FINAL DRAFT
For review and approval by GoV

Supplementary
Environmental Impact Assessment

VOLUME 1: MAIN REPORT

(Appendices in separate Volume 2)

Star Terminal *Development*

Port Vila, Vanuatu

April 2010

Government of Vanuatu

SOROS

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JOB SHEET

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DISCLAIMER

The views and opinions expressed in both Volume 1: Main Report and Volume 2: Appendices of this Supplementary EIA are those of the consultants alone, based on the best of their knowledge and expertise, and do not reflect the views and opinions of any other individuals, institutions or companies, unless where specific references are provided in the text.

All information and data relating to the engineering design of the project as provided by *Soros Associates (Australia) Pty Ltd*, and by other sub-consultants contracted by Soros as part of the Bankable Feasibility Study, are accepted and used in this report at face-value and in good faith, without question, including but not limited to the economic justification for the proposed development, the layout of the proposed development, the areas and volumes to be dredged and reclaimed, and demolition wastes to be generated.

Should the proposed works change in terms of location, layout, scope and/or scale from what has been assessed in this Supplementary EIA, including any changes to the proposed dredging and dredge spoil disposal activities as outlined in this report, then such changes should be subject to additional EIA prior to approval.

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EXECUTIVE SUMMARY (ES)

ES 1: The Supplementary EIA

Section 11 of the Vanuatu *Environmental Management and Conservation Act* stipulates that:

> *"All projects, proposals or development activities that:*
>
> *(a) impact or are likely to impact on the environment of Vanuatu; and*
>
> *(b) (b) require any license, permit or approval under any law;*
>
> *must comply with the provisions of this Act";*

including by undertaking an Environmental Impact Assessment (EIA) in accordance with Sections 12 to 23 of the Act.

The trustees and operators of Star Wharf and its associated facilities, Ifira Trustees Limited (ITL) - previously proposed the rehabilitation and further development of Star Wharf in 2005. As such development clearly fits with clauses (a) and (b) above, an EIA was required.

In support of their application for the necessary development permits, ITL engaged environmental consultant the late Mr David Esrom, to undertake an EIA in accordance with Terms of Reference (ToR) issued by the Vanuatu Environment Unit. The EIA was published in August 2006 and resulted in a *Foreshore Development Permit* being issued to ITL by the Minister for the Interior on 27 September 2006. This permit expired on 27 September 2009 without being used. Applications were not made for the necessary approvals under the *Ports Act*, *Physical Planning Act* and *Water Resources Management Act*.

The Bankable Feasibility Study (BFS) being undertaken by Soros Associates for the current Star Terminal development proposal includes a Supplementary EIA, for the following reasons:

- the current proposal differs in several significant aspects from the earlier proposal,
- a review of the previous EIA found that it did not properly address marine impacts and maritime issues; and
- generally did not meet the EIA standards of AusAID and other international donors.

The purpose of the Supplementary EIA is to:

- address the design differences between the earlier and current wharf development proposals,
- address marine impacts and maritime issues that were not fully covered in the previous EIA,
- propose an Environmental Management and Monitoring Plan (EMMP) that would help ensure that the proposed development would not have adverse impacts on the environment, both during construction and ongoing operation,

- produce an EIA that meets the standards of AusAID and other international donors, in order to support applications for funding construction of the project; and

- support the application for the necessary regulatory approvals, including under the *Foreshore Development Act, Ports Act*, *Physical Planning Act* and *Water Resources Management Act*

ES 2: Summary of findings

The Supplementary EIA was undertaken from December 2009 through March 2010, including various field surveys and studies, and following international EIA standards. The Supplementary EIA finds that the environment at and around Star Wharf and in Port Vila generally is important and valuable, including special cultural significance for the Ifira people, significant coral communities immediately adjacent to the site, and important socio-economic values such as subsistence fishing by local communities and marine-based tourism.

The Supplementary EIA finds that the proposed project has the potential to significantly impact on these resources and values, and that care needs to be taken in the design, construction and operation of the proposed terminal, so as to avoid/minimize such impacts.

In accordance with international EIA standards, the Supplementary EIA assesses the likely impacts of the proposed development according to the following categories:

- Construction Phase: Land-based Activities

- Construction Phase: Marine Activities

- Operational Phase: Land-based Activities

- Operational Phase: Marine Activities

The table at the end of this Executive Summary summarizes the main findings of the Supplementary EIA in relation to each of these impact categories. Some of the main impacts include, but are not limited to:

- clearing of all site vegetation,

- dredging of approximately 60,000 m^3 of material from the seabed,

- destruction of up to 1.6 ha of marine habitat, including healthy coral areas, for land reclamation,

- the potential for introductions of foreign marine species, including potential marine pests,

- the potential for spills of oil and other pollutants from vessels using the terminal,

- the generation of ship-sourced wastes,

- the potential contamination of Port Vila Harbour, including seafood species, by chemical pesticides used for container quarantine treatment,

- the discharge of site wash-down effluent and stormwater, including potential contaminants, into the Harbour; and

- a significant increase in electricity usage with increased fuel consumption and pollution production, including greenhouse gases, by the local power generation utility.

To address the potential for such impacts, the Supplementary EIA includes a proposed Environmental Management and Monitoring Plan (EMMP) for both the construction and operational phases.

As an off-set for the approximately 1.6 ha of marine habitat that will be destroyed by the land reclamation, it is suggested that consideration be given to implementing a community-based marine resource management regime over Vatumaru Bay, including traditional tabu mechanisms.

The Supplementary EIA also finds that the proposed development will improve environmental protection compared to the existing facility in a number of important ways, including but are not limited to:

- improved management of solid and liquid wastes,

- improved storage and handling of hazardous materials and dangerous goods,

- significantly improved traffic safety on Wharf Road,

- reduced dust and fumes,

- the revetment of reclaim faces to prevent erosion and turbidity plumes,

- improved water-use efficiency,

- improved drainage and stormwater management; and

- major improvements to site safety and security, reducing the chances of accidents resulting in pollution and environmental damage.

Overall the Supplementary EIA concludes that so long as the recommended EMMP is properly implemented, the proposed Star Terminal development should not pose an unacceptable risk of causing adverse impacts on the physical, biological, socio-economic and cultural environment, natural resources and values of Port Vila Harbour. The project is also assessed to comply with AusAID EIA checklist criteria for coasts and small islands.

The Supplementary EIA concludes there is no environmental reason that the project should not be approved for construction, on the condition that the recommended EMMP is fully and properly implemented.

Should the proposed works change in terms of location, layout, scope and/or scale from what has been assessed in this Supplementary EIA, including any changes to the proposed dredging and dredge spoil disposal activities as outlined in this report, then such changes should be subject to additional EIA prior to approval.

ES 3: Regulatory approvals required

ES 3.1: National Laws

All land, including reclaimed land, as well as waters, seabed and subsoil there-under, at and adjacent to Star Wharf are the sovereign territory of the Republic of Vanuatu, and both construction and operation of the proposed development are subject to all relevant national laws of Vanuatu.

As part of the Supplementary EIA, a Regulatory Review was undertaken to assess the implications of Vanuatu's environmental and maritime laws for the proposed Star Terminal development, from an EIA perspective, and to identify the regulatory approvals that are required. No less than 29 different laws were identified as being relevant. The full Regulatory Review is contained in Appendix 4.

In summary, under National laws the Star Terminal development will require the following EIA-related regulatory approvals:

- a *Foreshore Development Permit* under the *Foreshore Development Act* for all works below the mean high water mark, including on and/or over the seabed,
- a *Licence* under the *Ports Act* for any tidal lands and waters of the port that are to be used or occupied for the erection and use of any landing-place or wharf or for any other purpose relating to the convenience of shipping,
- *Building Permits* under the *Physical Planning Act* for the erection of all buildings and structures,
- *Permission* under the *Water Resources Management Act* for the construction, operation and/or maintenance of any physical works related to the protection, management and use of water, including any stormwater and/or wastewater works; and
- a *Quarry Permit* under the *Mines and Minerals Act* for dredging works.

In addition to these regulatory approvals, as a matter of course the construction and operation of Star Terminal will need to comply with a range of other environmental and natural resource management laws, such as but not limited to:

- the *Control of Nocturnal Noise Act* which prohibits excessive noise in Port Vila between 9pm and 5am.
- the *Wild Bird (Protection) Act* which prohibits the destruction of certain bird species (which may occur through clearing of site vegetation) without a permit; and
- the *Montreal Protocol on Substances that Deplete the Ozone Layer (Ratification) Act* which regulates the use of ozone depleting substances in facilities such as refrigeration and fire-fighting systems.

Details of the implications of these and other relevant Acts are contained in the Regulatory Review. Additionally, ships that use the Star Terminal will need to comply with a range of national maritime legislation as outlined in the Regulatory Review (Appendix 4).

ES 3.2: Local laws

The project site is located within the declared municipal boundaries of the City of Port Vila, and the project is therefore also subject to the by-laws of the Port Vila Municipal Council, including the Municipal Town Plan declared in 1979, which identifies the project site as being within Area D – *Industrial*. This zoning category allows for *inter alia:*

- warehouses,
- outside storage and handling of merchandise; and
- light and heavy industry.

A new town plan is currently under preparation (March 2010) and the Physical Planner at the Municipal Council advises that the project site will most likely remain zoned as *Industrial*.

The Municipal Council also administers the *Physical Planning Act* within town limits and the Building Permits referred to under section E 5.3.1 will need to be applied for through the Municipal Council.

ES 3.3: International laws

Vanuatu is party to a number of international environmental conventions, treaties and laws which have general relevance to the project. Some examples are:

- Convention for the Protection of Natural Resources and Environment of the South Pacific Region (Noumea Convention).
- Convention on Biological Diversity (CBD).
- Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol).
- United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol.

Vanuatu is also a member of the International Maritime Organization (IMO), which administers the international regulatory regime for shipping, and is a party to a number of IMO conventions, including:

- Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREG 72).
- International Convention for the Safety of Life at Sea, 1971 (SOLAS).
- International Convention on Load Lines, 1966 (Load Lines 66).
- International Convention on Civil Liability for Oil Pollution Damage, 1969 (CLC 69).
- International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL 73).
- Convention on Facilitation of International Maritime Traffic, 1965 (FAL 1965).
- International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971 (FUND 71).

Details of the implications of these and other relevant international conventions are contained in the Regulatory Review. Importantly, Vanuatu retains national legislation – the *Maritime (Conventions) Act 1982* – which implements a number of maritime conventions that are no longer in-force internationally, and/or which have been superseded or substantially updated in recent years. This includes those listed above, including CLC 69 and FUND 71 which relate to financial compensation for marine pollution damage from shipping incidents, leaving Vanuatu unprotected in this regard.

There are also a number of new, and extremely important international maritime conventions that have been adopted by IMO in recent years, that Vanuatu has not yet ratified/acceded to, such as the *ISPS Code*, the *International Convention on the Control and Management of Ships' Ballast Water and Sediments* and the international legal instruments relating to limits of liability for maritime claims.

It would therefore be highly beneficial for Vanuatu to review and update its ratification of international maritime conventions and update its national maritime legislation accordingly. This will in turn ensure that international shipping servicing the Star Terminal will be required to comply with IMO standards, which should be the norm for any international container terminal.

It should be noted that Vanuatu currently has a draft *Biosecurity Bill* ready for passing by Parliament which includes provisions to totally ban the discharge of bilge water and ballast water from ships in Vanuatu waters. This provision is totally unworkable and if implemented would effectively close-down shipping in Vanuatu. This needs to be removed from the *Biosecurity Bill*. Bilge water discharges should be regulated under specific legislation that is consistent with the MARPOL Convention and ballast water discharges should be regulated under specific legislation that is consistent with the IMO BWM Convention.

Summary of the main predicted environmental impacts from the proposed Star Terminal development

Impact category	Main Issues	Main proposed management measures
Construction Phase: Land-based Activities		
• Clearing of all site vegetation:	• Loss of over 60 trees overall • Loss of over 50 trees that produce fruit etc for workers (banana, mango, avocado, noni etc) • The need for visual screening along Wharf Road to minimize scenic impacts on cruise ship visitors.	• Allow workers to harvest products before clearing. • New landscaping to include productive species. • Retain significant Fig trees on fence line. • Retain Fan Palms along Wharf Road.
• Demolition of existing buildings:	• Generation of over 2000m^3 of demolition waste • Potential for hazardous materials in the demolition waste (e.g. refrigerant coolants, asbestos, sewage).	• Scrap metal to be recycled. • Concrete waste to go to reclaim/other waste to landfill. • Hazardous waste assessment prior to demolition.
• Sourcing of reclamation material:	• To be sourced from the proposed dredging.	• If additional material is required the sources should have relevant EIA/approvals (e.g. quarry permits).
• Traffic:	• Transport to and from the site will increase during construction.	• All vehicles used should comply with traffic laws. • Liaise with Police/Council re. any large items.
• Noise, dust & fumes:	• May increase during construction.	• Restrict work to between 5am and 9pm. • Dust suppression water truck on site.
• Impacts on terrestrial cultural values:	• No major impacts	• Retain Fig trees (Warasa and Lapetasi). • Traditional blessing prior to works commencing. • Cultural induction for construction workers.

Summary of the main predicted environmental impacts from the proposed Star Terminal development

Impact category	Main Issues	Main proposed management measures
Construction Phase: Marine Activities		
• Demolition of existing wharf and piles:	• Approx. 300m^3 of concrete and steel waste. • Destruction of marine life on/under existing wharf and piles. • Potential spread of introduced species.	• May be used in the reclaim taken to land-fill. • Off-set through possible tabu at Vatumaru Bay. • Dispose of all wharf and pile demolition waste on land, do not dispose in Harbour.
• Land reclamation:	• Destruction of up to 1.6 ha of marine habitat, including healthy coral areas. • Turbidity and sedimentation in adjacent areas.	• Off-set through possible tabu at Vatumaru Bay. • Biota-clearance dive prior to construction. • Marine silt curtains around reclaim works.
• Dredging:	• Removal of approximately 60,000 m^3 of material from the seabed. • Turbidity and sedimentation in adjacent areas.	• Off-set through possible tabu at Vatumaru Bay. • Biota-clearance dive prior to construction. • Marine silt curtains around dredging works. • Reactive environmental monitoring program.
• Introduction of new marine pests.	• Dredge, barge(s) and work boats may introduce foreign marine species via bio-fouling and ballast.	• Contracted vessels required to me free of fouling prior to leaving source ports • Fouling inspection prior to clearance into Port Vila.
• Marine spills:	• Potential for spills of oil and other pollutants from work vessels and land-based plant and machinery.	• Site-specific marine spill prevention and response plan, inc. training and exercise prior to construction commencing.
• Other users and uses:	• Use of area by marine tourism etc.	• Marine safety and security exclusion zone.

Summary of the main predicted environmental impacts from the proposed Star Terminal development

Impact category	Main Issues	Main proposed management measures
Operational Phase: Land-based Activities:		
• Traffic:	• Traffic safety on Wharf Road will significantly improve as container-moving machines and forklifts will not leave site. • Road traffic from terminal to other areas of Port Vila and Efate, including trucks carrying containers, may increase.	• All vehicles used will comply with Vu traffic laws. • Separate aid projects to develop roads will cater for any traffic increases.
• Noise, dust and fumes	• Will improve significantly compared to existing.	• N/a
• Container wash-down and effluent discharge:	• The potential contamination of Port Vila Harbour, including seafood species, by chemical pesticides used for container quarantine treatment. • Is a public health as well as an environmental issue.	• FBA quarantine consultancy to advise. • Stormwater Quality Improvement Device (SQID) at discharge. • Long term marine pollution monitoring program.
• Stormwater drainage and discharge:	• The discharge of site stormwater, including potential contaminants, into the Harbour.	• Gross Pollutant Traps at discharges. • Long term marine pollution monitoring program.
• Hazardous materials:	• Terminal may handle tanktainers of avgas and diesel and containers of paints, solvents, aerosols and other hazardous materials / dangerous goods. • Terminal will have fuel storage and facility for fueling on-site vehicles and machinery. • Terminal will have refrigeration and fire-fighting systems that may contain hazardous materials.	• Storage and handling to comply with IMDG code. • New fuel storage facility to comply with all relevant standards. • Ensure new refrigeration and fire-fighting systems free of ozone-depleting substances.

Summary of the main predicted environmental impacts from the proposed Star Terminal development

Impact category	Main Issues	Main proposed management measures
Operational Phase: Marine Activities:		
• Impacts on hydrodynamics and coastal processes:	Not predicted to be significant, however: • assessment is limited by lack of physical oceanographic data and model; and • accumulative impacts with adjacent developments may become significant.	• Collect sufficient physical data to develop 4D hydrodynamic model for Port Vila Harbour. • Assess all proposed developments in more strategic, integrated way.
• Marine spills:	• Potential for a significant oil spill from a ship using the new terminal. • Impacts within enclosed Port Vila Harbour could be extremely damaging and costly. • Vu not covered by current international pollution damage compensation regime and no proper spill prevention and response arrangements in place.	• Update Vu maritime and marine pollution laws to IMO standards. • Ensure ships using new terminal comply with IMO standards. • Build Vu Port State Control capacity. • Improve Harbour NavAids. • Continue compulsory port pilotage. • Develop proper spill prevention and response arrangements – inc. training & exercises.
• Marine pests:	• Ships using the new terminal may introduce foreign marine species, including potential pests, via ballast water and bio-fouling.	• Vu to ratify IMO ballast water Convention and develop implementing domestic legislation. • Ensure ships using new terminal comply with IMO ballast water Convention. • Undertake full-scale Marine Pest Survey of Port Vila Harbour.

Summary of the main predicted environmental impacts from the proposed Star Terminal development

Impact category	Main Issues	Main proposed management measures
• Ships' antifouling:	• Ships using new terminal may have TBT-based anti-fouling paints.	• Vu to ratify IMO AFS Convention and develop implementing domestic legislation. • Ensure ships using new terminal comply with IMO AFS Convention.
• Ships' waste management:	• Ships using new terminal may need reception facilities for garbage (inc. quarantine waste) and waste oil.	• Ensure high-temp quarantine incinerator is commissioned and kept operating. • Discuss waste oil management options with local oil terminals.
• Ships' sewage:	• Ships using new terminal will generate sewage on-board.	• Vu to ratify MARPOL Annex IV and develop implementing domestic legislation. • Ensure ships using new terminal comply with MARPOL Annex IV.
• Other marine users and uses:	• Use of area by marine tourism etc.	• Marine safety and security exclusion zone.

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This Supplementary EIA was led by Steve Raaymakers of EcoStrategic Consultants on contract to Soros Associates (Australia) Pty Ltd, as part of a contract between Soros and the Government of Vanuatu (GoV) (Ministry of Finance and Economic Management), to undertake the Star Terminal *Bankable Feasibility Study* (BFS). Funding for the BFS was provided to GoV by the Australian Agency for International Development (AusAID).

The following EcoStrategic team members / sub-consultants were involved in developing the Supplementary EIA and their efforts are greatly appreciated:

- Andrew Colville (Cairns) – Geographic Information System (GIS).
- Francis Hickey (Port Vila) – Cultural heritage, WWII history, vegetation survey, local support, peer review.
- Robert Jimmy and Sompert Gereva (Port Vila) – Marine biodiversity survey.
- Morris Stephen, Eri Sami and Thomas Steele (Port Vila) – Current velocity profiling.
- Dr Graeme Inglis (NIWA, New Zealand) – Marine pests.

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The completion of the Supplementary EIA and the production of this report would not have been possible without the efforts and inputs of all those mentioned above, plus many others, and this support is greatly appreciated.

LIST OF ACRONYMS

ADB	Asian Development Bank
AusAID	Australian Agency for International Development
BA	British Admiralty
BFS	Bankable Feasibility Study
CBD	Convention on Biological Diversity
CBD (2)	Central Business District
CLC 69	International Convention on Civil Liability for Oil Pollution Damage, 1969
COLREG	Convention on the International Regulations for Preventing Collisions at Sea
DGMWR	Department of Geology, Mines & Water Resources (of GoV)
DMP	Department of Marine & Ports (of GoV)
EIA	Environmental Impact Assessment
EMMP	Environmental Management & Monitoring Plan
FAL 65	Convention on Facilitation of International Maritime Trade, 1965
FUND 71	International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971
GIS	Geographic Information System
GoV	Government of Vanuatu
GPS	Global Positioning System
GPT	Gross Pollutant Trap
HFO	Heavy Fuel Oil
IMDG	International Maritime Dangerous Goods Code
IMO	International Maritime Organization
IPCC	International Panel on Climate Change (of the United Nations)
ISPS	International Ship & Port Security Code
ITL	Ifira Trustees Limited
JICA	Japan International Cooperation Agency
LOA	Length Overall (of a ship)
MARPOL	International Convention on the Prevention of Pollution from Ships
Montreal Protocol	Montreal Protocol on Substances that Deplete the Ozone Layer
MoU	Memorandum of Understanding
NIWA	National Institute of Water and Atmospheric Science (New Zealand)
NOHSC	National Occupational Health & Safety Council (Australia)

Noumea Convention	Convention for the Protection of Natural Resources and Environment of the South Pacific Region
NTF	National Tidal Facility (Flinders University, Adelaide)
NZAID	New Zealand Agency for International Development
PACPOL	Pacific Ocean Pollution Prevention Programme (of SPREP)
PSC	Port State Control
SEAFRAME	Sea Level Fine Resolution Acoustic Measuring Equipment
SOLAS	International Convention for the Safety of Life at Sea
SOPAC	South Pacific Applied Geoscience Commission
SPREP	South Pacific Regional Environment Programme
SQID	Stormwater Quality Improvement Device
TBT	Tri-butyil Tin
TEU	Twenty Foot Equivalent (shipping container)
ToR	Terms of Reference
UNFCCC	United Nations Framework Convention on Climate Change
WWII	World War II

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Appendix 7: Initial Marine Pest Assessment

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Appendix 9: Current Velocity Report

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PROJECT SITE

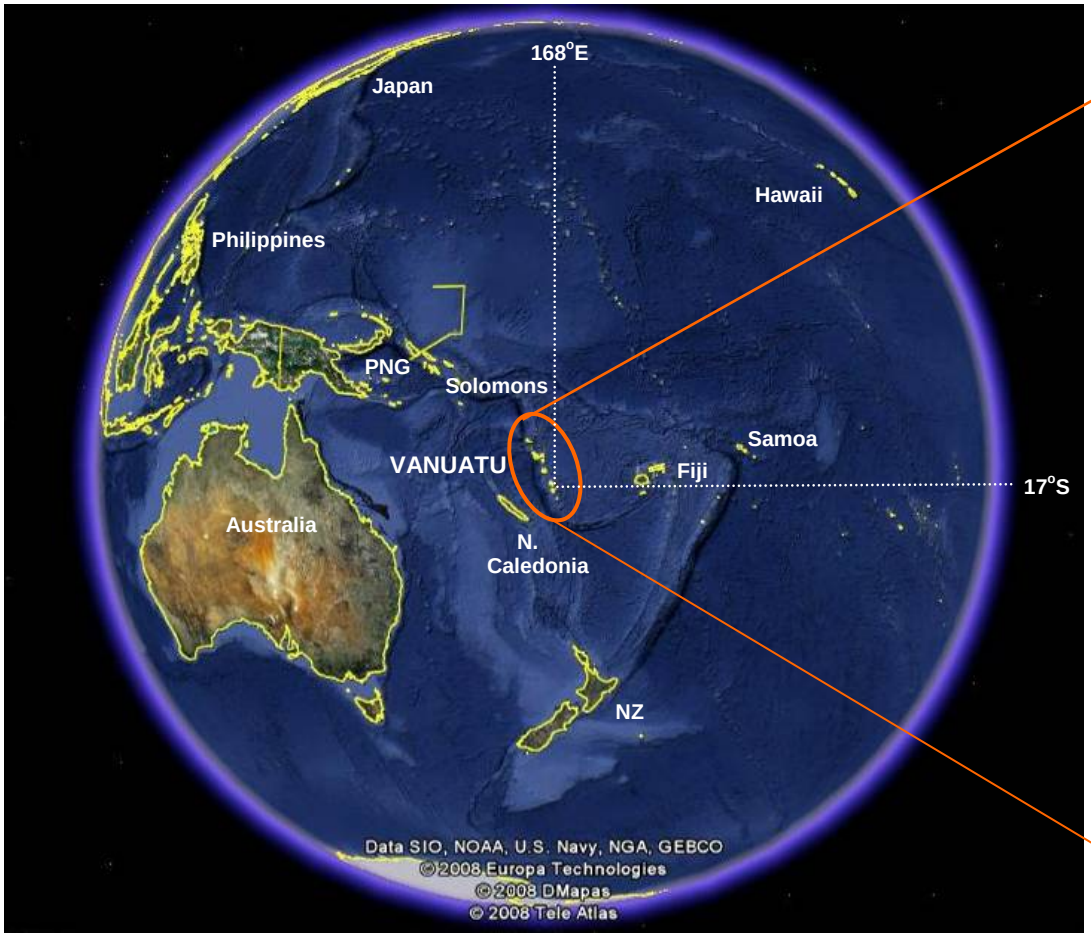

Figure 1: *The location of Vanuatu in the South West Pacific (Source: Google Earth).*

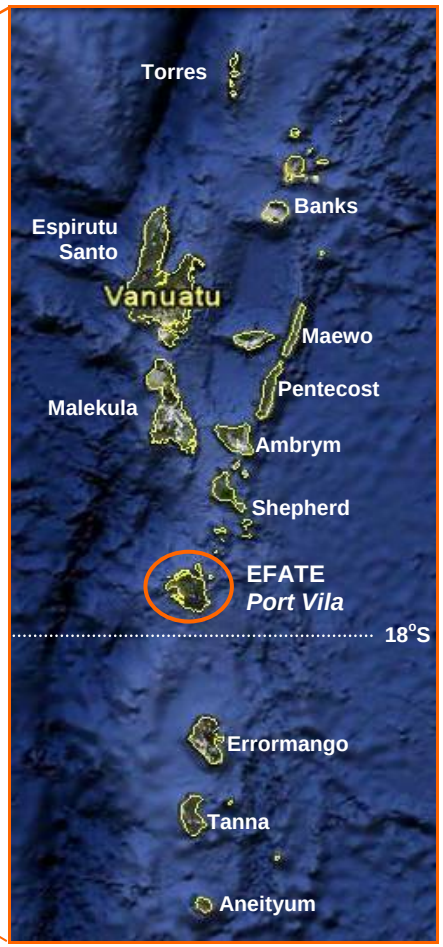

Figure 2: *The main islands of Vanuatu (Source: Google Earth).*

Fig 3A: The island of Efate and the capitol Port Vila
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Fig 3B: Port Vila Harbour – Star Wharf at bottom
(Source: www.cruising-vanuatu.com)

Fig 3C: Site of proposed Star Terminal
(Source: F Salisbury)

Figure 3: *Geo-projection Efate / Port Vila / Star Wharf, the site of the proposed Star Terminal.*

Figure 4: *Port Vila Harbour showing Star Wharf*

1. DESCRIPTION OF THE PROJECT

(Note: The term Star *Wharf* refers to the existing facility and Star *Terminal* refers to the proposed development).

1.1 Existing Star Wharf

The existing Star Wharf is located at the southern end of Port Vila Harbour, between Pontoon Bay and Paray Bay (Figures 1 to 4). The GPS coordinates for the main gate are 17°45.375' South and 168°18.297'East.

The site comprises approximately five hectares of reclaimed land jutting out from the natural coastline, and a 50 metre long by 15 metre wide concrete wharf built by Mrss Ardimani and Bourgeois in the early 1970s. The wharf has been used for a wide variety of trades and cargoes since its construction.

The facility is currently held by Ifira Trustees Ltd (IRL) under a 50 year concession granted by the Government of Vanuatu (GoV) in 2007, and operated by Ifira Ports and Services Development Ltd, in which the GoV retains a 25% shareholding. A copy of the decision of the Council of Ministers granting the concession is contained in Appendix 1. Following this decision, in 2009 the GoV signed a Memorandum of Understanding (MoU) with Ifira Trustees establishing the terms and conditions of the concession to operate all international stevedoring and wharfage activity in Port Vila, including GoV ratified charges, hours of operation, productivity targets and staffing levels.

The site (Figure 5) is currently used for the shipment, storage and washing of containers, including empty containers that cannot be washed at smaller Pacific ports such as Tarawa, and also for a variety of domestic ships and landing barges (Figure 6). There are two crushed-coral ramps for the landing barges, located to the east of the wharf.

The facility is operating way beyond capacity, and containers are stored right up to the shoreline and outside the site along Wharf Road (Figure 7). There is a major lack of control over cargo flows, safety and security, and without active maintenance the wharf is exhibiting significant deterioration and structural failure (Figure 8). The existing facilities at Star Wharf are shown on Figure 9. Some historical details about the site, including ni-Vanuatu cultural heritage, are presented in section 4.14.

Figure 5: *The site of the existing Star Wharf (Source: F Salisbury)*

Figure 6: *Domestic ships using the existing Star Wharf - Feb 2010. The container ship in the background of the image on the left is docked at the Main Wharf (Source: Raaymakers)*

Figure 7: *The existing facility is operating way beyond capacity. Containers are stored right up to shoreline and along Wharf Road, presenting safety, security and environmental risks - Feb 2010 (Source: Raaymakers)*

Figure 8: *Serious physical deterioration of the existing Star Wharf - Dec 2009 (Source: Raaymakers)*

Figure 9: *Star Wharf - Existing Facilities (March 2010)*

1.2 The proposed Star Terminal

As an island nation Vanuatu is totally dependent on shipping to sustain its economy. As Vanuatu has developed economically since independence in 1980, the importation and domestic trans-shipment of goods has continued to increase, and exports have fluctuated. Overall there has been a steady increase in shipping and increasing requirements for adequate port facilities, both in Port Vila and elsewhere in the country, which have not been maintained and developed to meet demand.

To meet the demand for improved port facilities, the Japan International Cooperation Agency (JICA) is currently undertaking a major upgrade of the *Main Wharf* located to the west of Star Wharf, which handles general cargo, tankers and cruise ships. The Asian Development Bank (ADB) and New Zealand Agency for International Development (NZAID) are also investigating options for improving wharf facilities for domestic shipping, with one option being a new *Domestic Wharf* on Paray Bay just to the east of Star Wharf.

In addition to the *Main Wharf* and *Domestic Wharf* initiatives, there is also a requirement to upgrade Star Wharf into an international container terminal. The demand for this terminal is outlined in the Economic Report (AMSTEC 2010) prepared as part of the Bankable Feasibility Study (BFS).

The AMSTEC Economic Report identifies a requirement for a terminal capable of handling 20,000 TEU (Twenty Foot Equivalent Container Units) per year by 2031, and exceeding 30,000 TEU by 2045, in order to service the ongoing economic development of Vanuatu. The Economic Report also finds that costs of development and doing business in Vanuatu are extremely high, due to poor infrastructure, including lack of port capacity. Improving port infrastructure is fundamental to improving much needed socio-economic development in Vanuatu.

The AMSTEC Economic Report also finds that shipping trade to and from Vanuatu is overwhelmingly dominated by imports of goods and materials, including to support growth in tourism and to provide essential services such as fuel for transport and for electricity generation. The development of export income is essential to the real growth of Vanuatu's economy, including at least some reduction in trade deficits with import-source countries. Exports from Vanuatu are currently tiny compared to imports. The development of port facilities that are un-constrained by the current lack of port capacity and efficiency, is vital if export volumes are to be increased.

To help meet this demand, the proposed *Star Terminal* development, as shown in Figures 10 and 11, comprises the following:

- Demolition and removal of the existing Star Wharf and piles.
- Construction of a new wharf (200m long x 20m wide) and associated moorings.
- Dredging of approximately 60,000m^3 of material over an area of seabed of about 0.33 of a hectare, to a depth of -12.3m just to seaward of the proposed new wharf.
- Reclamation of a minimum of one hectare and possibly up to 1.6 hectares of land from the sea along the eastern boundary of the site, to increase the area available for container storage and handling.

- Revetment of the seaward faces of the existing and proposed reclaim areas, using rock armour, to prevent erosion and siltation.
- Removal of most of the vegetation from the site to provide a clear hard-stand for container storage and handling, and prevent contamination of containers.
- Demolition of most existing buildings on site and construction of a new storage shed/bond store, workshop, office block and car park.
- Establishment of properly organized on-shore container handling and storage systems, including container stacking and refrigerated container facility.
- Construction of international standard container quarantine wash-down facility.
- Onshore areas for storing imported vehicles.
- Construction of on-site drainage and stormwater management system.
- New on-site lighting to international safety and security standards.
- Fencing of the site to provide security to International Ship & Port Security (ISPS) Code standards.
- New power and water services, including energy and water efficiency measures.
- Upgrading of on-site petroleum storage and refueling facilities.
- Improving on-site liquid and solid waste management arrangements.
- Establishment of a new main entrance with security gate.
- Provision of new navigational aids as may be required by the Harbour Master.

The construction phase will require a time period of 36 months. The wharf facility will have an overall design life of 50 years, and onshore facilities a design life of 20 to 25 years.

The terminal will be designed to handle container ships with dimensions of 184.9m Length Overall (LOA), 27.6m beam and 10.6m draft, with capacity for up to 1,257 TEU.

Figure 10 presents a comparison of the existing and proposed layouts, and Figure 11 shows the proposed layout in a larger size. Figure 12 shows the general engineering plan for the proposed development, Figure 13 shows the dredging and revetment plan and Figure 14 shows a cross-section through the proposed wharf

Full technical details of the engineering design are contained in the separate report by Soros Associates entitled *Star Terminal Bankable Feasibility Study, 31 March 2010.*

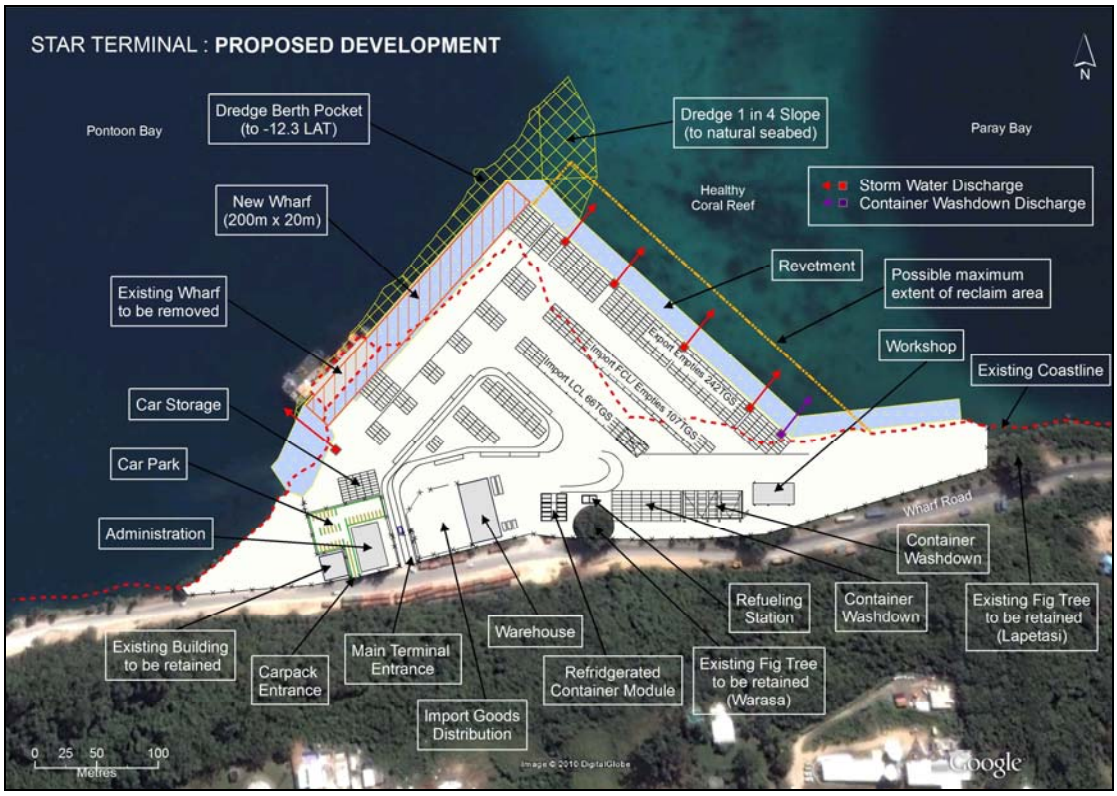

Figure 10: *General comparison of the plan view of the existing Star Wharf (top) and the proposed Star Terminal (details are clearer in Figures 9 &11 respectively)*

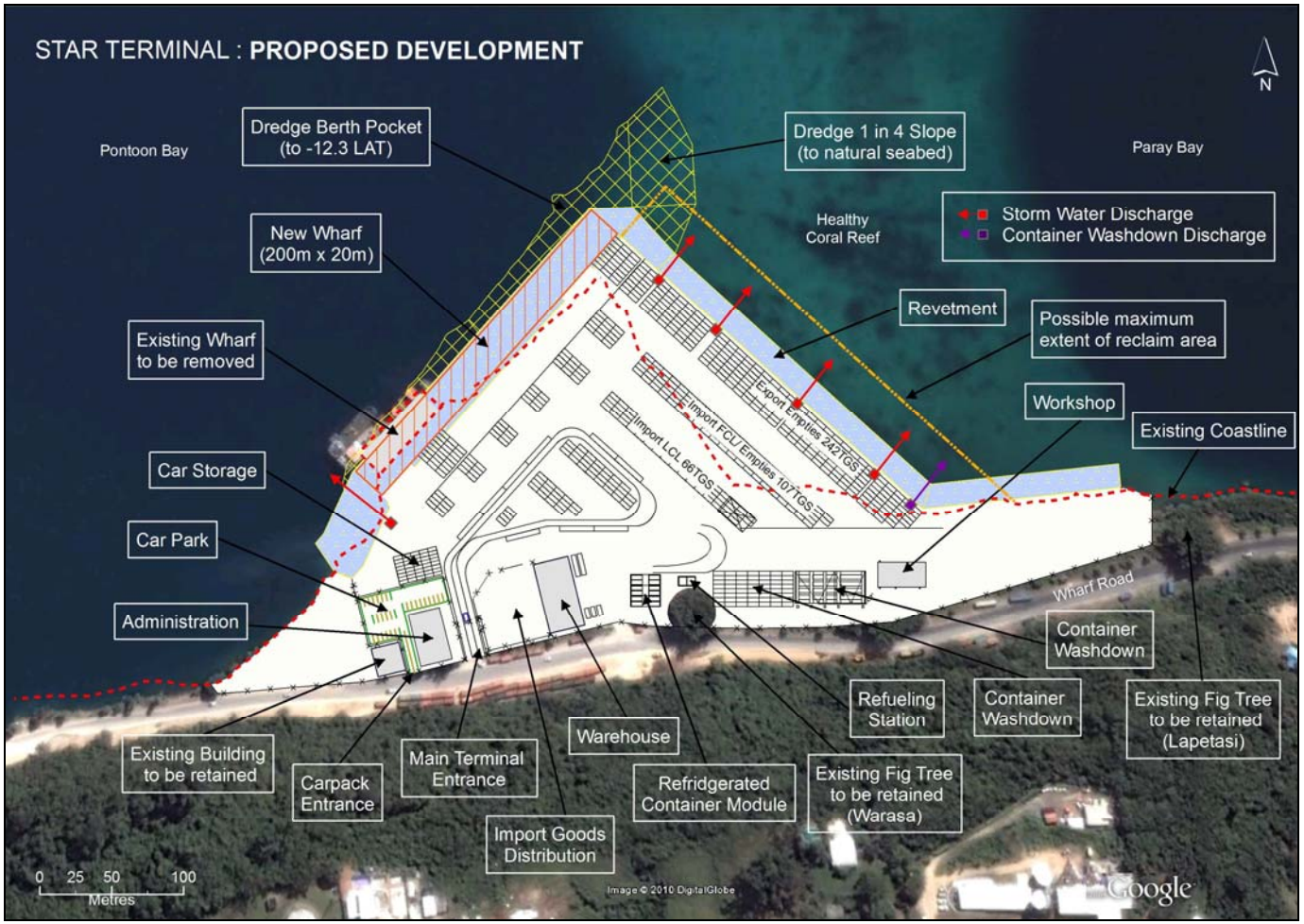

Figure 11: *Star Terminal - Proposed Development*

(NB. This plan shows the minimum extent of the reclaim area (~ 1 ha) along the eastern boundary of the site. Should additional dredge material (up to 60,000m3) be placed in this area, the reclaim may extend up to an additional 25m seaward along the eastern boundary of the site, increasing the reclaim to ~ 1.6 ha, as indicated by the dotted line. This will increase the area of marine habitat that will be destroyed)

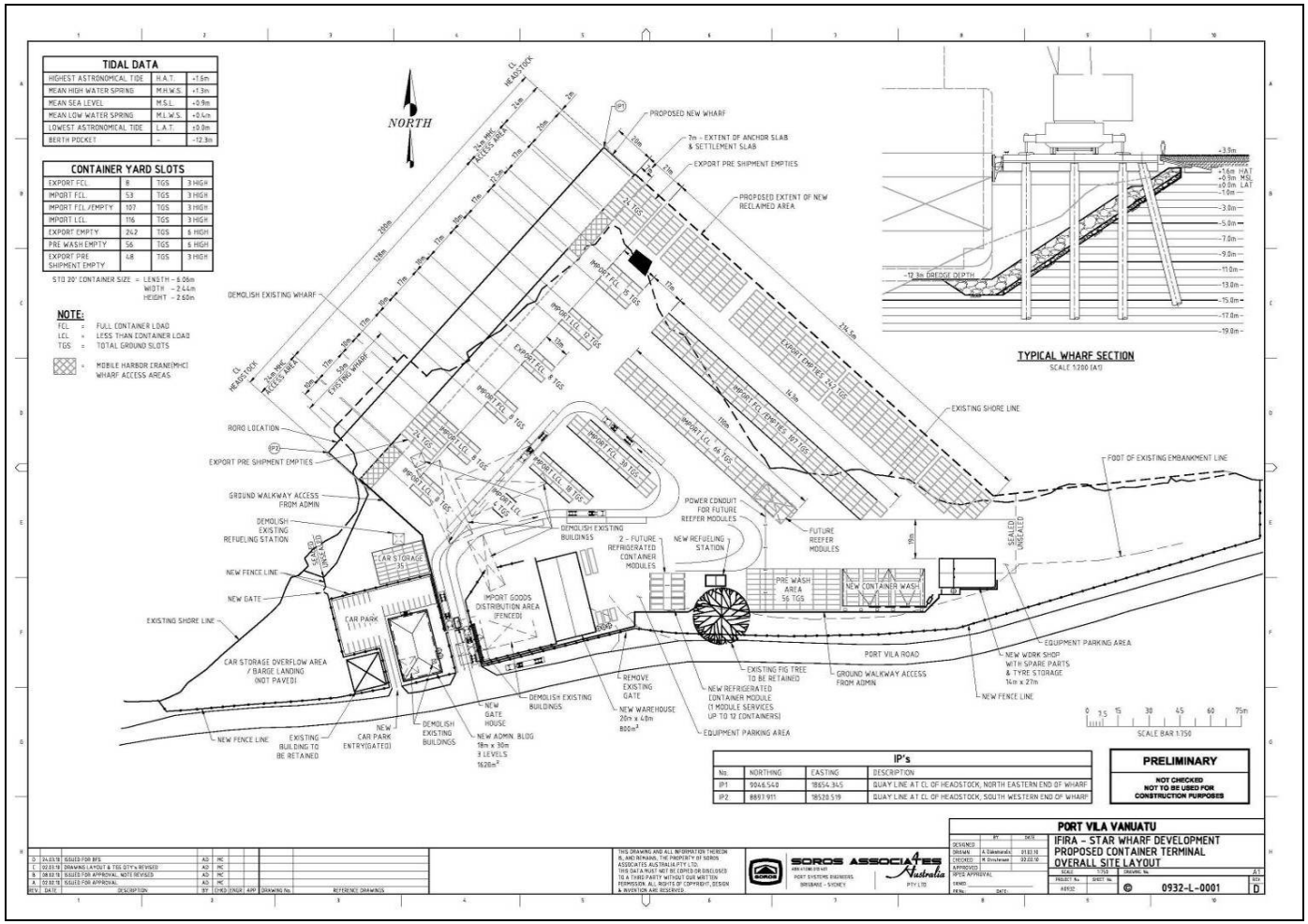

Figure 12: *General engineering plan for the proposed Star Terminal development (Source: Soros Associates)*

(NB. This plan provided by Soros shows the minimum extent of the reclaim area (~ 1 ha) along the eastern boundary of the site. Should additional dredge material (up to 60,000m3) be placed in this area, the reclaim may extend up to an additional 25m seaward along the eastern boundary of the site, increasing the reclaim to ~ 1.6 ha, according to Soros)

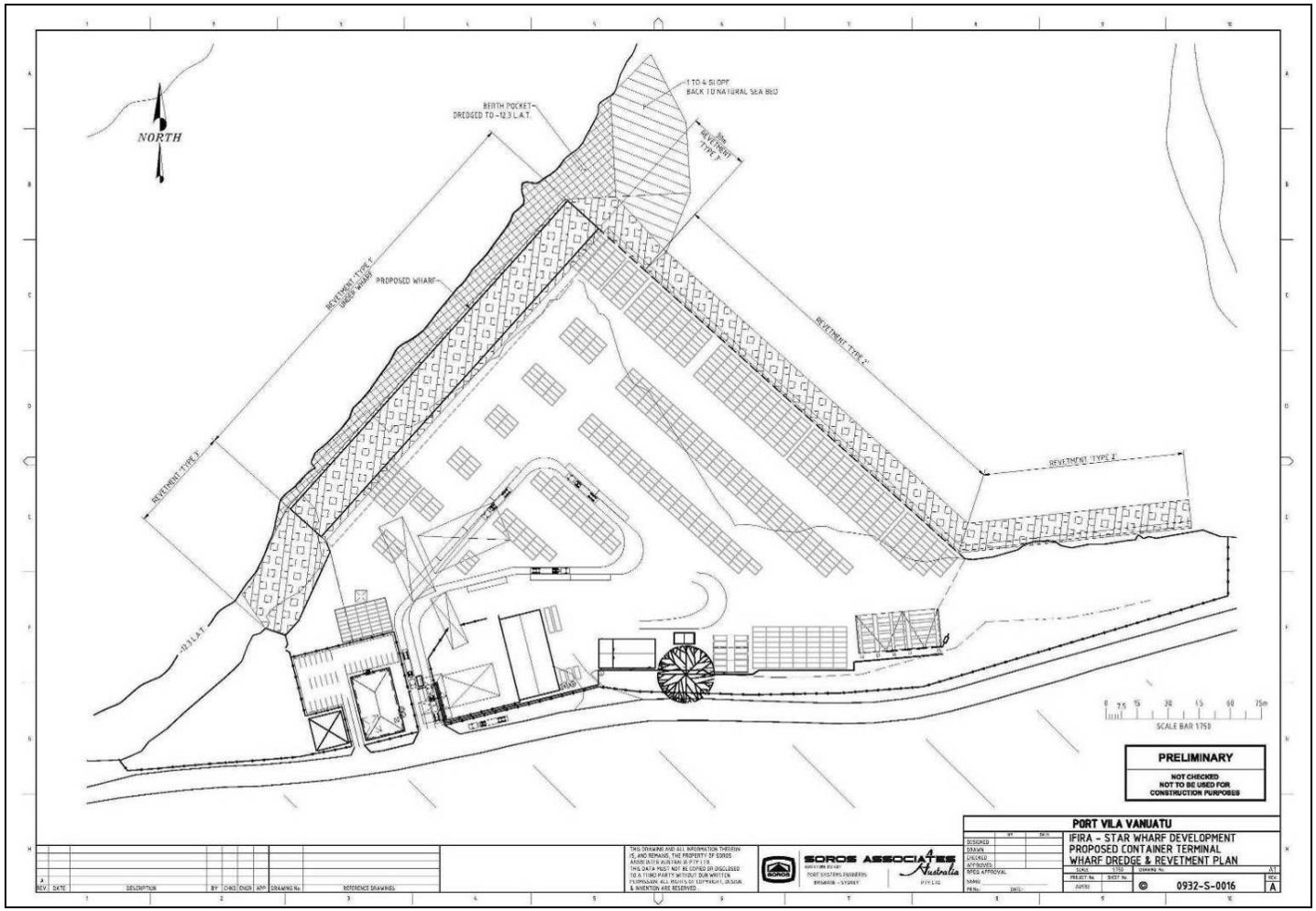

Figure 13: *Dredging and revetment plan for the proposed Star Terminal development (Source: Soros Associates)*

(NB. This plan provided by Soros shows the minimum extent of the reclaim area (~ 1 ha) along the eastern boundary of the site. Should additional dredge material (up to 60,000m3) be placed in this area, the reclaim may extend up to an additional 25m seaward along the eastern boundary of the site, increasing the reclaim to ~ 1.6 ha, according to Soros)

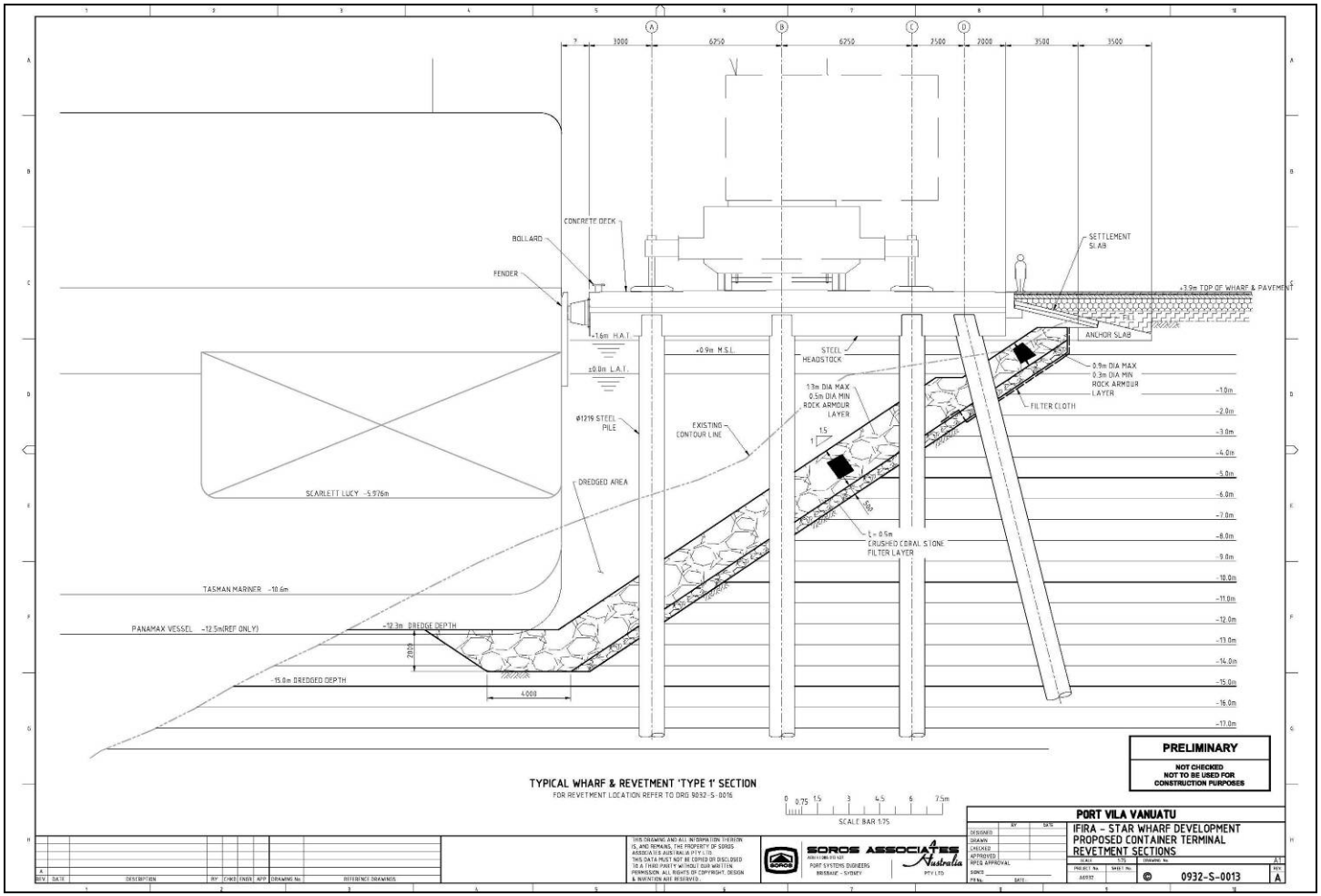

Figure 14: *Cross section through the proposed new wharf.*
(Source: Soros Associates)

1.3 Alternatives to the proposed development

In accordance with international standards for EIA's, it is necessary to undertake an assessment of alternatives to the proposed development, so as to ascertain if any such alternatives are available and viable that might present a lower risk of adverse environmental impacts.

As outlined in section 1.2, the demand for the new international container terminal in Port Vila is demonstrated in the BFS Economic Study (AMSTEC 2010). Without such a facility the economy of Vanuatu, which urgently requires development to lift much of its people out of abject poverty, will be seriously stifled.

The only other existing facility capable of handling shipping containers in Port Vila is the Main Wharf (Figure 15), which as outlined above is currently being upgraded by JICA. When fully developed, the Main Wharf will be able to handle 20% of the demand for container-based imports as assessed by AMSTEC (2010). Flat land is extremely limited at the Main Wharf and handling of container's is only a secondary use. The Main Wharf is the primary facility for visiting cruise ships and larger tankers.

Figure 15: *The Main Wharf being upgraded by JICA October 2009 – its limited container handling capacity will not provide a viable alternative to the proposed Star Terminal to meet predicted demand (Source: F Salisbury)*

Apart from the Main Wharf, there are no other sites around Port Vila Harbour suitable for the development of an international container terminal. Limitations are as follows:

- There area between Star Wharf and the Main Wharf does not have any flat land for onshore facilities, apart from the narrow strip which supports Wharf Road. Development of this area would require major excavation of the adjacent limestone cliff, with severe environmental impacts and geo-technical hazards.

- The area to the east of Star Wharf is already proposed for the development of a new Domestic Wharf, and would require major dredging to cater for international ships.

- The foreshore from the BP oil terminal to Vatumaru Bay is fully developed as the Central Business District (CBD) of Port Vila.

- Vatumaru Bay itself is an extremely sensitive fisheries nursery, with shallow tidal flats, seagrasses and mangroves. It is not suitable for any form of development and ideally should be protected by tapu and/or a marine reserve.

- The coastline and hill slopes of Malapoa Point on the North West side of the Harbour are zoned residential and are densely developed with high-value residential homes, which would be impacted heavily by an industrial port development.

- There is no other vacant shoreline around Port Vila Harbour.

Possible alternative sites outside Port Vila are indicated on Figure 16 and include:

- a potential new port facility on the north coast of Efate at Port Havannah (17°35'S / 168°14'E), which provides excellent deep water and sheltered conditions, used by US Navy fleets during WW II; and

- the Mine site at Forari Bay (17°41'S / 168°33'E), almost directly North East across Efate from Port Vila, closed in the 1970s but which previously berthed small bulk carriers to uplift cargoes of manganese ore.

- Undine Bay (17°30'S / 168°20'E) which is a declared port site in Vanuatu, although there is currently no commercial port infrastructure there.

Figure 16 shows the general location of these possible alternatives on the island of Efate outside of Port Vila.

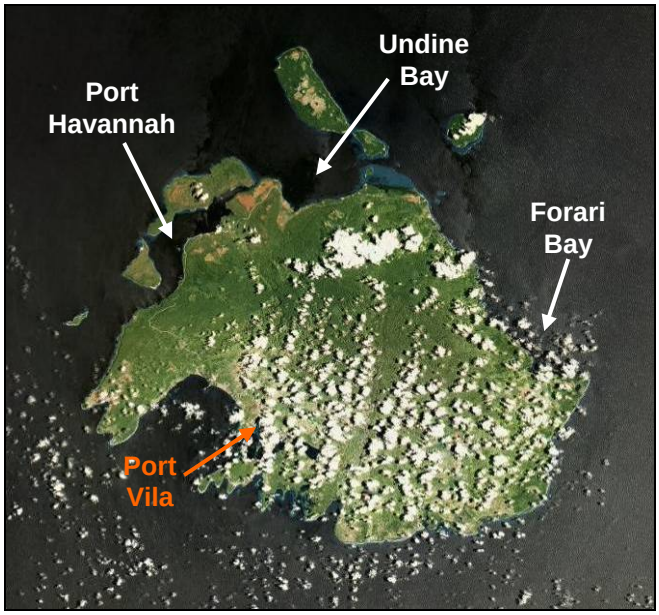

Figure 16: *Potential alternative port sites on Efate outside of Port Vila – environmental impacts at these green-field sites would be far more significant than developing the existing facility in Port Vila. The principles of integrated industrial development recommend that port development should focus on existing nodes rather than spread into new, less impacted areas.*

Development of a whole new port at one of these green-field sites would have far more significant environmental impacts than the Star Wharf site, and would require road transport of containers to consumers in Port Vila, increasing traffic impacts, energy consumption and air pollution, including greenhouse gas emissions. The 'out-of-town' sites also lack the adjacent supporting infrastructure (electricity, water, telecommunications) needed by a modern container terminal, as well as labour, which would need to be transported in and out, causing further impacts.

By contrast the existing Star Wharf site has been reclaimed since the 1970s, currently providing approximately 5 hectares of existing flat land that has been used for industrial and commercial port operations for over 40 years. The site has direct access to the deep, navigable water of Pontoon Bay and out to the Harbour Entrance. It has direct road access to Port Vila via Wharf Road, which was built for port usage, and is located well away from the CBD and residential areas (apart from a few new houses on the cliff-top above the site). The area is already zoned Industrial under the Municipal planning scheme (see section 3.2), and has all municipal utilities directly on hand. The site is also well away from the most sensitive marine environment of the Harbour, which is Vatumaru Bay.

The Star Wharf site is clearly the most suitable location for the development of a new international container terminal to help meet the economic development needs of Vanuatu, as outlined in the BFS Economic Report (AMSTAC 2010).

2. THE EIA PROCESS

2.1 Background

Section 11 of the Vanuatu *Environmental Management & Conservation Act* (CAP 12) stipulates that:

> "All projects, proposals or development activities that:
>
> (a) impact or are likely to impact on the environment of Vanuatu; and
>
> (b) require any license, permit or approval under any law;
>
> must comply with the provisions of this Act";

including by undertaking an Environmental Impact Assessment (EIA) in accordance with Sections 12 to 23 of the Act.

The trustees and operators of Star Wharf and its associated facilities – ITL, previously proposed the rehabilitation and further development of Star Wharf in 2005. As such development clearly fits with clause (a) above, and as the project requires approval under the *Foreshore Development Act*, *Ports Act*, *Physical Planning Act*, *Water Resources Management Act* and *Mines & Minerals Act* (see section 3.1 below), clause (b) above also applies.

In support of their application for the necessary development permits, ITL engaged environmental consultant the late Mr David Esrom, to undertake an EIA in accordance with Terms of Reference (ToR) issued by the Vanuatu Environment Unit. The EIA was published in August 2006 and resulted in a *Foreshore Development Permit* being issued to ITL by the Minister for the Interior on 27 September 2006 (Appendix 2). This permit expired on 27 September 2009 without being used. Applications were not made for the necessary approvals under the *Ports Act*, *Physical Planning Act* and *Water Resources Management Act*.

In 2009 the proposal to rehabilitate and develop Star Wharf into a modern container terminal was resurrected, with a grant from AusAID to GoV, to undertake the BFS referred to above. As part of the BFS, it was decided to include a Supplementary EIA for the following reasons:

- the current proposal differs in several significant aspects from the earlier proposal,
- the previously issued *Foreshore Development Permit* had expired and a number of additional regulatory approvals are required that have not been applied for,
- a review of the previous EIA found that it did not properly address marine impacts and maritime issues; and
- a review of the previous EIA found that it did not meet international donor EIA standards.

The Supplementary EIA was therefore undertaken based on supplementary ToR issued by the Vanuatu Environment Unit in March 2010 (Appendix 3).

2.2 Purpose of the Supplementary EIA

The purpose of this Supplementary EIA is to:

- Address the design differences between the earlier and current wharf development proposals.
- Address marine impacts and maritime issues that were not fully covered in the previous EIA.
- Produce an EIA that meets the standards of AusAID and other international donors, in order to support applications for funding construction of the project.
- Support the application for the necessary regulatory approvals, including under the *Foreshore Development Act, Ports Act*, *Physical Planning Act, Water Resources Management Act* and *Mines and Minerals Act* (see section 3.1 below).

2.3 Methods used

The primary method used for the Supplementary EIA was desk-top review of existing information, plus site visits and field studies to collect photographs and additional data where specifically needed. All engineering design data was provided by Soros Associates and was taken in good faith and at face-value by EcoStrategic Consultants. Existing information reviewed included but was not limited to:

- all relevant environment, planning, natural resource management and maritime laws of Vanuatu (29 different laws reviewed),
- the EIA for the earlier Star Wharf development proposal (Esrom, 2006),
- the marine section of the EIA for the Iririki Resort development (Jimmy, 2004),
- periodic water quality monitoring reports by the Department of Geology, Mines and water Resources (DGMWR) between 1999 and 2004,
- technical and environmental reports relating to other port development proposals in Port Vila,
- a range of national and regional climate-change reports and studies; and
- many others.

A reference list is provided in section 13.

An initial site visit was undertaken by lead EIA consultant Steve Raaymakers from 14 to 19 December 2009, during which:

- a general walk-around of the site was undertaken with the Soros Project Manager Mike Christensen and Strategic Ports Adviser Mick Payze,
- an *Initial Marine Reconnaissance* snorkel-dive was undertaken around the perimeter of the site,
- reconnaissance dives were undertaken at control (non-impact) sites around Port Vila,
- meetings were held with various GoV agencies,
- planning meetings were held with local consultants Francis Hickey and Robert Jimmy, and existing data and reports were collected; and
- a briefing was provided to the ITL board.

