LAND INFORMATION NEW ZEALAND (LINZ)

PACIFIC REGIONAL HYDROGRAPHY PROGRAMME - HYDROGRAPHIC RISK ASSESSMENT - VANUATU

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MARICO MARINE NZ LIMITED

Land Information New Zealand (LINZ)

Pacific Regional Hydrography Programme - Hydrographic Risk Assessment - Vanuatu

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Satellite AIS data (S-AIS) provided by exactEarth under licence

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EXECUTIVE SUMMARY

This hydrographic risk assessment allows the Vanuatu Government, with the support of regional charting authorities, to come to a conclusion about the nature and scope of chart improvement surveys in Vanuatu. It provides recommendations and conclusions to assist decision makers to prioritise hydrographic surveys in Vanuatu for the provision of accurate and adequate nautical charts to meet the needs of contemporary shipping.

The overall conclusion, based on evidence of economic growth, as well as vessel transit risk, is a need for improved charting. The findings are supported on grounds of traffic risk and of positive economic growth in Vanuatu. The economic case for hydrographic risk is made on cruise-vessels alone, but notes there is also transit risk associated with domestic coastal cargo vessels.

THE HYDROGRAPHIC RISK ASSESSMENT

The risk model identifies shipping routes at risk, in relation to traffic type, size and volume, when considered against a large number of consequence impact criteria. The model combines AIS datasets and non-AIS local trading routes, with known navigational hazards and areas of cultural/ environmental/economic value to produce a cumulative risk model. Potential environmental damage impacts feature strongly, such as the presence of corals or mangroves, world heritage sites, culturally important areas and the Vanuatu system of informal marine reserves.

In order to compare risk levels, the EEZ of Vanuatu was divided into cells of 20 kilometre squares. For there to be hydrographic risk there must be a combination of traffic, likelihood criteria and consequence criteria. The traffic type, size and volume thus influences the risk levels in each cell associated with each of the criteria. Domestic coastal vessel trades and volumes were added as an overlay, by using Gross Tonnage (GT) as a measure of capacity on a route. The resulting risk matrix is shown in **Figure 8-1**, **Page 117**.

The GIS based risk assessment methodology is attached in full at **Annex D,** with supporting traffic analysis at **Annex C**. **Annex D** outlines the 29 types of risk criteria overlays used to derive the risk result, with the scoring criteria for each.

DATA SOURCES ANALYSIS AND QUALITY

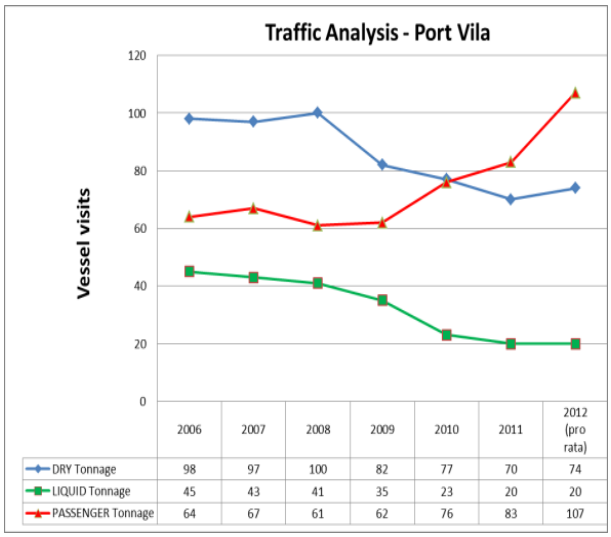
The risk approach is reliant on quality of input datasets. A number of sources were used with some augmentation. In particular, this was required for the satellite derived (S-AIS) data before it could be employed in the GIS modelling process. S-AIS data can only be received when an appropriate satellite is passing, which for Vanuatu is currently about every 8 hours.

The harbour masters of both Port Vila and Luganville provided a hard copy of port records for each international vessel visiting the ports. This data set was vital in providing the analysis of shipping trends, seasonality and size of vessels and was used to link S-AIS data to factual port calls. Vessels identified in port movement records that were not recorded in the AIS reception period could be manually routed-in, using known navigation patterns. Thus a database that incorporated factual port data with S-AIS data was created.

A similar approach was used for the Vanuatu islands, linking cruise vessel call schedules to S-AIS data.

PORT TRAFFIC ANALYSIS – ECONOMIC EXPANSION

More than 80,000 visitors travelled by air to Vanuatu in 2007, with 82,000 more by cruise ship. By 2011, this had risen to 93,824 by air and 147,500 by cruise ship. However, growth in cruise passenger numbers is such that it would challenge even a developed country to deliver the port and local infrastructure improvements needed to match the rate of cruise passenger expansion (57% in four years).



	2006	2007	2008	2009	2010	2011	2012 (pro rata)
DRY Tonnage	98	97	100	82	77	70	74
LIQUID Tonnage	45	43	41	35	23	20	20
PASSENGER Tonnage	64	67	61	62	76	83	107

The expansion is confirmed by analysis of the numbers of vessels using Port Vila, by ship type, 2006-2012; the red line is cruise vessels. There were 62 such vessel-calls in 2009, 76 in 2010, 83 in 2011, with 2012 showing over 100 cruise vessel-calls. Cruise vessel arrivals are set to increase further in the short to medium term and in 2013 Port Vila can boast two cruise vessel-calls a week.

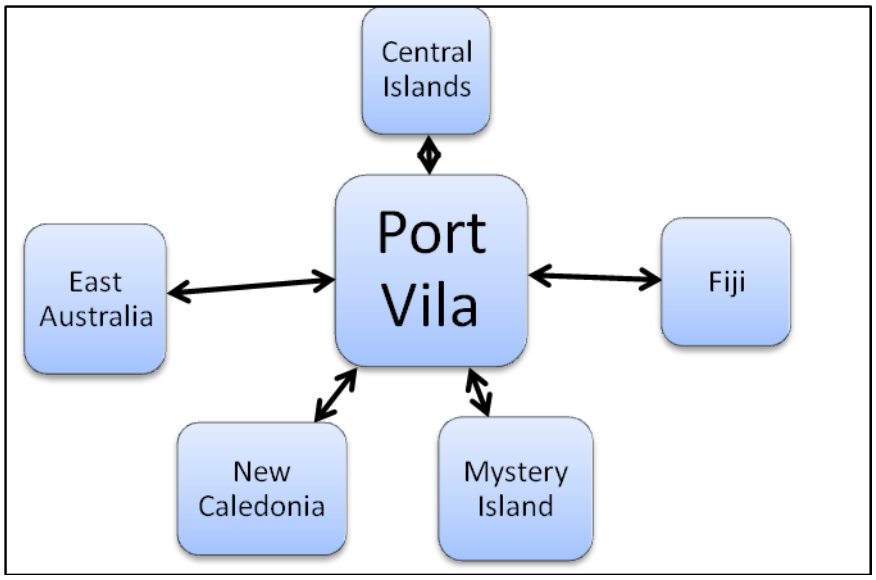
In addition, cruise vessels visiting Port Vila are becoming significantly larger. Over a four year period at Port Vila, a 34% increase in vessel numbers has

delivered a 57% increase in passenger numbers. Within five years, cruise ships visiting Vanuatu are likely to increase in size from the present 250m length and 70,000GT range to vessels of around 310m and 100,000GT, delivering up to 3,000 passengers to Port Vila in one day. These vessels additionally carry at least 900 crew.

The underlying expansion of cruise tourism is highlighted further if total vessel-calls to any Vanuatu location are considered. These have increased 171% in the four years 2009 to 2012.

THE IMPORTANCE OF PORT VILA

Port Vila and Luganville act as key nodes in vessel traffic in the archipelago. For domestic coastal vessels both ports are important, but Port Vila dominates the vessel traffic profile. It has five spokes:



Traffic Network Centred on Port Vila

In Luganville, the majority of the large vessel traffic transits south through the islands - only a third approximately transit to the north. Very little through traffic passes transits the Vanuatu islands; a small number of general cargo and fishing vessels pass between Ambrym and Pentecost. Occasional tankers transit east west through the waters of Torba Province.

No vessels were recorded transiting longitudinally north-south through Vanuatu without stopping at one of the ports.

Traffic analysis confirms that beyond Port Vila and Luganville, cruise-vessel stakeholders are almost the only harbour users of any size, reasonably assuming that the bay anchorages and jetties of the islands of Vanuatu can

be called harbours. For example, the island of Aneityum, (marketed as Mystery Island) enjoyed 43 cruise vessel calls in 2012.

Cruise ships are by far the largest vessels transiting the waters of Vanuatu and, as such, their contribution to transit risk is significant. The participation of cruise stakeholders in charting improvements is acknowledged and encouraged.

DOMESTIC COASTAL VESSELS

Inter-island domestic coastal shipping is the economic lifeline of Vanuatu with export goods being transported by domestic registered vessels from the outer islands to the two hub ports of Luganville and Port Vila. All imported goods are transported by the same means from the hub ports to the outer islands.

Data about the domestic fleet in terms of Gross Tonnage (i.e. vessel capacity) was obtained. Those on scheduled services and those available for charter were identified. This data provided surprise because of the licenced passenger capacity the domestic fleet possesses in relation to vessel size. This is significant and some general cargo coasters have greater licenced passenger capacity than one of the dedicated coastal passenger ferries. The domestic coastal vessels provide a cheap solution to interisland travel and are obviously the chosen (and probably most cost effective) means by which the Ni-Vanuatu population travel between their islands.

There are a large number of domestic wrecks around the archipelago caused by factors such as mechanical breakdown, poor quality fuel and cyclone damage. There is an obvious link between improving crew competence[1] to navigate safely and up to date charts of appropriate scale for a coastal route. Improved charts of appropriate scale also provide vital training material, as well as providing key reference material for the position of any vessel relative to hazards.

In risk terms, when a coastal vessel is lost in the SW Pacific, loss of life is likely and the potential loss of life arising out of such wrecks affects their risk contribution. Their contribution to pollution is low compared to the loss of a large SOLAS vessel. Both these factors were taken into account in the risk assessment, by use of a risk matrix scale based around the size of these vessels Gross Tonnage (GT) and relating size to passenger carrying capacity.

The island of Tanna enjoys a surprisingly large domestic coastal vessel service; this measured by the overall GT capacity scheduled on the route, with calls to Lénakel Wharf almost daily. There are also some of the largest domestic coastal vessels on this route, again measured by GT. The East

[1] Competence is a combination of training and experience.

Coast of Malakula is similarly busy, as are the central islands of Vanuatu. **Figures 5.4** and **5.5**, **pages 63** and **64**, show this clearly.

THE INFLUENCE OF THE GROWING COASTAL COPRA TRADE

The data gathering visit obtained similar advice from different provinces of a growth in copra production, with Penama Province reporting that scheduled domestic coastal vessels were often fully laden before leaving the coast, thus cutting short their schedule.

Indications are that in 2011, copra supplied for domestic oil production had increased more than production for direct export, evidenced by an 11% increase in copra received by oil producers from 2010 to the end of 2011. This suggests the biodiesel project (an aid funded project) is bearing fruit and oil produced by biodiesel mills is being used in the economy as opposed to being exported. During 2011 the value of coconut oil also increased by 4.6 per cent over 2010 in economic terms. This was important information for the hydrographic risk assessment as it independently confirmed the increase in domestic coastal shipping demand for copra movement.

Given that both copra and cocoa are shipped in bags of 50-60kg, freight cost from each province to Luganville or Port Vila was obtained (copra, cocoa and coffee). It was thus possible to estimate, in conservative terms, the value of the domestic coastal freight market. Revenue was about 150million Vatu (US$1.64 million) in 2012, equating to almost two million New Zealand dollars. The estimate excludes other earnings, such as passenger dues or delivery of supermarket stores and fuel. Although it needs to be treated with caution, it suggests that the domestic coastal market is capable of expansion.

REPORT CONCLUSIONS

The risk assessment results, by province, are shown pictorially in **Section 8**. Review is strongly recommended. The main report conclusions (**Section 9**) are represented in summary, by province, below.

1. The risk assessment outlines areas where charting should be upgraded to modern standards.
2. **Torba Province** experiences some heightened risk at Sola, Vanua Lava, with surrounding area of moderate risk. An underlying influence is vessels transiting through Vanuatu waters, including large tankers. This is combined with the presence of corals and mangroves as well as the environmental significance of Rowa Reef. The same risk influence occurs at Lorup Bay, Ureparapara. This destination is an

option for the larger cruise lines, but it is unlikely to eventuate before island groups to the north are established as cruise destinations.

3. In **Sanma Province**, the Luganville port area, Espiritu Santo, is an obvious candidate for survey, evincing significant risk. It has the uncertainty of its former use as a large, WW2 American base, with recommendations made to have this researched further. This port is of high economic value to Vanuatu. Heightened risk levels extend up the adjacent south east coastline of Espiritu Santo, with risk reflecting both economic and environmental importance.

4. **Penama Province** shows a confined area of heightened risk at Homo Bay, Pentecost, but moderate risk levels overall. Risk levels derived reflect only three large cruise vessel calls in the 2012 season (both AIS data and cruise operator records cross-relate). The risk profile extends northwards because of domestic coastal vessels and large yachts with passenger capacity attending land-diving events. Smaller cruise vessels are reported to attend, but none were recorded for 2012. A hydrographic survey here would need to be prioritised only with cruise stakeholder input.

5. The islands of Pentecost and Maewo present no risk on their east coasts, as there are presently no domestic services there. However, Pentecost and Maewo produce a majority of their kava and copra in the east, which is shipped out on the west coast. The risk would need to be reviewed if an east coast trade materialised.

6. In **Malampa Province**, the need for hydrographic work along the east coastline of Malakula is compelling. There is the second highest concentration of domestic coastal vessel GT capacity by schedule. However, work could be focused in the southeast and then Wala Island. Domestic coastal traffic may benefit from a review of current chart scales which may require an extension of surveys along the Malakula east coast.

7. The sea area between Malakula, Ambrym and Épi provides an area of significant risk, due to traffic and environmental importance. This sea area experiences a relatively high volume of traffic, including large SOLAS vessels and small domestic coastal vessels.

8. In **Shefa Province**, Port Vila, Éfaté, and its west coastal approaches are clear candidates showing an area of significant risk. Ship transits to the north-west of the island define a further area of heightened risk. Port Vila is the capital of Vanuatu; it is the largest port and the premier tourist destination, therefore of high economic value. Moderate risk areas, e.g. Port Havannah or Undine Bay should be evaluated on a vessel-needs basis. This would alert cruise operators

of the need to survey in the event either are planned as cruise destinations.

9. If cruise vessels elected to call once again at Lamen Bay, Épi, this would enhance its status as a candidate for survey. This is an area of significant risk as it forms part of the sea area between Malakula and Ambrym, with relatively high traffic volume. There are important mangrove sites, corals and breeding grounds.

10. In **Tafea Province**, Tanna, risk levels are heightened locally to Lénakel, but a magnitude lower than is indicated for Éfaté and Malakula. Risk extents are also local, unlike the Malakula coastline. The risk level at Lénakel arises from domestic coastal vessels as the route to Port Vila has the greatest scheduled domestic vessel capacity by GT; the jetty is also exposed to sea conditions of surge and swell. The decision to build a jetty at Waisisi Bay will doubtless influence cruise vessel calls but, practically, these may need to be limited in size (Mt Yasur).

11. Aneityum (Mystery Island) shows heightened risk at its southern end, but not significant risk, based on traffic levels in the data. It should be clearly recognised that risk contribution is dominated by cruise vessels.

ECONOMIC CONCLUSIONS

12. In terms of overall trade expansion, Vanuatu appears likely to remain in a steady state as far as exporting is concerned.

13. Tourism is the exception to this, where dramatic growth in cruise vessel visits, both in terms of numbers and in terms of vessel size has already occurred. This growth is likely to continue, but directly affects only the southern and central parts of Vanuatu.

14. The northern provinces of Vanuatu may equally benefit from cruise passenger visits if Papua New Guinea and the Solomon Islands become new cruise destinations.

15. The domestic shipping trade along the coast of Vanuatu has already grown, fuelled in part by a revival of the copra trade and its use domestically in biofuel production. The economic case to invest in shore based facilities (jetties and other such infrastructure) is justified by the need to improve efficiency of cargo loading, as well as the potential for passenger numbers on board any domestic coastal vessel.

16. There is a successful economic case to address the present limitations of charting and currency of hydrographic surveys - traffic risk also justifies this. The economic case is made on cruise-vessel growth

alone. However it should be noted that beyond Port Vila and Luganville, cruise-vessels are the only large vessels visiting.

17. A tourism strategy with respect to cruise visitors needs to be developed further for the benefit of Vanuatu. This will only be successful if underpinned by cruise stakeholders' confidence in official nautical charts.

VESSEL TRAFFIC ANALYSIS CONCLUSIONS

18. The volume of traffic transiting the waters of Vanuatu is greater than expected.

19. Vanuatu has a varied trade profile by vessel type. The volume of SOLAS general cargo vessels is approximately steady, with a drift towards marginally larger vessels entering the trade.

20. SOLAS general cargo vessels only visit Port Vila and Luganville. The only known anomaly to this may be Malakula where a small bulk carrier was reported to have delivered bagged cement and loaded copra at anchor in 2012. Vessels only transiting Ni-Vanuatu waters either pass to the west or transit in a north-west south-east direction through the islands. Some fishing vessels take similar routes.

21. There is a significant growth in SOLAS cruise-vessel visits, not only in terms of numbers, but also size. Some of the largest cruise vessels visiting New Zealand and Australia are also becoming regular traders to Vanuatu.

22. Cruise-vessel number growth year on year is such that in 2012, they form 30% of the traffic profile, analysed at a "GIS gate" between Malakula and Épi. General cargo vessels represent 50% of the traffic profile. However, as cruise vessels are by far the largest vessels transiting the waters of Vanuatu, their contribution to transit risk is significant.

23. Some islands are only visited by international cruise vessels. Cruise vessels transit in particular between Hog Harbour (Champagne Beach), Luganville, Wala Island, Port Vila and Aneityum (Mystery Island).

24. Port Vila is the most significant Vanuatu port (and therefore trading centre) by ship-traffic volume.

25. Port Vila has recorded a marginal fall in tanker visits. This may be the result of larger tankers in the trade or a beneficial effect of renewable power initiatives; i.e. that the copra to biodiesel project is already influencing demand for external supplies of fuel.

26. Port Vila shows a dramatic growth in cruise vessel visits. A 34% increase in vessel numbers in three years has been recorded, despite a recessionary period. Forecast data strongly suggests this increase will be sustained in future. Note that cruise vessels are becoming significantly larger, placing pressure on infrastructure in and around the port.
27. Large tankers are transiting through Ni-Vanuatu waters between the northern islands of Gaua and Vanua Lava. These tankers in particular influence transit risk in Torba Province.
28. Luganville shows a steady traffic profile, with a moderate increase in dry-cargo vessels being sustained in 2012. Cruise activity at Luganville is well below the level at Port Vila.
29. Most cruise vessels calling at Espiritu Santo visit Hog Harbour, bypassing Luganville. This is partly due to the condition of mooring arrangements at Luganville Main Wharf, which are in urgent need of attention.
30. Large superyachts are regular visitors to Ni-Vanuatu waters. Popular destinations include Lamen Bay (Épi), Maskelyne Islands and Port Stanley (Malakula), Ranon (Épi), Homo Bay (Pentecost), Champagne Beach (Hog Harbour, Espiritu Santo) and a number of the northern islands.
31. Within the islands themselves, a number of deep draught (over 10m) vessels pass through Torba Province. The majority of the central islands traffic profile has a draught of less than 9 metres which reflects that most modern cruise vessels are less than 9 metres draught.
32. There are vessels of significant length (over 300m) transiting between the islands, which reflect the cruise vessel profile.

DOMESTIC COASTAL VESSEL CONCLUSIONS

33. The loss of life that would occur from an incident involving small domestic coastal vessels is greater than expected. They are licensed to carry a large number of passengers which significantly influences the risk profile. Some have reported passenger capacity greater than the dedicated passenger vessels on the coastal trade.
34. There are a relatively large number of domestic coastal vessel losses. Although causal reasons are many, including breakdown and cyclone loss, there is a link to crew competency assurance and quality of nautical charting for coastal use.

35. There is an established domestic coastal trade, with both scheduled and chartered vessels in operation. Coastal trade appears to be growing strongly, with scheduled vessels sometimes fully laden with copra early in their trading sequence.

36. Domestic vessels provide a cost effective solution to interisland travel for the Ni-Vanuatu. However, given the number of wrecks, it follows that as trade grows, likelihood of an incident of significance is incrementally rising.

OFFICIAL NAUTICAL CHARTS

37. The present official nautical charts use historical names, even for the major islands, which is a cause of confusion and a potential maritime safety issue. Updating official nautical charts with official Vanuatu nomenclature should be undertaken with urgency.

KEY ITEMS OF RISK ASSESSMENT RELEVANCE

Culture and Land Ownership

38. Centralised rights of cargo passage into and out of coastal ports and jetties are needed if domestic coastal shipping is to have full access to all available landings. This is normally addressed by the concept of a local port or harbour authority providing freedom of traffic and cargo transit.

39. Local marine reserves, policed by the tabu system, are common in Vanuatu. These reserves cover some very important ecological areas and it provides a problem for a risk assessment as essentially these are informal arrangements. They were incorporated into the risk model, with similar risk prioritisation given to those that are formally recognised.

40. There are cultural locations of importance to Ni-Vanuatu that could be affected by oil pollution arising from a shipping incident. Locations in direct contact with coastal areas have been incorporated into the risk assessment.

Former Mined Areas and WW2 Artefacts

41. Request, at inter-governmental level, access to information from US military archives for records of equipment disposal for the south-eastern part of Espiritu Santo and the northern shores of Éfaté. Render information to the Vanuatu Primary Charting Authority to update official nautical publications and charts.

SUMMARY RISK TABLE

The following tables and risk model mapping provide an overview of the results of the comparative hydrographic risk assessment for the Vanuatu archipelago. **Table 1** is a high level risk summary, which must be interpreted with care. **Table 2** provides information to assist with interpretation.

VANUATU Priority Areas for Chart Improvements (Based on Comparative Risk Level)		
Province	**Area**	**Comparative Risk Level**
SANMA	Espiritu Santo, Luganville and approaches.	**Significant**
MALAMPA	Malakula, east coast.	**Significant**
SHEFA	Épi, north west corner.	**Significant**
SHEFA	Éfaté, west coast.	**Significant**
SHEFA	Éfaté, Port Vila and approaches.	**Significant**
TORBA	Vanua Lava, Sola.	**Heightened**
SANMA	Espiritu Santo, east coast.	**Heightened**
MALAMPA	Sea area between Malakula, Épi and Ambrym.	**Heightened**
SHEFA	South of Mataso Island	**Heightened**
SHEFA	Éfaté, north west coast.	**Heightened**
TAFEA	Tanna, Lénakel.	**Heightened**
TAFEA	Aneityum (Mystery Island).	**Heightened**
TORBA	Rowa Reef and Ureparapara, Lorup Bay	**Moderate**
PENAMA	Pentecost, Homo Bay.	**Moderate**
SHEFA	Éfaté, Undine Bay and Port Havannah	**Moderate**

Table 1 – Overall Comparative Risk Summary

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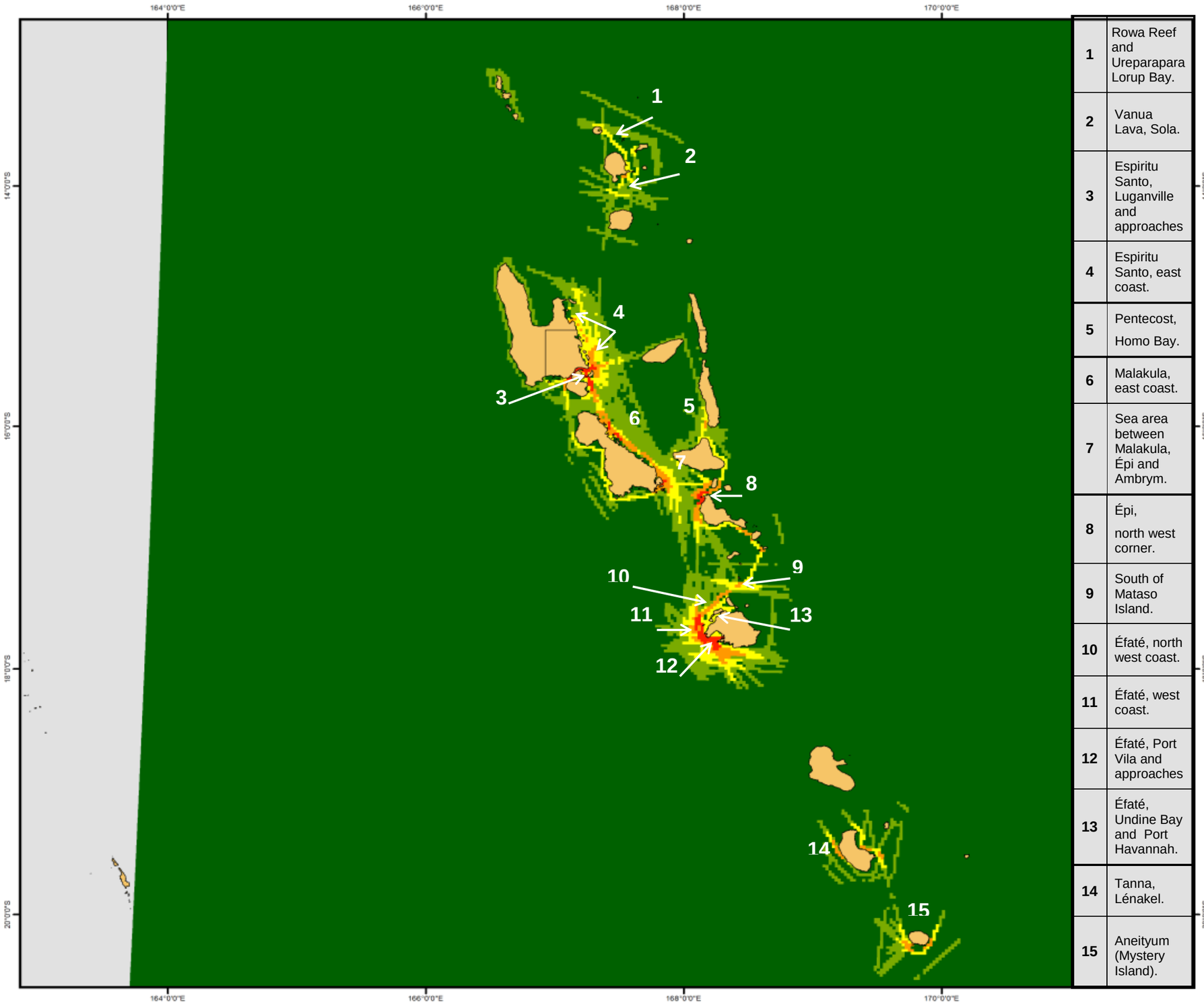
Area by Province (N to S)		Comparative Risk Level			Comments
		Moderate	Heightened	Significant	
					TORBA PROVINCE
1	Rowa Reef and Ureparapara, Lorup Bay	✓			• Considerable areas of environmental significance, corals and wetlands. • Visited annually by small boutique cruise vessels. • Risk influenced by Rowa Reef, an environmentally key surface breaking reef. • Some underlying risk contribution from domestic coastal vessels. • Possible future destination for large cruise vessels.
2	Vanua Lava, Sola.		✓		• Risk contribution from transiting vessels, including large tankers transiting east west through Vanuatu waters, between Vanua Lava and Gaua. • Sola has a large inventory of protected mangroves and corals in a marine reserve. • Localised area of heightened risk as mangrove area is a domestic coastal vessel anchorage for cargo (jetty at Sola damaged). • Possible future destination for large cruise vessels.
					SANMA PROVINCE
3	Espiritu Santo, Luganville and approaches.			✓	• High potential for loss of life and pollution. • Relatively narrow channel (especially the south west) significant tidal streams. • There are non-functioning Aids to Navigation. • WW2 former mined areas and dumped artefact locations. • Proximity to a number of sites of environmental importance including coral, breeding grounds and important informal marine reserves. • Proximity to sites of high cultural value. • Port of high economic value.
4	Espiritu Santo, east coast.		✓		• Espiritu Santo, east coast is an established tourist area of high economic value. • Proximity to corals and turtle breeding grounds. • Informal marine reserve.
					PENAMA PROVINCE
5	Pentecost, Homo Bay.	✓			• Mostly moderate risk, but localised area of heightened risk in Homo Bay. • Risk dominated by cruise vessels, but relatively low traffic.
					MALAMPA PROVINCE
6	Malakula, east coast.			✓	• Considerable amount of coastal traffic passes close to a moderately exposed lee-shore with non-functioning Aids to Navigation and breaking reefs. • Traffic passes close to a large amount of coral and wetland resources with informal reserves. • Coast is popular with tourists and a number of large cruise vessels call at Wala Island. • Significant risk concentrated in the south east and Wala Island. • Second highest concentration of domestic coastal vessel GT capacity by schedule. • Domestic traffic will benefit from a review of chart scales.

