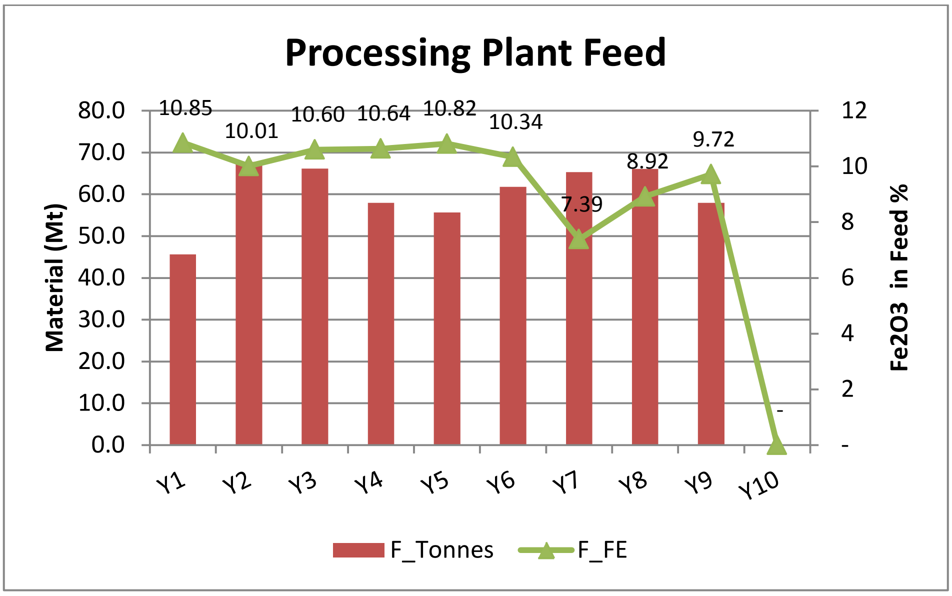

Figure 5-10Dredging Schedule - Processing Plant Tonnages and Fe Grades

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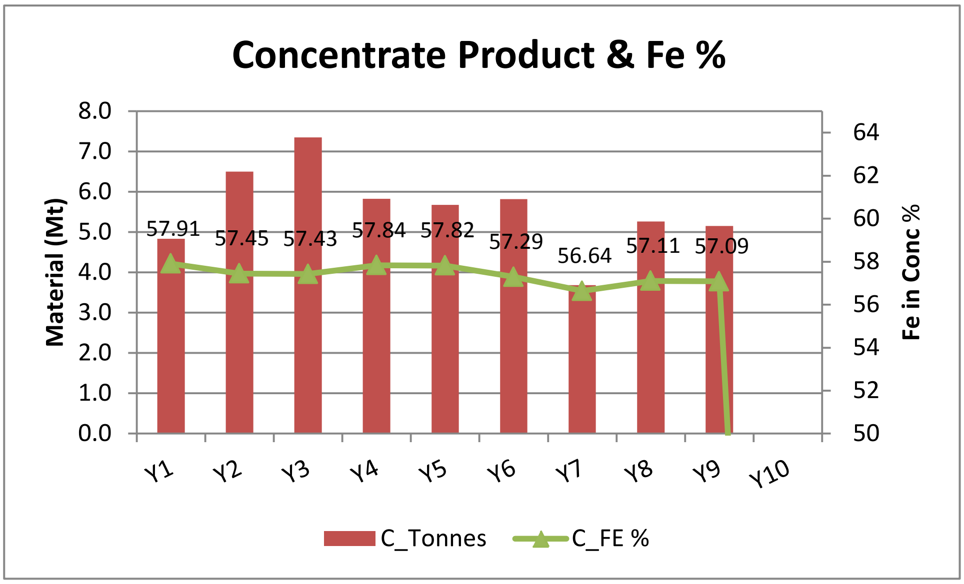

Figure 5-11 Dredging Schedule - Concentrate Tonnes and Fe Grades

Regardless of the selected extraction method, Dianne will be exploited first as this is the highest grade area outside the 12 nautical mile limit. In the case of the initial dredge option, both dredges were scheduled to work in this area for the first 3 years. Xantia and X2 would then be utilised, with both dredges scheduled in each area to attempt to even out the overall plant feed grades.

Christina would then start to be utilised late in Year 6 and with the majority of tonnes from Year 7 on, coming from Christina. The plant feed grades would fall as the upper lower grade Christina material was scheduled. From Year 8, both dredges were scheduled in the Christina area and plant feed grades would of improved a little as the dredging depth increased.

Average plant feed grades of over 10% Fe would be maintained for the first 6 years, but then fall as the lower grade Christina material, is mined.

A maximum concentrate production of 7.4 Mtpa would be achieved in Year 3 with average concentrate grades relatively consistent until the lower grade Christina material and the lower benches of X2 are scheduled in Year 7.

At the scheduled dredging rates, with two dredges operating, the high grade resources in the mining area would be depleted in nine years.

Royalties are payable on concentrate produced from within the 12 nm limit under the crown Minerals Act.

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Table 5-9Dredging Scenario Schedule - Two Dredges One Plant

Period	Dredging Tonnage			Processing Feed				Concentrate Production							Waste_Tonnes		Royalty
	Dredge 1	Dredge 2	Total Dredging	F_Tonnes	F_Fe	F_DTR	F_REC	C_Tonnes	C_Fe	C_Al_2O_3	C_SiO_2	C_Ti	C_P	C_LOI	+2 mm	-2 mm	Tonnes
	Mt	Mt	Mt	kt	%	%	%	Mt	%	%	%	%	%	%	Mt	Mt	Mt
Y1	32.3	15.0	47.3	45.7	10.85	11.51	96.89	4.8	57.91	3.54	2.79	5.19	0.11	-3.12	1.6	40.8	
Y2	34.5	34.5	69.0	67.8	10.01	10.43	97.88	6.5	57.45	3.62	3.27	5.15	0.11	-3.04	1.2	61.3	
Y3	34.5	33.8	68.3	66.2	10.60	11.99	96.29	7.4	57.43	3.68	3.29	5.13	0.11	-3.06	2.1	58.8	
Y4	30.0	31.5	61.5	58.0	10.64	10.93	94.54	5.8	57.84	3.64	3.00	5.05	0.10	-3.15	3.5	52.1	4.4
Y5	30.0	30.5	60.5	55.6	10.82	11.09	92.27	5.7	57.82	3.65	3.02	5.05	0.10	-3.15	4.9	50.0	3.9
Y6	32.5	32.0	64.5	61.8	10.34	10.23	95.65	5.8	57.29	3.66	3.60	5.08	0.11	-3.11	2.7	56.0	2.1
Y7	33.5	33.5	67.0	65.3	7.39	6.12	97.35	3.7	56.64	3.64	4.20	5.12	0.11	-3.03	1.7	61.7	
Y8	33.5	33.5	67.0	66.1	8.92	8.67	98.36	5.3	57.11	3.64	3.74	5.10	0.11	-3.07	0.9	60.8	
Y9	33.5	25.3	58.8	58.0	9.72	9.66	98.37	5.2	57.09	3.67	3.76	5.08	0.11	-3.06	0.8	52.8	
Y10																	
Total	**294.3**	**269.5**	**563.8**	**544.4**	**9.86**	**10.00**	**96.47**	**50.1**	**57.43**	**3.64**	**3.37**	**5.10**	**0.11**	**-3.09**	**19.4**	**494.3**	**10.3**

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5.14 Integrated Option (SSED)

For the integrated option, using a submerged sediment extraction device (SSED), it is now proposed to have the SSED and the FPSO both aligned along the SW - NE mining direction. The SSED will be located on the sea floor, connected to the FPSO via an umbilical delivery tube. A winching system will be used to locate the FPSO relative to the SSED which will be working 300 m × 300 m blocks in a predetermined sequence.

This alignment direction is parallel to the prevailing wind/wave direction (facing into the waves/wind) and perpendicular to the prevailing current direction.

5.15 Integrated Option (SSED) - Scheduling Blocks

The 7% DTR_Est cut-off grade shell of the block model was used to define the blocks for the Crawler option. The same digitised dredging strip bench plans were utilised for Xantia, X2 and Dianne but the Christina bench plans were rotated to align with the other areas and the prevailing wind/wave direction.

A bench height of one metre has been used but it is assumed that the crawler will operate at the base of the defined "ore body" and cut/dredge the full depth face (approximately 3 to 10 metres) during the scheduling sequence.

An *area2* field was added to the scheduling model north_acc_2013_250_flat.bmf. This field was coded with the area name and strip number.

The digitised the high grade crawler strips on each bench are given in Appendix D.

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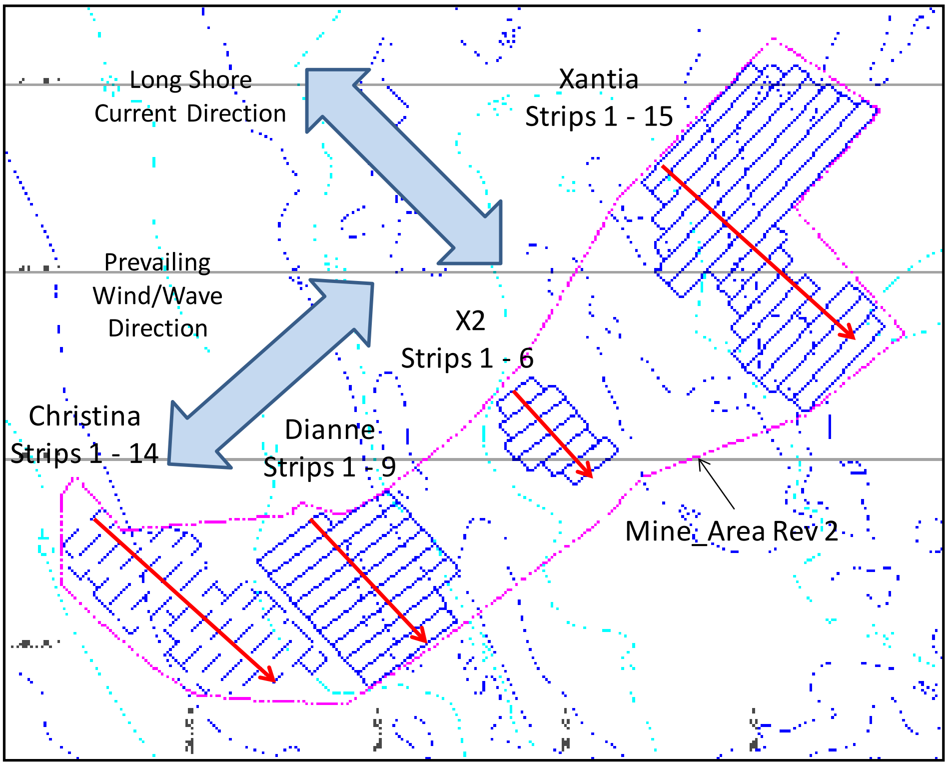

Figure 5-12 Proposed High Grade SSED Areas - Strip Naming Convention

For the integrated option, using a SSED, all areas are generally aligned parallel to the SW - NE wave and wind direction for the area. This is preferred alignment for directional control of the FPSO and the preferred alignment of the SSED advance direction to potentially minimise tails disposal onto the un-extracted areas.

Generally, the prevailing tidal current is in SE-NW alignment. Current direction is also substantially affected by tidal conditions.

The Xantia area is up to 4 metres in depth, while the other three areas are deeper and are up to 9 or ten metres in depth.

Some low grade blocks are included in the digitised strips as these blocks will have to be mined to access the lower levels.

In order to start the schedule in the highest grade area X2, the approximately 3 Mt of X2 material within the 12 nautical mile area has been removed from the schedule. It is assumed that this material will not be able to be mined once the adjoining areas have been backfilled with tails.

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Table 5-10 HG SSED Option - Tonnages and Grades

Area	*In Situ* Tonnes	Feed Tonnes	F_Fe_2O_3	F_Al_2O_3	F_SiO_2	F_TiO_2	F_P_2O_5	F_CaO	F_K_2O	F_Mgo	F_Mno	F_LOI	F_dtr	F_REC	Conc Tonnes
	Mt	Mt	%	%	%	%	%	%	%	%	%	%	%	%	Mt
Xantia	122.9	113.5	13.94	9.27	50.37	1.39	0.20	12.03	0.88	6.13	0.23	3.54	9.54	92.55	10.8
X2	57.5	56.0	18.27	10.38	45.79	1.84	0.32	11.39	0.95	6.99	0.28	1.42	13.83	97.05	7.7
Dianne	180.9	176.3	14.88	11.84	48.48	1.50	0.28	11.13	1.04	5.70	0.23	2.09	11.30	97.07	19.9
Christina	188.8	185.3	12.37	12.24	50.72	1.24	0.26	11.36	1.06	5.68	0.22	2.00	8.10	97.91	15.0
Grand Total	550.1	530.9	14.16	11.28	49.38	1.42	0.26	11.43	1.00	5.92	0.23	2.30	10.08	96.40	53.5

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5.16 SSED - Scheduling Parameterss

Basic scheduling parameterss for the SSED option have been provided by TTR following initial workshop/discussions and meetings between TTR and IHC Merwede (IHC), the suppliers of SSED type systems.

Scheduling Assumptions:

- SSED throughput = 6900 tph
- Annual operation hours = 6000 hrs
- Calculated scheduling rate = 6900 tph × 6000 hrs pa = 41.4 Mtpa.

5.17 SSED Assumptions and Scheduling Parameterss

For this scheduling scenario, it has been assumed:

- TTR will source a SSED and FPSO capable of achieving the above production rates after initial ramp up period.
- First 3 years are scheduled in 6 month periods, then annual scheduling periods.
- Recovery of the sediment < 2 mm is based on the modelled field “rec”.
- Fe% = Fe_2O_3% × 0.6994
- Mining recovery of *in situ* and feed tonnages = 100% (TTR request)
- Typical Process Recovery = 92%
- Concentrate tonnage = Feed tonnage × DTR_EST% × Process Recovery
- Indicated and Inferred resource classes have been used in the scheduling block tonnages and a Fe_2O_3 grade cut-off has not been applied.
- Each area is scheduled with strips being mined from the SE to the NW.
- All areas can be accessed by the crawler/FPSO system.

5.18 SSED Scheduling Results

The integrated SSED scenario schedule assumes a ramp up period of six months with a single large plant.

The scenario was developed using an Excel spreadsheet template. Each area was scheduled (SE to NW direction) until completed.

The minimum and maximum depths to the top and the bottom (from the ocean surface - 0 m RL) of the mined “ore” zone, and the minimum and maximum depths of the ore zone are also indicated in the table below.

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Period	SSED	Min Depth	Max Depth	Ore Depth	
				Max	Min
Y1	X2	-26	-38	8	8
Y2	X2 + Dianne	-25	-42	9	5
Y3	Dianne	-21	-42	10	8
Y4	Dianne	-21	-40	10	8
Y5	Dianne	-23	-41	10	9
Y6	Dianne + Xantia	-18	-41	9	3
Y7	Xantia	-17	-28	4	2
Y8	Xantia	-18	-32	3	2
Y9	Xantia + Christina	-18	-45	7	3
Y10	Christina	-34	-49	9	7

Table 5-11 SSED Scenario - Areas as Scheduled

The SSED, processing plant feed and concentrate product tonnages and grades are summarised below.

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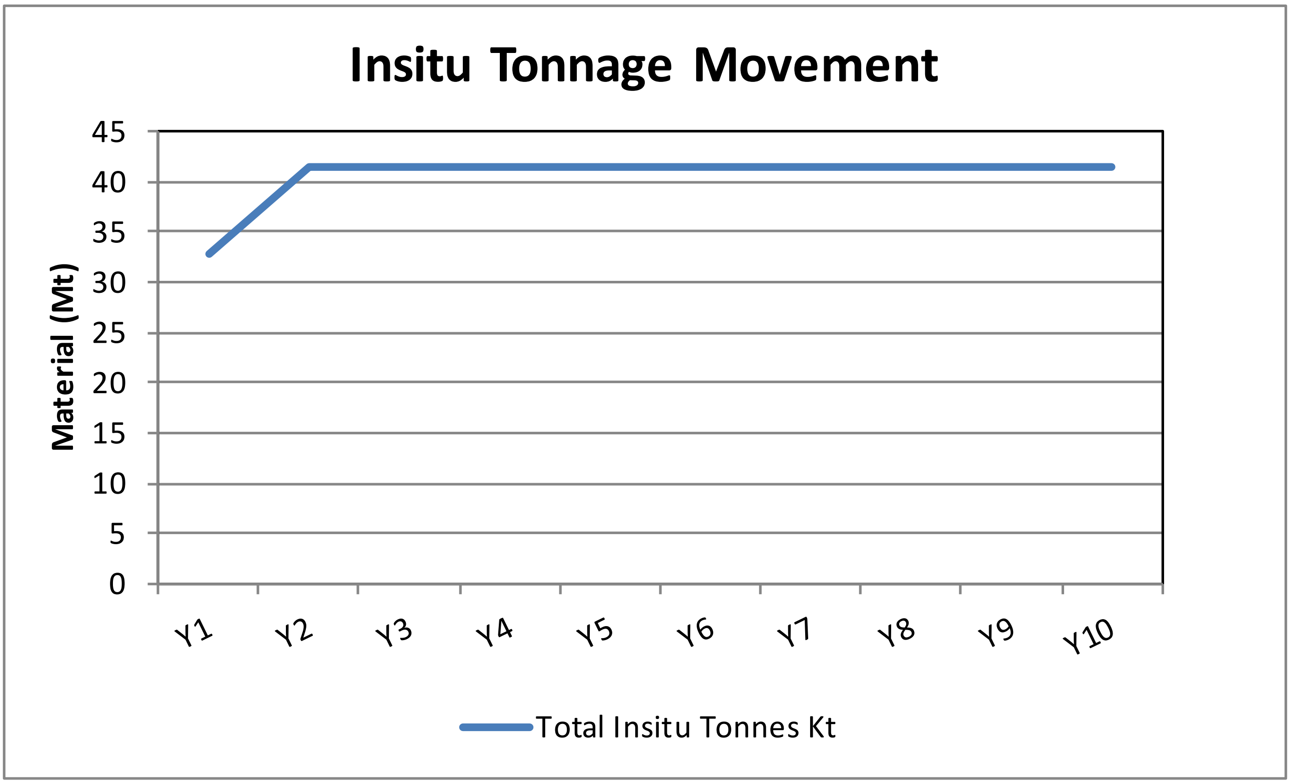

Figure 5-13 SSEDSchedule - In Situ Tonnes Mined

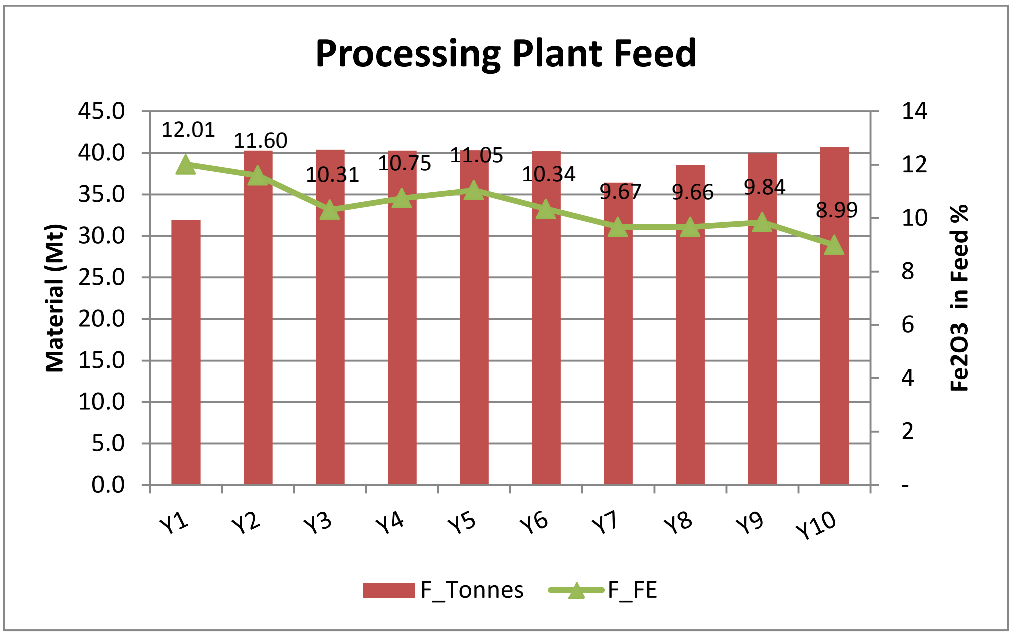

Figure 5-14 SSED Schedule - Processing Plant Feed Tonnes and Fe Grades

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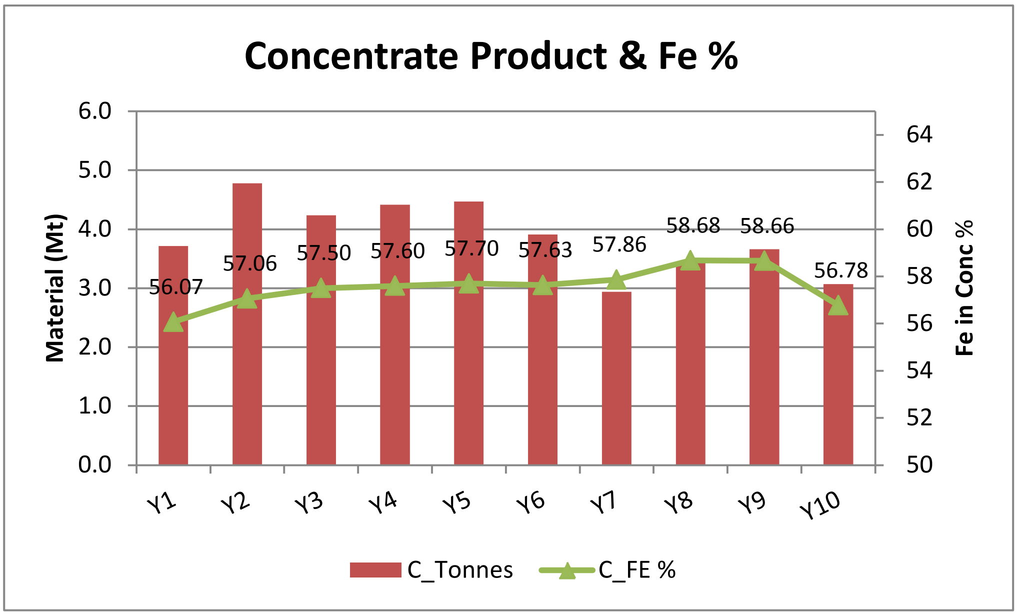

Figure 5-15 SSED Schedule - Concentrate Tonnes and Fe Grade

X2 has been scheduled first as this is the highest grade area. The X2 material within the 12 nm limit was removed from the schedule.The sequence is then to mine Dianne, Xantia and finally Christina. Due to the reduced scheduling rate in this scenario (41.4 Mtpa) only three of the defined area/strips are scheduled from Christina in late Year 9 and then in Year 10.

Average plant head feed grades of over 10% Fe are maintained for the first 6 years, but then feed grades fall as the lower grade material from Xantia and Christina are mined. Concentrate grades increase while Xantia is being mined but then decrease as Christina is mined. Concentrate tonnages start to decrease as the lower quality Xantia material is mined but then decrease further as Christina material is mined. The Xantia area has a higher trash content as indicated by the low recovery percentage, whereas the Christina material is a lower grade material.

A maximum concentrate production of 4.8 Mtpa is achieved in Year 2. The average concentrate grades are relatively consistent after Year 1, then increase while Xantia is being mined, then decreases further as Christina is scheduled.

At the scheduled crawler rates, the high grade resources in the mining area are not depleted at the end of the ten year schedule. The remaining Christina material would have an average Fe feed grade of less than 10%.

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6. EXTRACTION METHODOLOGIES

Several extraction/mining methodologies have been assessed in both this and the previous versions of the PFS in order to evaluate the most practical and cost effective solution given the stringent environmental conditions encountered in the proposed mining area as well as the large amount of sediment to be extracted from the sea bed.

6.1 Submerged Sediment Extraction Device Methodologies

The basis for this concept is a mobile device with a submersible dredge pump and slewing boom configuration. The concept is based on many years of actual operational experience of the mining and dredge processes, and the designing of offshore mining/dredge systems, submerged pumps, dredge components and subsea tracked vehicles within the IHC Merwede group.

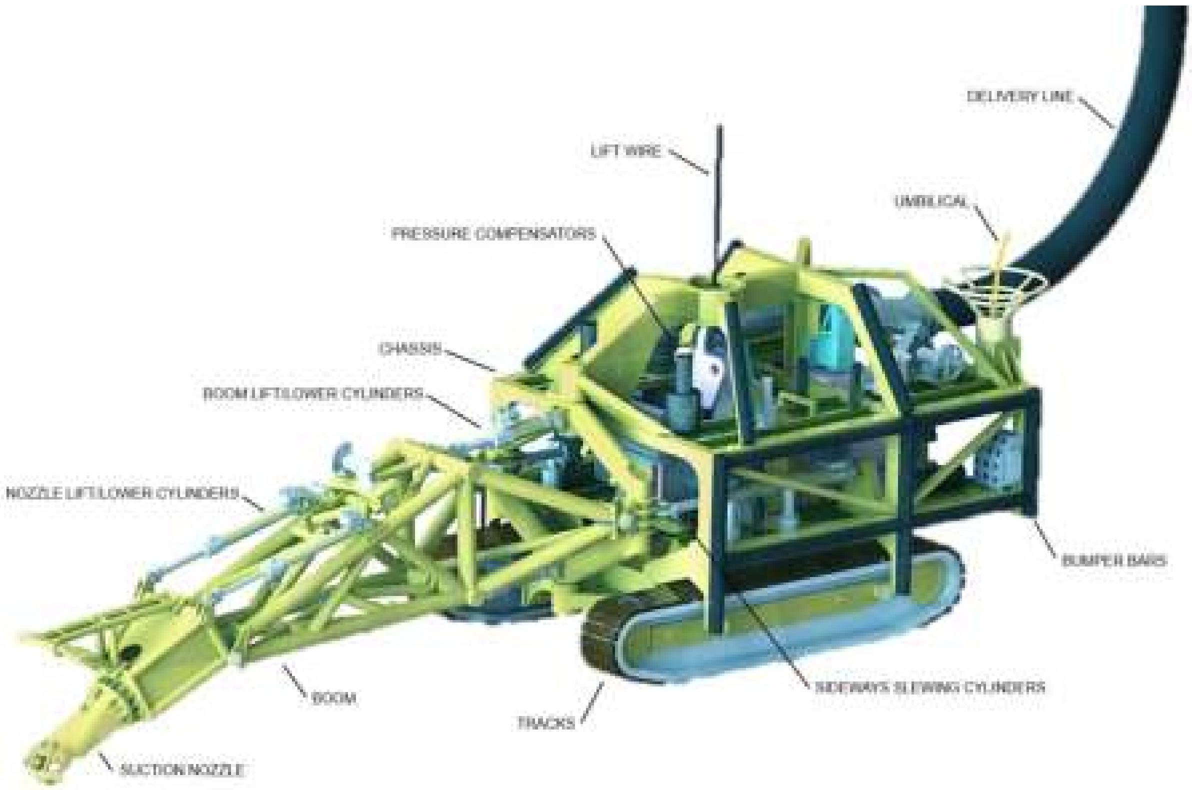

Figure 6-1 Submerged Sediment Extraction Device

After a rigorous selection process, TTR's concluded that the SSED provided the best overall mining solution particularly because it facilitates an acceptable tailings management strategy.

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During the operational scenario, the SSED will be lowered onto the sea bed and controlled remotely from the surface support vessel. The SSED is fitted with highly accurate acoustic sea bed navigation and imaging system, and extracts sediment by systematically advancing along a pre-determined 'lane'.

The SSED is the starting point of the extracted sediment slurry transport and comprises a suction head, pump system and a delivery line or STS. The suction head engages the sea bed, eroding and fluidising the material and effecting the extraction. The slurry system is built up from standard and commonly used dredging equipment.

- Suction head Suction Line
- Suction head (including jetwater nozzles if required);
- Pump System
  - Dredge pump; and
  - Dredge pump electric motor.
- Slurry Transport System (STS)

6.1.1 SSED Slurry Transport System (STS)

The STS enables the transport of slurry from the SSED to the processing plant aboard the support vessel. The STS allows for quick deployment and retrieval as well as mining at variable mining depths.

The STS consists of the following components:

- The coupling between the sea floor mining tool and the first riser segment;
- A riser hose string consisting of individual riser hose segments; and
- A coupling between the riser and the plant connection.

The riser hose string consists of riser hose sections, with integrated floatation as required, and be stored on board the vessel through the use of a riser train handling system. The riser train consists of framed rollers, allowing the riser string to be stored on the vessel. The riser train includes several riser tensioners, used to launch and recover the riser string. The hose connects to the plant through the use of a ball joint connection, allowing for simple connection and disconnection during operations.

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Figure 6-2 Riser Hose Handling

6.2 Dredging methodologies

The dredging methodology was amongst the best two options considered for TTR's sediment extraction operations. Within the dredging arena, the following dredging based methodologies were considered by both the Technip and TTR teams:

- Use of Airlift methodology,
- Use of a Trailing Suction Hopper Dredger (TSHD),
- Use of Plain Suction Dredger (PSD).

A general description of the different mining methodologies as well as the motivations for their selection (or not) are presented in the following paragraphs.

6.2.1 Airlift

Airlift operates by the injection of compressed air into the water inside of a discharge pipe, at a point below the water level. The injection of the air results in a mixture of air bubbles, water and fine particles of sand, which being lighter in weight than water outside the discharge the working principle of air lift method.

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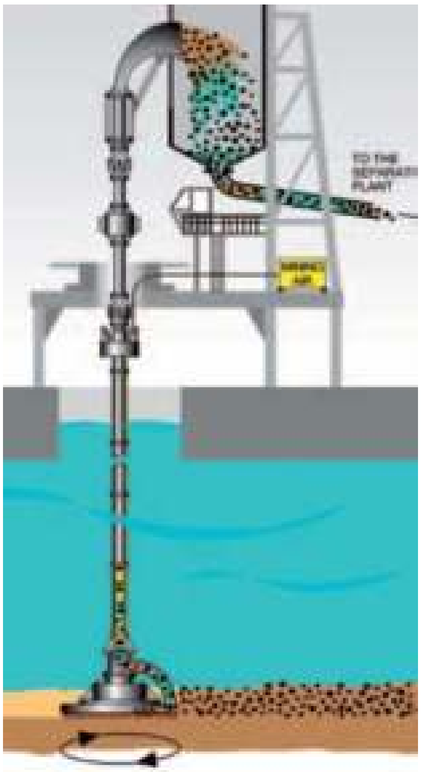

Figure 6-3 Airlift Methodology

The two critical factors in airlift pumping method are the submergence of the airline as well as the size of the discharge line. Submergence always means the depth of airline below the pumping level, rather than the static water level in the well. Best performance occurs when approximately 60% of the airline is submerged. If the submergence is too low, the system will not work.

With regards to its working principle and limitations, the use of airlift methodology was not progressed as a viable option because of the relatively high power consumption due to the requirement for pressurised air. Moreover, a restrictive and complex pressurised air management system is required to achieve the required production rate and simultaneously control the topside air expansion.

Also erosion induced by pumping the ore sands at relatively high pressures compared to other methodologies may be of concern and cause additional OPEX while drastically reducing the dredging operability.

6.2.2 Plain suction dredger

Compared to a TSHD, the main characteristic of a plain suction dredger is that it is a stationary (anchored) dredger, consisting of a vessel or barge equipped with a suction pipe, as represented on the drawing herein 6.4.

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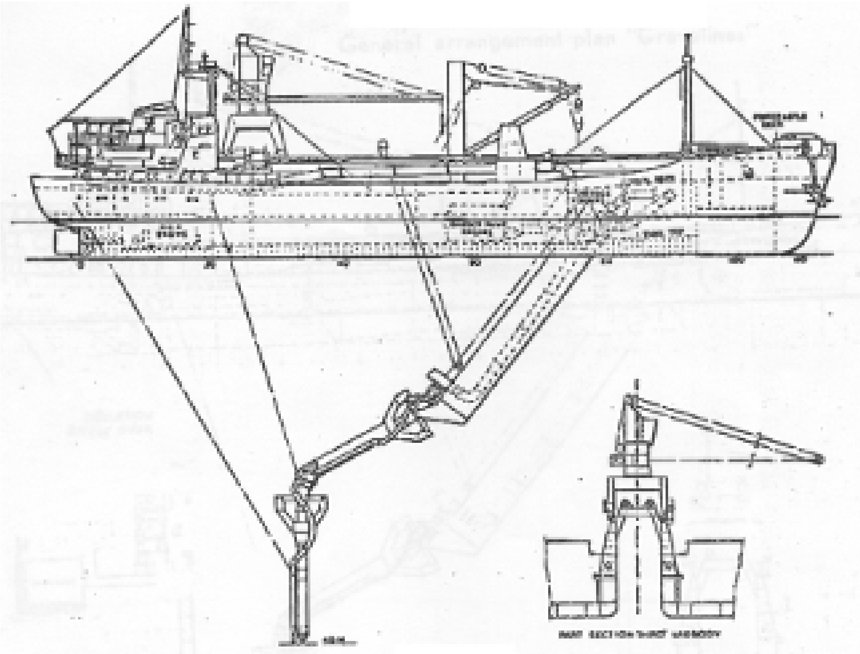

Figure 6-4 Plain Suction Dredger methodology

Material excavation is achieved by means of a jet stream and/or the suction flow of the dredge pump. During sand excavation, the dredger is moved slowly forwards by a set of winches acting on its anchoring lines. In order to increase the amount of dredged material flowing towards the suction mouth, a water jet is often directed onto the breach/bank. In this case, the jet pipe is often mounted above the suction pipe.

The pictures below describe the suction pit geometry obtained using a Plain Suction Dredger when slightly moved around its anchoring position.

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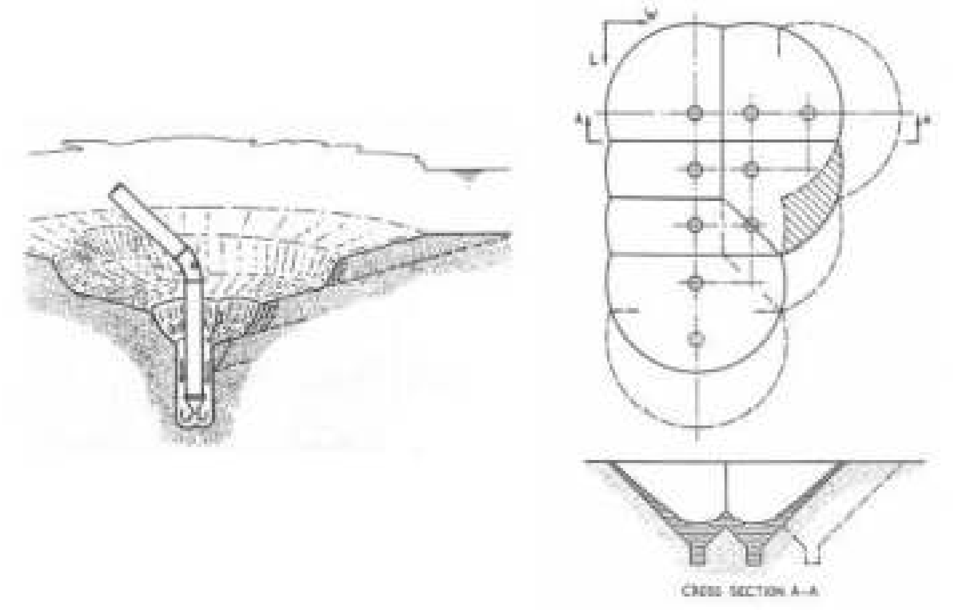

Figure 6-5 Suction pit geometry

Resulting from an extensive technical and economical comparison between the PSD and TSHD methodologies, the Plain Suction Dredger has proved to be less active for this specific application with regards to the environmental conditions, together with the high expected production rates, compared to the option using a TSHD.