A second site visit was undertaken by Steve Raaymakers from 4 to 12 February 2010, during which:

- the *Site Vegetation Survey* was undertaken with local consultant Francis Hickey,
- the first *Marine Biodiversity Survey* transect was undertaken with local marine consultants led by Sompert Gareva, to confirm methods and approach,
- the *Initial Marine Pest Assessment*, including training staff from Department of Fisheries and Environment Unit, was started with the arrival of Dr Graeme Inglis from NIWA in New Zealand,
- limited current velocity profiling was undertaken with local consultants Morris Stephen, Eri Sami and Thomas Steele,
- visits were made to local quarry at Ekavuut which may be source of fill for the reclaim; and
- further meetings were held with various GoV agencies.

Local marine consultants led by Sompert Gareva completed all *Marine Biodiversity Survey* transects by 5 March 2010, and Graeme Inglis completed the *Initial Marine Pest Assessment* on 16 February 2010, undertaking data analysis and report production back in New Zealand.

A third site visit was undertaken by Steve Raaymakers from 11 to 13 March 2010, during which the ITL Board, GoV and AusAID were briefed on the Draft Supplementary EIA, as well as on the BFS overall, by Soros Project Manager Mike Christensen.

Full reports on the *Initial Marine Reconnaissance*, *Site Vegetation Survey*, *Current Velocity Profiling*, *Marine Biodiversity Survey* and *Initial Marine Pest Assessment*, including methods used, are contained in the Appendices.

All GIS baseline data was provided by the Vanuatu Department of Lands and GIS analysis for the EIA was undertaken by Cairns-based sub-consultant Andrew Colville.

Most desk-top review and drafting of the Supplementary EIA was undertaken at the EcoStrategic office in Cairns, Australia, with some work at the Soros office in Brisbane to assist coordination with the engineering design and other components of the BFS.

2.4 Consultation with stakeholders

As part of the Supplementary EIA process consultations were held with a number of stakeholders in Port Vila in December 2009 and February 2010, as follows:

- AusAID
- JICA
- ITL
- Environment Unit
- Department of Lands
- Department of Marine & Ports
- Department of Fisheries
- Department of Geology, Mines and Water Resources
- Port Vila Municipal Council
- Vanuatu Quarantine Service

Consistent with best-practice for EIA's it was also proposed to hold a public meeting to present the Supplementary EIA to interested parties. However, given the status of the BFS as a concept proposal only and the uncertainty of securing funds for project construction, it is recommended to postpone any public/community consultation until when there is greater certainty about the project.

2.5 Data repository

All hard-copy and electronic data including all GIS data, photographs and video collected as part of the Supplementary EIA, including all field studies, are kept at EcoStrategic Consultants in Cairns, Australia (www.eco-strategic.com) and copied to Soros Associates in Brisbane.

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Hard and electronic copies of the Supplementary EIA report are to be provided to the Vanuatu National Library, the Vanuatu Environment Unit, Lands Department, Department of Fisheries, Department of Geology, Mines & Water Resources and any other GoV agency who wishes to have it.

The Department of Fisheries in Port Vila has established a central database for all data from the *Marine Biodiversity Survey*, to be used as a baseline for future monitoring.

The Department of Fisheries has also established a voucher collection of species collected from the existing Star Wharf piles as part of the *Initial Marine Pest Assessment*. This provides a taxonomic reference resource and a baseline for a possible future full-scale marine pert survey of Port Vila.

The New Zealand National Institute of Water and Atmospheric Science (NIWA) marine lab in Christchurch hosts the raw data from the *Initial Marine Pest Assessment*.

The Vanuatu Department of Geology, Mines & Water Resources (DGMWR) has the original data from the one-day current velocity sampling.

3. REGULATORY REGIME

3.1 National laws

All land, including reclaimed land, as well as waters, seabed and subsoil there-under, at and adjacent to Star Wharf are the sovereign territory of the Republic of Vanuatu, and both construction and operation of the proposed development are subject to all relevant national laws of Vanuatu.

The land tenure of the site is a concession granted to ITL by GoV (Appendix 1) and the Land Title No. is 11/OA13/001.

As part of the Supplementary EIA, a Regulatory Review was undertaken to assess the implications of Vanuatu's environmental and maritime laws for the proposed Star Terminal development, from an EIA perspective, and to identify the regulatory approvals that are required. No less than 29 different laws were identified as being relevant.

The Review did not address other laws that relate to non-EIA aspects of the development, such as customs, immigration, commercial and business, employment, workplace safety, construction and building standards and others. The full Regulatory Review is contained in Appendix 4.

In summary, under National laws the Star Terminal development will require the following EIA-related regulatory approvals:

- a *Foreshore Development Permit* under the *Foreshore Development Act* for all works below the mean high water mark, including on and/or over the seabed,
- a *Licence* under the *Ports Act* for any tidal lands and waters of the port that are to be used or occupied for the erection and use of any landing-place or wharf or for any other purpose relating to the convenience of shipping,
- *Building Permits* under the *Physical Planning Act* for the erection of all buildings and structures,
- *Permission* under the *Water Resources Management Act* for the construction, operation and/or maintenance of any physical works related to the protection, management and use of water, including any stormwater and/or wastewater works; and
- a *Quarry Permit* under the *Mines and Minerals Act* for the dredging.

In addition to these regulatory approvals, as a matter of course the construction and operation of Star Terminal will need to comply with a range of other environmental and natural resource management laws, such as but not limited to:

- the *Control of Nocturnal Noise Act* which prohibits excessive noise in Port Vila between 9pm and 5am.
- the *Wild Bird (Protection) Act* which prohibits the destruction of certain bird species (which may occur through clearing of site vegetation) without a permit; and

- the *Montreal Protocol on Substances that Deplete the Ozone Layer (Ratification) Act* which regulates the use of ozone depleting substances in facilities such as refrigeration and fire-fighting systems.

Additionally, ships that use the Star Terminal will need to comply with a range of national maritime legislation as outlined in the Regulatory Review (Appendix 4).

Details of the implications of these and other relevant Acts are contained in the Regulatory Review, and summarized in Table 1.

3.2 Local laws

The project site is located within the declared municipal boundaries of the City of Port Vila, and the project is therefore also subject to the by-laws of the Port Vila Municipal Council, including the Municipal Town Plan declared in 1979, which identifies the project site as being within Area D – Industrial. This zoning category allows for *inter alia:*

- warehouses,
- outside storage and handling of merchandise; and
- light and heavy industry.

A new town plan is currently under preparation (March 2010) and the Physical Planner at the Municipal Council advises that the project site will most likely remain zoned as Industrial.

The Municipal Council also administers the *Physical Planning Act* within town limits and the Building Permits referred to under section 3.1 will need to be applied for through the Municipal Council.

3.3 International laws

Vanuatu is party to a number of international environmental conventions, treaties and laws which have general relevance to the project. Some examples are:

- Convention for the Protection of Natural Resources and Environment of the South Pacific Region (Noumea Convention).
- Convention on Biological Diversity (CBD).
- Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol).
- United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol.

Vanuatu is also a member of the International Maritime Organization (IMO), which administers the international regulatory regime for shipping, and is a party to a number of IMO conventions, including:

- Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREG 72).
- International Convention for the Safety of Life at Sea, 1971 (SOLAS).
- International Convention on Load Lines, 1966 (Load Lines 66).
- International Convention on Civil Liability for Oil Pollution Damage, 1969 (CLC 69).
- International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL 73).
- Convention on Facilitation of International Maritime Traffic, 1965 (FAL 1965).
- International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971 (FUND 71).

Details of the implications of these and other relevant international conventions are contained in the Regulatory Review (Appendix 4). Importantly, Vanuatu retains national legislation – the *Maritime (Conventions) Act 1982* – which implements a number of maritime conventions that are no longer in-force internationally, and/or which have been superseded or substantially updated in recent years. This includes those listed above, including CLC 69 and FUND 71 which relate to financial compensation for marine pollution damage from shipping incidents, leaving Vanuatu unprotected in this regard.

There are also a number of new, and extremely important international maritime conventions that have been adopted by IMO in recent years, that Vanuatu has not yet ratified/acceded to, such as the *ISPS Code*, the *International Convention on the Control and Management of Ships' Ballast Water and Sediments* and the international legal instruments relating to limits of liability for maritime claims.

It would therefore be highly beneficial for Vanuatu to review and update its ratification of international maritime conventions and update its national maritime legislation accordingly. This will in turn ensure that international shipping servicing the Star Terminal will be required to comply with IMO standards, which should be the norm for any international container terminal.

It should be noted that Vanuatu currently has a draft *Biosecurity Bill* ready for passing by Parliament which includes provisions to totally ban the discharge of bilge water and ballast water from ships in Vanuatu waters. This provision is totally unworkable and if implemented would effectively close-down shipping in Vanuatu. This needs to be removed from the *Biosecurity Bill*. Bilge water discharges should be regulated under specific legislation that is consistent with the MARPOL Convention and ballast water discharges should be regulated under specific legislation that is consistent with the IMO BWM Convention.

Table 1: *Summary of legal implications for the proposed development*

Law	Implications for the Project
Environment, planning and natural resources laws:	
• Control of Nocturnal Noise Act 1965 (Chapter 40)	• Illegal to make noise that causes nuisance to nearby communities between 9pm and 5am. Star Terminal will need to comply both during construction and operation.
• Convention on Biological Diversity (Ratification) Act 1992 (Chapter 217)	• The Star Terminal development will impact directly on biodiversity through removal of on-site vegetation (and any associated fauna such as birdlife) and the destruction of marine communities including corals in the reclaim area. These impacts are considered to be extremely minor to negligible in terms of the very small area and the very low biodiversity significance of the impact areas. • The project may impact indirectly on biodiversity should ships using the terminal cause an oil spill and/or the introduction of alien species, and such impacts may be significant. • These issues are being addressed through the Supplemental EIA and the development of an Environmental Management and Monitoring Plan (EMMP) for both the construction and operational phases of the project (Section 11).
• Environmental Management & Conservation Act 2002 (Chapter 283).	• Clearly, the EIA provisions of EMCA apply in full to the Star Terminal development proposal. As the current proposal does not differ substantially from the earlier proposal by Ifira Trustees, in terms of likely environmental impacts – it is not intended to re-trigger the above process for the current proposal. The current (supplemental) EIA work is intended to simply: o build on the previous process, in order to addresses some key additional issues that were not addressed in the earlier EIA (mainly in relation to marine impacts, including shipping issues), o support the re-application for a Foreshore Development Permit (which had expired), o support the application for other necessary approvals; and o provide an EIA which meets international donor standards, thereby supporting bids for capital works funding.

Law	Implications for the Project
• Fisheries Act 2005 (Chapter 315)	• It is understood that no Marine Reserves have been declared in the vicinity of the project site.
• Foreshore Development Act 1975 (Chapter 90)	• The FDA is clearly directly applicable to the Star Terminal development proposal. As the previous FD Permit granted to Ifira for the earlier development proposal has expired, it will be necessary to apply for a new one, in accordance with the provisions of the FDA. This application should be made by Ifira Corporation, and be supported by the Supplementary EIA.
• Mines & Minerals Act 1986 (Chapter 190)	• Quarry Permit under MMA required for dredging. • If any material for the land reclamation is to be sourced from quarries, such quarries are required to have Quarry Permit under the MMA. While legal responsibility for Quarry Permits rests with the owner/operator of the said quarries, as part of general duty of care it is necessary for the Star Terminal developer to ensure that all suppliers have the necessary legal permits and approvals.
• Montreal Protocol on Substances that Deplete the Ozone Layer (Ratification) Act 1984 (Chapter 232)	• Historically, ozone depleting substances have been used in refrigeration, fire-fighting systems and similar applications that are relevant to shipping and may be relevant to the shore-side operations of the Star Terminal. While global application of the Montreal Protocol means that these substances are becoming unavailable in the marketplace, some manufacturers may still try to sell to developing countries. The design of relevant components of the Star Terminal development should ensure compliance with this Act by not including systems or components that use prescribed ozone depleting substances.
• National Parks Act 1993 (Chapter 224)	• The Act was never gazetted.
• Physical Planning Act 1986 (Chapter 193)	• The proposed Star Terminal development is consistent with the specified in the Plan for the Physical Planning Area (Industrial).
• Preservation of Sites and Artifacts Act 1975 (Chapter 39)	• It is understood that no sites or objects of historical, ethnological or artistic interest have been declared or classified in the vicinity of the project site.
• Water Resources Management Act 2002 (Chapter 281)	• Approval is required under the WRMA for container wash-down, stormwater, sewerage and other water-related project works.

Law	Implications for the Project
• Wild Bird (Protection) Act 1962 (Chapter 30)	• The proposed Star Terminal development will involve the removal of most vegetation on site, including several extremely large Fig and other trees that may well provide habitat, nesting, roosting and feeding areas for birds that are listed as protected under the WBPA.
Maritime laws:	
• Derelict Vessels (Disposal) Act 1923 (Chapter 9)	• As no derelict vessels have been found within the Star Terminal development area there are no current implications of this law for the project.
• Harbor Lights Act 1914 (Chapter 2)	• As most international vessels using Port Vila carry lights and markings in compliance with modern IMO standards ideally the antiquated Harbor Lights Act should be updated or repealed.
• Maritime Act 1981 (Chapter 131)	• None directly. Any ships engaged in foreign trade that are registered in Vanuatu under this Act and that use the Star Terminal will need to comply with the provisions of this Act. Ideally the Act should be reviewed and amended to bring it into line with international (IMO) standards, and Vanuatu should be assisted to develop a Port State Control and ship-survey capability.
• Maritime Zones Act 1981 (Chapter 138)	• Under the MZA the proposed Star Terminal development is located within the defined Internal Waters of Vanuatu, thereby giving the Vanuatu Government full sovereign jurisdiction of this area, including the seabed and subsoil thereunder.
• Maritime (Conventions) Act 1982 (Chapter 155)	• Any ships that use the Star Terminal will need to comply with the provisions of this Act. This may be difficult as many of the international Conventions implemented by this Act are no longer in force internationally and have been superseded by later international laws • MARPOL also places an obligation on ports and terminals to provide ships' waste reception facilities, and this will be addressed in new terminal design. • Ideally the *Maritime (Conventions) Act* should be reviewed and amended to bring it into line with latest international (IMO) standards, and Vanuatu should be assisted to develop a Port State Control capability.
• Motor Boats (Control) Act 1970 (Chapter 70)	• Need to determine if any relevant Regulations have been made that affect the project area.

Law	Implications for the Project
• Port Vila Harbor (Prohibited Area) Act 1952 (Chapter 22)	• None directly.
• Ports Act 1973 (Chapter 26)	• Development and operation of the proposed Star Terminal will need to comply with all relevant requirements of the Ports Act. • Of direct relevance to the Supplementary EIA, ITL will need to make application to the Minister responsible for Ports for approval under section 23. • Also need to determine if any relevant Regulations have been made that affect the project, and if so what the implications are for the project.
• Prevention of Collisions at Sea Act 1983 (Chapter 166)	• All relevant vessels servicing the proposed Star Terminal will need to comply with this Act.
• Shipping 1968 (Chapter 53)	• All relevant Vanuatu-flagged vessels servicing the proposed Start Terminal will need to comply with the *Shipping Act.* Ideally this Act should be reviewed and amended to bring it into line with latest international (IMO) standards, including STCW and SOLAS, and Vanuatu should be assisted to develop a Port State Control and ship-survey capability to help in ensuring compliance with this Act.
• Vanuatu Maritime Authority Act 1998 (Chapter 253) (Repealed)	• None directly.
Quarantine and related laws:	
• Animal Importation & Quarantine Act 1988 (Chapter 201)	• Being assessed under a separate study by New Zealand-based quarantine consultants FBA. When available the FBA report should be referred to on these matters.
• Biosecurity Bill	• It is vital that the Vanuatu *Biosecurity Bill* be reviewed ASAP and that the strongest representations be made to the Vanuatu Government to amend the ballast and bilge water provisions in the Bill before it is passed, otherwise this Bill will effectively shut-down international shipping in Vanuatu if passed as is.
• Pesticides (Control) Act 1993 (Chapter 226)	• FBA to review and advise implications.

Law	Implications for the Project
• Plant Protection Act 1997 (Chapter 239)	• FBA to review and advise implications.
• Quarantine Act 1909 (Chapter 1)	• FBA to review and advise implications.
• Stockholm Convention on Persistent Organic Pollutants (Ratification) Act 2005 (Chapter 301)	• Historically, POPs have been used in pesticides and similar applications that are relevant to quarantine operations. The design of relevant components of the Star Terminal development, including the container quarantine facility, should ensure compliance with this Act by not including POP-based chemicals.

4. EXISTING ENVIRONMENT

4.1 Geography & geology

Port Vila Harbour is located on the south-west coast of the island of Efate. The entrance to the Harbour is located at latitude 17°45' South and longitude 168°18' East, and opens to the larger Mele Bay to the West. The Harbour covers a water surface area of approximately 5.03 km^2 and within the Harbour there are four smaller bays, as follows (Figures 4 and 17):

- Port Vila Bay immediately to the east of the Harbour entrance (1.92km^2),
- Vatumaru Bay extending to the north (0.88km^2),
- Pontoon Bay to the south (1.46km^2); and
- Paray Bay in the south east corner of the Harbour (0.77km^2).

As can beg seen on Figures 4 and 17, shallow coral-limestone sills (ridges) separate each of the main sub-bays from each other, thereby restricting water circulation between the bays to the upper strata/surface layers, and keeping deeper waters largely stratified and isolated within each sub-bay (refer also sections 11 and 4.12).

There are two uplifted coral islands in the Harbour; Ifira Island just to south of the Harbour entrance, and Iririki Island which separates Pontoon and Paray Bays ((Figures 4 and 17).

The geology of the general area is seismically raised coral reef (limestone) and associated detrital coral limestone. The northern, eastern and southern coastlines of the Harbour are immediately backed by coral limestone hills rising to around 50m above sea level, upon which much of the town of Port Vila is built, affording picturesque views over the Harbour.

The majority of the Star Wharf site itself comprises reclaimed land formed from the placement of coral limestone, as well as assorted construction and other waste and debris (concrete, steel, car bodies etc), which has often been dumped to extend the reclamation on an ad-hoc basis. The site is geologically and structurally unstable.

The seabed adjacent to the site is also coral limestone and the bedrock beneath is poorly consolidated bedded pumiceous tuff material.

Immediately adjacent (south) of the Star Wharf site, an uplifted coral cliff rises almost vertically to 75m above sea level, and an hysteric fault line runs along the coastal baseline of this cliff (Esrom, 2006). The area is seismically active and earthquake tremours are very frequent in Port Vila. A report by SOPAC (2003) estimates the approximate average reoccurrence period for a ≥7 Ms earthquake in the vicinity of Port Vila to be every ten years.

The cliff face has slope instability risks and could possibly collapse directly on to the Star Wharf site, should a significant earthquake occur. In recent years large limestone boulders (some several meters in diameter) have dislodged from the cliff and fallen to the narrow coastal flat and into the sea in the vicinity of Star Wharf. The cliffs slope stability risks have been compounded by the construction of Wharf Road along the cliff base in 1972, resulting in over-steepening of the natural slope (Esrom, 2006), and also the more recent construction of houses at the top of the cliff, which are at serious risk should the cliff collapse in an earthquake.

Figure 17: *Port Vila Harbour surface areas*

4.2 Climate

According to the Vanuatu Meteorological Service (www.meteo.gov.vu) Port Vila has a tropical maritime climate. The dry winter season extends from May through October, during which the South East Trade Winds predominate bringing dry, sunny days and cool, clear nights. The wet summer season extends from November through April when the tropical air brings thunder showers and high humidity with light winds. The wet season is also the cyclone season, with cyclones being almost an annual event hitting some part of the country overall.

The average annual rainfall in Port Vila is approximately 230cm. Most rainfall occurs in the wet season, although during the wet season there can be periods with little precipitation, and during the dry season than can be prolonged periods of rain. Humidity ranges between 85 and 90 percent. Temperatures vary little throughout the year, with an annual average of 25 °C, an August average of 23 °C and a February average 27 °C.

4.3 Air quality & noise

No existing data on air quality or noise was found for Star Warf or Port Vila in general, and no new data on these parameters was collected as part of the Supplementary EIA.

Qualitative observations during Supplementary EIA site visits indicate that air quality in the vicinity of Star Wharf is good, with clearing sea-breezes. Existing sources of air pollution at the site include:

- exhaust emissions from vehicles and machinery operating on-site, and from vehicles passing on the adjacent Wharf Road,
- exhaust emissions from vessels using the wharf,
- possible emissions of small amounts of highly toxic volatile organic compounds from tanktainers of avgas and diesel that are handled on site,
- smoke and fumes from the ad-hoc burning of garbage, including plastics, on site (Figure 18); and
- fine dust stirred up by wind and vehicle movements on site (unsealed).

Vehicle, machinery and vessel operations are also the only sources of noise at/in the vicinity of the site. Qualitative observations during Supplementary EIA site visits indicate that such noise is not excessive and does not appear to constitute a nuisance or health hazard, so long as operators and workers wear relevant ear protection.

Apart from a few houses at the top of the cliff adjacent to Star Wharf there are no neighbouring residential communities that could suffer dust and/or noise impacts from the site. Anecdotal advice is that the houses at the top of the cliff can hear load bangs and feel vibrations when containers are dumped heavily by forklifts at Star Wharf.

Figure 18: *Existing air quality impacts at Star Wharf – burning of garbage on site, which may include plastics, generating toxic smoke (Feb 2010). This will be improved as part of the development (Source: Raaymakers)*

4.4 Terrestrial soil quality

Soils on the site are derived from crushed coral limestone and are of poor quality. No existing soil quality data was found for the area and no new data on soil quality was collected as part of the Supplementary EIA.

Qualitative observations during Supplementary EIA site visits indicate that there are a number of on-site sources of chemical contamination of soils, including clear signs (large oily stains) of spillages of fuel and oil directly onto the substrate near the existing workshop and fuel storage area (Figure 19).

Figure 19: *Oil stains on the porous coral ground at Star Wharf (Dec 2009) - this will be improved as part of the development (Source: Raaymakers)*

4.5 Freshwater runoff & groundwater quality

There is currently no formed drainage or stormwater management system on site and freshwater runoff from rainfall and the existing container wash-down area simply pools in depressions in the site surface, or runs-off to sea following natural drainage lines (Figure 20).

The coral limestone base of the site is extremely porous and much of the freshwater accumulation and run-off is likely to penetrate down into the substrate and possibly enter the sea as groundwater discharge.

No existing data on freshwater runoff and groundwater quality was found for the area and no new data was collected as part of the Supplementary EIA.

Qualitative observations indicate that there are a number of sources of chemical contamination of freshwater runoff and groundwater on-site, including the spillages of fuel and oil referred to under 4.4 above, as well as quarantine-pesticide chemicals which may be washed off containers at the existing container wash-down area.

Figure 20: *Pooling of surface water at the existing container wash-down facility – this will be improved as part of the development (Source: Raaymakers)*

4.6 Terrestrial biodiversity

A systematic vegetation survey was conducted on the Star Wharf site as part of the Supplementary EIA and all trees were photographed and identified to species level where possible, and plotted on Geographic Information System (GIS) using Global Position System (GPS). The full report on the vegetation survey is contained in Appendix 5.

As the site is an artificial, man-made reclamation and operational port facility, there is no natural forest or wild vegetation on site. However, a variety of trees and other vegetation has been planted or have naturally recruited around the site, especially along fence-lines and around buildings.

4.6.1 Productive species

Trees planted include many that are of value for food production, medicinal or other practical/traditional purposes (Figure 21), and which are utilized by workers on the site. This is a common practice in Vanuatu and the Pacific generally, where incomes are often limited. Productive trees on-site include, but are not limited to:

- Avocado (*Persea americana*) x 6 trees*
- Banana (*Musa spp.*) x 20 trees
- Citrus (species unknown) x 3 trees*
- Coconut (*Cocos nucifera*) x 7 trees
- Guava (*Psidium guajava*) x 1 tree*
- Mango (*Mangifera indica*) x 8 trees*
- Noni (*Morinda citrifolia*) x 2 trees
- Papaya (*Carica papaya*) x 1 tree
- Sugarcane (*Saccharum officinarum*) x several clumps

Other 'non-productive' trees on site include:

- Beach almond (*Terminalia littoralis*) x 3 trees
- Fan palms (*Oritchardia pacifica*) x numerous along road fence line.*
- Fig (*Ficus sp*.) x 2 trees
- Flame (*Delonix regia*) x 3 trees*
- Frangipani (*Plumeria rubra*) x 3 trees*
- Ironbark/Sheoak (*Casuarina equsetfolia*) x 4 trees

Those species above marked with an asterix are not native to Vanuatu and have been introduced for production or aesthetic purposes since first European contact with the islands. Three specimens of the introduced 'pest' species Prickly Pear cactus (*Optuntia stricta*) were also found on site.

4.6.2 Other values

In addition to the practical value to workers of the 'productive' trees, the existing on-site vegetation also provides shade, natural cooling and dust suppression, improves aesthetics and supports a number of native bird and insect species.

Of particular note is a large (approx. 20m high) fig tree (*Ficus prolixa*) located on the road-side just to the east of the main roadway entrance (Figure 21 top left). In addition to its own ecological, amenity and aesthetic values it also provides roosting and nesting habitat and a feeding resource for several species of birds and the occasional Flying Fox (*Pteropus tongatus*), especially during flowering and fruiting season. The Vanuatu *Wild Bird (Protection) Act* prescribes a list of protected birds.

This tree provides an effective screen between Wharf Road and the terminal, acting as an environmental buffer and minimizing visual impacts on arriving Cruise Ship visitors.

This tree also has major cultural significance as being in *Warasa*, the tabu area of *Lapetasi* – the one armed octopus totem of the octopus clan (*naflak wita*) of the Ifira people (refer section 14). Given these values the Fig should be retained, or if really required, pruned on the terminal side only.

There is a second, larger Fig (*Ficus subcordata*)at the eastern most boundary of the site, which overlooks the home of the totem Lepatasi, the area of coast and sea just east of the existing reclaim, also called Lepatasi. This Fig also supports bird-life, and ideally should also be retained.

Another significant tree is the Canoe tree (*Gyrocarpus americnus*) on the east side of the Nissan Hut. These have been used since ancient times to carve wooden outrigger canoes, the main-stay of traditional Vanuatu sea transport. While it has to be removed as part of the development, the timber should be used. It could be carved into a traditional canoe to go at main gate of new terminal, and which might be included as element in new Star Terminal logo.

There is a Cycad at the Security Hut at the Office Gate – which is of cultural significance throughout most of Vanuatu, being traditionally used to signify peace and to mark tabu boundaries. It is also an extremely ancient species linking Vanuatu with the Gondwana tectonics. This could be retained/transplanted/replaced as an entrance feature, given its traditional cultural significance as a boundary marker.

The ornamental gardens surrounding the Offices and amenity buildings include a number of local flowering perennials that have both aesthetic and cultural values to ni-Vanuatu, including:

- Croton – *Codiaeum variegatum*
- *Cordyline – Cordyline fruticosa* (Bislama – nangarae)
- *Poliscias spp.*

These are good examples of the types of local plants that could be used when landscaping around the new office buildings.

The Fan Palms along Wharf Road were planted as part of municipal beautification program, as this is the direct entry point for Cruise Ship visitors to Port Vila. They do not pose a threat of litter to the proposed container yard – and should be retained. The terminal should not detract too much from the scenic route into Vila for Cruise Ship visitors. It is recommended that terminal developers consult with Port Vila Council prior to any proposed disturbance of these.

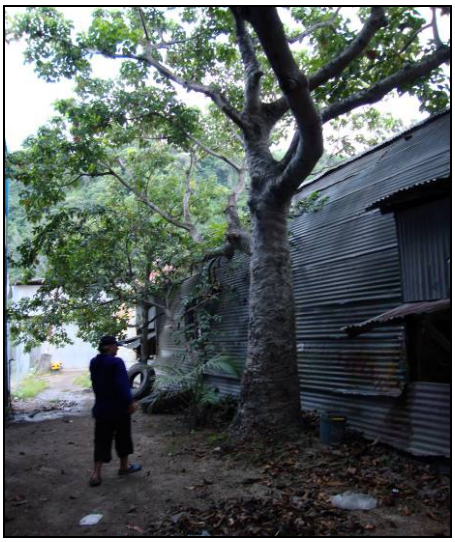
While most on-site vegetation will have to be removed for the Star Terminal development, the design should provide for landscaping of non-operational areas and ensuring minimal impact on visual amenity from Wharf Road, recognizing this as first point of entry for Cruise Ships, which injects approximately AUD$30 million/year into the Vanuatu economy (Nell, pers. comms. 2010). Future landscaping should include only native species and productive food species as currently practiced. Workers should be allowed to harvest all fruit and productive products prior to site vegetation being removed.

Apart from the birds and flying foxes that use the large fig tree no other significant wildlife was observed on the site.

Figure 21 shows some of the most significant existing vegetation resources on the Star Wharf site and Figure 22 summarizes the site vegetation map. Details are available in the full report on the *Site Vegetation Survey* contained in Appendix 5.

Large Fig east of Main Gate which should be retained

Fan palms along road that should be retained



Canoe tree which could be carved to make an entrance feature for the new terminal

Shady Beach Almonds suitable for landscaping non-operational areas

Cycad near Office Gate – has traditional significance and could be retained/transplanted for new entrance

One of many productive species on site which provide benefits for workers and which should be included in any future landscaping of non-operational areas

Figure 21: *Some of the more significant existing vegetation resources on the Star Wharf site (Source: Raaymakers)*

Figure 22: *Star Wharf existing vegetation (March 2010) (large images and details of each location are contained in the Site Vegetation Survey report in Appendix 5)*

4.7 Marine biodiversity

4.7.1 General

Vanuatu is located immediately adjacent to the global epi-centre of marine biodiversity known as the 'Coral Triangle', focused on Indonesia, the Philippines and Papua Guinea, and hosts an extremely high level of marine species diversity comparable to the World Heritage listed Great Barrier Reef in Australia.

Along with land, marine resources are the life-blood of Vanuatu, with subsistence fishing providing a significant proportion of national dietry protein and commercial fisheries making a major contribution to the national economy.

Port Vila Harbour itself is surrounded by a significant urban catchment and suffers serious pressures from coastal development and land-based sources of marine pollution, as well as intense subsistence fishing by local residents. Despite these impacts, the marine eco-system in the Harbour is generally healthy and productive with high levels of species diversity. The main marine biodiversity resources of Port Vila Harbour are shown on Figure 23.

4.7.2 Coral reef communities

Healthy coral reef communities are still found at several locations throughout the Harbour, particularly (Figure 23):

- Malapoa Reef: Extensive reef on the shallow shelf that separates Port Vila Bay from Vatumaru Bay,
- Malapoa Point: Fringing reef along Malapoa Point on the north-west coast of the Harbour,
- Iririki Fringing Reef: Patches of reef and coral heads (bommies) around the north and west coasts of Iririki Island,
- Ifira Fringing Reef: Patches of reef and coral heads (bommies) around the coast of Ifira Island,
- Iririki Ridge: Areas of high live-coral cover in numerous patches on the shallow ridge that extends between Star Wharf and Iririki Island.

All survey dives undertaken as part of the Supplementary EIA indicate that benthic organisms appear healthy and productive at most sites, including active feeding behavior, several spawning organisms and evidence of very high settlement and colonization rates on new substrate. Coral communities at most sites show good balance, in terms of number of colonies of old, slow-growing boulder corals (*Porites spp.*) and fast-growing staghorn corals (*Acropora spp.*).

There is also a balanced mix of hard corals (Sclerictinia) and soft corals (Alcyonaria) at all coral sites throughout the Harbour. Such diversity indicates a well developed and highly resilient system, although it is highly stressed by land-based pollution and over-exploitation.

All reefs surveyed, including at night, were highly depleted of fish and other food species. Approximately 12 adult and two juvenile Crown of Thorns Starfish were observed along Malapoa Reef. Figure 24 gives some examples of biodiversity at coral sites within the Harbour.

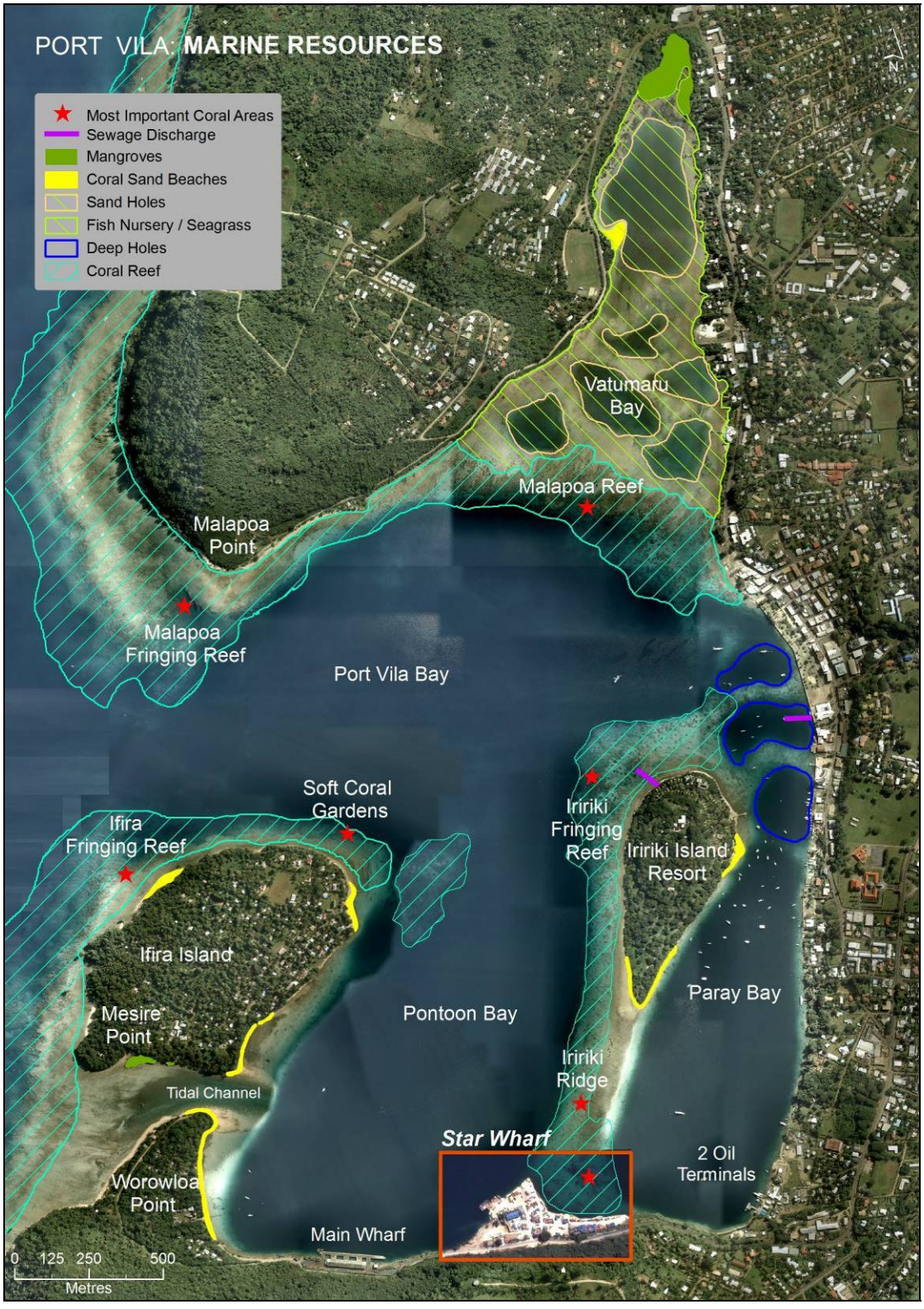
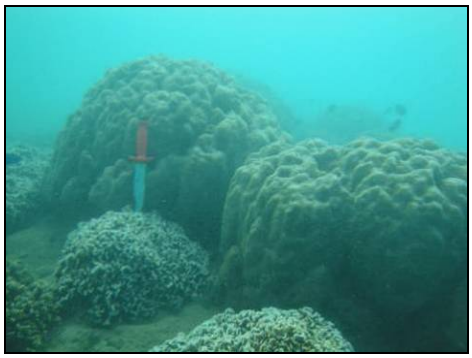
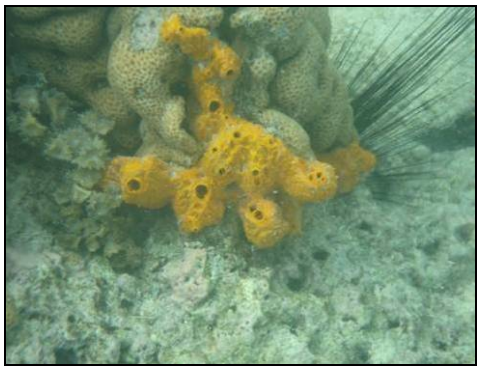


Figure 23: *Main marine biodiversity resources of Port Vila Harbour*

Staghorn coral(Acropora Sp.)in proposed reclaim area



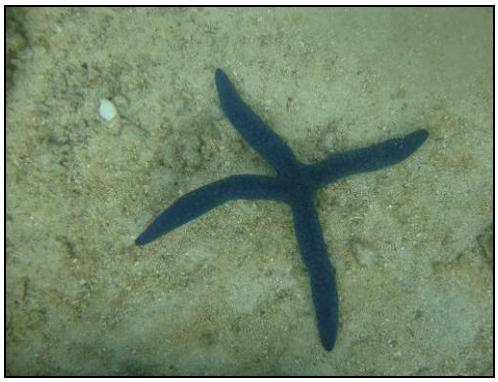
Boulder coral (Porites sp.) in proposed reclaim area



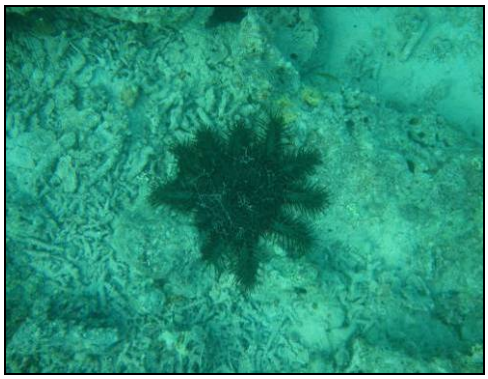
Sponge (Leucetta sp.)at Malapoa Reef

Large colonies of Lobophytum soft corals at Ifira Reef

Clown fish and staghorn coral at Malapoa Reef



4-legged Linckia Star fish at Malapoa Reef



Adult Crown-of-Thorns Starfish (approx 10cm diameter) at Malapoa Reef

Juvenile Crown-of-Thorns Starfish (approx 2cm diameter) at Malapoa Reef

Figure 24: *Some examples of biodiversity at Star Wharf (top row) and Malapoa Reef (lower 3 rows) – similar at other coral sites within the Harbour (Source: All images Raaymakers)*

4.7.3 Seagrasses & mangroves

Seagrasses are not common in the Harbour, being found mainly in the sandy shallows of Vatumaru Bay along with a meadow immediately west of Vatumaru Bay off the western area of the Kawenu area of Malapoa.. These areas are known foraging areas of a small resident population of dugongs (estimated at 3 individuals in 2010 (F. Hickey, *pers comm*.)). The only significant remnant mangroves are found in the upper reaches of Vatumaru Bay (where a spring is found) that includes *Rhizophora stylosa, R. apiculata., Bruguiera gymnorhiza, Sonneratia alba* and *Avicennia marina.* The only other significant stand (estimated to be 50-60 m^2) is on the south-west corner of Ifira Island that is dominated by *Avicennia marina* with smaller numbers of *R. stylosa* and *R. apiculata*. There is emerging evidence that mangroves were formerly more widely distributed throughout the Harbour, succumbing to development pressure especially with reclamation of the Vila foreshore in the 1960s (Figures 23 & 25).

***Figure 25**: **Left:** A view of Vatumaru Bay from Chantilly's Hotel. This is the main seagrass fish nursery for the Harbor, and has remnant mangroves at its headwater; **Right:** One of only two remaining mangrove stands in Port Vila, at Mesire Point on Ifira Island (Source: Raaymakers)*

4.7.4 Species & areas of conservation significance

Port Vila Harbour also provides habitat for several species that are of international conservation significance, including Dugong (*Dugong dugon*) which is listed as a species vulnerable to extinction under the World Conservation Union Red List. There are five species of marine turtles that inhabit Vanuatu waters, the Hawksbill (*Eretmochelys imbricate*), Green (*Chelonia mydas*), Leatherback (*Dermochelys coriacea*), Loggerhead (*Caretta caretta*) and Olive Ridely (*Lepidochelyis olivacea*) (Figure 26).

***Figure 26:** Examples of conservation-critical marine species, Dugong (D. dugon) which are seen in Port Vila Harbour and Hawks Bill turtle (E. imbricate), which have important nesting sites in Vanuatu (Source: GBRMPA).*

As outlined in the *Regulatory Review* (Appendix 4) there are three National laws which provide for the declaration of protected sites or areas that are of conservation significance – *Marine Reserves* under the *Fisheries Act*, *National Parks* under the *National Parks Act* and sites or objects of historical, ethnological or artistic value under the *Preservation of Sites & Artifacts Act*. There are no such sites in the vicinity of the proposed development.

4.7.5 Fisheries resources

Fisheries in general are and have always been a main-stay and life-blood for the Vanuatu society and economy. As mentioned above the marine resources of Port Vila itself are still heavily exploited for subsistence fishing and gathering by members of the local community. Species targeted include all edible fish (e.g. grouper family, parrot fish, surgeon fish, rabbit fish and trevally), octopus, lobster and various shellfish. Seasonally (summer months) when in abundance, inshore pelagic species including sardines and mackerels *(Selar spp.)* are also caught as valuable food fish.

Methods used include fine-mesh nylon set-nets, spearfishing on snorkel – including at night, line-fishing from the shore and from canoes and small vessels, and reef-gleaning – mainly by women – at low tide.

Such fishing has been undertaken as a core traditional activity by ni-Vanuatu throughout history, and was observed on all days during Supplementary EIA site visits. Areas targeted by the villagers include Malapoa Reef that separates Port Vila Bay and Vatumaru Bay, and the fringing reef along Malapoa Point on the north-west coast of the Harbour. On one visit a spear-fisherman was observed hunting on snorkel beneath Star Wharf (Figure 27).

Figure 27: Left: *Subsistence fishing with a highly-destructive fine-mesh nylon net (Source: F Hickey)*
Right: *Spear-fisherman hunting on snorkel beneath Star Wharf, 12 March 2010 (Source: Raaymakers)*

The effects of this intense and sustained extraction of living marine resources were clearly evident during survey dives undertaken as part of the Supplementary EIA. While many of the target areas exhibit very healthy coral growth and an abundance of non-edible invertebrates, there is a distinct lack of edible fish and shellfish species, and very few fish above a few centimeters in size, which would normally be abundant on these type of reef communities.

The only active commercial fishery within Port Vila Harbour is the occasional gathering of sea cucumbers (Beche-de-Mere) from Vatumaru Bay, although some of the catch from subsistence fishing and gathering may be sold informally. Commercial tuna and other offshore vessels offload at facilities at the south east corner of Paray Bay, next to the headquarters of the Vanuatu Department of Fisheries. At this site the Department maintains a

highly productive seed-stock hatchery and nursery for giant clams, trochus, green snail, pearl shell and other species of fishery value, with support from JICA.

The importance of the marine resources of Port Vila Harbour in supplementing the protein supply of local communities through subsistence fishing, combined with the depleted state of the resource, highlights the vital need for careful management and protection of the Harbour, including in relation to port developments and pollution.

4.7.6 Marine biodiversity at Star Wharf

As part of the Supplementary EIA an *Initial Marine Reconnaissance* was conducted along the entire perimeter of the existing reclamation and under and around Star Wharf itself. The full report is contained in Appendix 6. Despite being an operating port facility, the marine ecosystem at and immediately adjacent to Star Wharf is healthy with high levels of species diversity and biological activity, as well as clear water. In particular, the area immediately to the east of the site supports a rich coral community with very high live-coral cover (90% plus in areas), including large boulder corals (*Porites lobata*) that may be over 80 years old, and several stands of staghorn coral (*Acropora sp.*) up to 1.5 high (Figure 24 top row).

Marine life along the perimeter of the existing reclamation also includes several species that are of commercial / subsistence food value – e.g. nine tropical rock lobsters (*Palinurus sp.*) were observed inhabiting the concrete rubble dumped into the sea along the eastern side of the site. The coral and concrete reclaim material also provides excellent grazing habitat for the herbivorous spiny black sea urchin (*Diadema sp.*), and over a thousand of these are found in clumped groups along the shallow perimeter of the site.

Several species of value to the ornamental aquarium trade also inhabit the site, including the sea anemone (*Entacmaea quadricolor*) and associated clown fish (*Amphiprion melanopus*), and the lion fish (*Pteriois sp.*).

The existing piles that support Star Wharf are heavily encrusted with a wide diversity of species, and detailed data from sampling these piles is presented in Appendix 7.

In summary, the marine area to the east of Star Wharf, and beyond towards Iririki Island, supports healthy coral communities with high species diversity and high live-coral cover. Special measures are required to reduce impacts of both the Star Terminal development and adjacent developments on this area. Figure 28 shows these special areas, and Figure 29 shows a summary of the *Initial Marine Reconnaissance*. Figure 30 shows some of the main marine biodiversity features at Star Wharf (in addition to Figure 24 top row).

Figure 28: *Healthy coral communities with high live-coral cover near Star Wharf*
(Source: Left - F Salisbury, Right - Raaymakers)

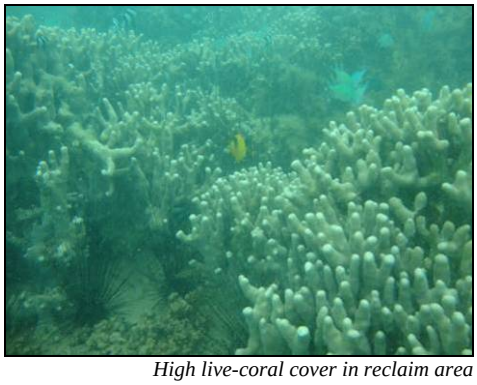
Figure 29: *Summary of the Initial Marine Reconnaissance at Star Wharf - details in Appendix 6*

There is high live-coral cover immediately off the eastern shore of the site

Clear water at Star Wharf, with clumps of Sea Urchins (Diadema sp.) extremely common in the area

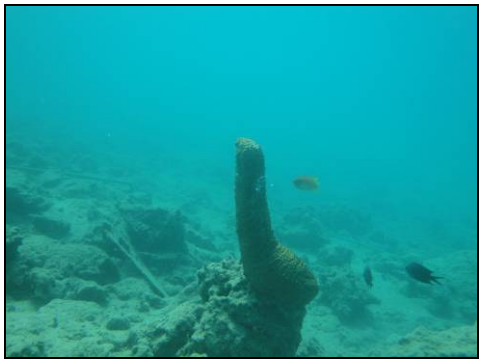
Staghorn coral (Acropora sp.) in proposed reclaim area

Large beard (over 1.5m length) of hydroids (left) and Halimeda algae (right) hanging from a Star Wharf pile.

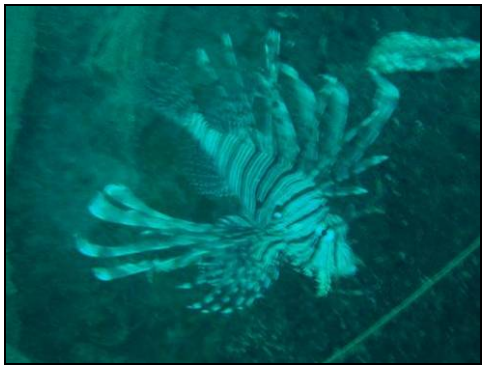


High live-coral cover in reclaim area

Cushion Starfish(Culcita novaeguineae) near Star Wharf



Spawning sea cucumber (Stichopus sp.) at reclaim area



Lion Fish (Pterois sp.) under Star Wharf

Figure 30: *Some of the main marine biodiversity resources around Star Wharf (Dec 09 & March 2010) (Source: All images Raaymakers)*

4.7.7 Introduced marine pests

Also as part of the Supplementary EIA, a global expert in introduced marine pests was engaged from the National Institute of Water and Atmospheric Sciences (NIWA) in New Zealand, to undertake an *Initial Marine Pest Assessment*, looking at the potential presence of introduced marine pests on the piles and associated structures at the existing Star Wharf, which support a very rich diversity of encrusting species and attendant fish populations.

Five species in the marine pest target list were recorded or suspected from Star Wharf. These were:

- the barnacle *Amphibalanus* (*Balanus*) *amphitrite* (Darwin 1854),
- the bryozoans:
  - *Amathia distans* (Busk 1886),
  - *Bugula neritina* (Linnaeus 1758),
  - *Watersipora subtorquata* (d'Orbigny 952); nd
  - *Zoobotryon verticillatum* (Delle Chiaje 1828)

All five species are suspected of being non-native to Vanuatu, but are now relatively widespread in tropical seas.

To prevent the potential spread of these species throughout Port Vila Harbour, when the existing piles are demolished they should be disposed of to land, and not to sea. Ideally a full scale *Marine Pest Survey* should be undertaken for the whole of the Harbour.

The NIWA expert also provided introductory training in marine pest survey methods to staff from the Department of Fisheries and the Environment Unit, and established a sample reference collection at the Department of Fisheries. The full report on the *Initial Marine Pest Assessment* is contained in Appendix 7.

Figure 31 shows examples of introduced species at Star Wharf and a heavily fouled sea-chest grating on a vessel berthed at Star Wharf on 15 February 2010. Fouled sea-chests are significant vectors for marine species trans-locations.

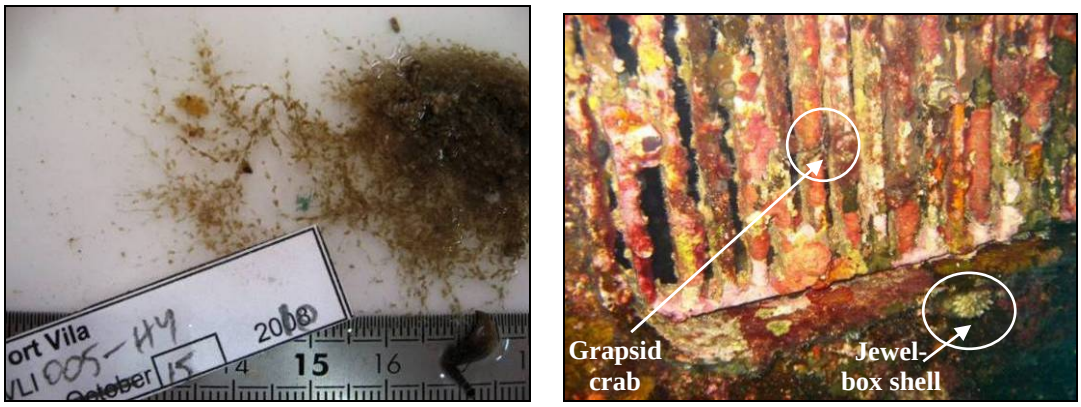


Figure 31: Left: *The bushy bryozoan A. distans, originally from the Caribbean, collected from Star Wharf Piles (15 Feb 2010).* ***Right:*** *Heavily fouled sea-chest grating on a vessel berthed at Star Wharf, (15 Feb 2010). Arrows indicate a fouling jewel-box bivalve (Chama sp.) and an unidentified grapsid crab (Source: G Inglis)*

4.7.8 Marine Biodiversity Survey

In addition to the *Initial Marine Reconnaissance* and *Initial Marine Pest Assessment*, three local marine biological consultants were engaged to undertake a comprehensive *Marine Biodiversity Survey* throughout the whole of Port Vila Harbor.

GPS-referenced survey transects were established at impact and control sites in the Harbour, as shown in Table 2.

At each transect, a benthic video swathe was run along 40m of tape, and photographs were taken of a 0.5x0.5m square quadrat placed on the seabed every 5m along the tape. Visual census for fish species, fisheries resources and substrate were also taken along each transect using the ProcFish method.

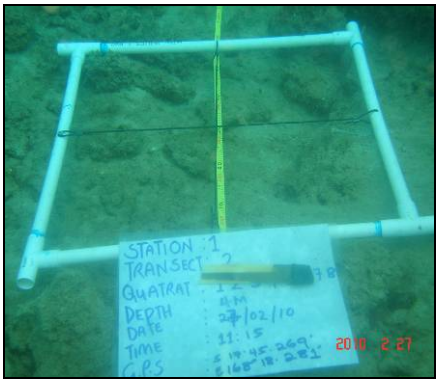
Table 2: *Stations and Transects for the Port Vila Marine Biodiversity Survey (March 2010)*

Station Location & No.	Transect	Start GPS	End GPS
Station 1 (S1): Star Wharf (immediate impact site)	T1.1	Not recorded	Not recorded
	T2.2	S17° 45.269", E168° 18.281"	S17° 45.254", E168° 18.303"
	T2.3	S17° 45.814", E168° 18.414"	S17° 45.306", E168° 18.395"
	T3.4	S17° 45.326",E186° 18.505"	Not recorded
Station 2 (S2): Iftira Island (possible impact site)	T2.1	S17°44.640'' E168°17.975''	Not recorded
	T2.2	S17°44.650'' E168°17.997''	Not recorded
	T2.3	S17°45.052'' E169°17.846''	Not recorded
	T2.4	S17°45.178'' E168°17.792''	Not recorded
Station 3 (S3): Iririki West Coast (possible impact site)	T3.1	S17° 45.195",E168° 18.427"	S17° 45.174", E168° 18.389"
	T3.2	S17° 45.129",E168° 18.454	S17° 45.121",E168° 18.426"
	T3.3	S17° 44.061", E168° 18.449"	S17° 45.021", E168° 18.430"
	T3.4	S17° 44.917", E168° 18.453"	S17° 44.911", E168° 18.430"
Station 4 (S4): Malapoa Reef (control site)	T4.1	S17° 44 .098', E168° 18.557''	S17° 44 .097', E168° 18.575''
	T4.2	S17° 44.037 , E168° 18.497"	S17° 44 .020', E168° 18.484''
	T4.3	S17° 44.036, E168° 18.359"	S17° 44 .016', E168° 18.355''
	T4.4	S17° 44.004", E168° 18.225"	S17° 44 .009', E168° 18.207''

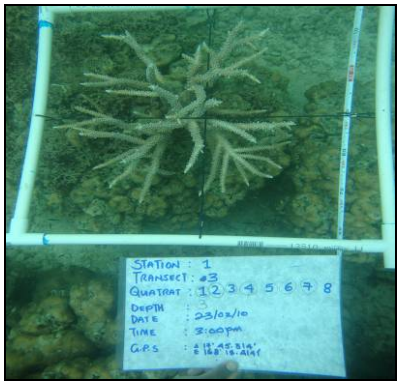
All data from the survey is provided to the Vanuatu Department of Fisheries and the Environment Unit, for use in any long-term monitoring program. All video data is provided as Windows MediaPlayer files and all photographs as JPEG files. The video and photographs from each transect can be analysed on computer for percentage cover of live and dead coral, algae, rubble etc, using techniques outlined in English et al (1997).

This provides baseline data which can be used to assist long term monitoring of any potential impacts from the Star Terminal operation, as well as from other developments and activities in the Harbour.

The full report on the *Port Vila Marine Biodiversity Survey* is contained in Appendix 8. Figure 32 shows representative quadrat photographs from some of the monitoring transects, providing baseline for future reference. Figure 33 shows marine monitoring sites in Port Vila Harbour, including the Marine Biodiversity transects.

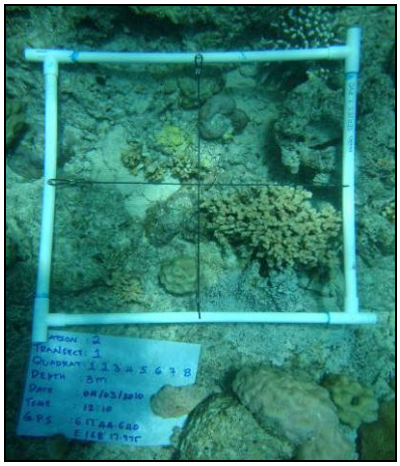


Transect T 1.2, Quadrat 6 (30m along tape)

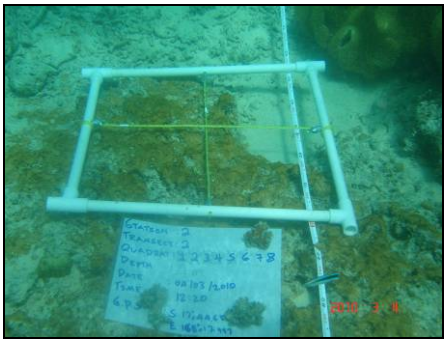


Transect T 1.3, Quadrat 6 (30m along tape)

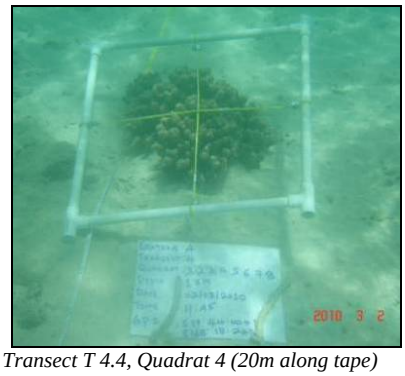
Transect T 2.1, Quadrat 4 (20m along tape)



Transect T 2.1, Quadrat 8 (40m along tape)



Transect T 2.2, Quadrat 7 (30m along tape)



Transect T 4.4, Quadrat 4 (20m along tape)

Figure 32: *Representative quadrat photographs from some of the marine biodiversity transects. The original data for all 16 transects is maintained at Department of Fisheries in Port Vila (Source: S Gareva).*

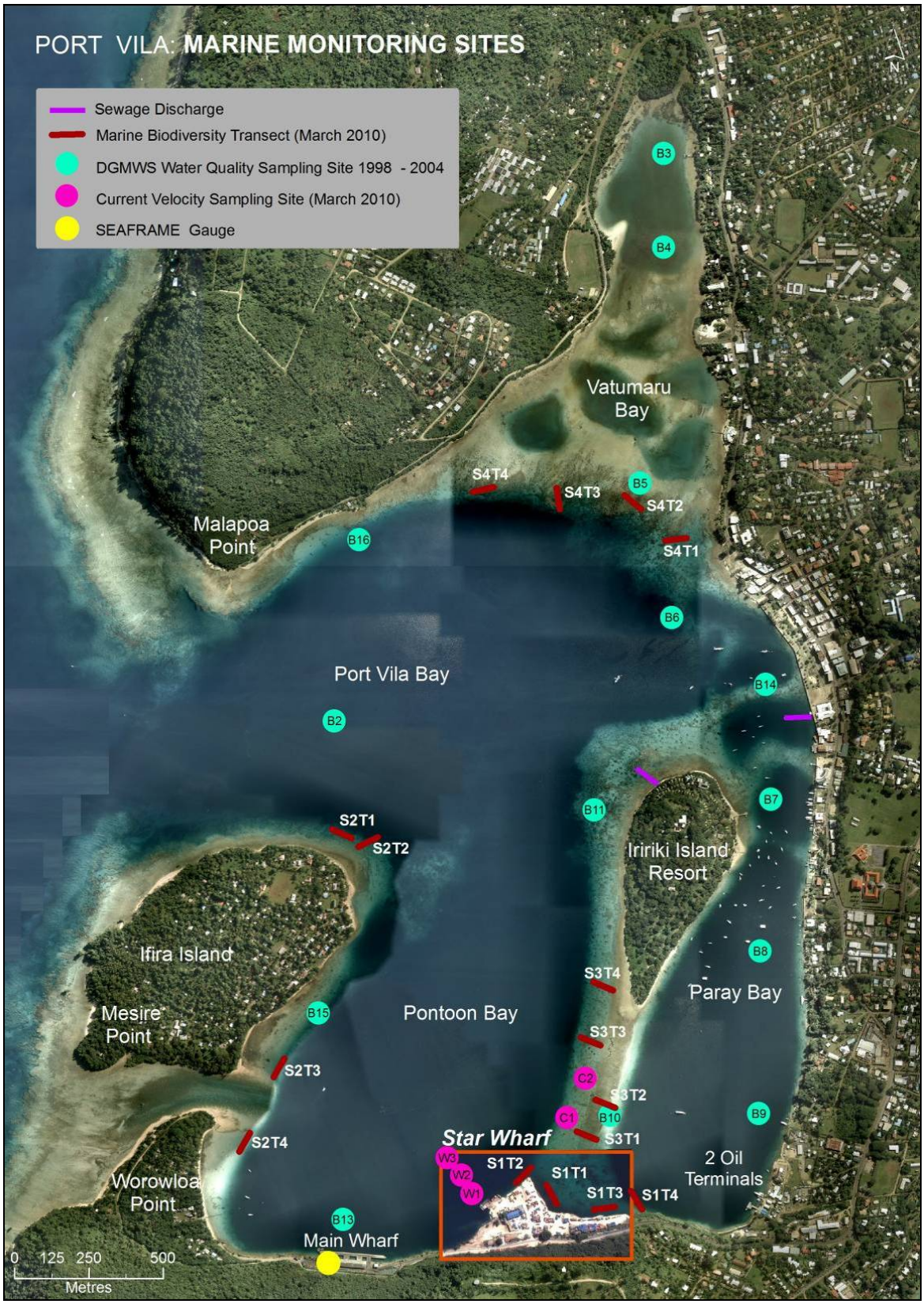


***Figure 33**: Marine monitoring sites in Port Vila Harbour*

4.7.9 Soft coral garden

An interesting finding of the *Marine Biodiversity Survey* was an extensive soft-coral garden of *Sarcophyton* colonies on the east coast of Ifira Island, near Transect 2.1 (Figures 23 & 33). All colonies observed were in full feeding mode during the middle of the day, taking advantage of good water flow and plankton supply from the deep channel just off the north and east of the Island. This location is flushed with new ocean water from Mele Bay by each changing tide.