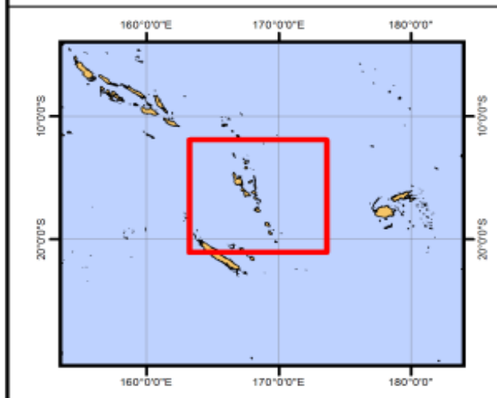
Area by Province (N to S)		Comparative Risk Level			Comments
		Moderate	Heightened	Significant	
7	Sea area between Malakula, Épi and Ambrym.		✓		• High volume of traffic including large SOLAS vessels and small coastal traders passing round the tip of Malakula, with non-functioning Aids to Navigation. • Vessels navigating close inshore with a number of breaking reefs and tidal hazards. • Area of high wetlands value, high coral value and significance for local communities. • Localised heightened risk with area of moderate risk.
					SHEFA PROVINCE
8	Épi, north west corner.			✓	• Density of domestic coastal vessels and super yachts with passenger capacity/recreational vessels. • Vessels navigating close to the shore with breaking reefs and non-functioning aids to navigation. • Considerable area of environmental significance, turtle breeding ground, corals, wetlands and mangroves. • Review if cruise vessels elect to call at Lamen Bay again.
9	South of Mataso Island.		✓		• Density of transiting domestic coastal vessels. • Risk associated with Shepherd Group, submerged volcanic activity. • Risk influenced by Cooks Reef. • Pristine diving attraction.
10	Éfaté, north west coast.		✓		• Density of transiting domestic coastal vessels. • Risk partially influenced by Cooks Reef. • Corals and mangroves on north west coast of Éfaté. • Vanuatu's World Heritage Site, Eretoka, Port Havannah.
11	Éfaté, west coast.			✓	• Density of marine traffic approaching the largest port in Vanuatu, both international and domestic. • High potential for loss of life and pollution. • Moderate exposure to prevailing conditions in an area of breaking reefs and rocky bottom. • Traffic risk is influenced by Vanuatu's World Heritage Site, Eretoka, Port Havannah, corals and breeding grounds.
12	Éfaté, Port Vila and approaches.			✓	• High potential for loss of life and pollution. • Proximity to shallow depths and breaking reefs. • Proximity to corals, wetlands and mangroves. • Port of high economic value and premier tourist destination.
13	Éfaté, Undine Bay and Port Havannah.	✓			• Evaluate on a vessel-needs case if planned as a cruise destination. • Vanuatu's World Heritage Site, Eretoka, Port Havannah. • WW2 former mined area in Undine Bay.
					TAFEA PROVINCE
14	Tanna, Lénakel.		✓		• Lénakel to Port Vila route has the greatest scheduled domestic vessel capacity by GT. • Area of coral reefs, breaking reefs and rocky bottom. • Coastline local to Lénakel exposed to prevailing conditions, surge and swell.
15	Aneityum (Mystery Island)		✓		• Heightened risk based on traffic levels. • Localised area of risk associated with cruise vessel approach and anchorage. • Environmentally sensitive areas, corals and breeding grounds. • Risk dominated by cruise vessels.

Overall Hydrographic Risk Profile for the Vanuatu Archipelago



1	Rowa Reef and Ureparapara Lorup Bay.
2	Vanua Lava, Sola.
3	Espiritu Santo, Luganville and approaches
4	Espiritu Santo, east coast.
5	Pentecost, Homo Bay.
6	Malakula, east coast.
7	Sea area between Malakula, Épi and Ambrym.
8	Épi, north west corner.
9	South of Mataso Island.
10	Éfaté, north west coast.
11	Éfaté, west coast.
12	Éfaté, Port Vila and approaches
13	Éfaté, Undine Bay and Port Havannah.
14	Tanna, Lénakel.
15	Aneityum (Mystery Island).

Vanuatu, Model 1 Results: Risk Assessment of Shipping.



Legend:

- Insignificant
- Low
- Moderate
- Heightened
- Significant

Project No.	Date	Issue Number
12NZ246-1	3/12/2012	001
Author Andrew Rawson	**Checked by** John Riding	**Scale at A3** 1:2,500,000

Data Source
Plot shows the results of the risk model of shipping activity in Vanuatu. Model combines shipping movements, navigational hazards and sensitive sites. Class breaks derived by five bin natural breaks (Jenks).

Coordinate System:
WGS 1984 Mercator 41
Projection:
Mercator
Datum:
WGS 1984
Units:
Meter

0 20 40 80 N
Nautical Miles

Produced by:

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Figure Reference Number: 12NZ246-1_ModelResults_v1

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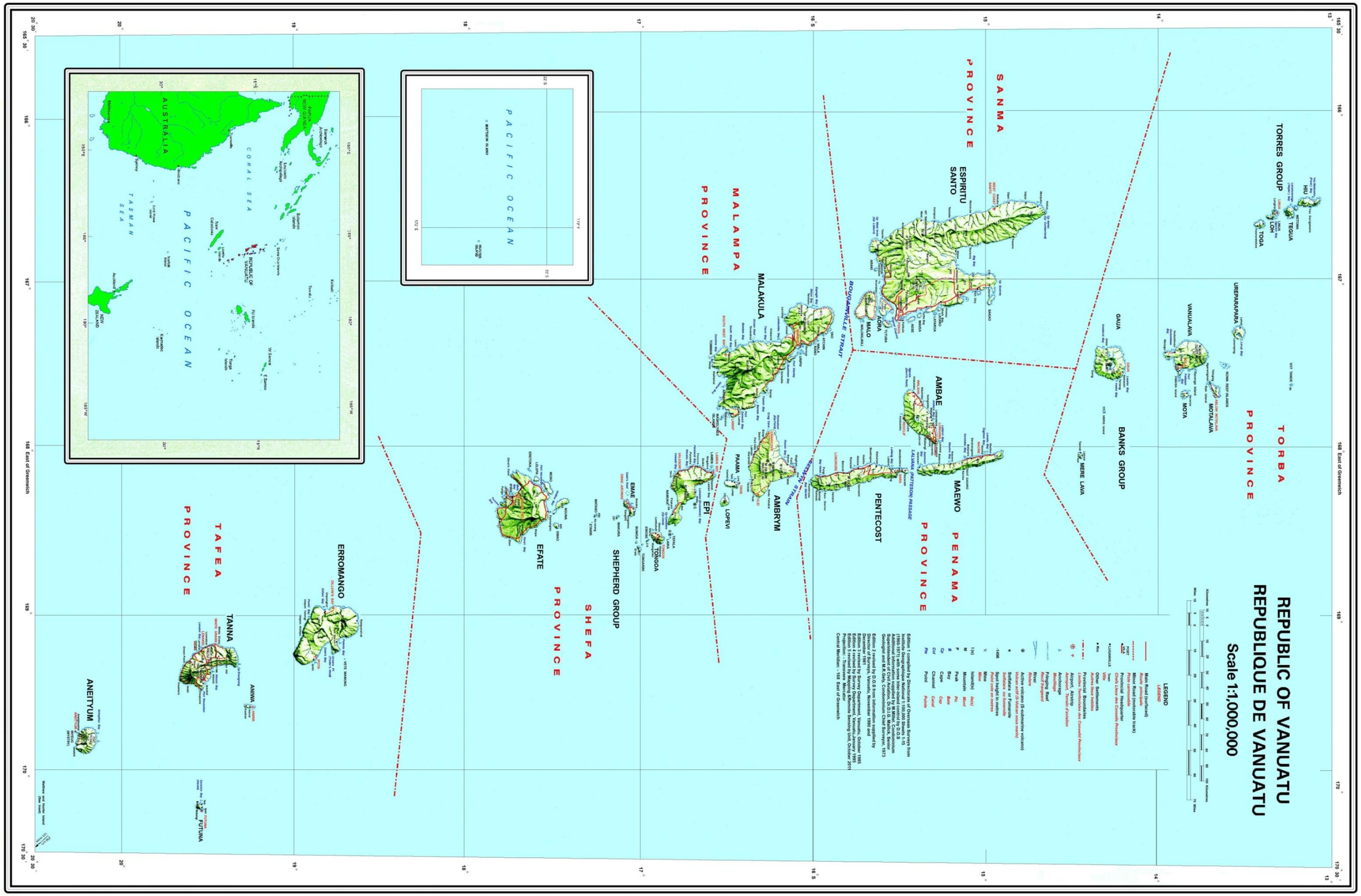
REPUBLIC OF VANUATU
REPUBLIQUE DE VANUATU
Scale 1:1,000,000
LEGEND
Main Road (surfaced)
Road principale
Road (unsurfaced)
Route non-revêtue
Track
Piste
Provincial Headquarter
Chef-Lieu des Conseils Provinciaux
Town
Ville
Other Settlements
Autres Agglomérations
Provincial Boundaries
Limites Territoriales des Conseils Provinciaux
Airport, Airstrip
Aéroport, Piste d'Aviation
Anchorage
Mouillage
Fringing Reef
Récif Frangeant
River
Rivière
Submarine Volcano (Subsidiary volcano)
Volcan sous-marin (Volcan secondaire)
Solfatara or Fumarole
Solfatare ou Fumerolle
Height in metres
Point coté en mètres
Mine
Mine
Mountain
Mont
Peak
Pic
Bay
Baie
Cape
Cap
Channel
Canal
Point
Pointe
SANMA PROVINCE
MALAMPA PROVINCE
PENAMA PROVINCE
SHEFA PROVINCE
TAFEA PROVINCE
TORRES GROUP
BANKS GROUP
ESPIRITU SANTO
MALAKULA
AMBAE
MAEWO
PENTECOST
AMBRYM
EPI
LOPEVI
PAAMA
EMAE
TONGOA
SHEPHERD GROUP
EFATE
ERROMANGO
TANNA
ANIWA
ANEITYUM
FUTUNA
HIU
TEGUA
LOH
TOGA
GAUA
MERE LAVA
VANUALAVA
UREPARAPARA
MOTA
MOTALAVA
PACIFIC OCEAN
CORAL SEA
TASMAN SEA
AUSTRALIA
NEW ZEALAND
REPUBLIC OF VANUATU
PENTECOST CHANNEL
SEGOND CHANNEL
BOUGAINVILLE STRAIT
LALUMA PATTESON PASSAGE
Edition 1 compiled by Directorate of Overseas Surveys from
Edition 2 revised by D.O.S. 1985
Edition 3 revised by Mapping & Remote Sensing Unit, October 2011
Central Meridian - 168 East of Greenwich

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1 INTRODUCTION

The islands of Vanuatu have experienced a large increase in commercial vessel traffic operating through their waters. Much of this growth is related to the numbers of large cruise ships stopping in the Vanuatu ports of Port Vila and Luganville, as well as visiting popular tourist destinations throughout the archipelago. This trend of growth is projected to continue. This is coupled by a growing coastal trade; small vessels in international terms, but vessels that can carry a significant number of passengers.

A disparity now exists between the size of the SOLAS vessels, a growing volume of domestic coastal traffic and the quality of the nautical charts used for navigation. Many of the charts date to the 1800s and mid-twentieth century and are in need of updating to modern standards. This study uses a top-down approach to risk assessment, recently developed in New Zealand, to prioritise areas for chart improvement surveys, based on a combination of vessel transit risk and economic growth. The risk-based result is designed to aid decision-making by hydrographic professionals with regard to updating nautical charts.

1.1 AIMS AND OBJECTIVES

The aims of this document are to demonstrate and describe:

- A trial application of a robust, risk based methodology for the prioritisation of hydrographic surveys;
- To investigate the comparative risk of a shipping incident in the Republic of Vanuatu; and
- To produce GIS plotted output clearly showing the spatial distribution of shipping risk that enables the Vanuatu Government to identify areas for chart improvement surveys.

1.2 METHODOLOGY

The method deployed uses risk assessment in a comparative way, to identify areas of Vanuatu that are more susceptible to an incident involving a large SOLAS vessel. This is in terms of the range of most likely and worst credible potential for loss of life, damage to the environment, damage to economic development and impacts to areas that are culturally important to the Ni-Vanuatu.

The types of accident that can occur to vessels are related to the type of vessel transiting the waters of Vanuatu as well as their size and

cargo/passenger capacity. Details of vessel transit information is thus key to the methodology, and was supplied from satellite AIS data (S-AIS), together with port pilotage records, obtained during a data gathering visit to Vanuatu. Further information was obtained from cruise vessel operators and agents about cruise-calls throughout Vanuatu. Details of the fleet of coastal domestic vessels were obtained and rough schedules. Ship traffic was analysed in a Geographic Information System and domestic shipping routes and associated volume added to this. Event Trees were used to derive the realistic types of grounding or foundering incident that could occur, and their outcomes related to the vessel types and the size of those vessels. Event Trees are attached at **Annex B** and a detailed description of the traffic analysis is attached at **Annex C**.

With both analysis of vessel traffic volume and information known about the more vulnerable locations of Vanuatu, the traffic analysis was linked to the locations, with risk criteria being developed in a matrix to conduct the risk assessment.

The use of a Geographical Information System (GIS) allowed a large number of factors (all of which were geographic in nature) to each be considered in terms of their risk contribution and linked to the most dense traffic areas, taken from the traffic analysis. The resulting risk levels, comparative in nature, could be displayed in the GIS as a coloured overlay. This made the end result visual and easy to interpret. A detailed description of the GIS Analysis through to the result is attached at **Annex D**.

Use of a GIS was vital to accommodate the multitude of datasets, undertake the analysis and present the results. This approach was used after it was determined that there has been a large amount of environmental research undertaken in relation to climate change, and datasets obtained, (e.g. corals or mangrove datasets) could be verified for Vanuatu by using the information obtained during the site visits.

The method used is advantageous as it is data driven (i.e. reducing opinion-based input), using expert judgement only where necessary (e.g. event tree outcomes and risk criteria), and identification of the relevant risk factors.

In summary, vessel traffic analysis was undertaken on satellite derived AIS data for a five month period of 2012 to build a model of shipping movements through the archipelago. A number of aggravating and mitigating risk factors related to maritime risk were then identified and scored on a five point scale across the study area. Each risk factor was then weighted in terms of its relative importance to the final model and combined with the traffic analysis to produce a final cumulative plot of maritime risk in Vanuatu, which took account of the accuracy of the current charting.

Against this a cost effective hydrographic programme can be developed for Vanuatu, which is based solidly on risk and data analysis.

A similar type of risk based methodology is now used by the United Nations agency, the International Maritime Organisation

The results are presented in **Section 8**.

2 VANUATU – INFORMATION AND ECONOMIC OVERVIEW

2.1 GENERAL DESCRIPTION OF VANUATU

The Republic of Vanuatu is an oceanic archipelago of 80 islands, of which 65 are inhabited, located in the south west Pacific region. The archipelago lies between 13°S and 21°S and 166°E and 171°E. It is located in a triangle formed between the Solomon Islands, New Caledonia and Fiji. The islands are mostly of volcanic and coralline origin, with a northwest and southeast orientation. The coastline is about 2,500kms, fringed by approximately 620km² of pristine coral reefs. Reefs fall away rapidly offshore to depths of 600–700 metres. The 200-mile maritime Exclusive Economic Zone (EEZ) covers 680,000km².

Vanuatu achieved independence in 1980. For more than a century the islands had been controlled by a French and British condominium agreement and were known as the New Hebrides.

Two uninhabited southern islands of Matthew and Hunter are subject to lack of territorial clarity, with France (New Caledonia) and Vanuatu both lodging territorial claims. These two islands are not included in this study.

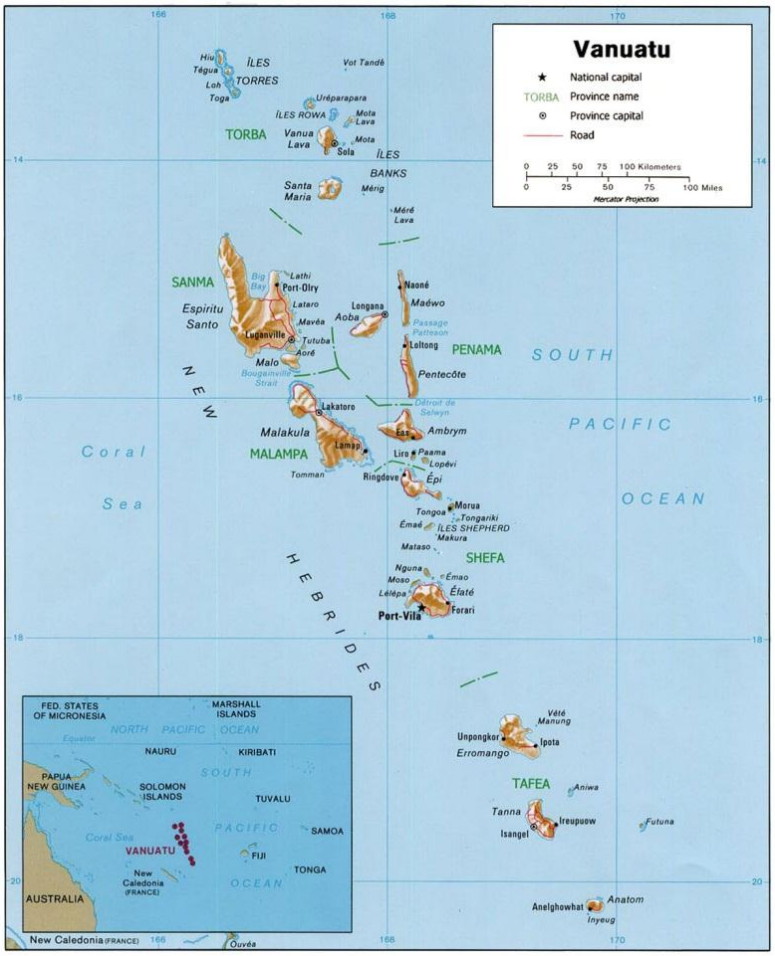


Figure 2-1 : Overview of Vanuatu

Vanuatu is a republic parliamentary democracy with the central government situated at Port Vila, Éfaté. It is a member of the Commonwealth. The republic is divided into six provinces, each of which are autonomous units with elected provincial councils having the authority to make by-laws governing local matters. Each council is headed by a chairman elected from among the council members. The chairman is assisted by a secretary general appointed by the Public Service Commission. As the secretary general is a civil servant funded by Central Government, the role is a key link back to the policy aims of the elected Government.

The six provinces are discussed in more detail in **Section 3.5**.

District and National Council of Chiefs, although not elected, have significant influence on local and national politics.

2.2 SEISMIC AND VOLCANIC ACTIVITY

The islands lie on the convergent boundary of the Australian and Pacific tectonic plates, with the Pacific plate subducting under the Australian plate. Thus a changing bottom bathymetry due to volcanic and seismic activity is common. As a guide, active volcanoes are found on Tanna, Lopevi, Gaua (named on official nautical charts as Santa Maria) Ambae and Vanua Lava.

Submarine volcanoes are found in the vicinity of Gemini Seamounts (south of Aneityum) and off the northeast, east and south coasts of Épi, north west and south coasts of Ambryn, Ambae (charted as Aoba), and the east coast of Espiritu Santo. The Pilot[2] advises that changes in configuration of the sea bed due to undersea volcanic activity may result in depths considerably different from those charted. Seabed locations such as Port Resolution (Tanna) are said to be rising by as much as 7cm per annum[3] and a number of islands (e.g. Éfaté) have frequent tremors[4].

The continual seismic activity experienced in the islands may have resulted in changes of depths to those charted.

[2] Admiralty Sailing Directions, Pacific Islands Pilot, Volume 2, NP61, Twelfth Edition
[3] This is advice from the Vanuatu data gathering visit, unsubstantiated by hydrographic data.
[4] Frequent even on a daily basis.

2.3 NATIONAL ECONOMIC OVERVIEW

Capital	Port Vila
Population	250,000
Land Area	12,190 km²
Exclusive Economic Zone	680,000 km²
Key employment industry	Agriculture (75% of employment)
Key GDP industry	Services (Tourism)
Major Ports	Port Vila (Éfaté) and Luganville (Espiritu Santo)
Climate	Tropical Maritime, E/SE trade winds dominate with a regular cyclone season

Table 1 : Key Economic Descriptors of Vanuatu[5]

The Vanuatu archipelago has a recorded land area of 12,336 km², much of which is mountainous with unstable soils. Approximately 9% of land is used for agriculture with approximately 6.97% under permanent crops and 1.64% arable[6]. It is estimated that 41% of the land mass is cultivable with good quality soils and a favourable climate. Vanuatu is currently free from most major plant and livestock diseases.[7]

The country's population was recorded as 243,304 in 2009[8] and 2011 GDP was estimated by the International Monetary Fund (IMF) at US$743M with a per capita income of US$3,036. A Canadian report[9], for the MSME sector, also published 2011, estimated a per capita income of US$4,300 in 2009.

Vanuatu has a classic dual economy: a small, high-cost modern sector and subsistence/small-scale agriculture and fishing with a majority of Ni-Vanuatu largely outside the cash economy. Nearly 80% of the population engage in subsistence agriculture contributing only 10% to GDP.

The mainstays of the economy are agriculture (led by copra and kava production), tourism, offshore financial services and cattle. There is fishing activity, which appears in volume to be different in each island, but is primarily for internal consumption rather than export. According to information taken from the site visits, a large majority (anecdotally as much as 90%) of Ni-Vanuatu households fish in some form.

[5] Vanuatu Government (2012). Trade Policy Framework.
[6] Pacific Islands Applied Geoscience Commission diagnostic reports (SOPAC 2007)
[7] Fourth National Report to the Conference of Parties of the Convention on Biological Diversity, August 2011
[8] 2009 Census Household Listing Counts, Vanuatu National Statistics Office
[9] Micro, Small and Medium Enterprise (MSME)Policy and Strategy for Vanuatu, 2011, AIMS Inc, Toronto, Canada

2.3.1 Commodities

Although from a 2012 perspective this data is relatively old, in 2007 and 2008[10] the recorded values of the main exports, in local currency, were:

Commodity	2007	2008	
Copra	485	1,079	Million Vatu
Coconut Oil	492	727	
Beef	180	385	
Kava	442	487	
Cocoa	221	241	
Timber	80	80	
Shells	24	43	
Cowhides	19	26	
Root crops	17	9	
Vanilla	10	8	
Coconut	6	3	
Coffee	-	1	
Other	255	483	
Total	2,229	3,566	**Million Vatu**

As commodity costs vary widely this data is only a rough guide for 2012, but it highlights an increase in copra trade that is reflected in an increase in domestic coastal trade to move it to market. Imports include fuels, machinery, mechanical equipment, foodstuffs and consumer products.

2.3.1.1 MINERALS

There is currently little or no mining activity in Vanuatu although some evidence of prospecting. Manganese mining did occur in Éfaté, but ceased in 1978, reportedly due to land disputes.

Espiritu Santo has considerable deposits of limestone formed from uplifted coral, which may be quarried and exported in the future.

2.3.2 Tourism

Tourism provides significant foreign exchange and appears to be an area with major growth potential, both mainstream (accommodation and services) and specialist (diving). The islands are regarded as a premier destination for scuba divers wishing to explore coral reefs in the Pacific. Reefs such as the

[10] ADB Vanuatu Economic Report 2009 and Vanuatu National Statistics Office, 2008

Tonga Wall are considered world class and easily accessible. World War II history provides further diving attractions, such as Million Dollar Point, Espiritu Santo, where US military equipment was dumped at the close of war. Shipwrecks, (both military and trading vessels) also attract diving specialists.

Over 80,000 visitors travelled by air to Vanuatu in 2007, as well as an additional 82,000 who visited by cruise ship. By 2011, according to Vanuatu Government arrival statistics, this had risen to 93,824 visitors by air, with 147,500 visitors arriving by cruise ship. Growth in tourism in that 4 year period is by any measure significant (17.3%), given world recessionary pressures during this period. However, growth in cruise passenger numbers is such that it would challenge even a developed country to delivering port infrastructure development projects to match the rate of cruise passenger growth (57% in four years).

One cruise line[11] dominates the market (90%) and expects to make 133 Vanuatu calls in 2013, delivering about 260,000 cruise visitors in that year.

Approximately 75% of all visitors are from Australia and New Zealand.

2.3.3 Financial Services

Financial services and ship registration are an important part of the economy. For shipping, the Vanuatu Registry is considered a tax haven and is listed by the International Transport Workers Federation (ITF) as a flag of convenience.

[11] Carnival Australia (P&O)

3 KEY ITEMS OF RELEVANCE TO THE RISK ASSESSMENT

3.1 CULTURAL INFLUENCES IN VANUATU

Vanuatu has a rich cultural heritage, and each island is said to have "cultural spirits" living on the island. The project site visits to Vanuatu took account of these, especially where there would be damage to coastal areas where tribal spirits were considered to exist.

Such spirits are thought to watch over tribes and moulded the island nation into what it is today. This is in common with island societies throughout the Pacific, with legends or myths surrounding such things as the creation of the land and the origin of the inhabitants. In many respects the spiritual Ni-Vanuatu thinking about the old spirits[12] is similar to that of the New Zealand Maori in explaining how the island topography of Vanuatu was created, as well as the origin of the inhabitants.

The cultural heritage is largely based on a clan system and there are said to be over a hundred such cultures in Vanuatu, with equally differing languages. The differences in language were, and are, such that a common lingua franca had to be found. This is Bislama, a pigeon English which evolved on the sugar cane plantations of Australia amongst blackbirded Ni-Vanuatu. Plantation workers from different Vanuatu islands needed a common language to be able to communicate with each other.

The backbone of Vanuatu culture is kastom, or custom, which is not just a series of beliefs, dances and rituals but it involves a whole way of life where every action is dictated by it. Kastom can vary significantly not only between islands, but between neighbouring villages. For example, land diving is practiced by a few clan settlements in Pentecost[13] and nowhere else, which attract individual tourists and cruise vessels alike. According to kastom other clans could only practice land diving if they purchased the right to do so from the original practitioners. Thus it has not spread to the other islands, even though it provides a key source of tourist income for the custodian owners of Pentecost.

3.1.1 Land Ownership

Land ownership in Vanuatu also has strong links back to culture. There are custodian owners of land in many locations, who have managed the land for many years. Historically, it was the clan as a community who owned land.

[12] A term widely used by representatives of each province.
[13] Penama province.

The "clan", in turn, gifted land to individuals for their use in housing, agriculture, or domestic production. This is not dissimilar to the original feudal system that once existed in many parts of Europe.

Thus historically, there was no individual ownership in Vanuatu. Indeed the clan was its land and the people of the clan were part of that land and indivisible from it. Conflicts over land ownership between neighbouring clans were settled by warfare, or more recently by the exchange of gifts by each side to negotiate an agreement.

This custodian concept of land ownership is central to Ni-Vanuatu culture, but alien to most modern democracies, who have transited such problems in their past to facilitate their own development. In Vanuatu, this has inevitably led to modern disputes over land ownership which is inhibiting economic development. Simply, ownership is unclear and open to competing claims.

An observation made out of the Vanuatu data gathering visit is that the cruise industry practice of paying "anchorage dues" into community funds (which in local terms is a significant monetary sum paid at each visit to any island), may well be fuelling the number of land disputes. As an observation, such funding may be better used in Trust to develop a coastal infrastructure, thus linking to the international aid system.

In Ni-Vanuatu history there is no concept of state ownership of land used for national infrastructure such as roads, hospitals, airports etc. Neither is there a concept of national authority. Laws were made and enforced locally according to kastom and defined by tabu.

As common-law rights of passage are accepted by local agreement only[14], those rights normally provided to all by a Port Authority (or e.g. Airport Authority) to facilitate the passage of cargo to and from ships, or along highways, are not necessarily in place. This makes it difficult for small ports and harbours to work efficiently, or can be easily disrupted, such as around coastal jetties[15]. For example, during the data gathering visit to Vanuatu, one of the best quality coastal jetties observed was on Ambae, located at Lolopuepue, close to Loltong Bay, in the sheltered lee of the prevailing weather conditions.

[14] No-one is allowed to impede passage by roads in existence at the time of Vanuatu independence
[15] A Port of International entry has been declared though at Aneityum, May, 2008 by the Minister of Infrastructure and Public Utilities. So there is a framework to introduce further ports (in law) into the Vanuatu archipelago.

Figure 3-1 : Jetty at Lolopuepue, Ambae

Jetties at nearby Loltong Bay were wrecked in a cyclone[16], meaning only landing craft can deliver to that part of Ambae. This jetty is of substantial construction and in terms of capacity, it is in excellent condition (reportedly built by French assistance some time ago). It remains available but is unused because of land ownership issues at its shoreside end[17], and a tabu is reportedly in place. Only centralised rights of cargo passage into and out of port systems in Vanuatu can resolve this. It would mean including coastal landing locations in a legal framework similar to that already in place for the main ports of Luganville and Port Vila.