6.2.3 Trailing Suction Hopper Dredger

With regards to dredging methodologies, the use of a TSHD was retained as a viable alternative to the SSED for the recovery of iron sands considering its operational performance, delivery and reliability of the dredge cycle for the four parts of the process, i.e. the dredging of sediment, sailing to the point of discharge, the connection and offloading of the sediment as well as the sailing time back to the mining location to continue dredging operations.

The sketch below in figure 6.6 represents a typical arrangement of a TSHD as well as the offshore dredging operation concept.

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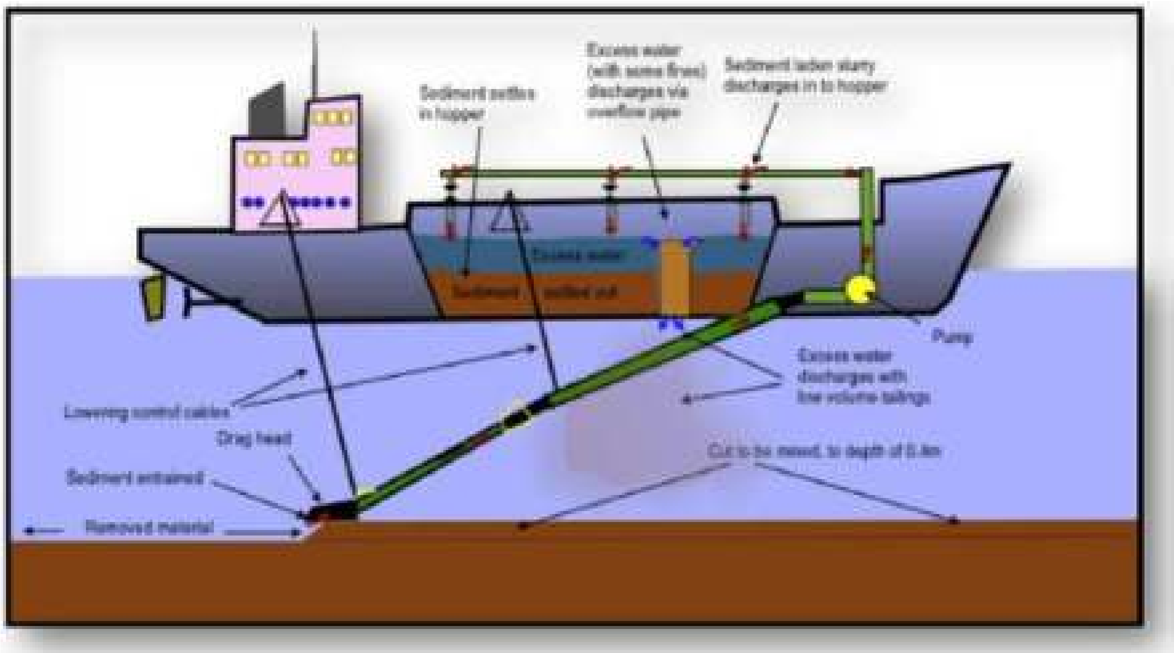

Figure 6-6 Typical section of the TSHD

In evaluating the TSHD over the SSED it was found that while the TSHD is easily scalable, the TSHD system cannot control the tailings dispersion and has the potential to generate large plumes. On the other hand SSED using their intensive extraction allows the return of the tailings material back on to the original location in a controlled way, and avoids the need to return to an extracted area. Operation logistics between the two systems are also different. The TSHD system must have the processing plant located on another vessel, whereas, an SSED can be incorporated into an integrated production vessel.

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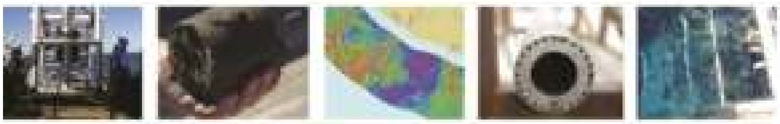

7. PROCESS PLANT

7.1 Metallurgy

7.1.1 Test work overview

The metallurgical test work was conducted in two phases:

- Stage 1 – Preliminary test work
- Stage 2 – Pilot plant test work

The purpose of the test work was to investigate the viability of upgrading the ore via conventional mineral sands and/or magnetite processing and to determine the base parameter's required for the design of the process flow sheet. The ultimate objective of the test work was to design a process flow sheet that is capable of producing a saleable iron ore concentrate whilst maximising recovery of the valuable component in the ore.

Initial test work focused on gravity separation as is commonly practiced at mineral and iron sands operations. This test work was largely unsuccessful and steered the process flow sheet design towards conventional magnetite processing based on magnetic separation. This report will focus on the test work conducted on the pilot plant.

7.1.2 Ore Characterisation

Qemscan

A composite head sample originating from the Xantia mining area was analysed by QEMSCAN (Quantitative Evaluation of Minerals by Scanning electron microscopy), an automated technique for quantitative mineralogical analysis of ores (Amdel report N3994QS11, 7th of April 2011). Qemscan identified the following minerals present in the ore:

	Description
Magnetite	Includes Magnetite and trace Hematite and Goethite
Rutile / Anatase	Includes Rutile / Anatase (>95% TiO2)
Ilmenite	Includes all TiO2 phases from Luecoxene to Ilmenite (50% TiO2 - 95% TiO2)
Titano-Hematite	Includes Titano-Hematite (50% TiO2 - 20% TiO2)
Titano-Magnetite	Includes Titano-Magentite (<20% TiO2)
Quartz	Includes Quartz
Calcite	Includes Calcite and CaCO3 from shell fragments
Feldspar	Includes K-Feldspar
Epidote	Includes Epidote
And/Sill/Kyan	Includes Al Silicate phase from the Andalusite/Sillimanite/Kyanite series
Tourmaline	Includes Tourmaline
Hornblende	Includes Hornblende
Pyroxene-En-Fs	Includes Pyroxene from the Enstatite/Ferrosilite series
Garnet	Includes Garnet phases, predominantly Almandine
Other Silicates	Includes all other silicate phases not listed above
Phosphates	Includes Apatite
Others	Includes all phases not listed above and occurring in trace form

Table 7-1 Minerals Present as Identified by Qemscan

According to the QEMSCAN analysis, titanomagnetite is the dominant mineral in the -180 +106 μm size fraction. Silicate minerals hornblende

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$[CaNa(Mg,Fe)_4(Al,Fe,Ti)_3Si_6O_{22}(OH,F)_2$ or $(Ca,Na)_{2.3}(Mg,Fe,Al)_5Si_6(Si,Al)_2O_{22}(OH)_2]$ and epidote are dominant in the -500 +180 µm size fraction.

The QEMSCAN analysis has indicated that a high proportion (~36%) of the Fe is present in gangue minerals (epidote, tourmaline, hornblende and garnet). The recoverable Fe is contained mainly in titano-magnetite and magnetite with only minor quantities present as hematite.

	-1000/+250	-250/+180	-180/+125	-125/+90	-90/+0	Total
Magnetite	0.44	1.76	1.60	0.33	0.32	**4.44**
Rutile / Anatase	0.00	0.00	0.00	0.00	0.00	**0.00**
Ilmenite	0.00	0.03	0.00	0.00	0.00	**0.04**
Titano-Hematite	0.03	0.28	0.14	0.03	0.02	**0.51**
Titano-Magnetite	1.26	24.37	26.49	5.68	2.59	**60.39**
Epidote	0.28	1.94	0.22	0.01	0.01	**2.47**
Tourmaline	1.24	14.17	0.86	0.06	0.14	**16.47**
Hornblende	0.74	10.61	0.48	0.02	0.05	**11.90**
Garnet	0.36	2.62	0.24	0.03	0.03	**3.28**
Other Silicates	0.01	0.05	0.01	0.00	0.00	**0.06**
Others	0.19	0.19	0.03	0.00	0.01	**0.42**

Table 7-2 Deportment of Fe to Different Species

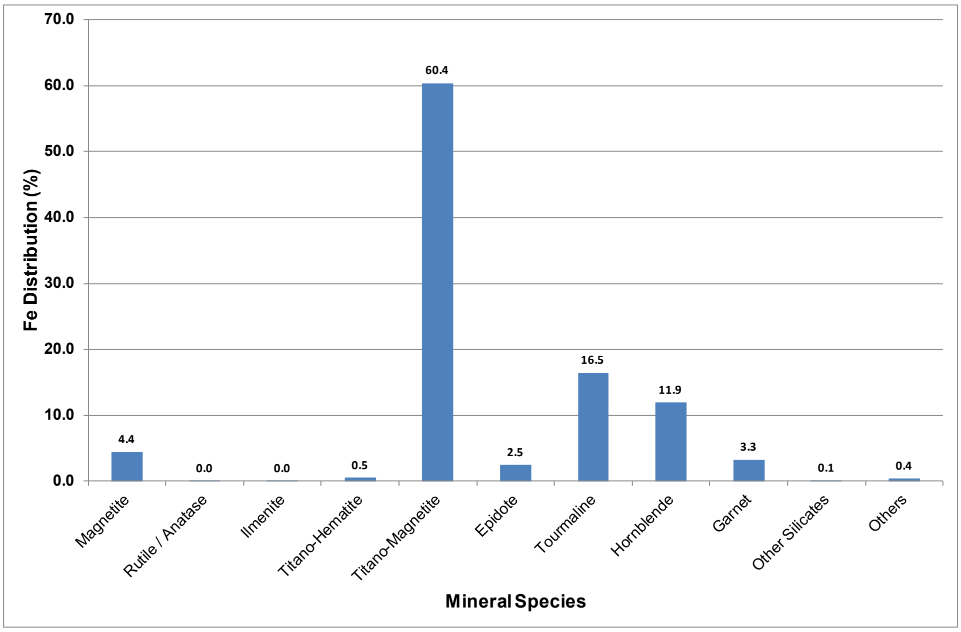

Figure 7-1: Fe Deportment to Mineral Species – Xantia Composite Sample

The Fe is therefore primarily present as titanomagnetite, which is a solid solution of ulvöspinel and magnetite. Pure ulvöspinel has a TiO_2 content of 35.7% and is non-magnetic. The TTR titanomagnetite typically has a TiO_2 content of around 8.5% and is therefore much closer to the magnetite side of the solid solution series refer (The FeO

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Fe2O3 TiO2 ternary phase diagram). As a result the TTR titano-magnetite is highly magnetic and would therefore be amenable to beneficiation by magnetic separation.

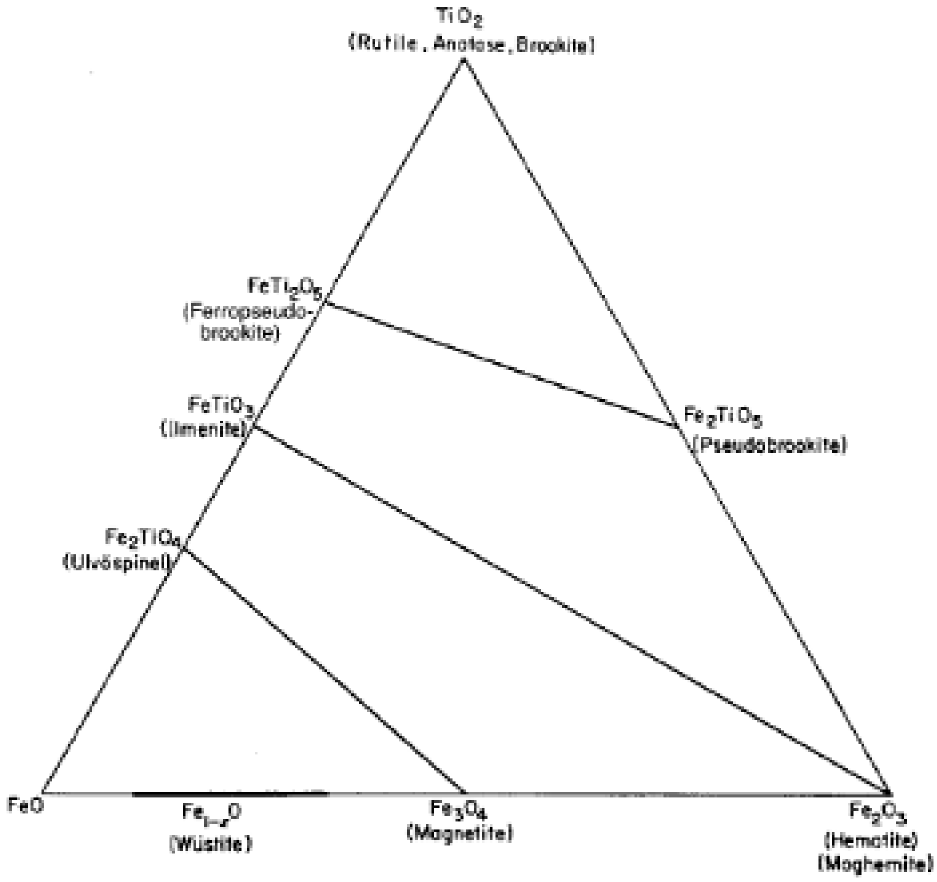

Figure 7-2: The FeO Fe2O3 TiO2 ternary phase diagram

7.1.3 Davis Tube Recovery (DTR)

In 2012 a Davis tube test work programme was launched to characterise the magnetic component of the ore and to quantify the maximum recoverable magnetic concentrate. In total, around 450 samples were tested. The DTR methodology that was developed had the specific aim of avoiding overgrinding of the sample which tends to lead to low concentrate grades and poor recoveries. All samples were stage pulverised and dry screened to avoid any oxidation of the sample during drying. The staged pulverisation typically produced a DTR feed with a P80 of 65 to 75µm. A magnetic field intensity of 3000 Gauss was used throughout.

The sample head Fe is plotted against the DTR weight recovery in Figure 7-3 below. The DTR weight recovery quantifies the relative proportion of magnetic material in the sample which is equivalent to the maximum weight recovery that can be expected at a given Fe head grade.

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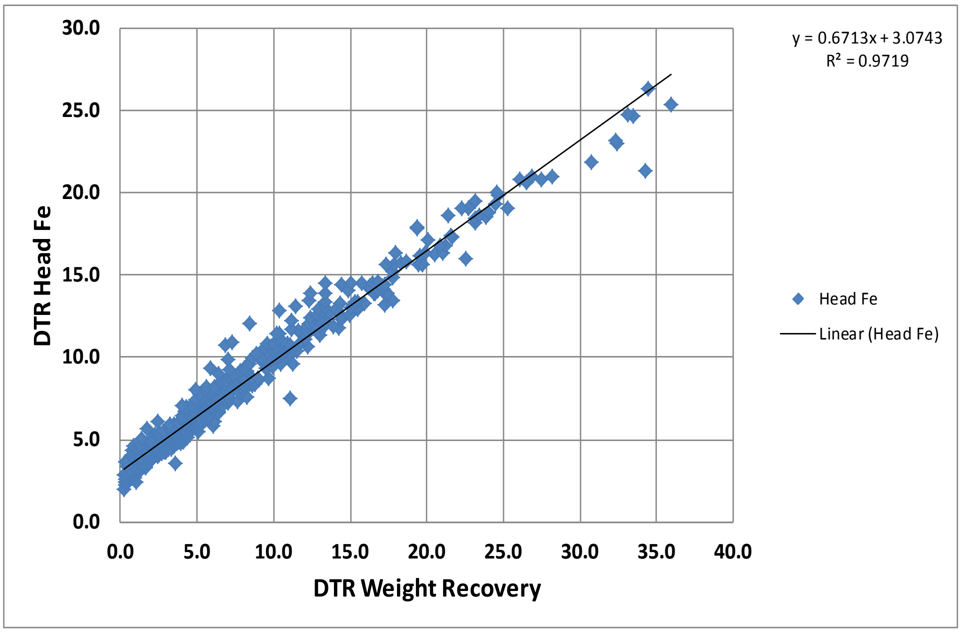

Figure 7-3: DTR Head Fe vs. Weight Recovery

The Fe recovery achieved with the Davis tube is plotted against Fe head grade in Figure 7-4. Although there is significant scatter in the data, the indication is that the Fe recovery drops below 40% from about 7% Fe. It also indicates that Fe recoveries ranging from 40 to 65% can be expected at a head grade of 10% Fe, with the average Fe recovery at 55%. No cut-off grade has been considered in this case.

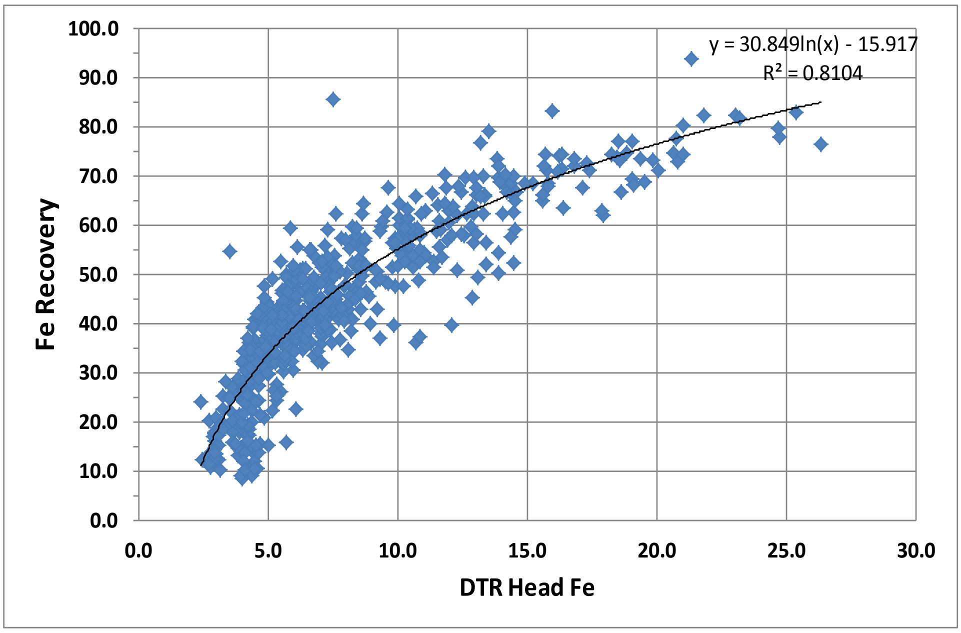

Figure 7-4 DTR Fe Recovery vs. Fe Head Grade

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The Fe – SiO_2 relationship is depicted below. The Y-axis intercept is 60.7%, indicating the theoretical maximum Fe of the concentrate. The Fe content is substantially lower than that of pure magnetite (72.4% Fe) due to the displacement of Fe in the magnetite matrix by Ti, but also by Al and V.

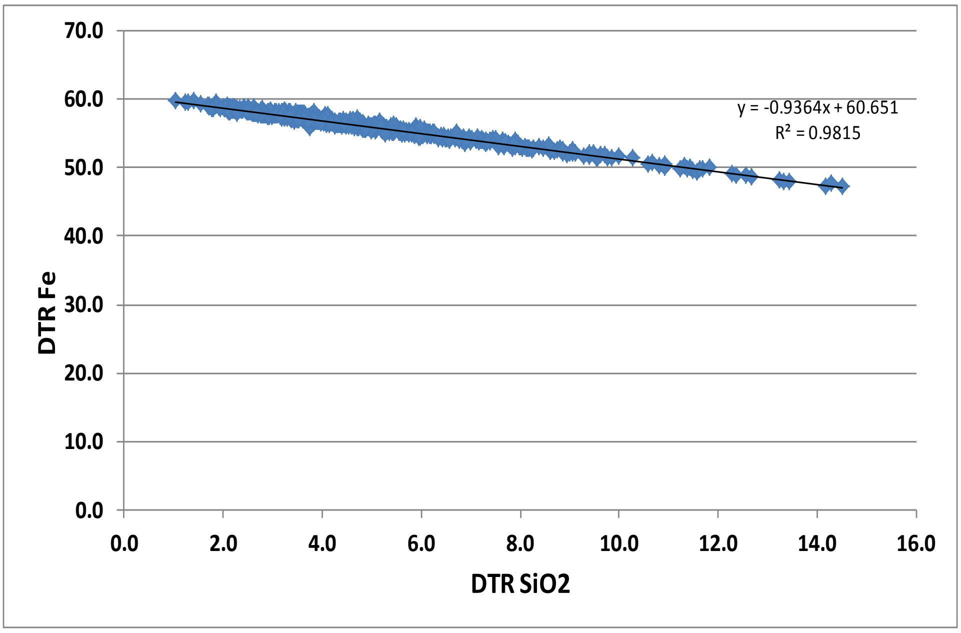

Figure 7-5 Fe – SiO_2 Relationship

The relationship between the DT Mag Fe (i.e. DT Concentrate Fe grade x DT Weight Recovery) and Head Fe is given in Figure 7-6 below, again illustrating the fact that a significant proportion of the Fe in the ore is non-magnetic and hence not recoverable.

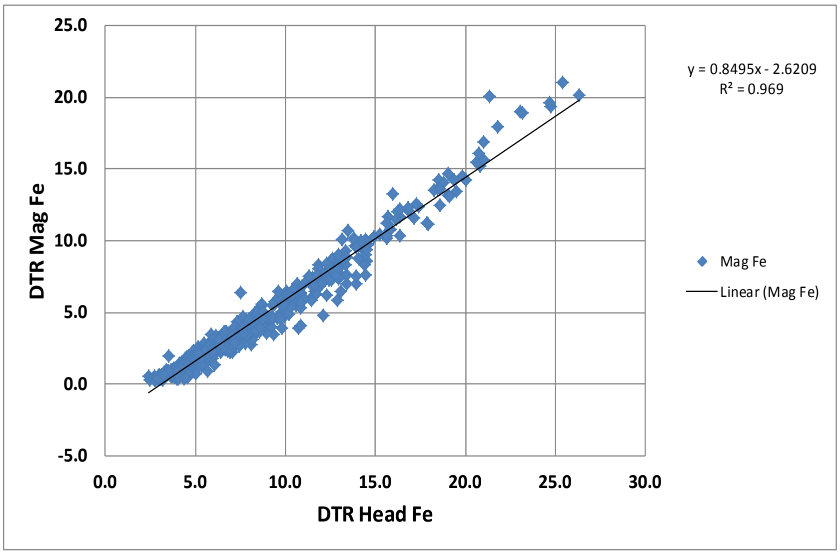

Figure 7-6 DT Mag Fe vs. DT Head Fe

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7.2 Pilot Plant Test Work

In 2012 a pilot plant was constructed in New Zealand in order to test bulk sample from the initial mining areas and to develop a viable flow sheet for the recovery of the titanomagnetite from the run of mine (ROM) ore. The initial pilot plant flow sheet was set up as depicted in Figure 7-7 and Figure 7-8.

After drying and removal of large pebbles and shells, the sample was homogenised in a tumble mixer and screened at 2 mm. The material was then slurried in an agitator tank and subjected to medium intensity magnetic separation (MIMS) at 3300 G for a single pass followed by three passes through a low intensity magnetic separator (LIMS) at 1250 G. The primary LIMS concentrate was subsequently ground in a 500 L ball mill using a mixture of 50 and 30 mm ceramic balls. The aim grind size was 80% passing 53 µm. Samples were periodically taken from the ball mill to collect data for grind establishment. The ground pre-concentrate was finally processed through a secondary LIMS for three passes at 1050 G. Grab samples of feed and product streams were taken and analysed at ALS Metallurgy in Perth. All feed and product streams were also weighed. All streams after the MIMS were weighed wet and the dry weights were determined by conducting moisture tests on the particular stream.

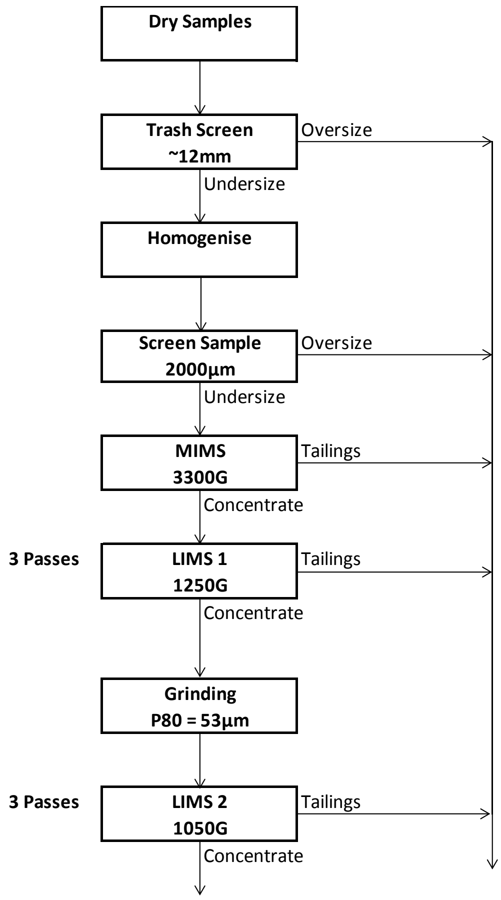

Figure 7-7 Initial Pilot Plant Flow Sheet Block Flow Diagram

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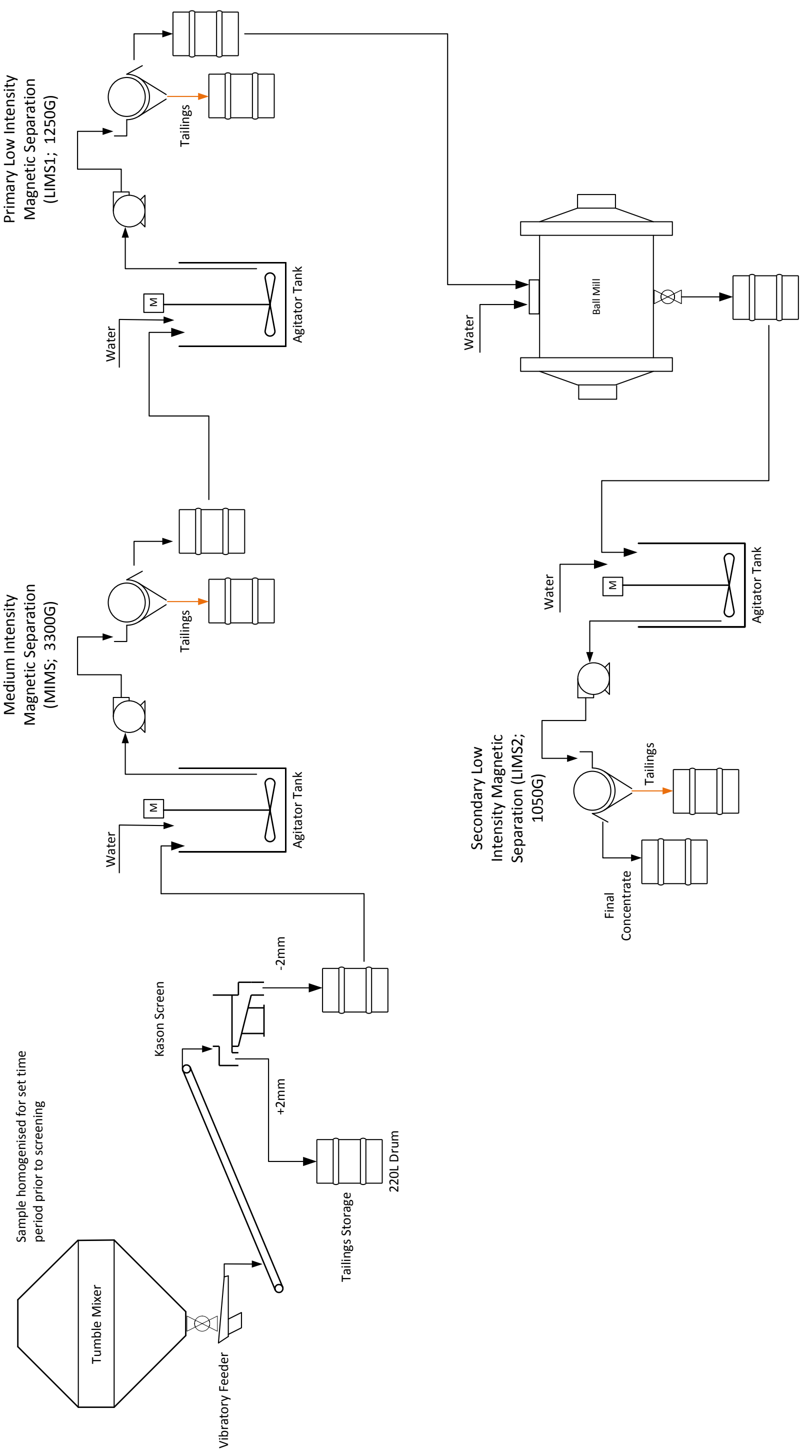

Figure 7-8 Pilot Plant Process Flow Diagram

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Figure 7-9 Pilot Plant LIMS-1 Concentrate

After the first five runs, it became evident that there is an opportunity to discard a significant amount of tailings at a grind of approximately 150 µm. The pilot flow sheet was thus altered to introduce a two stage grind with intermediate magnetic separation (refer Figure 7-11). For the second two stage grind run (Bulk 501), the field intensity on the MIMS was increased to 4300G in order to increase the initial Fe recovery on lower grade material.

Figure 7-10 Pilot Plant Ball Mill

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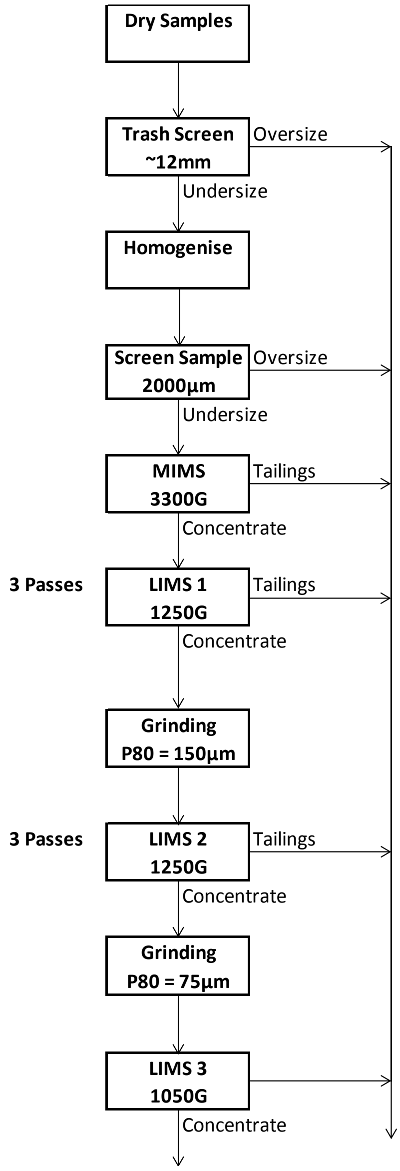

Figure 7-11 Two Stage Grinding Flow Sheet

The results from one sample, X039, were discarded due to operational problems during the run. Good magnetic Fe (Mag Fe) recoveries were obtained for all runs except Bulk 501. The reason for this is the low LIMS2 Fe recovery. It is not clear what the cause of this was. All the Davis tube wash (DTW) samples also returned relatively low Fe recoveries. However it is clear that the flow sheet maximises both Fe recovery and final product grade. The recovery of magnetic Fe is evidenced by the MIMS/LIMS1 Fe recovery being constantly higher than the DT Fe recovery.

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			Fe Recovery					
Sample ID	**Head Fe**	**Mag Fe**	**MIMS& LIMS1/1**	**LIMS2**	**LIMS3**	**O/All Fe Recovery**	**DT Fe Recovery**	**Mag Fe Recovery**
X450	7.8	3.5	48.6		83.4	43.3	45.0	96.3
X439	9.6	5.2	60.5		85.5	51.7	53.8	96.2
Bulk501	10.5	4.8	45.0	90.0	97.6	39.5	43.7	90.5
B456	13.9	8.9	66.3		92.7	61.6	62.7	98.3
X451Y	13.8	8.7	66.9	96.7	97.6	63.2	63.3	99.7
X438	21.1	16.4	76.9		91.2	71.9	74.4	96.7

Table 7-3 Pilot Plant Results – Fe Recoveries

	Weight Recovery			
Sample ID	MIMS& LIMS1	LIMS2	LIMS3	O/all
X450	12.0		46.0	5.7
X439	16.1		55.7	8.5
Bulk501	14.9	53.9	86.9	6.8
B456	20.4		64.0	12.9
X451Y	21.8	79.9	86.6	14.9
X438	34.9		68.8	23.4

Table 7-4 Pilot Plant Results – Weight Recoveries

	Fe Grade			
Sample ID	MIMS& LIMS1	LIMS2	LIMS3	LIMS2
X450	15.9	30.8		55.9
X439	18.8	34.2		56.3
Bulk501	14.3	29.7	49.4	56.9
B456	25.4	40.2		58.2
X451Y	26.1	40.9	51.8	57.8
X438	28.1	42.0		58.2

Table 7-5 Pilot Plant Results – Fe Grades

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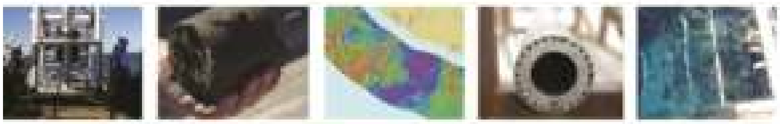

The pilot plant Fe recovery is plotted against mag Fe and DTR Fe recovery in Figure 7-12. It is clear that the pilot plant Fe recoveries fall well within the bounds predicted by the DTR work. Similarly, the pilot plant weight recoveries compared well with that achieved with the Davis tube.

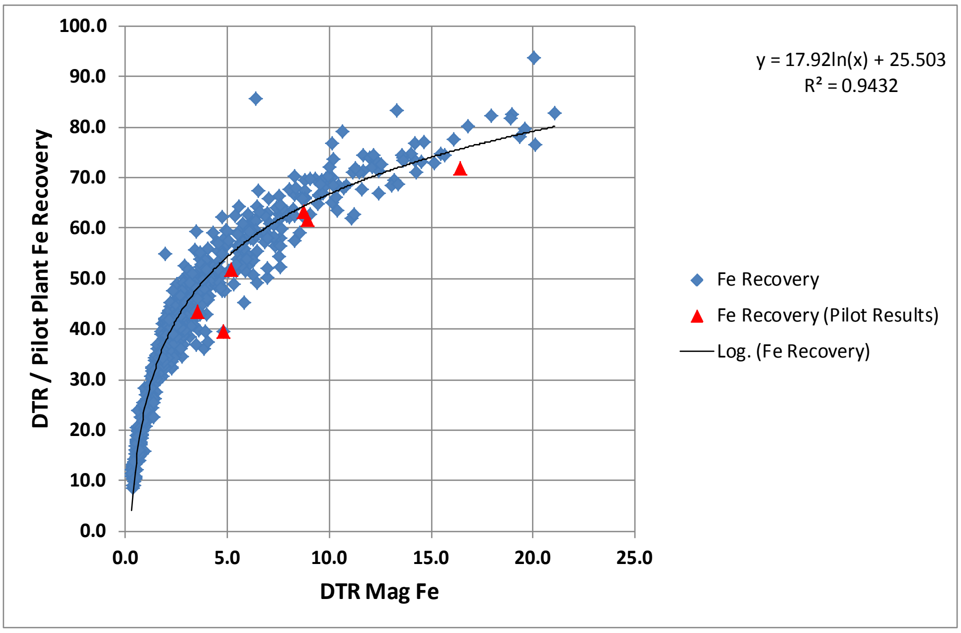

Figure 7-12 Pilot Plant and DTR Fe Recovery vs. Mag Fe

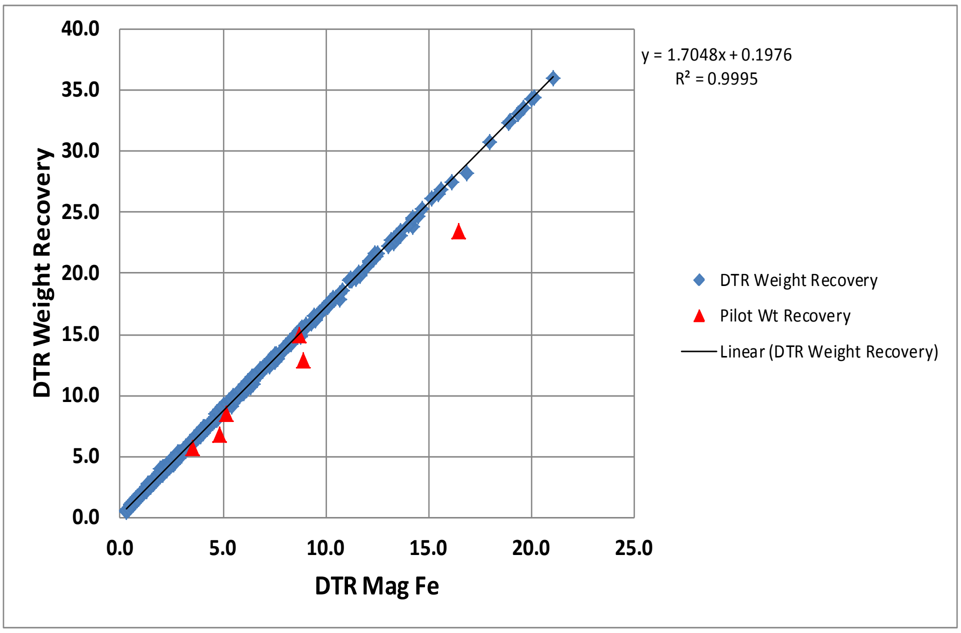

Figure 7-13 Pilot Plant and DTR Weight Recovery vs. Mag Fe

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7.2.1 Final Product Grade and Grind Determination

The Qemscan and other test work have confirmed that the TTR iron sands are immature in respect of its liberation from associated gangue silicates. It is therefore necessary to grind the ore in order to achieve liberation, increase the product grade and maximise the Fe recovery. Initial grind establishment work on medium grade near shore material from the Xantia area indicated a liberation grind size of 53µm. However this is deemed too fine a size from a marketing perspective. Grind establishment curves were generated for the pilot plant samples by taking samples at different stages during grinding in order to assist in determination of the optimum grind size. Each of these samples was subjected to Davis tube wash (DTW) at 3000 G.