Figure 34 shows some of the very large *Sarcophyton* in this area. Many colonies are over 1m in diameter. This soft-coral garden and the Ifira Island fringing reefs in general, are important resources that are generally down-stream of Star Wharf, and which need proper protection measures.

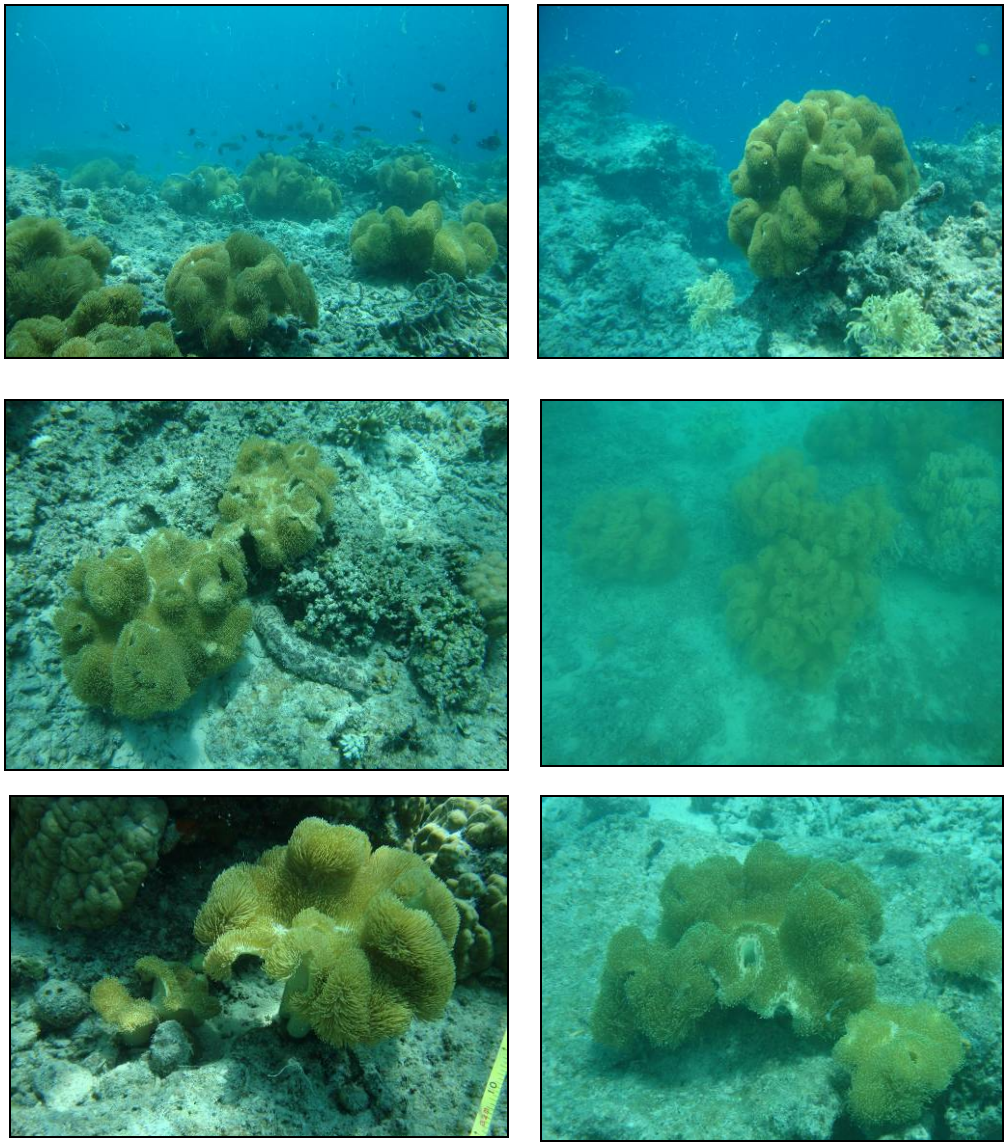


Figure 34: *Some of the numerous, large Sarcophyton colonies that make up the soft-coral garden near Transect T 2.1, on the NE coast of Ifira Island (March 2010)* *(Source: S Gereva)*

4.8 Marine water quality

Visually the waters of Port Vila can appear crystal clear (Figure 35). The turquoise sparkle of the water, including in the shallow areas just off Star Wharf, are a major part of the beauty of Port Vila, and one of the main draw-cards for the tourism sector.

However, despite a sometimes pristine appearance, water quality in the Harbour is under severe pressure from:

- land-based run-off of silts and hydrocarbons,
- septic tank overflow and discharge,
- the dumping of garbage and debris; and
- various wastes and spills from small and large vessels using the port.

As can be seen in Figure 36, following rain or a spring high tide, a highly visible plume of fine silts and hydrocarbon sheen can been seen dispersing into the Harbour from the porous, often ad-hoc land-reclamation works around the Harbour shoreline. On this occasion (February 2010), local residents were observed swimming directly in the plume of pollution, exposing themselves to elevated levels of sewage-related bacteria and toxic hydrocarbons. It is common practice in Vanuatu and elsewhere in the Pacific for children, adolescents and adults to swim in the sea for frivolous fun during rain.

There have been various reviews and studies of water quality in Port Vila over the years (e.g. Abbott 1991 and Loffler & Wetter 1994), although obtaining the reports and data proved difficult during the Supplementary EIA.

The Vanuatu Department of Geology, Mines and Water Resources (DGMWR) undertook water quality sampling at three to six monthly intervals (varying) at several sites throughout Port Vila Harbour and Ekasuvat lagoon between December 1999 and May 2004. The Port Vila sampling sites are shown on Figure 33.

It is understood that the sampling stopped after May 2004 when a fire destroyed the Department's offices and equipment, and that sampling commenced again in 2009 after the granting of new equipment by SOPAC, but that this has now come to a halt due to lack of operating budget.

As part of the Supplementary EIA the DGMWR water quality reports for the following sampling events were obtained and reviewed:

- December 1999
- May & December 2000
- October 2001
- April, June & October 2002
- May 2003
- May 2004

Water quality paramaters sampled for as part of this program include:

- Temperature
- Dissolved oxygen
- Conductivity & pH

- Water clarity (Secchi Depth)
- Faecal coliforms (Total Coliform and *E. coli*)
- Nitrogen & Phosphorous

Analysis of samples for Nitrogen and Phosphorous was not undertaken for most monitoring events due to break-down of the Department's spectrophotometers.

While there are significant inputs of hydrocarbons to the Harbour, primarily from road-runoff following rain (as observed during Supplementary EIA site visits and shown on Figure 36), the DGMWR water quality program has not included hydrocarbon analysis.

The results of this program consistently show elevated sewage-related bacteria (Faecal coliforms etc) at the sampling sites in Vatumaru Bay, at the Harbour Seawall near the discharge from the market toilets, in Emtem Channel between town and Iririki Island, and on two occasions near the Main Wharf. Since October 2002 elevated bacteria counts have also been measured at the Iririki Resort sewage outlet, on the North West side of the island.

At times bacteria levels at these sites have been measured well in excess of international public health standards. Apart from the market toilets and Iririki outlet, seepage from septic tanks into groundwater and thence into the Harbour, is likely to be the major source of this pollution, especially following rain and during spring tides.

Results for conductivity are reduced in the headwaters of Vatumaru Bay, consistent with freshwater inputs from the natural stream that flows into this bay there.

The results show that water clarity is often reduced in Vatumaru Bay due to its shallowness, which allows wave and tide-driven resuspension of fine bottom sediments. Terrestrial inputs of sediments, especially from ad-hoc land reclamation around the Harbour, can also be high, including at the Star Wharf facility. This is particularly the case following rain and during spring tides (as observed during Supplementary EIA site visits). Sampling since June 2002 has also measured reduced water clarity at the Iririki Resort sewage discharge outlet.

The results for dissolved oxygen indicate that the deeper bottom waters in Paray Bay, which is 40M+ deep, are anoxic, and may have limited mixing with surface waters.

There has been no water quality sampling in the immediate vicinity of Star Wharf, and the closest sampling sites located in Paray Bay and near the Main Wharf (Sites B10 and B13 on Figure 33) have not shown any major problems relative to other parts of the Harbour. Qualitative observations during Supplementary EIA site visits indicate that there are a number of potential sources of marine water quality impacts at the Star Wharf site, including:

- effluent from septic tanks servicing on-site toilets,
- run-off of hydrocarbons, quarantine pesticides and other pollutants from the site,
- inputs of fine silts and sediments from the unsealed hardstand on site,
- inputs of fine silts and sediments from ad-hoc, un-protected reclamation works (Figure 37),
- pollution from the dumping of debris, including toxic wastes such as old car batteries and computers, as part of the ongoing ad-hoc land reclamation (Figure 38); and
- discharges of waste oil/oily bilge and sewage from ships using the wharf.

Figure 35: *The marine waters of Port Vila, including near Star Wharf, can appear to be extremely clear and clean (Source: Raaymakers)*

Figure 36: *A highly visible plume of fine silts and hydrocarbon sheen, dispersing into the Harbour near Chantilly's Hotel following rain. In the lower two pictures local residents can be seen swimming directly into the plume (Feb 2010) (Source: Raaymakers)*

Figure 37: *Seepage of fine silts from the porous seaward face of ad-hoc reclamation works at Star Wharf (Feb 2010). Such silts can be detrimental to benthic marine life. The new development will improve this through proper rock armouring of all reclaim faces (Source: Raaymakers)*

Figure 38: *The ad-hoc dumping of waste and debris as part of ongoing, informal land reclamation is a serious threat to water quality at Star Wharf (Feb 2010). Material dumped was observed to include engines which may contain oil, car batteries containing lead, and computers containing heavy metals and other hazardous e-waste. The new development will improve this by ending the practice of ad-hoc dumping and through rock armouring of all reclaim faces (Source: Raaymakers)*

4.9 Seabed debris & UXO

4.9.1 Seabed debris

During the *Initial Marine Reconnaissance* undertaken on 17 December 2009 (Appendix 6), numerous items of underwater debris within the development area, including car bodies and similar large items, were identified and photographed. These may affect the structural integrity of the land reclamation and therefore may need to be removed prior to construction. If removed they should be disposed appropriately on land, to avoid spreading fouling species in the Harbour. Figure 39 shows a summary if seabed debris - refer Appendix 6 or details.

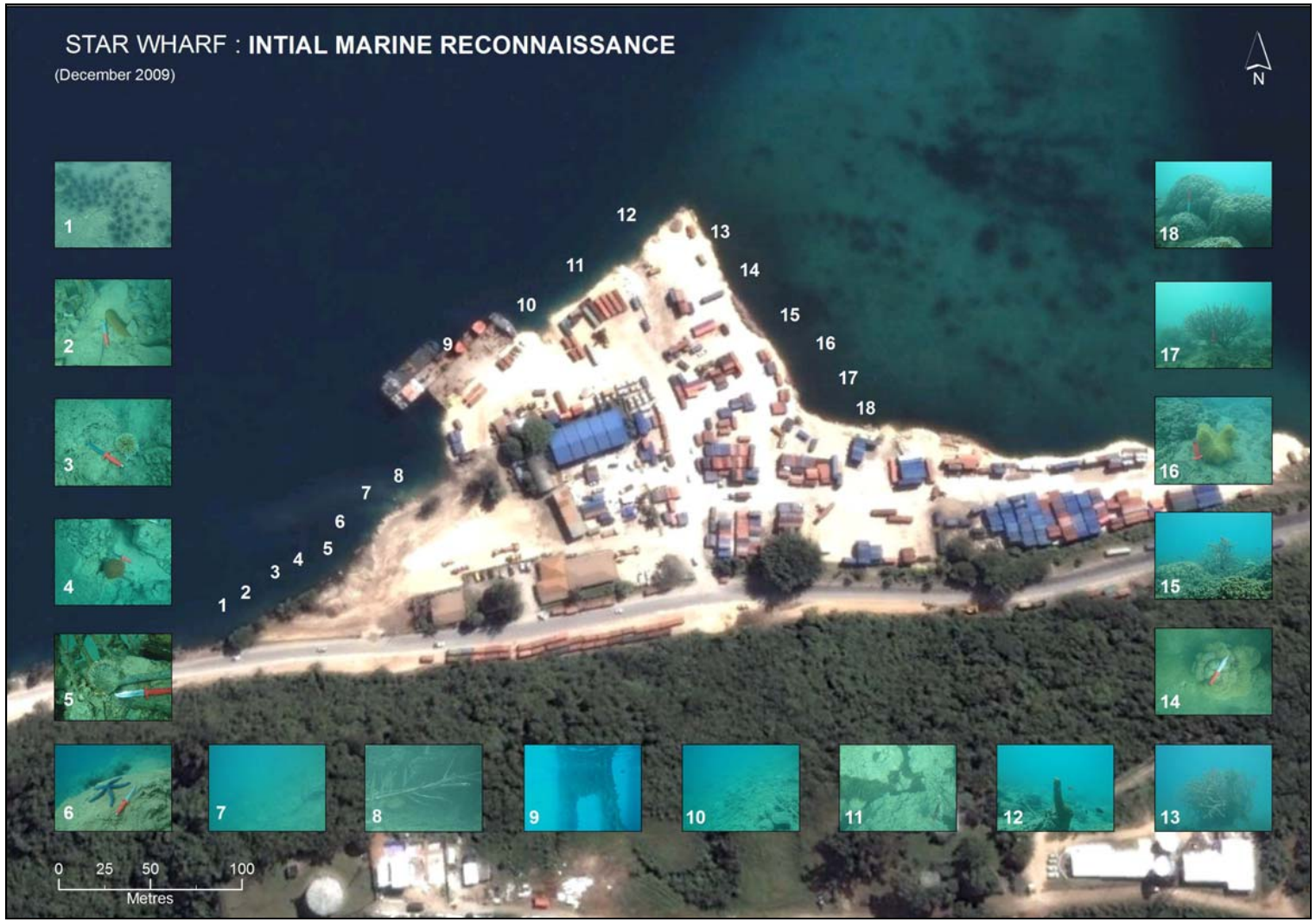


Figure 39: *Seabed debris observed during Initial Marine Reconnaissance - refer Appendix 6 for details*

4.9.2 Unexploded Ordnance (UXO)

Vanuatu hosted several major US military bases during World War II and saw a lot of action against the Japanese in the northern islands and in support of allied action in the Solomon Islands. At the end of the war the US military disposed of a lot of its equipment, including munitions, by dumping it into the sea. The most famous location is 'Million Dollar Point' on the island of Espirutu Santo – so called because of the immense value of the hardware, including trucks and jeeps, which was dumped into the sea there.

Given this practice, when proposing land reclamation and marine construction works in Vanuatu, it is prudent to assess whether the proposed works area may have been used as such a dump, and thereby might present a hazard from unexploded ordnance (UXO).

A review of historical documents and photographs at the Vanuatu National Cultural Centre does not appear to indicate that Port Vila itself was an *operational* base during the war, but was mainly used for administration, medical, rest and recreation etc . On the island of Efate US combat hardware and facilities, including munitions dumps, were focussed out of town at Bauerfield (airport) and at Havannah Bay (the large bay on the north east coast which US Nay ships used). The main US military bases were on the island of Espiritu Santo.

There do not appear to be any records of WWII munitions being dumped in the Star Wharf area. However, the US Military did not always formally record such dumps.

Ifira management advises that there is no local knowledge of the Star Wharf area having been used as a munitions dump. If it was it could have only been from the sea or the cliff top (there was no road or land there during WWII).

Ifira management advises that a large French company with interests in plantations – Ballande – stored explosives on site during the 1970s. Nobody knows if any were dumped in the harbour, although this is unlikely as these were an expensive resource.

In summary, it would appear that UXO are unlikely to be present at or near the Star Wharf site. However, given the lack of formal records kept on munitions dumping, the degree of uncertainty and the potentially serious implications of this risk, it is recommended that a detailed hydrographic survey of the area as well as a visual dive inspection by a qualified UXO expert (e.g. navy clearance diver), should be undertaken prior to any works commencing, and that relevant contingency provisions be built into all relevant contracts.

4.10 Marine sediment quality

Marine sediments at and around the site are derived from coral sand and rubble. No existing data on marine sediment quality was found for the area and no new data was collected as part of the Supplementary EIA.

As with water quality above, qualitative observations indicate that there are a number of sources of potential chemical contamination of marine sediments at the site, including run-off of hydrocarbons, quarantine-chemical pesticides and other pollutants from the land and the dumping of debris including toxic wastes such as old car batteries and computers, as part of ongoing ad-hoc land reclamation.

4.11 Bathymetry

4.11.1 General bathymetry of Port Vila Harbour

The latest bathymetric data for Port Vila is available from British Admiralty (BA) Chart No. 1494, Edition 5, published in December 2009. The bathymetry contours on this chart are derived from a number of hydrographic surveys at various scales as follows:

- British Government surveys of 1961-62, scale 1:7500
- Royal Australian Navy surveys of 1984, scale 1:2500
- Royal Australian Navy surveys of 1988, scale 1:7500
- Vanuatu Hydrographic Unit surveys of 1980, scale 1:2000
- Vanuatu Hydrographic Unit surveys of 1987, scale 1:5000

Copyright prevents reproduction of BA Chart 1494 in this report. However, the general bathymetry of the Harbour may be divided into distinct zones, as follows:

- Harbour Entrance: 33m deep at its deepest point, but quite narrow with steep walls rising to reef shelf on either side of the entrance.
- Port Vila Bay: Immediately to the east of the Harbour entrance, between 30 and 40m deep throughout.
- Vatumaru Bay. Shallow and sandy, extending to the north, generally less than 3m deep (with 6 distinct deeper holes within the Bay).
- Malapoa Reef: Shallow coral ridge generally less than 2m deep, separating Port Vila Bay and Vatumaru Bay.
- Three Deep Holes: (up to 30m deep) between the Central Market and Iririki Island.
- Paray Bay: Up to 40m deep in the south east corner of the Harbour.
- Iririki Ridge: Shallow coral shelf generally less than 2m deep, separating Paray Bay and Pontoon Bay, and extending from the area of Star Wharf to Iririki Island.
- Pontoon Bay: Up to 50m deep in the south of the Harbour.

4.11.2 Bathymetry at Star Wharf

The bathymetric contours on BA Chart 1494 in the immediate area of Star Wharf are derived from the last surveys listed above (Vanuatu Hydrographic Unit, 1987, scale 1:5000).

The Chart shows that the Star Wharf land reclamation sits atop the shallow coral shelf that extends to Iririki Island. The seaward face of the wharf is located right on the edge of the shelf at 7.2m depth, which slopes steeply to a depth of 40m plus in Pontoon Bay. The area to

the north-east and east of the Star Wharf site is part of the shallow coral shelf and is generally less than 2m in depth.

Unfortunately, the scale of the survey in this area (1:5000) is not sufficient to provide detailed bathymetric contours suitable for planning the development of Star Terminal. As part of the BFS, Soros Associates therefore arranged for a detailed hydrographic survey of the immediate area using manual plumb lines by Port Vila based surveyors CFS. The main bathymetric contours from this survey are shown in Figure 40).

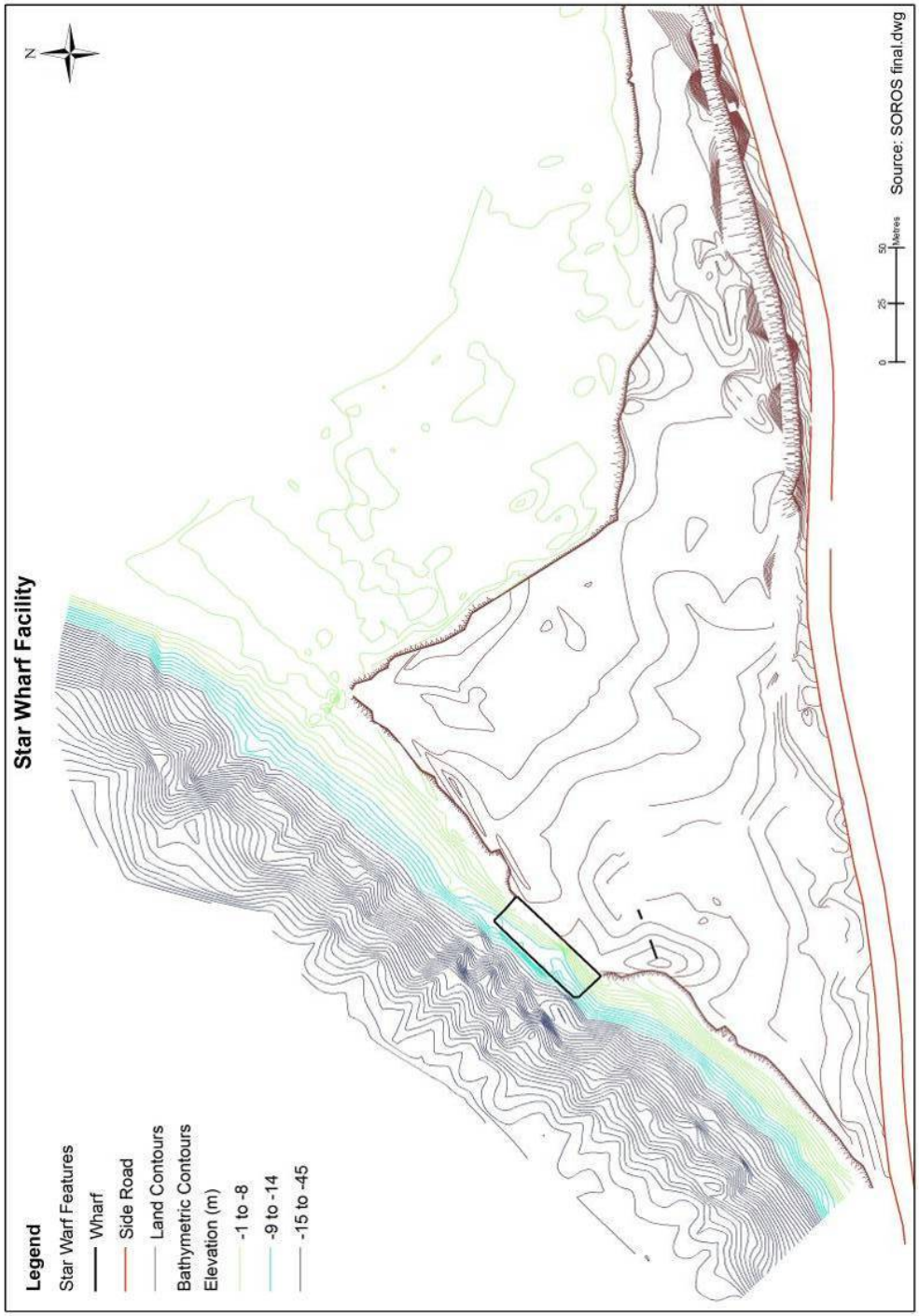


Figure 40: *Bathymetry contours at Star Wharf as taken my manual plumb-line in February 2010 (Source: Soros Associates).*

4.12 Oceanography, hydrodynamics & coastal processes

As far as could be determined through literature search during the Supplementary EIA, no recent studies or physical data collection of oceanography, hydrodynamics or coastal processes have been undertaken in Port Vila Harbour.

Apart from a baseline physical study by SPREP and SOPAC in 1983 (Carter 1983), general meteorological monitoring by the Vanuatu Meteorological Service and the SEAFRAME gauge referred to under section 9 below, oceanographic and hydrodynamic conditions in Port Vila Bay have mainly been derived anecdotally and theoretically. It is understood that SOPAC may have collected some oceanographic data in Port Vila using an Acoustic Doppler Current Profiler (ADCP) in the late 1990s/ early 2000's, and developed a basic hydrodynamic model – although it is understood that this was not validated or calibrated.

4.12.1 Waves

The Star Wharf is in a relatively sheltered location and appears to be subject to very moderate wave action.

In its planning report for the current upgrade of the Main Wharf (JICA 2008), JICA derives significant wave heights within Port Vila using the theoretical "single point spectrum model" based on horizontal data for winds in the south west Pacific, and planning points in Mele Bay and at the deepest point within the Harbour. This generated frequency tables for both wave height by direction and level and wave height by wave period.

The accuracy of this theoretical approach based on broad-scale regional wind data is subject to limitations and inaccuracies, compared to deploying a wave-rider bouy to collect real data.

4.12.2 Tides

Tide levels for Port Vila Harbour are shown on BA Chart No 1494 as follows (heights in metres above chart datum, which is approximately the level of Lowest Astronomical Tide):

Mean Highest High Water	MHHW	+1.2
Mean Lowest High Water	MLHW	+1.1
Mean Highest Low Water	MHLW	+0.5
Mean Lowest Low Water	MLLW	+0.2

Additional tidal information for Port Vila has been also derived from JICA (2008) as follows:

Highest Astronomical Tide	HAT	+1.6 m
Mean High Water Springs	MHWS	+1.3 m
Mean Sea Level	MSL	+0.9 m
Mean Low Water Springs	MLWS	+0.4 m
Lowest Astronomical Tide	LAT	0.0 m

The SPREP/SOPAC report (Carter 1983) states that the tidal prism amounts to approximately 5% of the total Harbour water volume, and that the hydraulic residence time for the Harbour is 69 days.

4.12.3 Currents & water circulation

Anecdotal advice from the Port Vila Harbour Master is that currents in vicinity of Star Wharf are generally not strong. In undertaking several survey dives on snorkel at the site and also around Iririki Island under various tidal conditions, the primary author of this Supplementary EIA did not experience noticeable currents at Star Wharf. However, currents on the ebb tide in the channel between Star Wharf and Iririki Island and on the west and north coast of Iririki Island, required significant effort to swim against even with large fins on. The SPREP/SOPAC study (Carter 1983) reports currents velocities in the Harbour of up to 0.8 m/s.

The original EIA for the Star Wharf development (Esrom 2006, page 15) states:

> *"Surface currents were observed during an entire tidal cycle to be between 0.3 to 0.10 m/s and currents at 15m depth were between 0.07 and 0.30 m/s. The surface current was set to the southwest most of the time during the field observation while the bottom current appeared to have a counter currents deeper out into the bay."*

However, no details are provided on the sources of this data, the sampling equipment and methods used, the data analysis methods used, nor the sampling sites, dates and times (such deficiencies are common throughout that EIA).

The SPREP/SOPAC study (Carter 1983) highlights the role that the shallow coral-limestone sills (ridges) play in separating each of the main sub-bays within Port Vila Harbour from each other, thereby restricting water circulation between the bays to the upper strata/surface layers, and keeping deeper waters largely stratified and isolated within each sub-bay. These act as settling basins that accumulate sediments, nutrients and pollutants, and which become anoxic at depth (esp. Paray Bay). This is a critical issue that needs to be considered should there be any proposals to increase connectivity between these sub-bays, for example by dredging a channel through Iririki Ridge to link Pontoon and Paray Bays.

As part of this Supplementary EIA, some current velocity sampling was undertaken opportunistically on 12 February 2010, using a locally-sourced hand-held current probe which is not well suited for marine use. The sampling was undertaken over a near-spring tidal cycle at three sites near Star Wharf (SW1, 2 & 3) and at two sites in the channel between Star Wharf and Iririki Island (C1 & C2). These sites are shown on Figure 33. Results indicate that tidal current velocities in the immediate Star Wharf area at that time of sampling are quite low (maximum velocity measured was 0.25 m/s). The full report on this sampling is contained in Appendix 9.

4.12.4 Tsunamis

Being located in a highly active seismic region Vanuatu is prone to tsunamis and two in particular have caused loss of life and damage to property since 1993. The SEAFRAME gauge in Port Vila referred to under section 9 has recorded 29 separate tsunami events since its installation in 1993. The largest tsunami signal to date, with a trough-to-peak height of 77cm, was recorded after an earthquake of magnitude Mw 7.5 near Vanuatu on 26 November 1999.

4.12.5 Conclusion

The lack of recent physical oceanographic data for Port Vila Harbour is a major deficiency and limits the ability to determine the real patterns of water circulation in the Harbour and undertake proper assessment of the likely impact of the project on hydrodynamics and coastal processes. The restricted budget and timeline for this Supplementary EIA did not allow for any proper collection of physical oceanographic data.

Ideally, as part of general master-planning for the whole of Port Vila Harbour, a comprehensive program to collect high quality oceanographic and hydrodynamic data, including current profiling and wind and wave monitoring, over a range of conditions and seasons, should be undertaken at representative locations and depths throughout the Harbour, as well as outside the Harbour to establish boundary conditions.

Ideally, the data collected should be suitable for developing, calibrating and verifying a four-dimensional hydrodynamic model for the Harbour. Such a model would be invaluable in assisting the assessment, planning and management of coastal development projects such as the Star Terminal proposal, especially when they involve alteration of the coastline, land reclamation and/or dredging. Such a model would also be useful for modeling likely dispersal of sewage and waste-water discharge plumes, dredge plumes, oil spills, introduced marine pests and other factors.

4.13 Other marine uses & users

In addition to being Vanuatu's major commercial port, Port Vila is also used by many other marine users for a variety of purposes, including but not limited to:

- subsistence fishing as referred in section 4.7.5,
- the main entry point to Port Vila for international cruise ships,
- a base for fishing charter vessels and cruising yachts,
- many very high-value waterfront properties and private vessels,
- the Iriwki Resort with over-water bungalows and various watersports,
- SCUBA diving, including at two wrecks within the Harbour (*QANTAS Flying Boat* in Paray Bay and *Star of Russia* in Pontoon Bay); and
- various other water-sports, both resort-based and run by local small-businesses, including sailing, para-sailing, wind-surfing, kayaking and snorkeling.

In addition, the shorelines of Port Vila are used as informal boat landings (originally canoe landings), where subsistence fishermen and local people transporting themselves and/or goods by small boat, simply pull-up to the shore and tie the vessel off as convenient (Figure 41).

Preserving such access to informal landing points is vital to enabling the maritime people of Port Vila to continue to use local-level water-based transport, as they have throughout history. However, the urbanization, industrialization and hardening of much of the shoreline is beginning to close-off these landing points and alienate such practices. Ideally, developments such as Star Terminal should cater for this through offsets in other areas.

Figure 41: *Small boats used for everyday transport, fishing and other traditional purposes tied up at an informal boat landing – in this case at Star Wharf (Source: Raaymakers)*

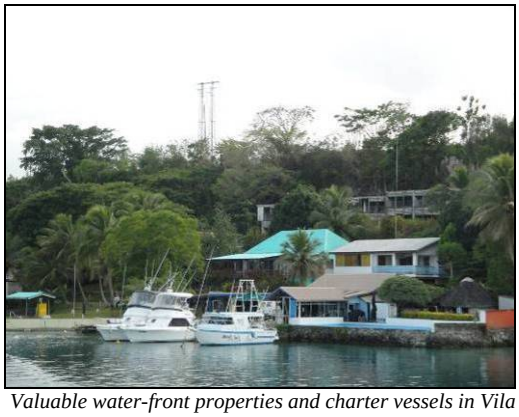
Figure 42 shows some examples of other uses of the Harbour. All of these activities are important contributers to the local economy, cruise ship visits contribute approximately AUD$30 million to the economy each year (Nell, pers, comms. 2010), and overall tourism in Vanuatu generated approximately 17% of the GDP in 2008 (AMSTEC 2010).

The proposed development and operation of the Star Terminal must recognize that the Harbour is a multiple-use area, and that measures need to be developed and implemented to protect other uses and users from potential impacts from the Terminal.

Perhaps the most significant potential threat from the proposed Terminal to these other uses and users, is the possibility of an oil spill from a ship using the Terminal. Even a relatively small spill of a few hundred or even a few tens of tonnes of Heavy Fuel Oil, could seriously impact on the marine tourism industry in Port Vila. Insurance and damage claims against the polluter could possibly reach tens of millions of dollars. This is of particular concern as Vanuatu is not currently a party to the latest international marine pollution compensation regime.

Iririki Resort, showing how clear the Harbour waters can be. If contaminated by an oil spill, tourism would be impacted

Cruise ship at the Main Wharf – this industry injects AUD$30 million/year into the local economy



Valuable water-front properties and charter vessels in Vila

As per left – if contaminated by an oil spill, damage claims against the polluter could be significant

Para-sailing over Port Vila Harbour – a valuable small business for a local operator

SCUBA diving on the Star of Russia – a popular dive site in Pontoon Bay, not far from Star Wharf

Tourists on a resort catamaran enjoying the turquoise water right in front of Star Wharf

Figure 42: *Some of the other uses of Port Vila Harbour, which need to be protected from possible impacts from the proposed Star Terminal*

4.14 Cultural heritage

(drafted by Francis Hickey with input from Mr Tari Kalkateri and Chief of Ifira)

While Vanuatu, Port Vila and the Star Wharf site do have significant non-native cultural heritage and history, including from the joint British-French colonial era (Condominium) and the US and Allied presence during WWII, it is the customary landowners of the area, the Ifiran people, who's cultural heritage may be impacted by the proposed development. This section will therefore focus on ni-Vanuatu cultural heritage, with only a brief discussion of the history of Star Wharf and one possible WWII relic currently on the site, the Nissan Hut.

4.14.1 Customary landowners - the Ifiran people

The area of Star Wharf is under the traditional tenure of the people of Ifira Island that sits at the entrance of Port Vila Harbor. Most of the land around Port Vila (along with many other areas throughout the islands), was alienated by Europeans for plantations and for the Capital of the New Hebrides Condominium. All alienated lands were returned to the indigenous inhabitants at independence in 1980, when the Republic of Vanuatu emerged as a new state.

Along with people at Mele and three other islands in Vanuatu, the people of Ifira are unique in Vanuatu in they speak a Polynesian dialect. Many Polynesian 'Outlier Islands' are known throughout the Western Pacific, being populated by 'back migrations' into Melanesia from Polynesia between 800 and 1200 years ago

During the 1800s, starting with the traders and missionaries, massive depopulation occurred throughout Vanuatu from the introduction of diseases and subsequent migration. Under the influence of the missionaries, during this period many people came to Ifira from the inland areas of Bouffa and Rangorango via Tagabe and Malulapa.

Living on a small island surrounded by the network of bays and lagoons of what is now Port Vila, the Ifiran's have always been a saltwater people with a strong marine and seagoing heritage. Today, they own and operate one of the larger coastal trading vessels, the *Sarafenua*, as well as *Ifira Trustees Limited* and *Ifira Wharf and Stevedoring Company*, which operates the existing Star Wharf.

4.14.2 The oral history of Star Wharf - Warasa & Lapetasi

A key feature of both Polynesian and Melanesian society is links to land and place, including the coast and the sea. For ni-Vanuatu, land and sea are like a nurturing mother, always providing the basis of food and social security, as well as the link with ancestors who came before them, and with subsequent generations that will continue the tradition. Most places and prominent geographic features of Vanuatu have names that are linked with the oral histories of a cultural group. Each group's oral history records and reflects their history and world view and are an integral part of the group's identity. The Star Wharf site is one such place.

The oral history of Ifira records that the area of Star Wharf is known as *Warasa.* This is known as a tabu place inhabited by an ancestral being in the form a one-armed octopus called *Lapetasi*. Lapetasi is an *abu* (ancestral totem) of the octopus clan of the Ifira people. The Ifiran clans (*naflak*) are matrilineal. Chief *Roi Mata* introduced this system at a ceremony at

Tuktuk near Devils Point on western Efate in the early 1600s, to maintain peace between the different tribes and villages.

This highly respected Chief, who remains famous on Efate and throughout the Shepherd Islands still today, invited people from all over Efate (who were in a state of warfare at the time) and asked them to bring any sort of food to the gathering. People who brought coconuts became part of the coconut clan, while those that brought yam became part of the yam clan, etc, and through this way, people from all over Efate became united into various clans or *naflak*. This brought peace to the island of Efate and helped to secure the well respected memory of this great Chief who was eventually buried on *Eratoka* (Hat) Island.

The octopus clan, (*naflak wita* in Ifira language) has very strong cultural links to the Star Wharf area, and in the old days would call upon *Lapetasi* to defend them against their enemies. This area therefore demands significant respect, to not only the octopus clan, but to all the people of Ifira. To this day, people who do not show respect in this area, such as making loud noises and shouting out recklessly, invite the wrath of *Lapetasi*.

There are many such sites throughout Vanuatu and their spirit remains alive amongst many people, regardless of physical developments and disturbances that may overlay or surround them. During construction of Star Wharf in the early 1970s, accidents occurred resulting in the death of some heavy equipment operators. Traditional belief attributed this to the workers having offended *Lapetasi*.

In other cases, people who have chosen to drink alcohol and become disorderly along the roadside near Star Wharf have sometimes found their vehicle end up in the sea with people inside. Some would say this may have been due to drunk driving, others say it is a result of not respecting the special significance of the site.

More recently, in 2002, a young crew member of a ship drank some kava and sat on the wharf at night. The next day he was found drowned beneath the wharf, and it is believed he had also somehow offended *Lapetasi*. There is a stone memorial on the wharf, placed by his family, to mark the spot where this occurred (Figure 43). This is to be retained in new the new development.

Figure 43: *Memorial on Star Wharf to sailor who drowned there in 2002 (Source: M Christensen).*

An example of how the Ifira people simultaneously act as both traditional owners with very strong cultural and spiritual ties to the site, as well as developers and operators of the Star Wharf, is provided by when further land reclamation was undertaken in 2009. On the order of the Chief of Ifira, the *naflak wita* organized a small ceremony to ritually explain to *Lapetasi* what they were doing, and a white fowl was sacrificed to him. This was done in order to show continued respect to their ancestral totem, so that he would understand their intent in developing the wharf area, and not be angered in seeking retribution for disturbing him and altering his habitat. This ritual was a sign of respect to their *abu* and the environment, and illustrates that this system of respect is still an important component of the life of the people of Ifira.

This system, which continues to promote respect to ancestors, places and clan members, should be maintained as the people of Ifira deem appropriate, and should be accounted for before any additional reclamation of land or construction is undertaken. The *naflak* system remains an integral part of people's lives and links with land and sea, relationships with people, and continues to play a role in maintaining peace and harmony. This system also plays an important role in maintaining respect for the environment and the management of

natural resources, as in most tabu areas of Vanuatu, people seldom visit these places, nor would negatively affect the environment or over-harvest resources.

Just east from *Warasa*, marked by a large banyan or fig tree (*Ficus subchordata*) is the place where *Lapetasi* is resident, also called *Lapetasi* (Figure 44). He is known to range out of this area and through *Warasa* and to the surrounding general area. About five years ago, an infant swimming with his father was attacked at a nearby beach (*Katatara)* by a giant octopus. The father managed to rescue the child and it is believed by some that this may have also been *Lapetasi*.

Figure 44: *The largest Banyan, or Fig Tree, in the Star Wharf area – marking the home of Lepatasi. The nautilus area 'Fatu Panuki' is found on the reef directly to seaward of this tree (Source: F Hickey)*

Directly to seaward of *Lapetasi* is the light coloured underwater limestone ridge which drops-off into Paray Bay, known as *Fatu Panuke* ('stone of the nautilus'). This area, visible from the shore under clear conditions, is where the marine cephalopod (*Nautilus pompilus*) was formerly found in abundance (Figure 45). This mysterious species makes diurnal vertical migrations, moving to deep water in the day and coming to the surface at night, where they were formerly seen by local night divers. The curved shell with red markings is popular with collectors. These are no longer found in abundance in this area, possibly due to declining water quality in Paray Bay.

Figure 45: *Example of the marine cephalopod (Nautilus pompilus) which used to rise out of the depths of Paray Bay at night, in the area known as Fatu Panuke (Source: nature.com)*

4.14.3 Tekoni & Vatumaru springs

An additional important cultural-heritage and historical site is found west of *Warasa,* called *Tekoni* (Figure 46). This place used to have a natural freshwater spring at the cliff base, under the shade of some large coastal trees, and was the primary source of spring water for the people of Ifira. For a people living on an extremely small island, this source of fresh cool spring water is an important site in their history. *Tekoni* was the name given to the former pilot boat used in Port Vila Harbour.

The Tekoni spring has been buried by the original reclamation work to build Wharf Road and the Main Wharf, but still manages to flow to the surface at certain times. Houses on Ifira Island are now served by rainwater tanks and town water.

Another such spring exists in the traditional territory of Ifira, at the head of *Vatumaru* Bay. It is said that this source was used for the washing of clothes (once they had been introduced) while the spring waters of *Tekoni* were reserved for drinking purposes. Today, this spring in Vatumaru Bay continues to provide a cool swim for people living in this area, and contributes to maintaining the only significant stand of mangroves found in the Port Vila area. These mangroves, along with the seagrass meadows of Vatumaru Bay, continue to act as a significant fish breeding and nursery area, and need proper protection and management.

Figure 46: *Mr Tari Kalterekie, Land Manager of Ifira Trustees, standing at 'Tekoni' freshwater spring (Source: F Hickey)*

4.14.4 Canoe landings & gardens

Located just west of the Main Wharf was the main canoe landing used by people of Ifira to go to their gardens in the hills above the Main Wharf. This landing is called *Pilingara*, and is important in that the vertical cliffs of the *Warasa* area near Star Wharf, precluded access to the garden areas above, an area now known as Le Plateau, but traditionally called *Filmal*.

The main plateau area used for gardening today is located above the *Pilingara* canoe landing, and is known as *Maltauriki.* There is an ancient trail directly to land-ward of the Main Wharf that is still used to access local gardens in the *Maltauriki* area, and this name has been given to the new tug boat provided to the Department of Marine & Ports by JICA.

Further west of *Pilingara* is an area called *Faturae*, meaning the 'stone of the unicorn fish' (*Naso annulatus*), that were once plentiful in this area. West of *Faturae*, the bay curves to become a sandy beach. This area is called *Katatara* and a small freshwater spring still exists

amongst the large boulders there. This area has recently (late 2009) been reclaimed with fill and formerly had mangroves that were buried in the original land reclamation associated with the road construction to Ifira Point (Figure 47).

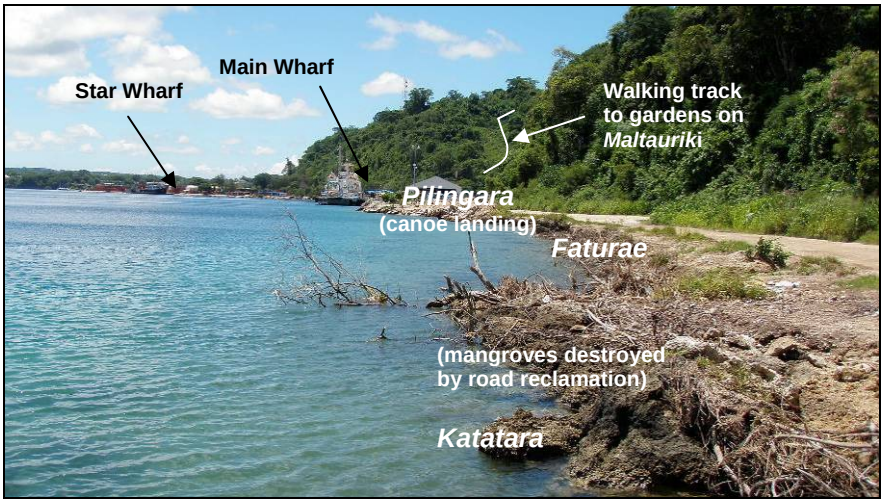


Figure 47: *Looking east from 'Katatara' through 'Faturae' towards 'Pilingara'. The small spring of 'Katatara' is just to the right of the road (Source: F Hickey)*

The sites of cultural heritage significance described above are summarized in Table 3.

Table 3: *Summary of sites of cultural heritage significance*

Site Name	Position	Site Significance
Lapetasi (Fig Tree)	17 45.347 S / 168 18.497 E	Residence of Lapetasi.
Warasa	Star Wharf	Tabu place of Lapetasi; current location of Star Wharf.
Tekoni	17 45.420 S / 168 18.075 E	Formerly the main freshwater spring for Ifira.
Pilangara	17 45.408 S / 168 17.889 E	Main canoe landing for Ifira to access mainland gardens.
Faturae	Between Pilangura & Katatara	Stony shore supporting abundant Unicorn fish.
Katatara	17 45.412 S / 168 17.757 E	Beginning of beach leading to Ifira Pt.; small freshwater spring.

14.14. 5 Brief history of Pontoon Bay & Star Wharf

Port Vila was originally an important harbour for the then New Hebrides as it offered a deepwater port with good protection from all winds. This was of obvious importance in an area of regular cyclones occurring throughout the summer months. Port Vila was also the administrative seat of the Condominium as well as a significant centre for trade and export of plantation goods. Pontoon Bay, where Star Wharf now sits, got its name from the days when a ship was anchored just off the current Star Wharf site. This 'pontoon' allowed visiting cargo vessels to come alongside and tie to while offloading their cargo to small lighters for transport of goods to Port Vila. At this time there was still no road to this area, so access was restricted to vessels only, as the sea went right to the base of the cliffs that rise to Le Plateau above

In the 1960s a Frenchman named Ardimani who worked for the Public Works of the Condominium, created a small bay at the current Star Wharf site through land reclamation.

Elders of Ifira remember ships arriving from Erromango Island loaded with kauri trees that were offloaded here and anchored in booms in this bay. They would then be towed out to ships anchored further out in Pontoon Bay where they could be loaded for export.

In the early 1970s, the Dew Company was contracted to construct the Main Wharf (also known as the 'Government Wharf' and the 'Administration Wharf'). Fill from this project was used to build the road to the Main Wharf and further reclaim land at Star Wharf (Figure 48). Limestone was also dug from the cliffs above and pushed over the cliff to the Star Wharf site below. This process formed a deep and wide gully from the cliff top down to sea level.

Nobody has been able to advise where the name 'Star Wharf' was derived. The facility has previously been called "Ardimani Wharf" after the Frenchman who worked for Public Works in the 1960s, and the site is marked such on the official British Admiralty chart for the area (BA 1494).

One of the local dive shop operators advised us that the term 'Star Wharf' was originally applied to the Main Wharf given its proximity to the wreck of the *Star of Russia,* so it is not clear how 'Ardimani Wharf' began to be referred to as 'Star Wharf'.

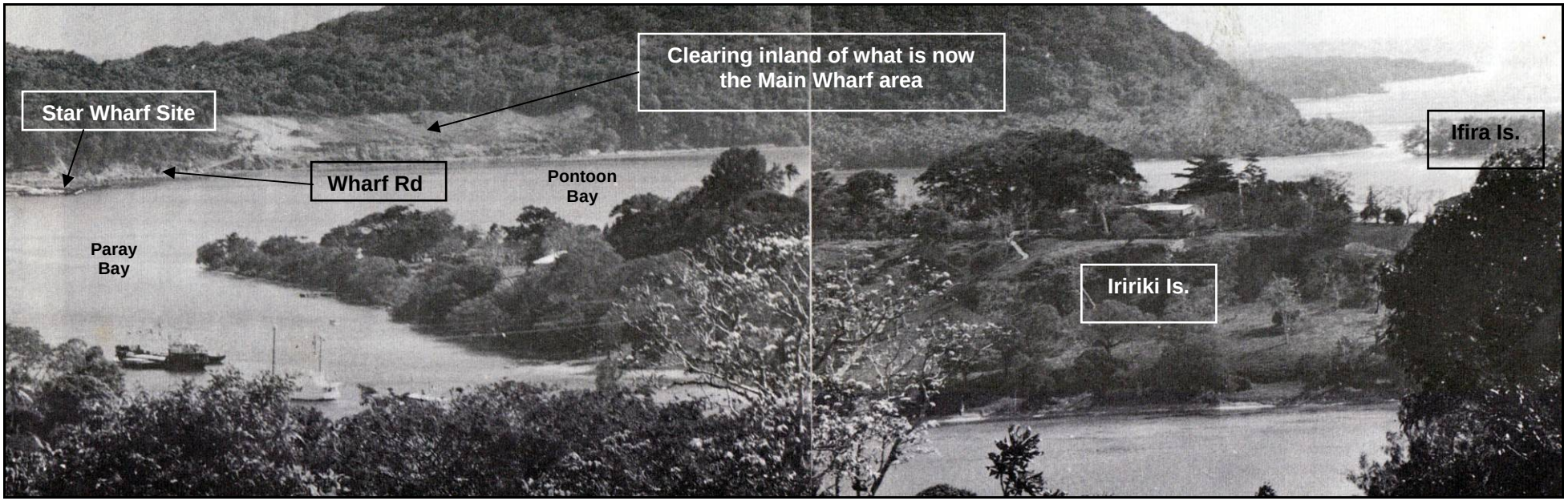


Figure 48: *Two-photo mosaic of Port Vila (undated) showing commencement of works on the slope behind what is now the Main Wharf area, the establishment of Wharf Road and the initial reclamation at what is now the Star Wharf area (Source: Vanuatu National Culture Centre)*

14.14.6 Nissan Hut

The only physical structure found actually on site that is of potential significance to cultural-heritage is the curved-roof Nissan Hut used as part of the on-site workshop (Figure 49). These prefabricated huts were widely used by US Forces during WWII, and many of them can be found still standing throughout the Pacific and northern Australia. As there was no land at Star Wharf during WWII - the frame for this hut would have had to have been moved to the site from elsewhere - although we were not able to discover any details. It has concrete end walls, which apparently was not typical of these huts during WWII. Unless other plans are made, it is proposed that the Nissan hut be demolished as part for the new terminal development.

Figure 49: *The WWII era Nissan Hut at Star Wharf - including internal frame structure at top (Source: Raaymakers)*

The location of the cultural heritage sites in the vicinity of Star Wharf are shown in Figure 50.

Figure 50: *Cultural heritage sites in the vicinity of Star Wharf*

5. CONSTRUCTION PHASE IMPACTS

5.1 Land based activities

5.1.1 Impacts on terrestrial biodiversity - clearing of site vegetation

Construction of the new Star Terminal will involve clearing of all of the existing on-site vegetation described in section 4.6 and Appendix 5, to provide a clear hard-stand for container storage and handling, and prevent contamination of containers by seeds, leaves and other vegetative matter.

This clearing is not considered to be a significant impact on biodiversity for the following reasons:

- all on-site vegetation has been planted by humans since construction of the facility in the early 1970's (i.e. it is not part of a natural biodiversity community),
- most of the plant species on site are non-native introduced species,
- no significant examples of wildlife were observed to be using the on-site vegetation; and
- there is a significant area of native tropical forest on the cliff slope immediately to the south of the site, which will not be impacted by the project.

The exception are the two large fig trees to the east of the existing main gate, which are the most significant terrestrial biodiversity resources on-site, and which support bird and flying fox species. Ideally the new terminal design should attempt to allow for the retention of these two significant trees, or at least just partial pruning of the terminal side.

As outlined in section 4.6, another significant tree is the Canoe tree (*Gyrocarpus americnus*) on the east side for the Nissan Hut. While it has to be removed as part of the development, the timber should be used. It could be carved into a traditional canoe to go at main gate of new terminal, and which might be included as element in new Star Terminal logo.

As outlined in section 4.6, the Cycad at the Security Hut at the Office Gate, could be retained/transplanted/replaced as an entrance feature, given its traditional cultural significance as a boundary marker.

Additionally, design of the new terminal should provide for landscaping and tree planting around office areas and along the fence line away from operational areas of the terminal, using both native species and species that produce fruit and other benefits for workers, as is currently practiced on site (and throughout the Pacific).

It is also recommended that just prior to clearing of the existing site vegetation, workers be invited to harvest any fruit and other useful products that might be present on the trees, and to take cuttings for transplanting elsewhere, including their homes and plantations, if desired.

5.1.2 Demolition of existing buildings

According to Soros Associates, demolition of the existing buildings will generate approximately 1,234m^3 of concrete waste, 275m^3 of metal waste, 483m^3 of other demolition waste and 900m of fencing.

There is a scrap metal company in Port Vila who could be interested in most of the 275m^3 of metal and the 900m of fencing. Also, most of the 1,234m^3 of concrete could be used in the reclamation at the site. This would leave only the 483 m^3 of construction waste to go to the Port Vila landfill.

Prior to demolition, a detailed assessment should be made to asses what material can be re-used as part of the development, or re-used or recycled in another way, e.g. by tender or sale, or given to company workers. Items include roofing, shed-cladding, shed steel frames, and fittings such as air-conditioners.

There may be hazardous materials associated with the demolition waste, such as refrigerant and air-conditioning coolants, fire extinguisher chemicals, septic tank sewage and residues and possibly asbestos. Proper arrangements need to be developed and implemented to allow for the identification, assessment and management of any such wastes prior to demolition works commencing.

Demolition of the existing building will create traffic, dust, noise and other impacts as outlined below.

5.1.3 Construction of new facilities

Construction of the new land-based facilities including new office, carpark, workshop, storage shed/bond facility, vehicle and container storage and handling hard-stands, container wash-down facility, refrigerated container facility and fuel-storage/refueling area; will create traffic, dust, noise, run-off and other impacts as outlined below.

5.1.4 Sourcing of reclamation material

Material for the proposed land reclamation will primarily be coral-limestone sourced from the dredging of the berth pocket just seaward of the new wharf (~ 60,000m^3 of material). This will be pumped directly from the dredge to the reclaim area, reducing impacts from quarrying and transport of fill material from land-based quarries.

Some material may still need to be sourced from existing commercial quarries in the Port Vila area. These quarries should have Quarry Permits under the *Mines and Minerals Act* and the management of environmental impacts is the responsibility of the quarry owners/operators.

As stated above concrete waste from demolition of existing buildings can go to the reclaim area, reducing the amount of quarrying required by up to 1,234m^3, and thereby reducing environmental impacts from the quarrying itself and transport of the material to site.

It has been suggested that reclaim material might be sourced more cost-effectively by quarrying lands owned by Ifira shareholders, and/or from a marina development proposal which requires dredging, South of Port Vila. Should such options be pursued, the proponent should ensure that the fill source(s) have the necessary EIA and regulatory approvals in place, before purchasing.

5.1.5 Traffic

Construction of the new facilities will result in an increase of traffic using Wharf Road and other roads throughout Port Vila for a variety of purposes, including:

- transportation of workers from locations in Port Vila to and from the site,
- transportation of demolition material and construction waste from the site to land-fill,
- transportation of building materials from the Main Wharf and other locations to the site,
- transportation of mixed concrete from the concrete batching plants to the site; and
- transportation of reclamation fill material from the local quarry(ies) to the site.

The main transportation routes for the above are shown on Figure 51. All road traffic that services the construction phase should be required to comply with all relevant Vanuatu traffic laws and will be operated by licensed divers. The project proponents and construction contractors should be required to liaise with the Vanuatu Police Service and the Port Vila Municipal Council prior to transportation of any particularly large or unusual items by road.

Figure 51: *Possible construction phase traffic routes*

5.1.6 Noise, dust & fumes

All construction activities will result in an increase in noise, dust and fumes typical of any industrial construction site, and as currently observed at the development of the nearby Main Wharf.

Apart from a few houses located near the top of the cliff slope immediately to the south of the site, there are no residential communities nearby, and increased noise, dust and fumes will primarily be an on-site issue.

Measures that are recommended to address noise, dust and fumes during construction phase include:

- restricting works to between 5am and 9pm to avoid possible breaching of the *Control of Nocturnal Noise Act,*
- ensuring that all on-site workers have appropriate ear protection according to construction works-site and machinery operation standards,
- having a dust-suppression water truck available on site to lay-down dust along the sides of Wharf Road and on site during dry and dusty periods; and
- ensuring that all vehicles, plant and machinery used during construction are properly serviced and maintained to avoid excessive exhaust fumes.

5.1.7 Impacts on soil quality

As outlined in section 4.4, qualitative observations during Supplementary EIA site visits indicate that there are a number of sources of chemical contamination of soils on-site, including clear signs (large oily stains) of spillages of fuel and oil directly onto the substrate near the existing workshop and fuel storage area and at numerous other locations around the site.

These sources of soil contamination may potentially increase during the construction phase, and there will be larger numbers of vehicles, plant and machinery using the site. It is therefore important that prior to construction commencing, proper arrangements are developed and implemented for:

- the servicing, oiling and refueling of vehicles and machinery,
- the safe storage, handling and containment of oils, fuels and other chemicals used during the construction phase,
- the handling and management of all waste oil and oily waste generated during the construction phase (see also section 7 below); and
- the prevention, containment and clean-up of any spills of these materials.

5.1.8 Impacts on freshwater quality - including groundwater

As per section 5.1.7 plus the construction phase also has the potential to increase silt and sediment loads in on-site freshwater runoff and groundwater. Prior to construction commencing, proper arrangements will need to be developed and implemented for temporary on-site drainage and siltation control.

Demolition of the existing facilities will also include demolishing the existing sewerage pipes and septic tanks. Prior to construction commencing, proper arrangements will need to be developed and implemented to ensure that on-site freshwater runoff and groundwater are not contaminated by sewage from these demolition activities.

Provision will need to be made for on-site toilets and sewage management, adequate for the anticipated construction workforce.

5.1.9 Impacts on terrestrial cultural values

The two large Fig trees on Wharf Road (one just to the east of the existing Main Gate which marks the area called *Warasa*, part of the range of *Lapetasi*, and the larger one at the eastern end of the site which marks the area called *Lapetasi*, the home of *Lapeatsi*, as outlined in section 4.14), will be retained as part of the new development - ensuring that these significant cultural sites are respected.

As the area of Star Wharf is generally part of the range of *Lapetas*i, and as site works, including dredging and land-reclamation, will cause significant disturbance during construction, it is recommended that the Chiefs of Ifira undertake relevant traditional site 'blessing' before construction commences, and that the EMMP recommended in section 11 be fully implemented to minimize this disturbance.

The cultural heritage sites to the west of Star Wharf (*Tekoni* freshwater spring, *Pilangara* canoe landing, *Faturae* unicorn fish area and *Katatara* freshwater spring), will not be affected by the proposed development.

The Nissan Hut which appears to have been moved onto the site after WWII (as there was no land there during the war), is proposed to be demolished as part of the development, unless other parties are interested to salvage and relocate it.

The memorial to the seaman who died in an accident on Star Wharf in 2006, will be retained and re-established in a discrete location at the new wharf.

In summary, the likely impacts of construction activities on terrestrial cultural heritage are unlikely to be significant, so long as:

- the two large Fig trees which mark the areas called *Wararsa* and *Lapetasi* are protected,
- the correct traditional blessings of the site and works are undertaken before commencement,
- construction management and workers are inducted about the cultural sites and the need to show respect during construction works; and
- the recommended EMMP is implemented properly.

5.2 Marine activities

5.2.1 Demolition of existing wharf & piles

According to Soros Associates, demolition of the existing wharf and piles will generate approximately 300m^3 of concrete and steel waste which should either be used for fill in the expanded land reclamation (if structurally suitable) or taken to land-fill at the official Port Vila land-fill site.

These demolition activities will destroy or significantly damage most marine life beneath and adjacent to the wharf and attached to the piles, as described in section 4.5 and Appendices 6 and 7. While regrettable, such loss is unavoidable and is not considered to be significant in the context of Port Vila Harbour as a whole, given the relatively small area that will be affected (50m x 5m) and the larger areas of healthy marine communities in other parts of the Harbour.

Additionally, in this productive tropical environment new marine life will rapidly colonize and populate the new wharf structures and piles.

In order to prevent the potential spread of possible introduced species detected on the existing wharf piles by the *Initial Marine Pest Assessment* (see section 4.7.6 and Appendix 7), the demolished piles should not be disposed of in the marine environment, but should be removed and disposed of to reclamation or land-fill.

Demolition of the existing wharf and piles may generate some disturbance and dispersal of silts and sediments, which may impact on marine life immediately adjacent to the site. To help mitigate such impact, marine silt curtains should be deployed around the work site during all marine demolition, reclamation and construction activities (Figures 52 and 53) (see also land reclamation, section 5.2.3 and dredging, section 5.2.4 below).

Figure 52: *Example of marine silt curtains deployed around marine works to prevent spread of siltation.*

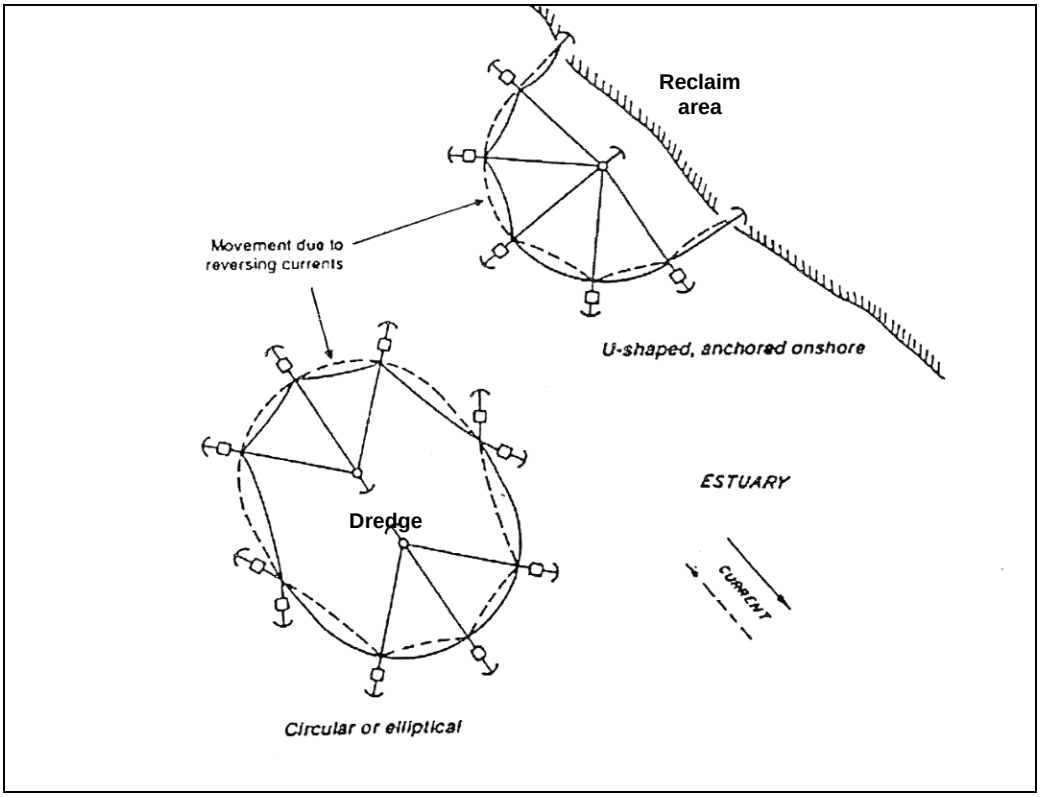


Figure 53: *Examples of how silt curtain can be deployed to prevent spread of sediment plumes from either reclaim or dredging works. In shallow areas (<3m) it may be more effective to stake rather than anchor the curtain. In some situations the dredge may only need to be screened downstream rather than fully encircled*

The silt curtains for works in the Wharf area need not drop the full depth to the sea-bed, which is unworkable, but just the first 2-3 metres of the water column, to drop any sediments out before dispersal by wind-driven surface currents (in the reclaim area where marine resources are much more valuable and sensitive, where depths are shallower and where silt curtains can be deployed more statically, they should extend vertically the full depth to the seabed - see section 5.2.3).