3.1.2 The Tabu and Risk Assessment

The tabu system remains central to law making and enforcement, even today (2012). A tabu can be imposed by the national or local government and local chiefs and clan leaders as representative of the communal clan land owner.

Occasionally, a tabu may put a particular area of land off limits to everyone, but usually it is used to prohibit certain activities. Although often informal the system is well respected by Ni-Vanuatu and any person breaking a tabu would answer to a high-chief.

The tabu system has often been used in Vanuatu to introduce a marine reserve if local fish stock were found to be depleted. Tabus also apply to foreign visitors, but relief can sometimes be granted, for example a yacht can

[16] And Loltong Bay is the subject of a joint aid grant to rebuild the jetty.
[17] It is also located adjacent to a lava stream if Mt Vui erupted again.

often be granted permission to anchor in an informal marine reserve, provided a gift (generally of low value) is given in return.

3.1.2.1 LOCAL MARINE RESERVES AND THE RISK ASSESSMENT

Each Province of Vanuatu has a number of informal marine reserves, with only two sites formally recorded, one part of a world heritage site. These are not always recorded, although some have a tentative formal status. They are maintained by the same tribal committee structure as the tabu system. As such they appear to be equally as effective. Those learned about during the Vanuatu visit were included in the risk assessment, with their informal status being differentiated from those with formal status.

As marine reserves defined by local agreement and tabu are essentially informal arrangements, they are difficult to include in a hydrographic needs risk assessment that needs to rely on formalised information. However as the majority of marine reserves in Vanuatu are informal, they have been introduced as an overlay in the GIS, that is separate, but linked to the formalised reserves, such as the world heritage site at Eretoka (Éfaté). Thus a formalised reserve will have an increased effect on the measured vessel transit risk.

3.1.3 Impacts to Ni-Vanuatu Culture out of a Marine Accident

Each separate island culture had its own selection of ghosts and spirits and ways of encouraging or appeasing them. Some of the spirits resided in stones, or in remote island locations, or commonly, in volcanos. In a particular area there may be a feature of coastal landscape that has submerged as a result of volcanic action.

The cultural damage that would occur from any marine fuel release in such an area susceptible to such damage would deeply affect the Ni-Vanuatu community.

The risk assessment work took account of such locations in its assessment. As there are no immediate formal records of such locations, these had to be obtained from provincial visits and discussions with local leaders. Not all sites were included in the risk assessment, only those where there was an obvious sea interface where pollutant release could enter the site. Examples of this are the island of Aniwa in Tafea Province (where the tidal lagoon is said to have been created when the god Aniuwa sat down after pulling the islands of Tafea Province together), and the island of Malakula, where on the west coast at Dixon Reef there was a local village that submerged due to a series of seismic events. Local tribes have strong spiritual links to this reef and it remains both a sacred area and an informal reserve.

3.1.4 Domestic Coastal Vessel Wrecks in Vanuatu

There are a significant number of coastal trading vessel wrecks in Vanuatu, with more than one on every island. For example, Malakula has 20 recorded wrecks, with its east coast being particularly susceptible. Espiritu Santo has similar records and each province visited could reference a number in recent memory.

There are many causes of such wrecks. Mechanical breakdown, poor quality fuel and abandonment alongside wharfs are factors. There are also a considerable number that are the result of cyclone damage and the vessels anchoring arrangements being overwhelmed when sheltering behind an island to ride out such storms; there may be a need to consider the present availability of safe cyclone anchorages or moorings. Navigational error is also a cause of wrecks, as are human factors such as crew sleeping and missing waypoints set by GPS. There is an obvious link to crew competence and navigation by the use of quality charts, of appropriate scale to cross reference locational information. Improved charts can be used for training, but importantly provide key reference material for the position of any vessel relative to hazards.

Figure 3-2 : Wrecks Alongside at Litslits Wharf, Malakula and at Simonsen Wharf, Luganville

For the purposes of the risk assessment, the random location of these wrecks and numerous but uncertainty of causes would be a red herring in terms of risk levels. The risk assessment recognised that the volume of released pollution in a wreck would be low relative to that of a SOLAS vessel.

However, domestic coastal cargo carrying vessels can have *significant* licenced passenger capacity in relation to their size, which showed the potential loss of life impacts arising out of such wrecks. To address this, a risk matrix scale based around the size of these vessels (Gross Tonnage) and relating size to passenger carrying capacity was used in the risk assessment.

3.2 TOURISM ECONOMICS AND BARRIERS

Tourism in Vanuatu is growing with obvious potential, but there are currently recorded impediments to tourism growth including limitations in:

- Implementation of tourism strategy;
- Effective marketing of Vanuatu as an attractive tourist destination;
- Air links with better internal connectivity to remote scenic places;
- Quantity and quality of accommodation;
- Lack of accreditation and staff training;
- Lack of information for visitors to pre-plan their stay;
- Water quality in remote islands;
- Electrical supply;
- Infrastructure including roads and sewage treatment;
- Development of tourist products, including areas of natural beauty or interest and cultural products;
- Land ownership issues.

Impediments have been identified by the Government and a tourism plan was available in each province[18]. However, at time of the Vanuatu data gathering visit, funding to implement the plans was required.

3.3 OFFICIAL NAUTICAL CHARTS

The Primary Charting Authority for the area is the United Kingdom Hydrographic Authority, who, on behalf of the Vanuatu Government, update and promulgate official nautical charts with information as supplied by the Republic of Vanuatu. Prior to commencement of this risk assessment, it was already established that charting information, including scale of charts are in need of attention. A Vanuatu Government hydrographic committee had recently been re-established, and a formal application for Vanuatu to join the South West Pacific Hydrographic Committee (SWPHC) was made during the risk assessment information gathering visit. This was a significant step forward.

Since independence, Vanuatu has reverted to traditional names for both islands and locations within islands. The present official nautical charts use outdated names, even for islands, and it is a cause of significant confusion.

[18] A copy of the province tourist plan was provided by each provincial Secretary General.

It is a widespread problem and undermines the utility of official nautical charts to domestic coastal vessels and provides an inherent, but unknown influence on risk to larger vessels wishing to navigate through the waters of Vanuatu. Official nautical charts need to be updated with official Vanuatu island names and locations. Updating official nautical charts with correct and official Vanuatu nomenclature should be undertaken with urgency.

3.4 FORMER MINED AREAS AND WW2 EQUIPMENT DISPOSAL

During the Vanuatu data gathering visit, the issue of artefacts remaining following the dumping of WW2 equipment was raised by a number of key stakeholders, including the Secretary Generals of Espiritu Santo and Éfaté. World War II artefacts are known to remain in waters in Vanuatu, but this is mostly mechanical equipment. There is both confusion and rumour, not a lot of which appears to be based on factual information. The risk assessment needed to take account of such information.

The marine advice provided to the navigating mariner is extremely cautious with respect to former mined areas and it is partly because of a lack of information. Without something to clarify that there is a reasonable amount known about what occurred where, hydrographic survey specifications would need to be stringent.

3.4.1 Advice to Mariners – Sailing Directions

There was a charted "Anchoring Prohibited" area off Luganville Main Wharf. Some ship masters reportedly understood this to mean that anchors could not be used at all as part of the berthing/unberthing process due to the possible existence of old mines. This has been clarified by a recently inserted note on chart BA 1638, which now states:

"Anchoring is prohibited in the approaches to Luganville Wharf to allow berthing vessels to manoeuvre."

The need for this note shows the need for clarity of local information to inform both the responsible Hydrographic Office and publishers of Sailing Directions. The Sailing Directions[19] (The Pilot) refers to former mined areas thus:

"The following areas are declared dangerous due to mines laid during the war of 1939-45. Due to the elapse of time the risk in these areas to surface navigation is now considered no more dangerous than the ordinary risk of

[19] Pacific Islands Pilot, NP61, V2 Appendix 1

navigation; but a very real risk still exists with regard to anchoring, fishing or any form of submarine or seabed activity."

The pilot describes the following five former mined areas in Vanuatu which are *"….open to navigation by surface vessels only. Vessels should not anchor nor submarines bottom therein:"*

1. Georges Philippar Passage
2. Million Dollar Point
3. Scorff Passage
4. Undine Passage
5. Undine Bay.

These areas are illustrated geographically in **Figure 3-3**, below.

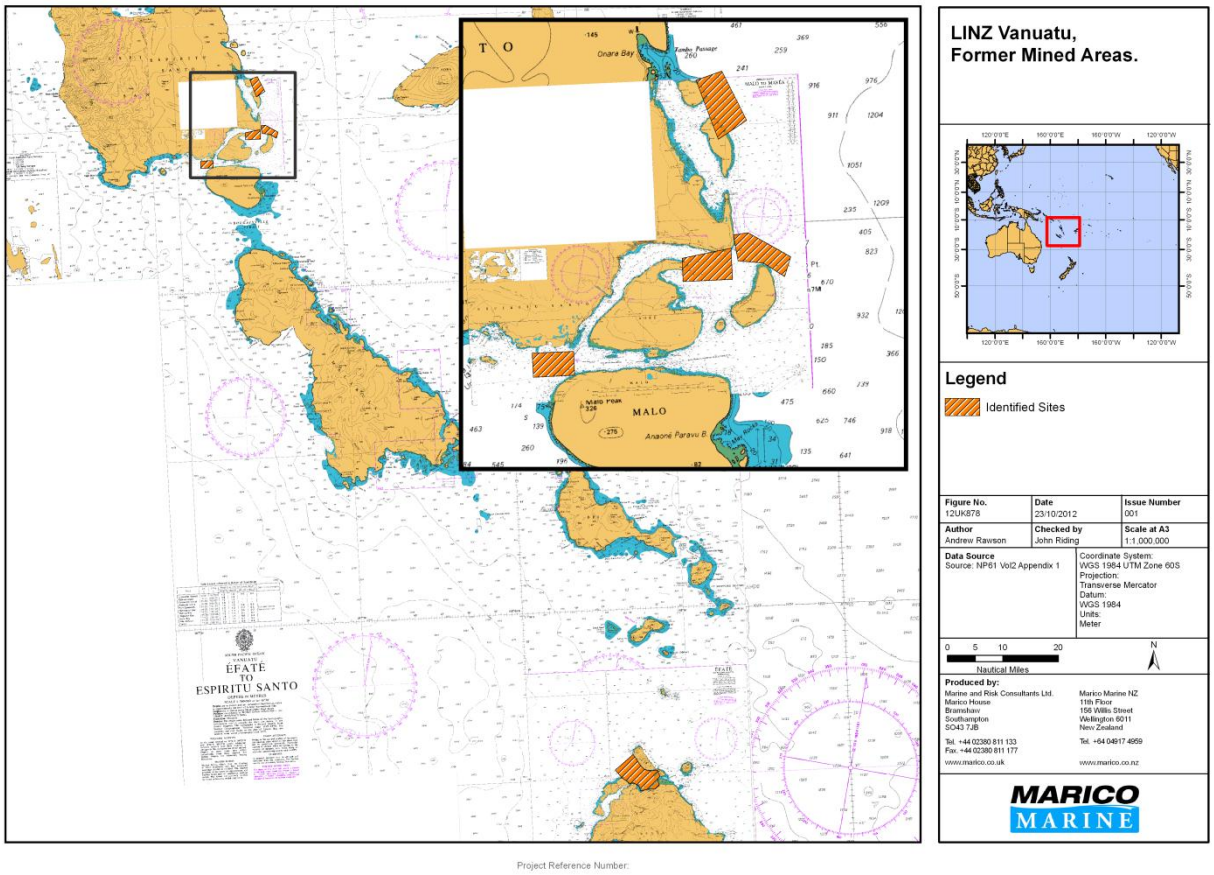


Figure 3-3 : A Plot of Known Former Mined areas in Espiritu Santo and Éfaté

These areas provide a layer in the risk assessment GIS, to reflect risk influence on vessels transiting affected waters.

Annex A provides further information about the former mined areas of the Vanuatu archipelago. This is included as it is clear that chart (BA 1638) has been updated with respect to the berthing areas at Luganville, but until the Sailing Directions for Vanuatu are updated with more specific information,

Official Nautical Charts will remain with Caution Notes. There is uncertainty about the cost of hydrographic services that may go some way to achieve the same thing. Admiralty Sailing Directions need to be clarified with US archives as part of any decision making to undertake hydrographic survey.

3.5 CONCLUSIONS AND RECOMMENDATIONS – KEY ITEMS OF RELEVANCE

3.5.1 Culture and Land Ownership

1. Centralised rights of cargo passage into and out of coastal ports and jetties are needed if domestic coastal shipping is to have full access to all available landings. This is normally addressed by the concept of a local port or harbour authority providing freedom of traffic and cargo transit.
2. Local marine reserves, policed by the tabu system, are common in Vanuatu. These reserves cover some very important ecological areas and it provides a problem for a risk assessment as essentially these are informal arrangements. They were incorporated into the risk model, with similar risk prioritisation given to those that are formally recognised.
3. There are cultural locations of importance to Ni-Vanuatu that could be affected by oil pollution arising from a shipping incident. Locations in direct contact with coastal areas have been incorporated into the risk assessment.

3.5.2 Official Nautical Charts

4. The present official nautical charts use historical names, even for the major islands, which is a cause of confusion and a potential maritime safety issue. Updating official nautical charts with official Vanuatu nomenclature should be undertaken with urgency.

3.5.3 Former Mined Areas and WW2 Artefacts

5. Request, at inter-governmental level, access to information from US military archives for records of equipment disposal for the south-eastern part of Espiritu Santo and the northern shores of Éfaté. Render information to the Vanuatu Primary Charting Authority to update official nautical publications and charts.

4 PROVINCIAL OVERVIEW

4.1 INTRODUCTION

The republic of Vanuatu is divided into six autonomous provinces, which are shown in **Figure 4.1** (Green text). The name of each province is made out of the island names within the province. This section provides information about each province, commencing with Torba.

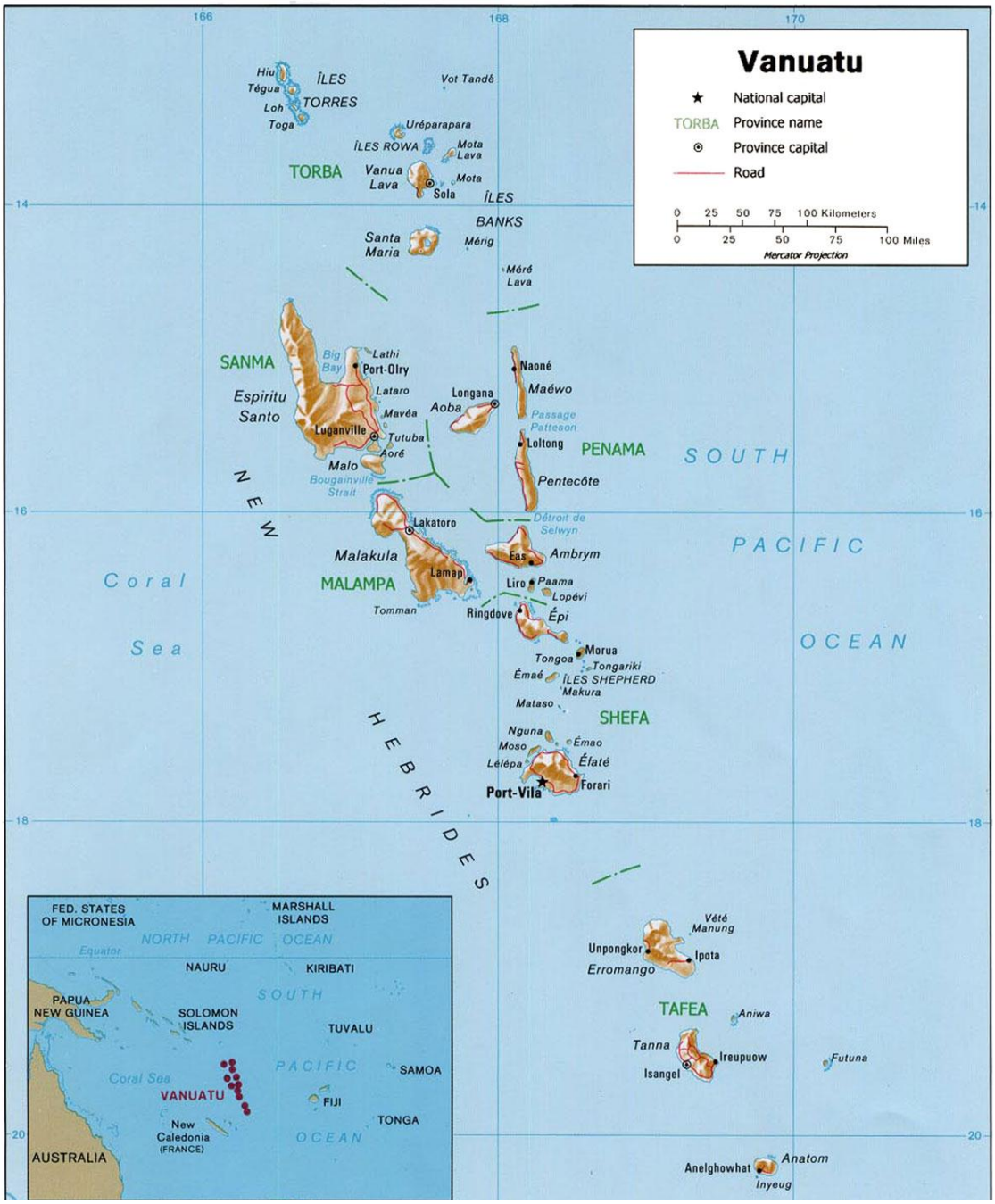


Figure 4-1 : Vanuatu Provinces

4.2 TORBA PROVINCE

Torba Province is made up of thirteen islands in the Torres and Banks Groups. The Torres Group (population about 950 in 2011), consists of the islands of Hiu, Nenia, Metoma, Tegua, Linua, Loh, and Toga. The Banks Group (population of 9,359 in 2012), consists of the islands of Ureparapa, Motalava, Vanua Lava, Mota, Gaua and Mere Lava.

The provincial capital is situated at Sola on the island of Vanua Lava.

About 80% of the population is engaged in semi-subsistence agriculture and fishing. The principal exports are copra, beef, forestry, fish products and cocoa. Copra and beef make up 42% of the province's economy, tourism accounts for 2%.

Gaua, Vanua Lava, Mota Lava and Torres are serviced by Air Vanuatu. The service is 2-3 days per week, which means that a visit must be taken over a period of more than one day.

The province, in the north, suffers from infrequent shipping services, which is considered to be a limiting factor in economic development. The Province was part of the Vanuatu Shipping Support Scheme, providing a subsidised coastal shipping service once a month. Vanua Lava and the islands to the south have a two-weekly shipping service.

There is also a lack of cargo logistics infrastructure, including wharves and storage sheds. The total road network is limited and is not sufficient to support major development initiatives on any of the islands.

The Provincial Government office is based in Sola, on Vanua Lava. In 2011, Port Sola was declared the International Port of Entry for Torba Province.

There are a number of active volcanoes in Torba Province. In 2012 Gaua was evacuated to its eastern side due to a violent eruption.

4.2.1 Tourist Attractions in Torba Province

The main tourist attractions are:

- The active volcanoes on Gaua and Vanua Lava
- Gaua women water music
- Cultural experiences
- Reef and cave diving
- Scenic attractions
- Scenic waterfall on the west side of Vanua Lava

- Currently cultural experiences are not scheduled but can be arranged with village chiefs.

There are currently 30 – 40 bungalow rooms, plus several guest houses and village stay projects. There is an annual church at the end November and early December, called St Andrews festival. This reportedly attracts around 50 tourists.

4.2.2 Ports and Harbours in Torba Province

Table 2, below, records the ports and harbours in Torba Province. Where there is an anchorage only, the facilities column is left blank. The ZOC[20] (Zone of Confidence) ratings are used in the Hydrographic Risk Assessment, where all U ratings are assumed to be a D category.

Port	Island	Chart	Year	Scale	ZOC	Facilities	Shipping
Lorup Bay[21]	Ureparapara	BA1638	1860-1905	1:4,800 – 1:72,000	D		Domestic shipping
Ravenga[22] Is	Vanua Lava	BA1575	1984-1988	1:300,000	U		Domestic shipping
Maseunar[23] Channel (Port Patterson)	Vanua Lava	BA1638	1860-1905	1:4,800 1:72,000	U		Domestic shipping anchorage only and cargo brought to and from the shore by dug-out canoe.
Sola	Vanua Lava	BA1638	1860-1905	1:4,800 1:72,000	U	Jetty	Domestic shipping

Table 2 : Ports and Harbours in Torba Province

There are an additional 20 beach landings and 30 anchorages throughout the province.

4.2.3 Domestic Coastal Vessel Trade

There are three domestic coastal vessels involved in a subsidised monthly service to the Torres Group, KATI; PRIS and ALCANO. Gaua has a two weekly service to export Copra. Copra is reported to have been waiting for shipment for two years prior to attention being given to coastal shipping.

There is a jetty at Sola, **Figure 4-2**, which was badly damaged in a 2011 cyclone, such that it is practically unusable. Domestic coastal vessels enter Sola, via a channel alongside South Island and now load in a lagoon. Cargo

[20] The ZOC (Zone of Confidence) rating is a scale referencing the level of confidence in the data underling an official nautical chart. Assessment is given against set criteria, on a scale A1, A2, B, C, D and U. U means *unassessed*.
[21] A private survey was undertaken in 2005.
[22] A private survey has been undertaken at Ravenga), Vanua Lava.
[23] A private survey has been undertaken at Kwakea (Maseunar Channel into Port Patterson Bay), Vanua Lava.

is worked from dugout canoes. The domestic coastal vessels also ferry passengers to and from each island as air transport is expensive relative to earnings.

Figure 4-2 : Jetty at Sola, built in 1997. Undermined and Damaged by a Cyclone, 2011

4.2.4 Cruise Vessel Visits

Smaller cruise vessels (*Bremen, Oceanic Discoverer*) currently visit Lorup Bay, Ureparapara Island. These are on an annual basis only, with BREMEN appearing to be the most regular. Lorup Bay remains uncharted, but has been the subject of a private hydrographic survey by a large cruise operator.

Torba Province is not currently on the itinerary of cruise vessels based in Australia. It would require a 12 night cruise from either Brisbane or Sydney in the future, which is a length that attracts lower passenger numbers.

However, should Papua New Guinea (PNG) and/or the Solomon Islands develop as a cruise destination, the Banks and Torres islands could be included in 14 night cruise from Australia. The benefit of this would be an increased number of port calls for passengers, to offset the longer cruise time.

There are a number of live-aboard dive vessels that can operate in the area, which serve the rather specialist diving market. There is also an Auckland based passenger catamaran, which has operated passenger coastal tours up to Mota Lava Island. This has a reported capacity of about 20 passengers.

4.2.4.1 CRUISING YACHT ACTIVITY

Gaua is the host of a significant recreational yachting festival every year (1st September). It is attended by 30-40 yachts, which reportedly cruise out of Australia to attend the event, which commemorates a devastating earthquake and landslip that occurred in 1945.

There is also a Brisbane to Moto Lava annual yacht-race, which occurs in June. Between 20-30 yachts are understood to participate.

4.2.5 Key Sites of Environmental Significance

Rowa Reef is a cluster of coral cays lying between Mota Lava and Ureparapara, which rise from deep sea. The site is an outstanding example of a pristine offshore reef. Environmental damage would be significant from any vessel accident involving a significant spill. The reef is uninhabited, being evacuated prior to a past cyclone, with customary owners remaining in Vanua Lava. Visitors are people from nearby islands on fishing trips and sometimes cruising yachts.

The Reef Islands are enclosed by a large, horseshoe-shaped reef that protects an expansive lagoon with sandy shallows. To the northwest is a large break in the reef and an anchorage. It is a prolific site for turtle breeding, both Hawkesbill Turtles and Green Turtles. The Secretary General of Torba Province advised there were local plans to make Rowa Reef into a protected area. The island of Ureparapara is on the tentative list of UNESCO World Heritage Sites.

Other sites of environmental significance:-

- Pakea Island Protected Area
- Sola, Informal Conservation Area on Vanua Lava
- Rah Island, Moto Lava, another informal conservation area
- Watansa (Reef) Island Protected Area

There are some important mangrove sites around Port Patterson, with 4 locations recorded. Although there is an informal reserve it is not clear if it encompasses all of the Mangrove areas; thus the blanket protection for mangroves is relied on. Each of these mangrove sites were found recorded in a Pacific mangrove data set, ready for GIS use.

4.2.6 Key Sites of Cultural Significance

Cultural sites that are exposed to coastal areas that could be directly affected by a shipping accident are included in the risk assessment criteria.

Although 12 sacred sites were referenced, there were no sites reported that met the risk inclusion criteria in Torba Province.

4.2.7 Summary of Economic Information - Cargo Exports

The economy of the Torba Province is linked to subsistence farming. It is too hot for cocoa to grow successfully in the Torba Province. However, the Island of Gaua successfully produces both vanilla and pepper. Copra is the main crop and Gaua is also the major copra producer of the province. There is apparently expansion potential, but this is related to coastal shipping capacity.

Cattle and pigs are exported. Fishing occurs for local domestic consumption only. Coconut crabs, when in season are exported to other provinces.

At the time of the site visit (September, 2012), there was a power generating station being constructed that would operate on biodiesel fuel, which may in future be produced in the province. This is part of an EU aid project to reduce the dependence of Vanuatu on imported fossil fuels, as well as reduce carbon emission.

4.3 SANMA PROVINCE

Sanma Province is dominated by the main island of Espiritu Santo (population about 30,000 in 2011), and numerous off lying islands, the largest being Malo and Aore. The estimated total population of the province in 2010 was 44,528, of whom approximately 13,604 live in Luganville, where the provincial capital is situated.

The west side of Espiritu Santo is volcanic in geological nature and the east side is coral. This divides the east into a growing tourist zone and the west remains remote with mountainous terrain. Limited farming and copra production occurs in the west. Mount Tabwemasana, the highest mountain in Vanuatu (1879 metres) is located in the southwest of Espiritu Santo.

4.3.1 Tourist Attractions in Sanma Province

Tourism in Sanma has increased considerably since the introduction of direct flights from Brisbane to Espiritu Santo by Air Vanuatu in 2007. International visitors to Espiritu Santo were estimated at approximately 10,500 in 2008, with approximately 75% of those visitors arriving or leaving via Port Vila.

There are three hotels on Espiritu Santo and 32 other sources of accommodation ranging from guest houses to resorts. The east coast of Espiritu Santo has some of best known beaches in Vanuatu (Champagne,

Lonnoc and Golden Beaches). These can be equalled at other islands, which require a further flight from Espiritu Santo.

- World class diving and snorkelling
- WWII based experiences
- Blue holes (fresh water springs with deep, crystal clear blue water
- Cultural events

Cruise lines visiting Luganville offer prepaid tours which include both cultural and scenic tours. Sports such as diving, canoeing and horse riding are readily on offer.

4.3.2 Ports and Harbours in Sanma Province

Table 3, below, records the ports and harbours in Sanma Province. Where there is an anchorage only, the facilities column is left blank. The ZOC ratings are used in the Hydrographic Risk Assessment, where all U ratings are assumed to be a D category.

Location	Island	Chart	Year	Scale	ZOC	Facilities	Shipping
Big Bay	Espiritu Santo	BA1575	1986	1:312,000	U		Domestic
Hog Harbour (Champagne Beach)	Espiritu Santo	BA1638	1892-9	1:12,000 – 1:20,000	D	Jetty	Cruise vessel visits
Port Olry	Espiritu Santo	BA1575	1883-1894	1:18,260 1:73,000	U		Small cruise vessel visits Proposed limestone export
Luganville	Espiritu Santo	BA1638	1943 1892-9 1892	1;5,000 – 1:10,000 1:12,000 – 1:20,000 1:72,000	C	Main Wharf (overseas shipping) Simonsen Wharf, (domestic shipping)	International import/export Domestic hub port Cruise vessel visits

Table 3 : Ports and Harbours in Sanma Province

4.3.2.1 LUGANVILLE

Luganville (Espiritu Santo) is the second of two key international ports in Vanuatu. With a controlling depth of 12.8 m it is capable of handling all types of vessels. The main traffic includes tankers, Ro-Ro vessels, container vessels, general cargo and cruise liners. The port traffic is analysed in **Section 5.2.1**.

Main Wharf is 310m in length and has a mooring dolphin off the west end. The depth alongside is reported to be 10.4 metres but the water deepens rapidly and vessels up to 12m draught may berth if they lie off the wharf. Simonsen wharf, nearby, is used by domestic vessels.

Divers are available and minor repairs can be carried out. The Segond Channel reportedly provides a good cyclone anchorage.

A maritime college is situated on the Luganville water front and provides training for masters, engineers, ratings and fishers for local vessels and SCTW training for officer cadets, ratings and hospitality crew for SOLAS vessels.