In Figure 7-14 the pilot plant Fe – SiO_2 relationship from DTW on grind samples is plotted showing a similar result compared to the DTR results from the drill samples (refer Figure 7-5). This would suggest that the final product SiO_2 must be reduced to less than 5% in order to have an Fe grade of more than 55%.

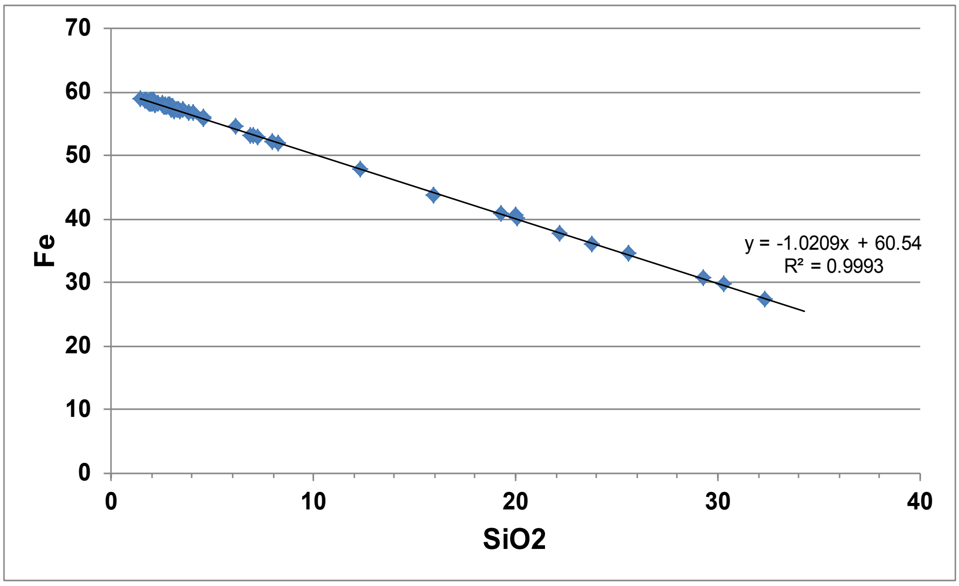

Figure 7-14 Pilot Plant DTW Results – Fe vs. SiO_2

The pilot plant DTW data for Fe and P are plotted as a function of grind size and for samples ground to a P_{80} of 150 µm in Figure 7-15. The data sets were further split into low, medium and high grade according to head Fe. The low grade data is most relevant as it best corresponds to the average ROM grade as determined by the mining schedule, i.e. 10.5% Fe. From the graph it can be seen that the low grade DTW Fe trend line intersects 55% Fe at a grind size (P_{80}) of 110 µm. However, the grade achieved with the LIMS will always be somewhat lower than that of the Davis tube. An allowance of at least 1 to 2% Fe should be made in order to cater for plant inefficiency and product grade variation. With this in mind, the graph indicates a product specification of 55% could be guaranteed at a grind size of around 90 µm and a

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specification of 56% Fe at 75 µm. A grind size of 90 µm corresponds to a product specification of 0.17% P maximum and 75 µm to 0.16%P.

The final grind size will be confirmed during ongoing pilot test work as well as negotiation with key product off-take customers. For the purpose of this Study, the plant grind circuit was designed for a grind size of 75 µm.

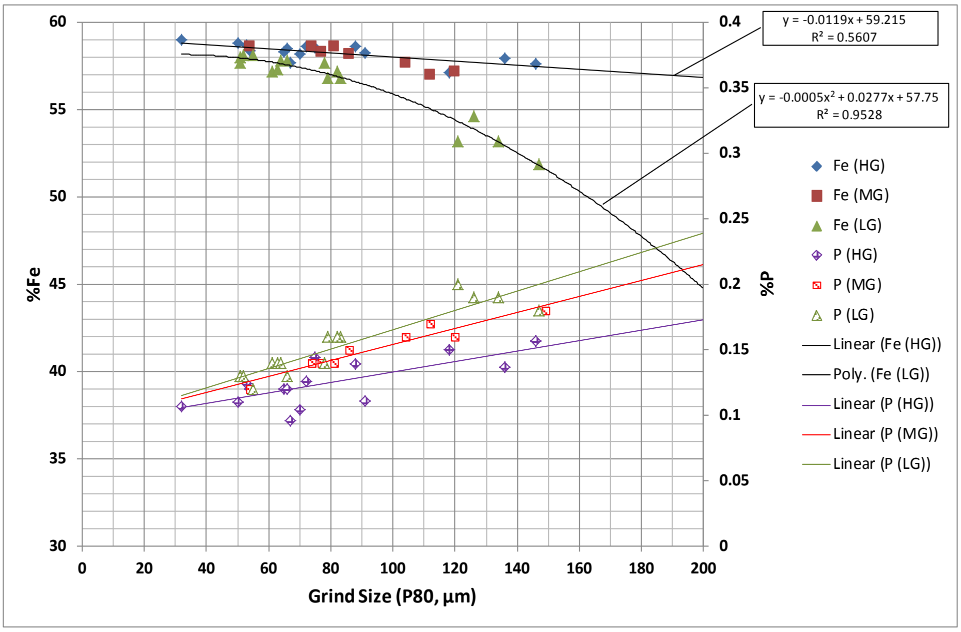

Figure 7-15 Pilot Plant DTW Results – Fe and P vs. Grind Size

The proposed final product specification for a concentrate at a grind size (P_{80}) of 75 µm is given in Table 7-6.

Fe (min)	P (max)	SiO_2 (max)	Al_2O_3 (max)	TiO_2 (max)	V (min)	CaO (max)	S (max)	MgO (max)	K_2O (max)	Na_2O (max)	Zn (max)	Cl (max)
56.0	0.160	3.9	4.2	8.9	0.28	1.00	0.01	3.2	0.15	0.20	0.085	0.029

Table 7-6 Product Specification – 75µm Concentrate

7.2.2 Grindability Test Work

Three sets of grindability test work were conducted. Samples from Xantia Extension (X038 and X039) were used for Levin test work and two sets of IsaMills™. signature plot work were subsequently carried out (X438 and X451). The IsaMills™. signature plot work is the most applicable due to the equipment choice. Due to problems experienced on the first signature plot work, this data could not be used. The most reliable data set is the most recent plot performed on X451. Unfortunately this sample was quite fine with a feed size (F_{80}) of 208 µm. It has however allowed a preliminary estimate of power requirements and sizing of the grinding mills by the mill vendor

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Xstrata. The grinding energy required for the first stage grind will be approximately 15 kWh/t (P80 = 130 μm) and the second stage 17 kWh/t (P80 = 75 μm). The signature plots for the first and second stage grinds are given in Figure 7-16 and Figure 7-17 respectively.

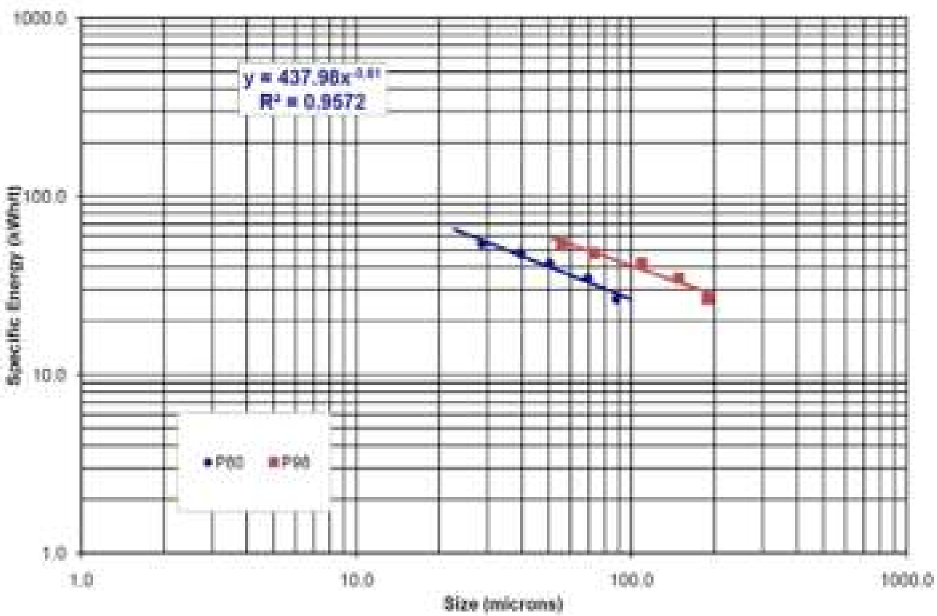

Figure 7-16 Signature Plot – First Stage Grind

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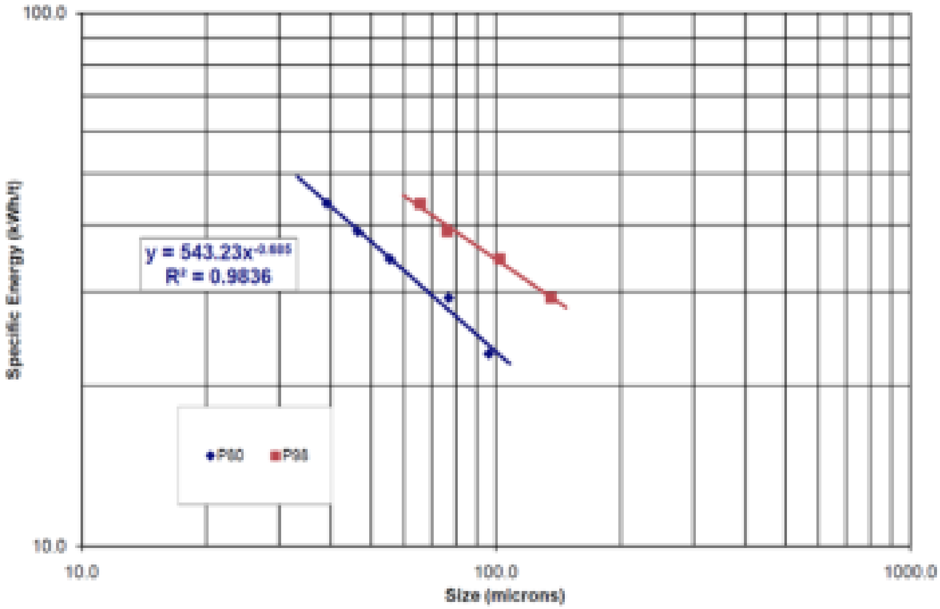

Figure 7-17 Signature Plot – Second Stage Grind

7.3 Process Overview

The TTR Iron sands Project is designed to deliver 4.7 Mtpa titano-magnetite concentrate. The iron sands will be mined using two SSED`s, one operating and one standby. The ROM will be delivered to a FPSO where it will be screened, magnetically separated and ground before final magnetic separation to produce a clean concentrate. All processing will be done wet using sea water throughout the process. The final concentrate will be dewatered to ~10% moisture and stored temporarily on the FPSO before being slurried with fresh water from a reverse osmosis (RO) desalination plant. The slurry will be pumped to a floating storage and offloading vessel (FSO) where it will be dewatered and stored in the FSO holds. Once fully loaded, the FSO sails to a sheltered area (if required by prevailing weather conditions) where it offloads the cargo to an ore carrier, typically a cape-size vessel.

Tailings will be disposed in real time via a fall pipe extending forward off the port side of the FPSO such that the tailings is deposited as far as possible from the mine face. The tailings disposal fall pipe will be of similar design as a trailing suction hopper dredge drag arm. The tailings will first be dewatered via hydro cyclones with the waste water disposed of separately along the tailings fall pipe.

7.3.1 Design Criteria

The design criteria for the process plant are listed in the table below. The reference key for the criteria is as follows:

1	Client supplied data
2	Test work data

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3	Calculated
4	Design assumption

Item	Unit of Measure	Value	Ref	Comment
1. Overview				
ROM slurry density	vol.%	30	3	
Slurry volume mined	m3/h	11,348	3	
Solids density in situ	t/m^3	2.35	2	
ROM Feed	t/h (db)	8,000	3	
	t/a	48,002,734	5	
Product %Fe	%	56-57	2	
Process plant weight recovery	%	9.6%	2	
Process plant mag Fe recovery	%	90.0%	2	
VTM Concentrate Production	t/h	765.0	3	
VTM Concentrate Production	t/a	4,590,261	3	
2. Operating Schedule				
Annual operating days	d/y	365	4	
Daily operating hours	h/d	24	4	
Dry docking	d/y	12	4	56 days every 5 years for 15 years, then every 3 years thereafter
Refuel	d/y	0	4	Refueling will take place without any loss to production
Anchor spread	d/y	0	4	
Maintenance	d/y	26	4	
Days lost		38		Base case: Total 38 days lost (26 for maintenance), 12 days

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				for buffer
FPSO Availability	%	92%	3	
Mining efficiency	%	85%	4	
Weather uptime	%	90%	4	
Total operational Availability	%	68.5%	3	
Operating time	h/y	6,000	3	
3. Ore Characteristics				
+2mm fraction	%	4.0	2	
-63µm fraction	%	0.6	4	
Concentrate specific gravity	t/m^3	4.75	2	
Feed specific gravity	t/m^3	3.2	2	
Water Density	t/m^3	1.03	4	
Ore in situ density (wet)	t/m^3	2.35	4	
Ore in situ density (dry)	t/m^3	1.9	4	
Concentrate bulk density (dry)	t/m^3	2.36	4	
ROM Head Grade				
Fe	%	10.1	2	
SiO_2	%	48.9	2	
Al_2O_3	%	11.5	2	
TiO_2	%	1.4	2	
CaO	%	11.7	2	
MgO	%	6.0	2	
V	%	0.1	2	

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Table 7-7 Project Design Criteria – Process Plant

7.3.2 Mass and Water Balance

The process plant mass and water balance was developed based on the design criteria and the pilot plant test work results. The main inputs and outputs for the beneficiation plant is given below.

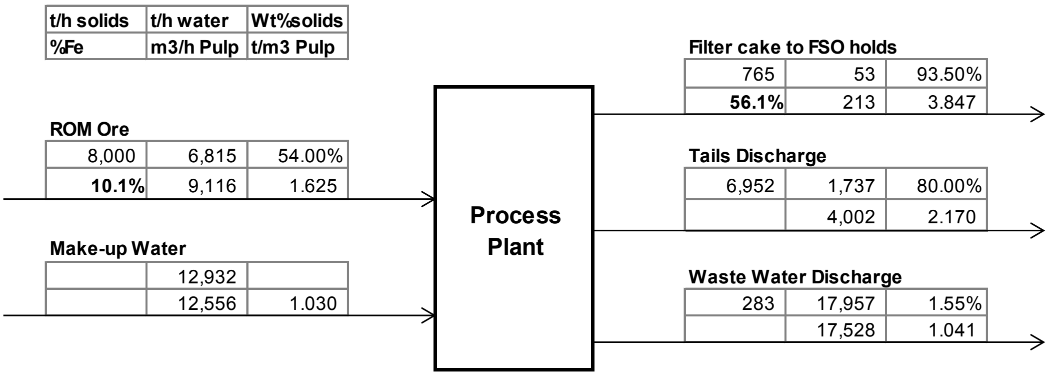

Figure 7-18 Process Plant High Level Mass and Water Balance

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7.4 Process Description

7.4.1 ROM Receipt

The process flow diagram for the beneficiation plant is given in Figure 7-19 and Figure 7-20 (also refer Section 19.6 for FPSO general arrangement). ROM ore will be delivered to the FPSO via an 800 mm ID rubber hose connected to the subsea mining vehicle. The design rate of ROM delivery is 8,000 t/h solids. The ROM ore will be directed into a boil box from where it is directed into two intermediate distribution sumps. Process water is added to reduce the slurry density to 31.5% solids by weight before the slurry is fed to 10 trommel screens at main deck level. The screen aperture will be 4 mm such that the effective screen size of the ROM will be ~2 mm. Spray water on the screens will reduce the slurry density further to 30% solids. The screen undersize is fed under gravity to 10 water agitated storage tanks directly below the screen area. The oversize will be fed via a chute to the tailings handling area.

7.4.2 Rougher Magnetic Separation

The -2 mm ore is pumped from the agitated storage tanks to the first stages of magnetic separation. The purpose of the rougher magnetic separation (RMS) is to capture both the liberated and locked magnetic particles whilst rejecting the majority of the gangue. This will be accomplished using single drum MIMS and double drum LIMS in series. The slurry is first pumped to the MIMS section located on the first level which will consist of 60 single drum units. The MIMS units will be split into 10 clusters of six each, corresponding with the number of agitated storage tanks. The MIMS drums will have a magnetic field intensity of 4500 G and consist of 3 m wide by 610 mm dia. stainless steel drums.

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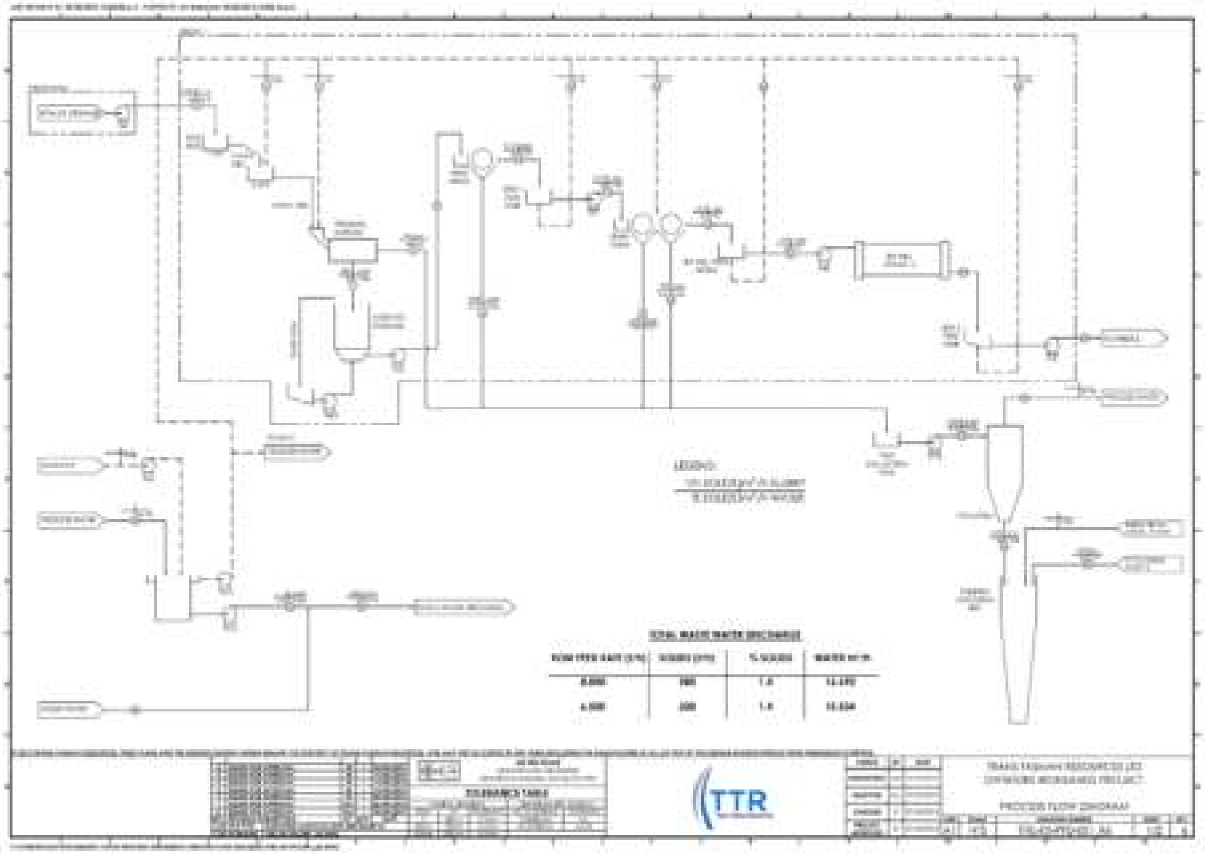

Figure 7-19 Process Plant PFD (Sheet 1)

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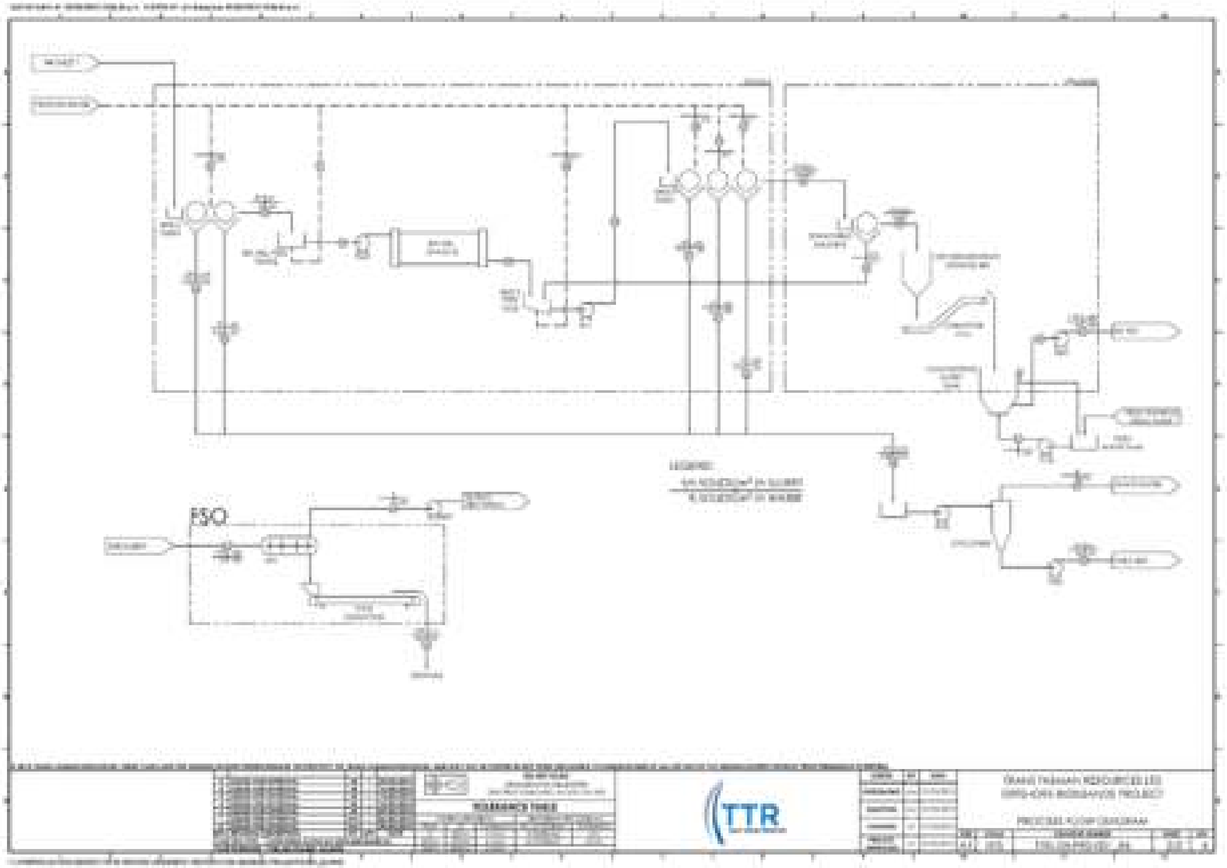

Figure 7-20 Process Plant PFD (Sheet 2)

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Due to the susceptibility of standard grade 304 stainless steel to pitting corrosion, grade 316 stainless steel was specified for the magnetic separator drums. The MIMS concentrate (approximately 41% of the feed) will be fed under gravity to the LIMS-1 feed tanks at main deck level. Process water will be added to reduce the concentrate slurry density from ~60 to 30% solids. The tailings will be gravity fed via a chute to the tailings handling area.

Figure 7-21 Magnetite Concentrate Exiting a Wet Drum Magnetic Separator

The MIMS concentrate will be pumped to the rougher LIMS distributors located on the second level. The rougher LIMS section will consist of 16 double drum units operating co-currently at an intensity of 1250 G. The units will be arranged in four clusters with four units each. Each unit has two 3.6 m wide by 1.22 m dia. drums in series. The weight recovery to concentrate is ~ 45%. Thus in the RMS section, approximately 82% of the feed is rejected to tailings. The Fe upgrade ratio is 3.2. The RMS concentrate will gravitate to the first stage grind feed bins. Magnetite concentrate from LIMS units are typically at the required solids density required for IsaMills™. grinding and no dewatering of the concentrate prior to grinding is required. The tailings will be gravity fed via a chute to the tailings handling area.

7.4.3 First Stage Grinding

The comminution circuit proposed for the Project consists of a simple two stage grind with intermediate magnetic separation (IMS) to remove liberated gangue and reduce grinding energy in the second stage grind. Both grinding stages will consist of M10,000 IsaMills™ (Xstrata), chosen for its light weight design and superior energy efficiency. The IsaMills™ will operate in open circuit. The feed to the first stage (~1,420 t/h) will be ground to a P_{80} of nominally 130 µm, requiring a grinding energy of 15 kWh/t. It is envisaged that the first stage grinding duty can be accomplished in six 3 MW IsaMills™

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Figure 7-22 M10,000 IsaMills™. Installation, South Africa

7.4.4 Intermediate Magnetic Separation

The IMS LIMS units will be identical to the RMS LIMS units. Ground RMS concentrate will be diluted to 30% solids in the IMS feed tanks and pumped to the IMS section (LIMS-2) distributors on the second level. The IMS section will comprise 12 units arranged into two clusters of six separators each. Approximately 30% of the IMS feed is rejected to tailings. The IMS concentrate will be gravity fed to the second stage grind feed tanks. The tailings will be gravity fed via a chute to the tailings handling area.

7.4.5 Second Stage Grinding

In the second stage grind the feed to the IsaMills™ are ground from 130 µm to 75 µm in order to liberate the titano magnetite sufficiently to achieve the final product specification on a consistent basis. Both the first and second stage grinding will be inert, i.e. ceramic grinding media will be used to avoid product contamination. The grinding energy required will be 17 kWh/t with the grinding duty performed by another six M10,000 (3 MW) IsaMills™

7.4.6 Cleaner Magnetic Separation

The cleaner magnetic separation (CMS) section will consist of eight triple drum co-current magnetic separators at an intensity of 950 G, arranged in two clusters of four each. Typical triple and double drum wet magnetic separators are shown in Figure 7-23. Ground IMS concentrate will be diluted to 30% solids in the CMS feed tanks and pumped to the CMS section (LIMS-3) distributors also located on the second level. The weight recovery to concentrate in the CMS section is expected to be 90% with the concentrate having an Fe grade of more than 56% Fe and SiO_2 less than 3.9%.

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Figure 7-23 Triple and Double Drum Magnetic Separators

The CMS concentrate will be gravity fed to a set of dewatering drum magnets to reduce the concentrate moisture to ~10%. The purpose of these drums is to reduce the level of sea water in the concentrate to aid in reduction of final product chloride levels. Dewatered concentrate will be gravity fed into the concentrate storage hoppers directly below the CMS area. Water removed from the concentrate is recycled to the CMS feed tank.

7.4.7 Final Concentrate Handling

The dewatered concentrate will be stored in two hoppers. The hoppers were sized for a buffer capacity of 40 h or approximately 32,000 t. This will allow enough time for the FSO to sail a distance of maximum 70 nautical miles to a sheltered area (if required by weather conditions), offload its entire load of 60,000 t concentrate and return to the FPSO. Once the FSO is on station, it will connect to the FPSO via a floating slurry line. Dewatered concentrate will be extracted periodically from the bottom of the storage hoppers onto a conveyor belt. It will be elevated to the top of a constant density (CD) agitator tank with a sandwich conveyor. In the CD tank the concentrate will be slurried with fresh water from the RO plant (from two intermediate fresh water tanks) to form a 50% solids slurry. Fresh water is required to wash the concentrate, i.e. to reduce the chloride level of the product. The slurry is subsequently pumped to the FSO and filtered to a low moisture content of less than 6.5% using four hyperbaric pressure filters (HPF; refer Figure 7-24).

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Figure 7-24 Hyperbaric Pressure Filter

These units were chosen for their much smaller footprint relative to conventional filtration units, both from an operational and maintenance perspective. The residual moisture content attainable is also much lower than that of conventional filtration with the added benefit that the minimum moisture is transported to the final destination. The HPF units will operate at an elevated pressure of 6 bar. The filter cake is discharged from the units via a double gate valve system onto conveyors which will deposit the concentrate in the FSO holds. Filtrate from the FSO will be discharged below surface.

During offloading of concentrate the process plant will continue to operate to produce the balance of the 60,000 t FSO cargo. Offloading to the FSO therefore will occur at double the production rate of the process plant (~1600 t/h).

7.4.8 Tailings Handling

No chemicals will be used anywhere in the beneficiation process. As a result, the tailings produced by the process plant will be inert. The only physical alteration of the ore is the size reduction during the grinding process. In order to minimise the environmental impact of the tailings in terms of plume formation, it will be dewatered before disposal via a set of hydro-cyclones (refer Figure 7-25).Coarse tailings from the RMS area will be treated separately from fine tailings from the IMS and CMS areas. Water removed from the coarse tailings will be recycled to the process water tank at a rate of 15,000 t/h, thus accounting for approximately 52% of the process water requirement. Water from the fine tailings dewatering will contain too high level of suspended solids to be used as process water and will be discharged.

The coarse and fine tailings will be dewatered separately to approximately 75 to 80% solids before being discharged under gravity via the tailings deposition pipe. The deposition pipe will be controlled using sonar such that the discharge occurs at a constant height from the sea bed. The tailings waste water will be discharged via a second pipe along the tailings deposition pipe slightly higher than the solids discharge.

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Figure 7-25 Hydrocyclone Cluster

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8. AUXILLIARY SUPPORT SERVICES

8.1 Power Generation

For the purposes of the PFS study the project has specified four (4) Siemens SGT-500 gas turbine generator sets for a total installed power capability of 80MW.

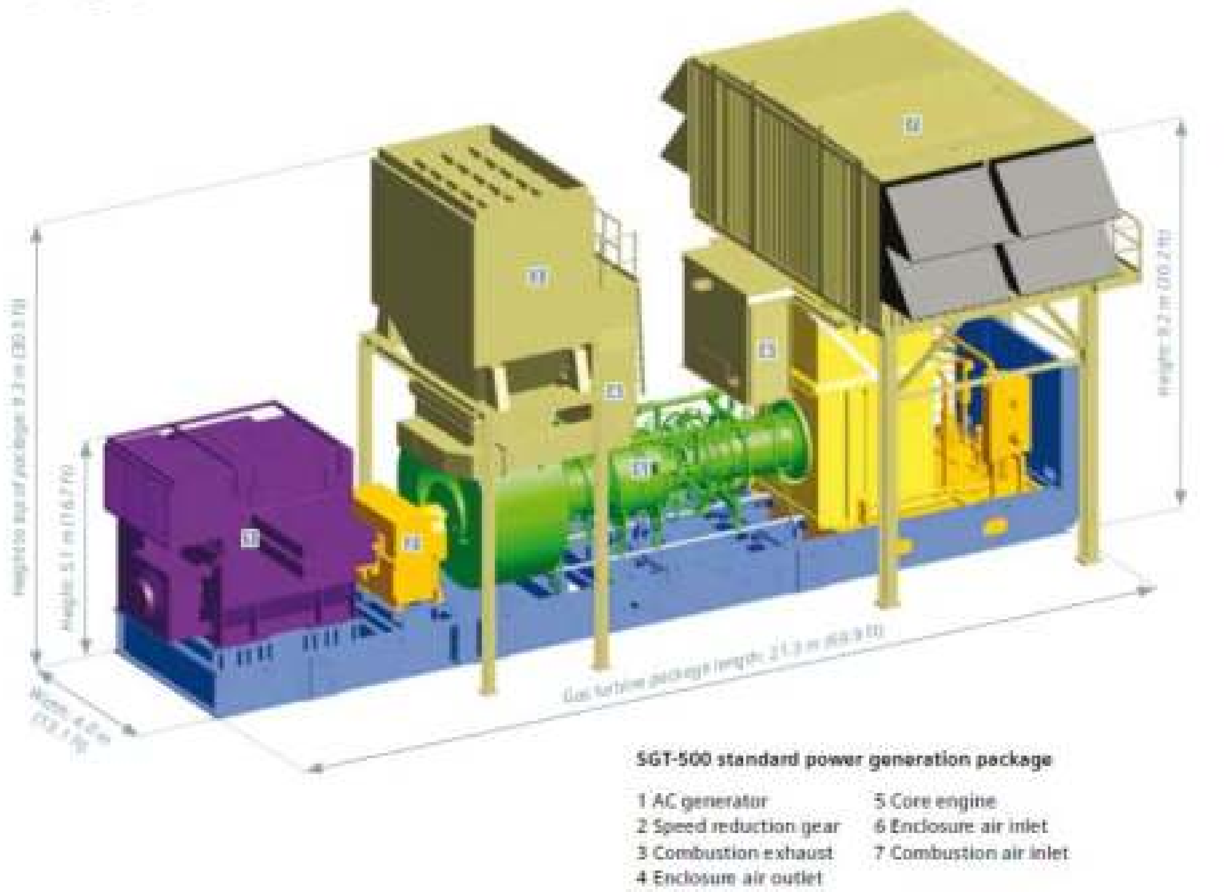

Figure 8-1 SGT-500 Power Generation Package

The SGT-500 is one of the few gas turbines which have capability to operate on HFO, something normally associated with diesel engines. Siemens has shown that the SGT 500 can operate continuously on liquid fuels with viscosity corresponding to IF700 with no requirements for blending with diesel oil.

The project acknowledges that there is an opportunity to rationalise the power installation and add considerable value to the project. The feasibility phase value engineering exercise will investigate fitting the FPSO with two turbines, along with four medium speed diesel generator sets giving the total installed power of around 80MW. The power generated will meet the ships' demand for energy, which includes the propulsion motors, mining, processing, desalination and low-voltage requirements for lighting and sockets.

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Typical medium speed diesel engines for marine applications are rated from around 1MW in small vessels to 10MW in large vessels. Installations of four, six or eight engines are commonplace with 2MW to 7MW being a popular power range. The engines are invariably multi-cylinder units in either in-line or V configuration.