It is recommended that just prior to any marine works commencing, the Vanuatu Department of Fisheries be invited to undertake a Biota-Clearance Dive to pick-up any easily movable marine organisms such as sea cucumbers, star fish and loosely attached staghorn corals, and moves these out of the impact zone to other suitable habitat in the Harbour (e.g. on the reef shelf extending to Iririki island).

The local marine aquarium collector may also be invited to collect all species of aquarium trade value (e.g. clown fish, lion fish) from the impact zone just prior to marine works commencing (refer Appendix 6).

From a cultural heritage perspective, demolition of the existing wharf will remove the memorial to the seafarer who died there in 2002, as described in section 14.4. Out of respect it is recommended that this be preserved and mounted in a discrete location on the new wharf.

5.2.2 Pile driving

Construction of the new wharf will involve driving 106 hollow steel piles into the seabed to carry the wharf platform. Pile driving can cause significant underwater noise over long

distances, and underwater noise can interfere with marine mammals which make use of sonar and sound for navigation, hunting and communication, such as whales and dolphins. Such species generally do not frequent the project site or Port Vila Harbour in general, which is a working port with many sources of underwater noise from vessel operations. However, in 2009 Humpback Whales (*Megaptera novaengliae*) returned to Vila Harbor on their annual breeding migrations (historically they used this area). This occurred in September and the main migratory months are July to November (Hickey pers. comms. 2010).

5.2.3 Land reclamation

A minimum of 1 ha and up to 1.6 ha of the healthy coral community found on the eastern side of the site as described in section 4.7.6 and Appendix 6, will be destroyed outright by the proposed land reclamation (Figure11). While regrettable, such loss is unavoidable and is not considered to be significant in the context of the Harbour as a whole, given the relatively small area that will be lost and the larger areas of healthy marine communities in other parts of the Harbour.

However, considering that there are other, separate development proposals for the marine area to the east of the Star Wharf site, including the Domestic Wharf proposal, accumulative impacts on the coral communities in this area may become significant.

Coral communities beyond the immediate reclaim area, including the numerous patches on the shallow shelf that extends between Star Wharf and Iririki Island, could also potentially suffer indirect turbidity and siltation impacts during construction of the reclamation. To help mitigate such impact, as described above, marine silt curtains should be deployed around the work site during all land reclamation activities (in the reclaim area where marine resources are much more valuable and sensitive, where depths are shallower and where silt curtains can be deployed more statically, they should extend vertically the full depth to the seabed).

As outlined for section 5.2.1, it is recommended that just prior to any reclamation works commencing, the Vanuatu Department of Fisheries be invited to undertake a Biota-Clearance Dive and that the local marine aquarium collector also be invited to collect all species of aquarium trade value from within the impact area.

As an environmental off-set for destroying the coral community in the reclaim area, it is recommended that consideration be given to establishing a traditional *tabu* and community-based marine resource management plan over Vatumaru Bay (Figure 54). This is the main fisheries nursery for Port Vila Harbour and is currently severly degraded by over-exploitation and pollution. Prohibiting the use of fine-mesh nylon nets, prohibiting the harvest of sea-cucumbers and controlling other forms of fishing in Vatumaru Bay would allow populations of edible species to begin to recover not only there but throughout the Harbour, with future benefits to local resource users. This would also help re-establish traditional management of marine resources by the traditional owners of these resources – the Ifiran people.

Figure 54: *Possible community-based marine resource management plan over the Vatumaru Bay - a potential environmental off-set for the loss of the coral community at the Star Terminal reclaim area*

5.2.4 Dredging

The proposed development includes the removal of approximately 60,000m^3 of material from a 0.33 ha area along the front of the wharf (Figures 11 & 13), to bring the berth depth down to -12.3m, as required to provide mandated Under Keel Clearance (UKC) for the project design vessel, while ensuring structural soundness of the revetment slope beneath the new wharf.

In developing the project design, Soros Associates investigated all possible options to avoid the need to dredge, including extending the reclamation and new wharf further sea-ward to the natural 12 and 14m contours. However, the dropoff slopes away to seaward extremely quickly, presenting major engineering and cost obstacles in the significantly extended revetment and deeper pile driving that would be required to reclaim and build further seaward in that area.

The amount of material to be removed is relatively small, and will be pumped directly from the dredge to the reclaim area, for productive use, thereby avoiding the impact of disposing the material at sea. Geotechnical data for the area (Coffey Geotechnics 2010) indicates that the dredged material will comprise coral limestone-based sandy gravel, gravel and gravelly clay, and karstic bioclastic limestone (coral limestone).

It is most likely that a cutter-suction dredge will be used, or possibly a grab-dredge (Figure 55). The cutter-suction dredge is one of the cleanest types of dredges, as a significant percentage of disturbed silt is sucked-up by the dredge.

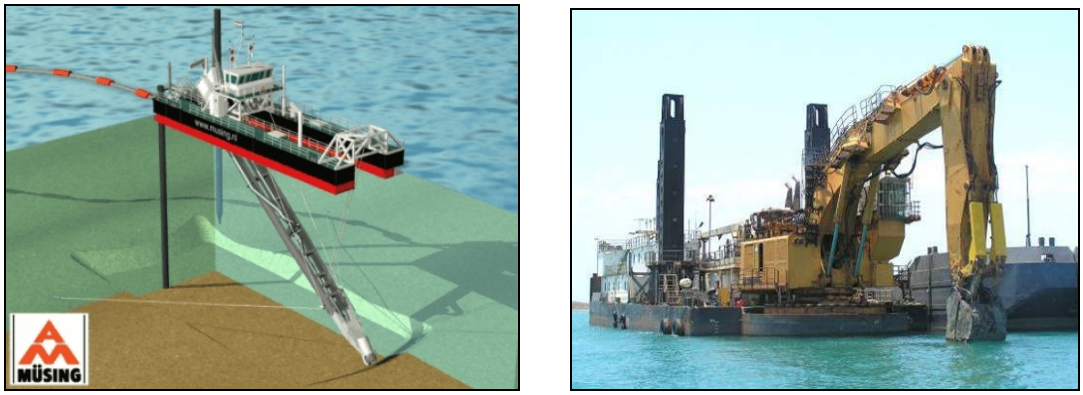


Figure 55: *Left: Cutter-Suction Dredge and right a type of Grab Dredge* (Source: AM Musing)

Figure 56: *The 'business-end' of a cutter-suction dredge – the 'cutter-head'. Any marine life that comes in contact with it when operating will be destroyed/severely damaged* (Source: dredgebroker.com)

However, significant silt plumes will still be produced (Figure 57), and silt curtains will need to be deployed around the dredge, to protect adjacent coral areas. The material pumped to reclaim will contain a percentage of water and dewatering of the reclaim area can cause significant sediment plumes and impacts on adjacent areas. Dewatering arrangements for the reclaim area will need to include provisions for dropping-out silts (e.g. staged ponding), and silt curtains will be required around the reclaim area.

Figure 57: Turbidity from dredging in reef areas. Sediment plumes can impact on adjacent corals and other resources. In the left image a silt curtain can be seen at top right, held in place with stakes. This might be the best method for fixing the silt curtain at the Star Wharf reclaim area (Source: left GBRMPA , right gldd.com)

Any marine life present in the actual area to be dredged (0.33ha) will be destroyed by the cutter-head and sucked up into the dredge. A marine biodiversity transect of the area (Transect T1.2 - Figure 58) indicates that the area is mostly bare coral rock with sparse filamentous algae and signs of a few molluscs, so this impact is minimal.

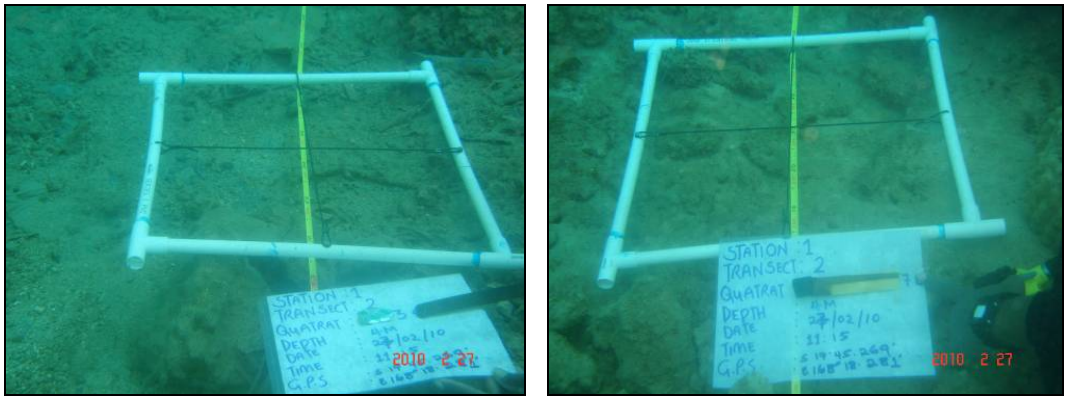


Figure 56: *Quadrat 4 and 7 on Transect T1.2 showing that the seabed in the area to be dredged is not rich in marine life (Source: S Gereva).*

Removing 60,000m^3 of material and altering bathymetry will change local hydrodynamic processes, although it is not possible to accurately assess this due to a lack of physical oceanographic data and no hydrodynamic model for Port Vila Harbour. Ideally, this should be done and used to assess all developments in the area. Current velocities in the area are assessed to be low (<0.3m/s) although data is extremely limited, and there is no data on current directions and water circulation over a range of conditions.

From a cultural heritage perspective the proposed dredge area is close to *Fatu Panuke* ('stone of the nautilus'), the site described in section 4.14 where abundant Nautiloids used to migrate

to the surface at night from the depths of Paray Bay. However, Ifira reports that these are no longer seen by night divers, and numbers may have declined due to water quality impacts. This highlights the value and sensitivity of the marine ecosystem in the area, and the need for careful management of dredging and other development activities.

Ongoing maintenance dredging is unlikely to be required as the area is a generally low-silt environment, and the berth is not a sunken pocket into which silts will accumulate, but rather a cutting out of an existing slop. The berth area slopes off very quickly to deep water in Pontoon Bay, where silts will gravitate. Additionally, vessels using the berth will self-scour any small accumulations of silt through prop-wash.

Overall, it is assessed that impacts from the dredging, in the form described, are not likely to be significant. However, it should be noted that the 1 in 4 slope proposed to be dredged at the north east tip of the Star Terminal berth (Figures 11 & 13), begins to cut into the coral ridge extending from Star Wharf to Iririki Island (Iririki Ridge). Should dredging be proposed that differs from what is described in this report, including any further into Iririki Ridge, the potential impacts, including on water quality, hydrodynamics, coastal processes and geological stability, should first be assessed in detail, including through collection of necessary physical data and development of a hydrodynamic model.

If dredging across Iririki Ridge to link Pontoon and Paray Bays is proposed, the potential impacts of increasing the connectivity of these two bodies of water would need to be very carefully assessed, including on water quality in Pontoon Bay.

Should not all of the dredged material be suitable for land reclamation and there arises a need to dump some of it at sea, any such proposal should be subject to a full EIA in its own right. This should include assessment of the contamination status of the material, and full environmental surveys of any proposed dump site(s), including oceanographic data collection and hydrodynamic modeling of likely plume and material dispersal. The Australian *National Assessment Guidelines for Dredging* (Australian Government 2009) provide comprehensive guidance for such assessments.

Assessment of possible dredging impacts should also fully consider other, separate development proposals for the marine area to the east of the Star Wharf site, including the ADB/NZAID Domestic Wharf proposal. Accumulative impacts on the coral communities in this area from separate but adjacent projects may become significant. Ideally, these projects should be assessed, managed and mitigated under a strategic, integrated planning framework for the Harbour, rather than the current fragmented, project-specific approach, which threatens to seriously degrade the Harbour eco-system further through “death by a thousand cuts”.

In addition to silt curtains, the Environmental Management and Monitoring Plan (EMMP) (section 11) recommends a reactive monitoring program for the dredging. This would include monitoring dredge plume dispersal from the top of the cliff above Star Wharf and measuring turbidity levels over sensitive adjacent coral areas. If plumes move over these areas, and/or if turbidity levels exceed pre-agreed trigger levels, the dredge can be moved or change operations.

5.2.5 Introduction of new marine pests

In addition to the marine pest issues identified in section 4.7.6, construction of the new marine infrastructure will involve the use of barges, work boats and a dredge, which most likely will have to be brought to Port Vila from other countries. Such vessels may carry bio-

fouling (encrusting marine life) on their hulls, picked up in their source ports, which may be introduced Port Vila Harbour on arrival at the site. Depending on these species, some may become harmful marine pests (Figure 59).

Figure 59: *Bio-fouling on vessels. Work boats, barges and dredges brought to Port Vila to construct the Star Terminal may cause marine pest introductions through bio-fouling (Source: IMO)*

Prior to construction commencing, proper arrangements will need to be developed and implemented for assessing and managing the risk of such marine pest introductions, including:

- assessing the environmental similarities between the source ports and Port Vila (if the source port is environmentally similar to Port Vila such as another Pacific island country or tropical Australia, the risk is high, and if the source is environmentally different, such as new Zealand or temperate Australia, the risk is low),
- a contractual requirement that such vessels must be totally free of bio-fouling *prior to leaving* their source ports (with inspections at the source port); and
- inspections of the hulls of these vessels for bio-fouling on arrival at Port Vila.

If such arriving work vessels are found to have fouling, they should be directed out to the open ocean beyond Mele Bay for in-water hull cleaning, prior to being allowed to commence work on the construction.

5.2.6 Marine spills

The work barges and vessels referred to in section 5.2.5 will also carry fuel (diesel or fuel oil), lubricating oils and hydraulic oils – and such oils will also be used for the shore-based construction machinery.

As with any construction site, there will be the possibility of accidents – which is heightened when working with vessels in the marine environment. Such accidents may result in pollution of the marine environment. The quantities of fuel and oils carried will be relatively small and any such spills are only likely to have localized impacts. However, the healthy coral communities at and adjunct to the site are sensitive to oil pollution, especially at low tides, and care needs to be taken to address this potential impact during the construction phase.

Vanuatu currently does not have a national oil spill contingency plan and nor is there a port-specific plan for Port Vila Harbour. The two local oil terminals (BP and Pacific Petroleum)

located to the east of Star Wharf in Paray Bay, maintain their own terminal-specific oil spill plans, and have stockpiles of basic oil spill containment and clean-up equipment. They also run regular training and equipment deployment drills for their staff (Figure 60). They have a Tier 1 response capacity to deal with small scale spills from their own facilities. This capacity would be suitable for covering possible spills from the Star Terminal construction phase.

Figure 60: *Joint oil spill boom deployment exercise by oil terminals in Paray Bay (Source: Raaymakers)*

It is important that prior to construction commencing, proper arrangements are developed and implemented for the prevention, containment and clean-up of any spills of pollutants into the marine environment from construction activities.

Such arrangements might include entering into an agreement with one or both of the two local oil terminals, to provide response and clean-up services in the event of a spill, and should include running an oil spill exercise with construction staff prior to work commencing.

5.2.7 Impacts on other marine users & uses

As outlined in section 4.13 the marine environment at and around the Star Wharf site is used opportunistically for non-shipping purposes, including subsistence and recreational fishermen and for water-based tourism, sport and recreation, including from the Iririki resort.

For safety reasons it is recommended that a marine exclusion zone be declared and enforced around the construction site, to prevent potential conflict between such users and work boats and barges.

5.2.8 Impacts on marine cultural values

As outlined in section 4.14, the area of Star Wharf is generally part of the range of *Lapetasi.* As site works, including dredging and land-reclamation, will cause significant disturbance during construction, it is recommended that the Chiefs of Ifira undertake relevant traditional site 'blessing' before construction commences, and that the EMMP recommended in section 11 be fully implemented to minimize this disturbance.

The area known as *Fatu Panuke* , where the Nautiloids used to rise out of Paray Bay, may be affected by the land reclamation on the eastern side of the site, and silt curtains should be used to minimize such impacts, as recommended in the EMMP (section 11).

The cultural heritage sites to the west of Star Wharf (*Tekoni* freshwater spring, *Pilangara* canoe landing, *Faturae* unicorn fish area and *Katatara* freshwater spring), will not be affected by the proposed development.

In summary, the likely impacts of construction activities on marine cultural heritage are unlikely to be significant, so long as:

- the correct traditional blessings of the site and works are undertaken before commencement,
- construction management and workers are inducted about the cultural sites and the need to show respect during construction works; and
- the recommended EMMP is implemented properly.

6. OPERATIONAL PHASE IMPACTS

6.1 Land-based activities

6.1.1 Traffic

Once constructed, operation of the new facility should significantly improve safety on Wharf Road, as containers will no longer be stacked haphazardly along the sides of road and the large container moving vehicles and forklifts will no longer have to work along Wharf Road.

Overall, as trade increases through the new Star Terminal, there may be an increase in traffic, including trucks carrying containers, moving between the terminal and other areas in Port Vila and Efate generally.

The current multi-donor project to upgrade roads around Efate will effectively cater for any such increase in traffic.

6.1.2 Noise, dust & fumes

Once constructed, operational noise emissions from the new terminal are likely to be less than from the current facility, as on-site machinery will be updated and management practices improved.

Like any international container terminal, the facility will need to be able to operate 24 hours a day, seven days a week. Apart a few houses located near the top of the cliff slope immediately to the south of the site, there are no residential communities nearby, so 24/7 operation should not cause breach of the *Control of Nocturnal Noise Act,* by causing annoyance to residential communities.

Operational dust emissions from the new terminal are likely to be less than from the current facility, as much of the currently bare hard-stand areas will be sealed.

Similarly, operational fume emissions from the new terminal are likely to be less than from the current facility, as on-site machinery will be updated and management and maintenance practices improved, and the current practice of burning garbage on site will be ended/prohibited.

6.1.3 Impacts on soil quality

Impacts on soil quality from the new terminal are likely to be less than from the current facility, because:

- much of the currently bare hard-stand areas will be sealed,
- the new site will include a properly designed drainage and stormwater management system; and
- proper management arrangements will be developed and implemented for:

- the servicing, oiling and refueling of vehicles and machinery,
- the safe storage, handling and containment of oils, fuels and other chemicals on site,
- the handling and management of all waste oil and oily waste generated on site (see also section 7 below); and
- the prevention, containment and clean-up of any spills of these materials.

6.1.4 Impacts on freshwater quality - including groundwater

As per 6.1.3 plus the new facility will include upgraded sewerage and septic tank facilities for on-site toilet amenities.

6.1.5 Container wash-down & effluent discharge

The new terminal will include a quarantine wash down facility for containers and container handling equipment. Containers may be sprayed with pesticide chemicals in various ports, including at the new Star Terminal, for quarantine purposes, to prevent the translocation of insects and other pests. These chemicals include:

- Ant Stop Granular G: Insecticide based on Chlorpyrifis with petroleum solvents and emulsifiers. Chlorpyrifis is a cholinesterase inhibitor (nerve toxin) in humans and toxic to birds, bees and fish.

- Biflex Ultra (Bifenthrin): Insecticide based on pyrethrin with petroleum solvents and emulsifiers. Bifenthrin is classified as Hazardous by NOHSC Australia. Studies show this product to be harmful if swallowed, including clonic convulsions, tremors and bloody nasal discharge. Irritating to eyes and respiratory system. This formulation also contains liquid hydrocarbons. May cause lung damage if swallowed. Inhalation of liquid hydrocarbon vapours may cause central nervous system damage. Highly toxic to fish and aquatic arthropods.

- Exterm-an-ant: Boron-based anti-cide. Harmful if swallowed causing nausea, vomiting and diaorehea. Eye and skin irritant.

- Maxforce GB Granular Ant Bait: Hydrazide-based anticide. Classified as Non-hazardous by NOHSC Australia.

- Mesurol Snail & Slug Bait: Carbamate-based molluscacide. Classified as Hazardous by NOHSC Australia. Includes active substance Methiocarb (mercaptodimetur), plus calcium sulphate and butylated toluene. Also contains BITREX™ which is a deterrent designed to prevent animals eating the bait pellets (can kill dogs). Methiocarb is a cholinesterase inhibitor (nerve toxin) in humans and toxic to mammals, birds and fish. Very toxic to aquatic organisms. DO NOT contaminate streams, rivers or sea with Mesurol or the used containers.

The Material Safety Data Sheets (MSDS) for each of these products are included in Appendix 10. Obviously several of them would be of serious concern if they began accumulating in waters, sediments and biota of Port Vila Harbour via discharges from the Star Terminal.

The on-site stormwater and drainage system for the Star Terminal will have 4 effluent discharge points along the eastern shore of the reclaim, three being for stormwater and one being for the container wash-down facility. There will also be one stormwater discharge to the west of Star Wharf (Figure 11).

Unfortunately, the four discharge points along the eastern shore of the reclaim will discharge directly into the most sensitive marine resources in the immediate vicinity – the coral area off that shore, which is also used for subsistence fishing and reef-gleaning. Chemical pesticides can accumulate in shellfish and fish, and are particularly harmful to marine crustraceans, which have many physiological similarities to the insects that the pesticides are designed to kill. Potential accumulation of these chemicals in Paray Bay could become a serious environmental and even public-health issue.

During engineering design Soros Associates were recommended to look at discharging all site stormwater to the west of the site, into the deep water of Pontoon Bay, where there are no corals or other similarly sensitive resources in the immediate vicinity. However, Soros advises that due to the limited site area and the need to keep drainage outlets above the high-tide mark, they are not able to engineer all site drainage to discharge into Pontoon Bay only, and the four discharges into Paray Bay are required.

Each of the stormwater discharges will have a Gross Pollutant Trap (GPT) to remove garbage and debris. The discharge from the container wash-down facility will have a GPT and a Stormwater Quality Improvement Device (SQID), to also remove sediment and hydrocarbons from the effluent. However, neither the GPTs or the SQID will do anything to remove pesticides from the effluent discharge.

The safety and environmental controls for storage, handling and use of these chemicals at the new Star Terminal are being developed under a separate study by New Zealand-based quarantine consultants FBA. The FBA report will also contain recommendations on best-practice design features and management practices to prevent pollution of the Harbour by pesticide chemicals and hydrocarbons that may be contained in the wash-down effluent. When available the FBA report should be referred to on these matters.

In summary, discharges of effluent from the container wash-down facility and site stormwater in general, comprise one of the main environmental concerns relating to the terminal, including potential long-term accumulative impacts, including on marine species collected for human consumption.

The EMMP outlined in section 11 includes a long-term marine pollution monitoring program, with sampling sites at the five discharge points, including for hydrocarbons and pesticides in water, sediment and biota, including food species.

6.1.6 Stormwater drainage &discharge

As per 6.1.5.

6.1.7 Hazardous materials

Apart from pesticide chemicals as outlined in section 6.1.5, hazardous cargoes such as tank-tainers of avgas and diesel and containers of paints, solvents and aerosols may be handled at the new terminal (Figure 61). The handling and storage of such cargoes will need to comply with the International Maritime Dangerous Goods (IMDG) Code.

Figure 61: *Tanktainers of avgas and diesel, and containers with contents of paints, solvents, aerosols and other hazardous materials may be handled at the new Star Terminal. These will need to be managed in accordance with the IMDG Code (Source: Raaymakers).*

On-site fuel storage tanks will be provided and must comply with basic safety and environmental standards – including:

- spill containment bunding,
- small spill response kit,
- signage relating to contents of tanks,
- safety warning,
- no smoking sign; and
- emergency number;

as well as local petroleum storage and handling standards.

6.2 Marine activities

6.2.1 Impacts on hydrodynamics & coastal processes

With the new wharf and extended land reclamation the new facility will jut a minimum of a further 23m and a maximum of 48m out into the Harbour than the existing facility, and reclaim up to an additional 1.6 ha of land from the sea. The dredging will remove 60,000m^3 of the seabed and change the bathymetry down to -12.3m. Any such alteration of the coastline and imposition of new structures into the marine environment has the potential to affect hydrodynamics and coastal processes.

As outlined in section 4.12, the lack of physical data on oceanographic and hydrodynamic conditions at the site and for the Harbour generally, and the lack of a functional hydrodynamic model for the area, prevent a proper quantitative assessment of the likely impacts of the development on hydrodynamics and coastal processes.

However, given the *relatively* small area of additional intrusion of the new facilities into the Harbour, and the rapid slope to deep, open waters of Pontoon Bay immediately to the north-

west of the site, combined with relatively low current velocities in the area, it would seem unlikely that the proposed development would cause any significant changes to hydrodynamics and coastal processes.

However, accumulative impacts on hydrodynamics and coastal processe from separate but adjacent projects may become significant. Ideally, these projects should be assessed, managed and mitigated under a strategic, integrated planning framework for the Harbour, rather than the current fragmented, project-specific approach, which threatens to seriously degrade the Harbour eco-system further through "death by a thousand cuts".

As outlined in section 4.12, ideally, a comprehensive program should be implemented to collect oceanographic data and develop a 4D hydrodynamic model for Port Vila, to support proper assessment, planning and management of all proposed developments and activities in the Harbour.

6.2.2 Marine spills

As outlined in section 2.2 the new Star Terminal will be designed to handle container ships with dimensions of up to 184.9 m Length Overall (LOA), 27.6 m beam and 10.6 m maximum draft, with capacity for up to 1,257 TEU containers. Figure 62 shows a container ship using the Main Wharf in December 2009, of a size and type similar to what is likely to serve the proposed Star Terminal.

Figure 62: *The container ship 'Southern Trader' using the Main Wharf in December 2009, of a size and type similar to what is likely to serve the proposed Star Terminal (Source: Raaymakers)*

Ships of this size may carry over 1,000 tonnes of fuel oil (often Heavy Fuel Oil or HFO), as well as quantities of diesel for generators and other on-board machinery, plus various lubricating and hydraulic oils.

Global data indicates that the vast majority of marine oil spill occur in port during oil-cargo transfer operations by tankers and during bunkering (fueling) of ships. Fortunately, Star Terminal will not handle oil or petroleum tankers, and will not offer bunkering services, so these two risks are removed.

However, if such a ship of the type that will use Star Terminal was to have an accident such as a collision, grounding or structural failure while approaching or while in Port Vila, it could result in the loss of some or all of the fuel oil and other oils carried on board. This could potentially cause an oil spill of a few tones up to several thousand tones, depending on the ship and the extent of hull/fuel tank damage sustained. Figure 63 shows the bulk carrier *Zhi Qiang* aground in neighbouring Papua New Guinea in July 2007 - which lost around 100 tonnes of oil and several thousand tones of raw sugar onto the reef, triggering a major response. Ships that service Star Terminal could be involved in similar incidents.

Figure 63: *The bulk carrier 'Zhi Qiang' aground in neighbouring Papua New Guinea in July 2007 – which lost around 100 tonnes of oil and several thousand tones of raw sugar onto the reef, triggering a major response (Source: J Ruh).*

To give an example of the potential scale of impacts, a spill of only 270 tonnes of HFO from the container ship *Pacific Adventurer* off the coast of Brisbane in March 2009:

- heavily polluted over 75 km of coastline,
- took over four months to totally clean-up, with the full resources of Australia's national oil spill response plan and international assistance; and
- caused over AUD$35 million in damages, including clean-up costs.

A spill of this size or even significantly larger could possibly be caused by ships using the new Star Terminal. The impacts of even a small spill of just a few tones of HFO could be extremely severe within the sensitive, enclosed, low-energy environment of Port Vila.

Under the SPREP/IMO *Pacific Ocean Pollution Prevention Programme* (PACPOL), a marine pollution risk assessment was completed for Port Vila and most other ports in the Pacific in 2003 (Anderson et al 2003). Areas of high risk for shipping accidents and pollution incidents

in Port Vila include the Harbour entrance, the entrance to Pontoon Bay, the channel between Iririki Island and the mainland and berthing at both the Main Warf and Star Wharf.

Measures for the prevention of such accidents in Port Vila include basic navigation aids (lateral and lead marks and lights) for the Harbour entrance and in-Harbour channels (Figure 64), and compulsory pilotage provided by the Harbour Master and Deputy Harbour Master.

Figure 64: *The Port and Starboard Lateral Marks on the entrance to Port Vila Harbour - an important part of arrangements to prevent shipping accidents and therefore spills (Source: Raaymakers).*

In addition to accidents resulting in oil spills, ships using the proposed Star Terminal may also cause pollution through the discharge of oily bilge water and/or waste oil. While Vanuatu is a party to the *International Convention for the Prevention of Pollution from Ships* (MARPOL), which *inter-alia* prohibits such discharges in ports, there is no national implementing legislation and therefore very little that the authorities could do legally to stop such discharges.

It should be noted that Vanuatu currently has a draft *Biosecurity Bill* ready for passing by Parliament which includes provisions to totally ban the discharge of bilge water from ships in Vanuatu waters. This provision is totally unworkable and if implemented would effectively close-down shipping in Vanuatu. This needs to be removed from the *Biosecurity Bill* and bilge water discharges should be regulated under specific legislation that is consistent with the MARPOL Convention.

As outlined in section 3.3 and in the Regulatory Review (Appendix 4), Vanuatu is a member of IMO and party to a number of IMO maritime safety and marine pollution conventions, which regulate the design, construction and operation of international shipping, so as to maintain safety and pollution prevention standards. As also outlined in section 3.3, many of the IMO conventions that Vanuatu has ratified are now out of date or superseded, and there are several new and extremely important conventions that Vanuatu has not yet ratified.

Additionally, the national legislation that gives the IMO conventions force-of-law in Vanuatu, is incomplete and quite out-dated, and Vanuatu is not properly protected by the international oil pollution compensation regime.

Vanuatu's capacity to ensure that ships visiting Port Vila, including the new Star Terminal, comply with IMO standards, is extremely limited. The Department of Marine and Ports currently does not have an effective Port State Control (PSC) capability.

As outlined in section 2.6, Vanuatu currently does not have a national oil spill contingency plan and nor is there a port-specific plan for Port Vila Harbour. Only the two local oil terminals have a limited capacity to deal with small spills from their facilities.

The risk of marine spills constitutes one of the most significant potential environmental impacts from the proposed Star Terminal development, which could cause major ecological, economic, community and even public health impacts. These include impacting on coral reefs and mangroves in the Harbour, closing down much of the Port Vila based tourist industry (e.g. Iririki Resort), and shutting-down subsistence fisheries, with direct impacts on protein-security for local families. The complex and fragile nature of coral reef and estuarine environments like those found in Port Vila mean that clean-up options are extremely limited and damage is likely to be difficult to mitigate (Figure 65).

Figure 65: *The impacts of oil on coral reefs and mangroves can be severe - especially in enclosed harbours like Port Vila, and clean-up options are extremely limited (Source: Raaymakers)*

It is therefore vital that as part of the Star Terminal development, measures are put in place to:

- ensure that ships using the new facilities comply with IMO safety and pollution prevention standards,
- prohibit the discharge oily bilge water, waste oil and other pollutants from ships,
- prevent/reduce the risk of shipping accidents resulting in marine pollution,
- ensure the effective response to and clean-up of any spills that do occur; and
- ensure that Vanuatu is part of and protected by the international oil pollution compensation regime.

Some of the actions that are required in order to achieve the above include:

- a thorough review and update of the IMO conventions that Vanuatu is a party to,
- a thorough review and update of the national legislation that implements the IMO conventions in Vanuatu,
- a review of the adequacy of navigation aids in Port Vila, and improvements to these as necessary,
- the inclusion of any necessary new navigation aids as may be required at Star Terminal (and other developments in the Harbour),

- a programme to build the PSC capacity of DPM, as well as the capacity of GoV in general to implement and enforce its maritime legislation; and

- the development of both national and port-specific oil spill contingency plans, including training and equipment.

6.2.3 Marine pests - ships' ballast water & hull-fouling

International ships arriving at the new Star Terminal will present a risk of introducing foreign marine species in their ballast water (Figure 66) and attached to their hulls as bio-fouling (Figure 59). Depending on the species, marine pest outbreaks can cause major ecological, economic and even public health impacts, and can include harmful algae blooms and disease-causing pathogens.

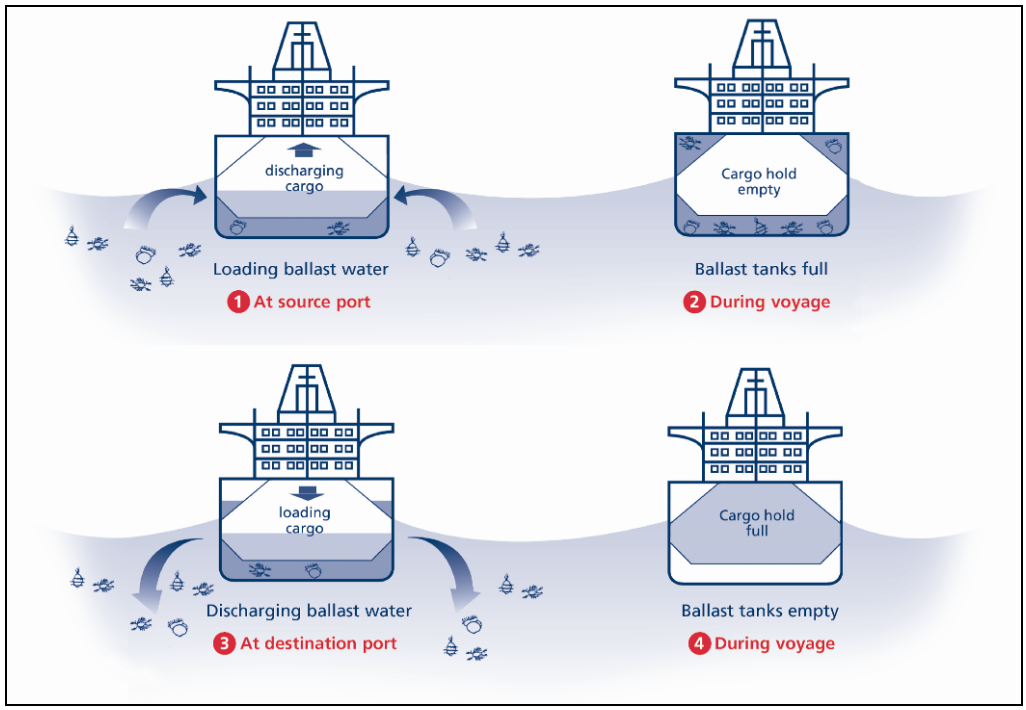


Figure 66: *Translocation of marine species in ships' ballast water (Source: IMO - GloBallast)*

The impacts of marine pest introductions can be significantly more severe than for oil pollution as described in section 6.2.2, and are usually irreversible and more long-term than the impacts of oil pollution.

As outlined in section 5.2.5, the degree of risk is to a large extent determined by the environmental similarities between the source ports and Port Vila. As the likely future voyage routes for ships using the proposed Star Terminal are difficult to predict, it is not possible for this Supplementary EIA to provide a detailed assessment of the potential risk of marine pest introductions. Once likely trading patterns are clarified, a marine pest risk assessment can be carried out for the terminal.

With regard to the ballast water vector, most of the trade to the Star Terminal will be to import loaded containers, so on most ship visits ballast is unlikely to be discharged. However, on some occasions, ships at the terminal may discharge some ballast when re-

distributing loads due to offloading, loading and re-arranging of containers, and ballast may be discharged on the rare occasions that cargo might actually be exported from the terminal.

There is an IMO convention on this issue, the *International Convention for the Control of Ships' Ballast Water and Sediments* (BWM Convention), which inter-alia requires ships to exchange their ballast water in the open ocean while enroute, and which over time will require ships to be fitted with ship-board ballast water treatment systems.

The best thing that Vanuatu can do to protect its valuable marine resources from ballast-mediated marine pest incursions through the Star Terminal development and other port developments, is to sign and ratify the BWM Convention and to develop, pass and enforce national legislation which implements this Convention for international ships visiting Vanuatu.

It should be noted that Vanuatu currently has a draft *Biosecurity Bill* ready for passing by Parliament which includes provisions to totally ban the discharge of ballast water from ships in Vanuatu waters. This provision is totally unworkable and if implemented would effectively close-down shipping in Vanuatu. This needs to be removed from the *Biosecurity Bill* and ballast water discharges should be regulated under specific legislation that is consistent with the IMO BWM Convention.

Additionally, ideally, the *Initial Marine Pest Assessment* undertaken at Star Wharf for the Supplementary EIA should be built upon by undertaking a full-scale *Marine Pest Survey* throughout the whole of the Harbour, as there are many other potential points of pest introductions, including the main wharf and cruising yacht moorings.

6.2.4 Ships' anti-fouling

In order to prevent bio-fouling, ships hulls are painted with anti-fouling paints. Traditional anti-fouling paints contain highly toxic organo-tin compounds such as trybutil-tin (TBT). While being highly effective at preventing bio-fouling, TBT leaches from the anti-fouling paint and is a serious source of marine chemical pollution, especially in enclosed port areas. Some ports in the Pacific, notably Suva, have some of the highest TBT levels found in port sediments anywhere in the world (Maata 1997).

In 2001 IMO adopted the *International Convention on the Control of Harmful Anti-Fouling Systems on Ships*, which bans the use of TBT in anti-fouling paints, and thereby necessitates the use of alternative, less toxic paints.

The best thing that Vanuatu can do to protect its valuable marine resources from TBT related pollution through the Star Terminal development and other port developments, is to sign and ratify the AFS Convention and to develop, pass and enforce national legislation which implements this Convention for international ships visiting Vanuatu.

6.2.5 Ships' waste management

International ships arriving at the new Star Terminal may have a requirement to dispose of shipboard waste such as garbage, waste oil and oily waste, which has been generated during the voyage.

The MARPOL Convention places an obligation on ports to provide shore-based facilities for the reception of such wastes that are adequate for the demand for such facilities. Vanuatu is a party to MARPOL.

Currently, only quarantine waste (garbage from international ships) is accepted by the Vanuatu Quarantine Service on an ad-hoc, on-request basis, for a fee, and taken to the Municipal land-fill, which is not ideal The are two high temperature incinerators for quarantine waste in Port Vila, but neither is operational due to lack of maintenance.

There are currently no arrangements for the reception and management of waste oil and oily waste from ships in Port Vila, although it is understood that the BP terminal used to accept such waste for reuse and recycling.

When port waste reception facilities are inadequate and ships are left with few alternatives, they often resort to the irresponsible and illegal practice of disposing of their garbage, waste oil and other wastes overboard, into the sea.

To prevent this source of marine pollution, proper ships' waste reception arrangements need to be developed for Port Vila, including for Star Terminal and other port facilities. As a minimum, these arrangements might include:

- repairing, recommissioning and maintaining one of the high temperature quarantine incinerators for burning quarantine waste (all garbage received from internationals ships); and

- opening discussions with the two oil terminals to explore options for them to receive, reuse and recycle waste-oil taken from ships using Star Terminal and other port facilities in Port Vila.

6.2.6 Ships' sewage

Depending on their size and type, international ships arriving at the new Star Terminal may have a crew onboard of between 10 and 25 people – who generate sewage on a day to day basis, including while alongside the berth. On many ships without proper shipboard sewage holding tanks and treatment systems (which is the case for many ships trading in the Pacific), raw sewage may be discharged directly into the port.

As outlined in section 4.8, the waters of Port Vila Harbour are already suffering serious pollution from sewage discharge and septic tank overflow from a city of around 40,000 people. There are also numerous cruising yachts at long-term moorings in the enclosed channel between the town and Iriwki Island, many of which have people living aboard who discharge their raw sewage directly into port waters. As outlined in section 4.8, highly elevated levels of sewage-related bacteria have been measured in that area. One might argue that sewage discharge from a ship carrying only 10 and 25 people is not worth addressing given this broader context.

However, the ship-sourced sewage may be from an international source where there are outbreaks of cholera, typhoid and other dangerous diseases and parasites, for example from South East Asian ports, and which would be best kept out of the waters of Port Vila.

Annex IV of MARPOL regulates the discharge of sewage from ships, including a prohibition on the discharge of untreated sewage in ports. The best thing that Vanuatu can do to protect its valuable marine resources from ship-source sewage at the Star Terminal development and other port facilities, is to sign and ratify Annex IV of MARPOL and to develop, pass and enforce national legislation which implements this instrument for international ships visiting Vanuatu.

6.2.6 Impacts on other marine users & uses

As outlined in sections 4.13 the marine environment at and around the Star Wharf site is used opportunistically for non-shipping purposes, including subsistence and recreational fishermen and for water-base tourism, sport and recreation such a sailing and kayaking from the Iririki resort.

For safety reasons it is recommended that a marine exclusion zone be declared and enforced around the new terminal, to prevent potential conflict between such users and ships that use the terminal.

7. GENERAL WASTE MANAGEMENT

Current waste management practices at the Star Wharf facility are not acceptable. Garbage and other solid waste is discarded randomly around the site and into the marine environment, and garbage, including plastics, is regularly burnt on site, creating safety risks and air pollution. The fumes from burnt plastics can be harmful to human health. Figure 67 shows some examples of current waste management issues on site.

Site workers advise that waste oil is provided to the public, including shipped to other islands, for painting the in-ground part of fence posts that are used around plantations, to preserve the posts. The waste oil is also used for marking school and village sports fields. This practice creates serious health risks – oil on fence posts can enter the soil environment and bio-accumulate and bio-magnify, including possibly into ground crops that are eaten by the villagers. Use of oil on sports field exposes children and sports players to contact with the oil. Hydrocarbons are toxic, carcinogenic and mutagenic, and all major oil companies today have policies of "zero oil to ground' in the management of their terminals and facilities.

Figure 67: *Some examples of current waste management issues on site (Source: Raaymakers)*

The practices described above should be halted immediately, and a proper waste management plan should be implemented for the existing terminal. As part of the Star Terminal development, it will be necessary to develop and implement proper arrangements for:

- the identification, assessment and management of any hazardous materials associated with the demolition of existing infrastructure, such as refrigerant and air-conditioning coolants, fire extinguisher chemicals, septic tank residues and possibly asbestos,

- reusing/recycling as much of the demolished material as possible (e.g. corrugated iron roofing on existing buildings, steel cladding on existing storage shed, box air-conditioners in existing offices), including for the new development where possible and by providing to staff/workers to take home,

- ensuring that all other demolition waste is taken to the municipal land-fill and not used for illegal, ad-hoc land reclamation in the Harbour,

- the proper management of waste oil, including investigating options with local oil terminals,

- identifying and implementing all possible opportunities to re-use and recycle solid waste, and taking all other garbage to the municipal land fill,

- ensuring that demolished piles are not be disposed of in the marine environment, but removed and disposed of to land-fill; and

- proper ships' waste reception arrangements. As a minimum, these arrangements might include:
    - repairing, recommissioning and maintaining one of the high temperature quarantine incinerators for burning quarantine waste (all garbage received from internationals ships); and
    - opening discussions with the oil terminals to explore options for them to receive, reuse and recycle waste oil taken from ships using Star Terminal and other port facilities in Port Vila.

8. ENERGY & WATER USE

8.1 Energy use

The current Star Wharf facility uses three different electricity power supply levels; 26.4, 6.60 and 2.20 KVA. According to electricity records for 2008 and 2009, the existing facility uses an average of 1700 kWh per month for the 26.4 KVA supply, an average of 1,300 kWh per month for the 6.60 supply, and an average of 214kWh per month for the 2.20KVA supply.

Considering all proposed components of the new facility, including new and improved site lighting, refrigerated container facility and container wash-down facility, Soros Associates predicts that the new Star Terminal will use an average of 45,360 kWh of electricity per month.

This represents a significantly increased environmental impact and carbon footprint through the increased burning of fuel at the Port Vila power station, to supply this additional electricity demand.

With current global climate change concerns and limited energy resources on small islands like Efate, energy use efficiency is a vital consideration in project design, and is also important for reducing operating costs. Energy efficiency elements to be considered in the design of the new facilities include, as a minimum:

- all on-site hot water to be provided by roof-top solar hot water panels (no electric hot water),
- all roof surfaces to be used for solar-voltaic panels to at least supplement electricity usage on site,
- energy efficient building design, including use of window shading, roof insulation and natural ventilation to reduce reliance on air-conditioning,
- all light fittings to be for low energy bulbs (not incandescent),
- all site lighting to be automatically controlled for shut-off when not in use.

8.2 Water use

The current Star Wharf facility has at least seven different water supply intakes from the local water utility Unelco, with separate water bills for each. This un-integrated approach makes it difficult for the existing facility to achieve water use efficiency.

According to water records analysed by Soros Associates in the third quarter of 2009 the existing facility used 1,790 m^3 of water and in the fourth quarter for 2009 it used 1,544 m3 of water.

Considering all proposed components of the new terminal, including the new container wash-down facility, the rationalization of supply inputs and the incorporation of roof rainwater tanks and other water efficiency features as outlined below, Soros Associates predicts that the new Star Terminal will use an average of 688 m^3 of utility-supplied water per quarter, significantly less than the existing facility.

The fact that the existing facility does supply water to ships, while it is proposed that the new terminal will not, is a significant factor in this reduction. If ships using the new terminal are supplied with water, then the water usage rate for the new terminal will be higher.

With current global concerns about water resource sustainability and limited water resources on small islands like Efate, water use efficiency is a vital consideration in project design, and is also important for reducing operating costs. Water efficiency elements to be considered in the design of the new facilities include, as a minimum:

- all roofs to be treated as catchments feeding to rainwater storage tanks – with such tanks to supplement on-site water usage,
- all on-site toilets to be dual flush,
- any on-site showers to have efficient shower heads; and
- all opportunities for on-site recycling of used water to be explored (e.g. waste water to be used for irrigating landscaped areas around offices).

9. CLIMATE CHANGE RISK ASSESSMENT

Given current global concerns about climate change it is a standard requirement that the design process for ports and coastal infrastructure include a climate change analysis and risk assessment. In the context of the proposed Star Terminal development global climate change presents two main risks:

- Sea level rise: Risk of sea level rise exposing asset components that have not been designed for saltwater contact and is likely to result in increased erosion. Carbon dioxide induced ocean acidification is likely to increase corrosion rates of port structures. The heights of wharfs, cranes and jetties may become maladapted as the sea level rises.

- Increased cyclone intensity and frequency and increase in temperatures: Risk of port closures leading to reduction in port through-put, productivity and supply of essential and emergency goods. Damage from more frequent intense cyclones which may to lead to increased maintenance, repairs and replacement assistance.

Each of these is discussed below.

9.1 Sea level rise

As part of a regional AusAID-funded initiative to address concerns about the impacts of global climate change, including sea level rise, a Sea Level Fine Resolution Acoustic Measuring Equipment (SEAFRAME) gauge was installed in Port Vila, Vanuatu, in January, 1993.

Data is from this program, which includes SEAFRAME gauges throughout the Pacific, is held, analysed and reported by the Australian National Tidal Facility (NTF) at Flinders University in Adelaide.

Aside from an inoperative 10-month period following damage caused by tropical cyclone Prema in March 1993, the gauge has been returning high resolution, scientific quality data since installation. It records sea level, air and water temperature, atmospheric pressure, wind speed and direction.

The December 2007 report of this program (Anon. 2007) concludes that at December 2007, a rate of sea level rise of **+3.6 mm per year** has been observed for Port Vila.

Accounting for the inverted barometric pressure effect and vertical movements in the gauge platform due to seismic/ tectonic subsidence, the measured net sea level rise in Port Vila is **+2.7 mm per year**.

It therefore appears that sea level in Port Vila is rising annually, most probably due to global climate change. Similar and sometimes increased rates of sea level rise are being observed at the other SEAFRAME gauges throughout the Pacific.

If 2.7mm per year is multiplied by the 50 year design life of the new wharf, this equates to an expected overall sea-level rise of 135mm, well within the design paramaters of the new wharf.

Of-course the rate of sea-level may not necessarily average be 2.7mm per year, and may well increase. It is therefore necessary to make projections based on the output of global climate models, for given emission scenarios. Hay (2008) undertook such projections in a report to GoV as part of a regional SPREP programme to assist Pacific Island countries to prepare for the Copenhagen climate summit in 2009. Hay's report "Climate Risk Profile for Vanuatu" is used as a policy reference by the GoV Office of Climate Change, as makes the following predictions and statements in relation to sea level rise:

- "Best estimates of long term, systematic changes in the average climate for Vanuatu indicate that by 2050 sea level is likely to have increased by 20 cm.
- The observed long term trend in extreme high sea levels for Port Vila is 1.9 mm/year, a rate similar to global trends in mean sea level but less than the observed trend in local mean sea level (5.5 mm/year).
- For Port Vila an hourly sea level of at least 1.9 m above mean sea level is currently a 136-year event. It will likely be at least a one in 4-year event by 2050."

It should be noted that data sources in Hay's report are not referenced and it is not clear if the report has been peer-reviewed and quality-controlled.

9.2 Cyclones & temperatures

Hay (2008) states that there is relatively high confidence in projections of maximum air temperature. Measurements at three sites in Vanuatu show maximum daily air temperatures of between 35 ^{o}C and 37 ^{o}C are currently approximately 150-year events. By 2050 Hay (2008) predicts that these are likely to be approximately 50-year events.

Hay (2008) makes similar projections for extreme water temperatures. A maximum water temperature of 33.5 ^{o}C is currently a one in 200-year event at Port Vila. Hay predicts it will likely be a one in 50-year event by 2050.

Less certainty exists in projections for extreme wind gusts. However, Hay predicts that a current one in 150-year event of a maximum daily wind gust of 40 kts is likely to be a one in 60-year event by 2050.

The observed annual rainfall shows an increase at some locations and a slight decrease at others. Currently a daily rainfall of at least 350 – 400 mm is a relatively rare event at the measurement sites in Vanuatu, with return periods of between 80 and 120 years. Hay states that there is large uncertainty in the rainfall projections, with one model suggesting substantial increases in rainfall, two models suggesting only small increases, and one model indicating a small decrease in rainfall into the future. An extreme daily rainfall of at least 350 mm at these sites will likely have return periods of between 60 and 80 years by 2050.

Hay states that best estimates of long term, systematic changes in the average climate for Vanuatu indicate that by 2050 maximum air temperatures by 0.2 ^{o}C, maximum water temperatures by 0.19 ^{o}C, extreme wind gusts by 6.8% and rainfall by 0.6%.

Again it should be noted that data sources in Hay's report are not referenced and it is not clear if the report has been peer-reviewed and quality-controlled.

Hay (2008) does not make specific reference to likely increases in frequency and intensity of cyclones. The SPREP *Pacific Islands Climate Change Adaptation Programme* (PICCAP), advises that they are not aware of any work that has been undertaken to support official predictions on the increase of frequency and intensity of cyclones in the Pacific region. This work still very much lies in the realm of research and some effort is being made in the US and Australia (via the Bureau of Meteorology) to better understand the climatology of tropical cyclones in the Pacific region, before climate change projections can be put upon it.

PICCAP advises that the general understanding from the United Nations International Panel on Climate Change (IPCC) and some research circles, is that there is still some work to be done in making a clearer case for either an increase in intensification or frequency. However, the latter is said to be a little clearer in most modeling work (i.e. tropical cyclones might increase in number per season but might not necessarily be of higher intensity).

10. EIA CHECKLIST

This Supplementary EIA was funded by AusAID as part of the broader BFS for the proposed Star Terminal development. The *Environmental Management Guide for Australia's Aid Program 2003* (AusAID 2003) contains guidelines that include checklists, procedures and examples to help with integrating environmental issues in program and sectoral policy, and identifying, assessing and managing the environmental impacts of AusAID activities. These are designed to be a resource for AusAID staff, contractors and NGOs involved in designing and implementing AusAID-funded projects and programs.

Guideline 4 contains issues that should be addressed in undertaking an EIA, including a specific section on *coasts and small islands*. Table 4 assesses the proposed Star Terminal development against each of these criteria.

Table 4: *Star Terminal development assessed against AusAID EIA checklist criteria for coasts and small islands*

AusAID EIA Checklist for coasts and small islands	Response in relation to Star Terminal development
1. *Will the activity affect beaches, coral reefs, seagrass beds, mangroves, wetlands or swamps directly or through 'downstream' effects?*	• The activity will not directly affect beaches, mangroves, wetlands or swamps. • The proposed reclamation will destroy up to 1.6 ha of marine habitat comprising healthy coral community. • The dredging and land reclamation may impact indirectly on adjacent coral areas through turbidity and sedimentation. • Once operational, the terminal may indirectly impact severely on all marine resources in the Harbour should a vessel using the terminal cause a serious oil spill or introduction of a serious marine pest. • The proposed EMMP includes measures to address these issues.
2. *Will mangroves need to be regenerated?*	• Only one very small mangrove tree will be removed as part of the development.
3. *Will the activity affect wading bird habitats or other habitats protected by CITES or other treaties?*	• No.
4. *Will the activity involve discharging nutrients or other effluent to the coastal zone or to coastal streams?*	• The terminal will include a container quarantine wash-down facility, the effluent from which will discharge into the harbour. If not managed properly this effluent may contain hydrocarbons, pesticides and other contaminants – which could become a serious source of marine pollution. • Site stormwater will also discharge into the harbour and may also contain hydrocarbons, quarantine pesticides and other contaminants. • The proposed EMMP recommends that a long-term Marine Pollution Monitoring Programme be implemented to help manage these potential impacts.

AusAID EIA Checklist for coasts and small islands	Response in relation to Star Terminal development
5. *Are there seasonal patterns of sand movement in the area? How will the activity ensure that it will not restrict movement and not cause coastal erosion?*	• There is very little sand movement in the project area – which is mostly loosely consolidated coral limestone.
6. *Does the activity involve the use of coastal bores? If so, how will the activity ensure the water source is not overused and saline intrusion does not occur?*	• No
7. *Will proposed structures be within 50 metres of the shoreline? Has the activity taken into account the potential rise in sea level and its impacts?*	• Yes and yes.
8. *Will all construction occur beyond the inland limit of any coastal wetlands or mobile coastal landforms?*	• All construction is on reclaimed land and below the natural high water mark.
9. *Will the activity require the use of pesticides or fertilizers? Will petrol, oil or other hazardous chemicals be used? If so, how will the activity ensure that such products do not enter the coastal zone?*	• Yes. A range of pesticides may be used at the terminal and the container washdown facility may wash pesticide residues off containers. Hydrocarbons will be stored and used on site. Some hazardous cargoes may be handled. Management measures are available to address these risks however the issue of quarantine pesticides potentially entering the marine environment via container wash-down effluent remains a serious issue. See also response to 4.
10. *Will the activity disturb the near shore area?*	• Yes. Approx 60,000m^3 of seabed will be dredged and up to 1.6 ha of marine habitat destroyed through reclamation.
11. *Will the activity involve extracting materials from the near shore area?*	• Yes. Approx 60,000m^3 of seabed will be dredged
12. *Will the activity damage the seabed?*	• Yes. As per response to 10 and 11.
13. *Will the activity affect marine species, fishery resources and fishery habitat?*	• Yes. As per response to 10 and 11. The marine habitat that is proposed to be reclaimed is occasionally used for subsistence fishing and gathering and will be lost. • Potential pollution from quarantine pesticides as outlined in response to 4 and 9 may potentially contaminate seafood species with public health implications. • Once operational, the terminal may impact severely on all fisheries resources in the Harbour should a vessel a serious oil spill or introduction of a serious marine pest. • The proposed EMMP includes measures to address these issues.

11. ENVIRONMENTAL MANAGEMENT & MONITORING (EMMP)

11.1 Management & oversight of the EMMP

Environmental Supervisor for construction phase

In order to manage and monitor implementation of the EMMP and to ensure compliance of the project, including contractors, with relevant environmental legislation, including permit and approval conditions, an *Environmental Supervisor* should be appointed for the construction phase

The *Environmental Supervisor's* duties should include providing induction and training to all contractors and workers involved in the construction phase, to ensure that they are fully aware of their obligations under the EMMP and relevant legislation, as well as holding weekly meetings with terminal management and contractors to review compliance, and agree measures to address any non-compliances.

Consistent with best practice, the *Environmental Supervisor* for the construction phase should be paid for from the capital budget and employed at the Vanuatu Environment Unit to give a degree of independence.

Cost: 18-24 months local-based consultant around AUD$250/day plus lap-top, digital camera and ground transport expenses.

Environment Officer for operational phase

Once the construction is complete, the terminal operator should designate an appropriately qualified staff member as *Environment Officer*, tasked with monitoring and reporting to management on implementation of the EMMP and on compliance of the ongoing operation of the terminal with relevant environmental legislation, including permit and approval conditions.

The *Environment Officer's* duties should include providing induction and training to all terminal staff and contractors involved in the operation of the terminal, to ensure that they are fully aware of their obligations under the EMMP and relevant legislation, as well as holding weekly meetings with terminal management to review compliance, and agree measures to address any non-compliances.

Cost: Part of the designated staff members regular duties.

Ultimate responsibility for environmental issues

Ultimate responsibility for ensuring compliance of the ongoing operation of the terminal with the EMMP and relevant environmental legislation, including permit and approval conditions, will rest with the General Manager of the terminal and the Board of Directors.