4.3.3 Domestic Coastal Vessel Trade

Luganville is a terminus for many of the coastal trading vessels and provides a hub to the northern and central islands, especially Malakula. Strong coastal trading links also occur between Luganville and Port Vila and the Islands in-between. Cargo arrives and departs to and from the islands at Simonson Wharf. There is a considerable domestic coastal passenger trade to/from Luganville, which also serviced by domestic coastal cargo vessels. These can have significant licenced passenger capacity (see **Section 5.4**). There are also more dedicated passenger vessels, such as *Efate Queen* and *Big Sista*, which provide a weekly passenger service between Luganville and Port Vila, with calls to adjacent islands along the route.

4.3.4 Cruise Vessel Visits

Cruise vessels visit Luganville and Champagne Beach in Espiritu Santo, with most visits going only to Champagne Beach. Champagne Beach, Hog Harbour, provides a soft white coral sand beach. There is a concrete jetty for tendering passengers and good quality toilets, both funded by the cruise line using the beach[24]. The local landowner has also built shelters for the local women to sell craftwork. When a passenger ship is in port a selection of taxis, mini busses and 4x4 vehicles drive up from Luganville and offer tours

[24] This is understood to be in return for lower marine safety charges, until the infrastructure is paid for out of the savings the cruise line makes.

to various attractions which are primarily on the east coast, which is served by a tar sealed road extending from Luganville to Port Olry.

The government charges a landing fee of about US$4,200 per call but the largest cruise operator's vessels are not obliged to pay this fee until their to build costs for jetties at Champagne Beach (Hogg Harbour) and "Mystery Island" (Inyeug, Aneityum) have been paid off.[25]

4.3.5 Key Sites of Environmental Significance

- Vatthe National Conservation Area;
- Sungmas Conservation Area;
- The coastal area from Turtle Bay south to Pekoa.

4.3.6 Key Sites of Cultural Significance

Cultural sites that are exposed to coastal areas that could be directly affected by a shipping accident are included in the risk assessment criteria. Although sacred sites were referenced, there were no sites reported that met the risk inclusion criteria in Samna Province.

4.3.7 Summary of Economic Information – Cargo Exports

The tourist economy in Sanma Province makes it an importer of most produce manufactured in Vanuatu. It also manufactures and exports items based on volcanic mud, which has been imported from other islands.

The province has a commercial copra mill, producing bio diesel, which takes copra from both Espiritu Santo itself and other islands in the area. This is an expanding trade.

Cattle production is significant with live cattle exports going to other islands of the Vanuatu group as well as beef export.

The port data is analysed in a later chapter but it shows a steady trade by SOLAS vessels.

Coal is reported to lie in the west and there are significant limestone reserves in the northeast. Limestone quarrying and export via coastal trader is planned but said to be the subject of competing land ownership claims. Anecdotal advice also suggests other minerals to be present.

[25] South Pacific Cruise Shipping Development Strategy, 2007.

4.4 PENAMA PROVINCE

Penama Province consists of the three islands of Pentecost (population about 12,000 in 2011), Ambae (population about 10,000 in 2011), and Maewo (population about 1,800 in 2011).

The provincial capital is situated at Longana on the island of Ambae, which was visited by the project team. This island is a large active volcano and the village is sited at a location where lava flows are likely to route away from during a large unexpected eruption.

Ambae has a biofuel mill and a generator being built at Longana, which will supply biofuel from copra.

4.4.1 Tourist Attractions in Penama Province

The main attractions are land diving at Homo Bay on Pentecost (April to June), Manaro Volcano and Voui Lakes (twin crater lakes) on Ambae and cultural activities. With the advent of direct flights from Australia to Espiritu Santo it is expected that tourism in the province will further increase.

In 2009 an estimated 1,257 international tourists visited Penama Province. Most visitors arrive via Port Vila and the land diving trip takes four days.

4.4.2 Ports and Harbours in Penama Province

Table 4, below, records the ports and harbours in Penama Province. Where there is an anchorage only, the facilities column is left blank. The ZOC ratings are used in the Hydrographic Risk Assessment, where all U ratings are assumed to be a D category.

Location	Island	Chart	Year	Scale	ZOC	Facilities	Shipping
Lolowai Bay	Ambae (Aoba)	BA1638	1860 – 1905	1:4,800 – 1:72,000	D	Charted jetty reported not to exist	Domestic shipping
Loltong Bay	Ile Pentecost	BA1570	Not known	Misc. lines	D		Domestic shipping
Homo Bay[26]	Ile Pentecost	BA1570	1890-4	1:70,000 – 1:145,000	C	Jetty (Construction funded by Carnival Cruise line)	Domestic shipping Cruise vessel visits (seasonal)

Table 4 : Ports and Harbours in Penama Province

4.4.3 Domestic Coastal Vessel Trade

There is a weekly coastal trader and passenger service to Penama Province. Vessels trade both up and down the west coast and take cargoes to both Luganville and Port Vila.

The east coast of Maewo and Pentecost is mountainous. Although this is where most of the kava and Copra production occurs, coastal vessel-calls are not made to the east coast. There are tentative plans reported for a trial subsidised service to east coast locations of both Maewo and Pentecost.

Jetties in Penama province are in most cases missing, having been destroyed by cyclone damage in 2011 (Lolowai). This was of wooden construction and is a subject for replacement by the joint NZ/AU and ADB project. This bay is directly accessible as coral has been removed by explosives[27]. A replacement jetty could be prudently located further on the east side of this bay, which would then be afforded better shelter from swell in adverse weather and cyclone in the worst case.

An intact but unused jetty at Lolopeupue, Ambae is shown in **Figure 3-1** (Page 11).

[26] A private survey was undertaken in 2002.
[27] Chart BA1638 Lolowai Bay insert needs to be updated where coral has been removed.

Figure 4-3 : The Remains of the Wooden Jetty at Lolowai Bay are Visible

4.4.4 Cruise Vessel Visits

Cruise vessels visit Homo Bay, South Pentecost, during the land diving season. There is a land-diving event once per week during May, Jun and the first two weeks of July. As the land diving ceremonies are planned and co-ordinated with the cruise operators, at least one large cruise-vessel is in attendance for each event.

Smaller cruise vessels are said to have visited Ambae, Maewo and Pentecost in the past, but these visits are infrequent.

There are also a number of megayachts that journey for the land diving event. Evidence of these vessels was received in the S-AIS data set.

4.4.5 Key Sites of Environmental Significance

There are no mangroves in this part of Vanuatu and areas of the Ambae coastline visited are suffering from significant sea erosion. It is mostly volcanic in nature. One site of significance is the Duviara Conservation Area, on the north eastern side of the island.

4.4.6 Key Sites of Cultural Significance

The following cultural site was taken account of in the risk assessment:-

- Homo Bay, Pentecost, which could be affected by a marine accident.

4.4.7 Summary of Economic Information – Cargo Exports

Penama Province is the largest kava producer in Vanuatu. It is exported via Port Vila and Luganville, and taken there by domestic coastal vessels which load on the west coast of Pentecost and Maewo and the north coast of Ambae. Copra and kava production is mostly on the east coast of Pentecost and Maewo. Thus cargo has to be transported over the mountains to the loading ports for sea transit[28].

4.5 MALAMPA PROVINCE

Malampa Province consists of the four islands of Malakula, Ambrym, Paama and Lopevi. The total population of the province was about 38,000 in 2011. The provincial capital is situated at Lakatoro on the island of Malakula.

There are six airfields; 3 in Malakula, 2 in Ambrym and 1 in Paama. These provide access to Espiritu Santo and Éfaté (Port Vila).

The principal exports are copra, cocoa and beef.

4.5.1 Tourist Attractions in Malapa Province

The main tourist attractions are the twin volcanoes of Mount Marum and Benbow on Ambrym, cultural experiences and trekking. In 2008 there were an estimated 3,000 visitors to Malakula and Ambrym. Malakula is marketed as a four day trip and Ambrym as an overnight trip. Most visitors arrive from Port Vila, but more are arriving from Espiritu Santo with the introduction of direct flights from Brisbane to Espiritu Santo. There are no hotels or resorts in Malampa and tourist accommodation is provided in a variety of bungalows and guest houses.

4.5.2 Ports and Harbours in Malampa

Table 5, below, records the ports and harbours in Malampa Province. Where there is an anchorage only, the facilities column is left blank. The ZOC ratings from the chart data are used in the Hydrographic Risk Assessment, where all U ratings are assumed to be a D category.

[28] There is some consideration been given to extending a domestic coastal vessel transport subsidy to facilitate loading on the East Coast.

Location	Island	Chart	Year	Scale	ZOC	Facilities	Shipping
Craig Cove	Ambrym	BA1577	1883-1914 1891-3	1:12,000 – 1:24,000 1:73,000	C C	Wharf - ruined	Domestic shipping
Wala Island[29]	Malakula	BA1570	1890-4	1:70,000 – 1:145,000	C	Jetty	Cruise vessel visits
Litslits	Malakula	BA1577	1966	1:25,000	U	Jetty	Main domestic shipping wharf
Norsup	Malakula	BA1577	1966	1:25,000	U	Private wharf	Domestic shipping.
Metenovor Bay	Malakula	BA1577	1974 1974	1:30,000 1:100,000	B C		Domestic shipping. Possible future cruise vessel visits
Port Sandwich and Maskelyne Is	Malakula	BA1577	1966 1883 – 1914 1972	1:25,000 1:12,000 – 1:24,000 1:5,000	B C B	Jetty	Cruise vessel visits Cyclone anchorage

Table 5 : Ports and Harbours in Malampa Province

Other wharves for remote areas are Lambumbu old wharf, west coast, Malakula. It is reported there are no serviceable wharves on the islands of Ambrym or Paama, due to cyclone damage.

4.5.3 Domestic Coastal Vessels in Malampa Province

There are 10 jetties and wharves in the province; seven in Malakula, two in Ambrym and one in Paama provide berthage for domestic coastal vessels. However the wharves are not well maintained and many have suffered cyclone damage. Domestic coastal vessels service all of these.

4.5.4 Cruise Vessel Visits

In 2010 there were 15 cruise vessel visits to Wala Island, Malakula, one visit to Rano Island, Malakula and one visit to Raron Bay, Ambrym.

[29] A private survey was undertaken in 2002.

Wala Island has a pristine fine coral sand beach fringed with palms and, with no roads, electricity or telephones, is regarded by passengers as an unspoilt island paradise.

In early 2007 there was a physical dispute amongst locals on the beach in front of passengers and the cruise vessel captain cancelled the visit.

4.5.5 Key Sites of Environmental Significance

There are a number of environmentally sensitive areas in Malampa province of relevance to the risk assessment. They are all informal reserves in that sustainable management of the marine assets and environment is being delivered, using the kastom system.

- Wiawi Conservation area in northwest Malakula was declared a protected area in 1994 by the kastom landowners. It covers a large inland area and its coastal area has a long white sand beach where sea turtles come ashore to nest and lay their eggs. It remains an informal reserve. Dugong also breed in the reserve.
- The Amal and Crab conservation area is located at Crab Bay, East Malakula. Although it remains an informal marine protected site, it is part of a UN funded project, promoting sustainable use of land crab resources at Crab Bay by strengthening the traditional system of restricting resource use through tabus. The green waters within the bay are lagoon-like and highly productive, supporting soft corals, seagrasses, turtle and dugong populations.
- There are significant areas of coastal mangroves around the coasts of Malakula (including both the conservation areas above). Uri Narong Marine Park is a conservation area established in 1994, close to Port Stanley. It covers more than 50 hectares of mangrove forest, tidal flats and reefs near Uri Island. Marine life found in the reserve, include giant clams, fish, crustaceans, coral and shellfish.
- Dixon Reef is located on the west coast of Malakula and has both an informal marine reserve as well as a site of cultural importance. It is managed by the tabu system, and has attractive diving attributes.

4.5.6 Key Sites of Cultural Significance

There are a number of important cultural sites in Malampa Province; the most important of these from the perspective of the hydrographic risk assessment (pollution damage from a shipping accident) is Dixons Reef on the west coast. There is a submerged village reported on the site. Dixons Reef is also an important (but informal) environmental reserve.

4.5.7 Summary of Economic Information – Cargo Exports

The island of Malakula is ideally located for coca production, which is mainly exported from Lambumbu Bay, on the west coast, where a landing craft is used (the jetty was destroyed by cyclone). Vanilla is also grown. There is a significant, and growing, copra trade to feed biofuel mills. The province also exports cattle.

4.6 SHEFA PROVINCE

Shefa is made up of approximately 27 islands; Éfaté is the most heavily populated and is also the location of the Vanuatu capital, Port Vila. It is in the south of the province and is surrounded by several smaller islands, (including Iririki, Ifira, Eratap, Erakor, Erueti Lep, Eratoka, Lelepa, Moso, Nguna, Pele, Kakuhla, and Emao). To the north are the Shepherd Islands, a group that includes 10 islands, and Cooks Reef. The other large island in the province, Épi, lies to the north.

Port Vila is both the Vanuatu capital and the Shefa provincial capital. The population of the province was 78,721 in the 2009 census.

The main produce of the province is root crops, vegetables, kava, peanuts, cattle, timber products, and beef and pelagic fish. Port Vila is the main market centre for these products. Éfaté and Épi islands lead the commercial beef production, with some cattle being barged from Épi to the Port Vila abattoirs.

4.6.1 Tourist Attractions in Shefa Province

There are a selection of resorts, bungalows and guest houses on Éfaté, Nguna, Pele, Emau, Tongoa, Emae and Épi.

Some 90% of visitors to Vanuatu arrive through the port or airport of Port Vila, thus it is the gateway into Vanuatu. Éfaté has a tar sealed ring road, funded by MCC[30]-America, and completed in 2010. Travel off the main ring road can be difficult, particularly in the wet. Roads exist on Emae, Épi and Tongoa but travel conditions can be bad as the roads are graded infrequently. Most tourist activity in the province occurs on Éfaté. Attractions include the Mele-Maat Cascades, the world's first underwater post office off the shore of Hideaway Island, the Vanuatu Cultural Centre, and Chief Roi Mata's Domain, Eretoka.

[30] MCC = Millennium Challenge Corporation, which was funded by a grant from the United States of America. Implementation in Vanuatu was established by a Millennium Corporation Account (MCA) Vanuatu.

There are four weekly flights to Épi (two each to Lamen Bay in the north and Valesdir in the south). Emae and Tongoa have three weekly flights each.

4.6.2 Ports and Harbours in Shefa Province

Table 6, below, records the ports and harbours in Shefa Province. Where there is an anchorage only, the facilities column is left blank. The ZOC ratings are used in the hydrographic risk assessment, where all U ratings are assumed to be a D category.

Location	Island	Chart	Year	Scale	ZOC	Facilities	Shipping
Tongoa Wall	Shepherd	BA1570	1890-1894	1:70,000 1:145,000	U		Diving
Port Vila	Efate	BA1494	1990 1987 1988 1984 1961-2	1:2,000 1:500 1:2,500 1:7,500 1:7,500	B	Main Wharf (International shipping) Star Wharf (Domestic shipping Yacht moorings and berths)	International import/export Domestic hub port Cruise vessel visits
Lamen Bay	Épi	BA1570	1998	1:4,000	U	Jetty	Domestic vessels

Table 6 : Ports and Harbours in Shefa Province

4.6.2.1 PORT VILA

Port Vila is the largest port of Vanuatu. It is the main hub of shipping, and handles overseas cargo, container, Ro-Ro, tanker and cruise vessels. The controlling depth in the channel is 11.9 metres. Main Wharf is 223 metres long with a depth alongside of 10.7 metres. A mooring dolphin is situated 30 metres off each end of the berth. Divers are available and minor hull repairs can be carried out.

Star Wharf (Ardimanni Wharf) handles domestic cargo, and is used by domestic coastal vessels. The wharf is 55 metres long with a depth alongside of 8.2 metres. Star Wharf is in a dilapidated state and subject to a program of refurbishment provided jointly by AusAid, NZAID and the ADB bank.

Figure 4-4 : Star Wharf is of Light Construction and in Poor Condition

Figure 4-5 : Star Wharf is in a Deteriorated Condition

There are six other wharves and jetties in Paray Bay which are also used by domestic vessels. There are also yacht moorings and berths used by locally registered and overseas yachts in Paray Bay.

There are plans to upgrade Star Wharf to better serve coastal shipping needs, and for it to include use by cruise vessels. There are further plans to

extend Main Wharf to allow two vessels to lie alongside and work cargo. At the moment any cargo vessel alongside Main Wharf has to vacate the berth to allow a cruise ship to berth.

4.6.3 Domestic Coastal Vessels in Shefa Province

The coastal shipping trade in Shefa province appears vibrant and growing. Port Vila is a major hub for both the coastal passenger trades and domestic coastal trades. The hub focus is on the central and southern islands, but there are also strong domestic coastal trading links between Luganville and Port Vila, involving the islands in between.

4.6.4 Cruise Vessel Visits

Cruise vessels visit Port Vila, and the volume of calls and the size of vessel visiting there has risen significantly in recent years (see **Section 4.7.7** for traffic analysis at Port Vila). Lamen Bay on Épi was visited in the early 2000s, by a number of cruise vessels. However, uncertainty of land ownership led to land disputes, and there have been no cruise vessel calls since.

Port Vila is rated highly by cruise passengers, reportedly among the highest in all of the South Pacific destinations. Currently, the major cruise operator, Carnival, have one cruise vessel a week calling at Port Vila but in 2013 this will increase to two vessels a week. Without attention to wharf construction, cargo and liquid vessels will compete with cruise vessels, which will result in delays due to the limited wharf space.

One of Port Vila's strengths is the variety of shore excursions available. It is reported that over 50% of all cruise passengers take at least one pre-sold excursion. More than 20 half and full day tours are offered with activities including island tours, Eskasup Cultural Village, day cruises, diving and snorkelling, horse riding, abseiling and sailing.

It is estimated that the passenger spend is approximately US$100 per passenger, including port fees etc.[31]

4.6.5 Key Sites of Environmental Significance

There are a number of marine reserves on Shefa Province, governed by informal agreements. These were taken account of in the risk assessment.

- Epau Land Reserve
- Emua Marine Protected Area

[31] South Pacific Cruise Development Strategy, December 2007

- Paunagisu Marine Protected Area
- Epau Marine Protected Area
- Nguna/Pele Marine Protected Area
- Mare Sauwai Protected Area
- Moso Marine Protected area
- Emae Marine Protected Area
- Cook Reef, which is situated west of Emae, is a coral atoll two miles wide. It has developed on volcanic foundations and like Rowa Reef (Torba Province), it is an outstanding example of a pristine offshore reef environment.

4.6.6 Key Sites of Cultural Significance

Chief Roi Mata's Domain was inscribed in 2008 as Vanuatu's first UNESCO World Heritage Site. It remains the only heritage site in Vanuatu that is formally recorded. It consists of three early 17th century sites on the islands of Éfaté, Lelepa and Eretoka associated with the life and death of the last paramount chief of central Vanuatu.

The sites are:

1. Mangaas on Éfaté where Roi Mata lived
2. Fels Cave on Lelepa Island where he died
3. Roi Mata's grave on Eretoka Island

The sites have tabu prohibitions which have reportedly been in existence for over 400 years.

4.6.7 Summary of Economic Information – Cargo Exports

Tourism accounts for 88.4% of the Shefa economy, agriculture 7.9%, forestry 1.5% and fisheries 1.1%. The contribution made by agriculture is reported at 52% commercial and 48% subsistence.

The Shefa Province Tourist Plan gives the Shefa economy a total value of 2,032M Vatu (US$22M) of which 1,796M Vatu was received from tourism which was mainly concentrated in the Port Vila urban area.

Éfaté is no longer a significant copra producer, but the Shepherd Islands, including Épi, produce a few hundred tonnes annually. A copra biofuel mill is in service on Épi, which is increasing both demand for copra, but also fuelling a booming coastal trade bringing copra for the mill, which turns it into diesel.

Coffee and cocoa are no longer produced in Shefa but the province remains a strong cattle producer, particularly on the islands of Éfaté and Épi. Large plantation holders are responsible for 90% of the beef production.

Exports include kava, spices, peanuts, beef and marine products.

4.7 TAFEA PROVINCE

Tafea Province consists of the five islands of Tanna (population about 20,000 in 2011), Erromango (population about 1,500 in 2011), Aniwa, Futuna and Aneityum.

The population of the province was about 29,047 in the 1999 National Census and was estimated to be 36,599 in 2009.

The provincial capital is situated at Isangel on the island of Tanna, where the Secretary General's office is located. This was visited by the project team in the 2012 data gathering exercise. Tanna has a cooler climate and has rich volcanic soil.

Many families in Tanna are dependent on subsistence agriculture and fishing.

4.7.1 Tourist Attractions in Tafea Province

The principal tourist activities are:

- Tanna; volcano tours and kastom villages and cultures;
- Aneityum (marketed as Mystery Island and visited by cruise vessels only);
- Erromango; kauri reserve;
- Aniwa; lagoon for diving and snorkelling.

The possibility of a direct international flight from New Caledonia to Tafea has the potential to increase tourism (Tanna airport has been made an international port of entry).

Mount Yasur volcano, on Tanna, is considered to be the most accessible active volcano in the world. Vehicle access is possible to within 5-6 minutes' walk of the crater rim, which is limited to 29 people capacity. Occasional increased volcanic activity tends to result in closure of access to the rim.

The number of visitors to Tanna has increased from an estimated 5,100 in 2004 to an estimated 10,100 in 2008. The main purpose of visits to Tanna is the Mount Yasur volcano, followed by kastom villages and wilderness areas.

There are approximately 11–12 resort/bungalow rooms and several guest houses/village stay projects.

4.7.2 Ports and Harbours in Tafea Province

Table 7, below, records ports and harbours located in Tafea Province. Where there is an anchorage only, the facilities column is left blank. The ZOC ratings are used in the Hydrographic Risk Assessment, where all U ratings are assumed to be a D category.

Location	Island	Chart	Year	Scale	ZOC	Facilities	Shipping
Waisisi[32]	Tanna	BA1581	1853 – 1906	1:7,500 – 1:36,000	U		Domestic shipping Possible future cruise vessel visits
Lénakel[33]	Tanna	BA1581	1853 – 1906 1984	1:7,500 – 1:36,000 1:12,500 – 1:24,000	U	Jetty	Domestic shipping Possible future cruise vessel visits
Port Resolution	Tanna	BA1576	1984-88 1968	1;250,000 1:870,000	U		Domestic shipping Small cruise vessel visits
Aneighowaht Bay (Mystery Island)	Aneityum	BA1581	1853 – 1906 1984	1:7,500 – 1:36,000 1:12,500 – 1:24,000	C	Floating jetties Inyeug Islet	Domestic shipping Cruise vessel visits

Table 7 : Ports and Harbours in Tafea Province

The jetty at Lénakel is exposed to Pacific swell and surge. It is also low in relation to the high water level. It is a substantial structure, which has some recognition of the sea conditions it is exposed to in its design. Domestic coastal vessels have to pull off the jetty when the sea conditions deteriorate (which is reported as regular) and the approach to the jetty is difficult. Although its location is historic, it does not appear to be in the best location on the island with respect to the prevailing sea conditions. There are now local supply businesses operating nearby.

[32] A private survey was undertaken in 2005
[33] A private survey was undertaken in 2005

Figure 4-6 : Lénakel Wharf is Open to Significant Surge Loading

4.7.3 Domestic Coastal Vessels in Tafea Province

The island of Tanna enjoys the largest volume of domestic coastal vessels, with calls to Lénakel Wharf almost daily. There are also some of the largest domestic coastal vessels on this route, measured by Gross Tonnage.

4.7.4 Cruise Vessel Visits

The primary cruise destination for cruise vessels in Tafea Province is Mystery Island, specifically the island of Inyeug, off Aneityum. Cruise vessels anchor in Aneighowhat Bay. Inyeug (meaning "mystery") is a small uninhabited island, which has a landing strip along its length[34] and is promoted as a 'day on an idyllic beach'. There is no tourism development or infrastructure but a cruise operator funded the construction of a jetty suitable for landing passenger tenders. The Government charges a landing fee of US$ 4,200 per vessel visit, however, the cruise operator are not obliged to pay this landing fee until the investment in this jetty and one at Champagne Beach has been paid down.

Aneityum Islanders travel to Mystery Island whenever a cruise ship visits to sell local handicrafts to passengers. It is understood the local community receives a landing fee reported to be approximately US$3,400[35] per ship visit. Local tribes provide entertainment and sell handicrafts to passengers.

[34] Advice suggests the landing strip was constructed in WW2, to provide an emergency facility for damaged aircraft.

[35] During the 2012 Vanuatu visit, Government representatives from different islands quoted landing (or visiting) fees ranging from 300,000Vatu to 400,000 Vatu (US$3300 –US$4.350). This is reported to include entertainment dances provided by local tribes.

Small "boutique" cruise vessels[36] occasionally call at Port Resolution and Waisisi Bay on Tanna. Both are anchorages requiring tendering of passengers ashore.

ADB and NZAID have provided funding in 2012 to build a jetty at Waisisi. This will benefit such trade. The main attraction out of Waisisi Bay is the active volcano, which is readily accessible. However there is a capacity of only 29 people at the crater rim at any one time.

Port Resolution has shallowed in living memory, with depths of less than 2m reported at low water. The sea bed in that area was quoted by cruise vessel agents to be rising at 7cm per annum, significant in geological terms.

4.7.5 Key Sites of Environmental Significance

Tanna has turtle breeding grounds and although the coastline is mostly rocky, it has an abundance of coral.

4.7.6 Key Sites of Cultural Significance

In relation to the hydrographic risk assessment, the most important cultural site in the province is on the island of Aniwa. Here there is a lagoon open to the tide, which is said to have been formed by one of the ancient gods. This is at sea level and pollution damage from a shipwreck would do both cultural as well as environmental damage.

[36] These vessels carry between 150 and 250 passengers.

4.7.7 Summary of Economic Information – Cargo Exports

Sector	Island	Product
Agriculture	Tafea (all)	Beef
		Copra
	Tanna	Coffee
		Potatoes
		Kava
		Root crops
		Spices
		Market vegetables
	Aniwa	Citrus
Forestry	Tafea (all)	Sandalwood
	Tanna	Timber processing
	Erromango	High value hardwoods
	Aneityum	Pine plantations
Fishing	Tafea (all)	Commercial fishing
Handicrafts	Tafea (all)	Mats, baskets, carvings

A coffee estate has been established on Tanna promising 200 tonnes of organic Arabica coffee annually. A commercial bean processing plant is also in production on Tanna. Additionally, coffee is increasingly been grown by individual families in their gardens with the produce being processed and marketed by a co-operative through the Fairtrade distribution system. Tanna Coffee ("*Vanuatu Gold*") won a bronze award in the 2012 Sydney Royal Fine Food Show.

A company has been established to export potatoes to Port Vila. Copra exports, whilst reportedly declining, are still significant. The pine plantations on Aneityum exports timber to Port Vila and logging concessions have been agreed to cut tamanu on Erromango.

Improved infrastructure, particularly roading, is required to allow the economy to grow.

5 ANALYSIS OF SHIPPING IN VANUATU FROM LOCAL RECORDS

5.1 INTRODUCTION

This section of the report analyses the vessel traffic in and around the waters of the Vanuatu archipelago, based on local records. In the case of large international vessels (trading under the SOLAS convention), port authority data from both Luganville and Port Vila became critical to the success of the risk assessment. This, and information kindly provided by cruise stakeholders about cruise calls throughout the islands of Vanuatu[37], allowed factual traffic port-call records to be merged with ship transit records taken from satellite monitoring.

In the case of domestic coastal shipping, vessel data was taken from the Vanuatu domestic fleet register, combined with schedule information and service frequency information gained from the provincial visits to Vanuatu.

This information was later used to cross check with satellite received data from SOLAS ships, which provided a QA function.

5.2 TRAFFIC ANALYSIS - ARRIVALS DATA FROM KEY PORTS OF VANUATU

The harbour masters' of both Port Vila and Luganville provided a hard copy of pilotage certificates for each SOLAS vessel visiting each of these two key Ni-Vanuatu ports. In the port management systems, all vessels had a pilotage certificate in some form, even those (such as some cruise liners) holding pilotage exemption status[38]. Other data about cruise vessel calls throughout the islands of Vanuatu was obtained from agents based in Vanuatu, cruise operators and web-based itineraries. Spreadsheets were manually created from this data to allow traffic analysis based on port-call records to be undertaken.

In a number of instances, such as feedback about cruise vessel visits, the port-call data was successfully cross referenced with cruise vessel data kindly supplied by Carnival Cruise Line, local vessel agents, as well as online itineraries for other regular callers, both cargo and cruise.

Once firmly established as factual, this data set was critical in providing the input for analysis of trends, seasonality and sizes of the visiting vessels.

[37] Which was itself supplemented by web based research of cruise vessel itineraries.
[38] Pilotage Exemption Holders (PEC) are mariners who regularly visit a port a number of times each year and have passed an examination of the port authority, to confirm they have acquired sufficient local knowledge to provide equivalence to the services of a pilot provided by the port.

More importantly, it was crucial in linking satellite AIS (S-AIS) data to factual port calls, thus creating a viable data set for GIS analysis.