Implementing this dual concept, electric power will be provided by several synchronous alternating current generators operating in parallel. The generators will be connected to switchboards by way of circuit breakers that will allow the generators and loads such as thrusters, service transformers and motors to be connected and disconnected as required.

The advantages of this envisaged concept will include:

- ability to provide large amounts of power for activities other than propulsion;
- ease with which power can be distributed for auxiliary systems;
- modular designs allowing maintenance to continue during operations;
- flexibility in engine assignment;
- good power plant efficiency.

8.1.1 BFS Power System Studies

Apart from the value engineering exercise, several other power related studies will be commissioned during the feasibility phase to support the design of the FPSO power system including:

- **Short circuit calculations**: This study will be performed to verify the proposed switchgear will be able to withstand the forces generated by the worst case short circuit current. It will also be used to verify the circuit breakers are able to interrupt that level of fault current. When calculating the contribution to short circuit current it will be necessary to consider the contribution from all motors and certain types of drives in addition to the fault current delivered by the generators.
- **Protection co-ordination study**: This study will be performed to determine the various protection settings necessary to ensure that faults are isolated as close to source as possible.
- **Load balance**: This study will be performed to show the power consumed under various operating conditions, which may include dynamic positioning (DP), transit and harbour with variations for summer and winter operation if appropriate.
- **Harmonic analysis**: This study will be used to verify that levels of harmonic distortion fall within acceptable levels under all expected operating conditions. Excessively high levels of harmonic distortion have been known to cause equipment malfunction exceeding worst case failure design intent.
- **Transient stability study**: This study will be performed to verify the ability of the generators in the power system to maintain synchronism when subjected to a severe transient disturbance such as a fault, sudden loss of generating capacity or large load rejection. It will also be used to ensure that motors can restart and that generators can restore voltage.

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8.1.2 Distributed Control System

The FPSO will be provided with a comprehensive vessel management system that will manage the functions of control, monitoring and alarm management of all machinery required to control the functions installed on the FPSO including engine and propulsion auxiliary systems, fluid and cargo systems and other ancillary systems

8.1.3 Power Requirement Simulation Model

Due to the complex nature of the operating environment, TTR commissioned a simulation model, (See Appendix 19.6), to examine the consequences of wave height, ROM grade variability, buffer sizes and maintenance shuts on the production rate and hence the instantaneous power consumption of the off-shore floating production, storage and off-loading vessel (FPSO).

A process mass balance model was constructed using the IDEAS modelling software to deliver modelling results for one year's operation at two production input rates of 6500 tonne per hour and 8000 tonne per hour respectively using actual historic variability in wave heights and observed variability of ROM ore grades based on site sampling surveys.

In addition to modelling the processing module, the model also accounted for:

- The power requirements of the FPSO's DP system (DP), influenced by wave height;
- The production by reverse osmosis of desalinated water;
- Routine fortnightly shuts of the plant for maintenance.

	Scenario 1 6,500 t/h ROM Solids	Scenario 2 8,000 t/h ROM Solids
Real Time for Model	366.4 days	366.4 days
kWh/tonne (ROM)	8.845 kWh/tonne	8.635 kWh/tonne
Peak MW	~ 66 MW	~ 79 MW
ROM Average Feed Rate t/h	6065 t/h	7465 t/h
ROM Total Tonnes	53.34 million tonnes	65.65 million tonnes

Figure 8-2 Simulation Results

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8.2 Sea Water Desalination

As the processing circuit will be using sea water there is a requirement to provide a fresh water rinsing step into the process. At levels above 300 to 350ppm chlorides begin to pose challenges to steel mills. The chloride forms a white plume during the smelting process as halide formation with potassium (K) and sodium (Na) occurs. High levels of chloride fed into sinter plants can also act as catalysts for the formation of dioxins.

This rinsing requirement will be accomplished using desalinated sea water to transfer the ore in a slurry form from the FPSO to FSO. This processing step will require the production of 30 000m^3 of fresh water per day.

The process of reverse osmosis is based on the fact that in all salt solutions an osmotic pressure arises whose magnitude is proportional to the salt concentration. When a semi-permeable membrane is placed between two solutions of different concentrations and osmotic pressures, the difference in osmotic pressures will result in a flow of solvent (and a tiny part of the solute) through the membrane, from the less concentrated solution to the more concentrated one. In the process of reverse osmosis, the direction of the solvent flow is reversed by exerting external pressure, higher than the difference in osmotic pressures, on the more concentrated solution.

The typical reverse osmosis plant consists of a bundle of membranes placed in a pressure chamber, a high pressure pump, a turbine for recovering energy from the high concentration brine which is discharged from the plant, and a system for the pre-treatment of the feed water and the product water.

In the TTR process the sea water will enter, via the sea chest, a pre-treatment system which will contains sand filters, micron filters and a system for chemical dosing. The purpose of this pre-treatment system will be to protect the membranes from fouling by dirt and biological deposits. The feed pump will generate sea water flow at pressures of 55– 80 bar through the membrane system. The discharged brine will be returned to the sea via the submerged tailings pipe. A secondary system used for periodical cleaning of the membranes is installed in each reverse osmosis plant.

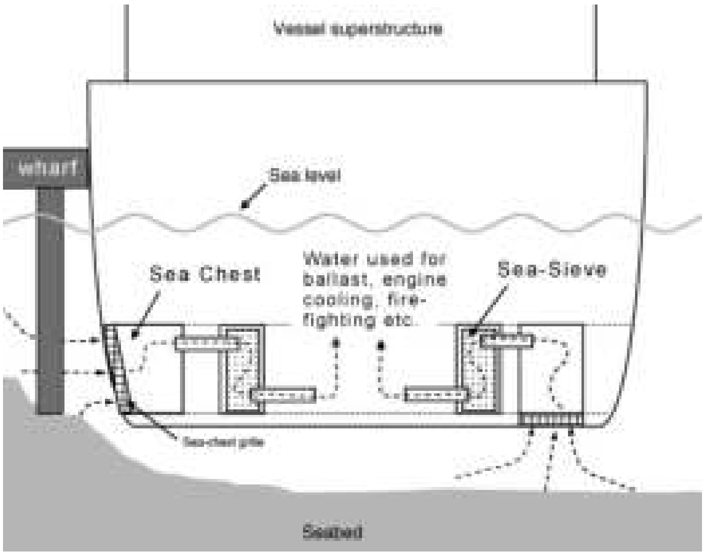

Figure 8-3 Vessel Sea Chest

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The TTR project has specified 10 separate containerised Reverse Osmosis plants, each with a production capacity of 3000 cubic Metres per day.

Modularising the plant up in this way reduces risk – in the case of a breakdown in one plant, nine others are still available. It is also advantageous from a maintenance downtime perspective: with only 10% capacity offline at any one time, production is hardly interrupted for scheduled servicing. Spare parts are common across all plants, further reducing costs of stocking critical parts and components.

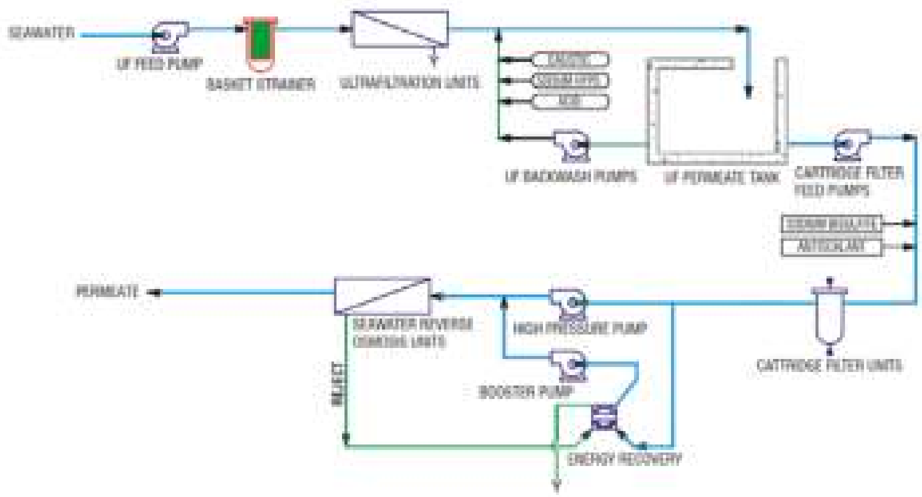

Figure 8-4 Typical Desalination Process

9. OFFSHORE FACILITIES & SHIPPING CYCLES

In order to fulfil the requirement for producing 4-5 Mtpa of concentrate, the integrated vessel solution requires several unique vessels to be permanently mobilised, each having a specific function.

9.1 Offshore Personnel levels

The personnel levels for the FPSO has been developed based on the personnel arrangements on FPSOs currently operating in the Taranaki Area. There are currently two FPSOs operating in the Taranaki offshore oil fields, and these have been operating since 2007.

The crews of both vessels are employed under separate employment contracts, some collective and some individual, these contracts are a progression from the original FPSO employment contracts developed for the 'FPSO Whakaropai' which was operated by Shell Todd Oil Services Limited in the Maui field from the mid 1990's to the mid 2000's. (See Appendix 19.9)

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9.1.1 Offshore Working Rosters

It is envisaged that the TTR will employ the same 21 day on and 21 day off roster as per the current FPSOs. This is a typical employment condition in the offshore oil and gas industry and results in two crews being engaged for each vessel.

Furthermore – the respective employment agreements will provide for six weeks annual leave and in order to meet the roster patterns a small number of relievers will be engaged to cover the disciplines when the core crew is taking these leave periods. The relievers are either sourced from onshore contractors or employed as casual permanent relievers.

9.1.2 Where crew reside when onshore

There are no employment restrictions as to where crew need to reside in New Zealand. As a natural result of Taranaki being the energy province of New Zealand a number of crew have been sourced locally in Taranaki, whilst others from other New Zealand regions. For the FPSO 'Umuroa' the current figures are 54% Taranaki residents, elsewhere in 46% NZ, the FPSO 'Raroa' is similar.

9.1.3 Nationality of crew

There are currently plans to incentivise the use of either New Zealand citizens or New Zealand residents as crew on all operational vessels.

9.2 FPSO – Offshore Operations

A FPSO, will extract sediment from the sea bed, process the sediment (ROM) and return the tailings to a previously mined area whilst moored on a temporary 4 point, DP assisted, mooring.

The table below summarises the calculated size required for the FPSO.

Duty	Weight (t)
Crawlers & LARS	3,651
Process Plant Equipment	4,388
Process Buffers:	
Rom Buffer	32,000
Material in Process	14,828
Process Water	15,000
Fresh Water (desal)	10,000
Tails Buffer	5,524
Concentrate Buffer	34,000
Process Plant Structure, Pumps & Electrical	5,188
Ship Mooring System, Propulsion Pumps & Electrical	745
Ship Fit-out, Consumables & Tanks (Incl Fuel)	14,750
Ship Hull & Superstructure	33,200
TOTAL	173,184

Table 9-1: FPSO Size

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Note: the amount of fuel required has been calculated based on an installed power generation capability of 80MW.

In order to fit with this requirement and also allow for potential future additional weight to be installed on-board the FPSO, a 200,000 tdw vessel has been considered for the mooring dynamic analysis in the rest of the study.

9.2.1 FPSO Mooring Analysis

As part of the IHC Crawler evaluation, a preliminary conceptual mooring study and dynamic analysis was performed on the FPSO in order to confirm the ability of the proposed 4 point mooring to cope with the environmental conditions. The loadings identified in the initial commissioned Principia mooring study, see appendix 19.23, provided IHC with the baseline loading cases for the preliminary conceptual 4 pint mooring study.

The proposed mooring system will consist of a 4 point mooring with an equal spread. The vessel will be able to operate in a mining grid of 600 m * 300 m with a water depth of 20 Metres. (see Appendix 19.16)

9.2.2 FPSO Personnel Levels

The total personnel complement required for the FPSO will be 139 personnell, this includes an allowance for relief during holiday periods. The detailed FPSO personnel requirement is detailed in Appendix 19.8 of this document

9.3 FSO – Offshore Operations

The FSO, i.e. Floating Storage and Offloading vessel, will be used in the overall production cycle to temporarily store the iron ore product before shipping and offloading onto the cape size vessels round tripping to export market.

The proposed FSO transhipment system will consist of a built-for-purpose, self-unloading vessel with a cargo capacity of 60,000 tons.

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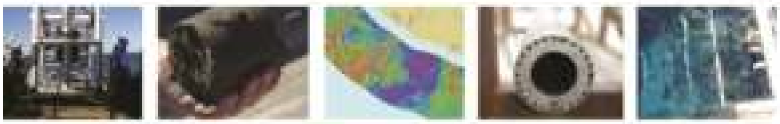

	Specifications
Length *(meters)*	230
Width *(meters)*	32
Summer Draft *(meters)*	13.0
Air draft in ballast condition *(meters)*	34.0
Class and flag	IACS class society and flag to be determined.
Propulsion	Main propulsion and rudder system designed for optimum maneuverability Powerful bow thrusters, allowing double-bank operation independent of tugs Further analysis required to determine maneuverability requirement during loading, including requirement for full Dynamic Positioning capability
Accommodations	25 people
Self-Unloading / Material Handling System	Hopper shaped cargo holds lined with UHMW Hydraulic mass flow gates Gravity fed inclining conveyors 2 x ship-loaders, each 4,000 TPH (peak 8,000 TPH, average 6,000TPH
OGV Limitations	Must be gearless and free of deck obstructions Max beam: 57m Max freeboard (waterline to hatch coamings): 21m Min hatch sizes to be determined

Table 9-2 FSO Specification

There will be two cargo handling systems on the FSO:

9.3.1 FSO Loading system

This loading system will consist of a dewatering plant and a mechanical, deck conveying system.

The dewatering of the ore will be achieved by 4 hyperbaric filtration units each with a throughput of 450 tons/hr, providing a total dewatering capability of 1,800 tons/hr.

The slurried ore will be transferred from the FPSO to the FSO through flexible hoses. Once the FSO is fully loaded with concentrate (60,000t), it can unmoor from the FPSO and sail to an awaiting export cape size vessel which will be located in a calm area off the South Island, approximately 70 nautical miles from the mining location (Table 9-3).

Upon arrival at the South Island, the FSO will moor to the cape size vessel and offload the concentrate for export.

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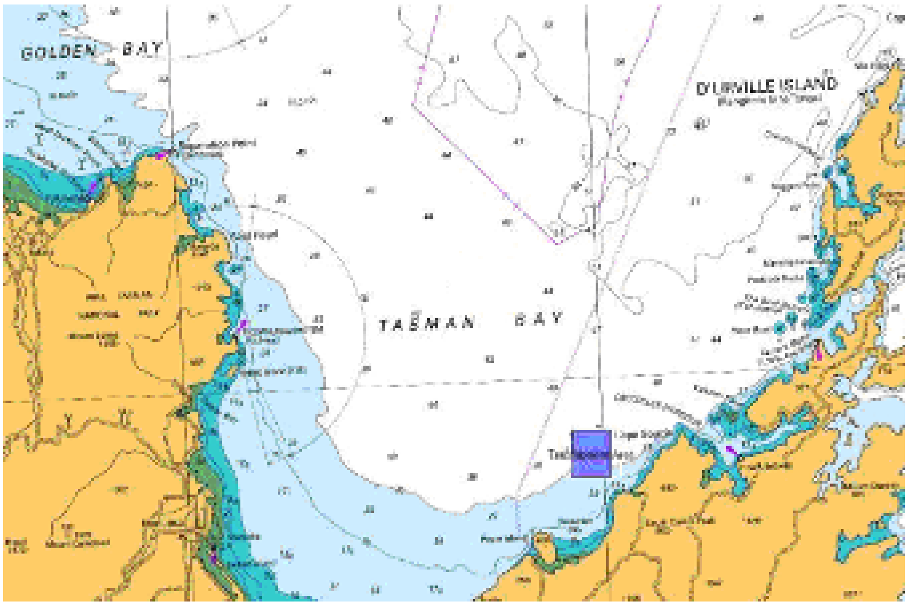

Table 9-3: Trans-shipment location off Southern Island

9.3.2 Cargo Vessel (Cape-size) Loading system

The cargo discharge system on the proposed FSO will be gravity based, and is wildly used across self-unloading bulk carriers and transhipment systems. The company approached during the completion of the PFS, i.e. CSL, has currently 3 gravity FSOs in operation and 9 self-unloading bulk carriers under construction (or newly completed) utilizing the same core technology as the proposed TTR FSO.

9.3.3 Trans-shipment Cycle

The overall cycle duration of the Floating, Storage and Offloading vessel.

Activity	**Time (h)**
Total positioning time	5.0
Loading FPSO to FSO	53.6
Average time for draft survey	0.2
Transit to Anchorage	5.8
Unload FSO (transhipping)	7.5
Shifting	0.5
Transit to FPSO	5.8
Total time per FSO (hours)	**78.4**
Total time per FSO (days)	**3.3**

Table 9-4: FSO shipping cycle

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The overall shipping cycle duration for the FSO is thus approximately 78.4 hours, putting the FSO on the critical path of the overall production cycle.

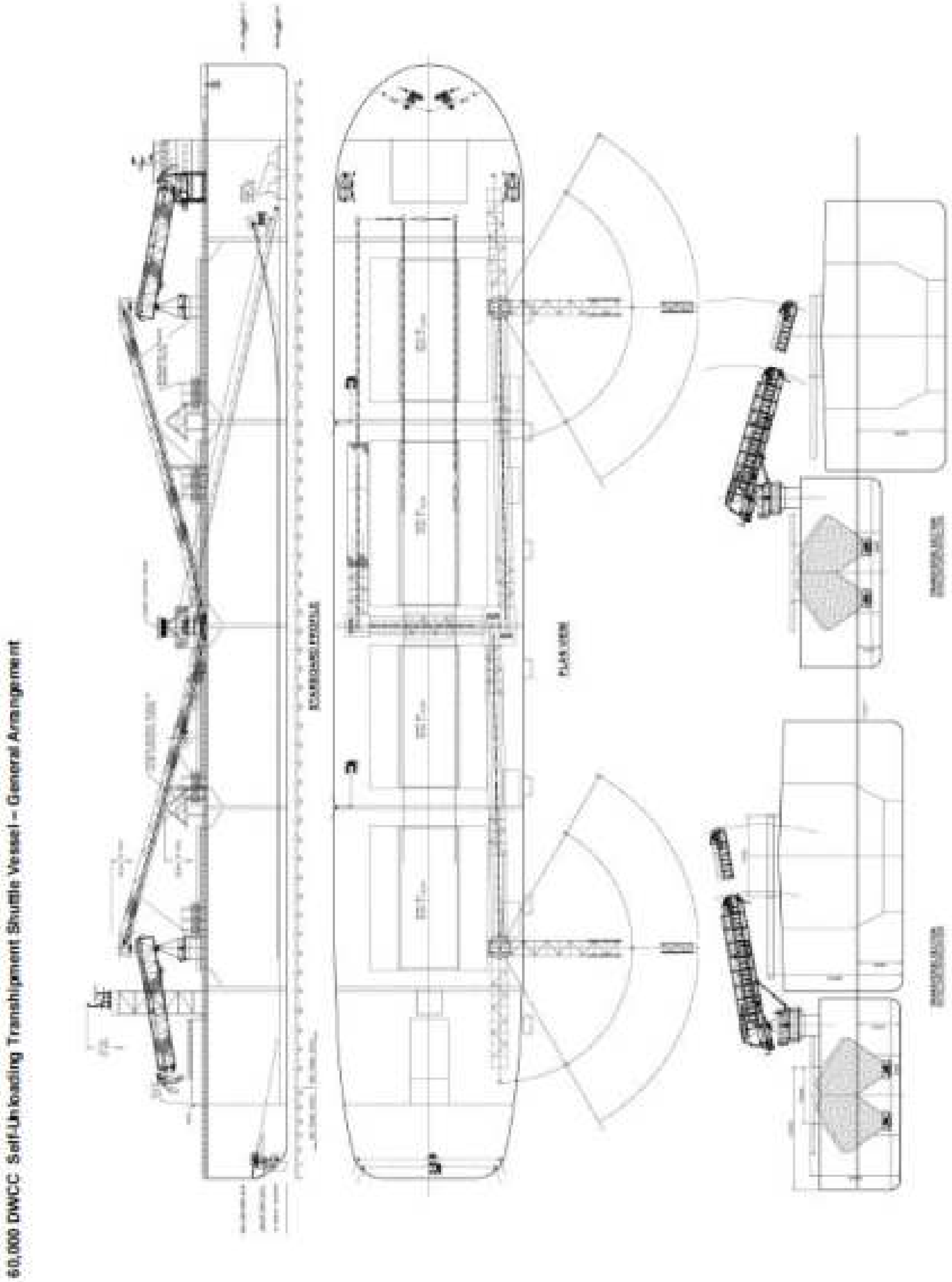

Figure 9-1 FSO General Arrangement

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9.3.4 FSO Personnel Levels

The total personnel levels, including holiday relief, for the operation of the FSO will number 34 and will be sufficient to operate and maintain the filtration modules provided they are given the relevant training.

9.4 Operational Support (AHT)

The TTR project has made provision for a 80te bollard pull Anchor Handling Tug (AHT) to assist with the provisioning of the FPSO and FSO, assistance with the connection of floating hoses and anchor moving.

The AHT will also provide refuelling assistance and be equipped to assist in case of any fuel spillage and fire.

9.4.1 AHT Personnel Levels

The total personnel levels, including holiday relief, for the operation of the AHT will number 24.

9.5 Iron Concentrate Export to China

The final iron ore product will be exported to China by means of standard cape size vessels, chartered by either TTR or their customers. The overall export cycle is detailed in the table below.

Activity	Duration (h)	Duration (d)
Load time 180kt	235.3	9.8
Sail to Qingdao (Cargo)	382.0	15.9
Unload	140.0	5.8
Sail to New Zealand (Ballast)	369.0	15.4
TOTAL	1126.3	46.9

Table 9-5: Cape Size Vessel shipping cycle

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10. OFFSHORE OPERATIONS

The integrated solution features a single FPSO, that will contain the mining, processing and tailings deposition mechanisms, a single FSO that will tranship the concentrate from the FPSO onto standard commercial bulk cape-size vessels for delivery to end users.

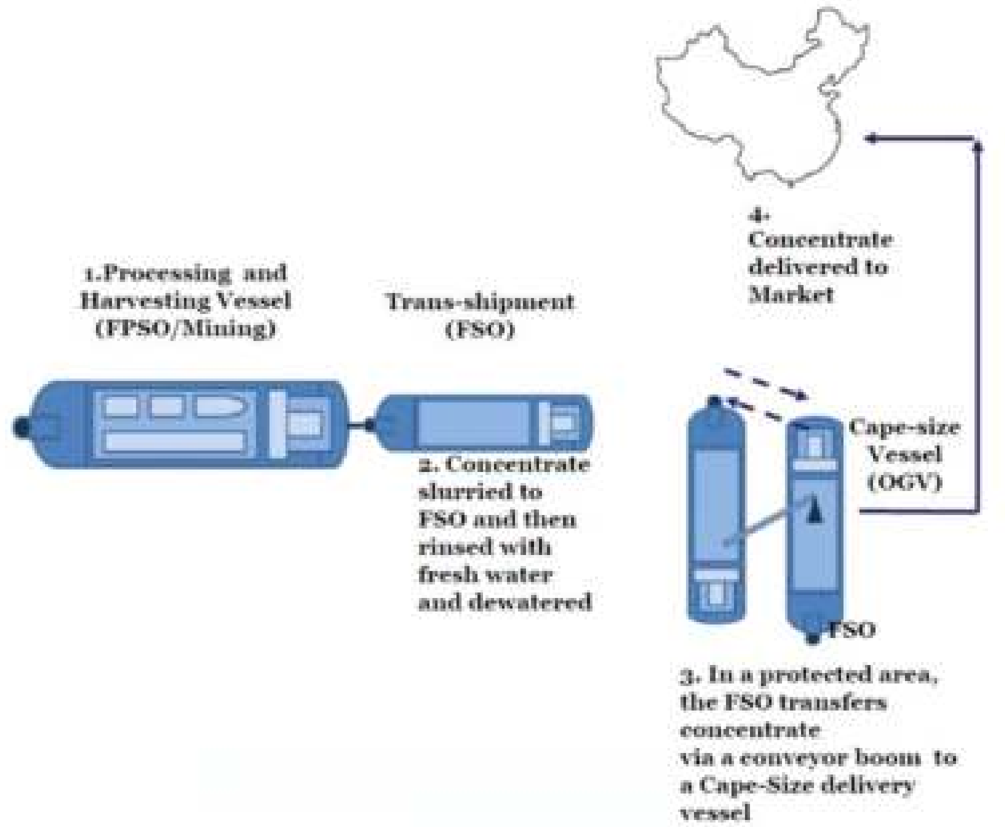

Figure 10-1Offshore Operations

10.1 Anchor Relocation

A 300x300 m mining block will typically be mined out in around 5 days, thus the mining block selected is 600x300 m requiring an anchor shift operation every 10 days.

With the FPSO in a DP assisted state, the AHT will move 2 (least loaded) adjacent anchors to their new position whilst the FPSO remains over its existing mining area. Once the FPSO has raised the mining crawler, moved over the new mining area and lowered the crawler the AHT will resume the relocation of the two remaining anchors.

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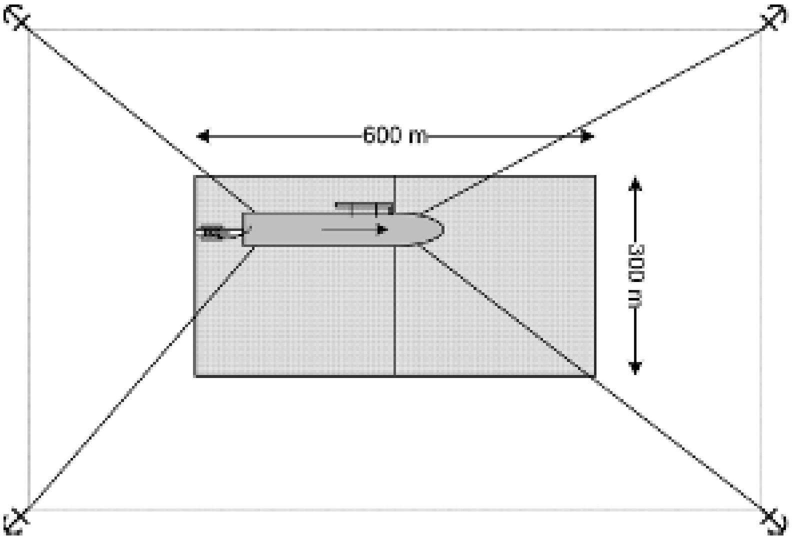

Figure 10-2 Anchor Spread

10.2 Iron Ore Unloading

Once beneficiated the iron ore will be unloaded to a FSO used for storage and transfer to cape size vessels for export to China.

This iron ore unloading operation will require the FPSO to be equipped with a bow offloading system to be connected to the bow of the FSO by floating, flexible hoses.

The average distance required between the FPSO and the FSO for safe unloading operations varies between 70 and 110 metres. The FSO will need to be equipped with some dynamic positioning capability in order to enhance operability and facilitate transfer operations whilst not disrupting mining operations.

The offloading system must offer the advantage of storing the flexible hoses on dedicated storage reels, in order to avoid leaving them at sea where they are subjected to waves and current which will induce wear, tear and fatigue damage of the lines.

10.3 Cape Size Vessels Loading

The transhipment from the FSO to the cape size vessel will be performed by means of dedicated belt conveyors which will be installed below the FSO holds which slope has been modified in order to allow removal of the ore by gravity (no additional equipment required for ore transfer).

The iron ore will flow through gravity feeder gates at the bottom of the FSO cargo holds, depositing cargo onto an inclining tunnel belt that will elevate the cargo to the main deck of the vessel. The cargo will then be deposited onto two separate incline conveyors, each feeding a “ship- loader” located fore and aft. The ship-loaders can slew, luff and telescope and are capable of loading and trimming cargo vessels up to 57m across. No additional mechanical trimming will required.

The distance between the two ship-loaders and the slewing capability will facilitate an optimized cargo vessel loading sequence with little or no shifting of the FSO along the cargo vessel.

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The FSO will be fitted with an optimised mooring systems and an azimuth propulsion system, allowing for a higher degree of manoeuvrability, shorter cycle times and improved safety. This will also allow the FSO to operate without tug assistance.

Figure 10-3 Gravity Transhipment Shuttle Vessel CSL Whyalla transhipping iron ore in South Australia

Figure 10-4 Cape Size Vessel Loading

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10.4 Heavy Fuel Oil (HFO) Supply & Transfer

HFO is still the standard grade of fuel for ocean going vessels and is readily available from Singapore, with a smaller supply also available from the New Zealand Marsden Point refinery. All of the operations on the FPSO will be powered by generators using HFO, at full production this will consume around 7,500T of HFO per month.

10.4.1 RAS (Replenishment at Sea)

The most efficient refuelling system would be a RAS system. This is proven technology and used widely around the world, including all major Navies. Its biggest advantage is the ability for the FPSO to continue operation during the fuelling process.

The process would involve a tanker vessel sailing directly from the supply point to the TTR mining area and refuelling would take place as shown below.

Figure 10-5 Typical Refuelling Configuration

The jackstay wire rope is fastened to the receiving vessel above the refuelling point, the fuel hose is then deployed and is guided to the reception manifolds, where the fuel probe self-locates and locks in place, once secure fuel can be transferred.

This system is capable of operating in up to 4m significant wave height[7].

10.4.2 Logistics

There is a large supply of HFO available around the world with Singapore being the nearest large supply, however the Marsden Point Refinery in New Zealand also produces a certain amount of HFO per year. During Summer, the supply and

[7] The **significant wave height** (H_s) is defined traditionally as the mean wave height (trough to crest) of the highest third of the waves.

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demand are relatively equal, during the Winter the requirement drops significantly and there is a surplus which needs to be exported.

TTR would contract a company to provide a turnkey solution providing a consistent fuel supply per month directly to the operating vessels via a RAS or similar system.

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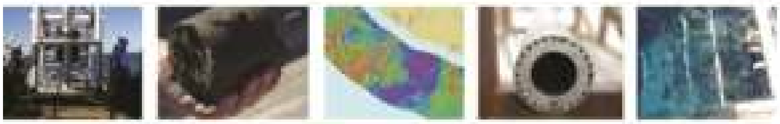

11. HEALTH AND SAFETY

11.1 Summary

There are a number of Health & Safety (H&S) considerations when carrying out such a large offshore project, TTR will be requiring the companies who are supplying all of the equipment to provide relevant H&S guidelines for use. The information provided will be assessed against the best practise in industry and improved where possible to ensure TTR is providing the safest work environment available. Below are the high level obligations TTR would have to cover when undertaking the mining operation:

11.2 Vessel Operations

All of the vessels involved in the mining operation will follow the International Safety Management Code (SOLAS) for vessel operations, Maritime Transport Act and Maritime NZ Marine Protection Rules. Each vessel will also have tailored H&S systems based on the unique normal day to day deck based operations. There will be specialist operations which the vessels take part in which will need specific H&S guidelines developed for them as follows;

FPSO

- Deployment, connection & Emergency release of slurry hoses to FSO
- Vessel proximity procedures (based on dynamic positioning capability)
- Safe sea state operating conditions
- On deck crawler operations
- Power plant operations
- Crane operations
- Anchoring operations
- Port Operations (handled by Pilot) – This will be specifically covered due to the size of the vessel

Anchor Handling Tug (AHT)

All of the anchor handling operations will be dependent on the met ocean conditions

- Loading and unloading supplies to the FPSO or FSO via deck cranes
- Moving the anchors of the FPSO

FSO

- Deployment, connection & Emergency release of slurry hoses to FSO
- Loading between the FSO & cape size export vessel

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11.3 Process

The process area will be treated in the same way as a high level production plant onshore, with each piece of machinery assessed and assigned Standard Operating Procedures (SOP's) & maintenance schedules with hazards and work plans associated to each.

A HAZOP will be undertaken before commissioning.

11.4 Submerged Sediment Extraction Device (SSED)

The SSED is an extremely large machine and will have similar H&S requirements around its handling as onshore mining equipment of the same size. Some of the unique requirements will be;

- Operating the SSED on deck
- Emergency lift procedures
- Loss of vessel position
- Umbilical tendering - steel wire lifting cable; slurry hose; high voltage power supply subsea & on deck
- Maintenance procedures on the SSED

An advantage is that the crawler is mature technology which has established its use at sea, so previous experience of H&S procedures developed can be used and updated to exceed international expectations.

11.5 Power Generation

Due to the large amount of power being generated for the various processes on the vessel and the environment it is being used in the H&S requirements will be of the highest standard and can be modelled on procedures used by on shore power plants.

The FPSO will have an integrated power system which will control, monitor and regulate the power being sent to each piece of plant, this will allow TTR to automate the safety systems for faster and more efficient deployment. Specific attention will also be applied to:

- Security & treatment of on deck power cables
- Integrity of areas where power is generated
    - Electrical isolation of plant & emergency stop of whole process
- Monitoring of fumes & gases
- Electrical safety plans
- High voltage safety
- Emergency power requirements
- Class protection of equipment established

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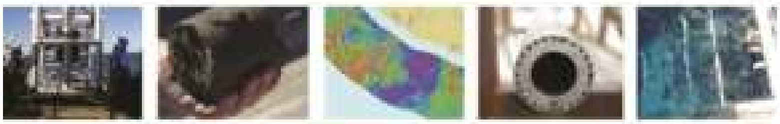

11.6 HFO Fuel Handling & Transfer

The fuel being used on the project will be Heavy Fuel Oil (HFO), this fuel is not as refined as other fuels and is more toxic than refined fuel. Specific H&S risks are associated with this fuel necessitating a need to reduce the exposure to zero where possible. If exposure is necessary then strict protective equipment would be specified and supplied.

Bunkering at sea is regulated under the Maritime Transport Act, Marine Protection Rules & MARPOL, the following H&S practices need to be followed;

- a safe and controlled surface transfer system – this system should have an automated mating / coupling system
- Transfer in daylight hours only
- A safety management system documenting all procedures to take place to allow the safe transfer of fuel oil
- Strict protocols in place for spill control
- The vessel transferring to have spill control and dispersants available and ready

11.7 Personnel

Maintaining the health of all personnel working within this operation is paramount. The crews will be working on a rotation basis such as three weeks on three weeks off, while they are on the vessel they will work every day on 12 hour shifts. Our H&S procedures should be similar to other manned production platforms such as the Raroa and Umoroa (Existing New Zealand offshore FPSO's). Some of the key H&S policies will be around;

- Physical health
- Dealing with accidents & injuries
- Promotion of a healthy lifestyle on board
- Physical properties of fine iron sand and associated hazards
- Mental Health
- Fatigue
- Isolated working environment
- Adherence to strict procedures and practices
- Active participation in promoting a safe work environment
- The proper training is provided in offshore survival; first aid & fire fighting

11.8 Helicopter Operations

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These operations are some of the most dangerous and will have to be carried out regularly to transfer crews & emergency / specialist supplies. The safety precautions that need to be taken are very specific and require a number of trained specialist, some of the considerations will be;

- Security
- Communications
- Cold water survival training
- Weather parameterss
- Fire fighting capability
- Rescue capability

New Zealand has a major helicopter port based in New Plymouth which carries out a number of flights each day to New Zealand offshore installations, they have strict H&S standards and procedures which allow them to operate around and land on oil installations, these same standards will be applied to TTR's offshore operations, these include adherence to Civil Aviation Rules; Safety Case methodology, Risk & impact assessments.

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12. MARKET STUDIES AND CONTRACTS

12.1 Introduction

TTR engaged the services of an independent global iron ore consultant Tennant Metals Pty Ltd to assist in determining the potential value, penalties and market opportunities of the beneficiated fines and to provide marketing input for the PFS, (Ref: Appendix 277).

Amongst other things the study considered the relative pricing of a 57% product compared with the PFS product specification of 60% Fe product in order to provide the foundation for a cost benefit analysis to be carried out in due course for the production of a higher grade Fe product at a likely lower overall process recovery.