11.2 EMMP for Construction Phase: Land-based Activities

Star Terminal Development: ***EMMP for Construction Phase: Land-based Activities (C-L)***		
Activity / Issue	**Environmental Management & Monitoring Measures**	**Responsibility**
C-L 1. Clearing of site vegetation:	C-L 1.1. Retain large Figs: Retain the two large Fig trees to east of the existing main entrance (prune on terminal side if required).	Designer Contractors Owner/Operator
	C-L 1.2.Harvest beneficial products: Allow workers to harvest any fruit and useful products / take cuttings from existing vegetation prior to removal.	Owner/operator.
	C-L 1.3. Landscaping: Provide for landscaping /tree planting around offices and non-operational areas. Use native species only or productive species as currently practiced (e.g. mango, avocado, noni etc).	Designer (Soros) Contractors Owner/operator.
C-L 2. Demolition of existing buildings:	C-L 2.1.Demolition Waste Assessment: Develop and implement proper arrangements for the identification, assessment and management of any hazardous materials associated with the demolition, such as refrigerant and air-conditioning coolants, fire extinguisher chemicals, septic tank residues and possibly asbestos.	Contractors Owner/operator.
	C-L 2.2. Reuse/recycle Demolition Waste: Reuse/recycle as much of the demolished material as possible (e.g. corrugated iron roofing on existing buildings, steel cladding on existing storage shed, box air-conditioners in existing offices), including for the new development where possible and by providing to staff/workers to take home.	"
	C-L 2.3. Landfill Demolition Waste: Ensure that all other demolition waste is taken to the municipal land-fill and not used for illegal, ad-hoc land reclamation in the Harbour.	"

Star Terminal Development: ***EMMP for Construction Phase: Land-based Activities (C-L)***		
Activity / Issue	**Environmental Management & Monitoring Measures**	**Responsibility**
C-L 3. Sourcing of reclaim fill:	C-L 3.1. Quarry Permits: Ensure that quarries have necessary Permit before purchasing fill from that quarry. Same applies if fill obtained from sources other than existing quarries.	Contractors Owner/operator.
C-L 4. Traffic:	C-L 4.1. Traffic Compliance: Ensure that all road traffic that services the construction phase complies with all relevant Vanuatu road and traffic laws and operated by licensed divers.	"
	C-L 4.2. Oversize Traffic: Liaise with the Vanuatu Police Service and the Port Vila Municipal Council prior to transportation of any particularly large or unusual items by road.	"
5. Noise, dust, fumes:	C-L 5.1. Noise Management: Restrict works to 5am and 9pm (*Control of Nocturnal Noise Act)*	"
	C-L 5.2. Dust Suppression: Provide a dust-suppression water truck to lay-down dust along the sides of Wharf Road and on site during dry and dusty periods.	"
	C-L 5.3. Vehicle Fume Prevention: Ensure that all vehicles, plant and machinery used during construction are properly serviced and maintained to avoid excessive exhaust fumes.	"
C-L 6. Impacts on soil quality:	C-L 6.1. Vehicle oiling and fueling: Develop and implement proper arrangements for the servicing, oiling and refueling of vehicles and machinery used during the construction phase.	"
	C-L 6.2. Oil and chemical handling: Develop and implement proper arrangements for the safe storage, handling and containment of oils, fuels and other chemicals used during the construction.	"
	C-L 6.3. Waste Oil Management: Develop and implement proper arrangements for the handling and management of all waste oil and oily waste generated during the construction.	"
	C-L 6.4. Land Spill Prevention & Response Plan: Develop and implement proper arrangements for the prevention, containment and clean-up of any spills of these materials during the construction.	"

Star Terminal Development: ***EMMP for Construction Phase: Land-based Activities (C-L)***		
Activity / Issue	**Environmental Management & Monitoring Measures**	**Responsibility**
C-L 7. Impacts on freshwater quality, including groundwater:	As per 6 plus, prior to construction commencing: C-L 7.1. Construction Drainage: Develop and implement temporary on-site drainage and siltation controls for the construction phase, including gross-pollutant, sediment and oil traps.	Contractors Owner/operator.
	C-L 7.2. Demolition Sewage: Develop and implement proper arrangements to ensure that on-site freshwater runoff and groundwater are not contaminated by sewage from demolition activities.	"
	C-L 7.3. Construction Sewerage: Provide for on-site toilets and sewage management, adequate for the anticipated construction workforce.	"
C-L 8. General waste management:	C-L 8.1. No Burning: End the current practice of burning garbage on site.	"
	C-L 8.2. Reuse & Recycle: Identify and implement all possible opportunities to re-use and recycle solid waste, all other garbage to be taken to municipal land fill.	"
	C-L 8.3. Waste Oil Management: End the current practice of allowing waste oil to be taken from the site for use on plantation fence posts and sports field – implement proper waste oil management practices, including investigating options with local oil terminals.	"

11.3 EMMP for Construction Phase: Marine Activities

Star Terminal Development: EMMP for Construction Phase: Marine Activities (C-M)		
Activity / Issue	**Environmental management and monitoring measures**	**Responsibility**
C-M 1. Demolition of existing wharf and piles:	C-M1.1.Existing Piles to Landfill: To prevent the potential spread of marine pests on piles, ensure that demolished piles are not be disposed of in the marine environment, but removed and disposed of to land-fill.	Contractors.
	C-M 1.2. Silt Curtains: Deploy marine silt curtains around the work site during all marine demolition, reclamation and construction activities (curtains do not need to drop full depth to sea-bed in deeper areas – just 1st 3 metres to stop surface plumes spreading)	"
	C-M 1.3.Marine Biota Clearance: Just prior to marine works commencing, invite the Vanuatu Dept of Fisheries to move any easily movable marine organisms out of the impact zone to other suitable habitat in the Harbour (apply also to reclaim area, see C-M 2).	Owner/operator
	C-M 1.4. Harvest Food Species: Just prior to marine works commencing, site workers be invited to collect all marine species of food value from the impact zone (apply also to reclaim area, see C-M 2).	"
	C-M 1.5. Aquarium Species Collection: Just prior to marine works commencing, invite the local marine aquarium collector to collect all species of aquarium trade value from the impact zone (apply also to reclaim area, see C-M 2).	"
C-M 2. Land reclamation:	C-M 2.1: As per C-M 1.2 to 1.5 (silt curtains at reclaim area should be full-depth to sea bed).	"
	C-M 2.2: Environmental Offset: Possible declaration of tabu over Vatumaru Bay to compensate from destruction of corals.	Ifira and GoV
C-M 3. Dredging:	C-M 3.1. Detailed Hydrographic Survey: Prior to dredging commencing, conduct detailed hydrographic survey using multi-beam side scan sonar to determine precise area to be dredged and optimize/reduce dredging required.	Contractors Owner/operator

Star Terminal Development: EMMP for Construction Phase: Marine Activities (C-M)		
Activity / Issue	**Environmental management and monitoring measures**	**Responsibility**
	C-M 3.2. Silt Curtains: Deploy marine silt curtains around the work site during all dredging activities (curtains do not need to drop full depth to sea-bed in deeper areas – just 1st 3 metres to stop surface plumes spreading)	Dredging contactor
	C-M 3.3: Productive Use of Dredge Material: Place all dredge material to reclaim area (which should be encircled by full-depth, fixed silt curtains)	"
	C-M 3.4: Visual Plume Monitoring: Environmental Supervisor to observe and video dredge plumes daily from top of hill behind Star Wharf site. If plumes moves towards sensitive coral areas, management action to be taken. Observations to be made over daily tidal cycle.	Environmental Supervisor Dredging contactor
	C-M 3.5: Turbidity Monitoring: Department of Geology, Mines and Water Resources (DGMWR) to be engaged to monitor daily marine turbidity levels over sensitive coral areas adjacent to the site, throughout the dredging period. If turbidity levels exceed pre-set trigger levels, management action to be taken. Observations to be made over daily tidal cycle.	DGMWR Dredging contactor
C-M 4. Introduction of new marine pests:	C-M 4.1: Marine Pest Prevention: Prior to construction commencing, develop and implement proper arrangements for managing the risk of new marine pest introductions via the arrival of work barges, work boats, dredge etc - including: • a contractual requirement that such vessels must be totally free of bio-fouling *prior to leaving* their source ports (with inspections at the source port); • inspections of the hulls of these vessels for bio-fouling on arrival at Port Vila, by Dept Fisheries divers; and • inspections of the hulls of these vessels for bio-fouling on arrival at Port Vila, by Dept Fisheries divers. • If such arriving work vessels are found to have fouling, they should be directed out to the open ocean beyond Mele Bay for in-water hull cleaning, prior to being allowed to commence work on the construction.	Terminal owner/operator. Contractors. Contractors Dept Fisheries Contractors

Star Terminal Development: EMMP for Construction Phase: Marine Activities (C-M)		
Activity / Issue	**Environmental management and monitoring measures**	**Responsibility**
C-M 5. Marine spills	C-M 5.1: Marine Spill Prevention & Response Plan: Prior to construction commencing, develop and implement proper arrangements for the prevention, containment and clean-up of any spills of pollutants into the marine environment from construction activities. Such arrangements might include entering into an agreement with one or both of the two local oil terminals, to provide response and clean-up services in the event of a spill, and running an oil spill exercise with construction staff prior to work commencing.	Terminal owner/operator. Contractors.
C-M 6. Impacts on other marine users and uses	C-M 6.1: Marine Exclusion Zone: For safety reasons, declare and enforce a marine exclusion zone around the construction site, to prevent potential conflict between work boats and barges and other marine users and for safety and security.	Harbour Master

11.4 EMMP for Operational Phase: Land-based Activities

Star Terminal Development: EMMP for Operational: Land-based Activities (O-L)		
Activity / Issue	**Environmental management and monitoring measures**	**Responsibility**
O-L 1. Container wash-down and effluent discharge:	O-L 1.1. Storage & Handling of Pesticides: FBA to advise the necessary safety and environmental controls for storage, handling and use of quarantine pesticide chemicals at the new Star Terminal:	FBA Terminal designer. Terminal owner/operator.
	O-L 1.2. Wash-down Effluent Controls: FBA to advise the necessary design features to prevent pollution of the Harbour by pesticide chemicals and hydrocarbons that may be contained in the wash-down effluent:	".
	O-L 1.3: Wash-down Drainage Maintenance: Ensure that the effluent catchment and drainage system for the wash-down facility is regularly maintained.	Terminal owner/operator.
	O-L 1.4: Marine Pollution Monitoring: Enter into an arrangement with the Department of Geology, Mines and Water Resources (DGMWR) to underatke marine pollution monitoring near the Harbour discharge points, and include suspended solids, pesticide chemicals and hydrocarbons in water, sediments and biota in the suite of parameters analysed. Site to be sampled quarterly or immediately following significant rainfall.	Terminal owner/operator DGMWR
O-L 2. Stormwater drainage and discharge:	O-L 2.1. Gross Pollutant Trap: Install Gross Pollutant Traps (GPTs) in stormwater drainage system and ensure these are regularly maintained.	Terminal designer. Terminal owner/operator.
	O-L 2.3. Stormwater System Maintenance: Ensure that the stormwater drainage system is regularly maintained.	Owner/operator.
	O-L 2.4: Marine Pollution Monitoring: As per O-L 1.4 above.	As per O-L 1.4

Star Terminal Development: EMMP for Operational: Land-based Activities (O-L)		
Activity / Issue	**Environmental management and monitoring measures**	**Responsibility**
O-L 3. Hazardous materials:	O-L 3.1: Compliance with IMDG Code: Ensure that the handling and storage of hazardous cargoes complies with the IMDG Code.	Terminal owner/operator.
	O-L 3.2: On-site Fuel Storage: Ensure that new on-site fuel storage tanks comply with relevant standards – including: • spill containment bunding, • small spill response kit, • signage relating to contents of tanks, • safety warning, • no smoking sign; and • emergency number.	Terminal designer. Terminal owner/operator.
O-L 4. General waste management:	O-L 4.1. No Burning: End the current practice of burning garbage on site.	Owner/operator.
	O-L 4.2. Reuse & Recycle: Identify and implement all possible opportunities to re-use and recycle solid waste, all other garbage to be taken to municipal land fill.	"
	O-L 4.3. Waste Oil Management: End the current practice of allowing waste oil to be taken from the site for use on plantation fence posts and sports field – implement proper waste oil management practices, including investigating options with local oil terminals.	"
O-L 5. Energy efficiency:	O-L 5.1. Energy Efficiency Measures: Include the following energy efficiency elements in the design of the new facilities, as a minimum: • all on-site hot water to be provided by roof-top solar hot water panels (no electric hot water), • all roof surfaces to be used for solar-voltaic panels to at least supplement electricity usage on site, • energy efficient building design, including use of window shading, roof insulation and natural ventilation to reduce reliance on air-conditioning, • all light fittings to be for low energy bulbs (not incandescent),	Terminal designer. Owner/operator. Contractors.

Star Terminal Development: EMMP for Operational: Land-based Activities (O-L)		
Activity / Issue	**Environmental management and monitoring measures**	**Responsibility**
	• all site lighting to be automatically controlled for shut-off when not in use.	
O-L 6. Water efficiency:	O-L 6.1. Water Efficiency Measures: Include the following water efficiency measures in the design of the new facilities, as a minimum: • all roofs to be treated as catchments feeding to rainwater storage tanks – with such tanks to supplement on-site water usage, • if possible, steam to be used for container washing – otherwise high-pressure water washing will result in significant increase in water usage (and effluent run-off), • all on-site toilets to be dual flush, • any on-site showers to have efficient shower heads; and • all opportunities for on-site recycling of used water to be explored (e.g. waste water to be used for irrigating landscaped areas around offices).	Terminal designer. Terminal owner/operator. Contractors.

11.5 EMMP for Operational Phase: Marine Activities

Star Terminal Development: EMMP for Construction Phase: Marine Activities (O-M)		
Issue	**Environmental management and monitoring measures**	**Responsibility**
O-M 1. Impacts on marine biodiversity	O.M 1.1 Marine Biological Monitoring: Undertake ongoing, long-term monitoring of the potential impacts of the terminal on the marine environment, by re-surveying the baseline survey sites at least annually into the future (building on the Marine Biodiversity Baseline Survey undertaken as part of the Supplementary EIA).	Terminal owner/operator to fund. Department of Fisheries to undertake.
O-M 2. Impacts on marine water quality	O-M 2.1 Marine Pollution Monitoring: As per O-L 1.4 – ongoing.	Terminal owner/operator to fund. DGMWR to undertake
O-M 3. Impacts on hydrodynamics and coastal processes	O-M 3.1 Hydrodynamic Model: Implement a comprehensive program to collect oceanographic data and develop a 4D hydrodynamic model for Port Vila, to support proper assessment, planning and management of all proposed developments and activities in the Harbour.	GoV with donor support.
O-M 4. Marine spill prevention and response	O-M 4.1 Oil Spill Contingency Plans: Develop and maintain oil spill contingency plans both for Port Vila and for Vanuatu as a whole, including training, exercises and equipment.	"
	O-M 4.2. IMO Conventions: Undertake a thorough review and update of the IMO conventions that Vanuatu is a party to.	"
	O-M 4.3. Maritime Legislation: Undertake a thorough review and update of the national legislation that implements the IMO conventions in Vanuatu – recent maritime legislative work in PNG may be used as a model.	"

Star Terminal Development: EMMP for Construction Phase: Marine Activities (O-M)		
Issue	**Environmental management and monitoring measures**	**Responsibility**
	O-M 4.4: Terminal Nav-Aids: Include any new navigation aids relating to Star Terminal as may be determined by the Harbour Master.	Terminal designer Owner/operator
	O-M 4.5: Nav-Aids Update: Undertake a review of the adequacy of navigation aids for the whole of Port Vila, and make improvements to these as necessary.	GoV with donor support.
	O-M 4.6 Port State Control Enhancement: Implement a programme to build the PSC capacity of DPM, as well as the capacity of GoV in general to implement and enforce its maritime legislation.	"
O-M 5. Marine pests	O-M 5.1: Marine Pest Risk Assessment: Once likely trading patterns are clarified, conduct a marine pest risk assessment for the terminal.	Terminal owner/operator
	O-M 5.2 Marine Pest Survey: Undertake a full-scale Marine Pest Survey for the whole of Port Vila Harbour.	GoV with donor support.
	O-M 5.3: Ballast Water Convention & Legislation: Vanuatu to sign and ratify the BWM Convention and develop, pass and enforce national legislation which implements this Convention for international ships visiting Vanuatu.	"
O-M 6. Ship' anti-fouling	O-M 6.1: AFS Convention & Legislation: Vanuatu to sign and ratify the AFS Convention and develop, pass and enforce national legislation which implements this Convention for international ships visiting Vanuatu.	"
O-M 7. Ships' waste management:	O-M 7.1. Ships' Waste Management: Develop and implement proper ships' waste reception arrangements for Port Vila, including for Star Terminal and other port developments. As a minimum, these arrangements might include: • repairing, recommissioning and maintaining one of the high temperature quarantine incinerators for burning quarantine waste (all garbage received from internationals ships); and • opening discussions with the oil terminals to explore options for them to receive, reuse and recycle waste oil taken from ships using Star Terminal and other port facilities in Port Vila.	"t.

Star Terminal Development: EMMP for Construction Phase: Marine Activities (O-M)		
Issue	**Environmental management and monitoring measures**	**Responsibility**
O-M 8. Ships' sewage:	• O-M 8.1: MARPOL Annex IV & Legislation: Vanuatu to sign and ratify the Annex IV of MARPOL and develop, pass and enforce national legislation which implements this Convention for international ships visiting Vanuatu.	GoV with donor support.
O-M 9. Impacts on other marine users and uses:	O-M 9.1: Marine Exclusion Zone: Declare and enforce a marine exclusion zone around the new terminal, to prevent potential conflict between ships using the terminal and other marine users and for safety and security.	Harbour Master

12. SUMMARY CONCLUSION

The Supplementary EIA was undertaken from December 2009 through March 2010, including various field surveys and studies, and following international EIA standards. The Supplementary EIA finds that the environment at and around Star Wharf and in Port Vila generally is important and valuable, including special cultural significance for the Ifira people, significant coral communities immediately adjacent to the site, and important socio-economic values such as subsistence fishing by local communities and marine-based tourism.

The Supplementary EIA finds that the proposed project has the potential to significantly impact on these resources and values, and that care needs to be taken in the design, construction and operation of the proposed terminal, so as to avoid/minimize such impacts.

In accordance with international EIA standards, the Supplementary EIA assesses the likely impacts of the proposed development according to the following categories:

- Construction Phase: Land-based Activities
- Construction Phase: Marine Activities
- Operational Phase: Land-based Activities
- Operational Phase: Marine Activities

The table at the end of this Executive Summary summarizes the main findings of the Supplementary EIA in relation to each of these impact categories. Some of the main impacts include, but are not limited to:

- clearing of all site vegetation,
- dredging of approximately 60,000 m^3 of material from the seabed,
- destruction of up to 1.6 ha of marine habitat, including healthy coral areas, for land reclamation,
- the potential for introductions of foreign marine species, including potential marine pests,
- the potential for spills of oil and other pollutants from vessels using the terminal,
- the generation of ship-sourced wastes,
- the potential contamination of Port Vila Harbour, including seafood species, by chemical pesticides used for container quarantine treatment,
- the discharge of site wash-down effluent and stormwater, including potential contaminants, into the Harbour; and
- a significant increase in electricity usage with increased fuel consumption and pollution production, including greenhouse gases, by the local power generation utility.

To address the potential for such impacts, the Supplementary EIA includes a proposed Environmental Management and Monitoring Plan (EMMP) for both the construction and operational phases.

As an off-set for the approximately 1.6 ha of marine habitat that will be destroyed by the land reclamation, it is suggested that consideration be given to implementing a community-based marine resource management regime over Vatumaru Bay, including traditional tabu mechanisms.

The Supplementary EIA also finds that the proposed development will improve environmental protection compared to the existing facility in a number of important ways, including but are not limited to:

- improved management of solid and liquid wastes,
- improved storage and handling of hazardous materials and dangerous goods,
- significantly improved traffic safety on Wharf Road,
- reduced dust and fumes,
- the revetment of reclaim faces to prevent erosion and turbidity plumes,
- improved water-use efficiency,
- improved drainage and stormwater management; and
- major improvements to site safety and security, reducing the chances of accidents resulting in pollution and environmental damage.

Overall the Supplementary EIA concludes that so long as the recommended EMMP is properly implemented, the proposed Star Terminal development should not pose an unacceptable risk of causing adverse impacts on the physical, biological, socio-economic and cultural environment, natural resources and values of Port Vila Harbour. The project is also assessed to comply with AusAID EIA checklist criteria for coasts and small islands.

The Supplementary EIA concludes there is no environmental reason that the project should not be approved for construction, on the condition that the recommended EMMP is fully and properly implemented.

Should the proposed works change in terms of location, layout, scope and/or scale from what has been assessed in this Supplementary EIA, including any changes to the proposed dredging and dredge spoil disposal activities as outlined in this report, then such changes should be subject to additional EIA prior to approval.

13. REFERENCES

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FINAL DRAFT
For review and approval by GoV

Supplementary
Environmental Impact Assessment

VOLUME 2: APPENDICES

(Main Report in separate Volume 1)

***Star Terminal** Development*

Port Vila, Vanuatu

April 2010

Government of Vanuatu

SOROS

ecostrategic CONSULTANTS

JOB SHEET

Job No.:	**01/2010**:
Document reference:	EcoStrategic Consultants, 2010. *Supplementary Environmental Impact Assessment (EIA) for Star Terminal Development, Port Vila, Vanuatu, April 2010 - Volume 2: Appendices.* Report to the Government of Vanuatu and Ifira Trustees Ltd, through Soros Associates (Australia) Pty Ltd. Funded by the Australian Agency for International Development (AusAID). EcoStrategic Consultants, Cairns.
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Internal review:	*Person:* Francis Hickey *Date:* 24 March 2010
Internal approval:	*Person: Steve Raaymakers* *Date: 15 April 2010* *Signature:* 
Submitted to client:	**15 April 2010**

DISCLAIMER

The views and opinions expressed in both Volume 1: Main Report and Volume 2: Appendices of this Supplementary EIA are those of the consultants alone, based on the best of their knowledge and expertise, and do not reflect the views and opinions of any other individuals, institutions or companies, unless where specific references are provided in the text.

All information and data relating to the engineering design of the project as provided by *Soros Associates (Australia) Pty Ltd*, and by other sub-consultants contracted by Soros as part of the Bankable Feasibility Study, are accepted and used in this report at face-value and in good faith, without question, including but not limited to the economic justification for the proposed development, the layout of the proposed development, the areas and volumes to be dredged and reclaimed, and demolition wastes to be generated.

Should the proposed works change in terms of location, layout, scope and/or scale from what has been assessed in this Supplementary EIA, including any changes to the proposed dredging and dredge spoil disposal activities as outlined in this report, then such changes should be subject to additional EIA prior to approval.

EcoStrategic Consultants accepts no liability what-so-ever for any decisions, acts or undertakings made or done by any persons, institutions or companies having knowledge of the contents of this report.

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GOUVERNEMENT DE LA
RÉPUBLIQUE DE VANUATU

LA SECRÉTAIRE-GÉNÉRALE

GOVERNMENT OF THE
REPUBLIC OF VANUATU

COUNCIL OF MINISTERS

Tasde 6 Septemba 2007

Hon. Edward Nipake Natapei Tuta-Fanua'ariki [MP]
Deputi Praem Minista & MIPU
Vanuatu Gavman

Hon. Minista,

Desison 86/2007: Ol divlopmen ekstenson blong ol fasiliti long Port-Vila wof

Kaonsel blong ol Minista (KBM) i bin holem long 3 Septemba 2007 namba 14 odineri miting blong hem

Taem ia, Kaonsel i apruvum desison antap ia olsem, KBM i endosem:

- Extension of the IWS concession to 50 years to facilitate Ifira trustees Ltd. to construct a world class international domestic ports terminal at no cost to Government initially – ie have a return
- That Government to retains a 25 % share holding in Ifira ports and services development Ltd. and 25 % of all gross revenues from quay dues and other charges all at no cost to Government
- That the Minister of Infrastructure & Public Utilities appoint a committee comprising of the Prime Minister's Office, MIPU, MFEM and SLO to facilitate the recommendations
- That this decision supersedes decision 98/2006 of 27 July 2006 (which is attached)

Tangkio

SPR 9053, Port Vila, Vanuatu – Telephone (678) 22413 – Facsimile: (678) 26301 – E-mail; nalatoa@vanuatu.gov.vu

APPENDIX 1:
DECISION OF COUNCIL OF MINSITERS GRANTING 50 YEAR CONCESSION TO IFIRA

ERNEMENT DE LA
UBLIQUE DE VANUATU
ECRÉTAIRE-GÉNÉRALE

GOVERNMENT OF THE
REPUBLIC OF VANUATU
COUNCIL OF MINISTERS

Fraede 28 Julae 2006

Hon. Tuta-Fanua'ariki [MP]
Minista blong Infrastrakja & ol Pablik utiliti
Vanuatu Gavman

Hon. Minista,

DESISON 98/2006: Projek proposal blong divlopmen ekstenson blong ol fasiliti blong Port-Vila mein wof

Namba 13 odineri miting blong Kaonsel blong ol Minista (KBM) i bin stap long Tosde 27/07/06

Taem ia, Kaonsel i disaed blong apruvum desison antap ia olsem, KBM i:

- Agri se ol Minista blong Infrastrakja mo ol Pablik utiliti wetem Faenans & Ikonomik Manajmen oli engejem wan konsaltent blong priperem wan ditel fisibiliti stadi long projekt

Tangkio

Nadine Alatoa
Sekreteri-Jenerol

c.c.: Ekselensi Hed blong Stet
Hon. Spika blong Palemen
Hon. Praem Minista
Hon. DPM
Evri Hon. Minista
PSC Jeaman
Akting Atoni-Jeneral
Evri Daerekta-Jenerol
Evri 1st Politikol Advaesa
PRO
DESP
DSM

RECEIVED
DATE: 12/07/07

SPR 9053, Port Vila, Vanuatu – Telephone (678) 22413 – Facsimile: (678) 26301 – E-mail; nalatoa@vanuatu.gov.vu

APPENDIX 2:
PREVIOUS FORESHORE DEVELOPMENT PERMIT

APPENDIX 2:
PREVIOUS FORESHORE DEVELOPMENT PERMIT

GOVERNMENT
OF THE
REPUBLIC OF VANUATU

MINISTRY OF
INTERNAL AFFAIRS

Private Mail Bag 036
PORT VILA
Tel: 22252 Tel/Fax: 25768

GOUVERNEMENT
DE LA
REPUBLIQUE DE
VANUATU

MINISTERE DE
L'INTERIEUR

Sac Postal Privet 036
PORT VILA
Tel: 22252 Tel/Fax: 25768

Wednesday, September 27, 2006

Ref.: MIA 202/2//212/20/06/GW/js

IFIRA TRUSTEES LIMITED
PO Box 68
PORT VILA

Re.: FORESHORE DEVELOPMENT

MINISTERIAL CONSENT FOR THE REHABILITATION OF STAR/ARDIMANI WHARF, PORT VILA, SOUTH EFATE

In pursuance of the powers granted to me under the Foreshore Development Act (Cap. 90), I am empowered to determine your application dated 24th August 2006 for rehabilitation of STAR/ARDIMANI WHARF, Port Vila, South Efate.

I have perused your application and after due consideration noted that the application is in itself made on the basis to improve and upgrade the above existing infrastructure for the betterment of the economic development of Port Vila and Vanuatu as a whole. Under the Foreshore Development Act, I do not foresee any difficulties as regard the future potential development provided.

In light of the above I hereby grant you APPROVAL to the application provided that you strictly adhere to the following conditions;

1. The consent hereby granted shall lapse and be of no effect if the development has not commenced within one (1) year of the date of consent or completed within two (2) years of the date or such extended period as I may specify.

2. The development must be carried out strictly and in accordance with the Business Development Plan and the Environmental Impact Assessment Report of the project.

3. The project proponents to cooperatively and collaboratively work with the following authorities, namely; the Physical Planning Unit, the Department of Provincial Affairs, the Department of Geology and Mines, the Department of Ports and Marine, Shefa Provincial Government Council and the Environment Unit to ensure a sustainable development.

4. Environmental Management of the area to be exclusively the sole responsibility of the developer and to be kept clean to the satisfaction of the Minister of Internal Affairs and in line with the Foreshore Development Act as well as the Environmental Management and

This consent is made under the Foreshore Development Act (Cap. 90) only and no other enactment, byelaw, order or regulation. Development on the shore or above the High Mean Water Mark (HMWM) will require permission either from Shefa Provincial Government Council or Port Vila Municipal Council under the Physical Planning Act (Cap. 193).

Please acknowledge receipt of this decision within 14 days.

.....

IMPORTANT NOTICE

Section 2 of the Foreshore Development Act [Cap. 90} stipulates that;

"NO PERSON SHALL UNDERTAKE OR CAUSE A PERMIT TO BE UNDERTAKEN ON THE FORESHORE OF THE COAST OF ANY ISLAND IN VANUATU WITHOUT HAVING FIRST OBTAINED THE WRITTEN CONSENT OF THE MINISTER TO SUCH DEVELOMENT".

.....

Yours faithfully,

REPUBLIC OF VANUATU
MINISTER OF INTERNAL AFFAIRS
MINISTRE DES AFFAIRES INTERIEURES
REPUBLIQUE DE VANUATU

Hon. George WELLS
Minister of Internal Affairs

Cc : 1st PA, MIA
: DG, MIA
: State Law Office
: Director, Department of Provincial Affairs
: Director, Department Lands
: Director, Department of Ports and Marine
: Director, Environment Unit
: Physical Planner, Shefa Provincial Government Council
: Town Planner, Port Vila Municipal Council
: Physical Planning Unit
: File

APPENDIX 3:
TERMS OF REFERENCE FOR THE SUPPLEMENTARY EIA

Terms of Reference for the Supplementary EIA as issued by the Government of Vanuatu - Environment Unit, March 2010.

(includes identification of relevant sections of Supplementary EIA against each Term of Reference)

Terms of Reference	Relevant section of the Supplementary EIA
1. **Project Description** • Background information/ summary on the development • Determine techniques or methods of approach deployed for developments	Section 1. Description of the Project
2. **Description of the existing environment**	Section 4. Description of the Existing Environment
• Identify existing infrastructures	Section 1.1. Existing Star Wharf
• Identifying drainage patterns & outlets	Section 4.5. Freshwater runoff & groundwater quality
• Assess the physical topography of area	Section 4.1. Geography & geology
• Assess current water circulation	Section 4.12. Oceanography, hydrodynamics and coastal processes
• Identify stability of existing coastline/wharf	Section 4.1. Geography & geology
• Quantitative assessment of coastal marine flora & fauna and other benthos and biodiversity within development site; marine species, species distribution, species diversity, & essential habitats	Section 4.6. Terrestrial biodiversity Appendix 5: Site Vegetation Survey Section 4.7. Marine biodiversity Appendix 6: Initial Marine Reconnaissance Appendix 7: Initial Marine Pest Assessment Appendix 8: Marine Biodiversity Survey
• Identify invasive marine species within site	Section 4.7.7. Introduced marine pests Appendix 7: Initial Marine Pest Assessment Section 5.2.5. Introduction of new marine pests (construction phase) Section 6.2.3. Marine pests (operational phase)
• Identification and assessment of significant marine ecosystems e.g. coral reefs, sea grasses, etc.	Section 4.7. Marine biodiversity Appendix 6: Initial Marine Reconnaissance Appendix 7: Initial Marine Pest Assessment Appendix 8: Marine Biodiversity Survey

Terms of Reference	Relevant section of the Supplementary EIA
3. **Environmental impact analysis**	
• Analysis of recent water quality of Port Vila harbour	Section 4.8. Marine water quality
• Analysis of water current circulation	Section 4.12. Oceanography, hydrodynamics and coastal processes Section 6.2.1. Impacts on hydrodynamics and coastal processes
• Indicate level of wastes to be produced (dredged materials etc.)	Section 5.1.2. Demolition of existing buildings Section 5.2.1. Demolition of existing wharf & piles Section 5.2.4. Dredging Section 7. General waste management
• Identify & locate potential exposed areas likely to be impacted by the proposed development	The meaning of 'exposed areas' is not understood.
• Identify the impacts of dredging on marine ecosystems & flow of water current	Section 5.2.4. Dredging Section 6.2.1. Impacts on hydrodynamics and coastal processes
• Identify level of suspended sediments in water and the concentration	Section 4.8. Marine water quality
• Effect of increase flow of water into surrounding coastlines, especially the reclaimed Ifira point (Woroloa point)	Section 6.2.1. Impacts on hydrodynamics and coastal processes
• Effect of coastal erosion within nearby coastlines	Section 6.2.1. Impacts on hydrodynamics and coastal processes
• Effect of development on traffic/routes	Section 5.1.5. Traffic (construction phase) Section 6.11. Traffic (operational phase)
4. **Socio-cultural impact analysis**	
• Effect of development on people; Ifira point residents & Ifira island eastern settlements	Section 4.14. Cultural heritage Section 5.1.9. Impacts on terrestrial cultural values Section 5.2.8. Impacts on marine cultural values
• Effect of development on tourism activities (water sports etc.)	Section 5.2.7. Impacts on other marine users & uses (construction phase) Section 6.2.6. Impacts on other marine users & uses (operational phase)

Terms of Reference	Relevant section of the Supplementary EIA
5. **Mitigation measures and options**	
• Verify measures to minimize effects on marine environment including significant species & habitats	Section 11.3. EMMP for Construction Phase: Marine Activities Section 11.5. EMMP for Operational Phase: Marine Activities
• Determine measures to minimize effects of coastal erosion on nearby coastal areas as a result of increase flow of water current	No such effects are predicted so no specific measures are proposed.
• Describe how the dredging approach designed to reduce complication to water circulation	No such effects are predicted so no specific measures are proposed. If proposed dredging changes from what is described in the Supplementary EIA - including into the limestone ridge that separates Pontoon and Paray Bays, more detailed EIA should be carried out, inc. hydrodynamic modeling.
• Describe how water quality can be improved or maintain	Section 11.3. EMMP for Construction Phase: Marine Activities Section 11.5. EMMP for Operational Phase: Marine Activities
• Determine measures to reduce concentration of suspended sediments	Section 11.3. EMMP for Construction Phase: Marine Activities Section 11.5. EMMP for Operational Phase: Marine Activities
• Identify waste management, generation, storage & disposal plans	Section 7. General waste management Section 11.2. EMMP for Construction Phase: Land-based Activities (Activities C-L 2, C-L 6 and C.L 8)
• Describe measures to minimize risk from the likely occurrences of natural disasters such as cyclones, tsunamis, earthquakes etc…	Refer broader Bankable Feasibility Study and related sub-reports.
• Determine measures to minimize risks to the lives of the inhabitants, workers, tourists etc…	Refer broader Bankable Feasibility Study and related sub-reports.
• Describes measures to mitigate against effects of other related impacts on the environment	Section 11. EMMP (all components)
6. **Rehabilitation plans**	
• Highlight plans to rehabilitate development site after completion of physical work; re-planting of coral reefs etc.	Section 11.3. EMMP for Construction Phase: Marine Activities (esp. Activities C-M 1.3, 1.4 & 1.5) Section 11.5. EMMP for Operational Phase: Marine Activities

Terms of Reference	Relevant section of the Supplementary EIA
• Identify organizations responsible for rehabilitation or restoration programs	Section 11. EMMP (all components)
• Identify persons/organizations to be liable for costs incurred during and after project operation, including costs to environmental damage	Not for Supplementary EIA to determine. Relevant laws to apply. Refer Section 3. Regulatory Regime and separate Regulatory Review Report.
7. **Conclusion** • Summary of major findings • Summary of mitigation measures • Recommendations	Executive Summary Section 11. EMMP (all components) Section 12. Summary Conclusions

APPENDIX 4:
REGULATORY REVIEW

APPENDIX 3:
TERMS OF REFERENCE FOR THE SUPPLEMENTARY EIA

Port Vila ***Star Terminal***
Bankable Feasibility Study

Supplementary EIA: **Regulatory Review**

Dec 2009

Steve Raaymakers
EcoStrategic Consultants
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www.eco-strategic.com

1. Introduction

This Regulatory Review assesses the main Vanuatu laws that have implications for the proposed Star Terminal development, from an EIA perspective, and identifies the regulatory approvals that are required, the application for which will be supported by the Supplemental EIA.

No less than 29 different relevant laws were identified and reviewed. The text of the laws reviewed was obtained from *Laws of the Republic of Vanuatu (Consolidated Edition) 2006*, available at www.paclii.org/vu.

There may be other laws that relate to non-EIA aspects of the development, such as customs, immigration, commercial and business, employment, workplace safety, construction and building standards and other laws, which have not been identified or reviewed here.

The laws reviewed are grouped into three categories and listed in alphabetical order as follows:

- Environment, planning and natural resources laws:
    1. Control of Nocturnal Noise Act 1965 (Chapter 40)
    2. Convention on Biological Diversity (Ratification) Act 1992 (Chapter 217)
    3. Environmental Management & Conservation Act 2002 (Chapter 283).
    4. Fisheries Act 2005 (Chapter 315)
    5. Foreshore Development Act 1975 (Chapter 90)
    6. Mines & Minerals Act 1986 (Chapter 190)
    7. Montreal Protocol on Substances that Deplete the Ozone Layer (Ratification) Act 1984 (Chapter 232)
    8. National Parks Act 1993 (Chapter 224)
    9. Physical Planning Act 1986 (Chapter 193)
    10. Preservation of Sites and Artifacts Act 1975 (Chapter 39)
    11. Water Resources Management Act 2002 (Chapter 281)
    12. Wild Bird (Protection) Act 1962 (Chapter 30)

- Maritime laws:
    13. Derelict Vessels (Disposal) Act 1923 (Chapter 9)
    14. Harbor Lights Act 1914 (Chapter 2)
    15. Maritime Act 1981 (Chapter 131)
    16. Maritime Zones Act 1981 (Chapter 138)
    17. Maritime (Conventions) Act 1982 (Chapter 155)
    18. Motor Boats (Control) Act 1970 (Chapter 70)
    19. Port Vila Harbor (Prohibited Area) Act 1952 (Chapter 22)
    20. Ports Act 1973 (Chapter 26)

21. Prevention of Collisions at Sea Act 1983 (Chapter 166)
22. Shipping 1968 (Chapter 53)
23. Vanuatu Maritime Authority Act 1998 (Chapter 253) (Repealed)

- Quarantine and related laws:
  24. Animal Importation & Quarantine Act 1988 (Chapter 201)
  25. Biosecurity Bill
  26. Pesticides (Control) Act 1993 (Chapter 226)
  27. Plant Protection Act 1997 (Chapter 239)
  28. Quarantine Act 1909 (Chapter 1)
  29. Stockholm Convention on Persistent Organic Pollutants (Ratification) Act 2005 (Chapter 301)

The year in the title of each law refers to when the law was first passed by the Vanuatu Parliament. Several laws have been amended since the passing dates. Chapter numbers refer to each law - as a part of Vanuatu's overall set of national legislation – and not 'chapters' within each law. Chapter numbers are chronological from when the first law was passed – Chapter 1, the Quarantine Act 1909.

2. Review of Laws

2.1 Environment, Planning & Natural Resources Laws

2.1.1 Control of Nocturnal Noise Act 1965 (Chapter 40)

This very simple Act has two sections as follows:

> ***Section 1. Prohibition of nocturnal noise***
>
> *No person shall within the town limits of Port Vila or Luganville and within 2 kilometres of the said limits between the hours of 9 o'clock in the evening and 5 o'clock of the following morning sing, shout, play a musical instrument, sound a motor horn except when necessary to avoid an accident, or make any other unreasonable noise so as to cause annoyance to the inhabitants of the said town.*
>
> ***Section 2. Penalties***
>
> *Any person who acts in contravention of the provisions of this Act shall be guilty of an offence and on conviction thereof shall be liable to a fine not exceeding VT 5,000.*

Implications for project:

Star Terminal will need to comply both during construction and operation.

2.1.2 Convention on Biological Diversity (Ratification) Act 1992 (Chapter 217)

This Act makes the *International Convention on Biological Diversity* legally binding in Vanuatu, including, *inter alia* a legal obligation to:

- conserve biological diversity and use its components sustainably;
- prevent the introduction of and control or eradicate those alien species which threaten ecosystems, habitats or species,
- undertake environmental impact assessment of proposed projects that are likely to have significant adverse effects on biological diversity, with a view to avoiding or minimizing such effects and, where appropriate, allow for public participation in such procedures.

Implications for project:

The Star Terminal development will impact directly on biodiversity through removal of on-site vegetation (and any associated fauna such as birdlife) and the destruction of marine communities including corals in the reclaim area. These impacts are considered to be extremely minor to negligible in terms of the very small area and the very low biodiversity significance of the impact areas.

The project may impact indirectly on biodiversity should ships using the terminal cause an oil spill and/or the introduction of alien species, and such impacts may be significant.

These issues are being addressed through the Supplemental EIA and the development of an Environmental Management and Monitoring Plan (EMMP) for both the construction and operational phases of the project, which will be contained in the Supplemental EIA.

2.1.3 Environmental Management & Conservation Act 2002 (Chapter 283).

This *Environmental Management & Conservation Act* (EMCA) provides for the conservation, sustainable development and management of the environment of Vanuatu, including its lands, air and waters, and the regulation of related activities. It forms the main environmental law of Vanuatu, which the project must comply with. The EMCA comprises six Parts as follows:

Part 1 – *Preliminary* (includes 'Interpretation' or definitions)
Part 2 – *Administration*
Part 3 - *Environmental Impact Assessment*
Part 4 - *Biodiversity and Protected Areas*
Part 5 - Offences
Part 6 - Miscellaneous

The points in each Part that are of most relevance to the project are highlighted below.

Part 1 – *Preliminary*

Two definitions in Part 1 that are of particular relevance to the project are:

- "land", which includes land covered by water; including the sea, which means that any reference to land in the Act includes the seabed that will be reclaimed and/or impacted by the project.

- "project proponent" which means the person whose signature appears, or is otherwise nominated, on any application form as being responsible for any project, proposal or development activity (this is assumed to be Ifira Corporation in the project's case).

Part 2 - *Administration*

Amongst other things, Part 2 provides for the appointment of the Director of the Department responsible for the environment, and confers certain powers and responsibilities on the Director, including to administer the EIA process under Part 3.

Part 2 also provides that the Minister responsible for the environment may determine that a National Policy or National Plan is required for the conservation, sustainable development and management of the environment, and that the Director must prepare that National Policy or National Plan. The consultant is currently determining whether any such Policies and/or Plans have been prepared under EMCA that may have implications for the project, and this will be reported on in the near future.

Part 3 - *Environmental Impact Assessment*

This is obviously the most relevant Part of EMCA to the project. The most pertinent points are discussed below.

Division 1 – Activities subject to EIA

Section 11. All activities subject to this Act

All projects, proposals or development activities that:

(a) impact or are likely to impact on the environment of Vanuatu; and

(b) require any license, permit or approval under any law;

must comply with the provisions of this Act.

The Star Terminal project clearly fits with (a) and as the project requires approval under the *Foreshore Development Act, Physical Planning Act, Ports Act* and possibly other laws (see section 3 below), (b) also clearly applies.

Section 12. Activities that are subject to an EIA

(1) All projects, proposals or development activities that:

(a) cause or are likely to cause significant environmental, social and/or custom impacts; or

(b) cause impacts relating to the matters listed in subsection (2);

are subject to the EIA provisions of this Part.

(2) Without limiting subsection (1), all projects, proposals or development activities that will do or are likely to do all or any of the following are subject to the EIA provisions of this Part:

affect coastal dynamics or result in coastal erosion;

result in the pollution of water resources;

affect any protected, rare, threatened or endangered species, its habitat or nesting grounds;

result in the contamination of land;

endanger public health;

affect important custom resources;

affect protected or proposed protected areas;

affect air quality;

result in the unsustainable use of renewable resources;

result in the introduction of foreign organisms and species;

result in any other activity prescribed by regulation.

Points (a), (b) and (j) clearly potentially apply to the Star Terminal project and others including (d), (e), and (h) may apply if the project is not designed, constructed and operated properly.

Section 13 deals with activities that are not subject to EIA (residential houses etc) and is not covered further here.

Section 14. Preliminary assessment of applications

(1) Subject to subsection (2), any Ministry, Department, Government Agency, local government or municipal council that receives an application for any project, proposal or development activity not exempted by section 13, must undertake, or have undertaken on its behalf, a preliminary EIA of that application to determine:

(a) whether the project, proposal or development activity is likely to cause any environmental, social or custom impact; and

(b) the significance of any identified impact; and

(c) whether any proposed actions are likely to effectively mitigate, minimise, reduce or eliminate any identified significant impact.

Additionally, subsection (4) of Section 14 requires:

(4) The Ministry, Department, Government Agency, local government or municipal council that received the application must, within 10 days after the preliminary determination is made, refer the application to the Director if the preliminary EIA determines that:

(a) significant environmental, social or custom impacts are likely to be caused by the project, proposal or development activity; or

(b) the proposed actions will not or are not likely to effectively mitigate, minimise, reduce or eliminate any identified significant impact.

Sections 15 and 16 deal with designation of the lead agency for the EIA, and Section 17 includes the following:

Section 17. EIA determination

(1) The Director must determine the need for an EIA if:

(a) a referral is required under section 14(2); or

(b) a referral has been made under section 14(4); or

(c) a direct referral has been made under section 15.

(2) The Director must advise the project proponent, in writing, of his or her decision on the need for an EIA within 21 days of receiving the application, unless a longer duration is agreed with the project proponent.

As part of Ifira Corporation's earlier Star Wharf development proposal, an application was made to the Minister of Interior for a *Foreshore Development Permit* under the *Foreshore Development Act*, for the proposed land reclamation and associated works, which triggered the process required under sections 14 and 17 of EMCA., and resulted in the Vanuatu Environment Unit requiring an EIA to be carried out, according to a Terms of Reference (ToR) (see below) issued in [insert month] 2006. The EIA process was undertaken by Ifira Corporation in accordance with the following requirements of Division 2 of EMCA.

Division 2 – EIA process

Section 18. Environmental Impact Assessment

(1) This section applies if the Director determines under section 17 that an EIA is required.

(2) The EIA must be undertaken:

(a) in such manner as the Director determines as appropriate in the circumstances; and

(b) as required under section 19; and

(c) in accordance with the regulations; and

(d) in a manner consistent with any guidelines issued for this purpose by the Director.

(3) The Director must:

(a) register the particulars of the project, proposal or development activity in the Environmental Registry; and

(b) notify the project proponent and any affected Ministry, Department, Government Agency, local government or municipal council concerning the registration of the project, proposal or development activity.

(4) An EIA must be undertaken with the fullest practicable consultation with the project proponent and other relevant interested parties.

Section 19. Terms of reference for EIA

(1) The Director must develop a terms of reference for any work that is to be undertaken for an EIA, including a description of the scope of work required.

(2) In developing the terms of reference, the Director must give special consideration to the need for consultation, participation and involvement of custom landowners, chiefs and other interested parties, and may consult with the National Council of Chiefs for that purpose.

(3) The Director must refer the terms of reference for the EIA to the project proponent for written comment within 15 days or such longer period as the Director specifies.

(4) Within 30 days after receiving any written comments from the project proponent, the Director must make such revisions as are considered appropriate, and issue the final written terms of reference for the EIA to the project proponent. A copy of the terms of reference must be lodged in the Environmental Registry at the same time.

(5) Unless otherwise agreed, all costs associated with the preparation of an EIA are the responsibility of the project proponent.

Section 20. Public notice of EIA

(1) The project proponent must give such public notice about the project, proposal or development activity as the Director determines is appropriate in the circumstances.

(2) Any requirement for public notice must be practical and be reasonably certain to reach any identified interested parties.

(3) If the public notice invites written submissions, it must specify:

(a) the time period by which submissions must be received; and

(b) the address to which submissions must be sent.

(4) If practicable, a copy of any public notice must be lodged by the project proponent in the Environmental Registry.

(5) Unless otherwise agreed, all costs associated with any public notice requirement are the responsibility of the project proponent.

Section 21. Deficiencies in EIA Report

After receiving and reviewing the EIA report, including any submissions made under section 20, the Director may, by notice in writing, require the project proponent to correct any deficiencies and/or provide additional information in relation to the EIA report.

Section 22. Review of EIA

(1) Within 30 days after receiving the EIA report and any additional material required under section 21, the Director must review the report and make a recommendation on the project, proposal or development activity to the Minister.

(2) The Director's recommendation must include any draft terms and conditions by which the application for the project, proposal or development activity can proceed.

(3) The Director and the project proponent may, by agreement, extend any time limit under subsection (1).

Section *23. Decision on application*

(1) The Minister must consider the Director's recommendation and, within 21 days after receiving the recommendation, make a decision on the application for the project, proposal or development activity.

(2) The Minister must do one of the following:

(a) approve the application with or without terms and conditions;

(b) refer the matter back to the Director for further assessment;

(c) reject the application.

(3) The Director must advise the project proponent in writing of the Minister's decision within 14 days after the Director becomes aware of it.

(4) If the Minister refers the matter back to the Director or rejects the application, the Minister must provide the Director with written reasons for the decision.

The EIA was undertaken in 2006 by consultant Esrom, presumably in full compliance with the requirements and procesess outlined above, and used to support the application to the Minister of Interior for a *Foreshore Development Permit* under the *Foreshore Development Act* (see assessment of that Act below), which resulted in a permit being issued on . However, a condition of that permit was that construction should start within two years of issue of the permit, where-after the permit would lapse. As construction did not commence within two years, that permit has lapsed.

There are a number of additional sections in Part 3 of EMCA relating to EIA, including Section 24 which provides for penalties of up to VT 1,000,000 fine or a prison term not exceeding 2 years or both, for parties who proceed with a development that is subject to an EIA without written approval from the Minister under Part 3, and;

Section 28. Minister's approval no guarantee

(1) If the Minister approves a project, proposal or development activity, the approval is not to be interpreted as an approval for all requirements under the laws of Vanuatu.

(2) A project proponent is responsible for ensuring that all approvals, permits, licences, agreements, authorities or permissions required under or by any other

Act are obtained before proceeding with the approved project, proposal or development activity.

Part 4 - Biodiversity & Protected Areas

The only Sections of this Part that could potentially have implications for the project relate to the establishment and management of Community Conservation Areas, although it is understood that no such areas have been declared in the vicinity of the project site. This will be confirmed through the EIA process.

Part 5 provides for Offences against the Act, with penalties of a fine of not more than VT 1,000,000 or imprisonment for a period of not more than 2 years, or both. Compliance with EMCA therefore needs to be considered both during the construction and operation of the new terminal.

Finally, Section 45 of EMCA provides that "*The Minister may make regulations to give effect to the purposes and provisions of this Act*" including for a list or prescribed purposes. The consultant is currently determining whether any such Regulations have been prepared under EMCA that may have implications for the project, and this will be reported on in the near future.

Implications for the project:

Clearly, the EIA provisions of EMCA apply in full to the Star Terminal development proposal. As the current proposal does not differ substantially from the earlier proposal by Ifira Corporation, in terms of likely environmental impacts – it is not intended to re-trigger the above process for the current proposal. The current (supplemental) EIA work is intended to simply:

- build on the previous process, using the same ToR, in order to addresses some key additional issues that were not addressed in the earlier EIA (mainly in relation to marine impacts, including shipping issues),
- support the re-application for a Foreshore Development Permit (which had expired),
- support the application for approvals under the *Physical Planning Act* and *Ports Act* (which were never applied for – see assessment of those Acts below); and
- provide an EIA which meets international donor standards, thereby supporting bids for capital works funding.

The intention to build on the previous EIA process rather than trigger a new one has been communicated to the Vanuatu Environment Unit by AusAUD, EcoStrategic Consultants and Vanuatu Fisheries Department, although a face-to-face meeting has not yet been held to obtain confirmation of this from the Environment Unit – due to their lack of response to multiple requests for meetings in the lead-up to Christmas. Such a meeting needs to be held ASAP so as to ensure that the proposed process is acceptable.

The consultant needs to determine if any National Policies, Plans or Regulations have been declared under EMCA, and confirm that there are no declared Community Conservation Areas in the vicinity of the project, and assess what implications any of such might have for the project.

2.1.4 Fisheries Act 2005 (Chapter 315)

Amongst other things the *Fisheries Act* provides for the management, development and regulation of fisheries within Vanuatu waters. It deals with a wide range of issues including *inter alia*; Fisheries Management Plans, the licensing of local and foreign fishing vessels, foreign investment in fisheries, obligations under international fishery agreements, a ban on drift-net fishing and destructive fishing methods such as use of explosives and poisons in Vanuatu waters, the establishment of a whale sanctuary in Vanuatu waters.

The only section of potential direct relevance to the Star Terminal development is Section 45 on Marine Reserves, which states:

> *(1) The Minister may, after consultation with owners of any adjoining land and with the appropriate Local Government Council, declare any area of Vanuatu waters and the seabed underlying those waters to be a marine reserve.*
>
> *(2) Any person who, except with the written permission of the Minister, within any marine reserve:*
>
> *(a) engages in fishing; or*
> *(b) takes or destroys any coral; or*
> *(c) dredges or takes any sand or gravel; or*
> *(d) otherwise disturbs the natural habitat; or*
> *(e) takes or destroys any wreck or part of a wreck;*
>
> *is guilty of an offence punishable on conviction to a fine not exceeding VT 50,000,000.*

Implications for the project:

It is understood that no Marine Reserves have been declared in the vicinity of the project site. This will be confirmed through the EIA process.

2.1.5 Foreshore Development Act 1975 (Chapter 90)

The purpose of the *Foreshore Development Act* (FDA) is to regulate the carrying out of works on the foreshore.

Under Section 1: Interpretation:

- "development" means the carrying out of any building, engineering, mining or other operations in, on, over or under the land, or the making of any material change in the use of buildings or other land whether or not such land is covered by water;

- "foreshore" means the land below mean high water mark and the bed of the sea within the territorial waters of Vanuatu (including the ports and harbours thereof) and includes land below mean high water mark in any lagoon having direct access to the open sea;

- "Minister" means the Minister responsible for town and country planning.

Under section 2 no person shall undertake or cause or permit to be undertaken any development on the foreshore of the coast of any island in Vanuatu without having first obtained the written consent of the Minister to such development.

Under section 3:

- application for the consent of the Minister is to be made on a standard form as contained in the Schedule to the Act,

- a copy of the application must be submitted to the District Commissioner for the district in which the development is to take place, who shall arrange for the same to be publicly displayed for a period of not less than 14 days following the day that the application is received.

- the applicant shall also advertise sufficient particulars of the proposed development in a special edition of the Gazette notifying that the application is displayed at the office of the District Commissioner for the said district.

Section 4 provides that the Minister may, after considering the application and any representations which may have been made to him as a result of the advertisement of the application, grant, refuse, or grant subject to such conditions as he may consider desirable, , which shall be final.

Section provides that any consent granted by the Minister shall lapse and be of no effect if the development has not been commenced within 1 year of the date of consent or completed within 2 years of that date or such extended period as the Minister may specify.

Section 6 provides that offences are punishable by a fine of VT 200,000:

Implications for the project:

The FDA is clearly directly applicable to the Start Terminal development proposal. As the previous FD Permit granted to Ifira for the earlier development proposal has expired, it will be necessary to apply for a new one, in accordance with the provisions of the FDA. This application should be made by Ifira Corporation, and be supported by the Supplementary EIA.

2.1.6 Mines & Minerals 1986 (Chapter 190)

The *Mines and Mineral Act* (MMA) regulates and controls the search for and development of minerals and related matters. There are some definitions in Part 1 – Interprettaion – that may be of relevance to the Start Terminal development. These are:

- "building minerals" means, subject to subsection (2), mineral substances and rocks commonly used for building, road making or agricultural purposes;

- "land" includes –
    - *land beneath water;*
    - *the seabed and subsoil beneath the territorial sea;*

- "quarry permit" means a permit issued under section 62;
- "mine" when used as a verb, means intentionally to get minerals from land and includes any operations necessary for or incidental to that purpose;
- "mineral" means any substance, whether in solid, liquid or gaseous form, occurring naturally in land, formed by or subject to a geological process

Implications for the project:

It is likely that material for the land reclamation proposed for the Star Terminal development will be sourced from one or both of two established quarries in the Port Vila area. Such quarries are required to have Quarry Permits under the MMA. While legal responsibility for Quarry Permits rests with the owner/operator of the said quarries, as part of general duty of care it is necessary for the Star Terminal developer to ensure that all suppliers have the necessary legal permits and approvals. This will be done for the quarries through the Supplemental EIA process.

Additionally, while no dredging is currently proposed for the project, should dredging be required, a permit may be needed under the MAA. This will be assessed further through the Supplemental EIA process.

2.1.7 Montreal Protocol on Substances that Deplete the Ozone Layer (Ratification) Act 1984 (Chapter 232)

This Act makes the *Montreal Protocol on Substances that Deplete the Ozone Layer* legally binding in Vanuatu, including, *inter alia* a legal obligation to reduce and ultimately eliminate the use of ozone depleting substances (CFS, Halons etc). Lists of such substances are included in schedules.

Implications for the project:

Historically, ozone depleting substances have been used in refrigeration, fire-fighting systems and similar applications that are relevant to shipping and may be relevant to the shore-side operations of the Star Terminal. While global application of the Montreal Protocol means that these substances are becoming unavailable in the marketplace, some manufacturers may still try to sell to developing countries. The design of relevant components of the Star Terminal development should ensure compliance with this Act by not including systems or components that use prescribed ozone depleting substances.

2.1.8 National Parks Act 1993 (Chapter 224)

The *National Parks Act* (NPA) makes provision for the declaration of national parks and nature reserves (implicitly including coastal and marine areas), and for the protection and preservation of such areas in their natural state.

Implications for the project:

It is understood that no national parks or nature reserves have been declared in the vicinity of the project site. This will be confirmed through the EIA process.

2.1.9 Physical Planning Act 1986 (Chapter 193)

The *Physical Planning Act* (PPA) provides for controlling the development of land, and land; with "development" being defined as "the carrying out of building or other operations in, on, over or under the land or the making of any material change in the use of buildings or land, or the subdivision of any land".

Municipal Councils and Local Government Councils have primary responsibility for implementing the PPA, including the declaration of Physical Planning Areas and the development and implementation of plans for such areas.

Section 5 of the PPA states that "No person shall carry on development in a Physical Planning Area, except as specified in the declaration of that Physical Planning Area, without having first received permission in writing from the Council".

Implications for the project:

Need to check if the proposed Star Terminal development is consistent with what is specified in the Plan for the Physical Planning Area. If it is consistent then there are no implications for the project. If it is not, application will need to be made to the Shefa Council for permission. This will be confirmed through the EIA process.

2.1.10 Preservation of Sites and Artifacts Act 1975 (Chapter 39)

The *Preservation of Sites and Artifacts Act* (PSAA) provide for the preservation of sites and objects of historical, ethnological or artistic interest, and requires, inter alia that ay person or body corporate in possession of a classified site shall be bound to prevent such site being modified or undergoing any deterioration and shall inform the Minister of any change that is likely to take place in the condition or the ownership of such site:

Implications for the project:

It is understood that no sites or objects of historical, ethnological or artistic interest have been declared or classified in the vicinity of the project site. This will be confirmed through the EIA process.

2.1.12 Water Resources Management Act 2002 (Chapter 281)

The Water Resources Management Act (WRMA) provides for the protection, management and use of water resources in the Republic of Vanuatu. There are some definitions in Section - Interpretation – that may be of relevance to the Start Terminal development. These are:

> "discharge" means all discharges whether intended, accidental or unintended;

"environment" means the components of the earth and includes all or any of the following:

(a) land and water;
(b) layers of the atmosphere;
(c) all organic and inorganic matter and living organisms;
(d) the interacting natural and human systems that include components referred to in paragraphs (a) to (c);

"pollute" means directly or indirectly to adversely alter the physical, thermal, chemical, biological or other natural properties of any water, and "pollution" has a corresponding meaning;

"water" means all or any of the following:

(a) water flowing over or situated upon the surface of any land;
(b) water flowing over or contained in:
(i) any river, stream, creek or other natural course for water;
(ii) any lake, lagoon, bay, swamp, marsh or spring,
whether or not it has been altered or artificially improved;
(c) groundwater;
(d) any water at any time contained by works;
(e) any estuarine or coastal sea water prescribed as water under this Act;

"works" mean any physical works related to the protection, management and use of water and includes any stormwater or wastewater works and their associated construction activities.

Section **7** regarding **Application for works states:**

(1) A person must apply to the Director for the right to construct, operate or maintain works for any purpose that does not comply with section 4 or 5, including:

(a) any work in or adjacent to any water or any bore; or
(b) any work whose purpose is to supply water to any other person.

As the definition of "works" includes any stormwater or wastewater works and their associated construction activities, it may be necessary for such an application to be made in relation to the Star Terminal development.

Section 26 provides for the **Declaration of Water Protection Zone**s. It is not yet clear if any such zones have been declared in the vicinity of the project site – this will be checked.

Section 32 makes it an **Offence** to *inter alia*:

- use water without approval under section 6
- construct or operate a work without approval under section 7
- contravene a term or condition of an approval or notice issued under this Act
- contravene a regulation, order, declaration or direction made under this Act
- without authorisation, pollutes any water

The last point above is relevant to the project, including in relation to discharges from the site during both construction and operation phases, and from the container wash-down facility.

Section 37 allows the Minister to make **Regulations** in relation to the following matters of potential relevance to the project:

- the prescription of water to be included as estuarine or coastal water;
- the registration of works or bores;
- the granting, amending, renewing, suspending or cancelling of approvals issued under this Act;
- the classification of any water by reference to its quantity, quality or possible use;
- the establishment of water quality standards, guidelines and criteria, and prescriptions for testing and monitoring;
- the design, construction, operation, maintenance or repair of any works;
- the control, regulation or prohibition of any matter or thing in connection with the diversion, taking, collection, storage, supply, disposal, or discharge of any wastewater;
- the declaration and management of a Water Protection Zone;
- public health protection;
- the protection of freshwater and seawater fisheries;
- the control of pollution or contaminant discharges into water.

The consultant is currently determining whether any such Regulations have been prepared under WRMA that may have implications for the project, and this will be reported on in the near future.

Implications for the project:

Need to determine if approval is required under the WRMA for container wash-down, stormwater, sewerage and other water-related project works, if any Water Protection Zones have been declared in the area and if any relevant Regulations have been made, and if so what the implications are for the project. This will be confirmed through the EIA process.

2.1.13 Wild Bird (Protection) Act 1962 (Chapter 30)

The *Wild Bird (Protection) Act* (WBPA) provides for the protection of wild birds and makes it an offence to kill, wound, capture or take the eggs of protected species without a permit – and a list of such species is provided.

Implications for the project:

The proposed Star Terminal development will involve the removal of most vegetation on site, including several extremely large Fig and other trees that may well provide habitat, nesting, roosting and feeding areas for birds that are listed as protected under the WBPA.

The site vegetation survey being conducted under the Supplemental EIA will also assess possible presence of any such species and make recommendations to ensure compliance with the WBPA if any such birds are found to use the area.

2.2 Maritime Laws:

2.2.1 Derelict Vessels (Disposal) Act 1923 (Chapter 9)

This law provides for the disposal of derelict vessels found within the waters of Vanuatu. It requires that any person who finds an abandoned vessel or wreck of any description at sea or on the seashore shall give notice of such finding to the Minister responsible for transport or to the nearest police station.

The law allows the owner of a derelict vessel to claim ownership of the vessel within three months, subject to proof of ownership and payment to the salvor, any applicable duty and other costs. If no claim of ownership is made within three months the Government may sell the derelict vessel by public auction, with the proceeds lodged with Treasury after payment to the salvor and other costs

There is no definition of 'derelict vessel' nor 'salvor', and no provisions on what is to be done if the derelict vessel cannot be sold.

Implications for project:

As no derelict vessels have been found within the Star Terminal development area there are no current implications of this law for the project, although judging by their condition, some of the domestic vessels currently using the existing Star Wharf may well end up 'derelict' in the near future, including while operating at the wharf, should an accident or catastrophic structural failure occur.

2.2.2 Harbor Lights Act 1914 (Chapter 2)

Although this law dates from 1914 it is still in force and requires that all vessels in movement or at anchor in Port Vila harbour carry certain lights and identification markings, however these requirements are not fully consistent with modern IMO standards.

Implications for the project:

As most international vessels using Port Vila carry lights and markings in compliance with modern IMO standards ideally the antiquated Harbor Lights Act should be updated or repealed.

2.2.3 Maritime Act 1981 (Chapter 131)

This Act provides for the establishment of a Vanuatu-based shipping register for vessels engaged in foreign trade (mainly foreign-owned vessels that never come anywhere near Vanuatu). This is primarily a money earning mechanism for Vanuatu and the "silent, brass -plate", private company that is behind the registry, through the payment of ships' registration fees. This has been used by

foreign ship-owners to register their vessels under the Vanuatu flag, in part to reduce compliance costs of registering under their home flags where compliance with international (IMO) maritime Conventions may be more stringently enforced (such "offshore" ship registries are often referred to as "Flags of Convenience". They are particularly popular with US ship-owners, who also set up the Liberian, Panamanian, Marshall Islands and other international ship registries for the same purpose).