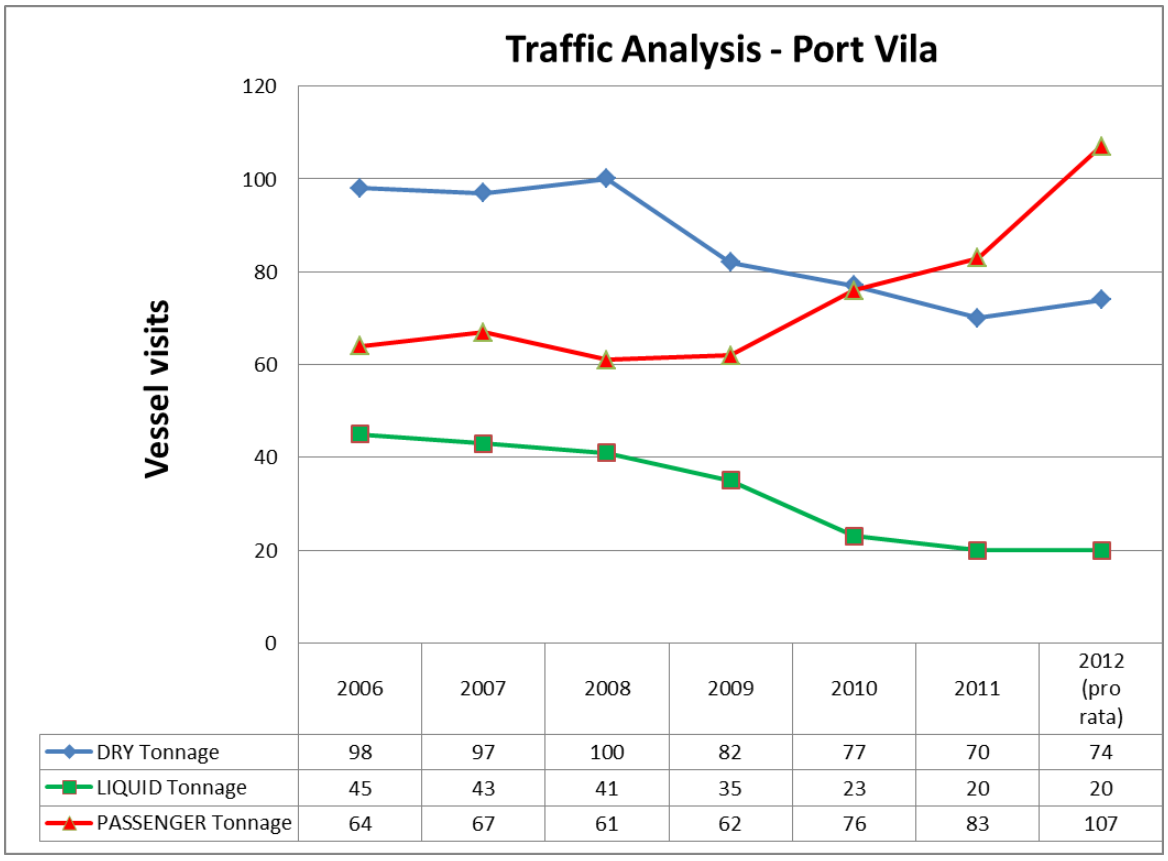
The data period for Port Vila was 2006 to September 2012, although for the period 2006 to 2008, only summary vessel call information was available. For Luganville, the data period was from 2009 to September 2012.

For the purpose of the traffic analysis, SOLAS vessel calls have been categorised into three core vessel types; passenger (cruise), dry cargo, and bulk liquid. The "dry" vessels include bulk carriers, general cargo, containers and Ro-Ro vessels. The "bulk liquid" vessels include all types of tankers, i.e. oil, chemical and gas.

5.2.1 Port Vila Traffic Analysis - Overall

Port Vila is the most significant Vanuatu port (and therefore trading centre) by ship-traffic volume. A graphical representation of the traffic of different types of vessels was shown below in **Figure 5-1**, below.

The key trend shown by the port data is the dramatic expansion of visiting cruise vessel numbers, 2009 to 2012.



	2006	2007	2008	2009	2010	2011	2012 (pro rata)
DRY Tonnage	98	97	100	82	77	70	74
LIQUID Tonnage	45	43	41	35	23	20	20
PASSENGER Tonnage	64	67	61	62	76	83	107

Figure 5-1 : Traffic Profile for Port Vila Showing Vessel Movement Trends

As nearly all cruise vessels visiting Vanuatu call at Port Vila, it is a good yardstick for vessel trends overall. Both liquid and dry cargo vessel numbers at Port Vila are drifting downwards but the underlying data shows that the size of vessels visiting Vanuatu are, in turn, gradually rising. Notwithstanding recessionary pressures, this is consistent with worldwide trends, where larger vessels ordered prior to the 2008-9 recession are now in service. Shipping lines in the scheduled container trades have also increased vessel visits to Luganville (see **Figure 5-3**, later in this section), but also improved their own efficiencies by introducing slow steaming and vessels transiting with increased cargo volumes.

5.2.1.1 CRUISE VESSELS VISITS – PORT VILA

The data shows that Port Vila has by far the most cruise visits to Vanuatu. Since 2009, there has been a year on year increase in cruise ship numbers. There were 62 vessel calls in 2009, 76 in 2010 and 83 in 2011. The forecasted figure for 2012 shows there will be over 100 vessel calls (and this is conservative as it is based on a pro-rata assumption for the final quarter of 2012). That is a 34% rise in three years; more importantly it has been a rise in a recessionary period. Forecast data from cruise operators and local agents strongly suggests this increase will be sustained in future years. What the graphs do not show is that cruise vessels visiting Port Vila are also becoming significantly larger. This is placing pressure on both port and the wider infrastructure of Port Vila. On present trends it will, in future years, be normal for up to 3000 passengers to visit in one day.

The cruise movement profile is steady throughout the year, with approximately weekly calls becoming the norm from 2009 onwards. In 2012/2013 summer season, two cruise ship visits per week is likely to become normal. Cruise ships only spend a day in port and two calls a week opens up a marketing opportunity for Vanuatu tourism interests to offer passengers tailored itinerates for a longer stay, to see key island attractions and then pick up a later cruise vessel to continue with their cruise.

During 2009 and 2010, vessel calls increased during Christmas and New Year vacations, a trend which has also continued.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2006	8	6	7	7	5	2	3	4	6	6	5	5	64
2007	8	10	5	6	5	3	4	2	4	5	6	9	67
2008	8	6	4	3	3	1	5	3	3	9	10	6	61
2009	10	9	6	7	5	2	5	2	4	6	3	3	62
2010	8	4	8	7	4	7	5	6	5	7	7	8	76
2011	9	8	4	9	9	8	6	4	5	4	6	11	83
2012 (Jan-Sep)	13	14	9	10	8	7	9	5	4				79

Table 8 : Cruise Vessel Visit Data for Port Vila

5.2.1.2 DRY CARGO VESSELS – PORT VILA

Port Vila's core trade is from dry cargo vessels, which include container vessels and other types of dry cargo carriers. During 2009 a total of 82 vessel calls were made, which had reduced to 70 by 2011. During 2011, there were 17 calls made by vessels of size 17,000-18,000 GT while there were 14 calls during 2009 of similar tonnage vessels. This shows that larger tonnage is beginning to visit more often.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2006	11	11	9	6	10	6	8	8	8	7	7	7	98
2007	7	7	6	7	11	9	9	8	8	10	9	6	97
2008	8	9	10	9	8	7	8	9	10	6	8	8	100
2009	9	8	5	8	7	8	10	7	6	6	3	5	82
2010	6	6	7	6	6	8	7	8	6	5	6	6	77
2011	5	5	8	5	7	5	6	6	7	6	5	5	70
2012 (Jan-Sep)	8	6	8	6	6	5	7	7	2				55

Table 9 : Dry Cargo Vessel Visit Data for Port Vila

5.2.1.3 TANKER VISITS- PORT VILA

Oil/chemical/gas vessels had also shown a reduction in calls since 2009; from 35 during 2009 to 20 during 2011. The port was served by one oil tanker *Maohi*, of 30,237 GT; there were 8 such calls in 2009 and only 6 in 2011. There could be a number of reasons for this, including the success of the copra consuming biofuel diesel project.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2006	5	3	4	3	3	4	3	4	2	6	1	7	45
2007	5	6	4	3	6	3	2	3	2	3	3	3	43
2008	5	3	3	3	2	4	4	6	4	2	3	2	41
2009	3	2	3	3	3	3	3	1	3	5	4	2	35
2010	3	2	2	1	2	2	2	1	2	1	1	4	23
2011	0	3	2	2	4	1	1	1	2	1	2	1	20
2012 (Jan-Sep)	2	1	2	3	1	2	3	1	0				15

Table 10 : Tanker Vessel Visit Data for Port Vila

The gas tanker statistics paint a different picture. The vessel calls increased from 11 in 2009 to 14 in 2011. The vessels calling were either about 4000 GT or mid 2000 GT. There were more vessel calls by both tonnages during 2011 than during 2009. The forecast for vessel calls for 2012 will be somewhere between 2009 and 2011 levels.

No chemical tankers have been recorded at Port Vila, 2009 to September 2012.

5.2.1.4 NOTE REGARDING RO-RO VESSELS

A ro-ro vessel *Havannah* was providing a service between Noumea (New Caledonia), Port Vila and Luganville, calling last at Port Vila, May 2012. The ports are also served by other SOLAS ro-ro vessels, trading to and from the Far East. These vessels were designed to carry both containers and ro-ro cargo.

Figure 5-2 : Type of SOLAS Ro-Ro Vessel Serving the Island Trade

5.2.2 Luganville Traffic Analysis

A graphical representation of the SOLAS vessel traffic trends at Luganville is shown below, **Figure 5-3**.

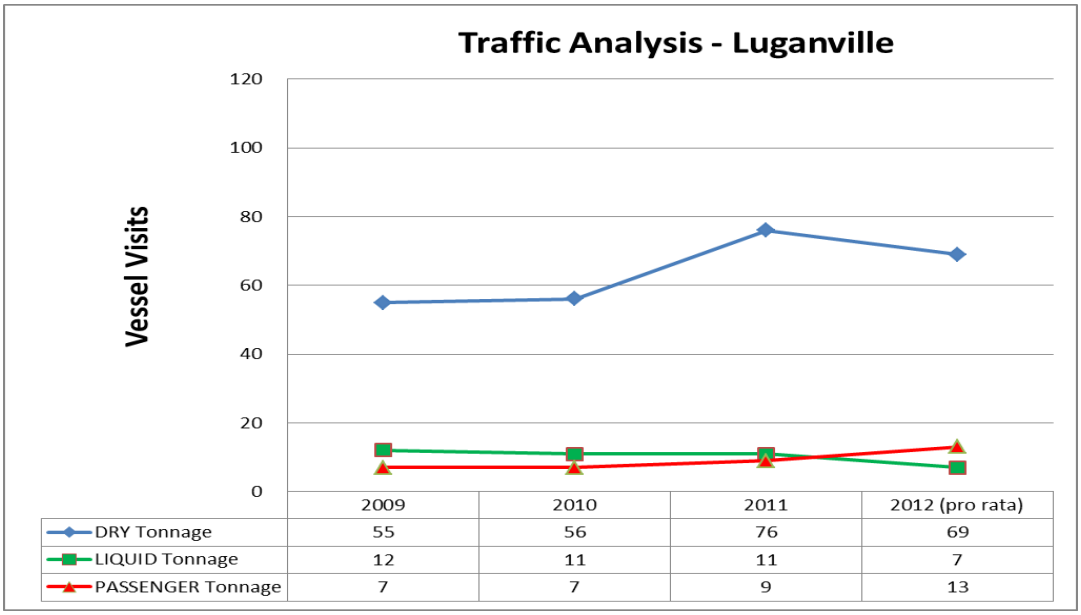


Figure 5-3 : Traffic Profile Showing Vessel Movement Trends at Luganville

The traffic profile shows that Luganville has fairly steady traffic levels, with a moderate 2010-2011 increase in dry-cargo vessels being sustained in 2012. It is noteworthy to compare the cruise vessel tonnage line with that of Port Vila.

5.2.2.1 CRUISE VESSELS

In comparison with Port Vila, Luganville has relatively low, but steadily increasing visits by cruise vessels. Feedback from a large cruise operator advised that if wharf facilities could be improved[39] (wharf length and bollard capability), then Luganville would benefit from a significant increase in cruise vessel calls. There is a sealed road along the east coast which would allow busses to be used to transport passengers to attractions, which is preferable to the use of cruise vessel tenders in an offshore bay.

There were around seven cruise vessel calls to Luganville per annum for 2009 and 2010, with 2011 onwards showing moderate increase that appears to be sustained in 2012.

[39] It is understood from the visit that Japanese aid sources (JICA) are considering help to improve Main Wharf facilities at Luganville.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2009	0	1	1	2	1	0	0	1	0	1	0	0	7
2010	1	0	0	1	0	0	0	0	0	1	4	0	7
2011	3	1	0	0	1	0	0	2	0	1	0	1	9
2012 (pro-rata)	2	2	2	1	1	1	1	0	0				10

Table 11 : Cruise Vessel Calls to Luganville

5.2.2.2 DRY CARGO VESSELS:

As per the recorded data, the port of Luganville was visited by an increasing number of "dry" tonnage. Such vessel calls have been on the increase every year. The recorded data shows 55 such calls during 2009 which increased to 76 calls during 2011. These vessel calls are, generally, spread out during a given year. The recorded data does not show any preferred period (months) of vessel-calls. The recorded vessel calls during 2012 show a reduction in traffic density.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2009	5	6	3	6	7	5	4	5	5	5	3	2	55
2010	6	5	1	5	4	3	6	6	6	5	8	2	56
2011	5	7	8	6	5	9	5	8	8	5	6	6	76
2012 (pro-rata)	6	4	6	5	6	5	8	4	4				54

Table 12 : Dry Cargo Vessel Calls to Luganville

5.2.2.3 TANKERS

The vessels under "bulk liquid" category (tankers) have not shown any change in the level of vessel calls. There were 12 such calls during 2009 and 11 such calls during each of 2010 and 2011. This shows an average of about one vessel call every month. However, the forecasted figure for 2012 shows a reduction in traffic density. There were only five "bulk liquid" vessel calls up until September 2012.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2009	2	0	1	0	1	1	0	1	2	0	0	4	12
2010	0	0	2	1	1	1	2	1	0	2	1	0	11
2011	1	1	1	2	1	0	1	0	2	1	0	1	11
2012 (pro-rata)	1	0	0	2	0	0	1	1	0				5

Table 13 : Tanker Calls at Luganville

5.3 PASSENGER VESSELS (CRUISE) TRAFFIC ANALYSIS

The Ni-Vanuatu ports were visited by a variety of vessel types including bulk, chemical and product tankers, container, gas carriers, general cargo, cruise, research, Ro-Ro and training vessels.

The data shows a general increase in number of vessel calls to Port Vila and Luganville. Port Vila experienced an increase in all types of vessel calls from 186 during 2009 to 226 in 2011 although there were 182 calls in 2010. Luganville experienced a similar general increase from 74 recorded vessel-calls in 2009 to 96 such calls in 2011.

All the cargo vessels visited one or both of the two commercial ports of Port Vila or Luganville. Cruise vessels also visited these ports but also called at anchorages such as Mystery Island, Champagne Beach, Pentecost and Wala.

These anchorage ports are discussed below.

5.3.1.1 MYSTERY ISLAND (ANEITYUM)

Aneityum has been given the marketing name of "Mystery Island" by cruise stakeholders[40]. Aneityum has experienced steady cruise vessel traffic growth, possibly due to its excellent location, north of Noumea. Cruise operator data shows calls for their vessels for the years 2008, 2009 and 2010 were similar, i.e. 22, 24 and 23 calls per annum respectively. In 2011, the number of vessel calls increased to 56, nearly two and half times the number of previous years. There are 43 vessel visits for 2012. Although this figure is lower than that of 2011, it is double of the 2008/2009/2010 levels. Forecast bookings of 34 port calls for the year 2013 and 20 for 2014.

In general, more vessel calls were made during the Christmas holiday period (Dec/Jan) for all the years (2008-2011). It was observed that during 2008, 2009 and 2010, the period from April to August was another busy period of cruise vessels' calls. From 2011 onwards, a different trend emerged; there were more vessel calls and these calls were made during all months of the year.

[40] This is because of the island of Inyeug, which is just off the south coast of Aneityum and where cruise vessels visit. Inyeug means "mystery".

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2008	1	1	1	2	3	1	5	2	1	2	1	2	22
2009	3	3		3	1	2	5	2	1	1	1	2	24
2010	2			2	2	4	3	2		2	1	5	23
2011	4	3	4	5	4	4	7	5	7	2	3	8	56
2012	4	3	4	3	4	5	3	1	6	5	1	4	43
2013	4	4	1	2	5	1	5		4	3	3	2	34
2014	2	3	3	2	4	1	3		1	1			20

Table 14 : Cruise Vessel Visit Data for Aneityum (Mystery Island)

5.3.1.2 CHAMPAGNE BEACH (HOG HARBOUR)

Champagne Beach is located at Hog Harbour, Espiritu Santo. Cruise vessels anchor in the bay and tender passengers ashore. It was initially visited by few, but visit data show steady growth from 2008 onwards. The data from the largest cruise operator visiting Vanuatu[41], records 4 vessel-calls to Champagne Beach during 2008, 8 during 2009 and 7 during 2010. As in the case of Mystery Island, 2011 saw an increase in vessel-calls, with 13 vessel-calls during 2011, a number that is being sustained in the 2012 season.

Every year, January had shown a busier period compared to other months due to Christmas and New Year period.

The bookings by Carnival Cruises for 2013 showed an even spread of vessels throughout the year. So far only 12 vessel-calls had been booked for 2013 and 5 such calls for 2014.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2008	2	1			1								4
2009	2			1	1			1		2		1	8
2010	2				2		1			1	1		7
2011	2	1		1	2		1	2		1	2	1	13
2012	4	1		1	1		3		2	1			13
2013	2	1	1	2	1	1	1	1	1			1	12
2014	2	1			1			1					5

Table 15 : Cruise Vessel Call Data for Hog Harbour (Champagne Beach)

5.3.1.3 PENTECOST (HOMO BAY)

Land diving takes place at Homo Bay, in south west Pentecost. The land diving ceremony takes place once a week in the Vanuatu winter period. There has been a general decrease in cruise visits since 2008 and vessel calls have been aligned to the land diving (Naghol) season, April, May and June.

[41] This data is sourced from Carnival Cruises schedule

During 2008, there were eight cruise vessel calls, reducing to three during 2009. The period of 2010 and 2011 showed a steady number of vessel calls, at five per year. The vessel-calls had reduced during 2012 and were expected to stay at about three per year in the foreseeable future.

Unlike other ports, passenger vessels do not call at Pentecost during the Christmas vacation period. For future years, the largest operator had booked two vessel-calls for 2013 and three calls for 2014.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2008	1		2	2	1	1		1					8
2009				2	1								3
2010			2	3									5
2011				2	1	2							5
2012				1	1	1							3
2013				1	1								2
2014					2	1							3

Table 16 : Cruise Vessel Call Data for Homo Bay, Pentecost

5.3.1.4 WALA ISLAND (MALAKULA)

Wala Island, Malakula, has been averaging 13-14 cruise-calls a year. As in the case of some other ports, 2011 had an increase compared to other years. There were 16 cruise-calls during 2011.

The busiest month of any year is January, especially the first half of January. During January, there were four to five vessel calls each year, except 2009, which recorded two vessel calls. Vessel have also called in the months of May and July.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2008	5	1	1		1		2	2		1		1	14
2009	2		1	1	1			1		2		2	10
2010	4				2		2	1	1	1	2	1	14
2011	4	1		1	2	1	2	2		1	1	1	16
2012	4	1		1	1		3		3	1			14
2013	4	2			2	1	2		2				13
2014	2			1	1		1						5

Table 17 : Cruise Vessel Call Data for Wala Island, Malakula

There are 13 vessel-calls planned for 2013 and five calls for 2014.

5.4 DOMESTIC COASTAL SHIPPING

Inter-island shipping is the economic lifeline of Vanuatu, with export goods being transported by domestic registered vessels from the outer islands to the two hub ports of Luganville and Port Vila. All imported goods are transported by the same means from the hub ports to the other islands of Vanuatu.

This data provides a surprise, as it shows the passenger capacity that the domestic fleet possesses. In risk terms, when a domestic coastal vessel is lost in the SW Pacific, loss of life is likely. However, many of the domestic coastal vessels trading within Vanuatu waters have licenced capacity for a significant number of fare paying passengers. The domestic coastal vessels provide a cheap solution to interisland travel and are obviously the chosen (and probably most cost effective) means by which the Ni-Vanuatu travel between their islands.

There are currently 29 vessels providing domestic cargo and passenger services. A further vessel (*Rabul Trader*) arrived in Espiritu Santo preparing for service at the time of information gathering visits. Three vessels are dedicated to passenger trades (but still appear to transport personal cargo), one is freight only and the remainder are cargo/passenger.

All vessels on the Vanuatu domestic registry can trade anywhere within the island group. Eighteen of the above vessels provide a scheduled service but, with the possible exception of the passenger services, schedule frequency and exact routes followed tend to vary with freight availability. Eleven of the vessels do not have a regular schedule or route but are chartered by cargo interests on an “as required” basis. All domestic services and routes are based on the hub ports of Luganville and Port Vila. Many of the remote islands, and even parts of the main islands, are poorly served by internal roads, thus making cargo aggregation difficult. Isolated villages, not on a scheduled shipping route, store export goods until sufficient quantities have been aggregated to make chartering viable. The current domestic shipping schedules are shown below in **Tables 18-22.**

Domestic Coastal Services : Port Vila and Luganville to Central Islands					
Vessel	**GT**	**Length**	**Type**	**Route**	**Frequency**
EFATE QUEEN	118	28.3	Pass (170)	Port Vila – Épi – Paama – Ambrym – Pentecost – Ambae- Luganville	Weekly
BIG SISTA	192	33.25	Pass (280)	Port Vila – Épi – Paama – East Malakula - Luganville	Weekly
LC TINA I	192	39.6	Cargo/Pass(140)	Port Vila – Luganville – West Ambae – East Ambae – West Pentecost – North Ambryn – Épi –Port Vila	Weekly
BRISK	104	24.9	Cargo/Pass (60)	Luganville – West Ambae – East Ambae – North Ambrym – Port Vila	Weekly
ESPIRITU SANTO QUEEN	94	24.5	Pass (70)	Luganville – East Malakula – Port Vila	Weekly
LC MGY	74.6	24.5	Cargo/Pass (80)	Port Vila – West Malakula – Port Vila	Weekly
ISLAND CLAWS	138.5	22.57	Cargo/Pass (28)	Port Vila – Shepherd Outer Islands – Tongoa – Épi – South Malakula – Port Vila	Weekly
BROOKLYN	45.46	14.38	Cargo/Pass (25)	Port Vila – Shepherd Outer Islands – Épi – South Malakula – Port Vila	Weekly
PAAJEF	29.3	15.2	Cargo/Pass (20)	Port Vila – Shepherd Outer Islands – Épi – South Malakula – Port Vila	Weekly

Table 18 : Domestic Coastal Shipping Services - Port Vila, Luganville and Central Islands

Domestic Coastal Services : Luganville to Central Islands					
Vessel	**GRT**	**Length**	**Type**	**Route**	**Frequency**
H. TINO	37.32		Cargo/Pass	Luganville – West Malakula – East Malakula - Luganville	Weekly
SALLEBURUM	50.33	16.08	Cargo/Pass	Luganville– East Malakula - Luganville	Weekly
ROSALIE	14.02	12.95	Cargo/Pass	Luganville– West Malakula – Malo - Luganville	Weekly
VADKORO	48	15.56	Cargo/Pass	Luganville – Malo – East Malakula – West Malakula - Luganville	Weekly
LC VALERY	100	20	Cargo	Luganville – east Malakula - Luganville	Weekly
JADAMS	45	15.25	Cargo/Pass	Luganville – East Malakula – West Malakula - Luganville	Weekly

Table 19 : Domestic Coastal Shipping Services - Luganville to Central Islands

Domestic Coastal Services - Luganville to Northern Islands					
Vessel	**GT**	**Length**	**Type**	**Route**	**Frequency**
ESPIRITU SANTO QUEEN	94	24.5	Pass	Luganville – Vanua Lava - Luganville	Monthly
H TINO	37.32		Cargo/Pass	Luganville – Mere Lava - Luganville	Monthly
BRISK	104	24.9	Cargo/Pass	All landings in Torres Group. (Service subsidized by AusAID)	Monthly
KEIDI	113.7	21.19	Cargo/Pass	These vessels provide an approximately fortnightly service to Banks and Torres Groups depending on cargo bookings. Route is dependent on cargo bookings. They are also chartered to pick up cargo anywhere in Vanuatu.	
KAWALE	114.9	20.54	Cargo/Pass		
SOWDIES	63	15.43	Cargo/Pass		
ELKEMAR II*	291	37.35	Cargo/Pass		
HAVETU*	98.93	20.9	Cargo/Pass		

Table 20 : Domestic Coastal Shipping Services – Luganville to Northern Islands

Domestic Coastal Services, Port Vila to Southern Islands					
Vessel	**GT**	**Length**	**Type**	**Route**	**Frequency**
MOAIKA	29.67	13.2	Cargo/Pass (47)	Port Vila – Lénakel – Port Vila	Weekly
TOUARAKEN	263.9	28.45	Cargo/Pass (100)	Port Vila – Lénakel – Port Vila	Weekly
TOUARAKEN	263.9	28.45	Cargo/Pass (100)	Port Vila – Lénakel - Port Resolution – Aneighowhat – Futuna –Aniwa – Port Resolution – Lénakel – Port Vila	Fortnightly
ISLAND CLAWS	138.5	22.57	Cargo/Pass (28)	Port Vila – Dillons Bay – Umpon – Port Resolution – Aneighowhat – Futuna – Aniwa – Port Resolution – Potenia Bay – Port Vila	Monthly
LC KALYARA	120	25.38	Cargo/Pass (30)	Pre-arranged or charter. Normally running Port Vila – Lénakel depending on cargo availability.	
LC MALCOS	126.4	32.01	Cargo		
MALAKULA	52.38	16.08	Cargo/Pass (30)		

Table 21 : Domestic Coastal Shipping Services - Port Vila and Southern Islands

Domestic Coastal Services - Luganville to Northern Islands					
Vessel	**GT**	**Length**	**Type**	**Route**	**Frequency**
ESPIRITU SANTO QUEEN	94	24.5	Pass	Luganville – Vanua Lava - Luganville	Monthly
H TINO	37.32		Cargo/Pass	Luganville – Mere Lava - Luganville	Monthly
BRISK	104	24.9	Cargo/Pass	All landings in Torres Group. (Service subsidized by AusAID)	Monthly
KEIDI	113.7	21.19	Cargo/Pass	These vessels provide an approximately fortnightly service to Banks and Torres Groups depending on cargo bookings. Route is dependent on cargo bookings. They are also chartered to pick up cargo anywhere in Vanuatu.	
KAWALE	114.9	20.54	Cargo/Pass		
SOWDIES	63	15.43	Cargo/Pass		
ELKEMAR II*	291	37.35	Cargo/Pass		
HAVETU*	98.93	20.9	Cargo/Pass		

***** These vessels are owned by copra mills but can be chartered for any cargo

Table 22 : Domestic Coastal Shipping Services – Luganville to Northern Islands

Domestic Coastal Services - Charter Vessels				
Vessel	**GT**	**Length**	**Type**	**Route**
AURORA*	102.8	20.5	Cargo/Pass	These vessels do not ply any regular route but are chartered to move cargo anywhere in Vanuatu.
LADY SABRINA	43	22.63	Cargo/Pass	
LC KALYARA	120	25.38	Cargo/Pass	
MAKILA	92.45	20.19	Cargo/Pass	
LC RABUL TRADER	191	36.3	Cargo/Pass	

***** This vessel is owned by a copra mill but can be chartered for any cargo

Table 23 : Domestic Coastal Shipping Services – Charter Vessels

5.4.1 Coastal Shipping Routes

The coastal trade picture is complex, and best shown as an image (**Figures 5.4 and 5.5**). The evidence from the data gathering visit is that the copra trade is growing strongly, which is being fuelled by demand for biodiesel, manufactured out of copra. This in turn is providing growth demand for coastal shipping services and a new vessel (*Rabul Trader,* a landing craft), had just arrived from Singapore to enter service (09-2012).

With new copra mills expected to come on line in the future, growth in domestic trading vessels is set to continue. **Figure 5-4** has been derived from the vessel tables above, including the scheduled frequencies of each vessel. It provides clarity of the domestic coastal vessel routes, which also have a surprisingly significant passenger capacity. Vessels transit in both

directions between Luganville and Port Vila, loading and discharging on the coast via the islands in between. If a vessel becomes full (which is said to occur with increasing frequency), another may be called to complete the route, possibly out of the charter pool. The ultimate destinations are either Luganville or Port Vila, but in the case of copra this will change as more copra mills come online. **Figure 5-5** shows which routes are busiest, based in simple terms, on both shipping volume and vessel capacity (measured by timetabled frequency and gross registered tons respectively). This clearly shows the relative importance of the links between Port Vila/Tanna and Luganville/Malakula.