The shipped iron ore fines product from the TTR Project is forecast to produce a 57% Fe contact with the remaining chemistry within the acceptable range for steel plant consumption. The 60% Fe iron ore fines product is well suited for the Asian market and at a production capacity of 4-5 Mtpa will be easily consumed by steel plants.

The relative Value in Use (VIU) of the 57% Fe iron ore fines compared to the Platts 62% Fe index was calculated using the Slag Volume Index (SVI) method. This index measures the amount of waste material required to be processed to obtain one tonne of iron. Using the SVI method it is forecast that the 57% Fe iron ore fines would attract a discount on a dmtu basis compared to the Platts 62% Fe index to provide the similar VIU based on the iron ore fines chemistry. It is assumed that the size distribution will have no impact on sinter plant productivity. This assumption will be tested in due course by laboratory-scale sinter pot test work program at an internationally recognised laboratory.

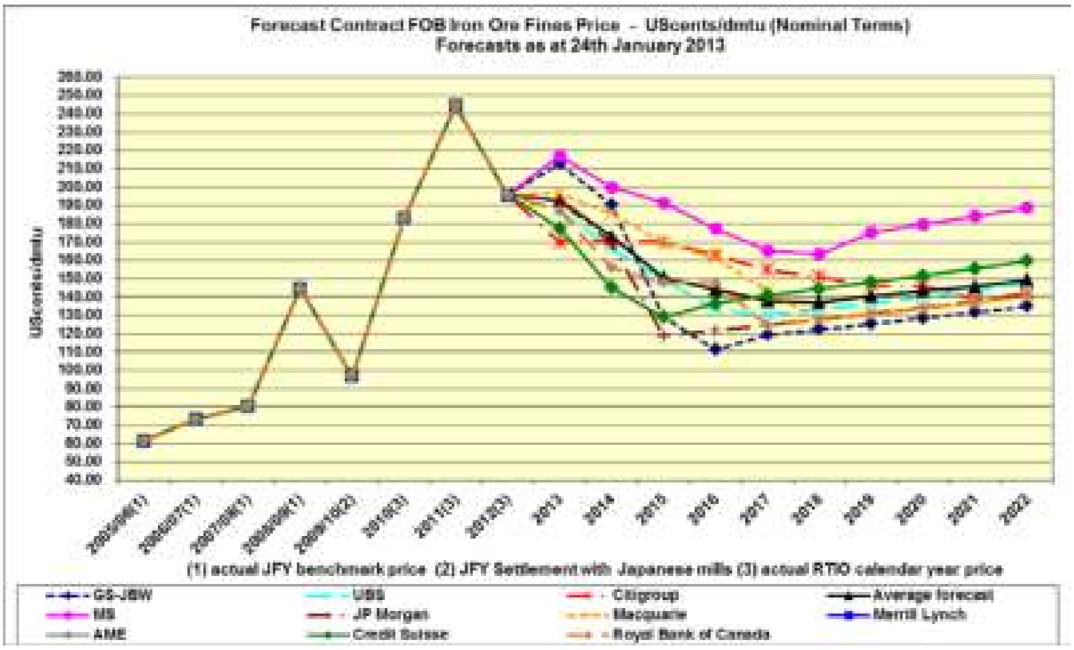

Table 12-1: Tennant Metals mid to long term price forecast consensus.

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12.2 Product Specification

The TTR Iron sands has been identified as a material which can be mined and processed to produce a product of a quality that can be sold in the current market. The forecast mine life is 20 years plus at a production capacity of 4 Mtpa.

Iron Ore	TTR iron sand
Type	Concentrate
Fe	56.70%
Fe^{3+}	66.70%
Fe^{2+}	33.30%
FeO	24.30%
Fe_2O_3	54.00%
SiO_2	3.40%
Al_2O_3	3.70%
CaO	0.94%
MgO	3.14%
Mn	0.53%
P	0.15%
S	0.01%
TiO_2	8.40%
V_2O_5	0.50%
Na_2O	0.15%
K_2O	0.12%
H_2O+	0.00%
H_2O-	6.50%
Total	99.40%
Ultrafines (for fines)	100.00%

Table 12-2: TTR's VTM Expected Typical Specification.

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12.3 Product Variability Targets

It is anticipated that the product variability will be within the range required for the market. This is based on the assumption that a total quality management plan will be implemented with mining and scheduling. The operational focus will be aimed at maintaining all key parameterss within the market contracted specifications between TTR and the customer.

12.4 Marketing Summary

Worldwide steel consumption is being driven by Asia's rampant demand for metallurgical raw materials such as iron ore, coking coal, manganese etc. China is the largest consumer of iron ore and will maintain this consumption demand for many years to come. There are however a number of other increasing markets, specifically the Middle East and the Indian Sub-Continent whose requirements for higher quality ores becomes more a necessity as base load steel capacity modernised and hence should not be ignored into the future.

Japan, Taiwan, Korea & Europe remain steady consumers of iron ore and other metallurgical commodities, but 2003 marked the commencement of the China era, and it is from this period that China became the dominant buyer. It is expected that China will be the 'base load country' for the TTR Vanadium Titanium Magnetite (VTM) concentrate product with other demand driven countries to follow suite, via a deliberate marketing and diversification strategy.

The TTR marketing strategy will be structured into a four phase plan as follows:

- Phase One: Development of the Chinese market.
- Phase Two: Development of other mature Asian buyers such as Japan, Korea and Taiwan.
- Phase Three: Development of new capacity buyers such as the Middle East and India.
- Phase Four: Development of mature markets of Europe etc.

All of the above is relative to modulated expansion of TTR's concentrate production moving forward.

Each phase has its individual subset development. For the purpose of this marketing strategy and the fact that China will be the base load customer for the project in the initial production development phase being around 4 to 5 million dry metric tonnes of processed VTM concentrate , this initial strategy will be specific to the Chinese phase one. Phase's two to four will be embarked upon following the achievement of a satisfactory outcome in China. The time line for the remaining phases will be relative to the project reaching world class capacity (around the 20 to 50 million tonnes per annum for a single operation) via modulated ramp up in production.

Phase one will consist of the following sub phases:

- Pre-introduction phase: The TTR VTM project has been well introduced by the Tennant Metals Beijing office & TTR management. This has occurred with tier one & tier two dedicated VTM consumers and traditional blast furnace users of similar ranking.

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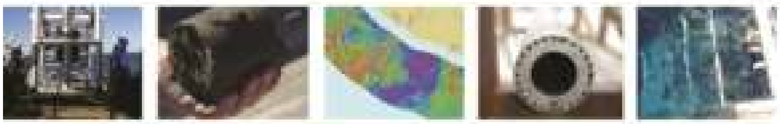

- Introduction phase: To date, several high profile conferences (CISA Iron Ore Conference on three occasions & other investment forums in China) have been used to present detailed concepts and the project dynamics to a large iron ore and investment specific audience. In addition, several road shows were conducted in which detailed presentations were given to prospective off-taker, funders and end user/buyers. This led to several Letters of Intent being signed, aimed at long term off-take for TTR’s VTM concentrate.
- Broader marketing phase: This phase is aimed at reducing the potential off-takers to a smaller pool, all of whom ideally contribute something back to TTR (equity/debt funding, strategic benefits, and/or market related off-take terms). To date, an initial portion of future offtakes have been negotiated and signed, and a tranche of equity investment secured from an offtaker. These have assisted the spread of the product through the market, allowing mills not familiar with VTM ores to become inquisitive. Others have appreciated the potential of the project and show a real path to production which is half the battle for new miners.
- Initial consummation phase: Final off-take negotiations (in some cases renegotiation of current off-take to fall in line with economics confirmed via the PFS) and execution of sales contract leading into First Ore On Ship (FOOS) and the commissioning phase have been executed

There is an excellent technical and economic case for using VTM concentrates as a substitute to traditional iron ores feeds, particularly if vanadium credits can be allocated on a positive basis.

The current VTM supply is limited on a Seaborn basis but there are significant quantities consumed domestically within China. As much as the Seaborne market is limited there is significant scope for this to increase.

In the short term, there is a substantial market accessible to TTR’s product that is estimated to be circa 20 million metric tonnes specific to TTR VTM feed. This is based on a combination of traditional blast furnace capacity using small amounts of VTM concentrate in the pre burden sinter matrix (somewhere between 3% to 5% with the constraints allowing higher blends being the elevated titania (TiO_2) and Phos (P), while seaborne supply for dedicated VTM consumers would be 100% reliant on dedicated VTM feed material.

In the medium to long term, there is potentially for a much larger market for VTM concentrates if integrated steel mills can be encouraged to convert traditional Blast Furnace capacity to dedicated VTM use during new construction of blast furnaces or that of modifications to traditional capacity. This larger capacity is relative to future iron price outcomes and the continuation of TTR’s cost of recovery sits favourable on the cost curve which would allow circa 100 million tonnes per annum circa 5 to 10 years.

The failure of new capacity coming on line from magnetite (Fe_3O_4) hard rock pier competition that has a cost of recovery well above US$70 (Free on Board basis) a tonne will assist by the significant CAPEX in hard rock processing and significant cost to deliver a logistics corridor to ships rail, the modulated and organic logistic solution for the TTR project gives it a significant advantage, in realisation of this new capacity constraint the mid to long term potential for VTM’s and TTR look excellent.

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12.5 Pricing Strategy

Baosteel has traditionally led a negotiation table consisting of members of the top tier one steel mills and traders. This single negotiation approach used to start around November each year, and continue through to March of the following year. This period was always known as the "mating season". These negotiations were then strained when the China Iron & Steel Association (CISA), which is an association of steel producers in China and acts as a quasi-semi-governmental organisation, was given the role to secure more favourable terms for the Chinese steel mills for JFY 09/10 this led to a total breakdown in the yearly benchmark.

From this period miners and buyers ended up pricing off a range of indices these indices have become much matured. The main Indices are as follows:

- Platts (published by Mcgraw Hill Financial). They publish the following range of indices:
  - IODEX 62% Fe CFR North China.
  - 63.5/63% Fe CFR North China.
  - 65% Fe CFR North China.
  - 58% Fe* CFR North China.
  - 52% Fe CFR North China.

*Al = 4.0% max

- The Steel Index (TSI.. TSI was purchased outright last year by Mcgraw Hill Financial). They publish the following range of indices:
  - 62% Fe fines, 3.5% Al, CFR Tianjin port.
  - 58% Fe fines, 3.5% Al, CFR Tianjin port.
  - 62% Fe fines, 2% Al, CFR Qingdao port.
  - 63.5/63% Fe fines, 3.5% Al, CFR Qingdao port

Miner and buyers agreed to a quarterly price outcome which was derived from the previous quarters Platts or TSI as the indices take into account the CFR landed basis so C3 (Brazil to North China) and C5 (West Australia to North China) whereas the previous yearly benchmark was on a Free on Board (FOB Incoterms 2000) basis. After a period of price volatility with many mills either deferring or defaulting the quarterly in arras still exist for larger buyer (particularly from Vale) a significant amount of tonnes are now driven by very narrow quotation period or are derived based on future price setting (M+1 or M+2 ad description of this is in section of pricing methodology).

12.6 Market Price forecast.

12.6.1 Current price assessment

The market price of the iron ore had stabilization in the first two weeks of February 2013 ($150-US$155 per dry metric tonne CFR China – 62% Fe Australian fines) and was followed by a negative trend in the second half of Q1, as spot prices rolled

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down to $US133-135 per dry metric tonne level. This trend continued into April and has continued onto US$120 or thereabouts for May.

According to the major market players and industry experts, the price decline was caused by weaker demand (Chinese consumers cut their purchases drastically after re-stocking) and better availability of material (there were seasonal difficulties with iron ore shipments from Australia at the beginning of the year). In early Q2, the situation in the Chinese steel worsened further. The following three facts demonstrate the Fe surplus currently affecting the market:

- Steel production in China gained 11% y-o-y in January-February 2013, reaching 50% of the total global production for the first time ever;
- Apparent consumption of steel products in the country increased by 10% y-o-y in the same period;
- China's PMI published in early April showed a drop of 14 points, reflecting Chinese consumers' negative expectations from Q2 in general.

As a result, the leading investment banks and industry analysts started to update their short- and medium-term forecasts for iron ore as well as other raw materials, revising the change direction again.

Several forecasts of iron ore price prepared after the beginning of 2013 are provided below. Many analysts will update their forecasts by late Q2 2013. Tennant runs its own mid to long term pricing model but has not updated its forecasts

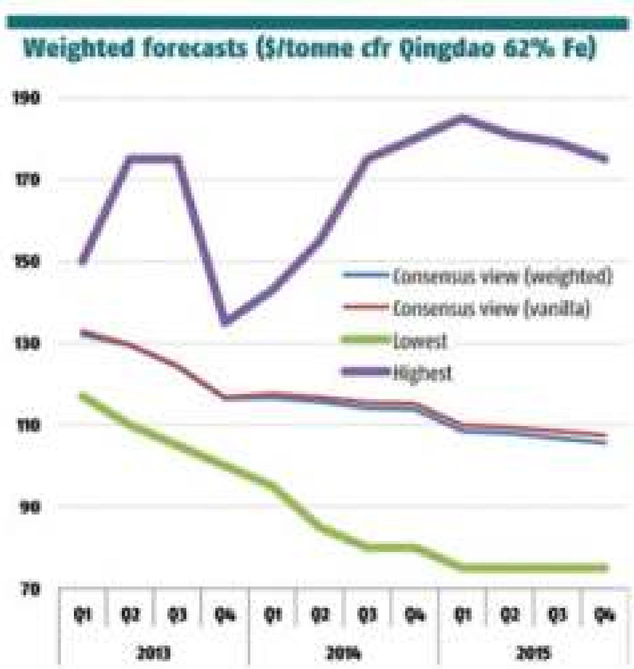

Figure 12-1 Weighted Forecasts

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Date	Analyst/Desk	2013 Q1	2013 Q2	2013 Q3	2013 Q4	2014 Q1	2014 Q2	2014 Q3	2014 Q4	2015 Q1	2015 Q2	2015 Q3	2015 Q4
21/01/13	ABN AMRO, Casper Burgering	130	130	130	130	116	116	116	116	112	112	112	112
20/11/12	BAML, Michael Widmer	117	110	108	108	110	110	110	110	100	100	100	100
17/01/13	Citigroup	135	120	110	115	125	122	122	120	125	122	122	120
15/01/13	CLSA, Ian Roper	125	110	105	100	95	85	80	80	75	75	75	75
03/01/13	Credit Suisse, Andrew Shaw	130	125	115	110	105	100	100	95	90	90	90	90
08/01/13	Deutsche Bank, Daniel Brebner	140	130	120	110	115	115	115	115	110	110	110	110
15/01/13	INTL FCStone, Edward Meir	150	135	130	125								
12/01/13	Jefferies, Chris Lafemina	130	130	130	130	120	120	120	120	105	105	105	105
01/09/12	Macquarie	131	121	121	111	120	120	110	110	105	105	105	105
14/01/13	Metal Bulletin Research*	140	120	105	105	120	120	105	110	100	100	100	100
15/01/13	Numis	140	135	130	125	125	120	118	116	115	113	111	109
04/01/13	RBCCM, Chris Drew	130	130	120	120	105	105	105	105	100	100	100	100
14/01/13	TDSecurities, Bart Melek	130	140	145	135	129	129	129	129				
04/01/13	UBS, Tom Price	131	133	123	118	118	118	111	106	108	109	101	96
17/01/13	Westpac, Justin Smirk	135	175	175	110	143	155	175	180	185	181	179	175

	2013 Q1	2013 Q2	2013 Q3	2013 Q4	2014 Q1	2014 Q2	2014 Q3	2014 Q4	2015 Q1	2015 Q2	2015 Q3	2015 Q4
Consensus view (weighted)	132	129	124	116	117	116	114	114	108	108	107	106
Consensus view (vanilla)	133	130	125	117	118	117	115	115	110	109	108	107
Lowest	117	110	105	100	95	85	80	80	75	75	75	75
Highest	150	175	175	135	143	155	175	180	185	181	179	175
% Vanilla to weighted	0.7%	0.1%	0.2%	0.3%	0.8%	0.9%	1.1%	1.2%	1.4%	1.3%	1.6%	1.7%

Figure 12-2 Source: MetalBulletin Index Iron Ore Forecasts Q1 2013

12.7 Marketing Risks

Given the forward looking nature of market analysis, there are several risks highlighted below that are addressed under the broader project risk management protocols.

Marketing Related Risks	Description
Market downturn	The GFC of 2008/2009 was largely unpredicted by the broader market until it was “almost upon us”, it is not possible to predict a re-occurrence of this type of global event in the future.
Project delay	Speed to market is a key factor in the success of obtaining long term off take agreements, should the project be delayed, these agreements will become more difficult for TTR to establish.
Pricing volatility	With price forecasts there is always a risk of incorrect prices (either high or low). Prices used by TTR in the evaluation of the project would be considered to be within the mid to upper range of the current range of estimates available.
Inaccurate sampling and analysis	Poor sampling techniques may result in lower revenue than anticipated.

Table 12-3 Marketing Related Risks

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13. ENVIRONMENTAL STUDIES, PERMITTING AND SOCIAL IMPACT

13.1 Introduction

This section describes the regulatory permit regime applying to the TTR (TTR) iron sand mining operation in the South Taranaki Bight project.

This section also describes the broad environmental characteristics of TTR's area of interest along with associated environmental risk factors. Information is presented on the investigations undertaken by TTR to provide information in support of applications for consents. In conclusion an anticipated consenting timeline is presented.

It is written on the basis that TTR's proposed mining activities will be both within and beyond New Zealand's (NZ) territorial boundary, in the exclusive economic zone and it addresses the legislative requirements for these activities.

Some aspects of NZ's legislation are expected to change in the near future and these expected changes are noted where relevant.

13.2 Mining Permit Regime

13.2.1 Legislation

Mining approvals required for TTR's project will require mining permit/s under the Crown Minerals Act (**CMA**) for extraction activities both within and beyond the 12 nautical mile (nm) limit[8].

13.2.2 Mining Applications under Crown Minerals Act 1991

TTR is working to obtain a mining permit under section 23 of the CMA, which covers the allocation of the Crown's mineral resources. The Mining Permit can be granted for up to 40 years and will be subject to the prevailing royalty regime. Permit applications will be lodged with NZ Petroleum and Minerals, a section of the Ministry of Business Innovation and Employment. Applications will be made in the prescribed form and will contain the following information:

- *Applicant and permit holder details*
- *Location details and permit area sought.*
- *A statement of the technical qualifications and financial resources of the applicant.*
- *A map of the permit area.*
- *A report that sets out the evidence for an exploitable mineral deposit or mineable resource sufficient to support a mining permit, that includes –*

  a) estimates of the mineable mineral resource, which may include –

- [8] The 12 nautical mile limit delineates the boundary of the Territorial Sea. The Territorial Sea is a belt of coastal water extending from the shoreline to the 12-nautical mile (22-kilometre) limit. The Exclusive Economic Zone (EEZ) is a belt of water from the territorial sea's 12-nautical mile limit to the 200-nautical mile (370-kilometre) limit.

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i. *inferred, indicated, and measured mineral resources; and*

ii. *probable and proved reserves;*

b) *a map showing the size and location of the deposit;*

c) *a description of the geology of the deposit; and*

d) *if applicable, a description of the type of coal and its properties.*

- *A statement of the proposed work programme [for full duration of permit] that provides an overview of how the permit area will be worked that includes –*

a) *the size, nature, extent, and siting of the proposed mining operations;*

b) *the proposed mining methods to be used;*

c) *the proposed mining and production schedule;*

d) *the expected production and long-term mining scheme for the mineable resource;*

e) *the proposed start date for production;*

f) *any proposed prospecting or exploration work in relation to the permit area;*

g) *the proposed expenditure under the permit; and*

h) *if applicable, the point of valuation for royalty purposes.*

The Ministry assesses the application, its plan, description and work programme and also forward a copy of the application to local iwi (Māori) as part of the Crown's consultation obligation.

The timing of the iwi consultation, obtaining of the agents report and internal assessment varies depending on current policy of the Ministry. Generally they run in parallel. The Ministry sets conditions on permits and if all matters are satisfied the Minister of Energy and Resources grants the permit. Other than the iwi consultation, there is no public participation process under the CMA.

Environmental aspects are addressed under the Resource Management Act 1991 (**RMA**) or the EEZA for activities within and beyond the 12 nautical mile (nm) limit respectively.

13.3 Environmental Permitting Regime

13.3.1 Legislation

Currently, approvals required for TTR's project can be broadly categorised as follows:

Environmental approvals, including:

a) <u>Marine consents</u> under the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012 (**EEZA**) for activities beyond the 12 nm limit.

b) <u>Resource consents</u> under the Resource Management Act 1991 (**RMA**) for activities (including discharges) within the 12 nm limit.

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c) Marine discharge consents under the EEZA or Discharge Management Plans under the Maritime Transport Act 1994 (**MTA**) for discharges beyond the 12 nm limit.

The environmental regulatory regime relating to TTR's areas of operation is presently undergoing changes as illustrated in table 13-1. In particular, environmental approvals for discharges from ships in the area beyond the 12 nm limit will come under the EEZA and this is expected to come into effect by late 2013.

Location	Category	Present	Future
Within 12 nm (No Change)	Environmental/discharges	RMA	RMA
Beyond 12 nm (Significant change)	Environmental (excluding discharges)	Continental Shelf Act	EEZA
Beyond 12 nm (Significant change)	Discharge from ships	MTA	EEZA

Table 13-1 Pending Changes in TTR's Environmental Regulatory Regime

In general, NZ's environmental legislation is effects and not standards based. In effects based legislation, the applicant must demonstrate the expected effects of its proposed activities and that these meet the requirements of the policy documents or will not have any more than minor effects. In the EEZA, if the information supporting the applications is inadequate or uncertain the decision maker must favour caution and environmental protection and an adaptive management approach could result or, in the worst case, an application could be declined.

13.4 Status of TTR's Proposed Activities

Depending on where they occur in relation to the 12 nm limit, TTR's activities will require consents under either the EEZA or the RMA. Requirements relating to each area are discussed as follows.

13.5 Marine Consents under EEZA

The following TTR activities (beyond the 12 nm limit) will potentially require a marine consent under the EEZA.

TTR Project Element – EEZA Activities	Activity Category needing Marine Consent
Permanent and semi-permanent mooring blocks and structures	Structures on or under the sea bed

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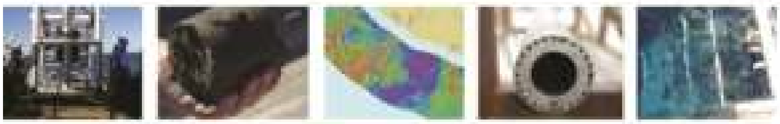

TTR Project Element – EEZA Activities	Activity Category needing Marine Consent
Extraction operation	Removal of non-living natural material from sea bed
De-ored sand deposition	Deposit of anything on, or under the sea bed
Extraction and deposition of de-ored sand	Destruction, damage, or disturbance of the sea bed.
FPSO, mooring structures	Construction, mooring or anchoring long-term, placement, alteration, extension, removal, or demolition of a structure or part of a structure in the waters of the EEZ.
FPSO operations – milling, power generation and other operations	Causing of vibrations (other than vibrations caused by the normal operation of a ship) in a manner that is likely to have an adverse effect on marine life.

Table 13-2 EEZA Activity Category Descriptions

The EEZA was passed in 2012 and came into force on 30 June 2013 when the required regulations will be promulgated.

13.6 Marine Discharge Permits under Maritime Transport Act 1994

The MTA currently regulates the discharge of harmful substances beyond the territorial sea. This is expected to change towards the end of 2013 with the enactment of the Marine Legislation Act and new regulations, which will bring mining-related discharges under the EEZA.

13.7 Resource Consents under RMA

If TTR's operations are within the territorial waters (12 nm limit), the following TTR activities will potentially require resource consent under the RMA (unless they are deemed to be permitted activities or already authorised by a designation where no consent application is required). If these are already permitted a certificate of compliance will be sought.

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TTR Potential Project Element – RMA Activities	Activity
Freshwater storage pond and ancillary equipment – includes noise and other land-related controls.	Land use
Freshwater pipeline; end-of-pipe structure for freshwater off take; power cable	Structures on or under the foreshore and sea bed
Installation of freshwater pipeline; power cable, extraction	Disturbance of foreshore and sea bed where adverse effect on foreshore or sea bed
Occupation of sea bed and exclusion of other users by pipeline and power cable.	Occupy any part of the common marine and coastal area
Discharges arising from mining on sea bed	Discharge of a harmful substance from a ship or offshore installation Discharge water into water from any ship or offshore installation
Extracting of the sea bed and deposition of de-ored sand	Disturbance of foreshore and sea bed where adverse effect on foreshore or sea bed Deposit any material on the sea bed in a manner that is likely to have an adverse effect on the sea bed Destroy damage or disturb the sea bed in a manner that has an adverse effect on plants and animals or their habitat
Noise	Every occupier of land (including coastal marine area) and every person carrying out an activity in the coastal marine area shall adopt the best practicable option [9]to ensure that the emission of noise ... does not exceed a reasonable level.

Table 13-3 RMA Activity Category Description

13.8 Information to be provided with applications

The information requirements for the relevant environmental legislation are described in the following.

---

[9] **best practicable option**, in relation to a discharge of a contaminant or an emission of noise, means the best method for preventing or minimising the adverse effects on the environment having regard, among other things, to—

a) the nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects; and
b) the financial implications, and the effects on the environment, of that option when compared with other options; and
c) the current state of technical knowledge and the likelihood that the option can be successfully applied

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13.8.1 Impact Assessment under EEZA

Section 38 of the EEZA requires that applications for marine consents to undertake a discretionary activity, such as activities associated with mining, must be made in the prescribed form; fully describe the proposal; and include an impact assessment prepared in accordance with Section 39 of the EEZA. Section 39 states that:

1. *An impact assessment must:*
   - *a) describe the activity for which consent is sought; and*
   - *b) describe the current state of the area where it is proposed that the activity will be undertaken and the environment surrounding the area; and*
   - *c) identify the effects of the activity on the environment and existing interests (including cumulative effects and effects that may occur in New Zealand or in the sea above or beyond the continental shelf beyond the outer limits of the exclusive economic zone; and*
   - *d) identify persons whose existing interests are likely to be adversely affected by the activity; and*
   - *e) describe any consultation undertaken with persons described in paragraph (d) and specify those who have given written approval to the activity; and*
   - *f) include copies of any written approvals to the activity; and*
   - *g) specify any possible alternative locations for, or methods for undertaking, the activity that may avoid, remedy, or mitigate any adverse effects; and*
   - *h) specify the measures that the applicant intends to take to avoid, remedy, or mitigate the adverse effects identified.*
2. *An impact assessment must contain the information required by subsection (1) in—*
   - *a) such detail as corresponds to the scale and significance of the effects that the activity may have on the environment and existing interests; and*
   - *b) sufficient detail to enable the Environmental Protection Authority and persons whose existing interests are or may be affected to understand the nature of the activity and its effects on the environment and existing interests.*
3. *The impact assessment complies with subsection (1)(c) and (d) if the Environmental Protection Authority is satisfied that the applicant has made a reasonable effort to identify the matters described in those paragraphs.*
4. *The measures that must be specified under subsection (1)(h) include any measures required by another marine management regime and any measures required by or under the Health and Safety in Employment Act 1992 that may have the effect of avoiding, remedying, or mitigating the adverse effects of the activity on the environment or existing interests.*

Section 6 of the EEZA defines "effect" as follows:

1. *In this Act, unless the context otherwise requires, effect includes—*

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a) *any positive or adverse effect; and*

b) *any temporary or permanent effect; and*

c) *any past, present, or future effect; and*

d) *any cumulative effect that arises over time or in combination with other effects; and*

e) *any potential effect of high probability; and*

f) *any potential effect of low probability that has a high potential impact.*

2. *Subsection (1)(a) to (d) apply regardless of the scale, intensity, duration, or frequency of the effect.*

13.8.2 Effects Assessment under RMA

Section 88 of the RMA sets out that

1) *A person may apply to the relevant consent authority for a resource consent.*
2) *An application must—*
   a) *be made in the prescribed form and manner; and*
   b) *include, in accordance with Schedule 4, an assessment of environmental effects in such detail as corresponds with the scale and significance of the effects that* the activity may have on the environment.

Schedule 4 outlines a specific list of matters an assessment of environmental effects (AEE) should include (subject to any additional information requirements of any relevant policy statement or plan). Requirements are set out as follows:

1. *Matters that should be included*
   a) *a description of the proposal*
   b) *where significant adverse effects are likely, any possible alternative locations or methods for undertaking the activity*
   d) *assessment of actual or potential effects on the environment of the proposed activity:*
   e) *hazards – where the activity includes the use of hazardous substances and installations, an assessment of any risks to the environment which are likely to arise from such use*
   f) *where the activity includes the discharge of any contaminant, a description of*
      i. *the nature of the discharge and sensitivity of the receiving environment to adverse effects;*
      ii. *any possible alternative discharge methods*
   g) *a description of the mitigation measures (safeguards and contingency plans where relevant) to be undertaken to help prevent or reduce the actual or potential effect:*
   h) *identification of the persons affected by the proposal, the consultation undertaken, if any, and any response to the views of any person consulted:*

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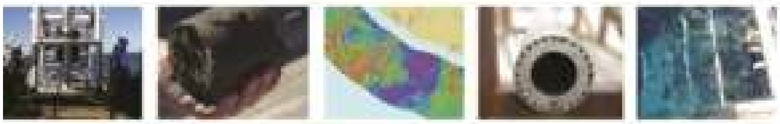

i) *where the scale or significance of the activity's effect are such that monitoring is required, a description of how, once the proposal is approved, effects will be monitored and by whom.*

1AA To avoid doubt, clause 1(h) obliges an applicant to report as to the persons identified as being affected by the proposal, but does not—

a) *oblige the applicant to consult with any person; or*

b) *create any ground for expecting that the applicant will consult with any person.*

1A Matters to be included in assessment of effects on environment

An assessment of effects on the environment for the purposes of section 88 must include, in a case where the activity for which a resource consent is sought will, or is likely to, have adverse effects that are more than minor on the exercise of a protected customary right, a description of possible alternative locations or methods for the exercise of the proposed activity (unless written approval for the proposed activity is given by the protected customary rights group).

2. *Matters that should be considered when preparing an assessment of effects on the environment*

Subject to the provisions of any policy statement or plan, any person preparing an assessment of the effects on the environment should consider the following matters:

a) *any effect on the neighbourhood and wider community (including socio-economic and cultural effects)*

b) *physical effects on locality (including any landscape and visual effects)*

c) *any effect on ecosystems, including effects on plants or animals and any physical disturbance of habitats in the vicinity:*

d) *any effect on natural and physical resources having aesthetic, recreational, scientific, historical, spiritual, or cultural, or other special value for present or future generations:*

e) *any discharge of contaminants into the environment, including any unreasonable emission of noise and options for the treatment and disposal of contaminants:*

f) *any risk to the neighbourhood, the wider community, or the environment through natural hazards or the use of hazardous substances or hazardous installations.*

Section 3 of the RMA defines effect as follows:

3. *Meaning of effect*

In this Act, unless the context otherwise requires, the term effect includes—

a) *any positive or adverse effect; and*

b) *any temporary or permanent effect; and*

c) *any past, present, or future effect; and*

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d) any cumulative effect which arises over time or in combination with other effects— regardless of the scale, intensity, duration, or frequency of the effect, and also includes—

e) any potential effect of high probability; and

any potential effect of low probability which has a high potential impact.

13.9 TTR Applications

Environmental consenting in NZ is an 'effects based' rather than standards based approach. Consequently, an applicant has to supply information on the expected effects of its proposed activities. In order to do this, TTR is required to provide information on all the matters identified in the applicable parts of Section 13.7 as detailed above such as the existing environment, the proposed activities and an evaluation of the effects or impacts of the activities on the environment.

The following sections of this report provide a general overview of the existing environment at the project site, and outline the various investigations commissioned by TTR to address all associated effects.

13.10 Environmental Characteristics of the TTR Area of Interest

13.10.1 Background

The "area of interest" in relation to the TTR project is the northern part of the South Taranaki Bight (STB). In this area, the water shoals gradually inshore from about 125 m deep in the west into the coastal shallows. Please note that the area outlined in Figure 13-2 will include only that portion shown in the EEZ ie. beyond the territorial boundary.

The geology of the area is discussed further in Section 4 of this PFS.

13.10.2 Coastal Physical Characteristics

The coast adjacent to the TTR area of interest 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, producing almost continuous near-vertical, 30 – 50 m tall cliffs along about 70% of the coastline. As the cliffs have retreated, they have left behind a hard shore platform on which sandy beaches have developed at the base of the cliffs (See Figure 13.1).

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Figure 13-1 Hawera Beach showing high cliffs and typical profile

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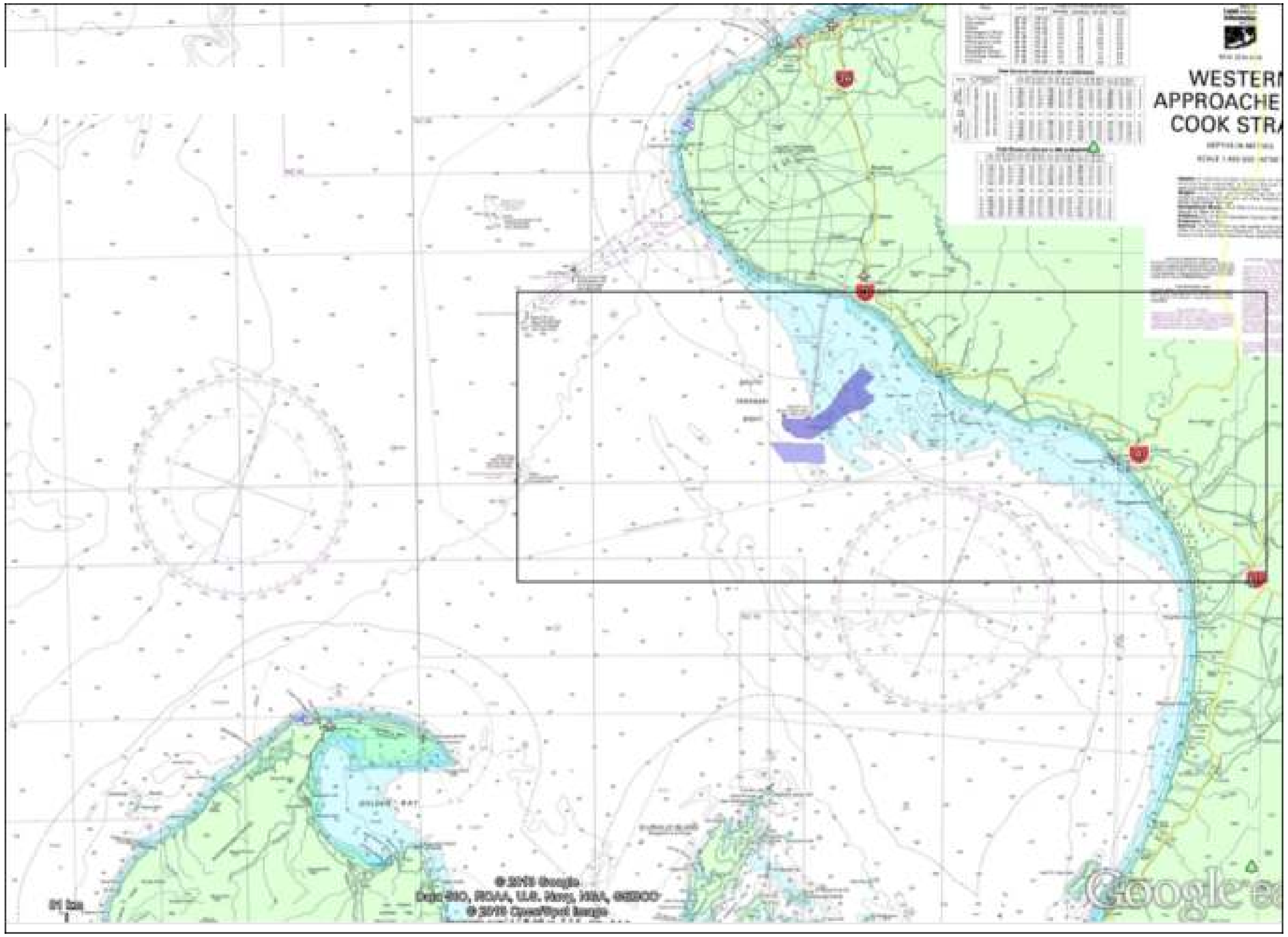

Figure 13-2Location of TTR “Area of Interest” relative to broader South Taranaki Bight.