The fact that Vanuatu does not currently have a Port State Control or ship-survey capability highlights its inability to ensure compliance of such ships on its registry with its own laws, let alone international laws.

Interestingly, the Act provides that the non-statutory general maritime law of the United States of America is declared and adopted as the general maritime law in respect of all vessels registered in Vanuatu under this Act. This is extremely odd as such vessels engaging in international trade need to comply with IMO Conventions, and there are many aspects of US maritime law that do not comply with the international standards (for starters their navigation markings system is completely opposite of the rest of the world). Vanuatu should be part of the international maritime standards, not US standards.

Implications for the project:

None directly. Any ships engaged in foreign trade that are registered in Vanuatu under this Act and that use the Star Terminal will need to comply with the provisions of this Act. Ideally the Act should be reviewed and amended to bring it into line with international (IMO) standards, and Vanuatu should be assisted to develop a Port State Control and ship-survey capability.

2.2.4 Maritime Zones Act 1981 (Chapter 138)

The *Maritime Zones Act* (MZA) provides for the delimitation of the maritime zones of Vanuatu; declaring, delimiting and giving Vanuatu legal jurisdiction over its:

- Internal waters
- 12 Nautical Mile Territorial Sea
- 24 Nautical Mile Contiguous Zone
- 200 Nautical Mile Exclusive Economic Zone (EEZ); and
- Continental Shelf,

in accordance with the United Nations Convention on the Law of the Sea (UNCLOS).

Implications for the project:

Under the MZA the proposed Star Terminal development is located within the defined Internal Waters of Vanuatu, thereby giving the Vanuatu Government full sovereign jurisdiction of this area, including the seabed and subsoil thereunder.

2.2.5 Maritime (Conventions) Act 1982 (Chapter 155)

This Act provides for the application in Vanuatu of certain international maritime conventions, and gives them the force of law in Vanuatu. The conventions implemented include, *inter alia*:

- Marine pollution:
  - CLC 69 (International Convention on Civil Liability for Oil Pollution Damage, 1969)
  - OILPOL 54 (International Convention for the Prevention of Pollution of the Sea by Oil, 1954)
  - MARPOL 73/78 (International Convention for the Prevention of Pollution from Ships, 1973 and Protocol of 1978)
  - FUND 71 (International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971)
- Maritime safety:
  - CLREG 72 (Convention on International Regulations for Preventing Collisions at Sea, 1972)
  - (SOLAS) International Convention for the Safety of Life at Sea, 1974
  - Load Lines 66 (International Convention on Load Lines, 1966)
  - Tonnage 69 (International Convention on Tonnage Measurement of Ships, 1969)
  - PAL 74 (Athens Convention Relating to the Carriage of Passengers and their Luggage by Sea, 1974)
  - FAL 65 (Convention on Facilitation of International Maritime Traffic, 1965)

This Act is seriously deficient in that many of the international Conventions that it implements in Vanuatu are no longer in force internationally, including:

- CLC 69 and Protocols which has been replaced by CLC 92 and subsequent Protocols
- OILPOL 54 which has been long dead
- FUND 71 and Protocols which has been replaced by FUND 92 and subsequent Protocols
- Recent additional Protocols and amendments to MARPOL.
- Various changes and update to the maritime safety Conventions.

There are also a number of additional international maritime laws which are extremely important to Vanuatu and to the Star Terminal development, that are not included in the list under this Act, including but not limited to the *International Ships and Port Security Code* (ISPS Code) and the *International Maritime Dangerous Goods Code* (IMDG Code).

A detailed analysis of all of these Conventions is beyond the scope of this review, however the consultant has worked with these Conventions for many years, including 5 years administering them at IMO in London, and recently drafting a whole new suite of maritime legislation which implements the IMO regime in PNG. A more detailed analysis can therefore be provided if required.

Of particular relevance is the implementation of MARPOL through this Act, which sets certain design standards for ship construction, and *inter alia* regulates the discharge of oil, chemicals, sewage and garbage from ships. From on-site observations it would appear that most if not all domestic ships and some international ships serving Port Vila, do not even begin to approach compliance with MARPOL or the safety Conventions listed, and may be in breach of this law.

The fact that Vanuatu does not currently have a Port State Control or ship-survey capability highlights its inability to ensure compliance of ships with this law.

MARPOL also places an obligation on ports and terminals to provide ships' waste reception facilities.

Additionally, the CLC and FUND Conventions are extremely important to Vanuatu, providing access to a major financial compensation regime in the event of oil pollution incidents (up to US$1000 Million), at no cost to Vanuatu. However, as CLC 69 and FUND 71 are now replaced with 92 versions of these Conventions, as well as additional new Protocols, Vanuatu needs to ratify and implement these later, current instruments in order have up-to-date compensation cover.

It is recommended that Vanuatu undertake a major review of the *Maritime (Conventions) Act* and update it to remove those international Conventions that are now redundant and replace them with the latest versions, and add a range of vital Conventions that are currently not included, including CLC 92 and FUND 92 as well as the ISPS and IMDG Codes. The new maritime legislation developed by the consultant for PNG may provide some useful models.

Additionally, Vanuatu should be assisted to develop a Port State Control and ship-survey capability, to help ensure compliance with this Act.

Implications for the project:

Any ships that use the Star Terminal will need to comply with the provisions of this Act. This may be difficult as many of the international Conventions implemented by this Act are no longer in force internationally and have been superseded by later international laws

MARPOL also places an obligation on ports and terminals to provide ships' waste reception facilities, and this will be addressed in the Supplemental EIA and new terminal design

Ideally the *Maritime (Conventions) Act* should be reviewed and amended to bring it into line with latest international (IMO) standards, and Vanuatu should be assisted to develop a Port State Control and ship-survey capability.

2.2.6 Motor Boats (Control) Act 1970 (Chapter 70)

The Motor Boats (Control) Act simply provides that the Minister responsible for transport may by Order make regulations regulating the passage, speed and use of boats propelled by motor within any area defined in and subject to any conditions specified in such regulations. It also requires boats towing water skiers to have at least two crew, with one as a lookout for the skier.

Implications for the project:

Need to determine if any relevant Regulations have been made that affect the project area, and if so what the implications are for the project. This will be confirmed through the EIA process.

2.2.7 Port Vila Harbor (Prohibited Area) Act 1952 (Chapter 22)

The *Port Vila Harbour (Prohibited Area) Act* is designed to prevent damage to electric and telephone cables connecting Iririki Island and the mainland, and prohibits the anchoring of vessels within the waters enclosed by a line drawn from the Iririki Island Resort jetty, to the southern extremity of Ballande Vanuatu wharf and a line drawn from the southern extremity of Burns Philip (Vanuatu) Ltd. wharf to the northernmost point of Iririki Island.

Implications for the project:

None directly.

2.2.8 Ports Act 1973 (Chapter 26)

The *Ports Act* provides for the control of ports in Vanuatu and contains a number of provisions of major significance to the Star Terminal development. The main provisions of direct relevance are:

- Section 2 - Port Vila is declared as a Port of Entry.
- Section 3 - any vessel which enters Port Vila from any place beyond Vanuatu shall be subject to such port dues
- Section 7 - harbourmaster or other officer appointed under this Act shall be entitled at any time while in the execution of his duty to enter and remain on any vessel. It shall be lawful for the harbourmaster to give directions regulating the time and the manner in which any vessel shall enter into, go out of or lie in the port, and the position, mooring, unmooring, placing or removing of any vessel within the same.
- Section 8 - Ships' Masters to comply with harbourmaster's directions
- Section 9 - Powers of harbourmaster to move vessels
- Section 10 - Harbourmaster may take necessary action to ensure security of shipping
- Sections 12 to 17 relating to pilotage
- Sections 18 and 19 regulating explosives on vessels
- Sections 20 to 22 relating to wrecks, obstructions and moorings

Of particular relevance to the proposed Star Terminal development are sections 23 and 24 relating to the Erection of Private Installations in a Port, which state as follows:

Section 23. Minister may licence occupation of foreshore for certain purposes

(1) The Minister may, subject to such conditions as he may deem fit and on payment of such fee or annual fee as may be prescribed by Order, licence and permit any part of the tidal lands and waters of a port to be used or occupied for all or any of the following purposes –

(a) the building or repairing of vessels of any kind;

(b) the erection of and use of any boat-shed, landing-place or wharf;

(c) the erection of baths and bath houses and any enclosure or fence necessary for the protection or privacy of the same;

(d) any other purpose relating to the convenience of shipping or of the public as they may approve:

Provided that the Minister may at any time revoke such licence without prejudice to any claim for compensation by any party adversely affected by such revocation.

(2) The revocation of any such licence shall not take effect until the expiration of 6 months after service on the licensee of a written notice of the revocation of the licence.

(3) No such licence or permit shall be granted which will interfere with the free navigation of the port.

(4) The Minister may authorise the licensee to make such maximum charges to the public for the use of a wharf as may be prescribed by the Minister by Order.

(5) Any person, not being the holder of a licence issued under this section, who shall erect or construct a wharf in any port or encroach in any way on the water of any port shall be guilty of an offence against this Act.

Section 24. Licensed part of foreshore to be lighted

There shall be exhibited such lights as may be required by the Minister from any such part of the tidal lands and tidal waters licensed as above provided for.

Sections 25 and 26 also give the Harbourmaster powers to enter onto land to control and if necessary order the screening of lights to prevent hindrance to safety of navigation, and Section 35 provides for the making of Regulations under the Act.

Implications for the project:

Development and operation of the proposed Star Terminal will need to comply with all relevant requirements of the Ports Act.

Of direct relevance to the Supplementary EIA, Ifira Corporation will need to make application to the Minister responsible for Ports for approval under section 23.

Also need to determine if any relevant Regulations have been made that affect the project, and if so what the implications are for the project. This will be confirmed through the EIA process.

2.2.9 Prevention of Collisions at Sea Act 1983 (Chapter 166)

The *Prevention of Collisions at Sea Act* applies the *International Regulations for Preventing Collisions at Sea 1972* (COLREG 72) in Vanuatu. This is in addition to the *Maritime (Conventions) Act* reviewed above which already gives COLREG 72 the force of law in Vanuatu by reference.

Implications for the project:

All relevant vessels servicing the proposed Star Terminal will need to comply with this Act.

2.2.10 Shipping Act 1968 (Chapter 53)

The Shipping Acts provides for the control and safety of Vanuatu vessels, including:

- Licensing of Masters and crew and certificates of competency
- Crew requirements
- Safety certificates and survey of ships
- Maximum number of passengers
- Loading of vessels and minimum free-board
- Unseaworthy vessels
- Dangerous goods
- Discipline of seamen

From on-site observations it would appear that most if not all domestic ships serving Port Vila, do not even begin to approach compliance with this Act, and are most likely in breach of this law. This heightens the risk of accidents potentially resulting in significant loss of life, as was seen with the Tongan ferry disaster in 2009 in which a total of 75 souls, including many women and children, were lost to the sea.

The fact that Vanuatu does not currently have a Port State Control or ship-survey capability highlights its inability to ensure compliance of ships with this law.

There are many provisions of the Shipping Act which are not consistent with the relevant international standards, including the SOLAS and STCW Conventions.

Implications for the project:

All relevant Vanuatu-flagged vessels servicing the proposed Start Terminal will need to comply with the *Shipping Act.* Ideally this Act should be reviewed and amended to bring it into line with

latest international (IMO) standards, including STCW and SOLAS, and Vanuatu should be assisted to develop a Port State Control and ship-survey capability to help in ensuring compliance with this Act.

2.2.11 Vanuatu Maritime Authority Act 1998 (Chapter 253) (Repealed)

This Act established the Vanuatu Maritime Authority as a competent organization for the regulation, administration and promotion of the maritime transport industry in Vanuatu, including improving compliance with international Conventions, national laws, safety standards and marine pollution prevention and control requirements.

However this Act was repealed in 2009 [check year] and the Authority disbanded. Similar functions are now performed by the Department of Marine and Ports which has diminished capacity.

Implications for the project:

None directly.

2.3 Quarantine and related laws:

2.3.1 Animal Importation & Quarantine Act 1988 (Chapter 201)

FBA to review and advise implications.

2.3.2 Biosecurity Bill

This is still a Bill and it is understood that once passed it will replace the *Plant Protection Act* and *Quarantine Act* (and possibly the *Animal Importation and Quarantine Act*) under a consolidated piece of biosecurity legislation.

The *Biosecurity Bill* is based on a regional template promulgated by the Secretariat of the Pacific Community (SPC). If passed as is it will have extremely serious implications for the proposed Star Terminal development, indeed the whole of shipping in Port Vila and Vanuatu, in effect closing down certain shipping operations, as follows:

Section 21(2)(b) of the Biosecurty Bill states that

> *the master of every incoming vessel must take all reasonable steps to ensure that*
>
> *(b) no bilge water or ballast water; and*
>
> *(c) no sewage or foul wasterwater*
>
> *is discharged from the vessel into the sea while the vessel is in Vanuatu.*

This provision completely ignores the fact that the routine discharge of bilge water, ballast water , sewage and wastewater is ***absolutely essential to the normal day-to-day operation of vessels.*** If

this provision is implemented it would effectively shut down the entire economy of Vanuatu. Ships arriving to export goods need to discharge ballast water as they load their cargo – and would not be able to operate at all. Similarly ships handling and trans-shipping containers need to discharge ballast in port from time to time – and would be prevented from operating should this provision apply.

This would of course be an entirely unacceptable impact on the economy and society, and the section must be re-worded, in order to allow shipping and the national economy to continue to operate. There is already an international legal regime in place for the regulation of these discharges from ships – the various IMO Conventions. Vanuatu laws on these matters should be consistent with the Imo Conventions, not re-invented in a Biosecurity Bill. A suggested re-wording for Section 22(1)(b) is as follows:

> *22. (1) The master of a vessel must ensure that –*
>
> *(a) any bilge water, sewage and wastewater that is discharged from the vessel into the sea while the vessel is in the territorial waters or the exclusive economic zone of Vanuatu,, are discharged in accordance with the provisions of the International Convention for Prevention of Pollution from Ships; and*
>
> *(b) any ballast water or sediments that are discharged from the vessel into the sea while the vessel is in the territorial waters or the exclusive economic zone of Vanuatu,, are discharged in accordance with the provisions of the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004.*

This wording would allow normal vessel operations to occur, while ensuring compliance with the standard global IMO regime.

Implications for project:

It is vital that the strongest representations be made to the Vanuatu Government to make the above amendments before it is passed, otherwise this Bill will effectively shut-down international shipping in Vanuatu if passed with such provisions.

2.3.4 Pesticides (Control) Act 1993 (Chapter 226)

FBA to review and advise implications.

2.3.5 Plant Protection Act 1997 (Chapter 239)

FBA to review and advise implications.

2.3.6 Quarantine Act 1909 (Chapter 1)

FBA to review and advise implications.

2.3.7 Stockholm Convention on Persistent Organic Pollutants (Ratification) Act 2005 (Chapter 301)

This Act makes the *Stockholm Convention on Persistent Organic Pollutants* legally binding in Vanuatu, including, *inter alia* a legal obligation to reduce and ultimately eliminate the use of Persistent Organic Pollutants (POPs) (including many pesticides, DDT, chloridin, aldrin, dieldrin and many others). Lists of such substances are included in schedules.

Implications for the project:

Historically, POPs have been used in pesticides and similar applications that are relevant to quarantine operations. The design of relevant components of the Star Terminal development, including the container quarantine facility, should ensure compliance with this Act by not including POP-based chemicals.

3. Summary of implications for the Project

Law	Implications for the Project
Environment, planning and natural resources laws:	
• Control of Nocturnal Noise Act 1965 (Chapter 40)	• Illegal to make noise that causes nuisance to nearby communities between 9pm and 5am. Star Terminal will need to comply both during construction and operation.
• Convention on Biological Diversity (Ratification) Act 1992 (Chapter 217)	• The Star Terminal development will impact directly on biodiversity through removal of on-site vegetation (and any associated fauna such as birdlife) and the destruction of marine communities including corals in the reclaim area. These impacts are considered to be extremely minor to negligible in terms of the very small area and the very low biodiversity significance of the impact areas. • The project may impact indirectly on biodiversity should ships using the terminal cause an oil spill and/or the introduction of alien species, and such impacts may be significant. • These issues are being addressed through the Supplemental EIA and the development of an Environmental Management and Monitoring Plan (EMMP) for both the construction and operational phases of the project (Section 11).
• Environmental Management & Conservation Act 2002 (Chapter 283).	• Clearly, the EIA provisions of EMCA apply in full to the Star Terminal development proposal. As the current proposal does not differ substantially from the earlier proposal by Ifira Trustees, in terms of likely environmental impacts – it is not intended to re-trigger the above process for the current proposal. The current (supplemental) EIA work is intended to simply: o build on the previous process, in order to addresses some key additional issues that were not addressed in the earlier EIA (mainly in relation to marine impacts, including shipping issues), o support the re-application for a Foreshore Development Permit (which had expired), o support the application for other necessary approvals; and o provide an EIA which meets international donor standards, thereby supporting bids for capital works funding.

Law	Implications for the Project
• Fisheries Act 2005 (Chapter 315)	• It is understood that no Marine Reserves have been declared in the vicinity of the project site.
• Foreshore Development Act 1975 (Chapter 90)	• The FDA is clearly directly applicable to the Star Terminal development proposal. As the previous FD Permit granted to Ifira for the earlier development proposal has expired, it will be necessary to apply for a new one, in accordance with the provisions of the FDA. This application should be made by Ifira Corporation, and be supported by the Supplementary EIA.
• Mines & Minerals Act 1986 (Chapter 190)	• Quarry Permit under MMA required for dredging. • If any material for the land reclamation is to be sourced from quarries, such quarries are required to have Quarry Permit under the MMA. While legal responsibility for Quarry Permits rests with the owner/operator of the said quarries, as part of general duty of care it is necessary for the Star Terminal developer to ensure that all suppliers have the necessary legal permits and approvals.
• Montreal Protocol on Substances that Deplete the Ozone Layer (Ratification) Act 1984 (Chapter 232)	• Historically, ozone depleting substances have been used in refrigeration, fire-fighting systems and similar applications that are relevant to shipping and may be relevant to the shore-side operations of the Star Terminal. While global application of the Montreal Protocol means that these substances are becoming unavailable in the marketplace, some manufacturers may still try to sell to developing countries. The design of relevant components of the Star Terminal development should ensure compliance with this Act by not including systems or components that use prescribed ozone depleting substances.
• National Parks Act 1993 (Chapter 224)	• The Act was never gazetted.
• Physical Planning Act 1986 (Chapter 193)	• The proposed Star Terminal development is consistent with the specified in the Plan for the Physical Planning Area (Industrial).
• Preservation of Sites and Artifacts Act 1975 (Chapter 39)	• It is understood that no sites or objects of historical, ethnological or artistic interest have been declared or classified in the vicinity of the project site.
• Water Resources Management Act 2002 (Chapter 281)	• Approval is required under the WRMA for container wash-down, stormwater, sewerage and other water-related project works.
• Wild Bird (Protection) Act 1962	• The proposed Star Terminal development will involve the removal of most vegetation on site, including

Law	Implications for the Project
(Chapter 30)	several extremely large Fig and other trees that may well provide habitat, nesting, roosting and feeding areas for birds that are listed as protected under the WBPA.
Maritime laws:	
• Derelict Vessels (Disposal) Act 1923 (Chapter 9)	• As no derelict vessels have been found within the Star Terminal development area there are no current implications of this law for the project.
• Harbor Lights Act 1914 (Chapter 2)	• As most international vessels using Port Vila carry lights and markings in compliance with modern IMO standards ideally the antiquated Harbor Lights Act should be updated or repealed.
• Maritime Act 1981 (Chapter 131)	• None directly. Any ships engaged in foreign trade that are registered in Vanuatu under this Act and that use the Star Terminal will need to comply with the provisions of this Act. Ideally the Act should be reviewed and amended to bring it into line with international (IMO) standards, and Vanuatu should be assisted to develop a Port State Control and ship-survey capability.
• Maritime Zones Act 1981 (Chapter 138)	• Under the MZA the proposed Star Terminal development is located within the defined Internal Waters of Vanuatu, thereby giving the Vanuatu Government full sovereign jurisdiction of this area, including the seabed and subsoil thereunder.
• Maritime (Conventions) Act 1982 (Chapter 155)	• Any ships that use the Star Terminal will need to comply with the provisions of this Act. This may be difficult as many of the international Conventions implemented by this Act are no longer in force internationally and have been superseded by later international laws • MARPOL also places an obligation on ports and terminals to provide ships' waste reception facilities, and this will be addressed in new terminal design. • Ideally the *Maritime (Conventions) Act* should be reviewed and amended to bring it into line with latest international (IMO) standards, and Vanuatu should be assisted to develop a Port State Control capability.
• Motor Boats (Control) Act 1970 (Chapter 70)	• Need to determine if any relevant Regulations have been made that affect the project area.
• Port Vila Harbor (Prohibited Area) Act 1952 (Chapter 22)	• None directly.

Law	Implications for the Project
• Ports Act 1973 (Chapter 26)	• Development and operation of the proposed Star Terminal will need to comply with all relevant requirements of the Ports Act. • Of direct relevance to the Supplementary EIA, ITL will need to make application to the Minister responsible for Ports for approval under section 23. • Also need to determine if any relevant Regulations have been made that affect the project, and if so what the implications are for the project.
• Prevention of Collisions at Sea Act 1983 (Chapter 166)	• All relevant vessels servicing the proposed Star Terminal will need to comply with this Act.
• Shipping 1968 (Chapter 53)	• All relevant Vanuatu-flagged vessels servicing the proposed Start Terminal will need to comply with the *Shipping Act.* Ideally this Act should be reviewed and amended to bring it into line with latest international (IMO) standards, including STCW and SOLAS, and Vanuatu should be assisted to develop a Port State Control and ship-survey capability to help in ensuring compliance with this Act.
• Vanuatu Maritime Authority Act 1998 (Chapter 253) (Repealed)	• None directly.
Quarantine and related laws:	
• Animal Importation & Quarantine Act 1988 (Chapter 201)	• Being assessed under a separate study by New Zealand-based quarantine consultants FBA. When available the FBA report should be referred to on these matters.
• Biosecurity Bill	• It is vital that the Vanuatu *Biosecurity Bill* be reviewed ASAP and that the strongest representations be made to the Vanuatu Government to amend the ballast and bilge water provisions in the Bill before it is passed, otherwise this Bill will effectively shut-down international shipping in Vanuatu if passed as is.
• Pesticides (Control) Act 1993 (Chapter 226)	• FBA to review and advise implications.
• Plant Protection Act 1997 (Chapter 239)	• FBA to review and advise implications.
• Quarantine Act 1909 (Chapter 1)	• FBA to review and advise implications.

Law	Implications for the Project
• Stockholm Convention on Persistent Organic Pollutants (Ratification) Act 2005 (Chapter 301)	• Historically, POPs have been used in pesticides and similar applications that are relevant to quarantine operations. The design of relevant components of the Star Terminal development, including the container quarantine facility, should ensure compliance with this Act by not including POP-based chemicals.

4. Regulatory Approvals Required

The proposed Star Terminal development will definitely require regulatory approval under the:

- *Foreshore Development Act*
- *Ports Act*

It may require regulatory approval under the:

- *Physical Planning Act*
- *Water Resources Management Act*

This will be determined with certainty during the consultant's next visit to Port Vila the first week of February, including through meetings with the Directors / senior officials of the relevant Ministries / Departments if possible. This should include a meeting with Director of Environment Unit to confirm that the Supplementary EIA process being followed is acceptable. AusAID will be asked to assist with setting up such meetings.

The project may also require regulatory approval under the various Quarantine laws identified by this review – and FBA should assess and advise on this as part of their consultancy.

Any quarries from which the development obtains reclamation fill and building minerals require a Quarry Permit under the *Mines and Minerals Act*, and this should be checked as part of general duty of care before the project purchases any such materials from such quarries.

APPENDIX 5:
SITE VEGETATION SURVEY

Port Vila ***Star Terminal***
Bankable Feasibility Study

Supplementary EIA: **Site Vegetation Survey**

5 Feb 2010

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1. Objectives

- To assess all existing vegetation resources at and in the vicinity of Star Wharf for conservation value, considering the need for container operations to be 100% free of sources of vegetative litter, pest species and other forms of quarantine contamination.

- To make recommendations on each main vegetation resource in terms of the proposed Star Terminal development.

2. Method

Satellite and aerial photography of the site was viewed to provide an initial overall assessment of vegetation resources on site.

A field survey comprising a site walk between 11am and 3pm, was undertaken by Francis Hickey and Steve Raaymakers on Friday 5 February 2010.

Each clump or significant specimen of vegetation was located on GPS, photographed and assessed for species identification on site or later on return from the field. Attention was paid to flowers and fruits. Notes were discussed and made on the conservation significance of each location, and recommendations developed in this report.

Digital originals of all images are held by EcoStrategic Consultants and are available to any GoV agency who wishes to have them. The image number, location name and GPS coordinates for each location surveyed are provided in Section 5, along with recommendations on each location.

3. Summary Results

The main existing vegetation resources of the Star Wharf site are shown in Figure 1. As the site is an artificial, man-made reclamation and operational port facility there is no natural forest or wild vegetation on site. However, a variety of trees and other vegetation has been planted around the site, especially along fence-lines and around buildings.

Trees planted include many that are of value for food production, medicinal or other practical/traditional purposes, and which are utilized by workers on the site, a common practice in Vanuatu and the Pacific generally, where incomes are often limited. Productive trees on-site include, but are not limited to:

- Avocado (*Persea americana*) x 6 trees*
- Banana (*Musa spp.*) x 20 trees
- Citrus (species unknown) x 3 trees*
- Coconut (*Cocos nucifera*) x 7 trees
- Guava (*Psidium guajava*) x 1 tree*
- Mango (*Mangifera indica*) x 8 trees*
- Noni (*Morinda citrifolia*) x 2 trees
- Papaya (*Carica papaya*) x 1 tree
- Sugarcane (*Saccharum officinarum*) x several clumps

Other 'non-productive' trees on site include:

- Beach almond (*Terminalia littoralis*) x 3 trees
- Fan palms (*Oritchardia pacifica*) x numerous along road fence line.*
- Fig (*Ficus prolixa* & *F. subcordata*) x 2 trees
- Flame (*Delonix regia*) x 3 trees*
- Frangipani (*Plumeria rubra*) x 3 trees*
- Ironbark/Sheoak (*Casuarina equsetfolia*) x 4 trees

Those species above marked with an asterix are not native to Vanuatu and have been introduced for production or aesthetic purposes since first European contact with the islands. Three specimens of the introduced 'pest' species Prickly Pear cactus (*Optuntia stricta*) were also found on site.

In addition to the practical value to workers of the 'productive' trees, the existing on-site vegetation also provides shade, natural cooling and dust suppression, improves aesthetics and supports a number of native bird and insect species.

Of particular note is a large (approx. 20m high) fig tree (*Ficus prolixa*) located on the road-side just to the east of the main roadway entrance. In addition to its own ecological, amenity and aesthetic values it also provides roosting and nesting habitat and a feeding resource for several species of birds and the occasional Flying Fox (*Pteropus tongatus*),

especially during flowering and fruiting season (June/July). The Vanuatu *Wild Bird (Protection) Act* prescribes a list of protected birds.

This tree provides an effective screen between Wharf Road and the terminal, acting as an environmental buffer and minimizing visual impacts on arriving Cruise Ship visitors.

This tree also has major cultural significance as being in *Warasa*, the tabu area of *Lepatasi* – the one armed octopus totem of the octopus clan (*naflak wita*) of the Ifira people. Given these values the Fig should be retained, or if really required, pruned on the terminal side only.

There is a second, larger Fig (*Ficus subcordata*) at the eastern most boundary of the site, which overlooks the home of the totem Lepatasi, the area of coast and sea just east of the existing reclaim, also called Lepatasi. This Fig also supports birds flying foxes, and ideally should also be retained.

Another significant tree is the Canoe tree (*Gyrocarpus americnus*) on the east side for the Nissan Hut. These have been used since ancient times to carve wooden outrigger canoes, the main-stay of traditional Vanuatu sea transport. While it has to be removed as part of the development, the timber should be used. It could be carved into a traditional canoe to go at main gate of new terminal, and which might be included as element in new Star Terminal logo.

There is a Cycad at the Security Hut at the Office Gate, which is of cultural significance throughout most of Vanuatu, being traditionally used to signify peace and to mark tabu boundaries. It is also an extremely ancient species linking Vanuatu with the Gondwana tectonics. This could be retained/transplanted/replaced as an entrance feature, given its traditional cultural significance as a boundary marker.

The ornamental gardens surrounding the Offices and amenity buildings include a number of local flowering perennials that have both aesthetic and cultural values to Ni-Vanuatu, including;

- Croton - *Codiaeum variegatum*
- *Cordyline* - *Cordyline fruticosa* (Bislama - nangarae)
- *Poliscias spp.*

These are good examples of the types of local plants that could be used when landscaping around the new office buildings.

The Fan Palms along Wharf Road were planted as part of municipal beautification program, as this is the direct entry point for Cruise Ship visitors to Port Vila. They do not pose a threat of litter to the proposed container yard - and should be retained. The terminal should not detract too much from the scenic route into Vila for Cruise Ship visitors. It is recommended that terminal developers consult with Port Vila Council prior to any proposed disturbance.

While most on-site vegetation will have to be removed for the Star Terminal development, the design should provide for landscaping of non-operational areas and ensuring minimal impact on visual amenity from Wharf Road, recognizing this as first point of entry for Cruise Ships, which inject approximately AUD$30 million/year into the Vanuatu economy (Nell, pers. comms. 2010).

Future landscaping should include only native species and productive food species as currently practiced.

The detailed assessments of each site are presented in section 5.

4. Summary conclusions / recommendations

Virtually all existing vegetation will need to be completely removed from the site as part of the Star Terminal development, to avoid quarantine contamination of containers and cargo and prevent fire hazards.

There are five areas that require special management as part of the development:

1. Prickly Pear: The two specimens of this invasive pest near the amenity building should destroyed without spreading (dig-up, dry and burn).

2. Fig tree (near existing main gate): Given its values the Fig should be retained, or if really required, pruned on the terminal side only.

3. Canoe tree: The timber should be used. Given historical significance to sea-transport, could be carved into a traditional totem or canoe to go at main gate of new terminal. Could include as element in new Star Terminal logo.

4. Fan Palms: The Fan Palms along Wharf Road should be retained. The terminal should not detract too much from the scenic route into Vila for Cruise Ship visitors. It is recommended that terminal developers consult with Port Vila Council prior to any proposed disturbance of these.

5. Cycad: Could be retained/transplanted as entrance feature, given its traditional cultural significance as boundary marker.

6. Terminal landscaping: The design should provide for landscaping of non-operational areas and ensuring minimal impact on visual amenity from Wharf Road, recognizing this as first point of entry for Cruise Ships, worth AUD$30 million/year to Vanuatu. Future landscaping should include only native species and productive food species as currently practiced.

Figure 1: Vegetation resources at the existing Star Wharf. Details of each image no. location are presented in Section 5.

5. Detailed Results

All images taken 5 Feb 2010.
Archived at eco-strategic.com

Image No. 1 **Location:** Office Gate

GPS: 17°45.376'S / 168°18.250'E

Description: Small clump of vegetation between security hut and amenities building comprising:

- 2 Casuarinas (*Casuarina equisetifolia*)
- 2 Mango (*Mangifera indica*)
- 1 Papaya (*Carica papaya*)
- 1 Cycad (*Cycas seemannii*)
- 2 Prickly Pear Cactus (*Opuntia stricta*)

Comment: Proposed to be removed. Cycad is ancient plant type. Has traditional significance, leaves are used to mark tapu areas. Prickly Pear is pest - should be destroyed without spreading.

Image No. 2a & 2b **Location:** Office Gate

GPS: 17°45.375'S / 168°18.250'E

Description: The Cycad (left) and the Prickly Pear (right) near the office gate security hut.

Comment: As above. Cycad could be retained/transplanted as entrance feature (given its cultural significance as boundary marker).

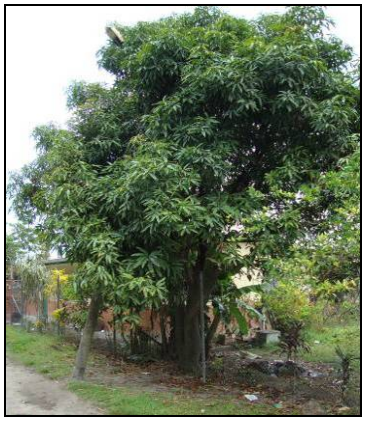

Image No. 3 **Location:** West of Office Gate

GPS: 17°45.375'S / 168°18.251'E

Description: Mango (*Mangifera indica*) on fence-line between between security hut and amenities building.

Comment: Proposed to be removed.. Mangoes were introduced to Vanuatu from India/SE Asia. Fruit are harvested by terminal workers. Harvest prior to clearing. Landscaping of new terminal should provide for such beneficial species. Retain existing examples where possible.

All images taken 5 Feb 2010.
Archived at eco-strategic.com

Image No. 4a & 4b **Location:** Roadside West of Office Gate

GPS: 17°45.381'S / 168°18.246'E

Description: Fan Palm (*Pritchardia pacifica*) on roadside to south of office gate - a row of these extends along the whole of Wharf Rd, planted as part of municipal beautification program (direct entry point for Cruise Ship visitors to Vila).

Comment: Do not pose a threat of litter to the proposed container yard - all these road-side palms should be retained. Terminal should not detract too much from the scenic route into Vila for Cruise Ship visitors. Fruit a food-source for birds (right picture). Consult with Port Vila Council prior to any proposed disturbance.

Image No. 5 **Location:** North of Amenity Building

GPS: Not recorded

Description: Second clump of Prickly Pear on internal fence just north of amenity building.

Comment: An introduced pest - should be destroyed without spreading.

Image No. 6 **Location:** NW Reclaim Area (west of wharf)

GPS: 17°45.351'S / 168°18.227'E

Description: Lone Casuarina tree (*C. equisetifolia*)

Comment: Casuarina's are extremely high sources of litter (needles and seeds) and all should be removed from operational areas of the site.

Image No. 7 **Location:** Refueling Facility

GPS: 17°45.342'S / 168°18.246'E

Description: Small clump of vegetation around vehicle and machinery refueling facility, comprising, from left to right in image:

- 1 Beach Almond (*Terminalia littoralis*)
- 1 Mango tree (*M. indica*)
- 1 Coconut tree (*Cocos nucifera*)
- 1 Casuarina tree (*C. equisetifolia*)

Comment: All pose a threat of litter to the proposed container yard. Fire hazard (fuel storage should be away from trees and with roof shade). Should be removed.

Image No. 8 **Location:** W Side of Nissan Hut

GPS: 17°45.348'S / 168°18.245'E

Description: Small clump of vegetation along west side of Nissan hut, including from left to right in image:

- 1 Mango tree (*M. indica*)
- 1 Noni (*Morinda citrifolia*) (fruiting)
- 1 Avocado (*Persea americana*) (fruiting)

Comment: Will be removed. All fruit of these trees are harvested by terminal workers. Noni is multi-ailment traditional medicine with huge commercial value. Harvest prior to clearing. Landscaping of new terminal should provide for such beneficial species.

Image No. 9 **Location:** SW End of Nissan Hut

GPS: 17°45.348'S / 168°18.245'E

Description: Fruiting Avocado at SW end of Nissan hut.

Comment: As above

Image No. 10 **Location:** NW end of Nissan hut

GPS: 17°45.336'S / 168°18.248'E

Description: Fruiting Mango (large tree) and Noni (to right) at SW end of Nissan hut.

Comment: As above

Image No. 11 **Location:** NW End of Nissan Hut

GPS: 17°45.336'S / 168°18.248'E

Description: Fruiting Noni at NW end of Nissan hut.

Comment: As above

Image No. 12 **Location:** NW End of Nissan Hut

GPS: 17°45.336'S / 168°18.248'E

Description: Fruiting Noni at NW end of Nissan hut.

Comment: As above

All images taken 5 Feb 2010.
Archived at eco-strategic.com

Image No. 13 **Location:** N Side of Blue Shed

GPS: 17°45.324'S / 168°18.261'E

Description: Flame tree (*Delonix regia*) on north side of blue shed.

Comment: Introduced to Vanuatu from SE Asia for decorative purposes – flowers in bright red in summer. This species is an extremely high source of litter in the form of small wind-carried leaves and heavy seed pods. All *Poinsiana* trees to be removed from the site.

Image No. 14 **Location:** NE End of Reclaim Area

GPS: 17°45.271'S / 168°18.294'E

Description: Lone, struggling mangrove (*Excocaria agollocha*) at NE end of reclaim area.

Comment: To be removed as part of reclamation. Mangroves are sparse in Port Vila and conservation efforts should focus on the two remaining stands at Vatumaru Bay and Ifira island.

Image No. 15 **Location:** East End of Blue Shed

GPS: 17°45.330'S / 168°18.285'E

Description: Two coconut trees at east end of blue shed

Comment: Coconut trees are a high source of litter in the form of small wind-carried flowers, large, heavy flower sheaths, coconuts and fronds. All Coconut trees to be removed from the site.

All images taken 5 Feb 2010.
Archived at eco-strategic.com

Image No. 16 **Location:** N Side of Blue Shed

GPS: 17°45.323'S / 168°18.274'E

Description: Row of three young coconuts along N side of the blue shed

Comment: As above

Image No. 17 **Location:** N Side of Blue Shed

GPS: 17°45.327'S / 168°18.266'E

Description: Flame tree (*Delonix regia*) on north side of blue shed.

Comment: As above

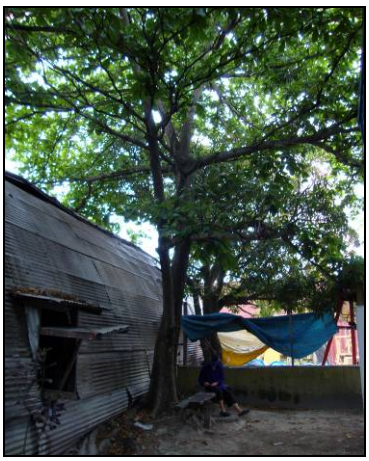

Image No. 18 **Location:** NE End of Nissan Hut

GPS: 17°45.332'S / 168°18.257'E

Description: Large shady Beach Almond trees (*T. littoralis*) on NE end of Nissan hut.

Comment: Provide excellent shade and edible fruit, and good coastal stabilizer common throughout region. Significant source of litter (large leaves and fruit pods). All Beach Almond trees to be removed as part of the development. Suitable for use in land-scaping non-operational areas.

All images taken 5 Feb 2010.
Archived at eco-strategic.com

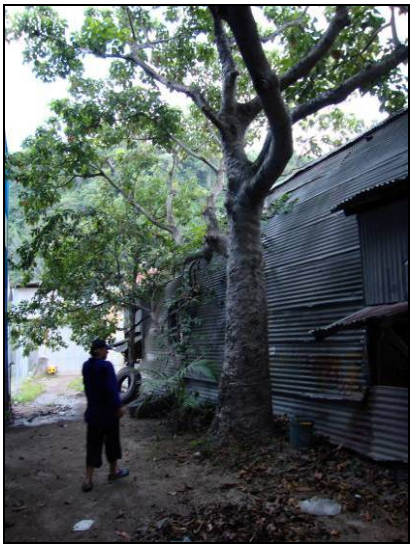

Image No. 19 **Location:** East Side of Nissan Hut

GPS: 17°45.338'S / 168°18.260'E

Description: Large Canoe tree (*Gyrocarpus americanus*) used since ancient times to carve wooden outrigger canoes, the main-stay of traditional Vanuatu sea transport.

Comment: High source of litter – to be removed as part of the development. Allow timber to be used. Could be carved into a traditional canoe to go at main gate of new terminal. Could include as element in new Star Terminal logo.

Image No. 20 **Location:** East Side of Nissan Hut

GPS: 17°45.338'S / 168°18.260'E

Description: Highly productive Avocado tree on east side of Nissan hut. Such on-site produce is harvested by workers to supplement their diet.

Comment: Will be removed. Harvest prior to clearing. Landscaping of new terminal non-operational areas should provide for such beneficial species.

Image No. 21 **Location:** East Side of Nissan Hut

GPS: 17°45.338'S / 168°18.260'E

Description: Fruiting Guava tree (*Psidium guajava*) on east side of Nissan hut. Such on-site produce is harvested by workers to supplement their diet.

Comment: As per other productive species on site.

All images taken 5 Feb 2010.
Archived at eco-strategic.com

Image No. 22 **Location:** Fence E of Blue Shed

GPS: 17°45.354'S / 168°18.289'E

Description: Coconut along W fence-line of Blue Shed bonded compound.

Comment: As above for this species - to be removed.

Image No. 23 **Location:** W of Main Gate

GPS: 17°45.375'S / 168°18.297'E

Description: Flame tree and small Coconut on W side of Main Gate.

Comment: As above for these species - to be removed.

Image No. 24 **Location:** E of Main Gate

GPS: Not recorded

Description: Clump of 3 Avocado trees, 14 banana trees and benoir tree (*Samanea saman*) on E side of Main Gate.

Comment: As above for these species - to be removed.

All images taken 5 Feb 2010.
Archived at eco-strategic.com

Image No. 25 **Location:** Roadside E of Main Gate

GPS: 17°45.369'S / 168°18.322'E

Description: Clump of wild Papaya on roadside E of Main gate. Seeds spread in bird droppings - not productive.

Comment: To be removed

Image No. 26 **Location:** E of Main Gate

GPS: 17°45.374'S / 168°18.347'E

Description: Large Fig (*Ficus prolixa*) about 20m high on road-side to E of Main Gate – the most significant tree on site. Provides a resource for several bird species. Significant value in screening the terminal from Wharf Rd. and retaining scenic value for Cruise Ship visitors on entrance to Vila. Cultural significance for Ifiran people as home-range of the one-armed Octopus Lepatasi, the totem of the Ifiran totem clan.

Comment: Should not be removed as part of the development. If necessary, prune only on the terminal side.

Image No. 27 **Location:** Roadside E of Main Gate

GPS: 17°45.376'S / 168°18.284'E

Description: Fan Palms (*Oritchardia pacifica*) along road side E of the main gate, planted as part of municipal beautification program.

Comment: Do not pose a threat of litter to the proposed container yard - all these road-side palms should be retained, scenic value for Cruise Ship visitors on entrance to Vila. Consult with Port Vila Municipal Council prior to any proposed disturbance.

Image No. 28 **Location:** SE Corner of Office

GPS: 17°45.379'S / 168°18.270'E

Description: Coconut tree at SE corner of office building

Comment: As above for Coconuts

Image No. 29 Location: SE Corner of Office

GPS: 17°45.376'S / 168°18.279'E

Description: Sugar cane at SE corner of office building, another productive species used by site workers

Comment: To be removed as part of development. Allow for inclusion in landscaping.

APPENDIX 6:
INITIAL MARINE RECONNAISSANCE

Port Vila ***Star Terminal***
Bankable Feasibility Study

Supplementary EIA: **Initial Marine Reconnaissance**

17 Dec 2009

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Summary

On 17 December 2009 Steve Raaymakers of EcoStrategic Consultants undertook an Initial Marine Reconnaissance in immediate impact areas around proposed Star Terminal, free-diving on snorkel. All main examples of living benthic organisms were recorded and photographed. Findings are presented in Figure 1 and Table 2.

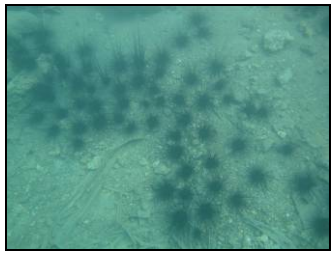
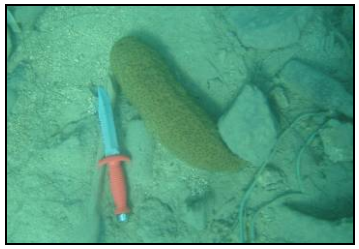
Despite being an operational port area the marine ecosystem in the immediate vicinty is healthy with high bio-diversity. In particular there is a very healthy and growing coral community with high live-coral cover along the eastern boundary of the site which will be destroyed by the development.

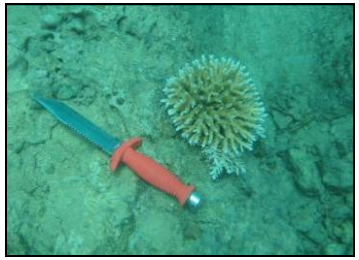
Certain management actions are recommended in Table 2. Fish species were not recorded as these are motile and this will be undertaken quantitatively during a full survey later (Marine Biodiversity Survey).

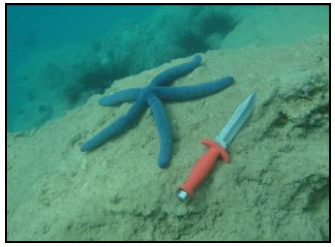
Numerous items of underwater debris within the development area, including car bodies and similar large items, were also identified and photographed. These may affect the structural integrity of the land reclamation and therefore may need to be removed prior to construction. Findings are presented in Figure 2 and Table 3.

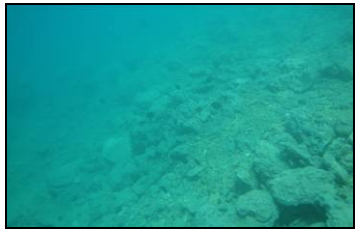
Figure 1: *Initial marine reconnaissance* - MARINE BIODIVERSITY in immediate impact areas (17 Dec 09). Details of each location/image are provided in Table 1.

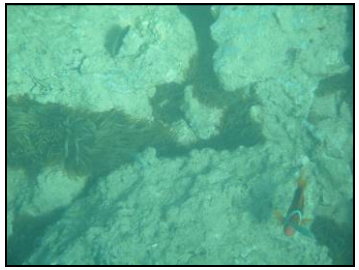
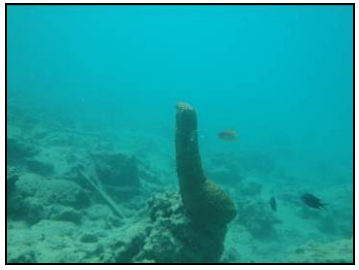
Table 2: *Explanatory Notes for Figure 1* (Dive Knife used for scale in pictures is 25cm long inc. handle)

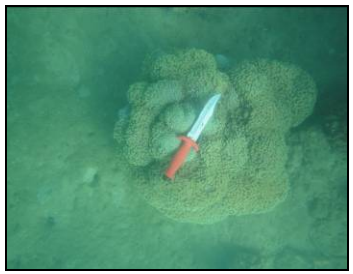
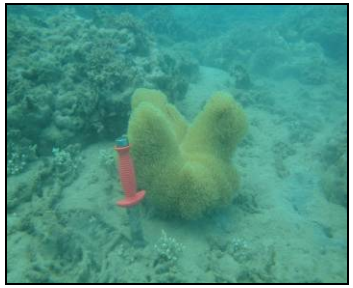
Location /Image	Description
A 	**Common name:** Spiny Black Sea Urchin **Species:** *Diadema setosum* (may be *D. savigny* – check) **Presence:** Several clustered groups containing up to 60 animals per group were observed at point A and several other locations along the toe-line of the proposed development, in water depths from near the surface to around 10m. There may be over 1,000 individuals in the immediate impact area, although numbers will vary as the groups move. **Significance:** This Sea Urchin is extremely common in warm shallow waters with low coral cover and good algae cover throughout the Indo-Pacific. It is extremely common throughout Port Vila bay. It normally forms clustered groups for protection during the day, with individuals fanning out across the seafloor to graze on algae during the night. It also feeds by filtering with its spines. *Diadema setosum* is an important component of the marine ecological balance. Some EIA's have asserted that their presence indicates a degraded eco-system; however they are present in similar grazing habitats in pristine environments so this assertion is unlikely to be correct. **Impact:** The Star Terminal development will destroy all *D. setosum* individuals present in the development areas, and individuals in adjacent areas may also be affected by sedimentation. **Action:** Given their extreme abundance throughout Port Vila bay and the difficulty of handling these extremely spiny and highly fragile creatures, no active management is proposed.
B 	**Common name:** Curry Fish Sea Cucumber **Species:** **Stichopus variegatus** **Presence:** 15 individuals of this sea cucumber were observed along the toe-line of the proposed development, including this individual at point B and the spawning (rearing-up) individual at point K. **Significance:** These large Sea Cucumbers can be greater than 40cm in length and are common on shallow water rubble and sandy habitats throughout the Indo-Pacific. They feed by vacuuming the sand and are therefore an important component of the marine ecological balance. This species is extremely common throughout Port Vila bay. The intestines of this species are collected for eating by subsistence fisher-folk (mainly women) in the Pacific although it is not important to the commercial Beche-de-Mer fishery. **Impact:** The Star Terminal development will destroy all **S. variegates** individuals present in the development areas. **Action:** Given the relatively small number of individuals present and the ease with which they can be relocated, it is recommended that as part of the EM&M Plan for the development, snorkelers from Fisheries Department undertake a biota-sweep of each area just prior to construction and relocate any individuals to alternative, similar habitat.

Location /Image	Description
C 	**Common name:** Staghorn Coral **Species:** *Acropora samoensis* **Presence:** Five small (up to 20cm diameter) colonies of *A. samoensis* were observed between points A and G. These are quite young (1-3 years) and appear to be recent settlers on the reclaim rubble that has been deposited in this area. This demonstrates the ability of coral to rapidly recolonize disturbed areas and provides an example of how rapidly marine life will return after construction. **Significance:** This coral is common in warm shallow waters throughout the Indo-Pacific and is an important contributor to the construction of coral reefs. Staghorn Corals generally are considered to be an ornamental species that enhance the aesthetic value of reefs for diving and snorkeling, They also provide protective habitat for several fish and invertebrate species. *A. samoensis* is extremely common throughout Port Vila bay. **Impact:** The Star Terminal development will destroy all coral colonies present in the development areas; and colonies in adjacent areas may also be affected by sedimentation. **Action:** Given their abundance throughout Port Vila bay, the very small numbers in the development area and the difficulty of removing these fragile corals which are attached to the seabed, no active management is proposed. Silt curtains should be used during reclamation to prevent impacts of sedimentation on corals in adjacent areas.
D 	**Common name:** Cushion Star **Species:** *Culcita novaeguineae* **Presence:** One animal was found at point D. **Significance:** The Cushion Star grows up to 30cm in diameter and is found in warm shallow waters throughout the Indo-Pacific. It feeds on coral and is usually found as individuals in low densities across a reef. **Impact:** The Star Terminal development will destroy all Cushion Stars present in the development areas. **Action:** Given the relatively small number of individuals present and the ease with which they can be relocated, it is recommended that as part of the EM&M Plan for the development, snorkelers from Fisheries Department undertake a biota-sweep of each area just prior to construction and relocate any individuals to alternative, similar habitat.

Location /Image	Description
E 	**Common name:** Black-lipped Pearl Oyster **Species:** *Pinctada margaritifera* **Presence:** One animal was found at point E, attached to the end of a discarded rubber hose. **Significance:** The Black-lipped Pearl Oyster was once common throughout the Pacific but its very high commercial importance (for pearl shell and for pearl culturing) has seen regional stocks decline drastically. The Oyster is also edible and is used by subsistence fisher folk. Vanuatu does not have an active pearl industry and Oyster stocks in Vanuatu may be healthy relative to other areas. **Impact:** The Star Terminal development will destroy all Pearl Oysters present in the development areas. **Action:** Although only one animal was found, given that it is attached to a rubber hose and is easily moved, this specimen can be moved to alternative habitat during the pre-construction biota- sweep as recommended for other species above.
F 	**Common name:** Blue Sea Star **Species:** *Linckia laevigata* **Presence:** Three animals were found; one at point F and two between points L and Q. **Significance:** The Blue Sea Star is extremely common in shallow flats throughout the Indo-Pacific. It is extremely common throughout Port Vila bay. It is a detritivore and will also graze for organic films or sedentary, low-growing organisms such as sponges and algae. **Impact:** The Star Terminal development will destroy all Blue Sea Stars present in the development areas. **Action:** Although only a few animals were found, given that they are easily moved, it is recommended that they be moved to alternative habitat during the pre-construction biota- sweep as recommended for other species above.
G 	**Common name:** Rubble **Species:** Filamentous algae **Presence:** Between points G and H there is newly deposited reclaim rubble and debris along about 15m of shoreline. It is devoid of marine life except for filamentous algae. **Significance:** The biological “nakedness” of this area indicates that it has been reclaimed only recently and exemplifies the impact of reclamation in removing existing biota. **Impact:** This area may be colonized by new life between now and when any construction starts, which will in turn be impacted. **Action:** Biota-sweep just before construction as recommended above.

Location /Image	Description
H 	**Common name:** File Fish **Species:** *Anacanthus barbatus* **Presence:** One small school of 15 juvenile File Fish was observed at point H. **Significance:** Common throughout the Indo-Pacific. Juveniles form groups for protection and swim upright (mouth towards seabed) mimicking natural objects for camouflage (in this case the File Fish are grouped around a discarded branch of a tree, disguising themselves as branches). Due to this interesting behaviour juveniles are displayed in aquariums. Feed on small crustraceans/worms. **Impact:** The Star Terminal development will destroy/displace all fish present in the development areas. **Action:** As this species may have commercial value in the aquarium export trade it is recommended that local aquarium-fish collector be invited to take these and other commercially useful fish from the area just prior to construction.
I 	**Common name:** Various encrusting species **Species:** *Various* **Presence:** All piles supporting the existing Star Wharf have heavy growths of various encrusting species including a range of algae as well as ascidians, sponges, encrusting corals, soft corals, hard-corals and various associated fish species. **Significance:** The encrusting species present are common on all such hard surfaces throughout Port Vila bay and their removal as part of the development is not considered to be significant. However, such surfaces are commonly the settling points for foreign (potentially invasive) species that may be introduced on ships' hulls and in ships' ballast. **Impact:** Demolition and removal of the existing Star Wharf will destroy/displace all encrusting marine life on the existing piles and related structures, although this is not considered to be significant. If the demolished piles are disposed of in the bay any foreign (potentially invasive) species that may have settled on the structures may be spread to other parts of the bay. **Action:** A detailed survey of the marine life on all existing wharf structures will be undertaken as part of the quantitative marine bio-diversity survey, including an assessment of the possible presence of foreign species. Demolished piles and associated structures should be disposed of on land to prevent potential spread of any foreign species.
J 	As per point G – a similar area extends for about 10m at point J. **Action:** As per point G

Location /Image	Description
K 	**Common name:** 1. Sea Anemone & 2. Anemone Fish **Species:** 1. *Entacmaea quadricolor* & 2. *Amphiprion melanopus* **Presence:** A large Sea Anemone supporting a family of at least six Anemone Fish was observed at point K. Typical of this species (*E. quadricolor*) the Anemone is actually a cluster of individual Anemone's grouped in a complex of crevices in the coral rubble. **Significance:** This species of Anemone and the symbiotic Anemone Fish *A. melanopus* are extremely common throughout the Indo-Pacific and are common throughout Port Vila bay. Both are collected throughout the Indo-Pacific for aquarium display. **Impact:** The Star Terminal development will destroy/displace all Anemones and Anemone Fish present in the development areas. However, as only one Anemone was observed and as these are common throughout the bay this impact is not significant. **Action:** It is recommended that local aquarium-fish collector be invited to take these and other commercially useful fish from the area just prior to construction.
L 	As per point B, although this individual at point L was rearing-up and spawning. **Action:** As per point B.
M 	**Common name:** Staghorn Coral **Species:** *Acropora lovelli* (may be *A. samoensis*) **Presence:** Several large (up to 1.5m high) colonies of Staghorn Coral were observed between points M & R. These may be up to 10 to 15 years old and are part of a very healthy and growing coral community along the eastern boundary of the proposed reclamation area. **Significance:** Staghorn Corals are common throughout the Indo-Pacific and are important contributors to the construction of coral reefs. They are fast-growing (up to 12cm/year) and are among the first colonizers of physically disturbed areas. Staghorn Corals are considered to be an ornamental species that enhance the aesthetic value of reefs for diving and snorkeling. They also provide protective habitat for several fish and invertebrate species. They are common throughout Port Vila bay. **Impact:** The development will destroy these colonies and the healthy coral community along the eastern boundary of the site. Adjacent areas may impact from sedimentation. **Action:** Given their aesthetic and habitat values plus good health, as well the fact that they are relatively easy to transplant, it is recommended that all movable Staghorn Corals in this area be relocated just prior to construction. Silt curtains should be used during reclamation to prevent impacts of sedimentation on corals in adjacent areas.

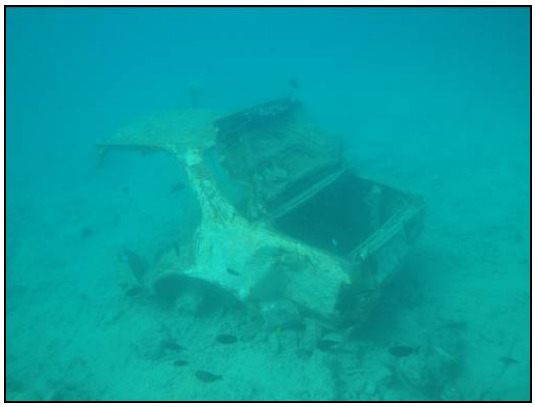
Location /Image	Description
N 	**Common name:** Flower Pot Coral **Species:** *Goniopera columna* **Presence:** Several medium-sized (up to 1 diameter) colonies of *Goniopora* were observed between points M & R. These are part of a very healthy and growing coral community along the eastern boundary of the proposed reclamation area. **Significance:** *Goniopera columna* is common throughout the Indo-Pacific especially in turbid waters and they are common in Port Vila bay. They are aggressive species that will extend their polyps to attack other corals within reach – and therefore do not usually have other corals growing immediately adjacent. **Impact:** The development will destroy these colonies and the healthy coral community along the eastern boundary of the site. **Action:** *Gonipora* are not movable and no active management action is recommended.
O 	Example of the healthy and growing coral community with very high live-coral cover along the eastern boundary of the proposed reclamation area. At centre background is a 1m high Stahghorn Coral as per point M and to the left and right are *Porites* Boulder Corals. **Impact:** The development will destroy these and the healthy and growing coral community along the eastern boundary of the site. Adjacent areas may impact from sedimentation. **Action:** As per M for Staghorn and other movable corals. As per N for non-movable corals.
P 	**Common name:** Soft Coral **Species:** *Sarcophyton s.p* (probably *tortuosum*) **Presence:** One *Sarcophtyon* colony approx. 80cm in diameter was observed at point P, as part of the very healthy and growing coral community along the eastern boundary of the proposed reclamation area. **Significance:** *Sarcophtyon* Soft Corals are extremely common on all reef types throughout the Indo-Pacific. These are extremely hardy species that can survive in highly turbid waters. They are very common in Port Vila bay. **Impact:** The development will destroy this colony and the healthy coral community along the eastern boundary of the site. Adjacent areas may impact from sedimentation. **Action:** *Sarcophtyon* can be difficult to detach without damage and no active management action is recommended.

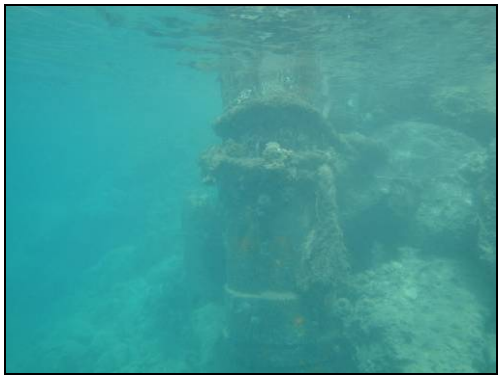
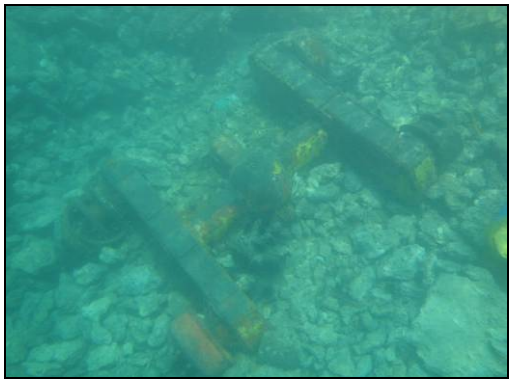
Location /Image		Description
Q		As per point M. **Action:** As per point M.
R		**Common name:** Boulder Coral **Species:** *Porites lobata* **Presence:** Several colonies of *Porites lobata* were observed at point R which are part of a very healthy and growing coral community along the eastern boundary of the proposed reclamation area. **Significance:** *Porites* Corals are extremely common on all reef types throughout the Indo-Pacific and they are common in Port Vila bay. They are extremely slow growing (millimeters per year) and these specimens at around a metre high may be over 80 years old. **Impact:** The development will destroy these colonies and the healthy coral community along the eastern boundary of the site. Adjacent areas may impact from sedimentation. **Action:** *Porites* are not movable and no active management action is recommended. Silt curtains should be used during reclamation to prevent impacts of sedimentation on corals in adjacent areas.

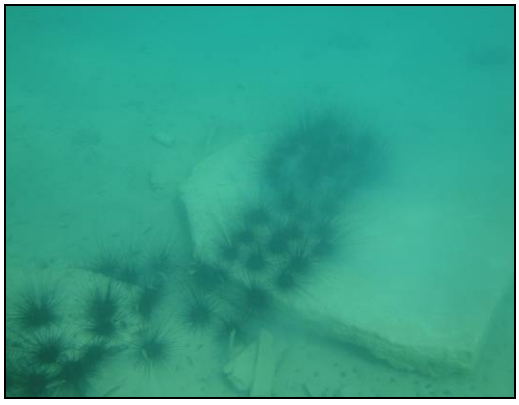
Figure 3: *Initial marine reconnaissance* - DEBRIS in immediate impact areas (17 Dec 09). Details of each location/image are provided in Table 2

Table 3: *Explanatory Notes for Figure 3*

Numerous items of underwater debris within the development area, including car bodies and similar large items, were identified and photographed. These may affect the structural integrity of the land reclamation and therefore may need to be removed prior to construction. If removed they should be disposed appropriately on land.