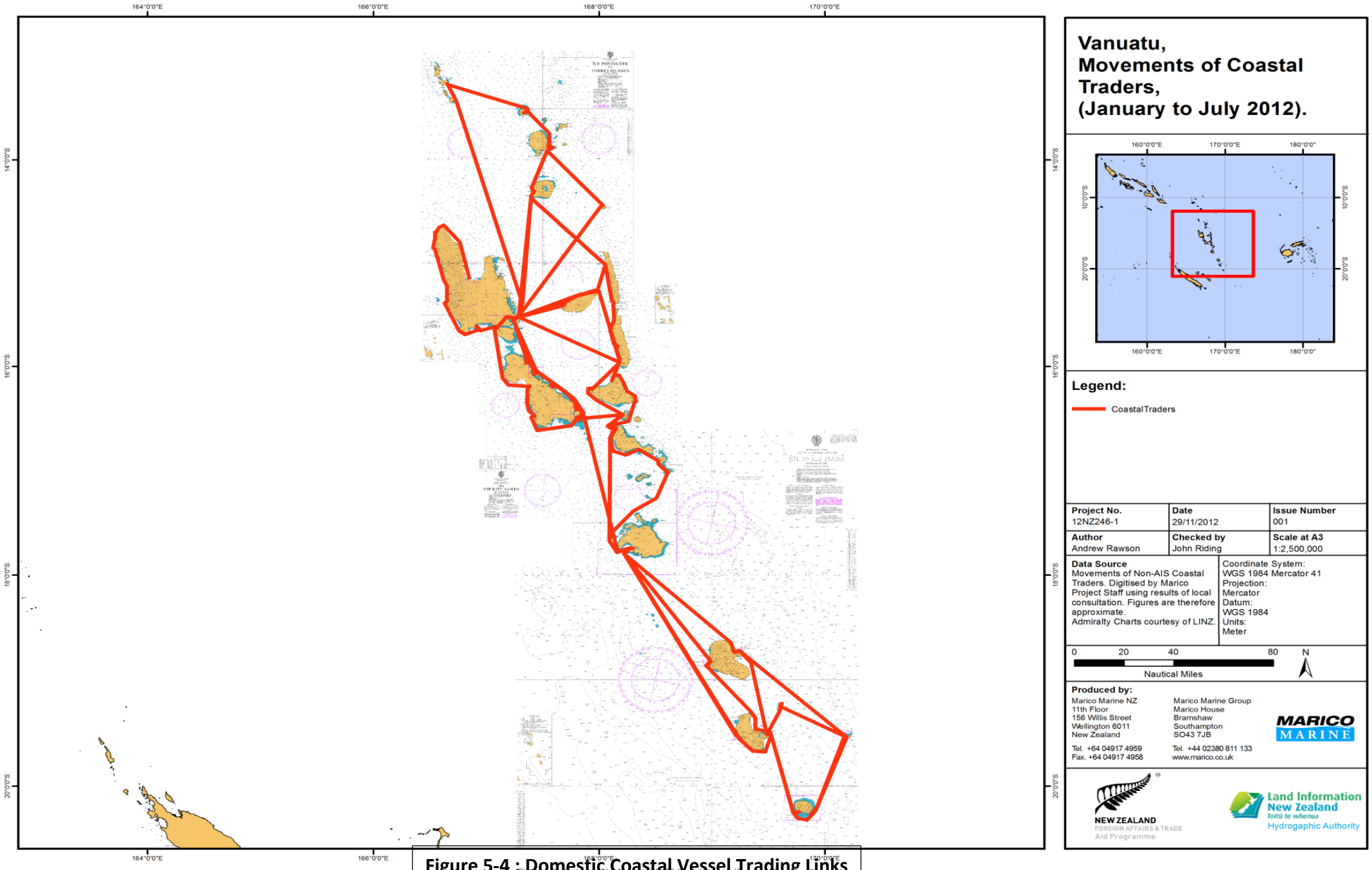


Figure 5-4 : Domestic Coastal Vessel Trading Links

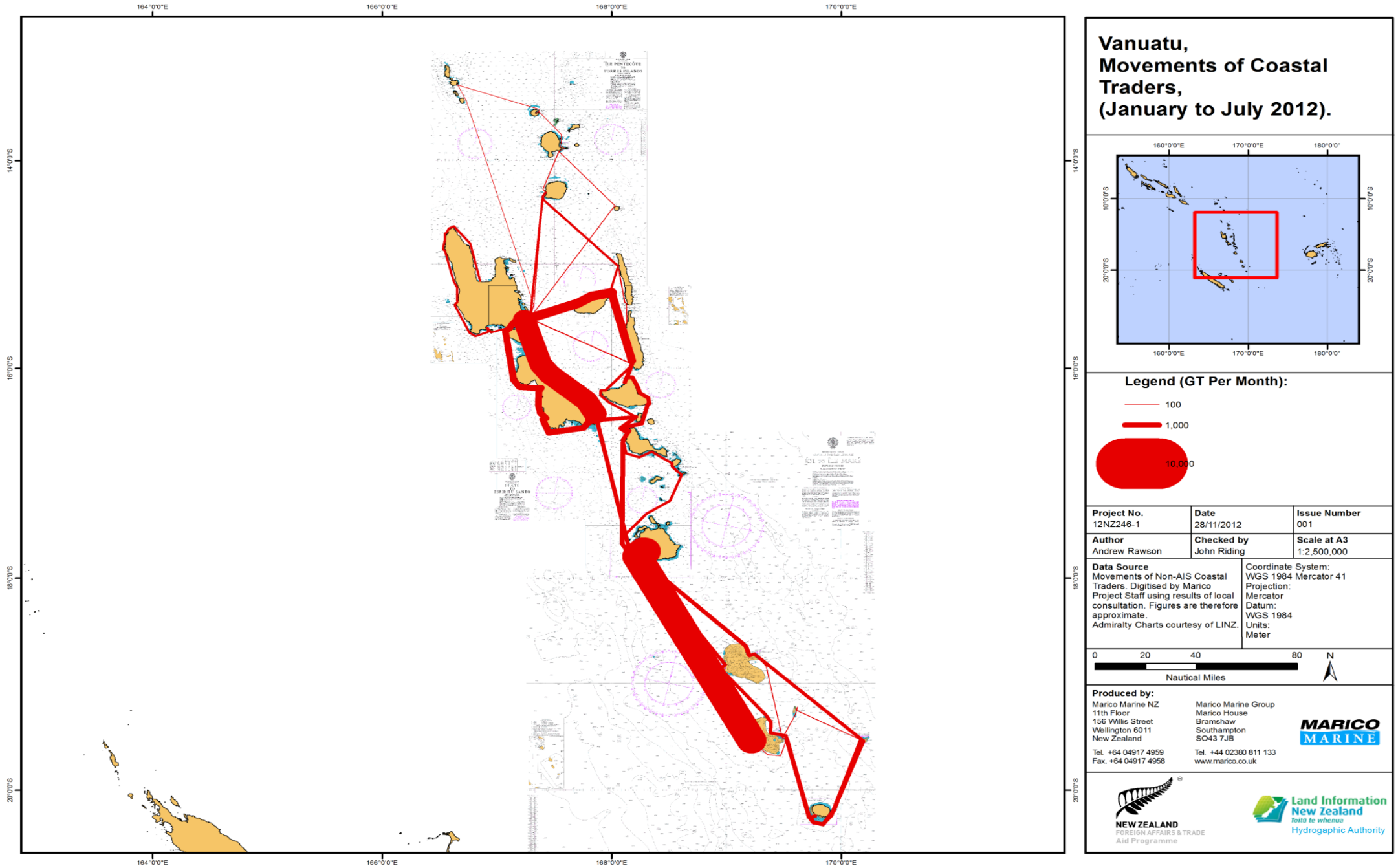


Figure Reference Number: 12NZ246-1_CoastalTraders_v1

Figure 5-5 : Domestic Coastal Vessel Scheduled Routes by Volume

5.4.2 Future Development of Coastal Shipping

It is recognised by the Vanuatu Government that some areas of Tafea, Malampa, Sanma, Penama and Torba provinces are receiving inadequate shipping services. This has resulted in stagnant economic development of those areas. This is being addressed in the Vanuatu Shipping Service Support Scheme (S^4), which is currently in draft policy guideline stage, but receiving support from ADB and NZAID (see below). The object of S^4 is to provide a more pro-active (subsidised) service to these areas which will encourage greater community participation in the country's economic development. The hope is that increased, regular, shipping services will result in increased production of agricultural crops and fish, which in turn will lead to a reduction in the need for subsidies.

A pilot project is currently underway for the Banks and Torres Islands in Torba Province, and Aniwa, Futuna and Aneityum Islands in Tafea Province.[42]

5.4.2.1 JETTY INFRASTRUCTURE DEVELOPMENT – NZAID AND ADB

In August 2012, the Asian Development Bank, in partnership with the New Zealand and Vanuatu governments, announced new initiatives to improve Vanuatu's inter-island shipping infrastructure, services and governance. Loan and grant funding agreements for the Vanuatu Inter-Island Shipping Project had been signed to improve domestic port facilities and expand shipping services to remote islands.

Planned improvements to domestic port facilities were:

- Construction of a new interisland terminal in Port Vila to provide sufficient berths to handle the growing volume of vessels, as well as separate transit facilities for men, women and the disabled;
- Construction of new jetties at Port Sandwich (Malakula), Lolowai (Ambae), Waisisi (Tanna) and Loltong (Pentecost);
- Rehabilitation of existing jetties at Litslits (Malakula), Lénakel (Tanna), Simonsen (Espiritu Santo).[43]

5.4.2.2 VANUATU COPRA BIOFUEL PROJECT

It appears there is a considerable change in coastal shipping demand apparent, which will grow with the installation of copra mills in key island

[42] Vanuatu Shipping Support Scheme – Policy guideline, Pilot project 2012
[43] ADB News Release, Port Vila, 31 August 2012

locations in Vanuatu. The mills use copra and turn this into a diesel biofuel[44]. It is an EU funded aid project and the link to revival in the Vanuatu coastal trade needs to be considered and welcomed. The project was at an early build stage in a number of provinces visited by the project team.

In July 2007, the European Commission approved grant co-funding from the ACP-EU Energy Facility. Vanuatu was the only country with proposals funded from this facility. Three out of the four approved projects were joint Energy Unti-UNELCO[45] projects. These included the provision of renewable energy using locally produced copra oil as biofuel to:

- 4 villages of North East Malakula, Malampa Province;
- 3 villages in Ambae, Penama Province, and;
- 2 villages of Vanua Lava Island, Torba Province.

At Malampa, in the North East of Malakula Island. the project brought energy to 660 households, six primary schools and one College, two dispensaries.

In East Ambae, the project is expected to bring energy to 185 households, a primary school, a branch of the University of the South Pacific (USP), a hospital and dispensary.

In Torba Province, the project is expected to bring electricity to 103 households, 2 primary schools, and a dispensary on Vanua Lava.

The demand for copra appears to be an important factor in a strengthening of the domestic coastal vessel trades. It is also an excellent example of how integrated aid can successfully assist a developing country.

The importance of the interisland shipping infrastructure project at this point in time cannot be overstated and the link to accurate charts is equally important.

5.4.3 Shipping of Copra

The importance of copra to Vanuatu is rising and its economic benefit to shipping needs to be explored (see **Section 7.7**). The options and process for selling and shipping copra are illustrated in **Figure 5-6,** below. A similar process is followed for other export goods and government set "beach prices" are also available for kava and cocoa. This trade needs to be analysed

[44] There were already other existing copra mils that manufacture coconut oils and other products in Éfaté and Espiritu Santo.
[45] UNELCO is the Ni-Vanuatu based power generator, which operates biodiesel oil mills commercially.

closely as it appears too significant to the development of coastal trading along the coasts of Vanuatu.

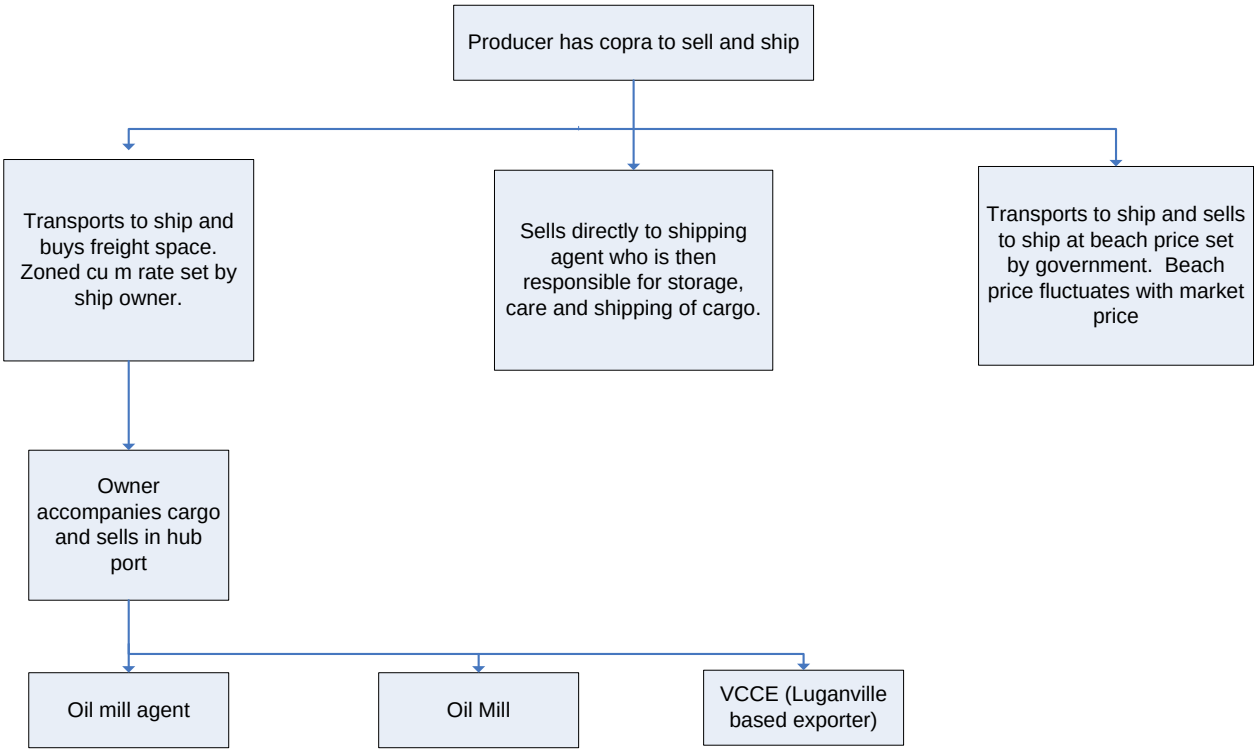


Figure 5-6 : Flow for Shipment and Sale of Copra

An individual village, or consortium of villages, may charter a vessel and arrange shipment themselves, but usually the goods are sold to an agent. Following sale the agent takes responsibility for the copra and arranges shipment when there is a sufficient aggregation of goods in an area to make chartering financially viable.

This means that the more remote islands with small populations and consequently low production rates, such as the Torres and Banks Islands, receive an infrequent and erratic service. Currently the Torres group benefits from a subsidised monthly schedule.

The west coast of Espiritu Santo is moderately populated but is isolated and not served by roads. Agents travel round the coast from Luganville to Big Bay by sea. Each village has a storage area for exports. The agents purchase cargo directly and/or arrange shipping. The agents will contact a shipping company either by VHF radio (there are three transmitters on the coast); by telephone from Lisburn; by returning to Luganville by sea; or by flying to Luganville from the airstrip in Big Bay.

Copra is transported to the hub ports for export and also to copra oil mills situated on the following islands for processing:

- Espiritu Santo; 3 mills
- Malakula; 1 mill
- Épi; 1 mill
- Éfaté (Port Vila) 2 mills.

There are bio-fuel mills and electricity generators being constructed on Ambae and at Sola in Vanua Lava, both had foundations in place at time of the on-site visit. Bio-fuel mills are owned and operated by the provincial governments.

The procedure for importation of goods from the hub ports by village retailers is shown in **Figure 5-7**. Generally, for islands not serviced by a scheduled route, shipping of imports to the islands will be dependent on the use of a vessel chartered to pick up exports. Thus the supply of imports to the more remote islands can be erratic.

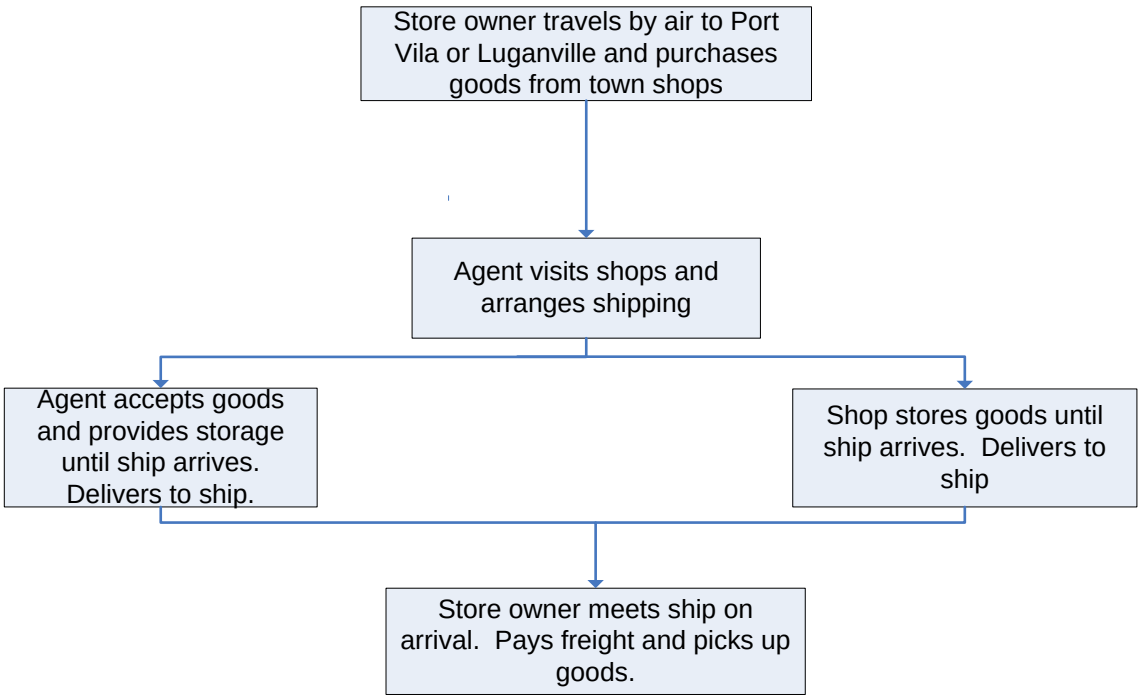


Figure 5-7 : Procedure for Purchasing Goods by Village Retailer

The following procedure is mostly followed by store owners on remote islands, some poorly serviced by internal flights:

1. Store owner telephones order to town shops.
2. Shop arranges transport through shipping agent and delivers cargo to ship C.O.D.
3. Ship delivers cargo and collects payment for freight and goods from island store owner (cash or cheque, usually cash).

4. Ship delivers payment for goods to town shop.

A number of the larger store owners are also coastal vessel owners[46], using the vessels to both supply their own stores, and provide cargo delivery services from Luganville or Port Vila to the islands. There are also reports that some vessel owners will purchase supplies from the major ports on their own account, and ship these to the outer islands, selling directly to local stores, thus, in part, trading as a mobile wholesaler.

5.5 CONCLUSIONS – ANALYSIS OF SHIPPING FROM PORT-CALL RECORDS

5.5.1 Conclusions - Analysis of Port Data

1. Port Vila is the most significant Vanuatu port (and therefore trading centre) by ship-traffic volume. Since 2009, it has a relatively steady trade in general cargo vessel visits, with a slight fall reflecting that fact that visiting ships are becoming marginally larger.
2. Port Vila has recorded a marginal fall in tanker visits. This may be the result of larger tankers in the trade or a beneficial effect of renewable power initiatives; i.e. that the copra to biodiesel project is already influencing demand for external supplies of fuel.
3. Port Vila shows a dramatic growth in cruise vessel visits 2009-2012. A 34% rise in vessel numbers in three years is recorded, a rise in a recessionary period. Forecast data strongly suggests this increase will be sustained in future. What the graphs do not show is that cruise vessels visiting Port Vila are also becoming significantly larger, placing pressure on infrastructure in and around the port.
4. Luganville shows a fairly steady traffic profile, with a moderate 2010-2011 increase in dry-cargo vessels being sustained in 2012. Cruise activity to Luganville is well below the level at Port Vila.
5. Most cruise vessels calling at Espiritu Santo visit Hog Harbour, bypassing Luganville. This is partly due to the condition of mooring arrangements at Luganville Main Wharf, which are in urgent need of attention.
6. Aneityum (Mystery Island) is visited solely by cruise vessels. In 2011 the number of vessel-calls increased to 56 from a steady 23/24 per annum, nearly two and half times the number of previous years.

[46] In Malakula for example, one store owns three vessels. One in service, one a wreck alongside Litslits Wharf, and one on a slip undergoing reported refurbishment at Norsup Bay.

5.5.2 Conclusions - Domestic Coastal Vessel Information

7. There is an established domestic coastal trade, with both scheduled and chartered vessels. Coastal trade appears to be growing strongly, with vessels reported to be fully laden with copra early in their trading sequence.
8. There are Vanuatu government initiatives to increase the number of domestic vessel calls to the more remote islands of the archipelago.
9. The loss of life that would occur from an incident involving small domestic coastal vessels is greater than expected. They are licensed to carry a large number of passengers which significantly influences the risk profile. Some have reported passenger capacity greater than the dedicated passenger vessels on the coastal trade.
10. There are a relatively large number of domestic coastal vessel losses. Although causal reasons are many, including breakdown and cyclone loss, there is a link to crew competency assurance and quality of nautical charting for coastal use.
11. There is an established domestic coastal trade, with both scheduled and chartered vessels in operation. Coastal trade appears to be growing strongly, with scheduled vessels sometimes fully laden with copra early in their trading sequence.
12. Domestic vessels provide a cost effective solution to interisland travel for the Ni-Vanuatu. However, given the number of wrecks, it follows that as trade grows, likelihood of an incident of significance is incrementally rising.

6 INTERNATIONAL SHIPPING - AIS TRANSPONDER DATA

6.1 INTRODUCTION

This section analyses the satellite derived Automatic Identification System (S-AIS) data recorded for the EEZ of the Republic of Vanuatu. It includes analysis of SOLAS vessels fitted with AIS transponders collected by satellite AIS reception and other vessels, such as yachts or fishing vessels, fitted with AIS transponders.

As domestic coastal vessels are not required to carry AIS transponders, these do not form part of this data set and have therefore been analysed in the previous section of this report.

6.1.1 Dataset Sources

The principal input for traffic analysis is data transmitted by ships' Automatic Identification Systems (AIS), and received by passing satellites. This data was provided by exactEarth[47] (EXACTAIS) under copyright licence, who receive ships' AIS transmissions on their satellite network. The AIS protocol was developed in the late 1990s' as an aid to collision avoidance between vessels. It was originally designed by the Swedish company SAAB as a system for military asset identification.

A transponder is carried by all SOLAS vessels over 300 Gross Tonnage. The transponder is linked to GPS positioning equipment and broadcasts this and key information about the vessel (such as size and type) and its navigational dynamics (such as speed, course, rate of turn) at regular intervals on a VHF bandwidth. Other vessels carrying an AIS receiver are able to receive and display this data and act accordingly. One key benefit that AIS brings to navigation is that two passing vessels are able to identify each other by name, location and radio licence number (which assists ship to ship calling).

The macro-scale nature of a project considering the SW Pacific area requires coverage that only satellite reception of AIS data can deliver. Terrestrial AIS receiving stations provide better data quality and frequency of positional reporting reception. However, there are no such services in many of the SW Pacific Island nations, and terrestrial systems do not have radio reception range to cover the distances between islands in some nations.

[47] exactEarth provided their exactAIS product.

Satellite AIS Data (S-AIS) was procured from exactEarth, who provided three months of S-AIS data for the whole of the South Pacific for use in this study.

In the event two data extents were extracted from the exactEarth global traffic database. The first extent was from 1st January to 31st March, 2012 and comprised 1.3 million received reports from across the Pacific.

The geographic boundaries of this dataset used in the study of Vanuatu waters are:

- Northern Boundary: 12 degrees south;
- Eastern Boundary: 171 degrees east;
- Southern Boundary: 22 degrees south; and
- Western Boundary: 164 degrees east.

A supplementary dataset was extracted for Vanuatu, covering the period 1st May 2012 to 15th July 2012. This data extract related to vessel traffic to Penama province, where the local custom of land diving occurs on the island of Pentecost (Homo Bay). The geographic boundaries of this dataset are:

- Northern Boundary: 12 degrees south;
- Eastern Boundary: 171 degrees east;
- Southern Boundary: 19 degrees south; and
- Western Boundary: 165 degrees east.

6.2 TRAFFIC IN THE SOUTH PACIFIC REGION

A plot of the S-AIS data received overall is shown below (**Figure 6-1**).

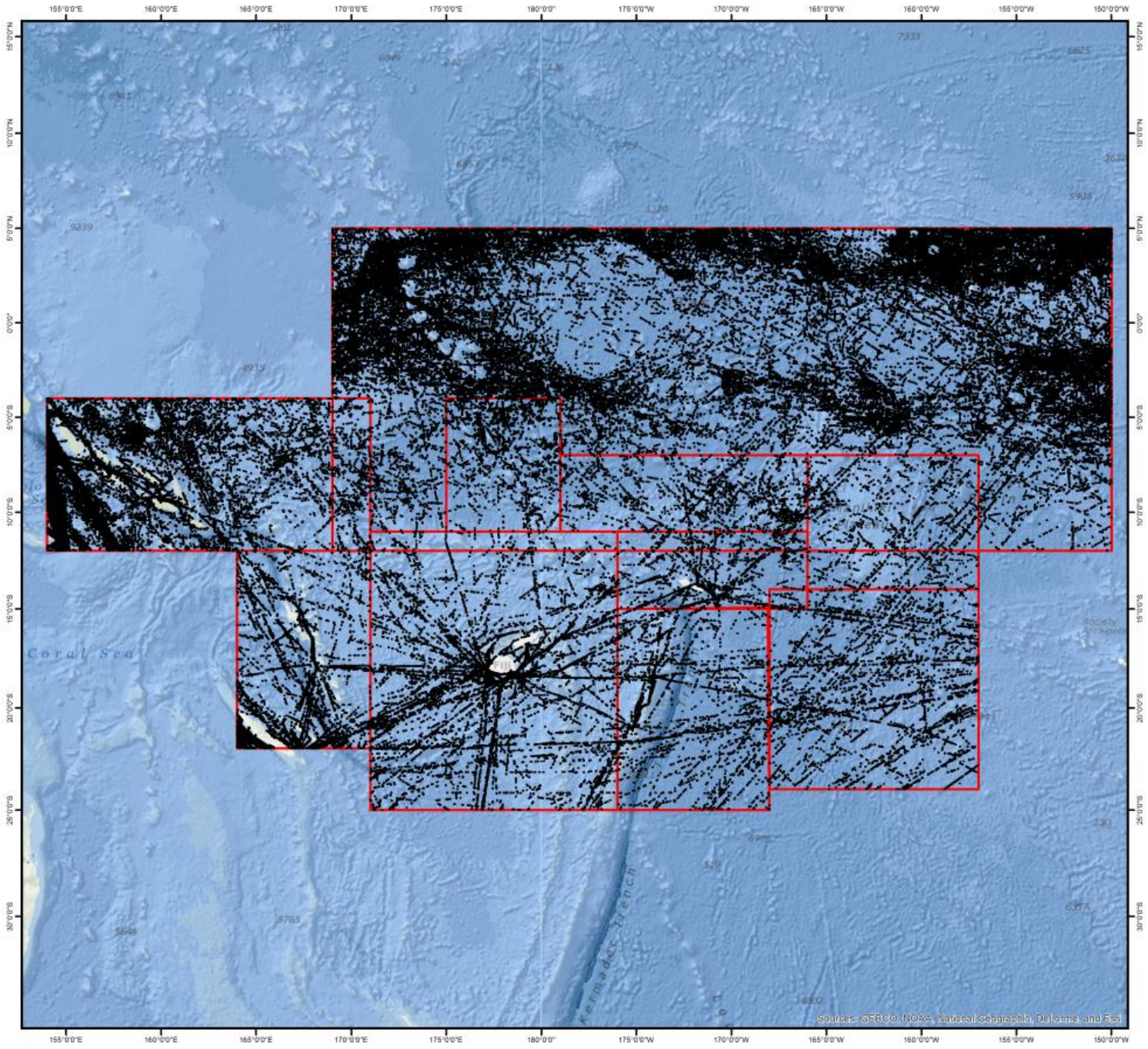


Figure 6-1 : Raw S-AIS Tracks in the South Pacific (January to March 2012).