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The beaches form in places where shallow embayments in the coast and headlands provide shelter from waves. Along a section of coast without cliffs (from the Patea River to about Waiinu), the beaches are backed by fore-dunes, 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.

Cliff erosion 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 the beach profile records.

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.

13.10.3 Physical Oceanography

Currents

Tidal currents account for 40-73% of the measured currents at all sites in TTR's area of interest, with wind driven current accounting for the remainder.

The peak ebb or flood current speed of the main twice-daily lunar (M2) tide, which is an average tide, ranges between 0.13 m/s and 0.25 m/s. Some-what higher and lower tidal speeds occur on spring and neap tides respectively. At all sites the M2 tide was 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 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. 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 This 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 times of moderate to strong W to NW winds, the prevailing SE drift was considerably enhanced.

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Wave Characteristics

The 20-year average of significant wave height for all output locations is plotted in Figure 13.3 [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 13.3 [Right]), which is a vector quantity reflecting the magnitude and direction of energy transfer by the waves. This shows relatively strong energy transfer, principally from the WSW, at the northern end of the STB, while further south, the more southerly energy components become blocked.

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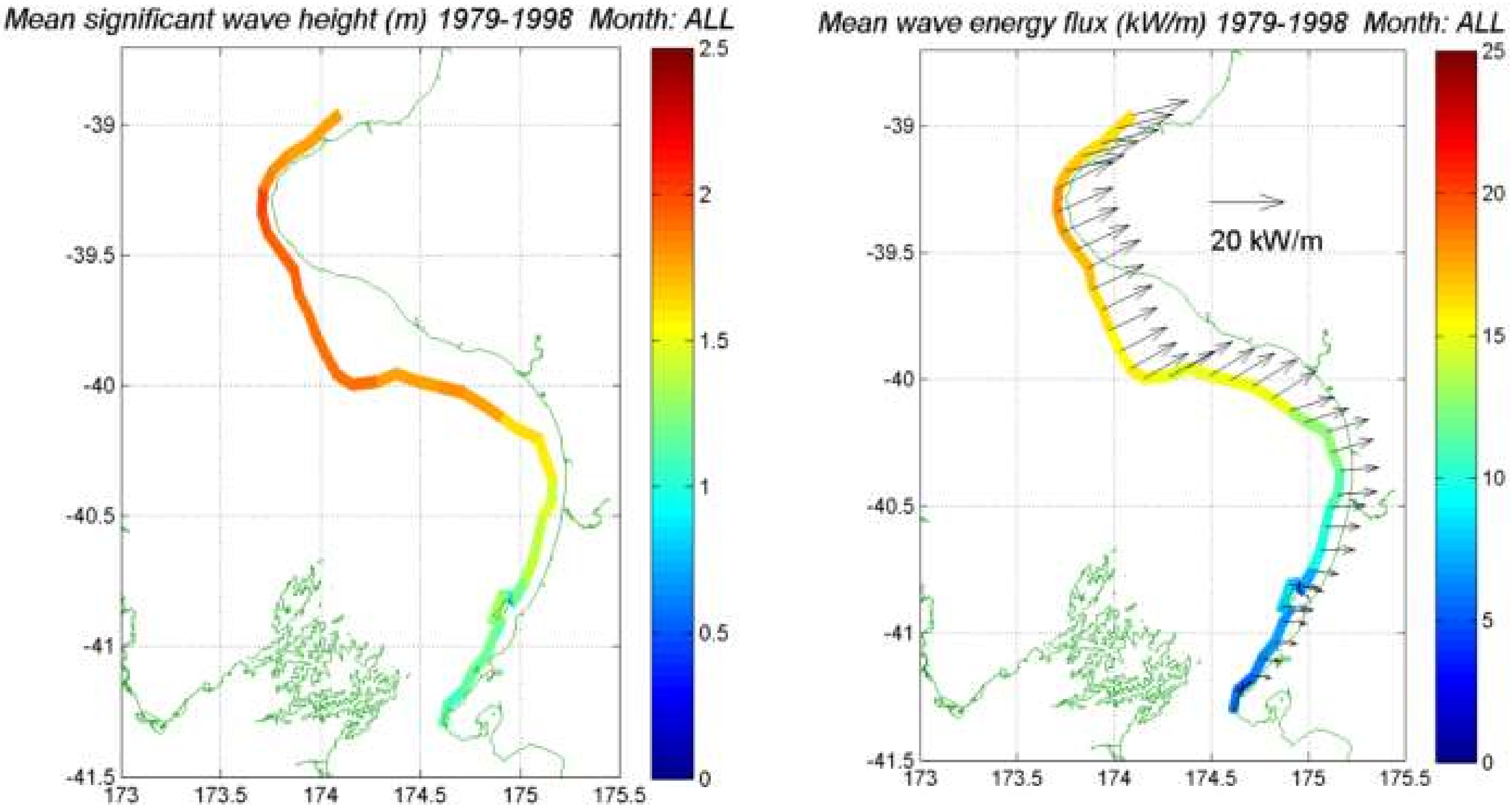

Figure 13-3 Wave Data

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

Right: Spatial distribution along the 50m 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.

Water Quality

TTR has undertaken a range of water quality investigations in the STB in relation to TTR's area of interest. Preliminary findings are as follows:

Temperature and salinity measurements show that the water column in the STB was 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).

Concentrations in the water column of suspended sands and suspended fine sediments (clays, silts and muds) were made at several sites and heights above the sea bed within the STB.

In the near-surface waters, maximum suspended-fine-sediment concentrations (*SSCm*) were very low. At some sites *SSCm* varied over the deployment period, with peaks in *SSCm* tending to occur during or just after periods of significant rainfall. At these times it is likely that rivers were discharging fine sediments into the STB, which were then transported in suspension through the measurement site. Some of the peaks in *SSCm* also coincided with times of large waves.

When there was any sand in suspension, suspended-sand concentration (*SSCs*) close to the sea bed was typically much greater than *SSCm*. The largest suspended-sand concentration very close to the sea bed was 1.9 grams/litre. 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 sea bed in the STB. During calm periods, no sand was found to be in suspension.

Over the duration of the largest sediment-transport event, 3355 kg of sand per metre width of sea bed was transported in suspension by currents. This equates to a volume of 2.1 m^3 of sand transported per metre width of sea bed.

13.11 Ecological Characteristics

13.11.1 Benthic Ecology

TTR commissioned investigations into the benthic flora and fauna (macrobenthos through to meiobenthos) in the STB, in the vicinity of the TTR's permit areas, in order to characterise faunal communities across naturally occurring gradients.

At the macro scale, the Benthic Ecology of the STB is typical of the range of benthic ecology found inshore around much of the North Island (See Figures 13-4 and 13-5).

Preliminary findings of TTR's investigations indicate that the sandy habitats, including the proposed mining areas, to have relatively low abundance and species richness. This is a pattern typical of highly disturbed habitats and is in contrast to sites in the deeper, less sandy, part of the study area.

Overall there was no evidence within the data to suggest that the proposed extraction or de-ored sand deposit areas are "unique" with respect to macrofauna

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collected/observed during the survey. Importantly, the investigations found no significant relationship between iron concentration and community structure.

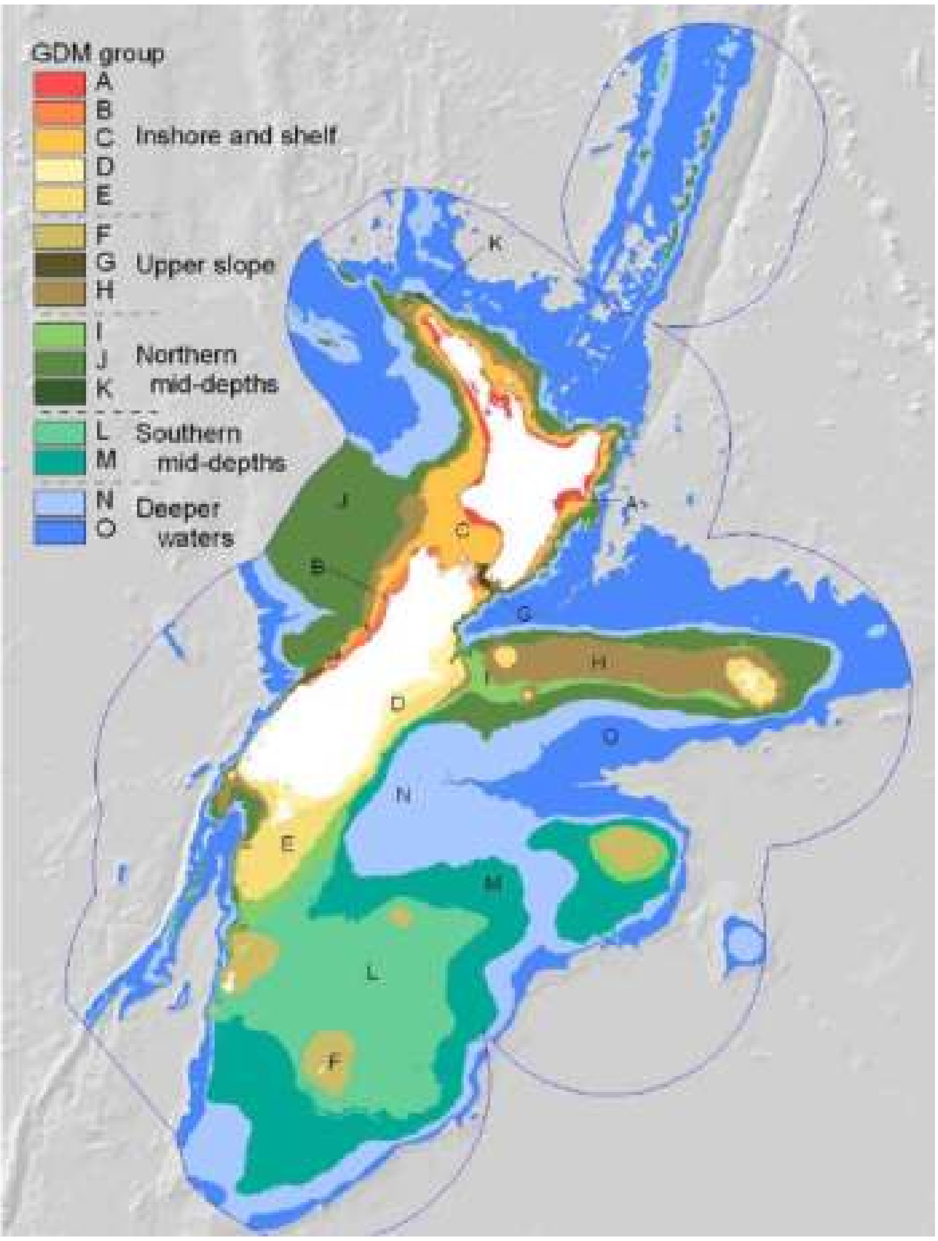

Figure 13-4 Geographic distribution across eight taxonomic groups of benthic species (from: Leathwick et al 2009 "Benthic-optimised marine environment classification for New Zealand Waters".

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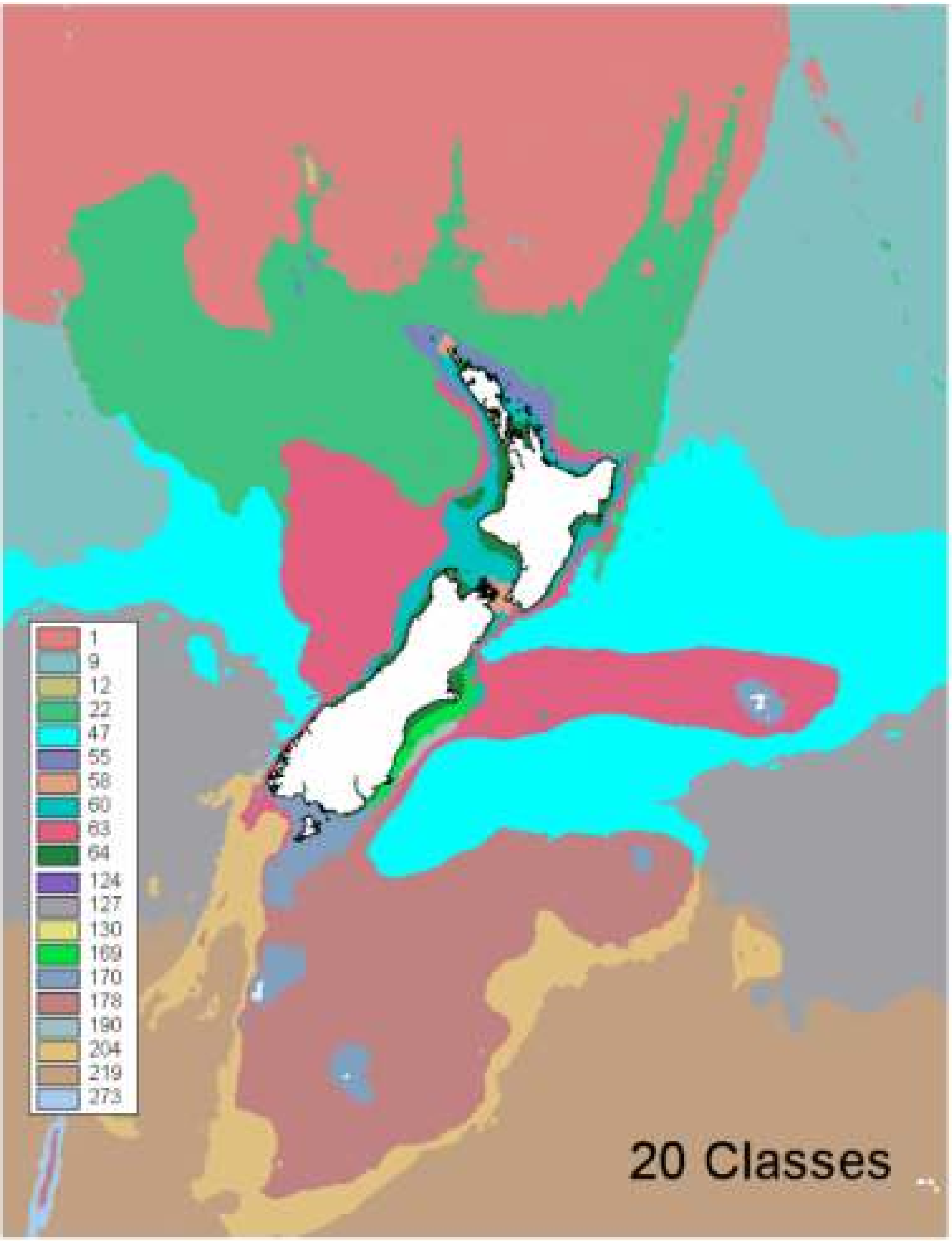

Figure 13-5 Marine Environment Classification – "The New Zealand Marine Environment Classification" NZ Ministry for the Environment 2005

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13.11.2 Plankton

Complex optical conditions are prevalent in the broader STB area. Particulate and dissolved terrigenous material are frequently advected into the region from the Marlborough Sounds, west coast of the South Island and from the Cook Strait. Phytoplankton blooms appear to peak in springtime, with an origin off-shore 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 resuspension 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.

The broader STB is biologically productive in terms of mesozooplankton, and the area may represent a breeding ground for zooplankton, which in turn promotes aggregations of larger mobile predatory species, particularly squid. The mesozooplankton species composition is neritic (nearshore) and is strongly influenced by the physical oceanography of the region, including the upwelling events off Cape Farewell and the D'Urville Current.

13.11.3 Fish

The STB has a moderately diverse reef fish fauna with only 38 of the 72 species modelled by Smith (2008) New Zealand wide predicted to occur on reefs within SCUBA diving depth range in the region.

Many of the reef fish are predicted to occur on the off-shore shoals and on coastal rocky reefs, which will not be influenced by TTR's extraction activities.

Moderate numbers of demersal fish species occur in the region. Most species are common within a restricted depth range.

Commercial fishing operations within the broader STB area have been dominated in recent years by bottom trawling (for a variety of species), midwater trawling (mainly for jack mackerel), and set netting (mainly for rig, blue warehou, and school shark). Together these methods have accounted for 95% of all fishing events recorded with position.

The highest levels of fishing effort (mainly bottom trawling and set netting) were relatively close to the shore between New Plymouth and Cape Egmont (well north of TTR's area of interest), and between Hawera and Whanganui near the 50 m contour.

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13.11.4 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.

13.11.5 Marine Mammals

Relatively few sightings of cetaceans have been made within TTR's area of interest. However, two endangered species are reported to occur in the area: the killer whale, and southern right whale.

In addition, the Maui's dolphin is reported to occur to the north and south of TTR's area of interest, generally within 7 nm of the shore.

13.12 TTR's Environmental Application Strategy

13.12.1 Consenting Risks

Based on an evaluation of data on the existing environment in the STB, TTR has identified three key consenting risks as follows:

TTR intends to extract up to 50 million tonnes (or 25 million m^3 per year). This is a large volume by international standards and is comparable with some of the largest individual dredging projects undertaken to date internationally. For example, around 30-40 million m^3 is dredged annually from waterways in the Netherlands; and two of the larger recent dredging programmes, the London Gateway Project and the Wheatstone Project in Australia, involve total dredged volumes of around 32 and 35 million m^3 respectively over the life of each project, or around 7 million m^3 per year.

TTR's preliminary modelling studies anticipate that the tailings and water discharge operation will cause a sediment plume. In particular, the modelling presently predicts relatively high levels of suspended sediments arising from the extraction and discharge operations within the 12 nautical mile limit. This can primarily be attributed to the shallower water and proximity to the coast. This could lead to associated effects on water clarity and marine biology (including effects on benthic organisms, plankton and fish). In addition the large volume discharged could result in adverse effects arising from the deposition of fine sediments on the sea floor and subsequent re-suspension by wave action. Extracting sediment from outside the 12 nm limit presents less of a sediment plume risk, although a plume will still result. This plume will at times extend to within the 12 nm area.

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Various stakeholders such as iwi and others have expressed an interest in the project. Some, such as “Kiwis Against Sea bed Mining” (**KASM**), have expressed opposition to the proposal. TTR will take all reasonable steps to avoid adverse environmental effects which may exacerbate any stakeholder concerns.

The Maui’s dolphin is a consenting risk largely due to the precarious state of the population with an estimated 55 adult dolphins remaining. The Maui’s dolphin is endemic to New Zealand and is considered to be the world’s rarest dolphin species. There has been recent interest in the measures to protect the species with the Government releasing a review of the Maui’s dolphin threat management plan. Whilst the dolphin has never been recorded as such in TTR’s area of interest it has been noted further south, implying that it has moved through the general area in the past. This dolphin is generally recognised to have a near-shore habitat preference, and it will be important to give attention to potential interactions with these dolphins and with other marine mammals.

13.12.2 TTR’s Risk Mitigation Approach

TTR’s approach to mitigating consenting risks involves adopting a flexible approach, incorporating if necessary, staging to initially avoid areas with an associated high and unacceptable risk.

Analysis indicates that only 15% of the identified ore resource occurs inside the 12 nautical mile limit. Preliminary analysis indicates potentially high consenting risk for extraction inside this limit as a consequence of predicted higher suspended sediment levels from extraction operations closer to shore.

TTR is adopting a staged approach involving application for all EEZ Activities (mining and other as noted above) with a later RMA mining component (thereby reducing the risk). A subsequent application for sediment extraction in the RMA areas not previously applied for would be lodged at a later date.

In addition, as described below, TTR has commissioned an extremely wide range of environmental investigations to provide a sound scientific basis for evaluation of effects associated with the project.

13.13 Environmental Studies

13.13.1 Introduction

In recognition of the need to identify environmental risks identified in relation to the project, TTR has undertaken a wide range of environmental investigations. These have focussed on ecology; coastal processes, physical oceanography, social impacts, landscape matters, noise, shipping and maritime transport.

In undertaking these studies, TTR has convened a team of leading environmental specialists to provide input, with expertise covering the following subject areas:

- Shore line monitoring
- Coastal stability

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- Surf break effects
- Fish and fisheries
- Wave modelling
- Biomass, species composition in the South Taranaki Bight
- Natural drivers of meso-zooplankton in the South Taranaki Bight
- Antifouling
- Plume modelling
- Cetacean habitat modelling
- Benthic survey – near shore and offshore
- Colonisation experiment
- Seabird distribution and abundance in the South Taranaki Bight
- Effects of ships lights on fish, squid and seabirds
- Water quality effects - Characterisation of suspended sediments and ground truth of satellite imaging of surface waters
- Noise effects
- Social impact assessment
- Marine mammals
- Pore water chemistry and toxicology
- Maritime and shipping
- Recreational and tourism
- Commercial fishing
- Sediment size distribution
- Statutory planning
- Landscape and visual effects
- Economic effects assessment
- Marine geotechnical – sediment behaviour
- Consultation and iwi liaison
- Cultural impact assessment

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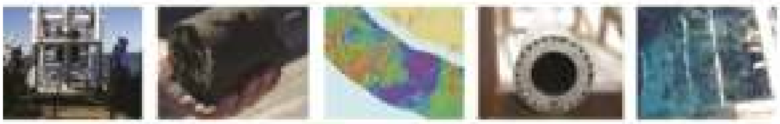

13.13.2 Ecological and Physical Oceanographic Studies

Particular focus has been given to detailed ecological and physical oceanography studies in a wide range of subject areas as described in Table 13-4 below.

Table 13-4: TTR Investigations commissioned 2011-2013.

Topic	Scope of Investigation
Wave modelling and surf effects	Develop SWAN nearshore wave model Determine sensitivity of model for detecting mining sea bed effects on waves/ shoreline. Shoreline stability modelling Develop worse-case scenarios for mounds and holes and incorporating into bathymetry. Identify and describe surf breaks potentially impacted. Determine range of wave and wind conditions that result in surfable conditions at each site. Assess impacts at the 10 m bathymetry offshore of each of the 10 surfing breaks.
Plume modelling	Estimate sediments concentrations and deposition rates arising from planned activities, incl. dredging, loading and dumping. Sensitivity analysis. Establish sediment release scenarios – including separate near field modeling to establish inputs to far field model Simulate sediment plumes Establish up to 3 sediment release scenarios (i.e. combinations of sediment sources) with input from client. Undertake laboratory analysis to determine optical properties of finest (<30 μ) sediments from TTR cores. Simulate sediment plumes, including optical response. Undertake sensitivity studies of up to 3 additional release scenarios.
Field instrumentation	Field investigations into ocean physical parameterss: Currents Waves

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Topic	Scope of Investigation
	Salinity Temperature Suspended sediments Methods: Optical and Acoustic Backscatter Sensors (OBS and ABS). Subsurface salinity and temperature mooring buoy. Datawell 70 cm wave rider directional wave buoy at an offshore location (approximately 40O 00'S, 174O 05'E, 50m depth), to record wave statistics. Dobie pressure sensors. Acoustic Doppler Current Profiler (ADCP).
Shore line monitoring	Desktop analysis of historical profile data Field reconnaissance to determine sites for beach survey profiles Ten monthly profile surveys and in addition one survey following a storm event. Beach sediment samples collection and grain size analysis along each profile during one of the monthly profile surveys
Offshore benthic	Fieldwork between September 2011 and May 2013 The sampling was carried out in three phases: Benthos the initial survey of the north-eastern end of the proposed mining area and surrounding area; Deepwater, an extension to the survey to include an expansion of the proposed mining area and Initial proposed site for de-ored sand New proposed site for de-ored sand. Three different sampling gear types were used: NIWA's CoastCam, a video and still imaging system; a small Agassiz dredge and a sediment corer. 144 sites were observed using the CoastCam video

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Topic	Scope of Investigation
	116 sites were dredged and 331 sediment cores were collected from 103 sites. Fifteen different habitats were identified, most of which were sandy (e.g. sand with ripples, sand with waves, sand and shell). Results are presented as distribution plots which, with few exceptions, show the sandy habitats, including the proposed mining and de-ored sand deposit areas, to have relatively low abundance and species richness. Recolonisation study - experiment, using treatments of iron-rich and de-ored sand - experiment out at two sites, Mahanga Bay and Evans Bay. Multivariate analyses of the data showed significant differences in benthic community structure between sites but little effect of iron concentration, which explained less than 4 % of the variation in species composition despite the highly contrasting iron-ore treatments. There was also no significant interaction between site and treatment. Further analysis showed that the relatively small differences in sediment properties among treatments had a larger influence on community structure than the very large differences in the concentration of iron.
Inshore benthic sampling	Characterisation of the inshore benthic macro-fauna and macro-algae, and collection and analysis of surficial sediments Field sampling benthic macro-fauna and macro-algae (Camera plus some dredging): 25 near-shore stations from Hawera in the west to south of Wanganui in the east where sediment plume modelling indicates possible occurrence of high concentrations of near-bottom suspended sediments and 5+ mm of deposited sediment. 10 stations along proposed route for Whanganui pipeline extension. Small van veen grab - samples of surficial sea floor sediments at each of the 35 sites where benthos is sampled. Analyse all sea floor camera transects to characterise the

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Topic	Scope of Investigation
	habitat at each site sampled. For each sample of surficial sediment characterise its particle size-frequency distribution using methods appropriate for each size class of particle.
Cetacean habitat modelling.	Whales and dolphins habitat modelling – Habitat (environmental) modelling analysis of New Zealand wide data of Killer whale -Orcinus orca, Maui's Dolphin - Cephalorhynchus hectori maui, and Southern Right whale - Eubalaena australis.
Suspended sediments.	Characterisation of suspended sediments and ground truth of satellite imaging of surface waters Collect 30 surface water samples from distinct bodies of water during other field sampling. Collect near sea-floor samples of water near optical back-scatter sensor on at least three occasions. Collect 5 sea bed samples. Laboratory analysis of grain size of the sea bed samples Laboratory analysis of optical properties of at least 30 water samples. Laboratory analysis of suspended sediments in at least 30 water samples. Deploy Wetlabs EcoTRIPLET device to provide increased spatial coverage of chlorophyll fluorescence, CDOM fluorescence and particulate backscatter across distinct water bodies. Derive surface distributions of phytoplankton, detritus, dissolved substances such as land-derived humic acids, and inorganic particulates from satellite imagery using a range of published algorithms. Quantitatively validate satellite estimates using field data. Estimate background levels of surface distributions of phytoplankton, detritus, dissolved substances such as land-derived humic acids, and inorganic particulates and their seasonal variation.
Sediment	Particle frequency distribution of samples from core

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Topic	Scope of Investigation
characterisation.	horizons provided by TTR
Fish and fisheries	Reef fish report Demersal fish report Commercial fisheries report
Coastal stability	Effects of climate change on coastal processes Effects on the landform and geomorphic character of the beach Effects on the deposition of substances to the foreshore and sea bed Effects on public access to the marine environment Effects on physical drivers and processes that cause coastal change incl. sea level rise How long will the effects of dredging last Effects of reduction in the supply of sand to the nearshore and littoral drift system Incorporate information from wave modelling studies into the coastal stability report.
Seismic survey	Seismic survey across parts of the resource area to establish the geology of the sub sea bed layers
Sidescan/Multibeam survey	Sidescan survey of deep sediment habitats Multibeam bathymetry over extension of Wanganui outfall pipeline, oceanographic instrument mooring, FPSO vessel mooring site, tailing dump site and all proposed mining areas.
Optical and suspended sediment concentrations.	Field investigations to characterise the background near-shore optical and SSC levels Static deployment of instruments at 6 near-shore sites (~10 m water depth) along the STB to measure the near-surface optical backscatter (from which beam attenuation and SSC levels can be derived). Undertake 2 synoptic boat surveys to measure near-surface optical backscatter (SSC) and beam attenuation along 18 shore-normal transects. The transects will be ~

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Topic	Scope of Investigation
	3.2 km long, and along each transect 8 spot measurements will be taken. In addition to these measurements, at up to one-third of the 144 measurement sites (18 transects x 8 spot measurements) water samples will be collected and analysed to yield SSC, light absorption and the size distribution of the suspended particles. On a single occasion collect and measure the size distribution of the sea bed surficial sediments from the 6 static sites and from 12 of the 18 synoptic boat survey transects.
Cetacean aerial surveys	Aerial surveys out to 22 nautical miles over a period of 2 years.
Pore water chemistry	Laboratory experiments to investigate the water-column effects of re-suspension of anoxic iron sands. Provide a detailed description of important properties of the target sediment: particle size distribution, water content, organic matter content, acid volatile sulphide content. Evaluate the release of trace metals (Cadmium, Copper, Lead, Nickel, Zinc) from suspensions of subsurface, anoxic iron sands with a series of elutriate tests (certification unavailable, but carried out subject to EPA 503/8-91/001 protocols). Evaluate the effects of iron sand resuspension on dissolved oxygen, pH, and turbidity with laboratory trials. Evaluate the potential for the release of toxic materials to the water column from grinding of sand particles.

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13.14 Consenting Timeline

The proposed consenting timeline is set out in Figure 13.6.

Target dates for the TTR consenting programme have been developed in terms of a “Best” Case, “Base” Case, and “Delayed” Case, with broad assumptions for each case summarised as follows:

Case Scenario	Broad Assumptions
“Best” Case	Field data collection and analyses completed early; Timely delivery of project design information; Efficient handling of applications by regulators.
“Base” Case	Allows for some weather downtime; Timely delivery of project design information; Efficient handling of applications by regulators.
“Delayed” Case	Adverse weather with associated downtime; Slow delivery of Project information; Inefficient handling of application materials by the regulators.

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Figure 13-6 Consenting Timeline

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14. CAPITAL AND OPERATING ESTIMATES

14.1 Capital Expenditure Estimate

As part of the PFS study TTR has calculated and assigned a level of contingency to the capital cost estimate for the TTR Offshore project, and also identified a prioritised list of risk factors affecting the capital cost estimate. The results are presented in the form of a cumulative S-curve showing project budget cost against probability and level of confidence and a register of ranked cost risk factors. These risk factors form the basis of the Risk Management Plan, i.e. significant risks that need to be controlled and managed throughout the project.

14.2 CAPEX Risk Model

The CAPEX cost risk model was developed in @Risk for Excel (version 6). The risk variables have been modelled as triangular distributions, using a 3-point estimate of their likely range of uncertainty. Thus, the least likely minimum (P10), the most likely (P50), and the least likely maximum (P90) are identified. The switches are modelled as discrete distributions, simply using the likelihood of their occurrence.

The @Risk model was analysed using Monte Carlo simulation (10,000 simulation runs were performed). Using risk analysis, the capital cost contingency is defined as the ***provisional*** sum required to bring the base estimate to the P50 probability. That is, the contingency is added to the base estimate so that the total cost budget has an equal chance of performing either over or under. The accuracy of the estimate is then defined as the P10 and P90 points on the cumulative curve, meaning that there is an 80% chance that the project capital cost will fall within that range. In order to produce a register of ranked cost risk factors, sensitivity analysis is performed on the risk factors, by ranking the factors in terms of contribution to the overall contingency.

14.3 Summary Scope of Work

Capital costs have been prepared based on the PFS documentation and the work breakdown structure (WBS) for the execution phase of the Project. Estimated costs have been broken down into the main areas of mining, processing and logistics.

The overall capital cost estimate includes the following scope:

- Project capital includes all development work
- Processing plant for the screening and beneficiation of iron sands based on 8000 tph
- Installed Power Generation of 80MW
- Sea Water Desalination capacity of 30,000 m^3/day

The following items are excluded from the overall capital cost estimate:

- Working capital

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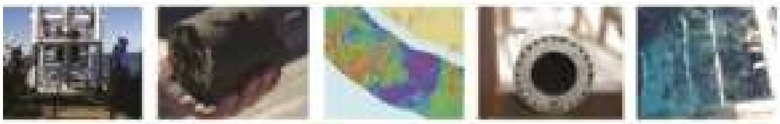

- Insurances
- Escalation

14.4 Capital Estimate Basis

The capital cost estimate has been prepared based on the detailed project scope developed during the PFS. The basis for the majority of the estimate is component cost ratios. A comprehensive equipment list was produced from which supply costs were then compiled, from historical information and by solicited budget quotations. Actual industry norms were extracted from published sources and applied to determine estimated costs of all activities associated with each equipment item. This included: equipment installation, piping material and labour, electrical material and labour, instrumentation, field expenses and project management including engineering. This enables a total capital cost to be calculated.

Budget prices have been received from pre-qualified OEM's/vendors for the major engineered/process equipment, namely the trommel screens, IsaMills™, magnetic separators, pumps, power generation units and the water desalination plant. These items currently represent approximately 65% of the total estimate value.

The historical norms used in the estimates were based on industry standards within the defined scope. The project has endeavoured to compile a reasonable level of basic engineering to facilitate the allocation of applicable norms, finalisation of project scope and verify aspects of constructability and understanding of risk associated with the implementation of the works.

The value of "normed" works is approximately 21% of the total estimate value.

The total CAPEX estimate comprises the following break-up:

- 5% Fixed Prices
- 60% Budget prices
- 21% Normed estimates
- 14% Provisional Prices

The project management and engineering requirements have been quantified using a resource-based schedule, reflecting current industry standards and historical data for this type of project. Incidental and non-labour costs such as travel, third party consultants, etc. have been included on expected activities for the project.

The current overall contingency applied to the bottom line of the estimate (total base estimate excluding sunk costs) is 12%. This percentage was calculated using the completed risk analysis. The capital cost contingency is defined as the ***provisional*** sum required to bring the base estimate to the P50 probability.

14.4.1 Normed Estimates

The normed estimates of the project, were compiled using the Cost Ratio method, which relates directly to equipment cost. The Cost Ratio method is particularly suited

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to preparing Pre-Feasibility estimates, where there is not a lot of detail available with regards to associated equipment, facilities and services.

```
1.  Purchased equipment costs from references
    and on current index basis .......................$000,000
2.  Equipment installation
    (0.17 to 0.25 times Item 1).......................$000,000
3.  Piping,material and labour, excluding service
    piping (0.13 to 0.25 times Item 1)................$000,000
4.  Electrical,material and labour, excluding
    building lighting (0.13 to 0.25 times Item 1).....$000,000
5.  Instrumentation (0.03-0.12 times Item 1) .........$000,000
6.  Process buildings, including mechanical services
    and lighting (0.33 to 0.50 times Item 1) .........$000,000
7.  Auxiliary buildings,including mechanical services
    and lighting (0.07 to 0.15 times Item 1) .........$000,000
8.  Plant services,such as fresh water systems,sewers,
    compressed air etc.(0.07 to 0.15 times Item 1)....$000,000
9.  Site improvements, such as fences, roads,
    railroads etc.(0.03 to 0.18 times Item 1).........$000,000
10. Field expenses related to construction management
    (0.10 to 0.12 times Item 1) ......................$000,000
11. Project management including engineering and
    construction (0.30 to 0.33 times Item 1)..........$000,000

12. Fixed capital = (Sum of 1+2+3+4+5+6+7+8+9+10+11)..$000,000
      Costs
```

Figure 14-1 Historical Norms

Using this method to project an estimated capital cost required the following actions:

- The preparation and verification of plant flow-sheets involving all major items of equipment, for each of the options considered.
- The calculation of equipment sizes using knowledge of the estimated plant mass balance.
- The costing of individual equipment items.
- The factoring of associated equipment and service costs to calculate the final estimated capital cost.