Location/Image/Description	Location/Image/Description
 **A.** Large canvas bag	 **B.** Wheel and tyre
 **C.** Car Body	 **D.** Car body and tyre
 **E.** Tyres	 **F.** Tyres

Location/Image/Description	Location/Image/Description
 **G.** Concrete with steel protruding	 **H.** Boiler
 **I.** Obsolete pile	 **J.** Bogey assembly
 **K.** Dude	 **L.** Degradation at west end of Star Wharf

Location/Image/Description	Location/Image/Description
 **M.** Concrete cancer – underside of wharf	 **N.** Hole in wharf from below
 **O.** Corroding piles supporting wharf	 **P.** Fallen pile under wharf
 **Q.** Concrete slabs (with Sea Urchins)	

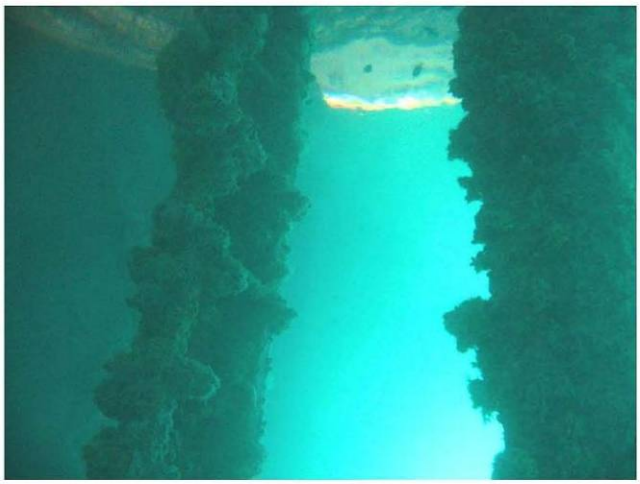
APPENDIX 7:
INITIAL MARINE PEST ASSESSMENT

This report has been inserted as an image and the text size is therefore small. A full-size, stand-alone version has been submitted to the client, and can be requested from EcoStrategic Consultants or the authors listed on the report.

NIWA
Taihoro Nukurangi

Reconnaissance Survey for Introduced Marine Pests at Star Wharf, Port Vila, Vanuatu

February 2010



NIWA Client Report: CHC2010-025
March 2010

NIWA Project: ESC105

Reconnaissance Survey for Introduced Marine Pests at Star Wharf, Port Vila, Vanuatu

February 2010

Graeme Inglis

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Prepared for

EcoStrategic Consultants Ltd

NIWA Client Report: CHC2010-025
March 2010
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NIWA
Taihoro Nukurangi

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Reviewed by:

Chris Woods

Approved for release by:

Don Robertson

NIWA
Taihoro Nukurangi

1. Background

The Star Wharf (17° 45.323 S, 168° 18.229 E) is a general purpose wharf that services Port Vila, Vanuatu. It is currently in a dilapidated condition and a Bankable Feasibility Study and Supplementary Environmental Impact Assessment (EIA) are being undertaken by Soros Associates Australia Pty Ltd and EcoStrategic Consultants respectively for development of an upgraded facility.

Piles supporting the existing Star Wharf are heavily encrusted with a range of fouling organisms. Wharf piles and other port structures are often the initial settlement points for non-native (potentially invasive) species introduced within discharged ballast water and/or on ships' hulls. Establishment on these structures can allow introduced marine pests to form beach-head populations that subsequently spread to, and have impacts on, other natural marine habitats. Initial marine reconnaissance of the Star Wharf site identified the potential for non-native species to be spread to other parts of the bay during demolition of the wharf (EcoStrategic Consultants Initial Site Visit Filed Report Dec 2009) and recommended an assessment of the existing piles for the possible presence of non-native species.

This report details the assessment survey undertaken by the New Zealand National Institute of Water and Atmospheric Research Ltd (NIWA) on sub-contract to EcoStrategic Consultants as part of the Supplementary EIA, to determine the likely presence of non-native species within the fouling assemblages at Star Wharf. The assessment was not intended as a full Port Biological Baseline Survey (PBBS) for introduced marine pests (Hewitt & Martin 2001). Such surveys require a high level of taxonomic expertise and resources that were beyond the scope and budget of the current study (Campbell et al. 2007). Instead, the survey determined the presence/absence of a suite of known, high profile marine pests from tropical waters ('target species') and used standard PBBS survey techniques to collect a set of biological samples from the wharf piles that will act as a reference collection for any future survey work.

2. Objectives of the survey

- to carry out a class room theory introductory course on marine pest survey methods and in-water sampling methods for Vanuatu Department of Fisheries and Environment Unit,

- to collect samples and photograph Star Wharf piles, including in-water hands-on demonstration of techniques to Vanuatu counterparts, and

- to prepare a brief report on the survey of Star Wharf and surrounding environments, including a reasonable assessment of whether or not any species found are likely to be introduced/non-native to Vanuatu, and likely mode of introduction based on species biology.

3. Methods

3.1. Basic training in surveys for introduced marine pests

A brief introductory course on marine pest survey methods was presented to staff from the Vanuatu Department of Fisheries (within the Ministry of Agriculture, Quarantine, Forestry and Fisheries) and the Environment Unit (within the Ministry of Lands and Natural Resources) at the offices of Vanuatu Department of Fisheries on the 12th February 2010. The presentations used training materials developed jointly by NIWA and the International Maritime Organization's GloBallast Partnerships Programme for undertaking PBBS for introduced marine pests. This training package typically comprises four days of classroom theory and practical exercises and has previously been presented to marine resource managers in Vietnam (2004), the Red Sea and Gulf of Aden (2007), the Mediterranean region (2008), and Pacific region (2009).

Three modules from the training package were presented in Vanuatu. These were:

- Module 1 (Types of Surveys for Marine Pests).

  This module described the stages of invasion by a marine pest – from residence in its native region, through transport outside its natural range, to establishment and invasiveness in the new region - and the types of management that are appropriate for each stage. Module 1 covered the types of pest surveys that are used to inform management for each stage of invasion and the types of information they provide. Examples of different types of marine pest survey were presented to show their different survey requirements. This background was used to set the context and purpose of PBBS.

- Module 2 (Design of PBBS).

  Module 2 described the general steps that need to be followed when designing a PBBS. These are:

  1. Decide the purpose of the survey
  2. Define the survey area
  3. Identify the types of sites to be sampled

4. Identify how the sites will be chosen and prioritised
5. Determine the type and number of samples to be taken
6. Determine how the data will be analysed and interpreted

- Module 3 (Survey Methods for PBBS).

  In this module the survey methods recommended in the CRIMP protocols for PBBS (Hewitt & Martin 2001) were discussed along with alternative sample methods that could be used in situations where the CRIMP methods were not practical. As the CRIMP protocols rely heavily on sample collection by divers and were designed primarily for temperate environments, these alternative methods are recommended where local conditions make diving hazardous or impractical (e.g. poor visibility, water contamination, dangerous animals, etc) or where different types of habitat are present (e.g. coral reefs).

Two staff from Vanuatu Fisheries and one from the Environment Unit subsequently took part in the surveys of fouling organisms at Star Wharf on the 15th February 2010.

3.2. Surveys for non-native marine species at Star Wharf

The survey of Star Wharf incorporated two general approaches:

- searches for high risk marine pest species ('target species'), and
- sampling of fouling assemblages at Star Wharf.

3.2.1. Searches for high risk marine pest species ('target species')

Visual searches were made over the entire wharf structure for a suite of easily identifiable high-risk species ('target species') that have the potential to survive in tropical environments. The purpose was to determine the presence or absence of these species in the Star Wharf fouling assemblages. A list of 'target species' was developed from existing literature and risk assessments done for similar tropical environments. Two principal sources were used:

1. In 2005, the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO) completed a ranking of high risk marine pests established in Australia or which had the potential to become established in Australia (Hayes et al. 2005). This risk ranking underpinned development of a formal 'trigger list' for marine pest emergency response in Australia that has been endorsed by the Australian National Introduced Marine Pest

Coordinating Group (NIMPCG) in 2006 (Appendix 1). The trigger list includes some species that have the potential to become established in tropical marine environments in Australia and which could, therefore, also establish in Vanuatu. These are indicated in bold font in Appendix 1.

2. Neil et al. (2008) extended the CCIMPE trigger list to include marine pest species of particular concern to Torres Strait and northern Australia. This list is reproduced in Appendix 2.

Other relevant reference material included records of marine pests of northern Australia (Hewitt 2002; Stafford & Willan 2007) and Hawaii (Eldredge & Smith 2001).

Species included in the target list for the Star Wharf survey were:

- not native (or suspected to be non-native) to the Indo-West Pacific,
- able to survive in tropical environments,
- could be expected to occur in fouling assemblages, and
- able to be identified by a scientist with para-taxonomic skills.

The final list of target species is presented in Table 1.

3.3. Sampling of fouling assemblages at Star Wharf

Samples of the fouling assemblages were taken from three wharf piles at Star Wharf. Selected piles were separated by 10 – 15 m and included two pilings on the outer face of the wharf (which typically have the greatest diversity) and one pile underneath the wharf. On each piling, quadrats (40 cm x 25 cm, Figure 1) were fixed to the outer surface of the pile at water depths of approximately -0.5 m, -3.0 m and -7 m. A diver descended slowly down the outer surface of each pile and filmed a vertical transect from approximately high water to the base of the pile using a digital camera in an underwater housing. On reaching the sea floor, the diver then ascended slowly and captured four overlapping high-resolution still images of each quadrat. A second diver then removed fouling organisms from the piling by scraping the organisms inside each quadrat into a 1-mm mesh collection bag attached to the base of the quadrat (Figure 2). Once scraping was completed, the sample bag was sealed and the divers ascended to the next quadrat.

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Table 1: Final list of 'target species' searched for at Star Wharf.

Serpulids (tube worms)
Hydroides sanctaecrucis
Hydroides diramphus
Hydroides ezoensis
Hydroids
Antenalla secundria
Plumularia setacea
Bryozoans (sea mosses and lace coral)
Amathia distans
Bugula neritina
Bugula stolonifera
Watersipora arcuata
Watersipora subtorquata
Zoobotryon verticillatum
Cirrepedia (barnacles)
Austromegabalanus krakatauensis
Chthamalus proteus
Balanus amphitrite
Balanus reticulatus
Megabalanus tintinnabulum
Megabalanus rosa
Megabalanus coccopoma
Megabalanus zebra
Isopods (sea lice)
Sphaeroma walkeri
Decapod (crab)
Charybdis japonica
Bivalve molluscs (mussels)
Musculista senhousia
Mytilopsis sallei
Perna viridis
Perna perna
Gastropod molluscs (marine limpet and thaid whelks)
Siphonaria pectinata
Thais rustica
Colonial ascidians (sea squirts)
Botrylloides leachi
Botryllus schlosseri
Didemnum vexillum

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Figure 1: **The quadrats (40 cm x 25 cm) used to sample fouling assemblages (left) were fastened to the wharf piles using bungy cords. Samples scraped from the piles (right) were captured in a 1 mm mesh sample bag suspended below the quadrat.**

Figure 2: **Staff from the Vanuatu Department of Fisheries scraping fouling organisms from one of the piles at Star Wharf into the collection bag.**

Divers also swam profiles of the structures collecting and photographing large, unusual and suspect species that could not be identified reliably in the field. Opportunistic visual searches were made along the piles at Star Wharf and surrounding breakwalls and rock facings.

Each sample collected in the survey was allocated a unique code on waterproof labels and transported to a nearby field laboratory where it was sorted into broad taxonomic groups (e.g. ascidians, barnacles, sponges etc.) and preserved in 5% formalin and seawater. Because of time restrictions and the limited availability of sample containers and preservative, only a representative sample of specimens recovered in the surveys was preserved. Large bivalves that could not fit into the available containers were placed in boiling water (to kill the animal and remove the soft tissue) and the shells were air-dried. The preserved and dried specimens were stored at the Vanuatu Department of Fisheries until further notice. A copy of the sample register has been supplied to EcoStrategic Consultants.

All identifications made during the survey were made by the report author, Dr Graeme Inglis. Dr Inglis has para-taxonomic skills in a range of marine taxa and is an expert in marine pests, but is not a specialist taxonomist. As such, all identifications should be considered provisional until confirmed by a specialist taxonomist.

4. Results

4.1. General description of fouling assemblages at Star Wharf

The piles at Star Wharf supported a diverse fouling assemblage that occupied most of the primary space available on the piles (i.e. > 90% cover; Figure 3 & Figure 4). Habitat on the seabed immediately below Star Wharf consisted primarily of unconsolidated concrete and rock fill and discarded materials of different kinds (Figure 5). The rocks were covered by a fine layer of sediment and had relatively limited fouling (< 10% cover).

The primary cover of fouling organisms on the wharf piles was typically dominated by a range of large bivalves. Cupped rock oysters (Family Ostreidae, principally species of *Saccostrea* and [possibly] *Crassostrea*) occupied most of the pile surface in intertidal and shallow subtidal (< 1.5 m depth) sections (Figure 6). Above them, several species of barnacle occurred in relatively sparse densities within the splash zone (Figure 6). The oysters were covered with a range of smaller fouling species, including thecate hydroids, spirorbid polychaetes, small nestling arc shells (*Barbatia* sp.) and encrusting and erect bryozoans.

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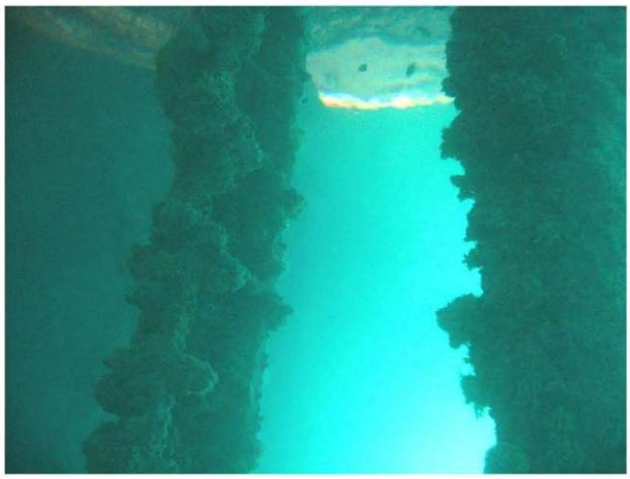

Figure 3: **Underwater view of pilings at Star Wharf. Piles were constructed of steel and concrete and were heavily encrusted by a variety of fouling organisms.**

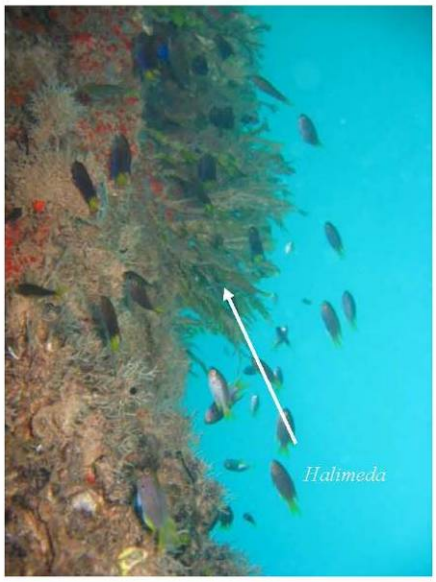

Figure 4: **Piles on the outer edge of Star Wharf supported growths of *Halimeda* and other macroalgae. Primary cover in the shallow depths (< 1.5 m) consisted predominantly of rock oysters covered with fouling bryozoans and hydroids. Small schools of fishes, such as these yellow tail damsels (Family Pomacentridae) occurred around the piles.**

Figure 5: **Habitat on the seabed immediately below Star Wharf consisted primarily of unconsolidated concrete and rock fill and discarded materials of different kinds. The rocks had relatively limited fouling, but some mobile predators, such as this lionfish, *Pterois* sp., were observed foraging among them.**

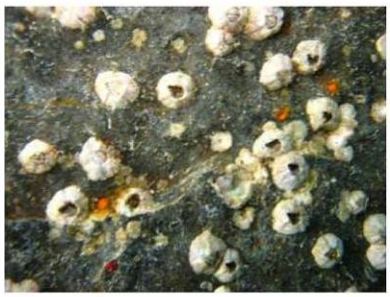

Figure 6: **Exposed areas of the top of the piles contained sparse densities of barnacles (left). Below the splash zone, rock oysters dominated the pile surfaces at intertidal and shallow subtidal depths (right).**

Below about 1.5 m depth, jewel box clams (Family Chamidae, Figure 7), thorny oysters (Family Spondylidae), tree oysters (Family Isognomonidae, Figure 8), and zig-zag oysters (Family Ostreidae, Genera *Lopha* and *Dendostrea*, Figure 8) formed the dominant primary cover. These were typically overgrown by a variety of encrusting sponges (Figure 9), colonial ascidians, anemones, solitary ascidians (Figure 10), and small colonies of ahermatypic corals (*Tubastrea* or *Dendrophyllia* species, Figure 10). Growths of macroalgae (*Halimeda* sp., *Padina* sp. and *Caulerpa lentillifera* ?) occurred on outer piles, in water depths < 3 m, where there was good light penetration (Figure 11).

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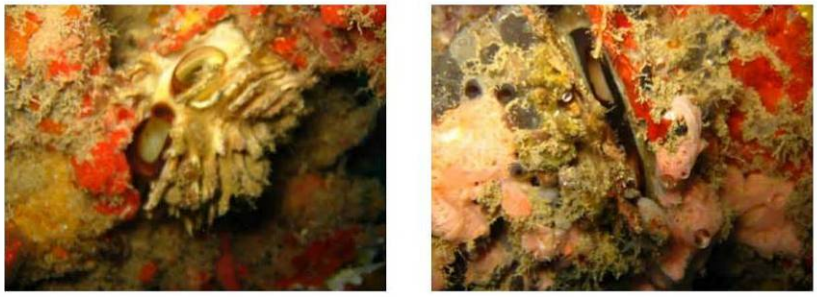

Figure 7: Large jewel shell clams (Family: Chamidae) formed the primary fouling cover in deeper subtidal areas and were usually heavily encrusted with sponges and colonial ascidians.

Figure 8: Other bivalves, like these zig-zag oysters (left, Family Ostreidae) and tree oysters (right, Family Isognomonidae) were also abundant in deeper subtidal sections of the piles.

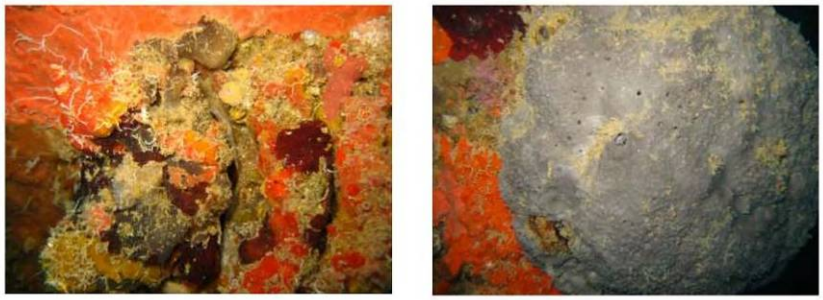

Figure 9: A variety of encrusting (left) and massive (right) sponges formed the predominant secondary cover of fouling organisms in deeper and shaded areas of the piles.

Figure 10: **Solitary ascidians (left; provisionally identified from photographs by Mr Mike Page as either *Polycarpa argentata* (Sluiter, 1890); and/or *Herdmania pallida* (Heller, 1878), natives of the West Pacific) and small colonies of ahermatypic corals (*Tubastrea* or *Dendrophyllia* species) were nestled in amongst the larger bivalves and sponges.**

Figure 11: **Tropical macroalgae such as *Halimeda* (left) and *Caulerpa lentillifera* ? (right) occurred on outer piles at depths < 3m where there was good light penetration.**

A range of small gastropod and crustacean predators occurred on and within the fouling assemblages. These included several species of nudibranch (Figure 12), muricid gastropods (Figure 13), and small swimming crabs (Figure 13).

4.2. Suspected non-native species

Five species in the target list (Table 1) were recorded or suspected from the Star Wharf. These were: the barnacle *Amphibalanus* (*Balanus*) *amphitrite* Darwin 1854 and the bryozoans *Amathia distans* Busk, 1886, *Bugula neritina* (Linnaeus, 1758), *Watersipora subtorquata* (d'Orbigny, 1952), and *Zoobotryon verticillatum* (Delle Chiaje), 1828. All five species are suspected of being non-native to Vanuatu, but are now relatively widespread in tropical seas. Details are provided below.

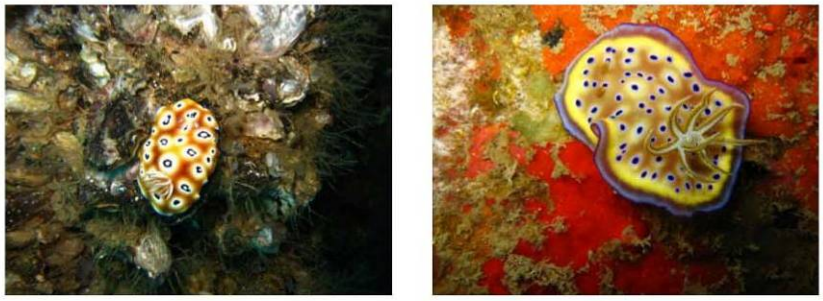

Figure 12: **Nudibranch molluscs were observed feeding on thecate hydroids among the rock oysters (left, *Chromodoris leopardus* Rudman, 1987) and encrusting sponges (right, *Chromodoris kuniei* Pruvot-Fol, 1930) on piles at Star Wharf. Both species are native to the Indo-West Pacific.**

Figure 13: **Muricid gastropods (left, *Chicoreus palmarosae* ?) and small swimming crabs (Family Portunidae) occurred within clusters of rock oysters on the wharf piles.**

4.2.1. Barnacles (Phylum Arthropoda)

Several species of balanomorph barnacle appeared to be among the fouling species at Star Wharf. One of the barnacles closely resembled *Amphibalanus* (*Balanus*) *amphitrite* (Figure 14). *Amphibalanus amphitrite* is a prolific fouler of vessels' hulls and internal water systems, and can displace native species (Stafford & Willan 2007). Although it was listed by Neil et al. (2008) as a marine pest of concern for northern Australia, it now has a world-wide distribution, as a result of global spread by hull fouling. The native range of *A. amphitrite* is uncertain, but may have been the south western Pacific (Eldredge & Smith 2001).

Figure 14: **Image of the suspected non-native striped barnacle, *Amphibalanus amphitrite* on piles at Star Wharf.**

4.2.2. Lace corals (Phylum Bryozoa)

Amathia distans

Amathia distans is a small, fragile-looking bryozoan that forms soft, bushy growths, 5-20 cm in diameter (Eldredge & Smith 2001). The stolon is thin, translucent and dichotomously branching, with zooids located in clumps at intervals. Stolons and zooids are brown in color but have bright yellow pigmentation (Figure 15). *Amathia distans* is common among fouling assemblages on ships' hulls. Eldredge and Smith (2001) suggest it has a Caribbean origin, but it is now widely distributed in tropical and sub-tropical seas.

Figure 15: **The bushy bryozoan, *Amathia distans*, collected from fouling assemblages at Star Wharf.**

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Brown bryozoan, *Bugula neritina*

Bugula neritina is an erect, bushy, red-purple-brown bryozoan that is common in fouling assemblages of ports and harbours worldwide (Figure 16). It has been reported from all seas except the sub-Arctic and sub-Antarctic regions (IUCN 2007). The native geographic range of *B. neritina* is unclear as it is thought to have been spread widely by shipping before scientific surveys commenced in most areas, but its origins are thought to have been in Europe. It is often very abundant on vessel hulls, wharf piles, pontoons and other artificial surfaces.

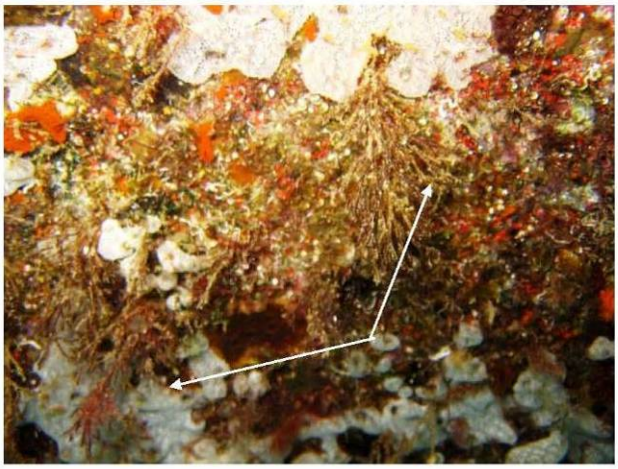

Figure 16: **Colonies of the non-native bryozoan *Bugula neritina* (indicated by arrows) within fouling assemblages at Star Wharf.**

***Watersipora* sp.**

Colonies of an encrusting bryozoan resembling *Watersipora subtorquata*, were observed at Star Wharf (Figure 17). *Watersipora subtorquata* is a problem fouling species that is considered invasive among cool temperate regions including southern Australia, New Zealand and California. It has also been reported from tropical Australia (Hewitt 2002) and (possibly) American Samoa (IUCN 2008). Although its geographic origins are uncertain, the northwest Pacific is thought to be its most likely origin (IUCN 2008).

Recent DNA testing and morphological description has defined *W. subtorquata* and differentiated it as a separate species from closely related *W. subovoidea* (= *cucullata*) (Mackie et al. 2006). In their 2001 account of cheilostomatous bryozoa from Vanuatu, Tilbrook et al. (2001) described a single specimen of *W. subovoidea* from Efate Island.

It is possible, therefore, that the species observed on Star Wharf is *W. subovoidea*. Confusion over the taxonomy of *W. subtorquata* and *W. subovoidea* means that it is difficult to determine the geographic origins of *W. subovoidea*, but it may have an Indo-West Pacific distribution. Other known locations of *W. subovoidea* include Florida, Brazil, and Australia (IUCN 2008).

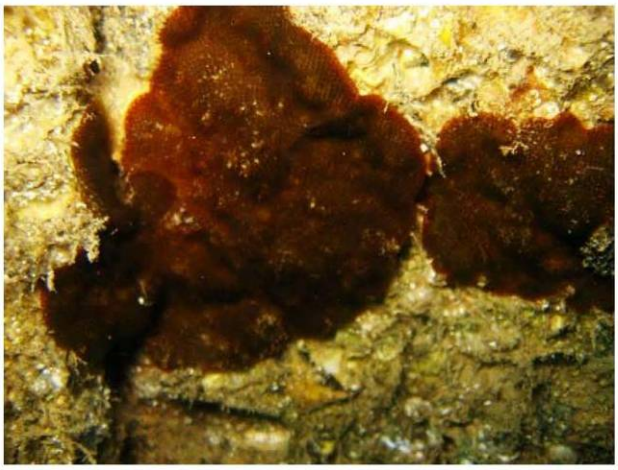

Figure 17: **Suspected colonies of the encrusting non-native bryozoan, *Watersipora subtorquata*, on piles at Star Wharf.**

Watersipora subtorquata is resistant to a range of antifouling paints. It can, therefore, spread rapidly on vessel hulls and provide an area for other species to settle upon as well as impacting on vessel performance (Cohen 2005). This ability to colonise toxic antifouling surfaces means that *W. subtorquata* can also facilitate the transport and spread of other non-indigenous fouling species (Floerl et al. 2004). In Japan it is known as a nuisance species in oyster farming operations (Matawari 1952).

Spaghetti bryozoan: *Zoobotryon verticillatum*

Colonies of the non-native bryozoan *Zoobotryon verticillatum* occurred in stringy clusters around several of the outer piles on Star Wharf (Figure 18). Unlike most other bryozoans, the exoskeleton of *Z. verticillatum* lacks calcium carbonate (Gordon & Matawari 1992). It grows into large, repeatedly branching, bushy colonies up to 1 m long (Gordon & Matawari 1992).

Zoobotryon verticillatum is now widely distributed in tropical and subtropical seas, including the Caribbean, Indian Ocean, north-west and north-east Pacific, Hawaii,

New Caledonia and Australia (Bock 1982; Gordon & Matawari 1992). It is thought to be spread by fouling on the hulls of vessels. The type specimen of this species was recorded originally from Naples, Italy, but its geographic origins are unclear.

Figure 18: **Colonies of *Zoobotryon verticillatum* on piles at Star Wharf.**

Under optimal conditions, *Z. verticillatum* may form large aggregations that can clog fishing nets and potentially exclude other sessile organisms (Gordon & Matawari 1992). Large masses of drifting *Z. verticillatum* become entangled around submerged surfaces, and can have significant impacts on the settlement and survival of hard-bottom sessile invertebrates (Walters & Abgrall 2000). Drift mats of *Z. verticillatum* can also be sucked into cooling water intakes causing operational difficulties (Hayes et al. 2005). However, as a filter feeder it may also have a beneficial role in maintaining ecosystem heath of waterways when in significant abundance (Robinson 2004).

4.3. Other species of note

4.3.1. Oysters – Family Ostreidae

Cupped rock oysters – Genera: *Crassostrea* and *Saccostrea*

Cupped rock oysters were a dominant component of the fouling assemblages in intertidal and shallow subtidal sections of the piles. A large number of species of rock oyster have been described from the Indo-West Pacific, including several species that are not native to the region, most notably *Crassostrea gigas* and *C. virginica* (Angell 1986). In some cases, regional identities have been given to species that are relatively widespread throughout the Indo-West Pacific (Lam & Morton 2006). The variable

morphology and lack of distinguishing characteristics among the *Crassostrea* and *Saccostrea* has made the taxonomy of these groups particularly confusing.

Bell and Amos (1993) described two species of rock oyster – *Saccostrea glomerata* (= *S. commercialis*) and *Crassostrea echinata* (= *Saccostrea echinata*) – as native to Vanuatu. It is unclear how accurate these identifications are. Based on recent morphological and DNA phylogenies, Lam and Morton (2006) suggest that *S. echinata* is genetically identical to *S. cucullata*, clades of which are common throughout the region. Lam and Morton (2009) also describe the pink or coral rock oyster, *S. mordax*, from Vanuatu. Little is known about the distribution of native oyster species in the Vanuatu waters (Bell & Amos 1993).

The invasive Pacific oyster, *C. gigas*, was introduced to Vanuatu for experimental trials as an aquaculture species from Australia in the 1920's, and from California in the 1970's (Bell & Amos 1993). Culture trials occurred in Mounparap Bay and Turtle Bay (Santo), Port Sandwich Bay (Malekula), and in Erakor lagoon (Efate) (Bell & Amos 1993). Most of these trials were not successful due to high mortality caused by parasites and heavy rainfall (Bell & Amos 1993), but it is unclear how abundant or widespread any remnant populations may be. Bell and Amos (1993) suggest that most oysters found near Turtle Bay (Santo) are derived from species introduced from Australia in the 1920s.

Rock oysters on the piles at Star Wharf exhibited a range of sizes and shapes, with most being relatively squat, with strong radial ribs toward the shell margin and a deep purple coloration (Figure 19). Closer examination of the interior of the shell valves showed that many of these oysters had distinct chomata (or denticles) present (Figure 20), a feature that is characteristic of the genus *Saccostrea* (Angell 1986; Poutier 1998). I suspect that these are likely to be the native species *S. cucullata*. However, several of the oysters examined were larger, relatively elongate and appeared to lack chomata, characteristics that are more consistent with species of *Crassostrea* (Figure 21; Angell 1986; Poutier 1998). It is possible that some non-native Pacific oysters, *C. gigas*, are among the assemblages at Star Wharf, but this would need to be confirmed by an expert taxonomist.

4.3.2. Colonial ascidians (Family Didemnidae)

A colonial ascidian in the Family Didemnidae was common on the wharf piles (Figure 22). The CCIMPE trigger list includes "exotic strains" of *Didemnum* (Appendix 1), referring principally to the forms that have shown invasive characteristics in New Zealand, Europe and the USA (Lambert 2009). Recent genetic and morphological evidence suggests that these forms are a single species, now referred to as *Didemnum vexillum* Kott, 2002.

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Figure 19: Close up image of cupped oysters on wharf piles at Star Wharf.

Figure 20: Image of the shell valve of a cup oyster removed from piles at Star Wharf showing distinct chomata in the shell margin, indicative of the genus *Saccostrea* (possibly *S. cucullata*).

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Figure 21: **Image of a shell valve of a cup oyster removed from piles at Star Wharf showing elongate shape and apparent lack of chomata, more typical of the genus *Crassostrea*.**

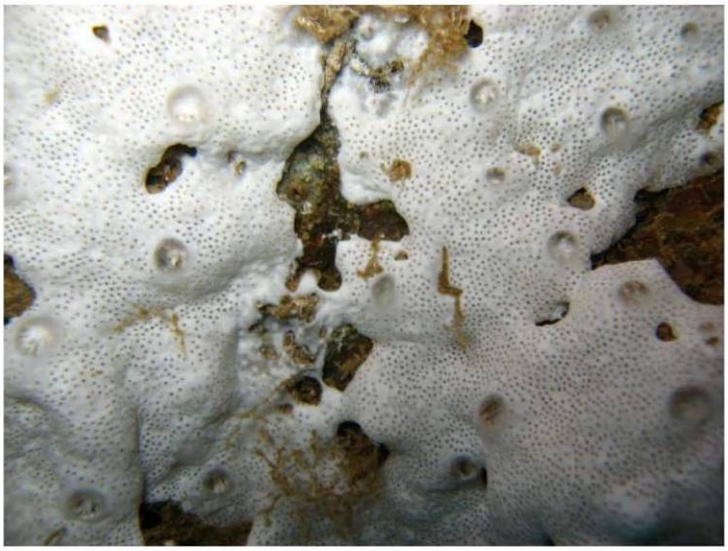

Figure 22: **Didemnid ascidian observed on piles at the Star Wharf.**

Didemnids are notoriously difficult to identify, and require microscopic examination of the zooids by an expert (Kott 2004). They can not be identified reliably in the field. Nevertheless, the species observed at Star Wharf was a bright white colour (Figure 22) rather than the yellow/cream that appears characteristic of the invasive *D. vexillum* (Lambert 2009). It also did not appear to form lobes or have meandering, dark, spicule-free areas in the tunic surface, characteristics which Lambert (2009) suggests may be typical of *D. vexillum*.

Didemnid ascidians are common in the Indo-West Pacific, with 151 species recorded from northern Australia alone (Kott 2004). It is likely that the species observed on Star Wharf is native to the Indo-West Pacific region.

4.3.3. Jewel box clams (Family Chamidae)

Jewel box shells (Family Chamidae) are common fouling organisms throughout the Indo-West Pacific. The highly variable shell morphology of the Chamidae means that distinguishing among species is difficult. Specimens on the piles at Star Wharf appeared to comprise at least two species that most closely resembled *Chama lazarus* Linné, 1758 and *Chama pacifica* Broderip, 1835, both of which are native to the Indo-West Pacific (Poutiers 1998).

Jewel boxes are, however, notorious foulers of ship hulls (as can be seen from the specimen attached to a vessel at Star Wharf, Figure 23). *Chama pacifica* has been introduced to the Mediterranean (Zenetos et al. 2005) and other non-native species of Chamidae have been recorded from vessel hulls and oil rigs in the Mediterranean (Zenetos et al. 2005) and Hawaii (Paulay 1995). A Caribbean jewel box (*Chama macerophylla* Gmelin, 1791) is thought to have been introduced to Hawaii (Eldredge & Smith 2001).

4.3.4. Sea grapes – (Family: Caulerpaceae)

Strains of several species of the tropical green algal genus *Caulerpa* are known to be invasive. These include *C. taxifolia*, *C. racemosa* and *C. prolifera*. Of these species, only *C. racemosa* has stalked globose ramuli (rounded leaf tips) similar to those observed on the species noted at Star Wharf (Figure 11). The morphology of *C. racemosa* can be highly variable with the tips of the ramuli ranging in shape from spherical, to oval, to disc-like, depending on the environment in which it occurs (Trono 1998). It is possible, therefore, that the species observed on Star Wharf is *C. racemosa*, rather than *C. lentillifera*. Nevertheless, as both *C. racemosa* and *C. lentillifera* are native to the Indo-West Pacific and as the invasive strains of *Caulerpa*

appear to be introduced predominantly via discarded waste from marine aquaria, it seems unlikely that the species observed at Star Wharf is non-native.

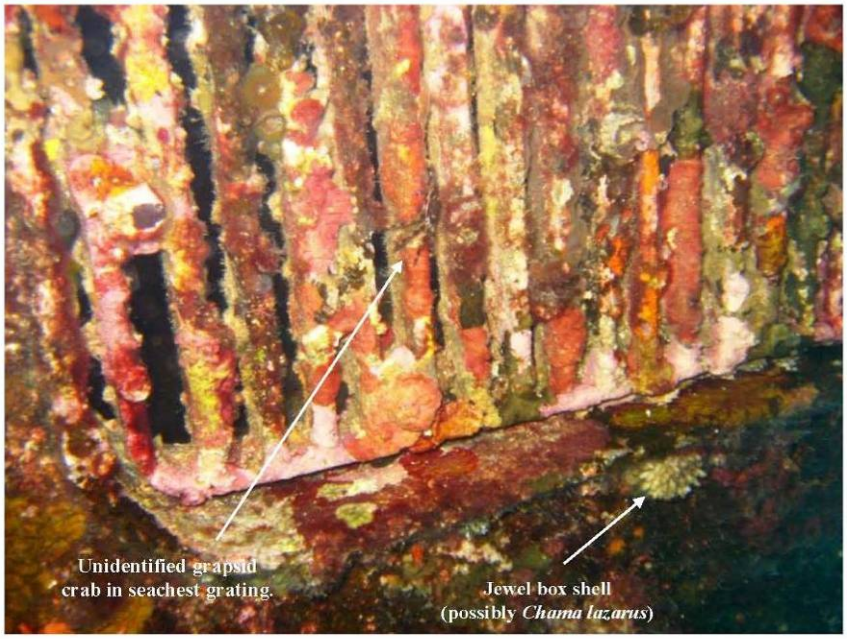

Figure 23: **Heavily fouled sea-chest grating on a vessel berthed at Star Wharf. (15/02/10). Arrows indicate a fouling jewel box bivalve (*Chama* sp.) and an unidentified grapsid crab.**

5. Summary and Discussion

Samples taken from piles at Star Wharf and visual searches made by divers identified five species that are suspected of being non-native to Vanuatu. These were the striped barnacle, *Amphibalanus amphitrite*, and the bryozoans *Amathia distans*, *Bugula neritina*, *Watersipora subtorquata* and *Zoobotryon verticillatum*. All five species are now relatively widely distributed in tropical and subtropical seas and are likely to occur on other port structures within Port Vila.

5.1. Potential ecological and economic effects of the non-native species

Each of these species is known to cause nuisance fouling on ships, piers, buoys and other man-made structures in marine environments. They are all capable of recruiting in large densities and exhibit rapid growth. Several of the non-native species (notably

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A. amphitrite, *B. neritina* and *W. subtorquata*) are tolerant of copper-based antifouling paints and are especially efficient at colonizing new artificial structures in ports and marinas where they can become very abundant. When they occur in large densities, the hard, encrusting species, such as *A. amphitrite* and *W. subtorquata*, significantly increase drag on vessel hulls, thereby increasing operating and maintenance costs. Significant fouling by these species can also increase costs and cause stock mortality in bivalve aquaculture facilities.

Bugula neritina, *W. subtorquata* and *Z. verticillatum* were all considered medium-to-low priority marine pests by Hayes et al. (2005) based on their potential impacts. For *B. neritina* and *W. subtorquata*, these impacts are largely confined to man-made structures and the associated costs of maintaining the surfaces when subject to intensive fouling. They may also compete with native species for resources in these habitats. Both *B. neritina* and *W. subtorquata* tend to be less abundant in natural habitats.

Large aggregations of *Z. verticillatum* can cause a variety of economic and ecological impacts. Masses of drifting *Z. verticillatum* can clog fishing nets and have caused operational difficulties in coastal power stations by blocking cooling water intakes (Gordon & Matawari 1992, Hayes et al. 2005). *Zoobotryon verticillatum* has also reportedly caused problems for salt production in South Australia by regularly blocking drainage systems in saltfields (Coleman 1999).

Williams (2007) observed that large growths of *Z. verticillatum* on seagrass (*Zostera marina*) caused the leaf canopy to collapse, reducing its value as habitat for small fishes and, eventually, leading to patches being denuded. Seagrasses are an important resource in Vanuatu (Chambers et al. 1990). They are the major food of dugongs and green turtles and provide important habitat for a variety of invertebrates and fishes that are the basis of subsistence fisheries (Chamber et al. 1990). Prolific growths of *Z. verticillatum* could smother patches of some of the smaller seagrass species recorded from Vanuatu (e.g. *Halodule pinifolia*, *Halodule uninervis*, *Halophila ovalis* and *S. isoetifolium*) and have impacts on the resources they support.

Zoobotryon verticillatum is also a very efficient suspension feeder. A colony of 1 m^2 may filter phytoplankton from an estimated 184,728 litres per day (Winston 1995). Such rates of clearance may reduce the availability of food for other suspension feeders (such as bivalves), particularly where masses of *Z. verticillatum* overlay these species, creating both smothering and competition for food resources.

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5.2. Limitations of the survey

Although only five species recorded during the survey are suspected of being non-native to Vanuatu, it is likely that others are present on Star Wharf and in the surrounding environments of Vila Bay. As noted earlier, the invasive Pacific oyster, *C. gigas*, was cultured in nearby Erakor Lagoon (Bell & Amos 1993), but it is unclear if it is still a component of fouling assemblages and how widespread it may be. This requires more specialised taxonomic investigation. Tilbrook et al. (2001) recorded at least one other non-native bryozoan from Port Vila Harbour that was not observed during the survey: the branching bryozoan *Schizoporella errata* (Waters, 1878). *Schizoporella errata* is another nuisance fouling species that is widespread in warm temperate and sub-tropical seas and which is spread by vessel fouling. It can form heavy growths on vessel hulls, wharf pilings, pontoons, mollusc shells, algae and mangroves (Tilbrook et al. 2001).

The present survey was aimed at providing an initial assessment of the likely presence/absence of non-native species within fouling assemblages at Star Wharf, with particular emphasis on a checklist of known, easily identified, high profile marine pests ('target species'). Specimens collected opportunistically from the wharf and from a relatively small number of quantitative samples (n = 9) were provisionally identified by Dr Inglis. A collection of preserved voucher samples and images taken during the survey has been registered to allow later examination by expert taxonomists. However, some groups of organisms that were common in the fouling assemblages (e.g. red algae, sponges, colonial ascidians, polychaete worms, etc) require specialist expertise to identify, as many of them have distinguishing characters that are microscopic. Species from these groups are known to be invasive in other tropical environments (Coles & Eldredge 2002).

Tropical fouling assemblages are relatively poorly described within the Pacific Islands and there have been few studies of the distribution of non-native species outside Hawaii, Guam and tropical Australia (Coles & Eldredge 2002; Hewitt 2002). There is a need for more detailed surveys of port and harbour habitats in key shipping nodes within the Pacific to increase local knowledge of native and non-native species and to establish a baseline against which monitoring for marine pests can be developed. To be effective, the baseline surveys must be supported by specialist taxonomic expertise (Campbell et al. 2007).

Nevertheless, the reference collection assembled from this project provides a useful starting point to develop better local knowledge on native and non-native species within the Port of Vila. To be useful, the specimens should be identified by taxonomic authorities and curated locally, with the associated collection details and *in situ* images. This will allow local marine managers to begin building an archive of fouling

species known to be present in Vila Bay against which collections from future surveys can be compared.

5.3. Management recommendations

5.3.1. Demolition of Star Wharf

Removal of the existing structures at Star Wharf entails some risk since it is unclear how widely distributed the non-native species within the fouling assemblages may be within other environments of Port Vila and Efate Island. Although the non-native species described in this report are widely distributed in tropical seas, their local distribution is often confined to port areas as these are the environments in which they are first introduced and which provide the greatest amount of available habitat for them (Coles & Eldredge 2002). However, several of the species are capable of inhabiting other habitats, including mangroves, salt-marshes, seagrass beds and coral reefs, where they can have impacts. Removal of the piles and fouling assemblages to land-fill would mitigate the risk of distributing them further in Vanuatu's marine environments.

A less desirable, alternative strategy is to eliminate the fouling assemblages *in situ*, before the pilings are removed. A relatively benign way of achieving this is described by Coutts & Forrest (2007). Divers wrap the piles tightly using rolls of black polyethylene (1 m wide × 50 µm thick) to prevent or restrict water circulation around the fouling assemblages, effectively suffocating the organisms. The edges of the polythene are overlapped by ~400 mm and secured by PVC tape to achieve a tight seal on each pile. The polythene wrap is left in place for six days or longer before it is removed and disposed of. The tightness of the seal on each pile and length of time the polythene is left in place are important determinants of the effectiveness of the technique (Coutts & Forrest 2007). This 'set-and-forget' technique has the advantages of confining and killing all species (native and non-native) within the fouling assemblage and of preventing release of offspring and gametes. It does not require chemical treatments. Although there is some limited biological oxygen demand associated with release of decomposition products from the fouling organisms once the polythene is removed, this is relatively minor and short-lived and is unlikely to have any significant impacts on surrounding communities. Of more concern is the disposal (usually to landfill) of the waste polythene wrap.

5.3.2. Construction of new wharf facilities

New port developments or shipping pathways often provide opportunities for the introduction of new non-native species and/or the proliferation of species that are already present in low abundance. New shipping pathways introduce species from

novel geographic regions, whilst new port facilities provide unoccupied habitat for establishment of fouling populations. Because many fouling pests produce large numbers of offspring, grow rapidly and are tolerant of pollutants found in ports and harbours, they can colonise new structures rapidly and reach large abundances.

Members of the Pacific Regional Environment Programme (including Vanuatu) have adopted a *Regional Strategy on Shipping-Related Introduced Marine Pests in the Pacific Islands* (SRIMP-PAC; Raaymakers & Nawadra 2006). A key objective of this strategy is to establish effective monitoring and early warning systems for introduced marine pests within Pacific Island ports and marinas so that incursions can be detected early and managed to mitigate their impacts. The foundations of effective monitoring systems are *risk assessment* (to identify important shipping pathways and species of concern) and *port biological baseline surveys* (to characterise the existing native and non-native marine assemblages within the port and surrounding environments). These activities will also assist port States to:

- meet obligations under the International Maritime Organization's *International Convention for the Control and Management of Ships' Ballast Water and Sediments*,
- alert shipping and other interested parties to 'outbreaks' of harmful aquatic organisms,
- assist in preventing their uptake, and
- detect invasions as early as possible, thereby increasing the chances of successful response, control and mitigation actions (Raaymakers & Nawadra 2006).

This preliminary study has identified a number of suspected non-native species from Port Vila, but there is a large gap in knowledge of non-native species within Pacific ports in general, and from Vila Bay, in particular. A key recommendation from this assessment is that development of future port facilities be accompanied by (1) assessment of likely risk pathways and species of concern to Vanuatu, and by (2) a more comprehensive port biological baseline survey for introduced marine pests (Hewitt & Martin 2001). Both activities can be used to build local capability in marine pest monitoring and management, through training and involvement of local staff in marine pest risk assessment and baseline surveys, and by developing a verified reference collection of native and non-native species present in Vila Bay.

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Appendix 1: Introduced Marine Pests that are on the Australian Consultative Committee for Introduced Marine Pest Emergencies (CCIMPE) Trigger List of Unwanted Species. Species that are capable of inhabiting fouling assemblages in tropical environments are highlighted in bold font.

	Scientific name	Common Name
Species not known to be present in Australia		
1	*Eriocheir* spp.	Chinese Mitten Crab
2	*Hemigrapsus sanguineus*	Japanese/Asian Shore Crab
3	*Crepidula fornicata*	American Slipper Limpet
4	***Mytilopsis sallei***	**Black Striped Mussel**
5	***Perna viridis***	**Asian Green Mussel**
6	***Perna perna***	**Brown Mussel**
7	*Corbula (Potamocorbula) amurensis*	Asian Clam, Brackish-Water Corbula
8	*Rapana venosa (syn Rapana thomasiana)*	Rapa Whelk
9	*Mnemiopsis leidyi*	Comb Jelly
10	***Caulerpa taxifolia* (exotic strains only)**	**Green Macroalgae**
11	***Didemnum* spp. (Exotic invasive strains only)**	**Colonial Sea Squirt**
12	*Sargassum muticum*	Asian Seaweed
13	*Neogobius melanostomus* (marine / estuarine incursions only)	Round Goby
14	*Marenzelleria* spp. (invasive species and marine/estuarine incursion only)	Red Gilled Mudworm
15	***Balanus improvisus***	**Barnacle**
16	*Siganus rivulatus*	Marbled Spinefoot, Rabbit Fish
17	*Mya arenaria*	Soft Shell Clam
18	*Ensis directus*	Jack-knife Clam
19	*Hemigrapsus takanoi/penicillatus*	Pacific Crab
20	***Charybdis japonica***	**Lady Crab**
Species established in Australia, but not widespread		
21	*Asterias amurensis*	Northern Pacific Seastar
22	*Carcinus maenas*	European Green Crab
23	*Varicorbula gibba*	European Clam
24	***Musculista senhousia***	**Asian Bag Mussel, Asian Date Mussel**
25	*Sabella spallanzanii*	European Fan Worm
26	*Undaria pinnatifida*	Japanese Seaweed
27	*Codium fragile* spp. *tomentosoides*	Green Macroalga
28	*Grateloupia turuturu*	Red Macroalga
29	*Maoricolpus roseus*	New Zealand Screwshell

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Appendix 2: **Marine pest species that have a moderate or high capacity to survive and establish in fouling assemblages within tropical Australian waters (adapted from Neil et al. 2008).**

Rhodophytes (red seaweeds)
Acanthophora spicifera
Hypnea musciformis
Serpulids (tube worms)
Hydroides sanctaecrucis
Hydroides diramphus
Hydroides ezoensis
Hydroids
Antenalla secundria
Plumularia setacea
Bryozoans (sea mosses and lace coral)
Amathia distans
Bugula neritina
Bugula stolonifera
Watersipora arcuata
Watersipora subtorquata
Zoobotryon verticillatum
Cirrepedia (barnacles)
Austromegabalanus krakatauensis
Chthamalus proteus
Balanus amphitrite
Balanus reticulatus
Megabalanus tintinnabulum
Megabalanus rosa
Megabalanus coccopoma
Megabalanus zebra
Isopods (sea lice)
Sphaeroma walkeri
Paradella dianae
Decapod (crab)
Charybdis japonica
Bivalve molluscs (mussels)
Musculista senhousia
Mytilopsis sallei
Perna viridis
Gastropod molluscs (marine limpet and thaid whelks)
Siphonaria pectinata
Stramonita haemostoma floridana
Thais rustica
Colonial ascidians (sea squirts)
Botrylloides leachi
Botryllus schlosseri

APPENDIX 8:
MARINE BIODIVERSITY SURVEY

The full report was still being finalised at time of submission of the Supplementary EIA. Once completed this report can be obtained from EcoStrategic Consultants (www.eco-strategic.com)

APPENDIX 9:
CURRENT VELOCITY REPORT

Port Vila ***Star Terminal***
Bankable Feasibility Study

Supplementary EIA: **Port Vila Harbour Current Velocities**

12 Feb 2010

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1. Objective

To provide some quantitative data on current velocities in the vicinity of Star Wharf.

2. Method

On Friday 12 February 2010, three hydrologists/technicians from the Vanuatu *Department of Geology, Mines and Water Resources* joined Steve Raaymakers of EcoStrategic Consultants to measure current velocities in the vicinity of Star Wharf, Port Vila.

Three sites to the north-west of Star Wharf and at two sites in the channel between the south end of Iriwiki Island and Star Wharf were sampled, as shown by the pink dots on Figure 1, with GPS coordinates as follows:

Site	GPS Coordinates
Wharf 1:	S 17˚45.267 / E 168˚18.185
Wharf 2:	S 17˚45.255 / E 168˚18.181
Wharf 3:	S 17˚45.246 / E 168˚18.173
Channel 1:	S 17˚45.153 / E 168˚18.372
Channel 2:	S 17˚45.078 / E 168˚18.404

The team deployed using a small Yamaha 'banana boat' with outboard motor from Vanuatu *Department of Fisheries.*

Current velocities were measured with a NIWA Instruments OTT hand-held Current Probe connected to a Hydrological Services CMC20A Current Meter Counter (see Figures).

The OTT Current Probe is designed primarily for use from a fixed location in freshwater streams – and measurements are based on the number of revolutions of a propeller over 40 seconds. As movement of the probe through the water will cause revolution of the propeller, this instrument is not suited for use from an unstable platform such as a dinghy. It is vital that the sampling platform (in this case the dinghy) is absolutely fixed with no movement, so that only the natural water currents cause movement of the propeller.

To achieve this, the dinghy was anchored firmly at each sampling site, and the probe was only deployed when the vessel had fully settled at anchor. Sampling was suspended whenever other small vessels passed nearby causing wake and movement of the sampling dinghy.

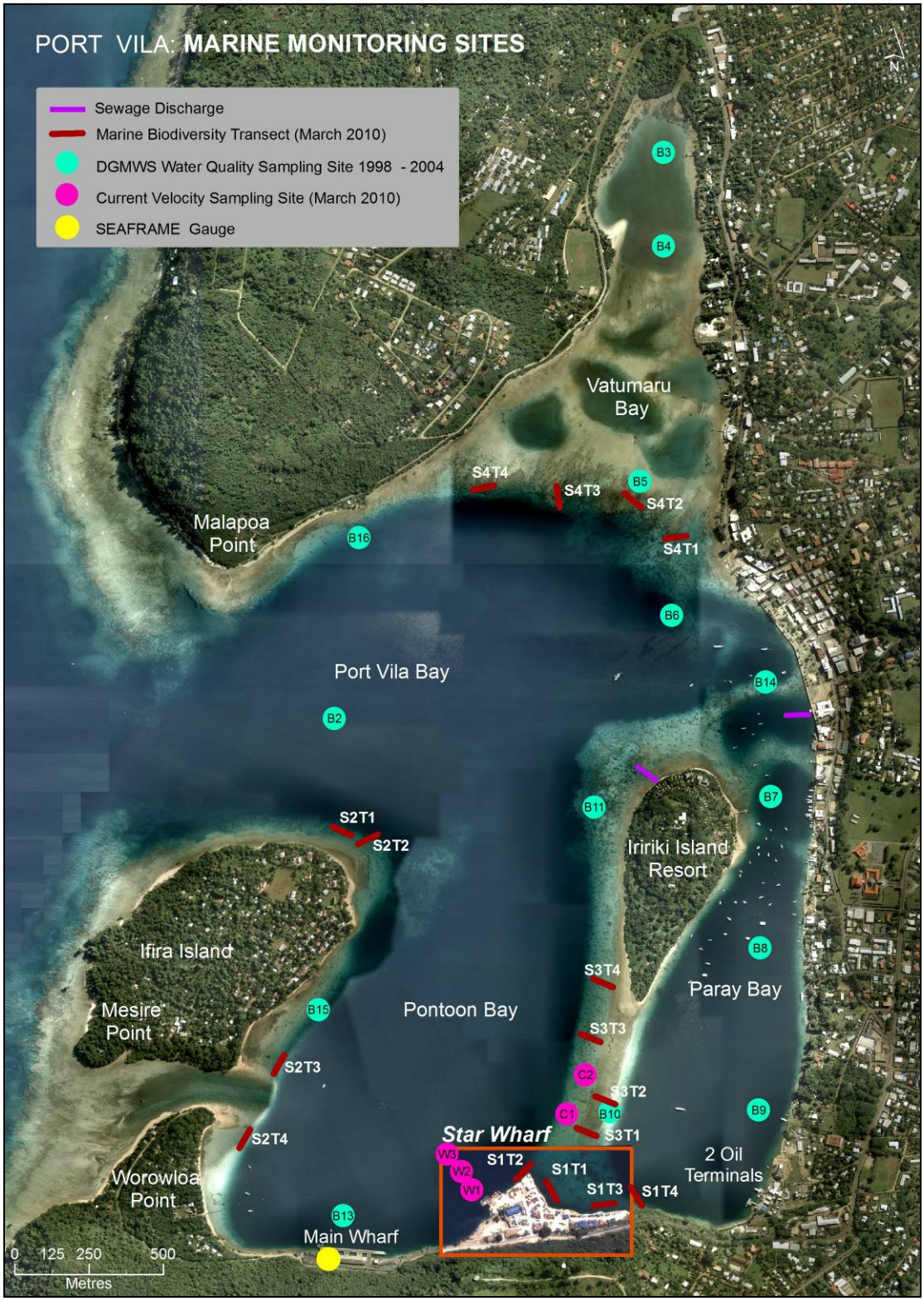


Figure 1: Pink dots show the current velocity sampling sites W1 to W3 and C1 & C2

Sampling was undertaken at 1m and 2m depths at each site, commencing at 0530 hours (high tide) and through the ebb tide until 0851 hours. A second sampling event was undertaken at each site on the flood tide between 1204 hours and1300 hours.

Sampling was dis-continued after 1300 as the dinghy was required to deploy the marine pest expert on a survey dive at Star Wharf, plus a light sea-breeze (around 5 knots) had developed, making it impossible to keep the dinghy from moving at anchor and thereby compromising the validity of propeller revolution readings.

The tides on the day were as follows:

- High: 1.26 metres at 0533 hrs
- Low: 0.74 metres at 1100 hrs
- High: 1.38 metres at 1645 hrs
- Low: 0.33 metres at 2328 hrs

The revolutions/40 seconds data was converted to metres/second back in the laboratory using the formula below, as specified in the current probe user manual.