6.3 S-AIS DATASET PROCESSING

S-AIS data is received from transmitting vessels by satellite sweeps and as such there can be a considerable interval between received reports, up to eight hours. At such a data interval it is impossible to accurately reflect the fine navigation undertaken by vessels transiting through the Vanuatu archipelago. In many cases, vessels making a port call for only one day (e.g. all cruise vessels do this), often show only a single data point close to a port, but not within the port (or in the case of a cruise vessel, an anchorage or bay).

Therefore it was necessary to undertake a large amount of traffic post-processing to augment the S-AIS data. This was done using known port records and information from cruise agents and operators about cruise stops at Vanuatu islands.

Annex C presents the **Traffic Analysis Methodology,** which details the process by which the raw NMEA[48] S-AIS data was processed to produce useable vessel tracks. It is vital reading as it adds significantly to the information in this report. The process is summarised below:

- Raw NMEA AIS was decoded and plotted as geographic points;
- The points were connected to form vessel tracks;
- Port commercial movements data[49] (and vessel agents records, supplemented by cruise itinerary research), obtained by visit to Vanuatu, were referenced to create port calls from data positions recorded only in port approaches;
- Vessels identified in port movement records that were not recorded by AIS in that port were manually routed-in, using known navigation patterns and behaviour of similar vessels, thus linking factual port data with sparse S-AIS data;
- Tracks near the boundary of the study area were extrapolated provided their course bearing was constant;
- A query was undertaken to select all remaining vessel tracks that intersected the coastline and were manually routed onto their most-likely route using the behaviour of similar vessels; and
- Finally vessel attributes, such as length, type and Gross Tons, were attached to each vessel track from a centralised database of ships.

[48] NMEA is the default marine data encoding format.
[49] This data was crucial to the project outcome and obtained during a data gathering visit to Vanuatu in September 2012.

Routes of domestic coastal vessels/passenger vessels that trade on the coasts between the islands of Vanuatu were geocoded into the GIS dataset to ensure that these important, but non-SOLAS registered ships were accounted for.

6.4 S-AIS TRAFFIC DATA ANALYSIS IN VANUATU

The S-AIS data suggests that Vanuatu is an area of moderate shipping activity with a number of vessels of different types calling at its two main ports of Port Vila and Luganville. Furthermore a number of recreational craft and cruise ships visit a number of scenic anchorages and wharfs throughout the island chain. To better understand these movements analysis was undertaken using satellite derived AIS data.

Section 6.5 shows the outputs of the S-AIS vessel tracks.

Section 6.6 shows the distribution of vessel tracks by their vessel type.

Section 6.7 then breaks down the vessels by their characteristics; namely, gross tonnage, length and draught.

6.5 ANALYSIS OF ALL TRACKS

Figure 6-2 shows the tracks of all vessels recorded between January and March 2012 and May and mid-July 2012. **Figure 6-3** takes the vessel tracks and calculates the number of transits per month transiting through an overlaid 2.5km by 2.5km grid network.

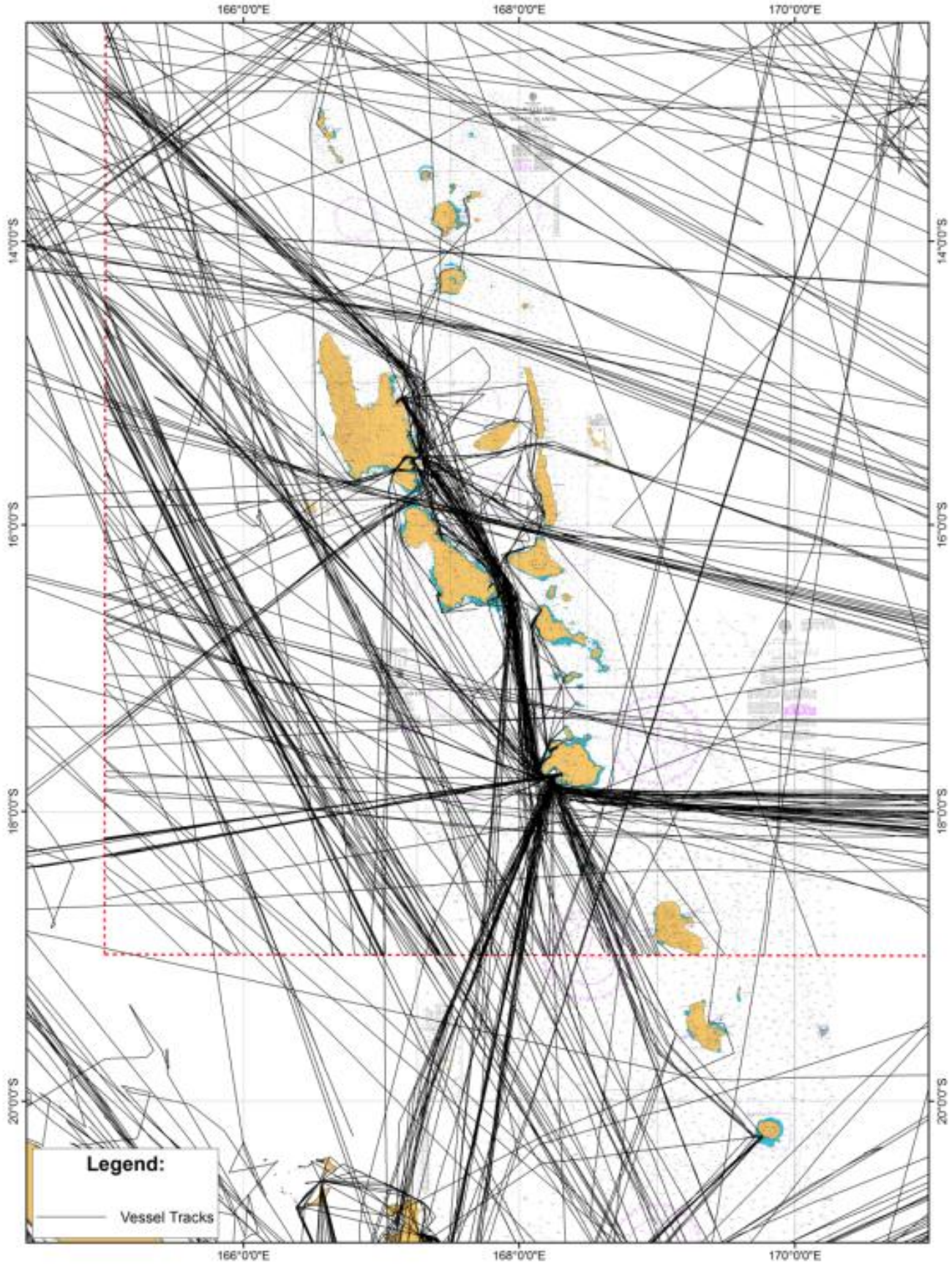


Figure 6-2 : Vessel Tracks

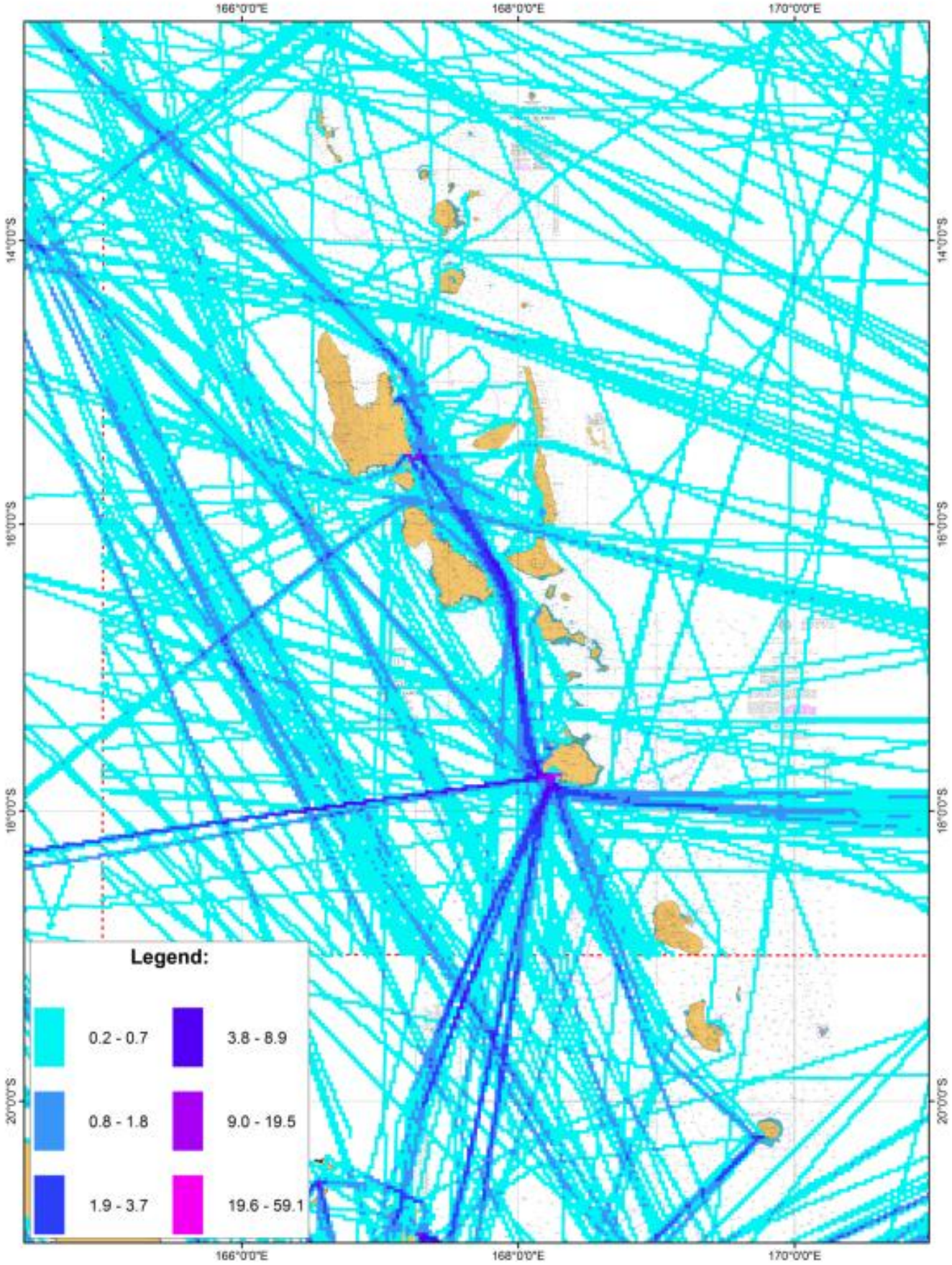


Figure 6-3 : Transit Density per Month.

A number of observations can be drawn from the plots. Firstly Port Vila and Luganville act as key nodes in vessel traffic in the archipelago. Port Vila has five spokes (**Figure 6-4**):

1. A western route to Australia, used by cruise ships, particularly the Cruise Ships *Pacific Dawn* and *Pacific Sun* , and a number of LPG Tankers;
2. A southwest route to New Caledonia, mostly used by cruise ships, Ro-Ro cargo and container ships;
3. A southeast route to Mystery Island, almost exclusively used by cruise ships and recreational craft or superyachts;
4. An eastern route to Fiji, used by an assortment of cruise ships, dry cargo, liquid tanker and recreational craft; and
5. A northern route to Vanuatu's central islands and Luganville, a high density route used by a number of vessels.

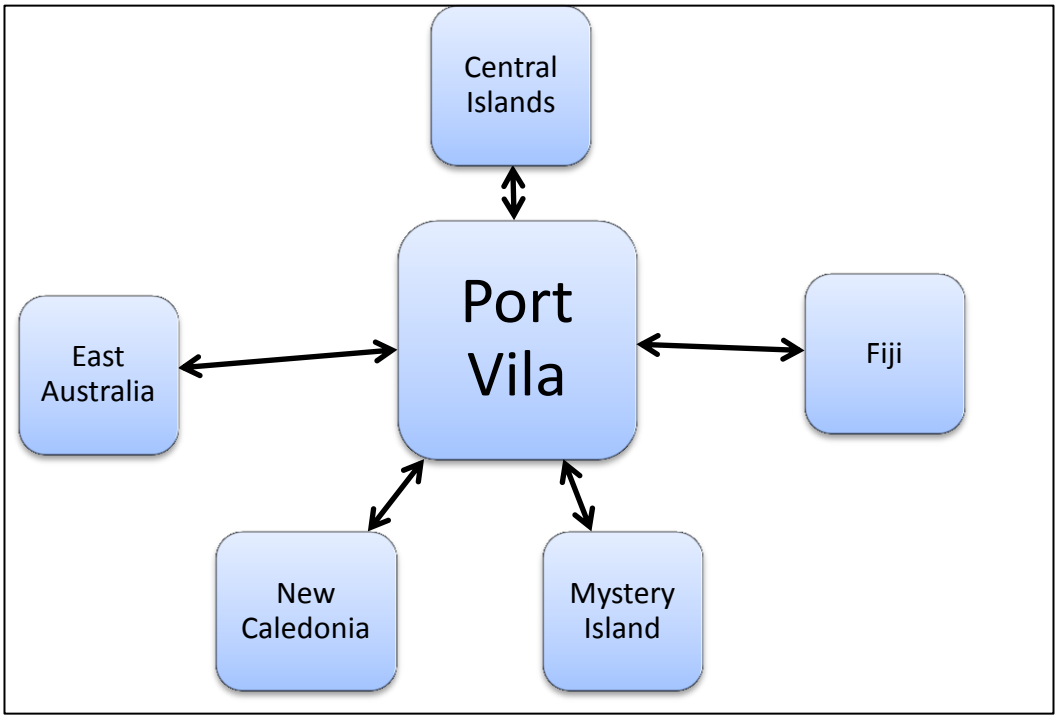


Figure 6-4 : Traffic Network Centred on Port Vila

In Luganville the majority of the traffic transits south through the islands, only approximately a third transit to the north. Very little through traffic passes through the islands in Vanuatu with a small number of cargo and fishing vessels passing between Ambrym and Pentecost.

Furthermore no vessels were recorded transiting longitudinally north-south through Vanuatu without stopping at one of the ports.

6.6 ANALYSIS BY VESSEL TYPE

Further analysis was undertaken on the vessel transits by differentiating their type. **Figure 6-5** shows all vessel transits coloured by their declared vessel-type.

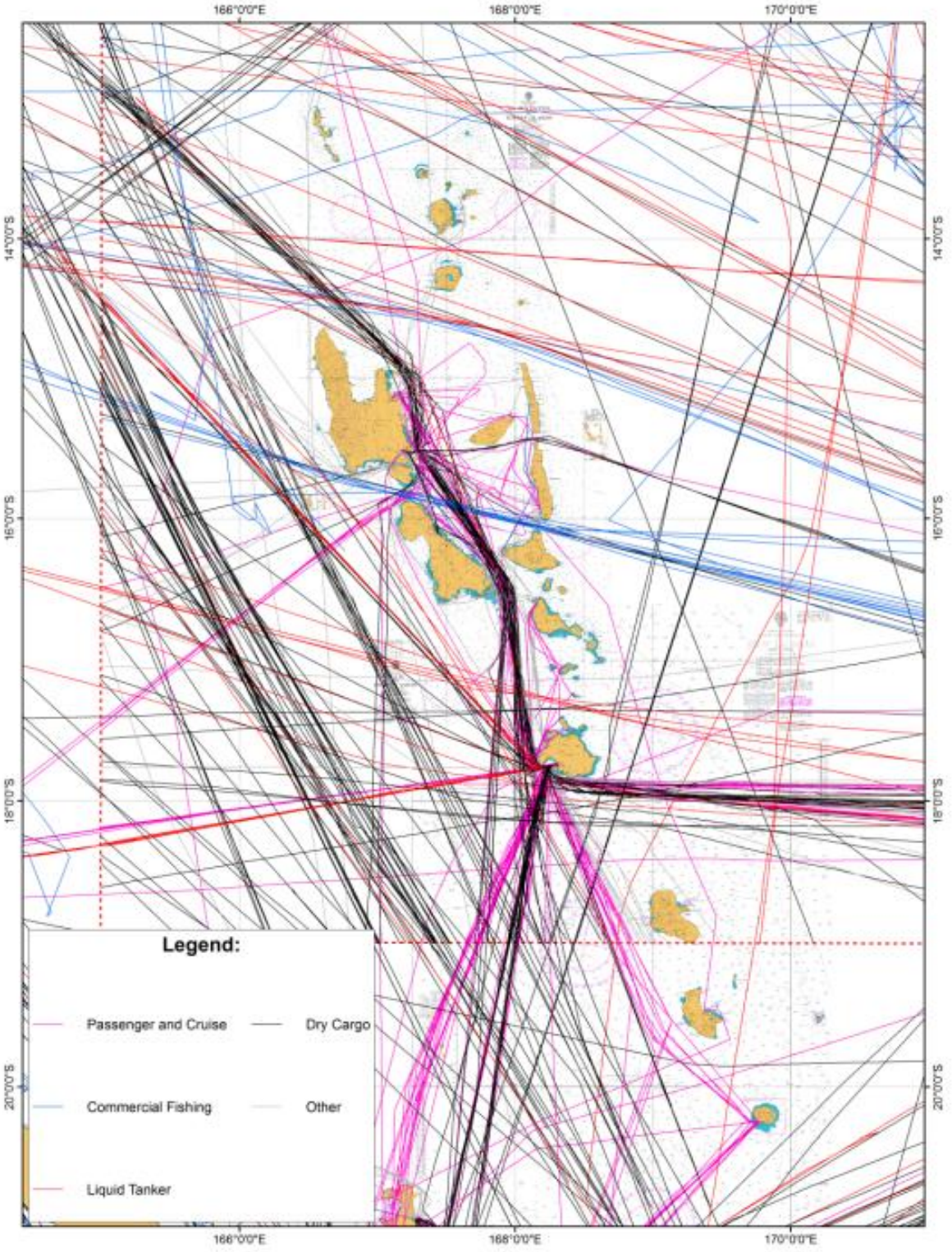


Figure 6-5 : Vanuatu Transits by Type

Figure 6-6 extracts and displays all dry cargo vessels recorded from AIS transmitters. The plot shows that this vessel type's activity in the islands is limited to Port Vila and Luganville. Outside of Vanuatu's islands a large proportion of the vessels recorded to the west are cargo vessels transiting in a north-west south-east direction. This route has a gross tonnage distribution of between 5,000 GT and 60,000 GT.

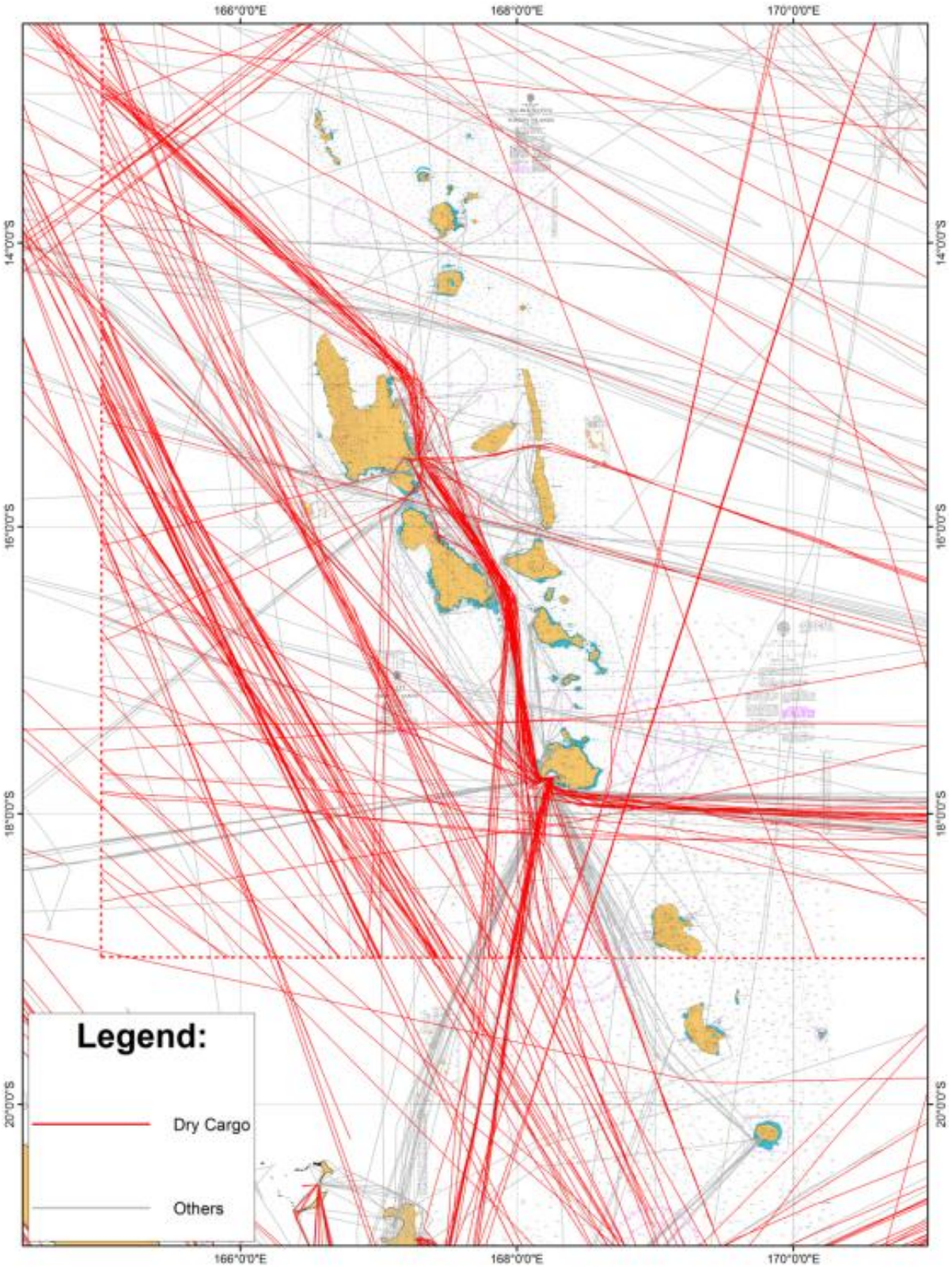


Figure 6-6 : Dry Cargo Transits

The transits of liquid tankers in **Figure 6-7** are far fewer and call at Port Vila only. Luganville calls do occur, but not in this dataset. The distribution of tracks is orientated more to an east-west direction with a number of large

tankers of 25,000 GT transiting through Vanuatu waters between the northern islands of Gaua and Vanua Lava. These tankers in particular have an effect on the risk result in the northern part of Vanuatu.

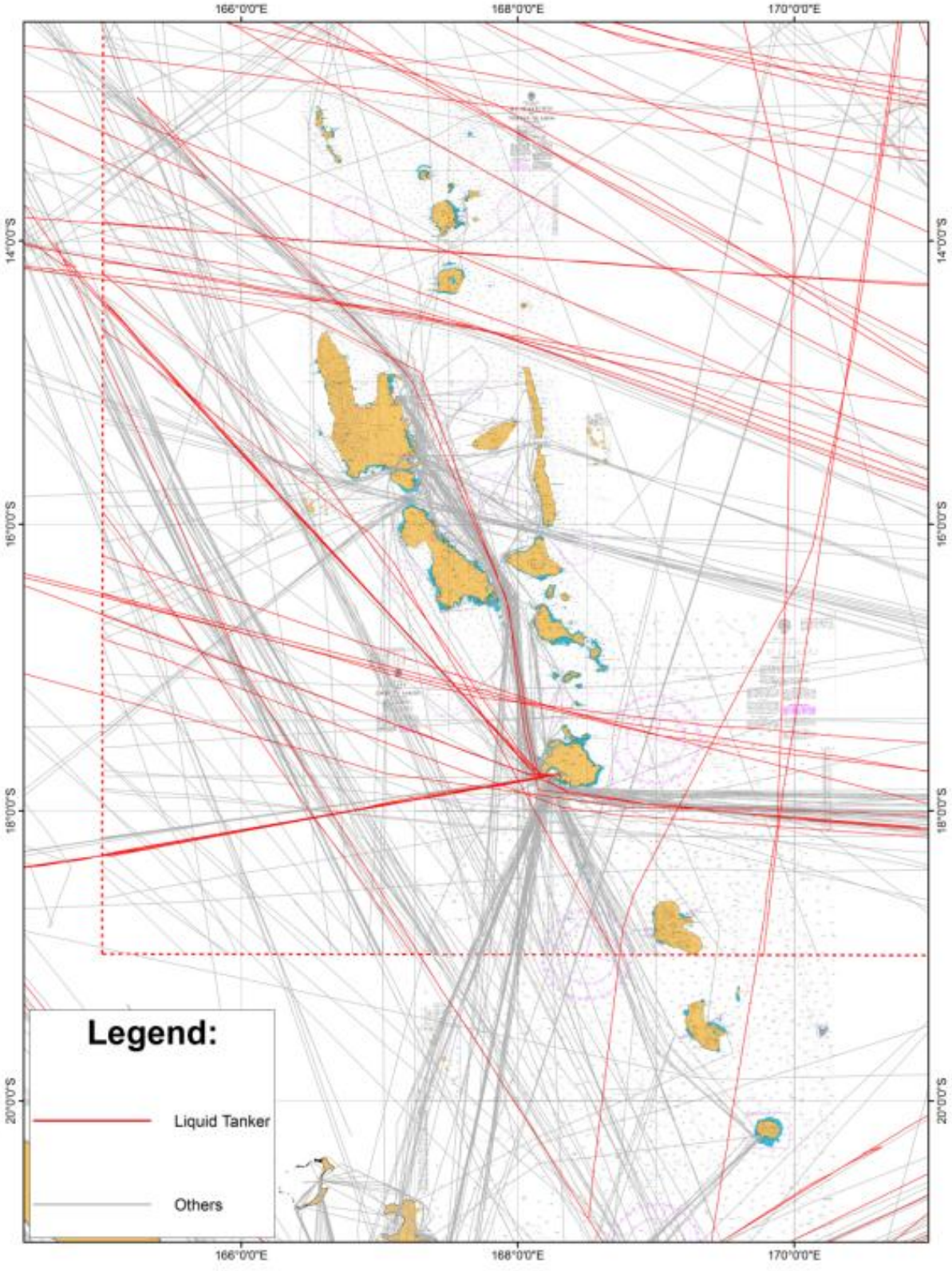


Figure 6-7 : Liquid Tanker Transits.

Fishing vessels in **Figure 6-8** refer to commercial vessels that carry AIS. No fishing activity takes place within Vanuatu's waters, however, a number of small commercial craft flagged in China and Taiwan transit between the archipelago's islands.

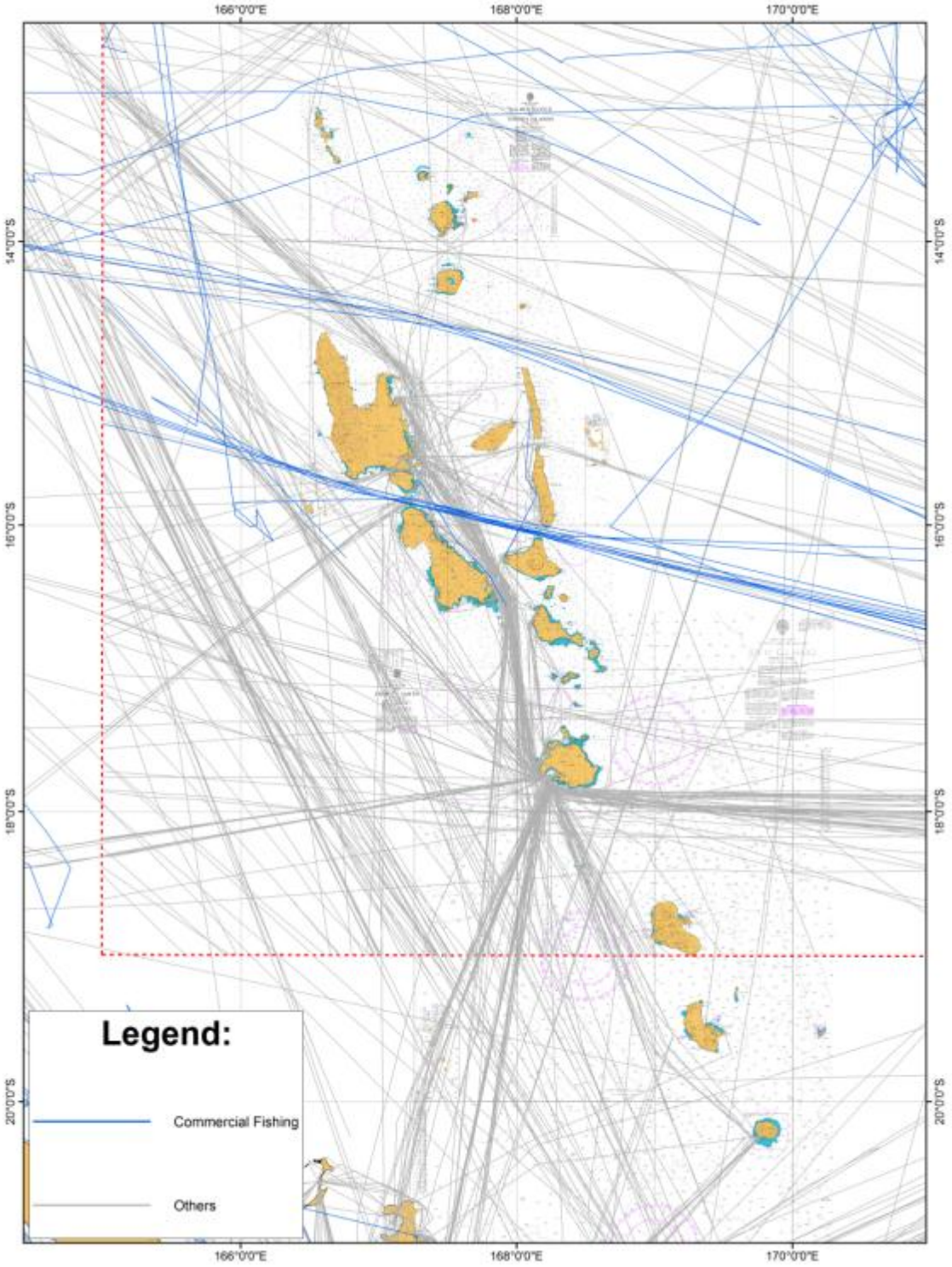


Figure 6-8 : Fishing Vessel Transits.