14.4.2 Range

The estimate for the TTR Project was developed in the usual manner using vendor quotations, contractor estimates and rates applied to a defined scope of work. Therefore, the cost risk of planned work includes the risks associated with the scope definition, quantity take-offs and rate estimation (i.e., the basis of the estimate). For each item in the estimate, three point range estimates consisting of the likely (P50), the maximum pessimistic (P90) and minimum optimistic (P10) values were determined for each of these risk factors.

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These ranges were determined by key project team members based on factors such as the stage of scope development, the source of rate information and the level of complexity associated with the estimated item, and applied in the form of an accuracy margin and contingency.

14.4.3 Accuracy

The accuracy margin applied to the base estimate is the amount by which an estimate is corrected to allow for inherent uncertainties brought about by the extent of analysis and design undertaken to quantify risk elements enabling costs to be determined to the prescribed level of accuracy.

Therefore the level of accuracy margin applied depends on the nature of the information supplied to vendors or suppliers and the information received from these same vendors or suppliers.

As the level of detail engineering increases, as does the cost to undertake the higher level studies. Therefore it is common for detailed engineering to be conducted in the full feasibility study after the project concepts have been fully optimised.

14.4.4 Contingency

Contingencies are the amounts of money allocated to the project to provide for uncertainties in project definition and technology, and risks associated with execution of the project. A quantitative risk analysis was used to determine the most likely project cost outcome and estimate accuracy.

14.4.5 Capital Benchmarks

No specific benchmarking of capital costs has been completed as part of the PFS study given that the process for determination of the capital costs used current market data as the basis of the project estimation. During the PFS study a number of processes have been adopted to assist in determining the optimum capital necessary for the project. From the outset of the PFS study it was expected to achieve a high level of front end loading. Extensive consideration of execution planning, engineering definition, and understanding site-specific factors have been the basis of the work completed by the PFS study team. In the course of progressing the study a number of Value Improving Practices have been followed, including;

- Formal technology selection
- Simulation modelling
- Customised standards and specifications
- Constructability reviews
- Risk assessments

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14.4.6 Verification

Due to the lack of detail engineering within the Pre-Feasibility stage, the verification of the accuracy of estimates and assumptions used in creating these estimates was regarded as essential to the potential success of the Project.

Experienced consultants in each of the different technology areas, namely mineral sands mining, concentration and beneficiation/comminution, were retained to independently evaluate the integrity of the specifications and assumptions. The projects verification plan has been included in Appendix 19.2 of this document.

14.4.7 CAPEX Cost Estimate

Considering the operational tools and equipment requested to reach the production of 4-5 Mtpa of final iron sands concentrate, the risk analysis indicates a CAPEX budget estimate of US$ 576 million.

CAPEX Risk Analysis Results		
Least Likely Minimum	**Most Likely Cost**	**Least Likely Maximum**
P10	**P50**	**P90**
US$ 555 Million	US$ 576 Million	US$ 597 Million

Table 14-1CAPEX Risk Analysis Results

PROJECT ELEMENT		CAPITAL COST					TOTAL
		FPSO	FSO	AHV	PM & ENG.	CONTINGENCY	
VESSSEL	HULL	$52,084,340		$6,000,000			$58,084,340
	EQUIPMENT	$39,018,518					$39,018,518
	INTEGRATION	$45,000,000					$45,000,000
PROCESS	PROCESS PLANT	$173,228,799				$4,980,767	$178,209,566
	DEWATERING	$0	$17,035,800			$1,062,000	$18,097,800
MINING	CRAWLER	$97,862,279				$11,189,989	$109,052,268
AUX SYSTEM	POWER GENERATION	$78,767,500				$1,837,500	$80,605,000
AUX SYSTEM	DESALINATION	$26,555,900					$26,555,900
MANAGEMENT	PM&E	$3,096,200			$16,683,407	$973,790	$20,753,397
TOTAL		$515,613,536	$17,035,800	$6,000,000	$16,683,407	$20,044,046	$575,376,789
% OF TOTAL		89.61%	2.96%	1.04%	2.90%	3.48%	100.00%

Table 14-2CAPEX Breakdown

As expected the integrated production platform represents the major portion (90%) of the estimated total CAPEX.

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14.5 CAPEX Risk Analysis Results

Simulation Summary Information	
Workbook Name	580349-SCH-X0003-RA (Model as basis of
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	728
Number of Outputs	2
Sampling Type	Latin Hypercube
Simulation Start Time	5/06/2013 14:28
Simulation Duration	00:01:03
Random # Generator	Mersenne Twister
Random Seed	1

Summary Statistics for Offshore Mining Project Single Crawler Case Output Cost to First O				
Statistics			**Percentile**	
Minimum	$	526,862,079.58	**5%**	$ 549,832,265.32
Maximum	$	634,253,397.05	**10%**	$ 554,893,905.72
Mean	$	575,789,726.41	**15%**	$ 558,914,951.91
Std Dev	$	16,037,537.22	**20%**	$ 561,915,649.79
Variance	2.57203E+14		**25%**	$ 564,637,019.94
Skewness	0.086414368		**30%**	$ 567,122,070.02
Kurtosis	2.83794671		**35%**	$ 569,365,376.92
Median	$	575,698,033.89	**40%**	$ 571,551,335.30
Mode	$	569,201,978.78	**45%**	$ 573,713,932.03
Left X	$	549,832,265.32	**50%**	$ 575,698,033.89
Left P	5%		**55%**	$ 577,686,901.09
Right X	$	602,896,044.60	**60%**	$ 579,749,049.00
Right P	95%		**65%**	$ 581,844,951.65
Diff X	$	53,063,779.28	**70%**	$ 584,050,012.81
Diff P	90%		**75%**	$ 586,465,806.62
#Errors	0		**80%**	$ 589,248,432.06
Filter Min	Off		**85%**	$ 592,378,155.94
Filter Max	Off		**90%**	$ 596,963,914.97
#Filtered	0		**95%**	$ 602,896,044.60

Change in Output Statistic for Offshore Mining Project Single Crawler Case Output Cost to				
Rank	**Name**	**Lower**		**Upper**
1	Equipment Procurement / Budget Price	$	561,726,468.09	$ 592,182,986.31
2	Procure / Budget Price	$	565,463,888.61	$ 587,414,309.92
3	12 of 3MW M10,000 IsaMill / Budget Price	$	565,311,063.27	$ 587,053,811.36
4	Integration / Provisional Price	$	566,039,295.36	$ 586,765,907.18
5	HULL , SUPERSTRUCTURE, PAINT / Budget Price	$	567,377,669.94	$ 585,708,246.91
6	Procurement, Insurance, Packing, Shipping / Normed Price	$	571,125,351.02	$ 581,631,357.53
7	Desalination / Provisional Price	$	571,139,662.94	$ 580,590,010.79
8	MIMS / Budget Price	$	572,393,590.66	$ 579,360,514.06
9	Electrical / Normed Price	$	573,078,874.62	$ 579,833,338.53
10	MACHINERY / Budget Price	$	572,814,849.60	$ 578,778,403.34
11	Equipment / Budget Price	$	573,712,013.48	$ 578,335,144.87
12	One year Operating Spares / Normed Price	$	574,261,855.44	$ 578,115,983.13
13	Instruments / Normed Price	$	574,065,385.08	$ 576,994,313.48
14	Trommel screen/chutes / Fixed Price	$	574,700,251.56	$ 577,498,318.62

Table 14-3Simulation Summary

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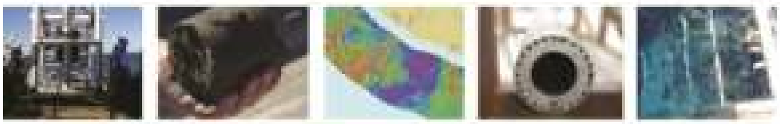

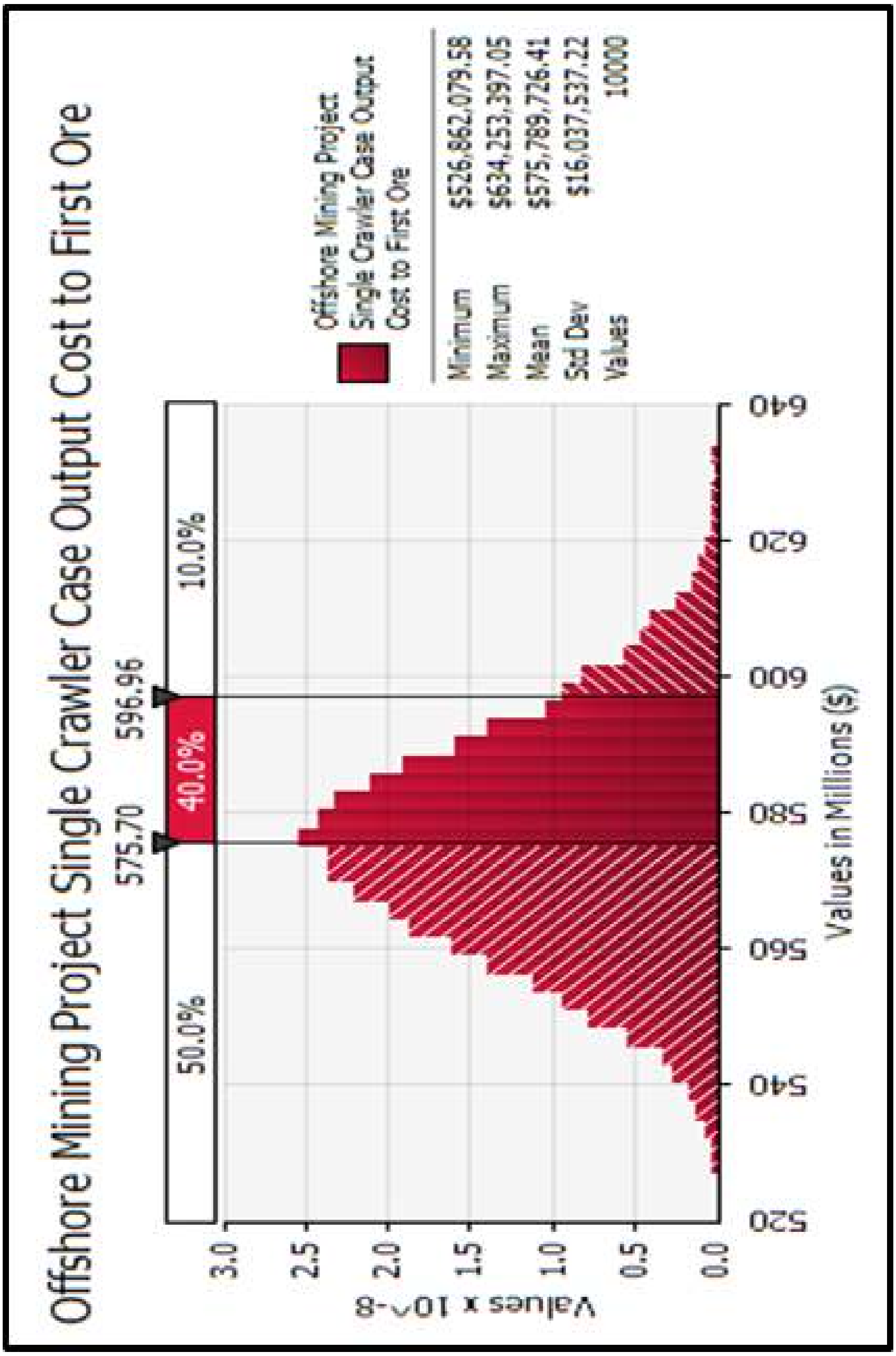

Figure 14-2 Estimate Distribution

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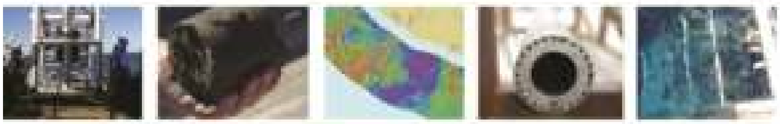

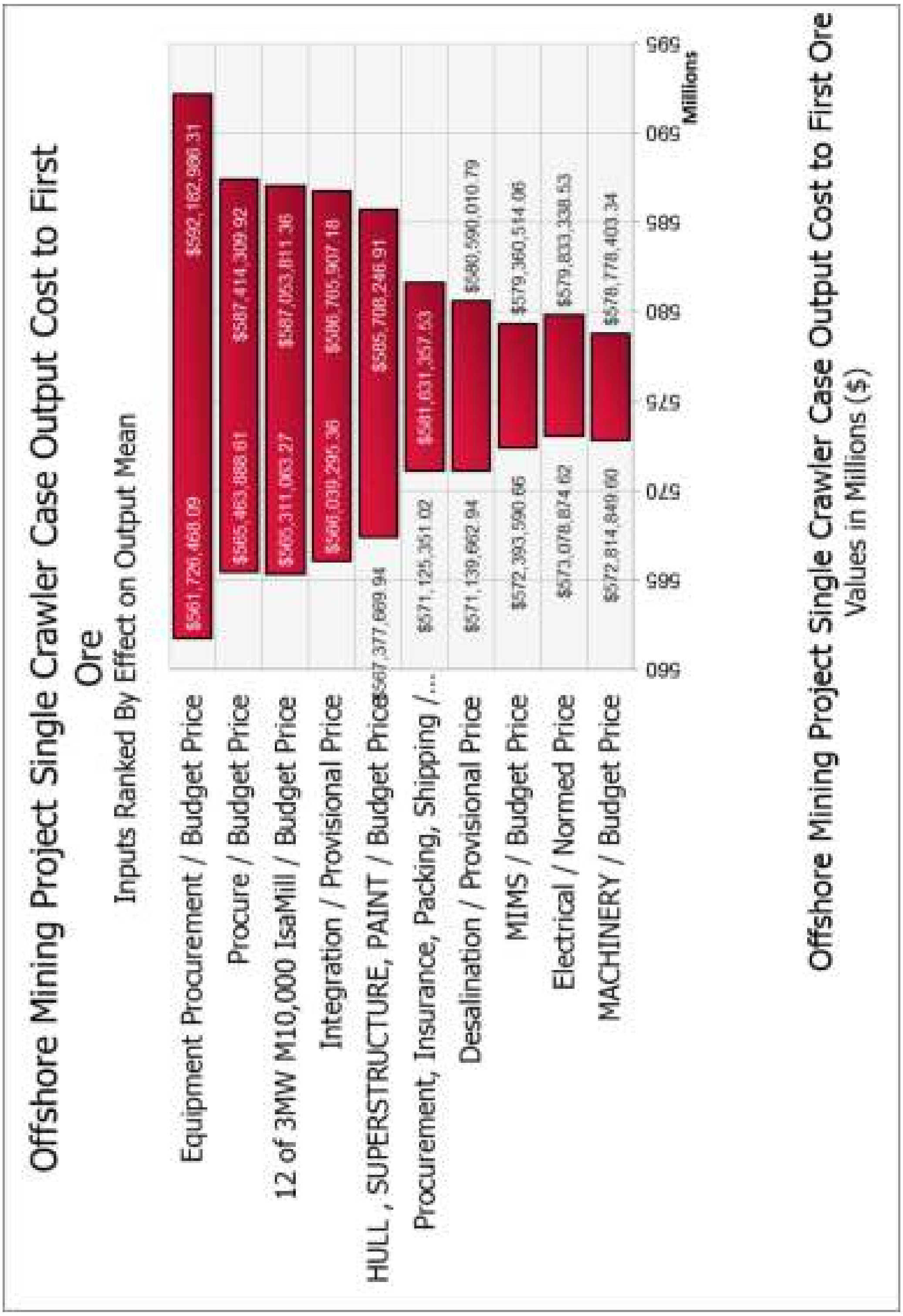

Figure 14-3 Estimate Tornado Chart Risk Ranking

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Task Name	Cost	Installed	Piping	Electrical	Instruments	Structural Steel	Contractors fees	Procurement, Insurance, Packing, Shipping	Construction and Commissioning Spares	One year Operating Spares	Capital Spares	Contingency	
Overall Price Breakdown	81.7%	1.1%	1.5%	4.4%	0.6%	0.3%	1.6%	3.3%	0.3%	1.3%	0.8%	3.2%	
Process Plant Price Breakdown		2.9%	4.4%	6.4%	1.7%	0.9%	4.6%	5.0%	0.2%	1.1%	0.7%	1.1%	
Mode Applied		14%	8%	10%	6%	14%	7.6%	7.6%	0.6%	2.6%	1.6%	0.25	
Standard Deviation Applied												0.05	TOTAL
Offshore Mining Project	$464,816,793	$8,184,974	$7,983,043	$20,051,957	$4,676,126	$2,236,541	$7,384,468	$24,975,664	$1,669,241	$8,346,209	$5,007,725	$20,044,046	$575,376,789
Project Management	$8,204,917	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$969,590	
Project Management And Cor	$8,204,916.67												
BFS	$8,478,490.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	
Resource Definition	$592,600.00												
Beneficiation and Meta	$519,166.67												
Permits and Licences	$2,476,834.17												
Consenting and Appro	$3,078,128.33												
Environment and Com	$1,811,780.83												
Engineering and Design	$3,096,200	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$4,200	
FPSO - Hull/Plant													
Part A Estimate Receive	$82,600.00											4,200	
Estimate for Part B	$3,013,600.05											0	
Procurement	$445,037,186	$8,184,974	$7,983,043	$20,051,957	$4,676,126	$2,236,541	$7,384,468	$24,975,664	$1,669,241	$8,346,209	$5,007,725	$19,070,256	
Procurement - FPSO - Hull	$136,102,858.00											0	
Procurement - Mining RO\	$93,249,920.00								512,484	2,562,422	1,537,453	11,189,989	
Procurement - Process Pl	$115,351,074.48	7,512,374	7,629,043	9,845,957	4,499,128	2,236,541	7,384,468	12,998,684	590,757	2,953,787	1,772,272	4,980,767	
FPSO Transfer Hos	$433,333.33			0					2,600	13,000	7,800		
Procurement - Power gen	$81,250,000.22	0	0	8,125,000	0		0	8,085,000	367,500	1,837,500	1,102,500	1,837,500	
Procurement - Desalinatio	$20,650,000.00	0	0	2,065,000	0		0	2,725,800	2,725,800	2,725,800	2,725,800	0	
Procurement - FSO Concentrate Onloading	$12,000,000.00	672,600	354,000	2,016,000	177,000	0	0	1,168,200	72,000	360,000	216,000	1,062,000	
AHT Procurement	$6,000,000.00												

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Table 14-4 Capital Estimate

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15. FINANCIAL EVALUATION

This section summarises the financial and operating parameters of the TTR project for the first 10 years of operations, as well as the Capex and Opex with an accuracy of +/-30% as defined in the scope of work set out in the pre-feasibility study.

		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	
PRODUCTION												
Head Grade		12.0%	11.6%	10.3%	10.8%	10.8%	11.1%	9.5%	9.5%	9.5%	9.5%	
Metallurgical Yield		58.2%	57.8%	55.8%	58.5%	61.5%	55.7%	55.7%	55.7%	55.7%	55.7%	
Fe Product Grade		57.0%	57.0%	57.0%	57.0%	57.0%	57.0%	57.0%	57.0%	57.0%	57.0%	
												Average
Sediments Mined	Mtpa	39.00	39.00	39.00	39.00	34.11	39.00	39.00	39.00	39.00	34.11	38.02
Fe Concentrate @ 57% Fe	Mtpa	4.65	4.40	3.84	4.10	3.87	3.72	3.48	3.48	3.48	3.04	3.81
SALES												
Nominal 62% Fe CFR China Price	$/t	108.50	108.50	108.50	108.50	108.50	108.50	108.50	108.50	108.50	108.50	
Fe % Adjusted Product Price	$/t	99.75	99.75	99.75	99.75	99.75	99.75	99.75	99.75	99.75	99.75	
Offtake Price	$/t	79.80	79.80	79.80	79.80	79.80	79.80	79.80	79.80	79.80	79.80	
Market Sale Price	$/t	81.80	81.80	81.80	81.80	81.80	81.80	81.80	81.80	81.80	81.80	
COSTS	$M											
Crawler												
Repairs		6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	
FPSO												
Repairs		14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	
Labour		14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	
Insurance		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
Power		38.4	38.3	38.2	38.2	33.4	38.2	38.2	38.2	38.2	33.4	
		70.3	70.2	70.1	70.1	65.3	70.1	70.1	70.1	70.1	65.3	
FSO (Outsourced)		34.4	33.8	32.5	33.1	32.6	32.3	31.7	31.7	31.7	30.7	
Ancillaries Support		5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	
Others												
Sales G&A		7.8	7.3	6.4	6.8	6.5	6.2	5.8	5.8	5.8	5.1	
Others		2.2	2.1	1.3	1.4	1.4	1.3	1.2	1.4	1.5	1.5	
Marketing		7.5	7.0	6.1	6.6	6.2	6.0	5.6	5.6	5.6	4.9	
Freight		46.6	44.0	38.4	41.0	38.7	37.2	34.8	34.8	34.8	30.4	
Royalty		11.6	9.9	6.3	7.9	6.7	2.7	2.5	3.8	5.5	4.3	
		75.7	70.3	58.5	63.8	59.5	53.4	49.8	51.4	53.2	46.1	
												Average
Total Opex per ton (FOB)	$/t	31.25	32.36	35.14	33.64	33.75	35.05	37.07	37.52	38.04	40.09	35.46
Total Opex per ton (CFR)	$/t	41.25	42.36	45.14	43.64	43.75	45.05	47.07	47.52	48.04	50.09	45.46
FINANCIAL SUMMARY	$M											
												Total
Revenue		379	357	312	333	315	303	283	283	283	247	3,094
Direct Costs		117	116	115	115	110	114	114	114	114	108	1,136
Other Costs		76	70	59	64	60	53	50	51	53	46	582
EBITDA		187	171	138	154	145	136	119	117	116	93	1,376
Profit before Tax		105	89	56	71	64	49	34	73	104	82	727
Profit after tax		75	64	41	51	44	35	22	53	75	59	519
CAPEX	$M	576										
NET PRESENT VALUE @ 10%	$M	338										

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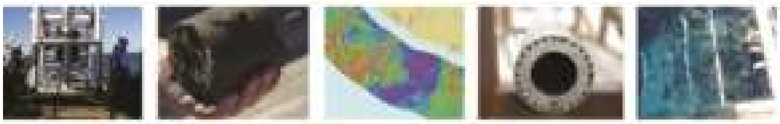

15.1 Business Model

The business plan has been elaborated by TTR in the section above in particular with regards to the marketing approach in terms of pricing and sales. TTR and its various consultants have also collectively contributed to the necessary inputs in relation to the Capex and Opex estimates for the project for the purpose of economic evaluation.

There is a compelling technical and economic case for using VTM concentrates as a substitute to traditional iron ore, particularly when the valuable vanadium is recovered as a by-product.

In the short term, there is a substantial market accessible to TTR’s product that is estimated to be in excess of 50 Mtpa, which is based on a combination of traditional blast furnaces using initially small amounts of VTM concentrates and also existing heavy VTM concentrate users looking to source their VTM concentrates from the seaborne market. This market is substantial and unlikely to be swamped by the competing VTM hopefuls from the Philippines and Indonesia which have small mineral resources compared to TTR.

TTR’s business plan assumes that its project can readily capture 4-5 Mtpa of the existing VTM market. Currently TTR has secured framework agreements for an initial portion of its products.

In the medium term, there is the optionality for TTR to supply VTM concentrates to integrated steel making facilities located in New Zealand, China, as well as other Asian countries. The combination of a TTR supply of VTM concentrates and a dedicated steel making facility would enjoy total cost leadership on a worldwide basis. There are a number of possible combinations that TTR could deploy to capture this market.

In the longer term there is potentially a much larger market for VTM concentrates, amounting to few hundred million tons per annum, as dedicated facilities are developed and as existing steel mills start using ‘heavy blends’ of VTM concentrates (which require some operational adjustments but no substantial investments). This market is very lumpy as each individual blast furnace would require large amounts of VTM product, at least 2-10 Mtpa. As a result this market is only accessible to VTM producers that have a very large mineral resource, in excess of 150 Mt of VTM concentrate.

TTR’s key strategic advantage compared to other VTM hopefuls is that TTR has potentially a vast mineral resource that enables steel mills to envisage customized steel making activities (through ‘heavy blending’ or the development of dedicated facilities) that would have a strong economic edge compared to traditional steel mills sourcing their iron ore supply from the majors (Vale, Rio Tinto and BHP). Additionally the low capital intensity and operating cost of TTR’s project is a key strategic proposition to iron ore users. It is critical that TTR leverage this structural advantage when looking for trade sale or funding opportunities.

TTR’s project has significant upside scalability that can be deployed on a modularised basis following successful investment and deployment of its first production unit. TTR has a vast amount of resource potential (only 9% of its tenement has been explored to date) providing significant expansion opportunities to become a major, low cost supplier of VTM iron ore concentrates.

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15.2 Key Inputs and Assumptions

In performing financial evaluation of the project, the following assumptions have been considered for the base case scenario:

- Run-of-mine sediment mining tonnage and anticipated head grade based on proposed mine plan prepared by Golders Associates for first 5 years as follows and thereafter assuming average head grade of 9.5% based on average of year 8 to 10 ;

Grade 1 Fe Head Grade	12.0%
Grade 2 Fe Head Grade	11.6%
Grade 3 Fe Head Grade	10.3%
Grade 4 Fe Head Grade	10.8%
Grade 5 Fe Head Grade	11.1%
Grade 6 Fe Head Grade	9.5%

- Metallurgical yield estimated based on analysis of results from samples tested through the pilot plant and Davis Tube Recovery results and adjusted by the FE recovery of the pilot plant and then compared against the proposed mine plan;

Year	Fe Yield
Y1	59.17%
Y2	57.58%
Y3	55.78%
Y4	58.52%
Y5	61.46%
Y6	58.92%
Y7	54.69%
Y8	54.53%
Y9	53.59%
Y10	43.80%
Weighted Average	55.73%

- Product Fe grade of 57%;
- Production projected for 20-years, thereafter assuming same level of grade and yield on an ongoing basis with terminal value;
- Crawler cycle time of 250 net operating days or 6,000 hours;
- Crawler dredging capacity of 6,500 tph throughput;
- FPSO requires Dry Docking of 56 days every 5 years for first 15 years, and every 3 years thereafter;
- FPSO is powered by Heavy Fuel Oil (HFO) converted to power cost on kwh per ton of HFO used basis based on estimated conversion factor;

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- Power usage based on estimated average power consumption from engineering modelling conducted during pre-feasibility study;
- Estimated personnel required and estimated labour costs;
- Estimated repair and maintenance costs based on industry norms;
- Estimated insurance and other ancilliary support costs;
- Sales, General and Admin costs as a dollar per ton of concentrate estimate;
- Marketing costs as a percentage of sales;
- Royalties based on higher of ad valorem or accounting profit basis;
- Sale price based on nominal 62% Fe CFR China benchmark price, adjusted for 57% Fe product grade, and thereafter applying sale discounts and/or adjustments as applicable;
- FSO on a fully outsourced basis, charged on a fixed cost plus a variable per ton charge;
- Estimated freight cost from New Zealand to China;
- Estimation of other ancillary costs such as anchor support vessel, community development, exploration, environment, etc.

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15.3 Operating Costs

The Opex breakdown is set out below:

COSTS	$M											Average
Crawler												
Repairs		6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	
FPSO												
Repairs		14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	
Labour		14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	
Insurance		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
Power		38.4	38.3	38.2	38.2	33.4	38.2	38.2	38.2	38.2	33.4	
		70.3	70.2	70.1	70.1	65.3	70.1	70.1	70.1	70.1	65.3	
FSO (Outsourced)		34.4	33.8	32.5	33.1	32.6	32.3	31.7	31.7	31.7	30.7	
Ancilliaries Support		5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	
Total Direct Costs		**116.7**	**115.9**	**114.6**	**115.2**	**109.9**	**114.4**	**113.8**	**113.8**	**113.8**	**108.0**	
Others												
Sales G&A		7.8	7.3	6.4	6.8	6.5	6.2	5.8	5.8	5.8	5.1	
Others		2.2	2.1	1.3	1.4	1.4	1.3	1.2	1.4	1.6	1.5	
Marketing		7.5	7.0	6.1	6.6	6.2	6.0	5.6	5.6	5.6	4.9	
Freight		46.6	44.0	30.4	41.0	38.7	37.2	34.8	34.8	34.8	30.4	
Royalty		11.6	9.9	6.3	7.9	6.7	2.7	2.5	3.8	5.5	4.3	
		75.7	70.3	58.5	63.8	59.5	53.4	49.8	51.4	53.2	46.1	
Total Opex per ton (FOB)	$/t	31.26	32.36	35.14	33.64	33.75	35.05	37.07	37.52	38.04	40.69	35.45
Total Opex per ton (CFR)	$/t	41.26	42.36	45.14	43.64	43.75	45.05	47.07	47.52	48.04	50.69	45.45

Table 15-1Opex Breakdown

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The Opex per ton is a function of production tons hence the head grade and metallurgical yield variabililty will have significant impact on the unit operating cost. Moreover, the Opex estimation has been calculated taking into account the %Fe content in the iron concentrate in order to be able to make a direct correlation with the sale price defined by the %Fe (dmtu on dry basis). Therefore a direct relation exists between the grade of Fe in the sediment, the metallurgical yield and the unit cost.

As most of the operating cost compoments are largely fixed with minimal variability with increased production, increased crawler and plant throughput can also have a direct positive impact on reducing unit operating cost on a per ton of concentrate basis. The key component of operating costs on the FPSO would be power generation and therefore fuel consumption, which represents approximately 1/3 of the total direct operating costs.

As such, the key to managing opex would be to minimize grade variability and improve crawler/plant throughput. The following have been and will continue to be further considered:

- A mining plan which will take into account of the grade variation of the 3 lips (already planned) in order to minimise the Fe standard deviation of the ROM which will be by definition a guaranty of the iron concentrate quality;
- Further exploration and test work which will drive accuracy of the mining operations;
- Further engineering studies to investigate potential of increasing crawler throughput capacity; and
- Study and planning to achieve operational optimization with the aim to improve mining efficiency and reduce operating hours loss.

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15.4 Scenario Analysis

The following operating scenarios and the corresponding key financial parameters have been considered:

	$M NPV	Mt Prod Ave 1st 5 yrs	$M Capex	$/t FOB Opex Ave 1st 5 yrs
1-CRAWLER 6500 tph / 6000 hrs < BASE CASE >	339	4.17	576	33.2
1-CRAWLER 8000 tph / 6000 hrs	582	5.04	576	31.2
1-CRAWLER 8000 tph / 6224 hrs	632	5.21	576	30.9
2-CRAWLER 8000 tph / 6224 hrs	593	5.21	637	30.5

Table 15-2 Operating Scenarios

The financial results of the base case operating scenario of 6,500 tph crawler throughput at 6,000 operating hours has a post-tax project NPV of US$339 million. Higher operating throughput scenario both in terms of crawler throughput and operating efficiency will be considered in the next stage engineering studies, with the aim to achieve higher production rate to maximise designed specification. The higher throughput scenarios are set out above, which has post-tax NPV of US$582 – 632 million.

The sensitivity analysis of the various key parameters of the base case scenario is set out below:

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BASE CASE	1-CRAWLER	6500 tph / 6000 hrs	Product Grade 57%

SENSITIVITY ANALYSIS

Iron Ore Benchmark Price ($/t) 62% Fe China CFR			$M NPV	Ave 1st 5 yrs Mt Prod	$M Capex	Ave 1st 5 yrs $/t FOB Opex
	30%	141	823	4.2	578	36.3
	20%	130	661	4.2	578	35.2
	10%	119	500	4.2	578	34.2
BASE CASE		108.5	339	4.2	578	33.2
	-10%	98	178	4.2	578	32.4
	-20%	87	8	4.2	578	31.9
	-30%	76	-173	4.2	578	31.5

Uncommitted Sale Volume: Price Discount (applicable to on-market sale volume)		$M NPV	Ave 1st 5 yrs Mt Prod	$M Capex	Ave 1st 5 yrs $/t FOB Opex
	26%	219	4.2	578	32.6
	24%	249	4.2	578	32.7
	22%	279	4.2	578	32.9
	20%	309	4.2	578	33.0
BASE CASE	18%	339	4.2	578	33.2
	16%	369	4.2	578	33.4
	14%	398	4.2	578	33.6
	12%	428	4.2	578	33.8
	10%	458	4.2	578	34.0

Crawler Throughput (tph) 6500			$M NPV	Ave 1st 5 yrs Mt Prod	$M Capex	Ave 1st 5 yrs $/t FOB Opex
	10%	7150	445	4.6	578	32.1
BASE CASE		6500	339	4.2	578	33.2
	-10%	5850	232	3.8	578	34.7

HFO Price ($/t) 610-608-606 (2016, 2017, 2018 and after)		$M NPV	Ave 1st 5 yrs Mt Prod	$M Capex	Ave 1st 5 yrs $/t FOB Opex
	30%	277	4.2	578	35.7
	20%	298	4.2	578	34.8
	10%	318	4.2	578	34.0
BASE CASE		339	4.2	578	33.2
	-10%	359	4.2	578	32.4
	-20%	380	4.2	578	31.6
	-30%	400	4.2	578	30.8

Power Usage (MW) 39.4 (average power usage on FPSO)			$M NPV	Ave 1st 5 yrs Mt Prod	$M Capex	Ave 1st 5 yrs $/t FOB Opex
	30%	51.2	277	4.2	578	35.7
	20%	47.3	298	4.2	578	34.8
	10%	43.3	318	4.2	578	34.0
BASE CASE		39.4	339	4.2	578	33.2
	-10%	35.5	359	4.2	578	32.4
	-20%	31.5	380	4.2	578	31.6
	-30%	27.6	400	4.2	578	30.8

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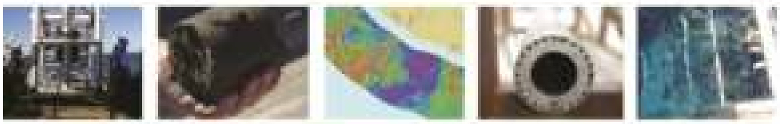

Discount Rate 10%			$M NPV	Ave 1st 5 yrs Mt Prod	$M Capex	Ave 1st 5 yrs $/t FOB Opex
		12%	217	4.2	576	33.2
BASE CASE		**10%**	**339**	**4.2**	**576**	**33.2**
		8%	523	4.2	576	33.2

Capex ($m) 576			$M NPV	Ave 1st 5 yrs Mt Prod	$M Capex	Ave 1st 5 yrs $/t FOB Opex
	30%		208	4.2	748	32.9
	20%		252	4.2	691	33.0
	10%		296	4.2	633	33.1
BASE CASE			**339**	**4.2**	**576**	**33.2**
	-10%		382	4.2	518	33.4
	-20%		425	4.2	460	33.5
	-30%		467	4.2	403	33.7

Freight Rate ($/t) 10			$M NPV	Ave 1st 5 yrs Mt Prod	$M Capex	Ave 1st 5 yrs $/t FOB Opex
	30%	13.0	279	4.2	576	32.9
	20%	12.0	299	4.2	576	33.0
	10%	11.0	319	4.2	576	33.1
BASE CASE		**10.0**	**339**	**4.2**	**576**	**33.2**
	-10%	9.0	359	4.2	576	33.4
	-20%	8.0	379	4.2	576	33.5
	-30%	7.0	398	4.2	576	33.6

Head Grade **12.0% - 11.6% - 10.3% - 10.8% - 11.1% - 9.5%** *(Yr 1-5, and thereafter average of Yr 6-10 grade)*			$M NPV	Ave 1st 5 yrs Mt Prod	$M Capex	Ave 1st 5 yrs $/t FOB Opex
	10%		598	5.5	576	28.3
	5%		463	4.8	576	30.5
BASE CASE			**339**	**4.2**	**576**	**33.2**
	-5%		222	3.6	576	37.1
	-10%		111	3.1	576	42.2

Metallurgical Yield **59.17%-57.58%-55.78%-58.52%-61.46%-55.73%** *(Yr 1-5, and thereafter weighted average)*			$M NPV	Ave 1st 5 yrs Mt Prod	$M Capex	Ave 1st 5 yrs $/t FOB Opex
	10%		473	4.6	576	31.3
	5%		406	4.4	576	32.2
BASE CASE			**339**	**4.2**	**576**	**33.2**
	-5%		272	4.0	576	34.3
	-10%		204	3.8	576	35.7

Table 15-3 Sensitivity Analysis

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15.5 Project Discounted Cash Flow

DCF Valuation

US$m

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
EBIT	-	-	105	89	56	71	61	49	31	73	104
add back depreciation/amortisation	-	-	82	82	82	83	85	86	88	44	12
EBITDA	-	-	187	171	139	154	145	135	119	117	116
less Capital Expenditure	(114)	(462)	-	-	-	(12)	(12)	(12)	(12)	(12)	(12)
Working Capital Movement	-	-	-	-	-	-	-	-	-	-	-
Tax on EBIT	-	-	(29)	(25)	(16)	(20)	(17)	(14)	(9)	(20)	(29)
Free Cash Flow for Enterprise	**(114)**	**(462)**	**157**	**146**	**123**	**123**	**117**	**110**	**99**	**85**	**75**
Terminal value											
Year No	1.1	2.1	3.1	4.1	5.1	6.1	7.1	8.1	9.1	10.1	11.1
Discount Factor (Value Date)	0.90	0.82	0.74	0.67	0.61	0.56	0.51	0.46	0.42	0.38	0.35
Present Value	(102)	(377)	117	99	75	69	59	51	41	33	26
Project NPV	338.85										

Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	Terminal cash flows
EBIT	82	104	104	104	104	82	104	104	82	104	
add back depreciation/amortisation	12	12	12	12	12	12	12	12	12	12	
EBITDA	93	116	116	116	116	93	116	116	93	116	
less Capital Expenditure	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)	
Working Capital Movement	-	-	-	-	-	-	-	-	-	-	
Tax on EBIT	(23)	(29)	(29)	(29)	(29)	(23)	(29)	(29)	(23)	(29)	
Free Cash Flow for Enterprise	**59**	**75**	**75**	**75**	**75**	**59**	**75**	**75**	**59**	**75**	**75**
Terminal value											**750**
Year No	12.1	13.1	14.1	15.1	16.1	17.1	18.1	19.1	20.1	21.1	
Discount Factor (Value Date)	0.31	0.29	0.26	0.24	0.21	0.20	0.18	0.16	0.15	0.13	0.13
Present Value	18	21	19	18	16	11	13	12	9	10	100

Assumptions

WACC	10.00%	Calculated	10.00%
Terminal growth rate	0.00%	Valuation date	15/5/13

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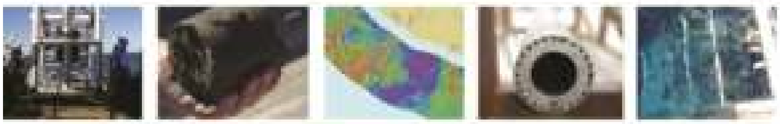

16. RISK & UNCERTAINTIES

In addition to the detailed risks identified on the Project Risk Register, other general risks and uncertainties associated with this project are discussed below.