- If n<2.35 V (Velocity) = 0.0652n (n Revolutions) + 0.016
- If n>2.35 <6.82 V (Velocity) = 0.0567n + 0.036
- If n>6.82 V (Velocity) = 0.0545n + 0.051

Figure 2: The sampling team

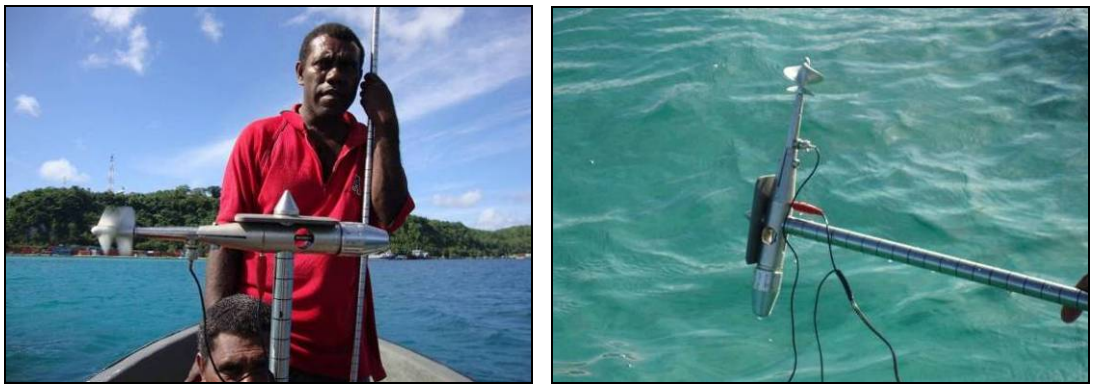


Figure 3: Close up of the OTT current probe propeller unit

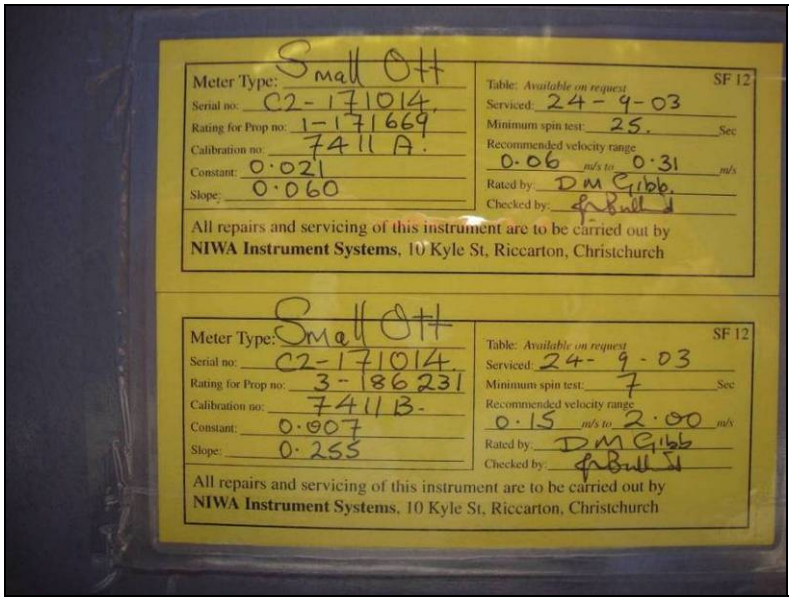


Figure 4: Specifications of the OTT current probe

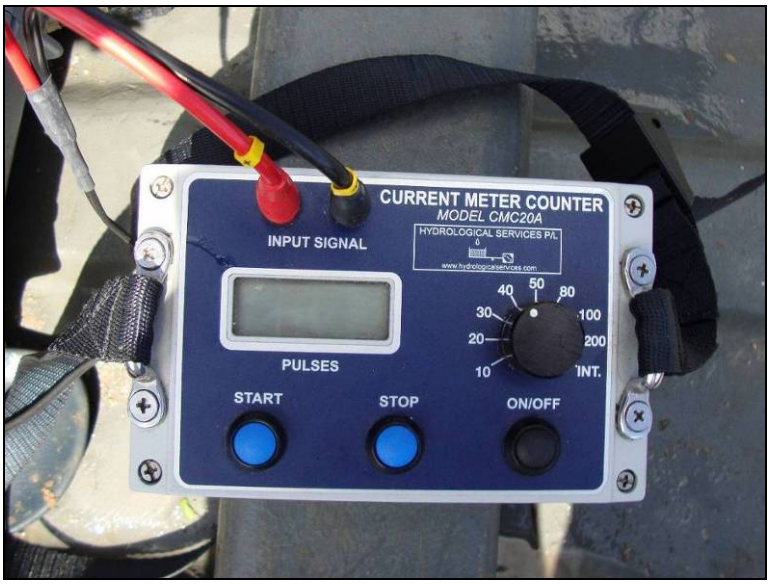


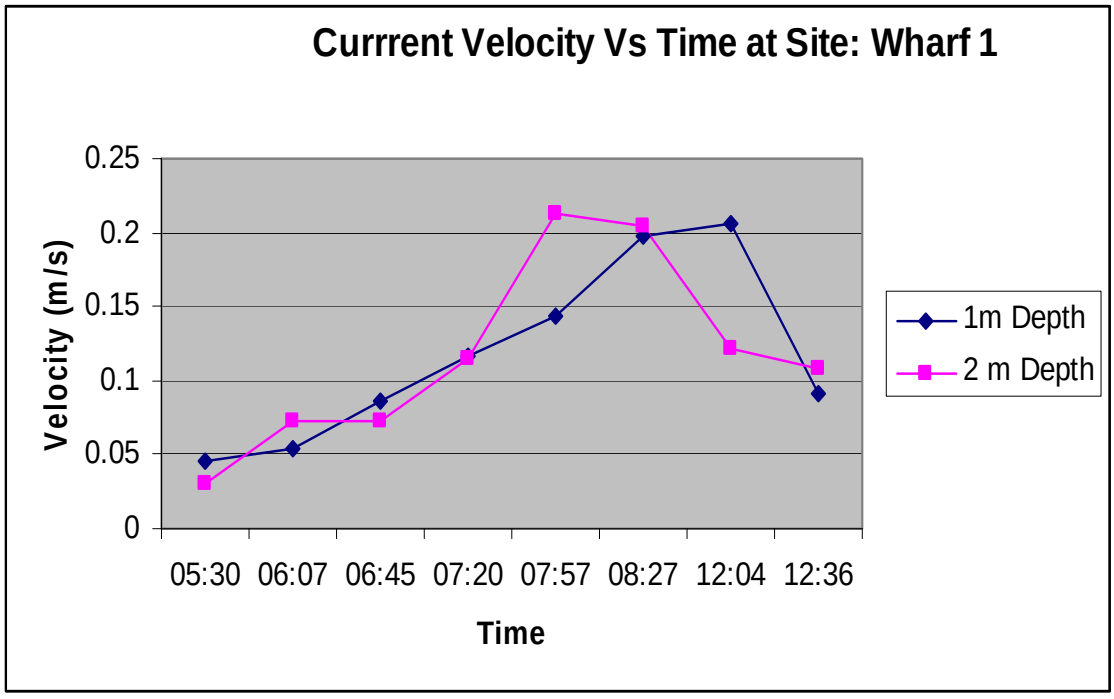
Figure 5: The Hydrological Services CMC20A Current Meter Counter

3. Results

SITE: WHARF 1 GPS: S 17˚45.267 E 168˚18.185

12 Feb 2010

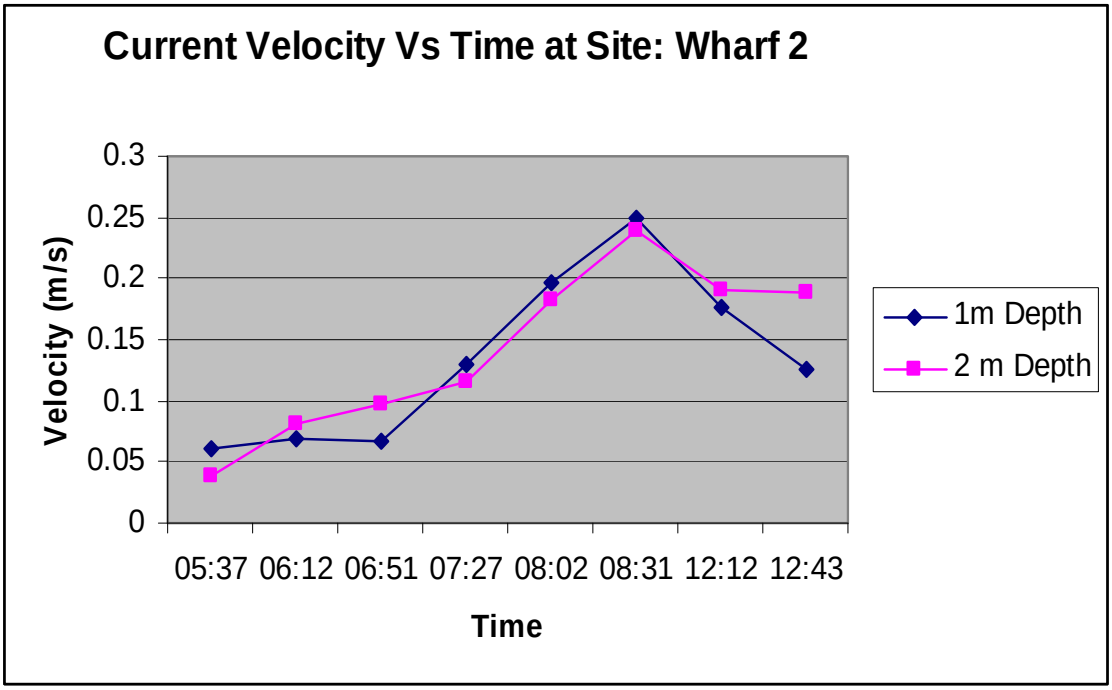
TIME	DEPTH (m)	REVOLUTIONS/40 SECONDS	VELOCITY(m/s)
5:30 am	1	18	0.04534
	2	9	0.03067
06:07 am	1	23	0.05349
	2	35	0.07305
06:45 am	1	43	0.08609
	2	35	0.07305
07:20 am	1	62	0.11706
	2	61	0.11543
07:57 am	1	78	0.14314
	2	125	0.213188
08:27 am	1	114	0.197595
	2	119	0.204683
12:04 pm	1	120	0.2061
	2	65	0.12195
12:36 pm	1	46	0.09098
	2	57	0.10891



SITE: WHARF 2 GPS: S 17˚45.255 E 168˚18.181

12 Feb 2010

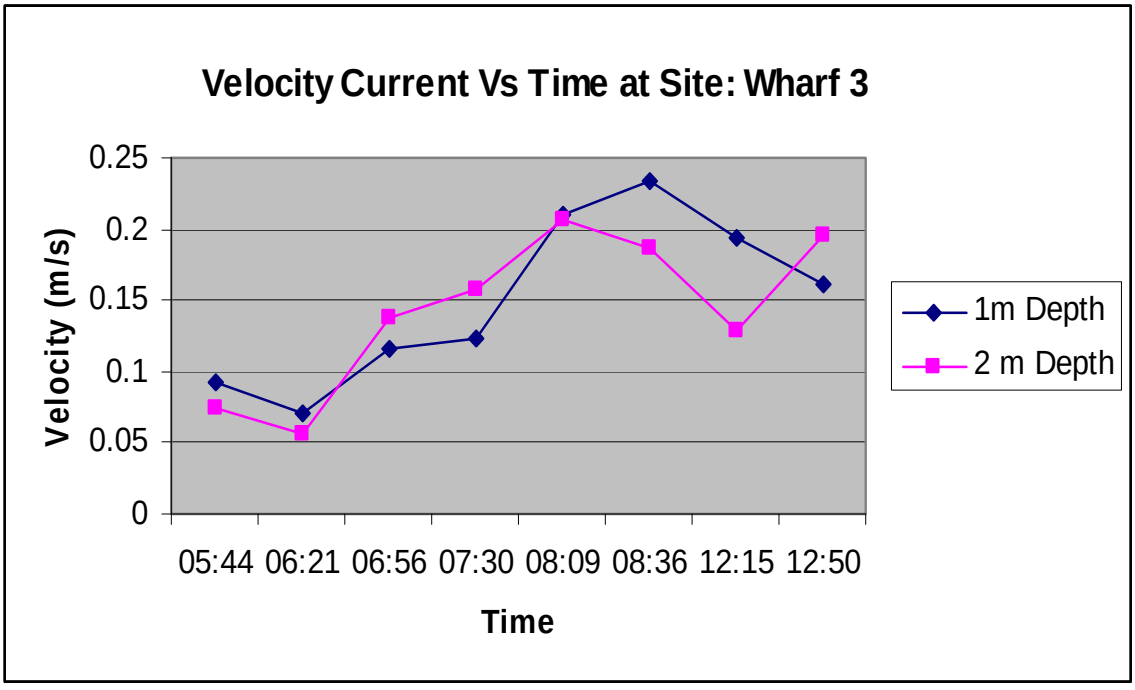
TIME	DEPTH (m)	REVOLUTIONS/40 SECONDS	VELOCITY(m/s)
05:37 am	1	27	0.06001
	2	14	0.03882
06:12 am	1	33	0.06979
	2	40	0.0812
06:51 am	1	31	0.06653
	2	50	0.0975
07:27 am	1	70	0.1301
	2	61	0.11543
08:02 am	1	114	0.197595
	2	103	0.182003
08:31 am	1	151	0.250043
	2	144	0.24012
12:12 pm	1	99	0.176333
	2	109	0.190508
12:43 pm	1	67	0.12521
	2	107	0.187673



SITE: WHARF 3 GPS: S 17˚45.246 E 168˚18.173

12 Feb 2010

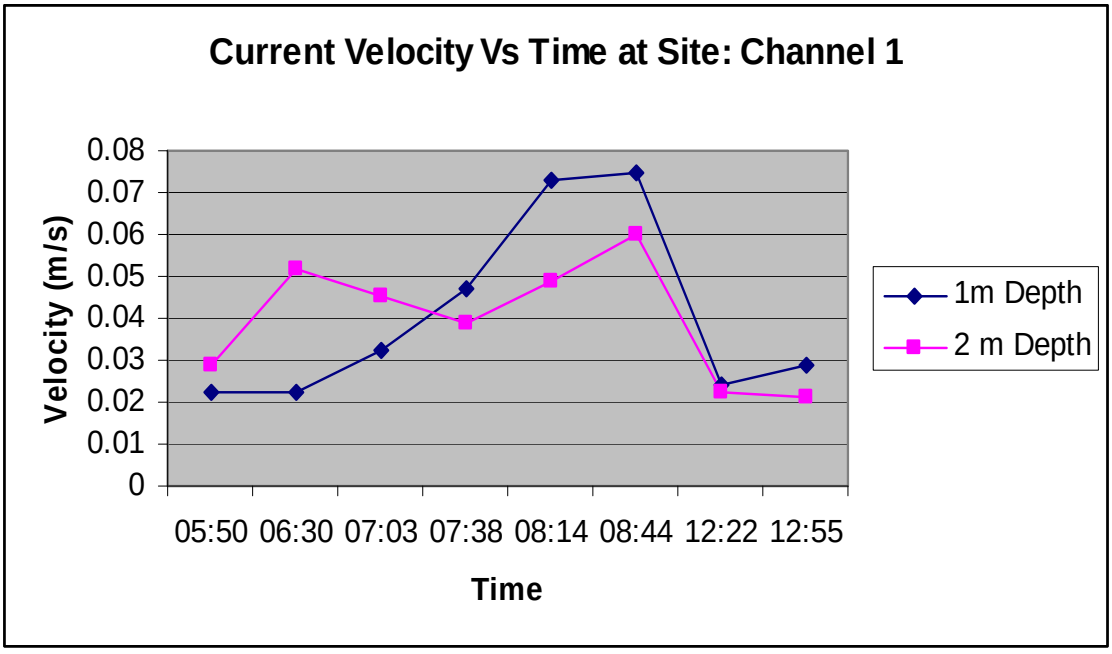
TIME	DEPTH (m)	REVOLUTIONS/40 SECONDS	VELOCITY(m/s)
05:44 am	1	47	0.09261
	2	36	0.07468
06:21 am	1	33	0.06979
	2	25	0.05675
06:56 am	1	61	0.11543
	2	75	0.13825
07:30 am	1	66	0.12358
	2	87	0.15781
08:09 am	1	123	0.210353
	2	120	0.2061
08:36 am	1	139	0.233033
	2	106	0.186255
12:15 pm	1	111	0.193343
	2	69	0.12847
12:50 pm	1	89	0.16107
	2	112	0.19476



SITE: CHANNEL 1 GPS: S 17˚45.153 E 168˚18.372

12 Feb 2010

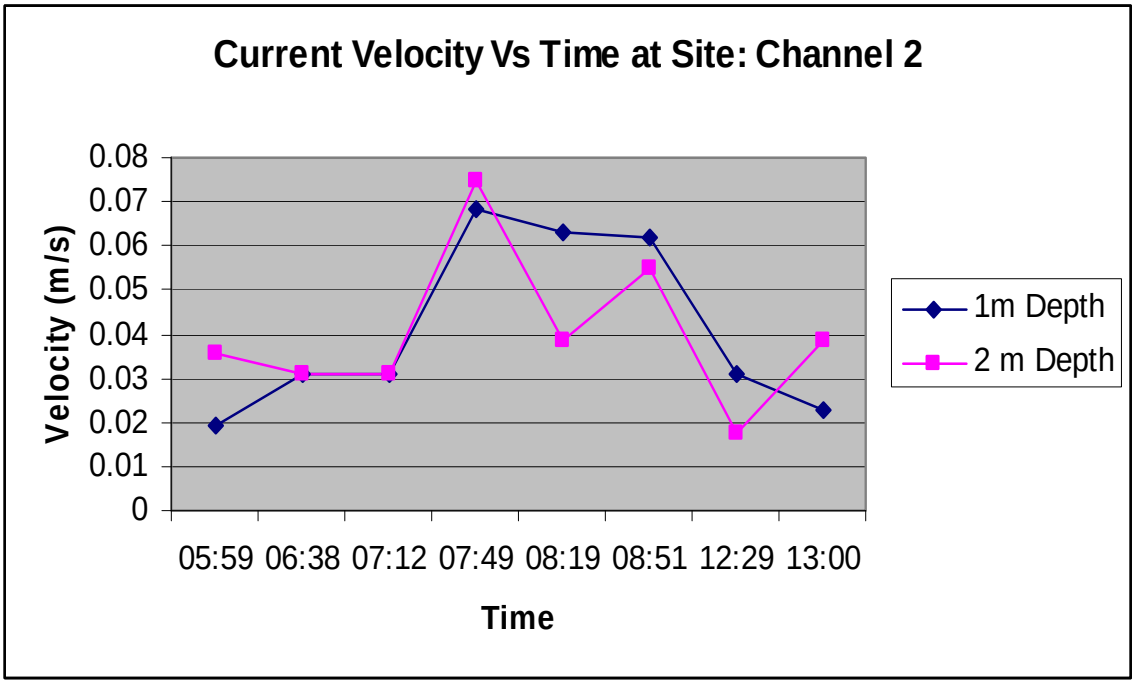
TIME	DEPTH (m)	REVOLUTIONS/40 SECONDS	VELOCITY(m/s)
05:50 am	1	4	0.02252
	2	8	0.02904
06:30 am	1	4	0.02252
	2	22	0.05186
07:03 am	1	10	0.0323
	2	18	0.04534
07:38 am	1	19	0.04697
	2	14	0.03882
08:14 am	1	35	0.07305
	2	20	0.0486
08:44 am	1	36	0.07468
	2	27	0.06001
12:22 pm	1	5	0.02415
	2	4	0.02252
12:55 pm	1	8	0.02904
	2	3	0.02089



SITE: CHANNEL 2 GPS: S 17˚45.078 E 168˚18.404

12 Feb 2010

TIME	DEPTH (m)	REVOLUTIONS/40 SECONDS	VELOCITY(m/s)
05:59 am	1	2	0.01926
	2	12	0.03556
06:38 am	1	9	0.03067
	2	9	0.03067
07:12 am	1	9	0.03067
	2	9	0.03067
07:49 am	1	32	0.06816
	2	36	0.07468
08:19 am	1	29	0.06327
	2	14	0.03882
08:51 am	1	28	0.06164
	2	24	0.05512
12:29 pm	1	9	0.03067
	2	1	0.01763
13:00 pm	1	4	0.02252
	2	14	0.03882



APPENDIX 10:
MATERIAL SAFETY DATA SHEETS (MSDS) FOR PESTICIDES

Includes the MSDSs for:

- Ant Stop Granular G.
- Biflex Ultra
- Exterm-an-Ant
- Maxforce GB Granular ant bait
- Mesurol snail & slug bait

These MSDSs have been inserted as images and the text size is therefore small. Full-size, stand-alone versions can be requested from EcoStrategic Consultants: www.eco-strategic.com

PO Box 100 287
NSMC
North Shore City 0745
New Zealand
Ph: 09 443 9218
Fax: 09 443 5083

MATERIAL SAFETY DATA SHEET

ANT STOP G GRANULAR INSECTICIDE

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME

ANT STOP G GRANULAR INSECTICIDE

RECOMMENDED USE

A granular insecticide for the control of ants in gardens and other outdoor areas.

COMPANY IDENTIFICATION

Environmental Health Products
42B Ellice Rd, Glenfield
Phone: +64 9 440 9994
Fax: 09 443 5083

EMERGENCY TELEPHONE NUMBERS

24 hour Emergency Service Phone: -	0800 Chemcall (0800 243 622)
National Poisons Centre: -	0800 764 766

2. HAZARDS IDENTIFICATION

HSNO CLASSIFICATION

6.1D, 6.3B, 6.4A, 6.8B, 6.9B, 9.1A, 9.2C, 9.3B, 9.4A

EYES

May irritate eyes

SKIN

The product may cause some skin irritation after prolonged contact and will irritate broken skin.

INHALED

The risk of poisoning by dust inhalation is low but the dust will irritate the mucous membranes and cause sinuous discomfort. Prolonged exposure to the product may cause headaches and other discomfort as a result of the presence of petroleum solvents.

ACUTE

Chlorpyrifos is an organo-phosphate insecticide and will inhibit cholinesterase. Symptoms of overexposure to the active constituent may include headaches, dizziness, incoordination, muscle twitching, tremors, nausea, abdominal cramps, diarrhoea, sweating, constrictive pupils, blurred vision, salivation, tightness of the chest, excessive urination and convulsions.

SWALLOWED

The acute oral toxicity of the active constituent is high with reported LD_{50} measurements for the active at 115mg/Kg. Because of the low levels of active constituent in this product the risk of serious poisoning by ingestion is low.

CHRONIC

Rats and mice that were administered the active ingredient in long term studies showed no increase in tumours compared to the control. Studies in rats and rabbits indicate that the active constituent does not cause birth defects or interfere with reproduction. There is no known evidence of genetic change or accumulation of the active constituent in the body.

3. COMPOSITION/INFORMATION ON INGREDIENTS

CHEMICAL ENTITY	CAS NUMBER	PROPORTION
Chlorpyrifos	2921-88-2	50g/kg
Petroleum Solvents	63231-51-6 & 64742-4-8	<50g/kg
Emulsifiers and inerts		900g/kg

4. FIRST AID MEASURES

SWALLOWED

If swallowed contact a doctor or the National Poisons Centre (0800 764 766)

EYES

If in eyes hold eyelids open, flood with water for at least 15 minutes and see a doctor if irritation persists.

SKIN

Wash skin with soap and water.

INHALED

Remove victim to fresh air and seek medical advice if effects persist. If breathing difficulties become acute give oxygen.

ADVICE TO DOCTOR

Chlorpyrifos is a cholinesterase inhibitor. Atropine by injection or Atrovent/ipratropium by airway puffs are the desirable antidotes. Oximes such as 2 PAM/protopam may be therapeutic if used early but only in conjunction with atropine.

5. FIRE FIGHTING MEASURES

- Product may emit potentially harmful gases.
- Fire fighters should wear appropriate breathing apparatus and all non-essential personal should be kept downwind.

6. ACCIDENTAL RELEASE MEASURES

- Spills and Disposal
- Spills should be swept or vacuumed.
- Avoid breathing dust.
- Personal protective equipment as outlined above should be utilised in cleaning up all spills.
- The best method of disposal of spills is to use the product in accordance with the label directions.
- If this is not possible dispose of at an appropriate local authority landfill.

7. HANDLING AND STORAGE

- Store in a cool dry place in sealed original containers away from direct sunlight.
- Store away from food, feed or any items intended for human or animal consumption.
- Keep out of reach of children.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

- When using the product wear rubber gloves.
- Avoid breathing dust by using an appropriate dust mask.
- Wash hands after use.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	A tan coloured granule
Flash Point (°C)	N/A
Boiling Point (°C)	N/A
Flammability Limits (%)	N/A
Vapour Pressure	N/A
Solubility in Water (g/L)	Insoluble
Specific Gravity	1.1g/mL (bulk density).

10. STABILITY AND REACTIVITY

Product is not highly flammable although the small amount of petroleum solvent will support short-term combustion.

11. TOXICOLOGICAL INFORMATION

Time weighted average for chlorpyrifos is 0.2 mg/m^3.
Exposure standards for nuisance dusts should also be observed.

12. ECOLOGICAL INFORMATION

- Chlorpyrifos is toxic to birds, fish and bees.
- The product should be irrigated immediately after use to move the granules from the surface to reduce the risk of poisoning to foraging birds.
- Do not apply in any manner that may result in the granules washing into waterways. Chlorpyrifos does not bioaccumulate in animal systems.

13. DISPOSAL CONSIDERATIONS

- Spills should be swept or vacuumed.
- Avoid breathing dust.
- Personal protective equipment as outlined above should be utilised in cleaning up all spills.
- The best method of disposal of spills is to use the product in accordance with the label directions.
- If this is not possible dispose of at an appropriate local authority landfill.
- Containers should be tripled rinsed, punctured and disposed of at an appropriate local authority landfill.

14. TRANSPORT INFORMATION

Proper Shipping Name:
ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Contains chlorpyrifos)

UN Number:	3077
DG Class:	9
Packing Group:	III
Marine Pollutant:	Yes

15. REGULATORY INFORMATION

ERMA Approval Code: HSR000170

16. OTHER INFORMATION

Date of Preparation: May 2009

NOTICE

Information for this product is believed to be reliable, however buyer and user assume all risk of use, handling and storage whether in accordance with directions or not.
Environmental Health Products and its agents give no guarantee or warranty of any kind expressed or implied concerning the use of this product and will not accept any responsibility whatsoever whether in contract or tort for any loss including consequential loss arising out of the use of this product or caused by this product.

MATERIAL SAFETY DATA SHEET

Date of Issue: July 2007
MSDS No. FMC/BIFUL/1

SECTION 1 IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Product Name:

BIFLEX® ULTRA-LO-ODOUR TERMITICIDE & INSECTICIDE

Other Names: Bifenthrin.
Use: Termiticide and insecticide in buildings and other structures.
Company: FMC Australasia Pty Ltd.
Address: Unit 26, 8 Metroplex Ave, Murarrie, Qld 4172
Telephone Number: 07 3908 9222 **Fax Number:** 07 3908 9221
Emergency Telephone Number: 1800 033 111 (All hours - Australia wide).

SECTION 2 HAZARDS IDENTIFICATION

Classified as hazardous according to criteria of NOHSC Australia.
Not classified as a Dangerous Good according to the ADG Code.

Risk phrases:	R20/22	Harmful by inhalation and if swallowed
	R36/37	Irritating to eyes and respiratory system.
	R65	Harmful: May cause lung damage if swallowed.
Safety Phrases:	S2	Keep out of reach of children.
	S13	Keep away from food, drink and animal feeding stuffs.
	S23	Do not breathe vapour or spray.
	S24/25	Avoid contact with skin and eyes.
	S36/37	Wear suitable protective clothing and gloves.

SECTION 3 COMPOSITION/INFORMATION ON INGREDIENTS

Ingredients:

CHEMICAL	*CAS NUMBER*	*PROPORTION*
Bifenthrin	82657-04-3	100 g/L
Liquid Hydrocarbons	64742-94-5	> 60% w/w
Other ingredients determined not to be hazardous	mixture	10 - 30 % w/w

SECTION 4 FIRST AID MEASURES

FIRST AID

Swallowed: If poisoning occurs, contact a doctor or Poisons Information Centre. Phone Australia (13 11 26). If swallowed, do not induce vomiting. Give a glass of water. If any discomfort persists seek medical advice.

Eye: If in eyes, hold eyes open and flush with water for at least 15 minutes. If irritation occurs and persists, obtain medical attention.

Skin: If on skin wash with plenty of soap and water. Remove contaminated clothing. If irritation occurs and persists see a doctor.

Inhaled: Remove patient to fresh air. If breathing discomfort occurs, obtain medical attention.

Advice to Doctors: Bifenthrin the active ingredient in this product is a pyrethroid insecticide. The formulation also contains petroleum distillate that can cause severe pneumonitis or fatal pulmonary oedema if aspirated. Consideration should be given to gastric lavage with an endotracheal tube in place. Treatment is otherwise symptomatic and supportive.

SECTION 5 FIRE FIGHTING MEASURES

Specific Hazard: Product is a combustible liquid. Flash point 68°C.
Extinguishing media: Foam, CO_2 or dry chemical. Soft stream water fog if no alternatives. Contain all runoff.
Hazards from combustion products: On burning will emit toxic fumes of carbon monoxide, carbon dioxide, hydrogen chloride, chlorine, fluorine and hydrogen fluoride etc.
Precautions for fire-fighters and special protective equipment: Isolate fire area. Evacuate downwind. Wear full protective clothing and self-contained breathing apparatus. Do not breathe or contact smoke, gases or vapours generated.

SECTION 6 ACCIDENTIAL RELEASE MEASURES

Emergency procedures: Isolate and post spill area. Keep out unprotected persons and animals. Wear prescribed protective clothing and equipment. Large spills should be dyked or covered to prevent dispersal. Vacuum shovel or pump spilled material into an approved container and dispose of as listed in section 13.
Material and methods for containment and cleanup procedures: To clean spill area, tools and equipment, wash with a solution of soap, water and acetic acid/vinegar. Follow this with a neutralisation step of washing the area with a bleach or caustic soda ash solution. Finally, wash with a strong soap and water solution. Absorb, as above, any excess liquid and add both solutions to the drums of waste already collected.
Do NOT allow spilled product or wash solution to enter sewers, drains, dams, creeks or any other waterways.

SECTION 7 HANDLING AND STORAGE

Precautions for Safe Handling: Ensure containers are kept closed until using product. Avoid skin and eye contact and breathing vapour. When opening the container and preparing spray, wear cotton overalls buttoned to the neck and wrist (or equivalent clothing), elbow length nitrile gloves and face shield or goggles. When using the prepared spray, wear cotton overalls buttoned to the neck and wrist (or equivalent clothing) and elbow length nitrile gloves.

Conditions for Safe Storage: DO NOT store near (or allow to contact) fertilizers, fungicides or pesticides. Store in the closed original container, in a cool well ventilated area, out of direct sunlight. Store in a locked room or place away from children, animals, food, feed stuffs, seed and fertilizers. Do not store near sources of ignition or naked flames.

This product is classified as a C1 (Combustible Liquid) for the purpose of storage and handling, in accordance with the requirements of AS 1940. Refer to state regulations for storage and transport requirements.

Product Name:	Biflex Ultra-Lo-Odour Termiticide & Insecticide	Page 3 of Total 6 Issued: July 2007 FMC/BIFUL/2

SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

National Exposure Standards:
No exposure standard for bifenthrin has been established by NOHSC Australia.

Biological Limit Values:
No biological limit allocated.

Engineering controls:
Use in well ventilated area only. Use local exhaust at all process locations where spray may be emitted. Ventilate all transport vehicles prior to unloading. Keep containers close when not in use.

Personal Protective equipment (PPE):
Work Clothing: Wear cotton overalls buttoned to the neck and wrist and a washable hat, elbow-length PVC gloves and face shield or goggles.

Eye Protection: When using product, wear chemical protective goggles or face shield.

Respiratory Protection: If inhalation risk exists, wear a properly fitted half-face or full-face air-purifying respirator which is approved for pesticides (Australian Standards).

Gloves: Wear chemical protective gloves made of materials such as nitrile, Viton® brand or PVC when handling this product. Inspect regularly for leaks. Wash the outside of gloves with soap and water prior to removal.

Personal Hygiene: Clean water should be available for washing in case of eye or skin contamination. Wash skin before eating, drinking or smoking. Shower at the end of the workday.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Clear straw to golden yellow liquid.
Odour:	Aromatic hydrocarbon odour.
Boiling point:	Not available.
Freezing point:	Not available.
Specific Gravity:	0.88 g/mL.
pH:	Not available.
Solubility in Water:	Product emulsifies in water.
Flammability:	Combustible liquid (C1).
Corrosive hazard:	Non corrosive; compatible with stainless steel containers & polyethylene used in spray tanks and parts.
Flashpoint (°C) :	68°C.
Flammability Limits (%):	Not established.
Poisons Schedule:	Product is a schedule 6 poison.

SECTION 10 STABILITY AND REACTIVITY

Product is considered stable in ambient conditions for a period of at least 2 years after manufacture.

SECTION 11 TOXICOLOGICAL INFORMATION

Potential Health Effects:
Studies with laboratory animals have shown this product to be harmful if swallowed. Ingestion of large doses of bifenthrin by laboratory animals produced signs of toxicity which included clonic convulsions, tremors and bloody nasal discharge. Irritating to eyes and respiratory system.

This formulation also contains liquid hydrocarbons. Harmful: May cause lung damage if swallowed. Inhalation of liquid hydrocarbon vapours may cause central nervous system

depression, dizziness, disturbances in vision and respiratory irritation. Moderately irritating to the eyes. Contact with the skin may be irritating. Dermal sensitisation may occur.

Acute

Swallowed: This product is harmful if swallowed; the acute oral LD_{50} (rat) = 531 mg/kg.

Eye: Moderately irritating to the washed eye and severely irritating to the unwashed eye. Product can be absorbed through the eyes.

Skin: This product has a low dermal toxicity. The dermal LD_{50} (rabbit) > 2000 mg/kg. Skin sensitising may occur in sensitive individuals. Skin contact may result in irritation with a degreasing action on the skin. Repeated or prolonged skin contact may lead to irritant contact dermatitis.

Inhaled: This product is harmful if inhaled. Inhalation of liquid hydrocarbon vapours may cause dizziness, disturbances in vision and irritation to the eyes, skin and mucous membrane of the respiratory and gastrointestinal tracts. Acute inhalation LC_{50} = 4.9 mg/L/4 hour

Chronic: No data available on this formulation. In studies with laboratory animals, Bifenthrin Technical did not cause teratogenicity or reproductive toxicity. Tremors were associated with repeated exposure of dogs, rats, rabbits and mice to Bifenthrin. The overall results from a battery of genotoxicity studies indicate that Bifenthrin is not considered to be genotoxic. Ames test results were negative. Kidney and liver damage is possible from over-exposure to liquid hydrocarbons over long periods. Additionally, some reversible haematopoietic depression has been observed in animals with extended exposure to liquid hydrocarbons.

SECTION 12 ECOLOGICAL INFORMATION

Environmental Toxicology: The active ingredient, Bifenthrin, is highly toxic to fish and aquatic arthropods with LC_{50} values ranging from 0.0038 µg/L to 17.8 µg/L. In general, the aquatic arthropods are the most sensitive species. Care should be taken to avoid contamination of the aquatic environment. Bifenthrin had no effect on molluscs at its limit of water solubility. Bifenthrin is only slightly toxic to both waterfowl and upland game birds with LC_{50} values range from 1800 mg/kg to > 2,150 mg/kg. Do not contaminate sewers, drains, dams, creeks or any other waterways with product or the used container.

Environmental Properties: The active ingredient, Bifenthrin, degrades at a moderate rate in agricultural soils (t½ = 50 to 205 days), and more rapidly on the surface of bare soils (t½ = 7 to 62 days). Bifenthrin is tightly bound in most soils and has extremely low water solubility.

SECTION 13 DISPOSAL CONSIDERATIONS

Spills & Disposal: In the case of spillage, contain and absorb spilled material with absorbent material such as sand, clay or cat litter and dispose of waste as indicated below or according to the Australian Standard 2507 - Storage and Handling of Pesticides. Wear prescribed protective clothing and equipment. Keep out animals and unprotected persons. Keep material out of streams and sewers. Vacuum, shovel or pump waste into an approved drum. To decontaminate spill area, tools and equipment, wash with a suitable solution (i.e. organic solvent, detergent, bleach or caustic soda) and add the solution to the drums of waste already collected. Label for contents. Dispose of drummed wastes, including decontamination solution, in accordance with the requirements of Local or State Waste Management Authorities.

Do not cut or weld metal containers. Vapours that form inside may create an explosion hazard.

Dangerous to Fish: Do NOT allow spilled product or wash solution to enter sewers, drains, dams, creeks or any other waterways.

Disposal of empty, non-returnable containers: Triple or preferably pressure rinse containers before disposal. Add rinsings to spray tank. Do not dispose of undiluted chemicals on-site. If recycling, replace cap and return containers to recycler or designated collection point. If not recycling, break, crush or puncture and bury empty containers in a local authority landfill. If not available bury the containers below 500 mm in a disposal pit specifically marked and set up for this purpose clear of waterways, vegetation and roots. Empty containers and product should not be burnt.

Returnable and refillable containers: Empty containers fully into application equipment. Close all valves and return to point of supply for refill or storage. Do not burn empty containers or product.

SECTION 14 TRANSPORT INFORMATION

Road & Rail Transport: Biflex Ultra-Lo-Odour is not classified as a Dangerous Goods under the Australian Code for the Transport of Dangerous Goods by Road and Rail. Product is a C1 combustible liquid for storage purposes.

Marine and Air Transport: Product is a Marine Pollutant according to International Maritime Dangerous Goods (IMDG) Code and the International Air Transport Association (IATA). If transporting by sea or air the following Dangerous Goods Classification applies:-
UN 3082, Class 9 (Miscellaneous Dangerous Goods), Packing Group III, Proper Shipping Name ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S. (Contains 10% Bifenthrin).

SECTION 15 REGULATORY INFORMATION

Classified as a hazardous substance according to criteria of NOHSC Australia. (Xi, Xn).
Under the Standard for Uniform Scheduling of Drugs and Poisons (SUSDP No. 19), this product is a schedule 6 poison.
This product is registered under the Agricultural and Veterinary Chemicals Code Act 1994. Product Registration No. 59269.
Product is not classified as a Dangerous Good according to the ADG Code (6th Ed).
Product is classified as a Dangerous Good according to International Maritime Dangerous Goods (IMDG) Code and the International Air Transport Association (IATA).

SECTION 16 OTHER INFORMATION

Issue Date: 23 July 2007 (Second issue, due to typographical error)
Key to abbreviations and acronyms used in this MSDS:

Genotoxic	Capable of causing damage to genetic material, such as DNA.
Oedema	Accumulation of fluid in tissues.
ADG Code	Australian Dangerous Goods Code (for the transport of dangerous goods by Road and Rail).
NOHSC	National Occupational Health and Safety Commission.
PPE	Personal protective equipment.

References

1. "National Exposure Standards for Atmospheric Contaminants in the Occupational Environment". NOHSC Australia, Guidance Note NOHSC:3008(1995).
2. "List of Designated Hazardous Substances". NOHSC Australia. NOHSC:10005(1999).

Product Name:	Biflex Ultra-Lo-Odour Termiticide & Insecticide	Page 6 of Total 6 Issued: July 2007 FMC/BIFUL/2

3. "Draft Approved Criteria for Classifying Hazardous Substances" 3rd Ed. NOHSC Australia. [NOHSC:1008 (2003)]. April 2003.

This MSDS summarises our best knowledge of the health and safety hazard information of the product and how to safely handle and use the product in the workplace. Each user should read this MSDS and consider the information in the context of how the product will be handled and used in the workplace including in conjunction with other products.

If clarification or further information is needed to ensure that an appropriate risk assessment can be made, the user should contact this company.

ENVIRONMENTAL HEALTH PRODUCTS
PO Box 100287, NSMC, Auckland, New Zealand
Ph: (09) 440 9994 Fax: (09) 443 5083

Material Safety Data Sheet

Date of Issue: 24 September 2004 Page 01of 01

PRODUCT NAME:	**Exterm-An-Ant**
NB:	To be read in conjunction with the label.
REGISTER MAF No.	5100
USE:	Toxicant formulation for killing ants
APPEARANCE:	Odourless Green Liquid
HEALTH EFFECTS:	No adverse health effects expected if the product is handled in accordance with the safety data sheet and the product label. Acute effects if the product is mishandled. This product may be harmful if swallowed and can result in nausea, vomiting and diarrhoea. **EYES:** May be an eye irritant. **SKIN:** Extended contact with skin may result in mild irritation. It is unlikely that harmful quantities can be absorbed.
FIRST AID:	**IF SWALLOWED:** Immediately rinse mouth with water, give plenty of water to drink. Induce vomiting and seek medical advice. **EYES:** Irrigate with copious quantities of water for 15 minutes. Seek medical advice. **SKINS:** Wash contaminated skin with plenty of soap and water. If irritation occurs seek medical advice.
ADVICE TO DOCTOR:	Treat symptomatically and as for exposure to boron compounds.
TOXICITY:	Oral lowest lethal dose. Child nausea, vomiting, 5gm/kg. Dermal lowest lethal dose. Child Conductive Irritation, respiratory depression, hypermotility Skin Mild Irritant. No evidence of carcinogenicity.
EXPOSURE STANDARDS:	No value assigned for this product by the N.Z.OSH.
ENGINEERING CONTROLS:	Keep container closed when not in use and store away from children.
PERSONAL PROTECTION:	Always wash hands before smoking, eating, drinking or using the toilet.
FLAMMABILITY	Non combustive material.
STORAGE AND TRANSPORT:	Not defined as a dangerous good. As this product contains an ingredient described as a toxicant with a scheduled poison (S4) rating it should be stored, maintained and used in accordance with the label. Not defined as a Hazardous substance by the New Zealand Code of Practice for the Transport of Hazardous substances on land.
DISPOSAL:	Dispose of used baits and empty container safely in accordance with label.
NOTE: This MSDS summaries at the date of issue our best knowledge of the health and safety hazard information of the product, and in particular how to safely handle and use the product.	

MATERIAL SAFETY DATA SHEET
Maxforce® GB Granular Ant Bait

Date of Issue: September 15th, 2006

1. IDENTIFICATION OF THE SUBSTANCE / MIXTURE AND SUPPLIER

Product name:	**Maxforce® GB Granular Ant Bait**
Other names:	None
Product code:	5990660 (907 g)
Chemical group:	Hydrazide
Recommended use:	A granular bait insecticide for control of fire ants and other ants in a variety of situations
Formulation:	Granular bait
Supplier:	Bayer Environmental Science – A Business Group of Bayer CropScience Pty Ltd ABN 87 000 226 022
Address:	391 - 393 Tooronga Road, East Hawthorn Victoria 3123, Australia
Telephone:	(03) 9248 6888
Facsimile:	(03) 9248 6800
Website:	www.bayercropscience.com.au
Contact:	Technical Manager (03) 9248 6888
Emergency Telephone Number:	1800 033 111 – Orica SH&E Shared Services

2. HAZARDS IDENTIFICATION

NON-HAZARDOUS SUBSTANCE - NON-DANGEROUS GOOD
Not flammable.

Hazard designation:	Non-hazardous (National Occupational Health and Safety Commission - NOHSC)
Risk phrases:	Not applicable
Safety phrases:	See sections 4, 5, 6, 7, 8, 9, 13
ADG classification:	This product is not classified as a Dangerous Good under the Australian Code for the Transport of Dangerous Goods by Road and Rail.
SUSDP classification:	Schedule 6 (Standard for the Uniform Scheduling of Drugs and Poisons)

3. COMPOSITION / INFORMATION ON INGREDIENTS

Ingredients:	CAS Number:	Concentration (g/kg):
Hydramethylnon	[67485-29-4]	10
Other ingredients	(non hazardous)	990

MATERIAL SAFETY DATA SHEET

Maxforce® GB Granular Ant Bait

Date of Issue: September 15th, 2006

4. FIRST AID MEASURES

If poisoning occurs, immediately contact a doctor or Poisons Information Centre (telephone 13 11 26), and follow the advice given. Show this Material Safety Data Sheet to a doctor.

Inhalation:	No first aid measures are normally required. However if dust has been inhaled and irritation has developed remove patient to fresh air and observe until recovered. If irritation persists or becomes painful seek medical advice.
Skin contact:	If product gets on skin wash affected areas with plenty of soap and water. Seek medical advice if irritation occurs.
Eye contact:	If product gets in eyes wash eyes with copious quantities of water to remove material. Seek medical assistance if irritation occurs.
Ingestion:	If swallowed, immediately contact a doctor or Poisons Information Centre (telephone: 13 11 26) and follow the advice given. Keep under medical supervision.
First Aid Facilities:	Ensure washing facilities are available.
Symptoms:	No human poisoning cases have been reported. After high doses in animal experiments nasal secretion, lacrimation, lethargy and diarrhoea have been observed.
Medical attention:	Gastric lavage does not seem to be mandatory in regard of the low toxicity of the compound. However, the application of activated charcoal and sodium sulphate is always advisable in significant ingestions. As there is no antidote, treatment has to be symptomatic and supportive.

5. FIRE FIGHTING MEASURES

Extinguishing media:	Extinguish fire using: Carbon dioxide, Dry agent, Water spray, Foam
Hazards from combustion products:	In the event of fire, hydrogen fluoride, oxides of carbon and nitrogen may be released.
Precautions for fire fighters:	Firefighters should wear full protective gear, including self-contained breathing apparatus (AS/NZS 1715/1716). If possible and without risk, remove intact containers from exposure to fire. Otherwise, spray unopened containers with water to keep cool. Contain fire-fighting water by bunding area with sand or earth to prevent it entering any bodies of water. Dispose of extinguishing agent and spillage safely later. Contamination of water bodies should be avoided.

MATERIAL SAFETY DATA SHEET

Maxforce® GB Granular Ant Bait

Date of Issue: September 15th, 2006

6. ACCIDENTAL RELEASE MEASURES

Dealing with spills and disposals may result in the potential for increased personal exposure. Protective clothing and equipment as described in the PERSONAL PROTECTION section should be worn. Avoid contact with spilled material or contaminated surfaces. Contain spill, sweep up or shovel and place in properly labelled sealed drums for safe disposal. Prevent spillage from entering drains and water courses. Deal with all spillages immediately. If contamination of drains, streams, watercourses etc. is unavoidable, warn the local water authority. After spill wash area, preventing run-off from entering drains.

7. HANDLING AND STORAGE

Handling: Keep out of reach of children. Avoid contact with eyes, skin and clothing. Wear long sleeved overalls and gloves while handling. After handling and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water.

Storage: Store in the closed original container in a cool, well ventilated, locked place out of the reach of children. Do not store in direct sunlight.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure standards: No occupational exposure standards have been established for the product or its ingredients. A blanket limit of 10 mg/m^3 for dusts and mists has been established when limits are not otherwise specified.

Engineering controls: Control process conditions to avoid contact.

Personal Protective Equipment:

Eyes: Not normally required. Avoid touching eyes while handling product.

Clothing: Protective clothing is not normally required with this product but it is recommended to wear full-length work clothes as good practice.

Gloves: Wear waterproof gloves when handling product.

Respiratory: Not normally required.

Other: Wear appropriate foot-wear for the situation in which the product is applied.

MATERIAL SAFETY DATA SHEET

Maxforce® GB Granular Ant Bait

Date of Issue: September 15th, 2006

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Off-white to brown granulated solid.
Odour:	Characteristic odour.
Vapour pressure:	Not applicable
Vapour density:	Not available
Boiling point:	Not available
Freezing/melting point:	Decomposes before melting.
Solubility:	Insoluble
Density:	Not applicable
Molecular weight:	494.5 (Hydramethylnon)
pH:	Not available
Flash Point:	Not flammable
Flammability (explosive) limits:	Not available
Auto-ignition temperature:	Not available
Octanol/water partition coefficient:	Not available
Formulation:	Granular bait

10. STABILITY AND REACTIVITY

Chemical stability:	Stable under normal conditions of use. No dangerous reaction known under normal conditions.
Hazardous polymerisation:	None
Conditions to avoid:	Extreme heat and fire
Incompatible materials:	None known
Hazardous decomposition products:	In the event of fire, hydrogen fluoride, oxides of carbon and nitrogen may be released.

MATERIAL SAFETY DATA SHEET
Maxforce® GB Granular Ant Bait

Date of Issue: September 15th, 2006

11. TOXICOLOGICAL INFORMATION

POTENTIAL HEALTH EFFECTS

Inhalation: The presentation as a granular bait makes inhalation unlikely. Minor irritation from inhalation of dust (if present) may occur.

Skin contact: No symptoms are to be expected through skin contact with this product

Eye contact: May cause irritation of the eye.

Ingestion: The product exhibits low toxicity by the oral route.

Other: None

ANIMAL TOXICITY DATA - PRODUCT (OR ACTIVE IF INDICATED):

Acute:

Oral toxicity: LD_{50} rat: >5000 mg/kg

Dermal toxicity: LD_{50} rabbit: >2000 mg/kg

Inhalation toxicity: LC_{50} (4 h) rat: > 5 mg/L (hydramethylnon)

Skin irritation: Not irritating (hydramethylnon)

Eye irritation: May cause reversible irritation (hydramethylnon)

Sensitisation: Non-sensitising (hydramethylnon)

Chronic:

In two year feeding studies with hydramethylnon in rats the No Observable Effect Level was 50 mg/kg diet. Hydramethylnon is not mutagenic and not teratogenic.

12. ECOLOGICAL INFORMATION

Fish toxicity: Hydramethylnon: LC_{50}: 1.70 mg/L (96 h) bluegill sunfish
Hydramethylnon: LC_{50} 0.16 mg/L (96 hr) rainbow trout

Daphnia toxicity: Hydramethylnon: LC_{50}: 1.14 mg/L. (48 h) Daphnia magna.

Toxicity to algae: Not available

Bird toxicity: Hydramethylnon: LD_{50}: >2510 mg/kg mallard ducks
Hydramethylnon: LD_{50}: 1828 mg/kg bobwhite quail

Bee toxicity: Hydramethylnon dust is non-toxic topically to honeybees at 0.03 mg/bee

Environmental fate, persistence and degradation: Hydramethylnon has low solubility in water and is rapidly degraded in sunlight.

MATERIAL SAFETY DATA SHEET

Maxforce® GB Granular Ant Bait

Date of Issue: September 15th, 2006

13. DISPOSAL CONSIDERATIONS

Dispose of empty container by wrapping in paper, placing in plastic bag and putting in the garbage. DO NOT burn empty containers or product.

14. TRANSPORT INFORMATION

UN number:	Not applicable
Proper shipping name:	Not applicable
Class and Subsidiary Risk:	This product is not classified as a Dangerous Good under the Australian Code for the Transport of Dangerous Goods by Road and Rail.
Packing Group:	Not applicable
EPG:	Not applicable
Hazchem code:	Not applicable
Marine pollutant:	No

15. REGULATORY INFORMATION

Registered according to the Agricultural and Veterinary Chemicals Act 1988

Australian Pesticides and Veterinary Medicines Authority Approval number: 54361

16. OTHER INFORMATION

Trademark information:	Maxforce® is a Registered Trademark of Bayer
Preparation information:	Replaces November 10, 2003 edition. Reasons for update: First aid measures, Firefighting measures, Accidental release measures, Hazardous decomposition products.
Data sources:	Bayer CropScience internal technical information and BCPC Pesticides Manual.

This MSDS summarises our best knowledge of the health and safety hazard information of the product and how to safely handle and use the product in the workplace. Each user should read this MSDS and consider the information in the context of how the product will be handled and used in the workplace including in conjunction with other products.

If clarification or further information is needed to ensure that an appropriate risk assessment can be made, the user should contact this company.

Our responsibility for products sold is subject to our standard terms and conditions, a copy of which is sent to our customers and is also available on request.

END OF MSDS

MATERIAL SAFETY DATA SHEET

Bayer CropScience

Date of Issue: September 10, 2007

1. IDENTIFICATION OF MATERIAL AND SUPPLIER

Product name	**Mesurol® Snail and Slug Bait**
Other names	None
Product code and pack sizes	4953559 (10 kg) 4953575 (150 kg)
Chemical group	Carbamate
Recommended use	Molluscicide
Formulation	Ready to use bait (RB)
Supplier	Bayer Crop Science Pty Ltd ABN 87 000 226 022
Address	391 - 393 Tooronga Road, East Hawthorn Victoria 3123, Australia
Telephone	(03) 9248 6888
Facsimile	(03) 9248 6800
Website	www.bayercropscience.com.au
Contact	Development Manager (03) 9248 6888
Emergency Telephone Number	1800 033 111 – Orica SH&E Shared Services

2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

HAZARDOUS SUBSTANCE (see Risk phrases below) – NON DANGEROUS GOOD (road/rail)
Cholinesterase inhibitor. Very Toxic to aquatic organisms. Dangerous to domestic animals and wildlife.

Hazard classification	Hazardous (National Occupational Health and Safety Commission - NOHSC)
Risk phrases	R22 – Harmful if swallowed.
Safety phrases	See Sections 4, 5, 6, 7, 8, 9, 13
ADG classification	Not "Dangerous goods" for transport by road or rail according to the Australian Code for the Transport of Dangerous Goods by Road and Rail. For transport by sea this product is a Class 9, Marine Pollutant – See Section 14.
SUSDP classification (Poisons Schedule)	Schedule 5 (Standard for the Uniform Scheduling of Drugs and Poisons)

3. COMPOSITION / INFORMATION ON INGREDIENTS

Ingredients	CAS Number	Concentration (g/kg)
Methiocarb (mercaptodimetur)	[2032-65-7]	20
Calcium sulphate	[7778-18-9	75
Butylated hydroxy toluene	[128-37-0]	2
Other ingredients, non hazardous	---	903

This product contains BITREX™ which is a deterrent designed to prevent animals eating the bait pellets.

MATERIAL SAFETY DATA SHEET

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4. FIRST AID MEASURES

If poisoning occurs, immediately contact a doctor or Poisons Information Centre (telephone 13 11 26), and follow the advice given. Show this Material Safety Data Sheet to the doctor.

Inhalation — If inhaled, remove to fresh air and keep at rest. Obtain medical advice. If breathing stops or shows signs of failing, start artificial respiration. If advised by doctor or Poisons Information Centre, atropine tablets may be administered.

Skin contact — Immediately remove contaminated clothing. Wash skin with soap and water. Seek medical attention if irritation develops or persists. If signs of poisoning occur get medical attention immediately. Persons assisting the patient should protect themselves from contamination. If advised by doctor or Poisons Information Centre, atropine tablets may be administered.

Eye contact — Rinse eyes immediately with clean water for at least 15 minutes and obtain medical aid, preferably from an eye specialist.

Ingestion — Wash out mouth with water. Keep patient at rest and seek urgent medical advice as above. Transport patient to doctor or hospital quickly. If advised by doctor or Poisons Information Centre, atropine tablets may be administered.
DO NOT attempt to give anything by mouth to a semi-conscious or unconscious person.

First Aid Facilities — Provide eyewash and safety shower facilities in the workplace.
Obtain an emergency supply of atropine tablets 0.6 mg.

Medical attention — Mesurol Snail and Slug Bait contains methiocarb, which is a carbamate insecticide, and as such it is a cholinesterase inhibitor.

Symptoms of poisoning

Mild intoxication causes headache, blurred vision, weakness, sweating, mild chest pain, nausea and vomiting. Severe intoxication causes cyanosis, muscular twitching, spasms, miosis and respiratory paralysis.
Onset of symptoms may be delayed. Cholinesterase inhibition sometimes persists for several weeks.

Treatment

Basic aid, decontamination, symptomatic treatment and if necessary administration of antidote.
Antidote: Atropine sulphate. Atropine should not be given to a cyanosed patient.
Oximes are contraindicated. Monitor respiratory, cardiac and central nervous system functions. Monitor red blood cell and plasma cholinesterase levels. Administer oxygen if necessary. Watch for pulmonary oedema and delayed neurological symptoms.

Contraindications

Adrenergic derivatives. Never give patient morphine, theophylline or theophylline-ethylenediamine. Large amounts of intravenous fluids are generally contraindicated because of the threat of pulmonary oedema.

Veterinary — Dogs find this bait attractive and if ingested it may kill them. If a dog eats pellets take it to a veterinarian immediately. Do not give dogs Ipecac Syrup.

MATERIAL SAFETY DATA SHEET

Bayer CropScience

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5. FIRE FIGHTING MEASURES

Extinguishing media	Waterspray, foam, dry chemical, carbon dioxide, sand.
Hazards from combustion products	In a fire, hydrogen cyanide, carbon monoxide, methyl isocyanate, sulphur dioxide and nitrogen oxides may be formed.
Precautions for fire fighters	Fire fighters should wear full protective gear, including self-contained breathing apparatus (AS/NZS 1715/1716). Keep unnecessary people away and move all other personnel to windward side of fire. Bund area with sand or earth to prevent contamination of drains or waterways. Dispose of fire control water or other extinguishing agent and spillage safely later.
Hazchem code	Not applicable

6. ACCIDENTAL RELEASE MEASURES

Avoid contact with the spilled material or contaminated surfaces. Do not smoke, eat or drink during the cleanup process. Personnel involved in cleanup should wear protective clothing and equipment as described in Section 8 – PERSONAL PROTECTION. Keep people and animals away. Prevent spilled material from entering drains or watercourses. Contain spill and sweep up carefully. Avoid creating dust. Collect and store in recovery drums. Clean floor with a damp cloth and place it in the recovery drum. Seal and label drums for safe disposal. Deal with all spillages immediately. If contamination of drains, streams, watercourses, etc. is unavoidable, warn the local water authority.

7. HANDLING AND STORAGE

Handling	Keep out of reach of children. Product is poisonous if swallowed. Avoid contact with eyes and skin. If product on skin immediately wash area with soap and water. After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water. After filling applicator, clean up spilled pellets so that they are not eaten by animals and birds.
Storage	Store in the closed, original container in a dry, cool, well-ventilated, secure area out of direct sunlight. Lock in a safe place preventing access of children, animals, poultry or ducks. Keep away from domestic pets.
Flammability	Not readily combustible.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure standards	There is no NOHSC Exposure standard for methiocarb. The National Occupational Health and Safety Commission (NOHSC) exposure standards: TWA calcium sulphate: 10 mg/m³ (as inspirable dust) TWA butylated hydroxy toluene: 10 mg/m³. Definitions: *Exposure standard – Time Weighted Average (TWA)* means the average airborne concentration of a particular substance when calculated over a normal eight-hour working day, for a five-day working week.

MATERIAL SAFETY DATA SHEET

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8. EXPOSURE CONTROLS / PERSONAL PROTECTION - continued

Biological limit values	None allocated. However, monitoring of manufacturing workers for blood cholinesterase levels is recommended.
Engineering controls	Control process conditions to avoid contact. Use local exhaust ventilation during manufacture. Use this product in a well-ventilated area only.
Personal Protective Equipment	Product is poisonous if absorbed by skin contact, inhaled or swallowed. • During manufacture a respirator or hood with an independent air supply should be worn. If dust is formed in handling the bait pellets, a disposable dust mask should be worn. • Wear goggles. • Wear cotton overalls buttoned to the neck and wrist. • Wear elbow-length PVC gloves if there is a possibility of skin contact.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Blue pellets
Odour:	Weak characteristic
pH:	5.5 to 6.5 (10% in water)
Vapour pressure:	0.015 mPa at 20° C (methiocarb)
Vapour density:	Not available
Boiling point:	Not applicable
Freezing/melting point:	119° C (methiocarb)
Solubility:	The bait pellets swell in water. Methiocarb is practically insoluble in water.
Bulk Density:	164 (loose) / 148 (packed) mL/100 g
Flash Point:	Not applicable
Flammability (explosive) limits:	Not available
Auto-ignition temperature:	Not available
Partition coefficient (octanol/water):	Methiocarb: Log P_{ow} = 3.08 at 20° C

10. STABILITY AND REACTIVITY

Chemical stability	Stable under normal conditions of use. Unstable in highly alkaline media.
Conditions to avoid	Extreme heat, moisture
Incompatible materials	Oxidising agents, alkalis
Hazardous decomposition products	In a fire, hydrogen cyanide, carbon monoxide, methyl isocyanate, sulphur dioxide and nitrogen oxides may be formed.
Hazardous reactions	None known

MATERIAL SAFETY DATA SHEET

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11. TOXICOLOGICAL INFORMATION

POTENTIAL HEALTH EFFECTS

Methiocarb, the active ingredient in Mesurol Snail and Slug Bait, is a carbamate pesticide which is a cholinesterase inhibitor. Symptoms typical of cholinesterase inhibition (for all routes of entry):

Mild cases

Headache, blurred vision, weakness, sweating, mild chest pain, nausea and vomiting.

Severe cases

Cyanosis (blueness of the skin, as from lack of oxygen), muscular twitching, spasms, miosis (pinpoint pupils) and respiratory paralysis. These symptoms commence from one to three hours after excessive exposure.

Dogs find this bait attractive and if ingested it may kill them.

Inhalation	Methiocarb is very poisonous by inhalation. Inhalation of the bait pellets containing 2% methiocarb is unlikely, unless dust is created.
Skin contact	Poisonous if absorbed by skin contact, but this route of exposure is unlikely. Not expected to irritate the skin.
Eye contact	May irritate the eyes.
Ingestion	Harmful if swallowed.

ANIMAL TOXICITY DATA - *PRODUCT*

Acute:

Oral toxicity	LD_{50} rat: > 500 to < 1000 mg/kg
Dermal toxicity	LD_{50} rat: > 2000 mg/kg
Inhalation toxicity	LC_{50} (4 h) rat: > 0.224 mg/L – *dustable powder – highest producible concentration*
Skin irritation	Non irritant (rabbit)
Irritation to mucous membranes	Non irritant (rabbit)
Sensitisation	Not a skin sensitiser.

Chronic:

The main health effects from repeated exposure would be toxic symptoms of cholinesterase inhibition as described above. Methiocarb showed no evidence of oncogenic or carcinogenic potential in animal studies. Methiocarb is not mutagenic, and has shown no teratogenic effects in animal studies. It does not cause delayed neurotoxicity. In the USA methiocarb is considered to be a developmental toxicant.

12. ECOLOGICAL INFORMATION

Very toxic to aquatic organisms. This product is dangerous to game, wild birds and animals. Methiocarb has a repellent effect on birds. DO NOT contaminate streams, rivers or waterways with Mesurol Snail and Slug Bait or the used containers.

MATERIAL SAFETY DATA SHEET

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12. ECOLOGICAL INFORMATION - continued

Ecotoxicity

Methiocarb:
Fish toxicity:
LC_{50}: 0.65 mg/L (96 h); bluegill sunfish (*Lepomis macrochirus*)
LC_{50}: 1.1 mg/L (96 h); trout (*Oncorhynchus mykiss*)
Aquatic invertebrate toxicity:
EC_{50}: 7.7 µg/L (48 h); waterflea (*Daphnia magna*)
Algae toxicity:
Growth rate:
IC_{50}: 2.2 mg/L (72 h); green algae (*Scenedesmus subspicatus*)
Bird toxicity:
LD_{50}: 5 to 10 mg/kg; Japanese quail
LD_{50}: 7.1 to 9.4 mg/kg; male mallard ducks

Environmental fate, persistence, degradability, mobility

Degradation of methiocarb in soil is rapid. Photodegradation contributes to the overall elimination of methiocarb from the environment - DT_{50} = 6 to 16 days.

13. DISPOSAL CONSIDERATIONS

Ensure plastic bag is completely empty before disposal. Puncture and bury empty bag in a local authority landfill. If no landfill is available, bury the bag below 500 mm in a disposal pit specifically marked and set up for this purpose clear of waterways, desirable vegetation and tree roots. Empty bags and product should not be burnt. Dispose of waste product via a reputable disposal contractor to an approved landfill. Do not discharge into drains or sewers.

14. TRANSPORT INFORMATION

UN number	Not applicable (road/rail)
Proper shipping name	Not applicable (road/rail)
Class and Subsidiary Risk	Not applicable (road/rail)
Packing Group	Not applicable (road/rail)
EPG	Not applicable (road/rail)
Hazchem code	Not applicable (road/rail)
Marine Pollutant	Yes. If Mesurol Bait is shipped by sea, it is classified as a Class 9, ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (contains methiocarb), Packing Group III, UN 3077, Hazchem 2Z, Marine Pollutant.

15. REGULATORY INFORMATION

Registered according to the Agricultural and Veterinary Chemicals Act 1988
Australian Pesticides and Veterinary Medicines Authority approval number: 33274

See also Section 2.

MATERIAL SAFETY DATA SHEET

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Bayer CropScience

16. OTHER INFORMATION

Trademark infomation Mesurol®is a Registered Trademark of Bayer.

Preparation infomation Replaces December 8, 2003 MSDS.
Reasons for revision : marine pollutant, ecological information and exposure standard added for butylated hydroxyl toluene.

This MSDS summarises our best knowledge of the health and safety hazard information of the product and how to safely handle and use the product in the workplace. Each user should read this MSDS and consider the information in the context of how the product will be handled and used in the workplace including in conjunction with other products.

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Our responsibility for products sold is subject to our standard terms and conditions, a copy of which is sent to our customers and is also available on request.

END OF MSDS

This EIA is presently in Final Draft status, awaiting approval by GoV. Formal GoV approval is anticipated shortly.