- The resource is located in an area that is subject to severe sea states, although these have been factored into the dynamic model there is a risk that down time due to inclement weather is higher than allowed;
- The mineable grade is based on an annual mining schedule, as more detailed schedules are applied loss and dilution factors will need to be applied;
- Assumptions on process plant iron units recovered prove to be overly aggressive;
- Capital estimates are based predominantly on supplier estimates, industry “norms” have been used to calculate fabrication and integration costs and hence there is a risk that our allowances have been aggressive;
- Operating costs have been built up using a combination of suppliers budget estimates, estimated personnel numbers, estimates on consumables and industry “norms” for maintenance. There is a risk our estimates have been aggressive;
- Production estimates have been based on IHC estimates with caveats on further work to understand the “dig - ability” of the sands to be dredged. A dig – ability test program is proposed for the PFS. There is a risk the estimates used have been aggressive;
- The crawler solution current operating model restricts its depth to c.25 m, hence shallow areas in the RMA zone cannot be mined requiring, if a crawler operating solution cannot be found higher mining costs will be incurred, this is not expected until after year 5;
- The project does not get Resource consents, consent are is appealed or the consents are granted with conditions what make the Project uneconomic;
- The Company is not in a position to make early commitments to long-lead procurement items with consequential delays to first commercial ore production;
- Mineable grades are materially worse than assumed;
- The Project is subjected to protest vessels that stop/slow operations;
- Assumptions on tailings are worse than allowed for and result in significant amounts of ROM dilution increasing unit costs;
- Assumptions on plume models and overall environmental effects are materially worse than allowed for requiring cost imposts to mitigate on the project that have not been allowed for;

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- Revenue assumptions prove to be aggressive.
- Capital estimates prove to be conservative with significant savings identified and materialised through BFS and execution;
- Operating costs prove to be conservative with significant savings identified through BFS and executed through operations, a key driver of opex will be HFO demand (linked to power demand) and HFO price;
- Mining production rate proves to be conservative and is materially exceeded driving higher sales revenue and lowering unit costs;
- Mineable grades prove to be conservative and are exceeded driving higher revenue through higher sales and lower unit costs;
- Assumptions on process plant iron units recovered prove to be overly conservative;
- Revenue assumptions prove to be conservative;
- Schedule assumptions prove to be conservative allowing for an early start up of operations.

16.1 Deposit and associated process

The main risks regarding the deposit and the process are:

- Some significant grade (%Fe) variation which increases the yearly ROM requisition, and thus the Opex with an immediate impact on profitability.
- The modification of mineral grain size into the particles which may require a very fine grinding during processing.
- The proposed flow sheet is based on the original Xantia samples; it is therefore necessary to confirm the results by means of pilot plant tests on material from new representative samples collected in the 3 promising (lips) areas.
- A significant upside exists if the full mining plan can be based on high grade material. As the mineralisation is open at depth in most cases, it is reasonable to assume that additional high grade material exists. This would allow for the continued use of only two dredging vessels and substantially reduce the cost base. This upside has not been taken into account at this stage and will be assessed when further deep drilling has been completed.

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INCREASING CONSEQUENCE ↓	INCREASING PROBABILITY →	A Rare	B Unlikely	C Moderate	D Likely	E Almost Certain
	0 None	0	0	0	0	0
	1 Slight	0	0	0	3	1
	2 Minor	0	0	2	6	4
	3 Moderate	1	1	5	17	9
	4 Major	0	0	1	0	1
	5 Catastrophic	0	0	1	0	0

Key:

- Low (green)
- Moderate (yellow)
- High (orange)
- Extreme (red)

Figure 16-1 Number of Current Risks by Assessment

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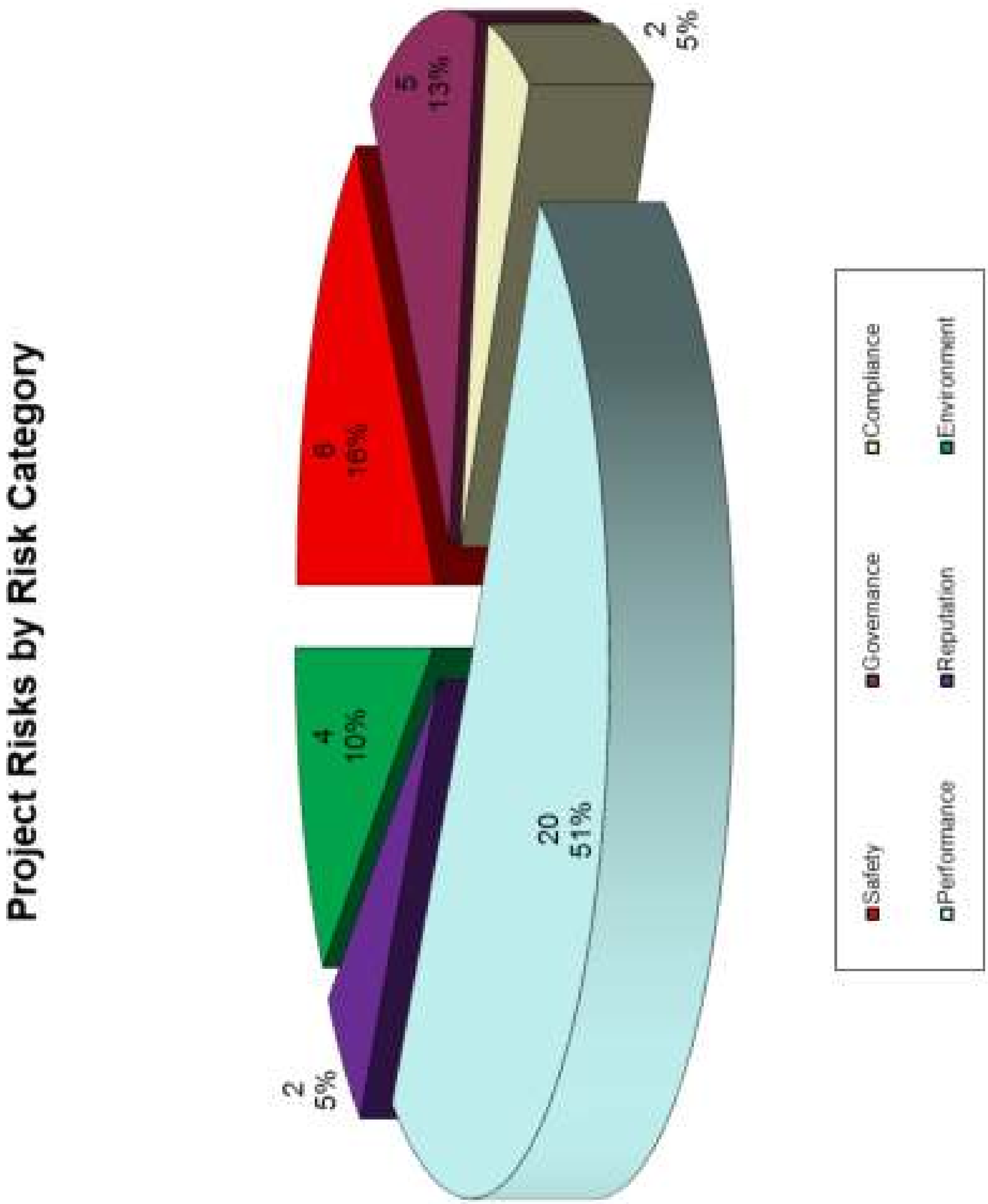

Figure 16-2 Project Risks by Category

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Issue	Current Priority	Mitigated Priority
Rewetting of iron sand post the drying step making the product structurally unstable	Extreme	Low
Third party will appeal positive Consent/License award	Extreme	High
Price of iron ore drops significantly - project becomes uneconomic	Extreme	High
Insufficient contingency allowance applied to budget pricing	Extreme	Moderate
Restricted access to NZ ports	Extreme	High
Power required is nominal, BFS estimate has insuffucient allowance for power generation	Extreme	Moderate
Get declined for Environmental Consent or restrictive operational conditions on consents i.e. smaller operation	Extreme	High
Increase in Shipping costs	Extreme	High
Oil spills during transfer at sea	Extreme	High
Insufficient Fresh Water	Extreme	High
Extreme Weather event during Operations	Extreme	High

Table 16-1 Risk Register (Extreme)

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17. BASIC SCHEDULE

The basic development schedule for the future stages of the TTR project is proposed in the schedule shown below:

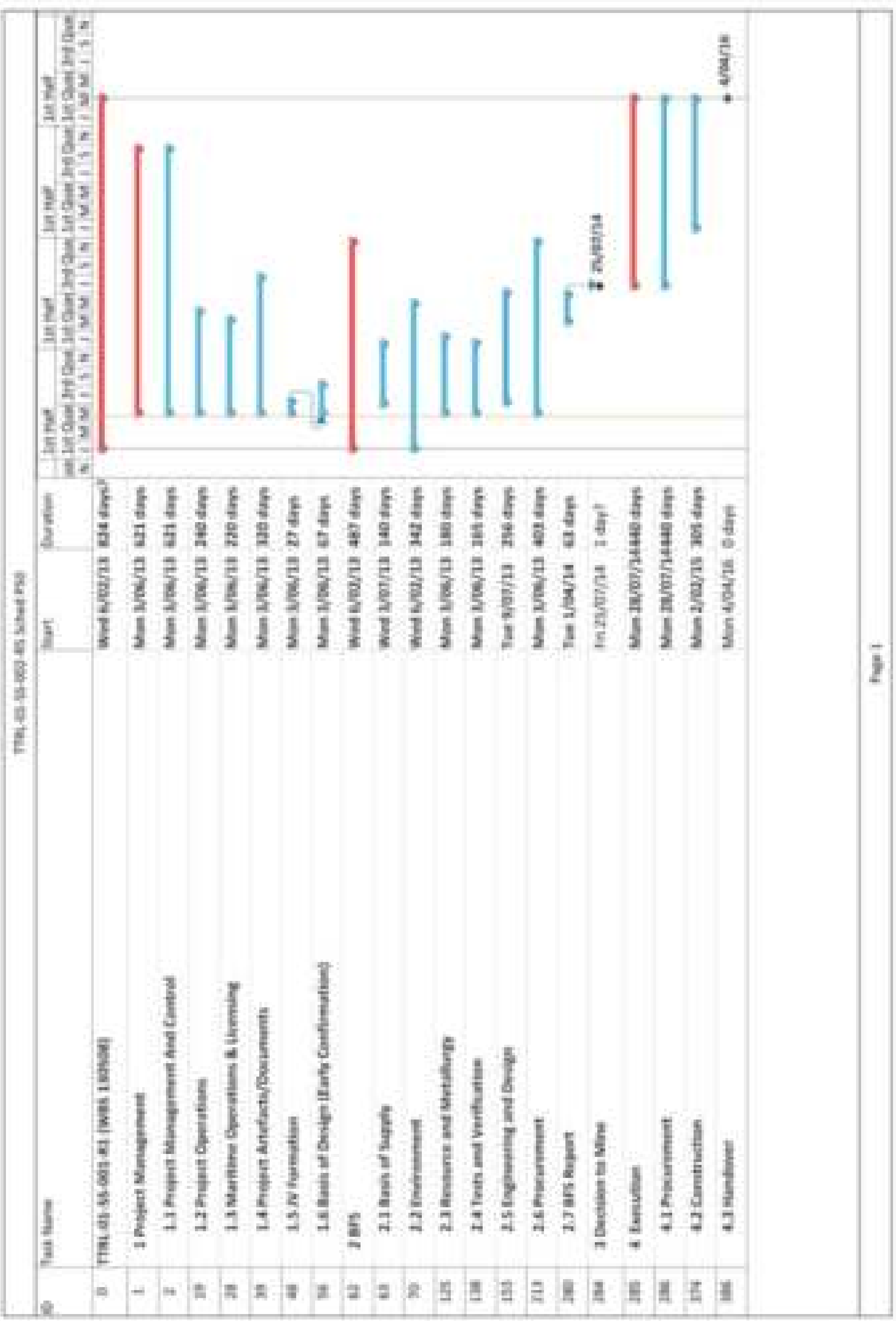

Figure 17-1 Basic Schedule

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18. BANKABLE FEASIBILITY STUDY

A Bankable Feasibility Study (BFS) is one that will be suitable to enable TTR to negotiate project financing from typical lending sources. The bankable document will satisfactorily provide all the technical / economic information and auditing necessary for a banker (and the banker's independent engineer) to determine that the project risks are acceptable and that the project is indeed viable on a stand-alone project financing basis.

The scope of work for this phase will be to carry out detailed project definition and planning to produce a BFS. This will include:

- General arrangements & P&IDs
- Lists of required mechanical & electrical equipment
- Estimate +/- 10% and Schedule that meets TTR's business case
- Materials take off lists in support of Capital Cost Estimate

From this point should the project meet the TTR's business case and the "green light" is given to proceed, the project will then enter the Execution stage.

Completion of the BFS requires development of preliminary engineering drawings and other documentation. Equipment quotations will be solicited competitively, material take-offs will be prepared, and a direct field cost estimate supported in its entirety by competitive bids will be prepared.

18.1 BFS Strategy

There are two generic strategies that could be implemented to execute the TTR offshore project. The first strategy, i.e. "Project Management by Owners Team", will require that TTR assume full responsibility for the management and engineering of the project, forming a TTR led team that comprises hired or seconded individuals and engaged organisations, each retained for a distinct portion of work or responsibility.

The second strategy, i.e. "Project Co-ordination by Owners Team", requires a smaller owners team that after the contracting of suitable vendors or in this case a consortium or Joint Venture, will concentrate on the management of the contract and it's deliverables.

18.1.1 Project Management by Owners Team

With this strategy, TTR will organise the study and assemble the final BFS report. Various tasks and specialized contributions to the report will be subcontracted to outside consultants and could include the following:

- Exploration drilling,
- Specialized geotechnical investigations,
- Environmental baseline studies and investigations,

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- Possibly metallurgical test-work,
- Detailed engineering design and material take-offs.

TTR will co-ordinate all the geological assessment and modelling, mine design and planning, production scheduling, flow-sheet development and estimating of both capital and operating costs. The developed WBS will be used to define all the tasks required, and then a decision will be made as to which tasks could be carried out with internal resources.

These internal tasks could include geologists, mining engineers, mechanical, civil and electrical engineers, metallurgists, legal resources, and purchasing, construction and marketing experts.

A formal project organisation will be developed, with the necessary internal people assigned responsibilities for budgets, deliverables and schedules.

All externally contracted parts of the study will have a very well defined scope and definition of work, including the contractual basis for carrying out the work and the required dates for completion.

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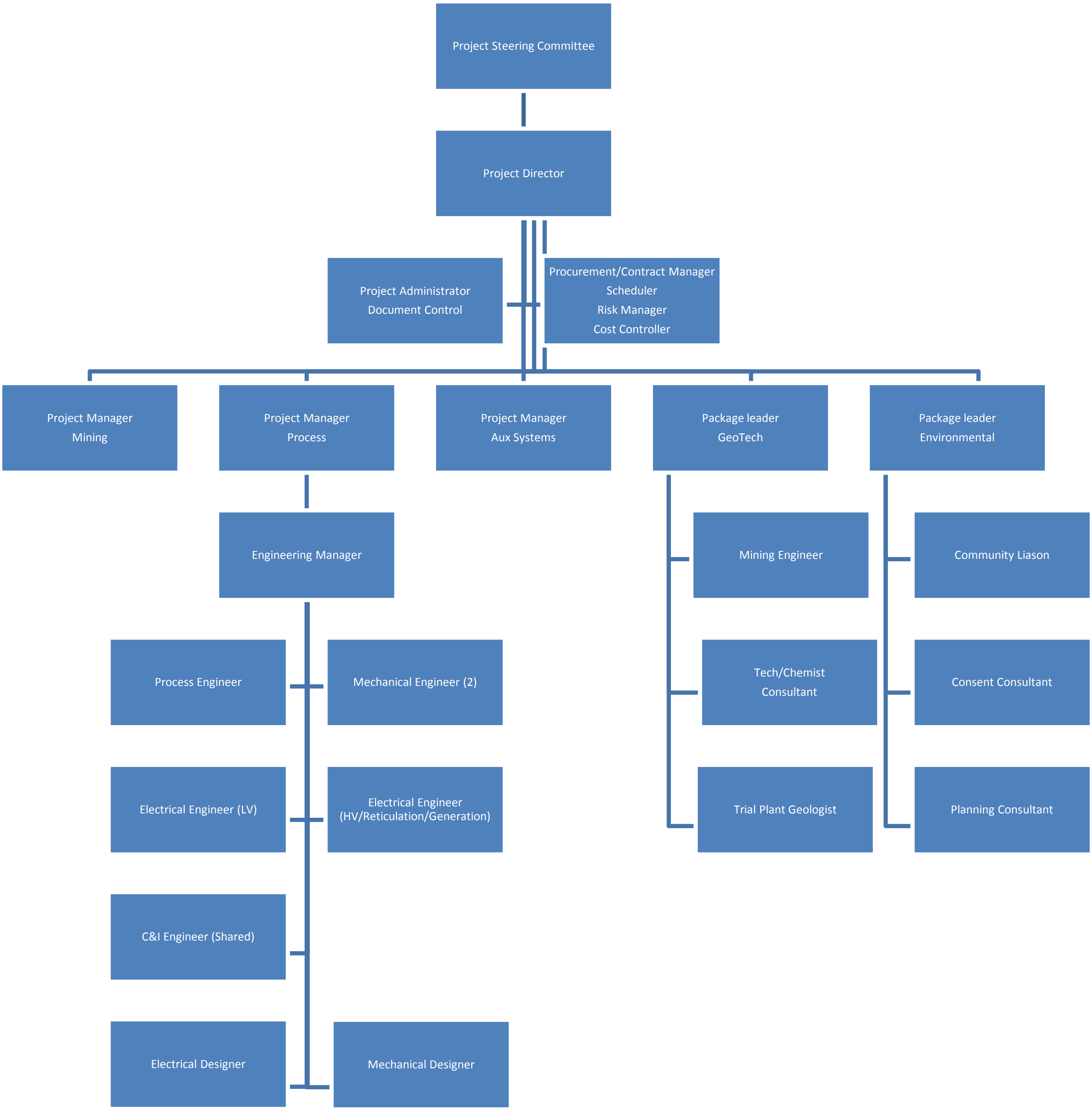

Figure 18-1 Proposed Owners Team Organisation Chart

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18.1.2 Project Management by Consultant/PME Contractor

The main consideration for this strategy is the requirement that the independent opinion of a major engineering company will be needed to provide project credibility. In the application of this strategy, TTR will retain the responsibility for "owner's" concerns, i.e. environmental consents, property titles, legal matters, financing arrangements and product marketing.

The appointed Project management and engineering company will act as the "prime contractor", supervise all the sub-consultants and take responsibility for assembling and preparing the final report, ensuring that schedules and budgets are adhered to. Typically, sub-consultants would be required for the following work:

- Geotechnical studies.
- Ore reserve calculations
- Tailings system design.
- Metallurgical test work

In the application of the second strategy, it is TTR's view that the diverse capabilities required to prepare the BFS describing the management, engineering and construction of the TTR Floating Production Storage and Off-take vessel (FPSO) will require an association of capabilities, formed under the basis of a Joint Venture (JV) (or consortium or association) with the individual entities each providing specialist services.

The ideal joint venture, consortium or association will be one that brings together partners with complementary skills and resources. TTR accept that such complementarity cannot be narrowly confined to complementary technologies of the participants but should also encompass other capabilities that are deemed valuable to all partners, such as experience in operating within JV's, specific market access, etc.

TTR envisions the JV as comprising of a leading Project Management and Engineering (PM&E) partner, mining technology partner and a local constructor each of which will be awarded a reimbursable contract for the completion of the Bankable Feasibility Study (BFS). The PM&E partner will act as the lead on all or some of the JV activities and hold specific responsibility for project management and engineering, with responsibilities for detail design shared with the other joint venture partners.

Project Management & Detail Eng.

- PM Responsibility, Complete or for defined portions;
- Complete JV Engineering Responsibility;
- Co-ordination of the vessel Fit-out/Integration in a TTR defined shipyard;
- Power Generation Specification and Integration into the vessel hull and systems;
- Desalination Specification and Integration into the vessel hull and systems;

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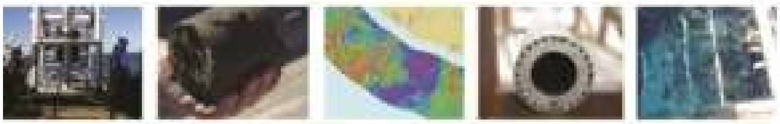

- Process Unit Integration into the vessel hull and systems;
- Electrical Reticulation Detail Design & Integration into the vessel hull and systems;
- Control & Instrumentation Detail Design & Integration into the vessel hull and systems;

Construction and Support

- Process Unit Detail Design &Fabrication
- Mining Component Fabrication. TTR envisages that this partner will provide local construction support to the Mining Technology provider.

MINING TECHNOLOGY

- Mining Unit Supply & Integration
- Mooring System Supply & Integration
- Dynamic Positioning System Supply & Integration

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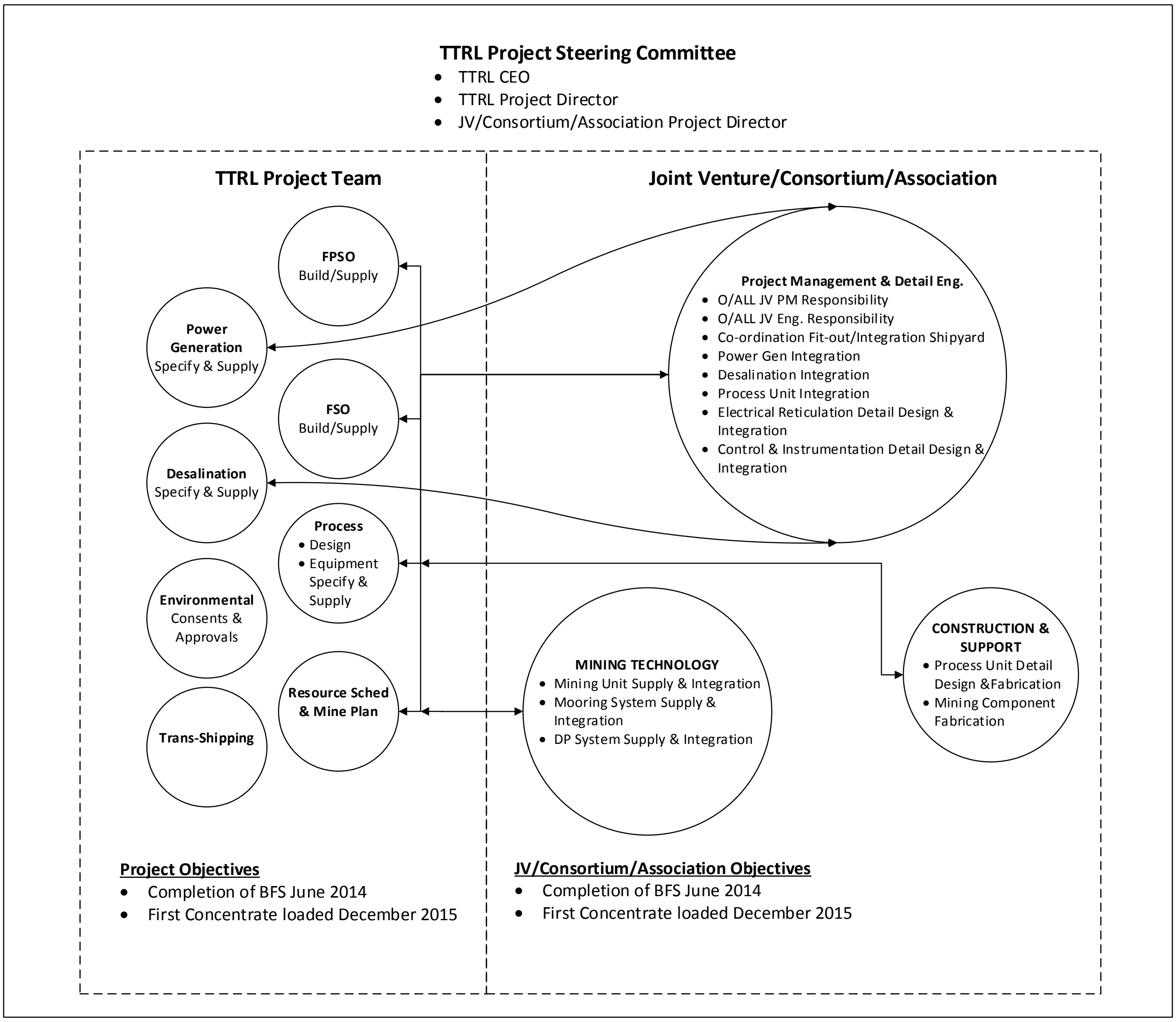

Figure 18-2 BFS Joint Venture/Consortium/Structure

18.2 BFS Capital cost estimate

18.2.1 BFS Contracting and Procurement Strategy

Choosing the right suppliers that can deliver value for money outcomes is the core principle underpinning TTR's strategy for the development of the BFS capital cost estimate of the Offshore Iron sands Project. This means that TTR will need to be satisfied that the best possible outcome has been achieved taking into account all relevant costs and benefits over the whole of the procurement/project cycle.

With regards to competitive costing processes for this project are, the procurement and contracting processes adopted will be designed to:

- encourage competition to deliver the most favourable submission;

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- ensure that rules and procedures adopted do not operate to limit competition by discriminating against any one supplier;
- enable suppliers to develop reliable, informed and competitive proposals which assist in making informed decisions as to the preferred supplier; and
- Ensure contractual compliance.

The procurement of services and equipment for this project will require a number of strategies to be employed dependent upon the nature and type of contract or purchase required. In identifying and managing the chosen strategy those directly involved in the process will be required to adhere to the following key requirements:

- Impartiality, whereby potential suppliers are treated equally and have the same opportunity to access information and advice;
- Consistency and transparency of process so that requests are evaluated in a systematic manner against explicitly predetermined evaluation criteria;
- Security and confidentiality of processes for receiving and managing supplier information to ensure the security and confidentiality of intellectual property and proprietary information;
- Identification and resolution of any actual or perceived conflict of interest prior to undertaking any tender evaluation; and
- Contractual compliance

Adherence to the above behaviours will provide surety that TTR is undertaking procurement and contracting in a professional and transparent manner and consistent with contractual requirements.

18.2.2 Selection of TTR Preferred Suppliers

In general, competitive tenders will be sought with both local and international suppliers and manufacturers who will be given full, fair and reasonable opportunity where possible.

Where Sole Sourcing is proposed, a Sole Source Justification will be required to be submitted to the TTR CEO for approval.

Recommended suppliers will be determined having assessed their submission on the basis of compliance with the contractual requirements of the tender, the below mentioned selection criteria and price.

The tender selection process will address the following:

- Health and Safety;
- Industrial relations policies and practices;
- Quality (AS/NZ ISO 9000.2000);
- Technical capabilities;
- Contractor capabilities;

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- Available resources;
- Deadlines and timeframes;
- Key personnel;
- Environmental impacts;
- Commitment to local employment opportunities; and
- Local (New Zealand) Content.

Preferred suppliers may also be asked to provide references for similar work undertaken so that these can be used to assess the capabilities of the company to meet the project deliverables.

Specific emphasis will be placed on contractor safety records, and recent and previous experience with a similar project. All selected suppliers will be required to demonstrate an understanding of the safety requirements, submitting an overview of their proposed management process for the safe implementation and management of the contract.

18.2.3 Confidentiality

Submissions will be required to be submitted in sealed packages and be delivered to TTR by the nominated tender closing date. Specific procedures have been established for this purpose.

18.2.4 Probity

When calling for tenders or expressions of interest, TTR will maintain effective probity of the decision-making and procurement and contracting processes.

Conflicts of interest will be managed and staff associated with potential suppliers will not take part in the decision-making process for that procurement or contract. Members of the TTR selection panel will be required to sign a Declaration of Confidentiality and Interest form prior to assessing the submissions.

18.2.5 Risk Management

Prior to accepting any offer, TTR will conduct a risk analysis/due diligence to identify potential problems, the likelihood that these risks could occur and their consequences. As part of the risk management process a criticality assessment shall be completed to identify the level of mitigation required for the "purchase". Following this a specific risk management mitigation strategy will be put in place.

Risk assessments will be carried out at regular intervals of the contracting process, not just in the initial procurement planning stage. This will assist in identifying and monitoring risk factors as they arise or change, but also will assist in managing the total procurement and contracting risk.

18.2.6 Contracting and Procurement Legal Advice/Services

TTR retained counsel and lawyers from Bell Gully will be engaged during the contract formation, tender assessment and contract negotiations stages to provide advice of contractual requirements, form of contract required and supplier

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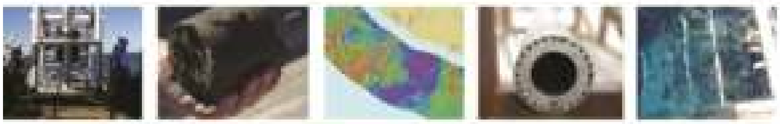

conformance with the Terms and Conditions of the contract. They will also assist in ensuring that TTR fulfils its legal and contractual obligations in terms of the BFS tender process.

18.2.7 Contracting and Procurement Document Control

During the procurement and contracting process all documents (both electronic and hardcopy) will be collected and filed together, thereby providing a record of procurement activities and how they have been conducted. The records will facilitate an understanding of the reasons for the procurement, the process that was followed and all relevant decisions, including approvals and authorisations. The filing system has already been established by TTR for the purpose of this project.

A contracts/procurement control database will be maintained during the project life cycle to communicate status information for Contracts/Purchase Orders and other related packages. This will be controlled within the Document Control Management System.

Document Control is a centralised process and a dedicated person will be charged to manage, collate and record all incoming and outgoing correspondence.

18.3 Value engineering

As part of the BFS phase both internal and external reviews will be scheduled to assess all aspects of the project to ensure that of process documents will be carried out, addressing materials of construction, surge and design safety factors, adherence to general philosophy, and completeness etc.

18.4 Detailed PFS Recommendations

In the previous version of the PFS study,Technip recommended the following additional works in order to confirm some of the key assumptions made in the study:

- To improve the knowledge of each prospective mining area via infill-drilling and deep drilling as required.
- To elaborate a robust mining plan which will allow an estimation of the reserves (quantity, quality: associated standard deviation). This mining has to be elaborated with the dredging company in order to take into account of all the technical specificities of the dredger.
- The pre-concentrates and concentrates obtained during the 2012 pilot tests, as well as at least 100kg of sediment should be sent to the main equipment suppliers (magnetic separation, coarse and fine grinding, filtration) in order to:
- Improve the final design (number, size and power requirement) of their equipment, especially for the grinding steps and the filtration units,
- Confirm if an open circuit is enough for the coarse grinding or if a closed circuit has to be installed,

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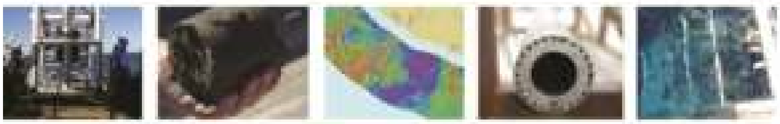

Collect acute engineering data such as:

- Specific gravity, bulk densities per type of material (sediment, pre-concentrate, tailings, concentrate before and after filtration),
- Slopes of material in holds, on conveyors,
- Work indexes (grinding and wear index),
- Grinding media consumptions,
- Filtration index (in ton/h/m²).

During the pilot plant erection, it will be advisable to repeat the ore characterisation (mainly the size of the mineral grains inside the particles) and to confirm the former best laboratory tests with the same settings.

FMP (Flow Moisture Point) in order to avoid the liquefaction of iron concentrate during the transportation from New Zealand to China.

Fresh Water Supply: A detailed technical and economic analysis of the potential fresh water sources and buffering method shall be performed t determine the most appropriate option.

Vessels Sizing: an independent study focusing on a preliminary feasibility and associated cost of retrofitting a large VLOC to be used as a process plant in stringent met-ocean conditions shall be performed.

Standard Penetration Test (SPT) measurements in mining areas can be scheduled by TTR at a later time, as they will only be required if a deep drill hole reveals the existence of a thick, high grade resource. This may change the economics of a point suction dredge pending SPT results.

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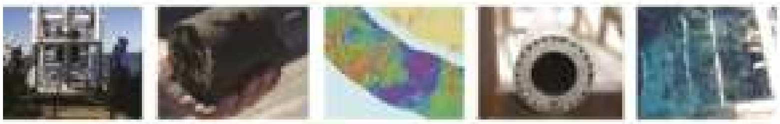

19. APPENDICES

19.1 PFS (TECHNIP REVISION) Executive Summary

Technip Mines	TTR – NEW ZEALAND	TTR
	PROJECT TANGAROA	

EXECUTIVE SUMMARY

PREFEASIBILITY STUDY ON TTR OFFSHORE IRON SANDS PROJECT TANGAROA

	6 February 2012	PFS	PhE/AM/HCC/ThR	PhG	ThR
	Date	**Designation**	**Writers**	**Checked by**	**PM**

0061	TTR Project – NEW ZEALAND	0061 005
N° study	**Project**	**Report reference**

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