Cruise ship traffic represents the largest component of the high tonnage vessels transiting through the archipelago (**Figure 6-9**). Vessels transit in

particular between Champagne Beach, Luganville, Wala Island, Port Vila and Mystery Island. Only a single vessel was identified that transits past the islands to the west and that is the 70,000GT *Crystal Serenity* en route from Fiji to New Caledonia.

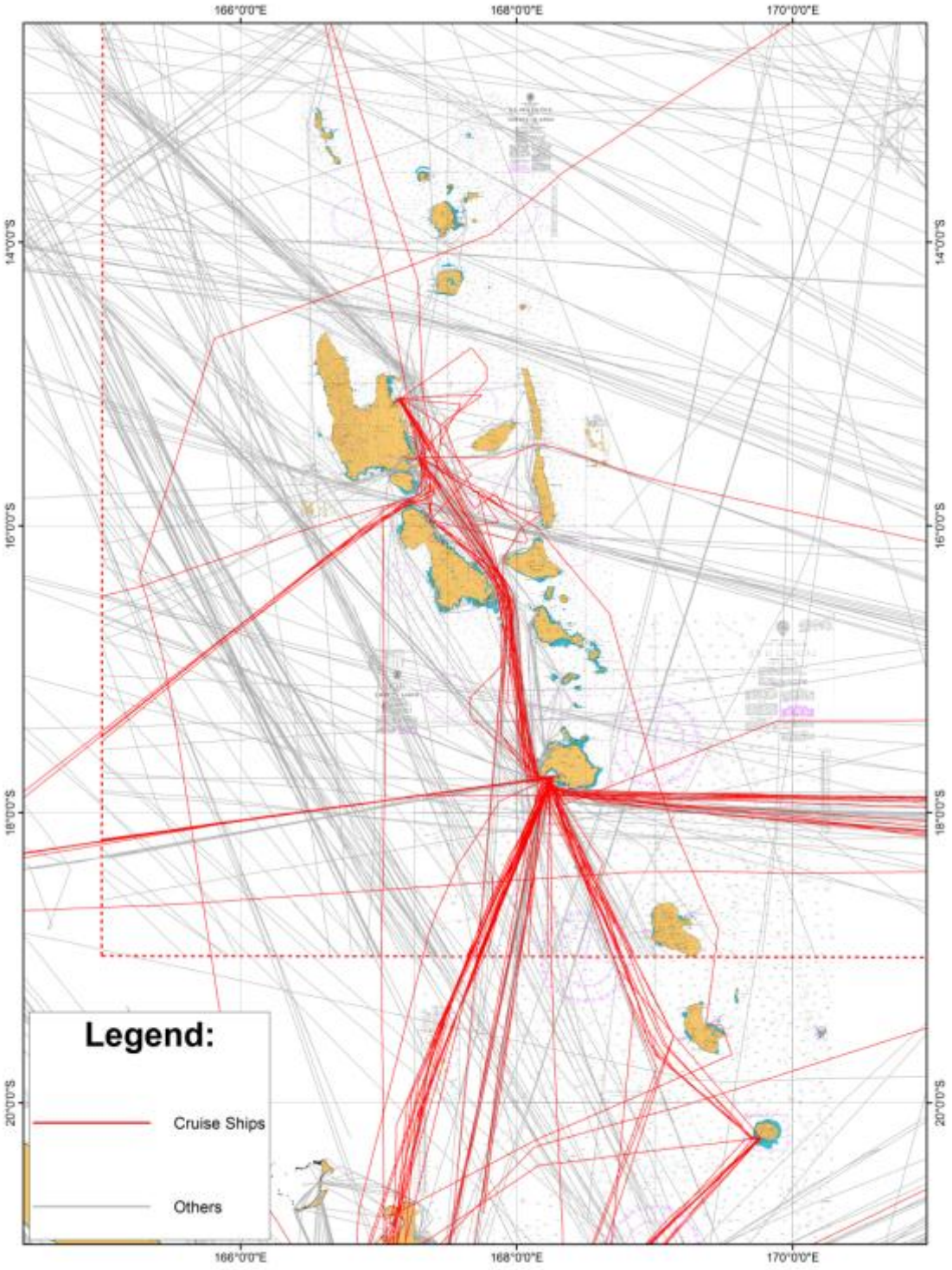


Figure 6-9 : Cruise Ship Transits.

Recreational craft and superyachts shown in **Figure 6-10** are active throughout Vanuatu. As smaller vessels in terms of size the quality of the

received data is not as high as other vessel types and breaks are evident in reception. Popular destinations for this type include Lamen Bay (Épi), Maskelyne Islands (Malakula), Ranon (Épi), Port Stanley (Malakula), Homo Bay (Pentecost), Champagne Beach (Espiritu Santo) and also a number of the northern islands.

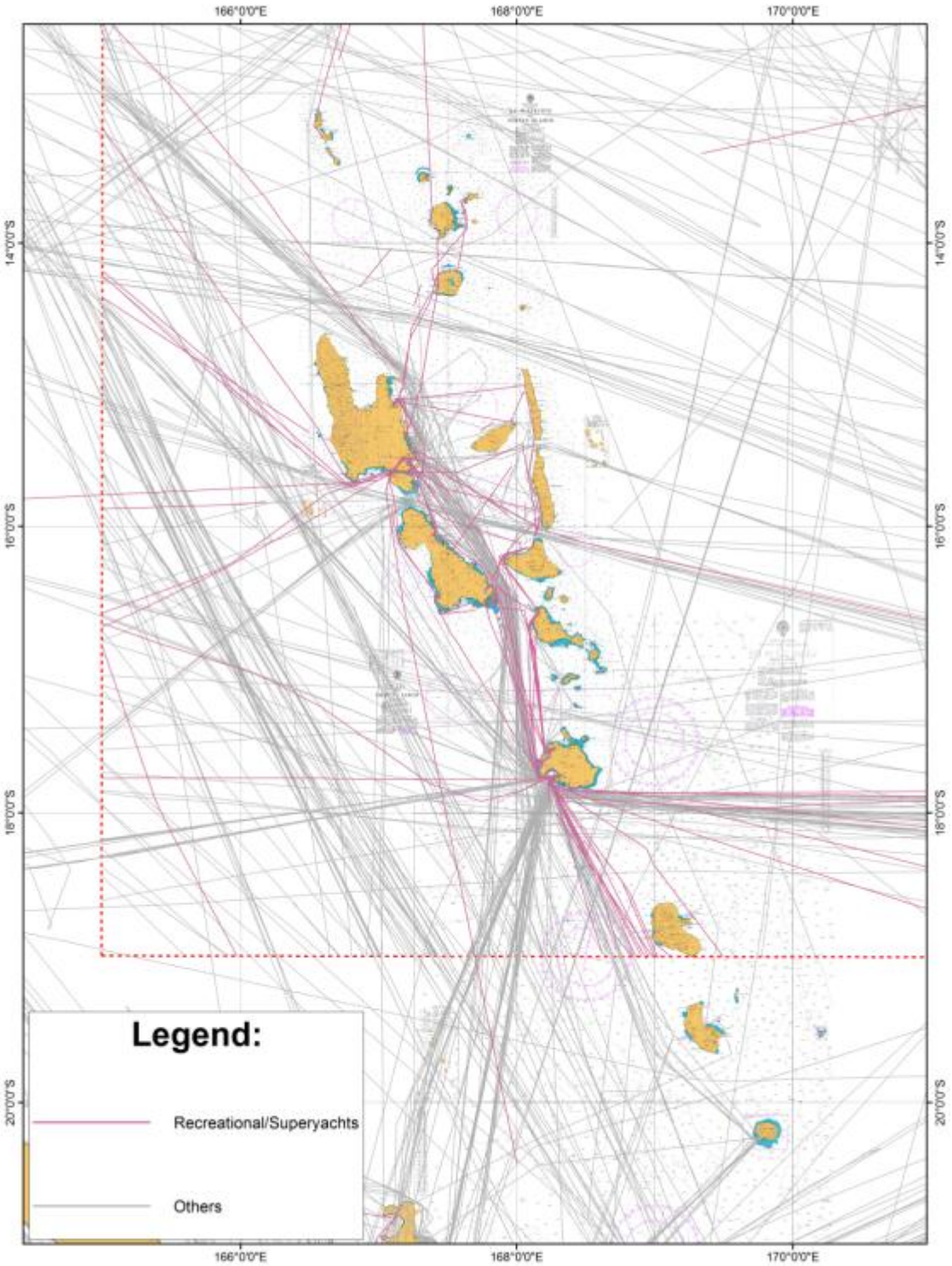


Figure 6-10 : Recreational/Superyacht Transits.

6.7 ANALYSIS BY VESSEL CHARACTERISTIC

Analysis was then undertaken on the characteristics of vessels transiting through Vanuatu. In particular analysis was used to identify routes used by the largest vessels by undertaking a density count of the largest vessel in each grid square. **Error! Not a valid bookmark self-reference.**, shows the spatial distribution of the largest vessels in terms of gross tonnage. This plot is similar to that of cruise ship transits in Figure 6-9 with routes identifiable between popular destinations.

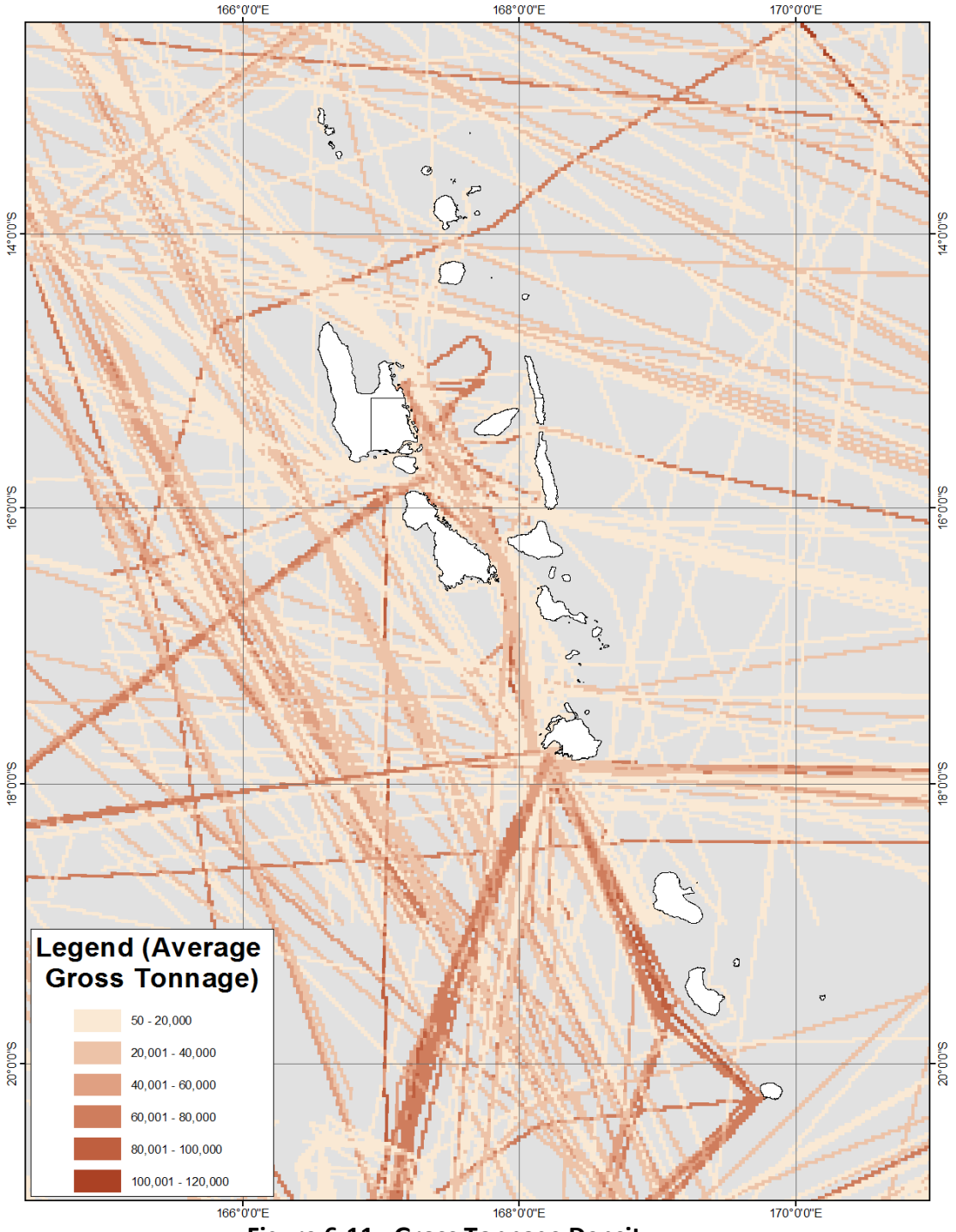


Figure 6-11 : Gross Tonnage Density.

The plot presented in **Figure 6-12** shows the routes of the deepest draught vessels. The plot shows that those vessels drawing over 10 metres are mostly located to the west of Vanuatu orientated on a northwest-southeast course. Within the islands themselves a number of deep draught vessels pass through the northern islands, however the majority of the central islands traffic profile has a draught of less than 9 metres.

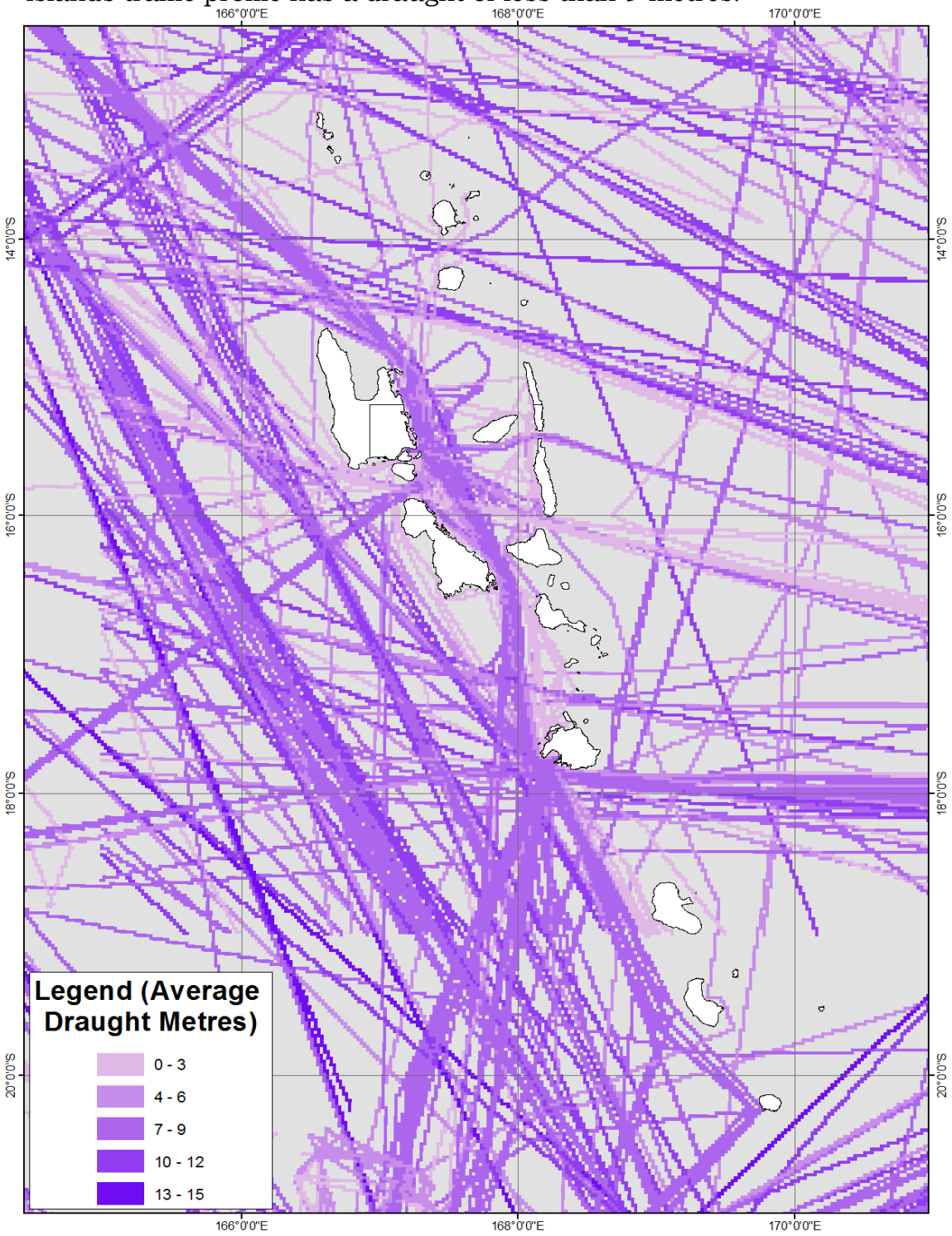


Figure 6-12 : Distribution of Deep Draught Vessels (Draught in Metres).

The final measure of vessel size presented in **Figure 6-13** is that of vessel length.

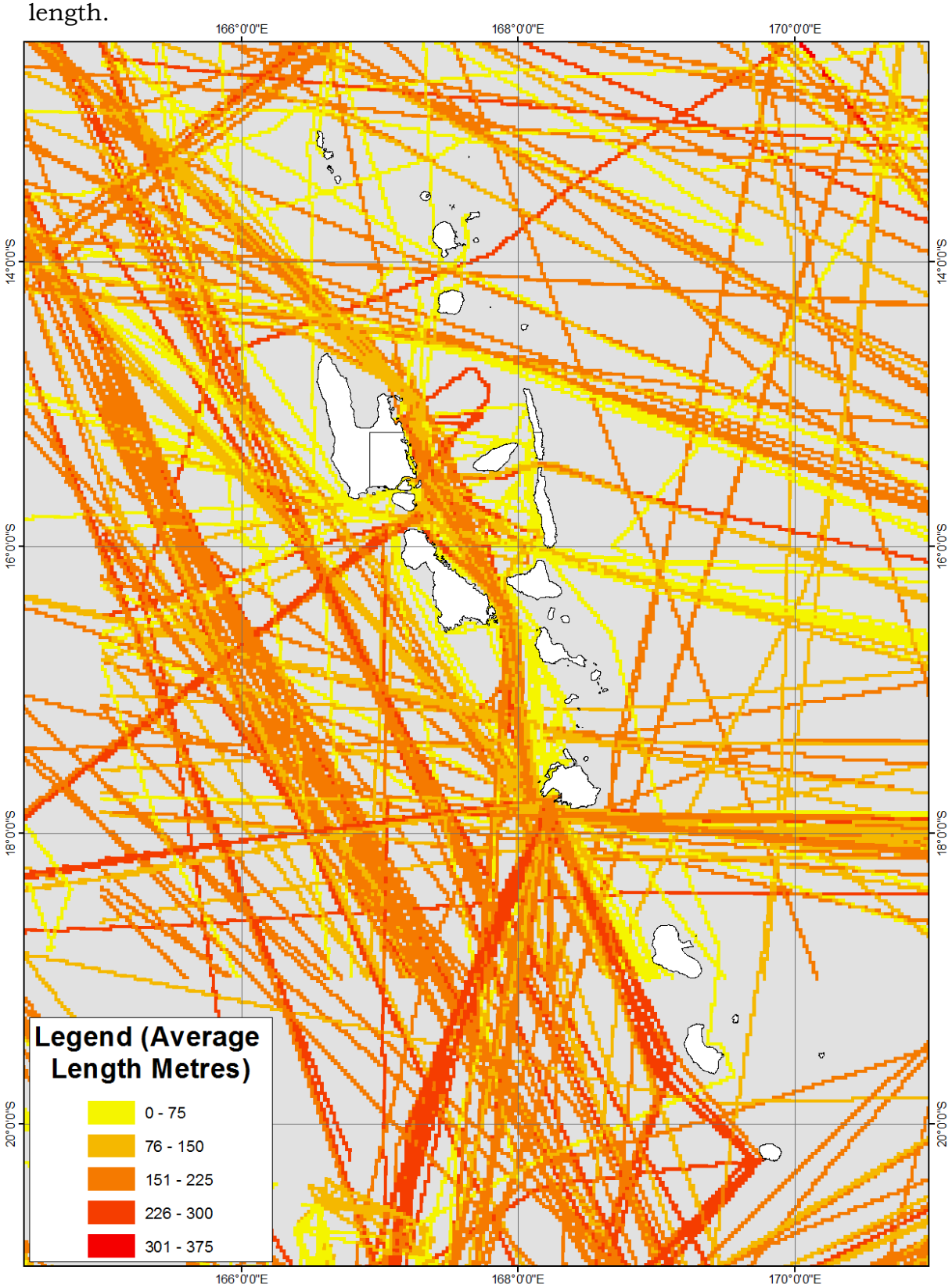


Figure 6-13 : Length Overall Density (Length in Metres).

There are vessels of significant length transiting between the islands. These are cruise vessels.

6.8 ANALYSIS OF MALAKULA-ÉPI GATE

A transect, or gate, was created between the south-east extremity of Malakula and the western tip of Épi to analyse the distribution of traffic passing through the central islands. The gate allowed the GIS to measure the traffic at that location, see **Figure 6-14**, below. The gate is shown against the traffic data recorded from vessel AIS transponders.

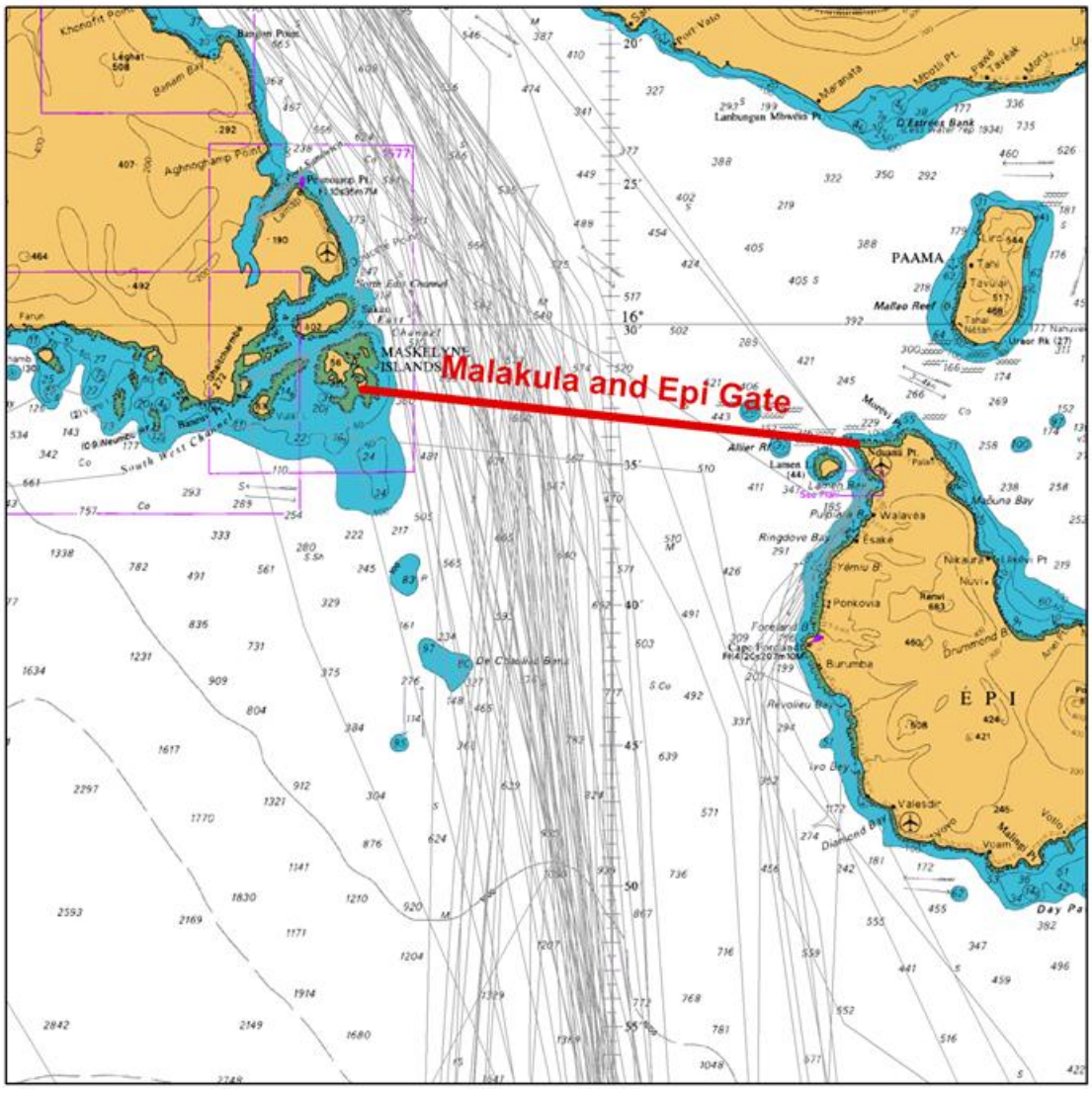


Figure 6-14 : Plot of the GIS Gate Location

Figure 6-15 shows that the distribution of vessel transits though this gate by their type. Dry cargo vessels constitute more than half of the passing traffic, mostly en route to or from Luganville. Passenger ships and then recreational craft make up the majority of the remaining traffic count. Overall, cruise ship traffic accounts for 30% of the movements in the data period.

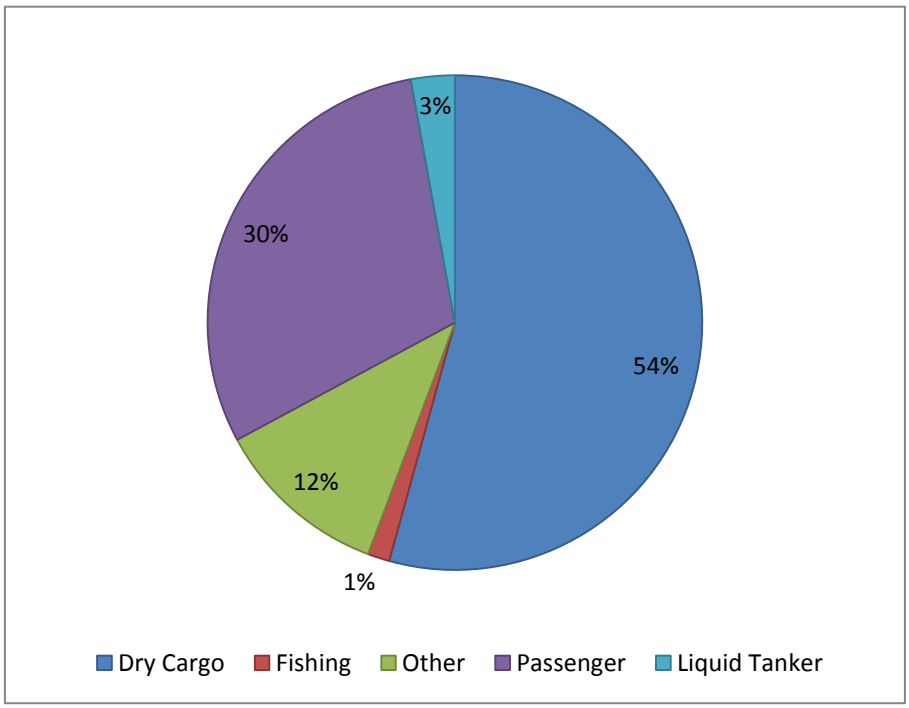


Figure 6-15 : Distribution of traffic transiting through Traffic Gate.

Traffic is analysed in terms of the gross tonnage of each vessel in **Figure 6.16**. The majority of international vessels are relatively small, less than 30,000 GT. However, in comparison, a number of cruise ships raise the tonnage profile; in particular the *Radiance of the Seas* at 90,100 GT makes a number of transits.

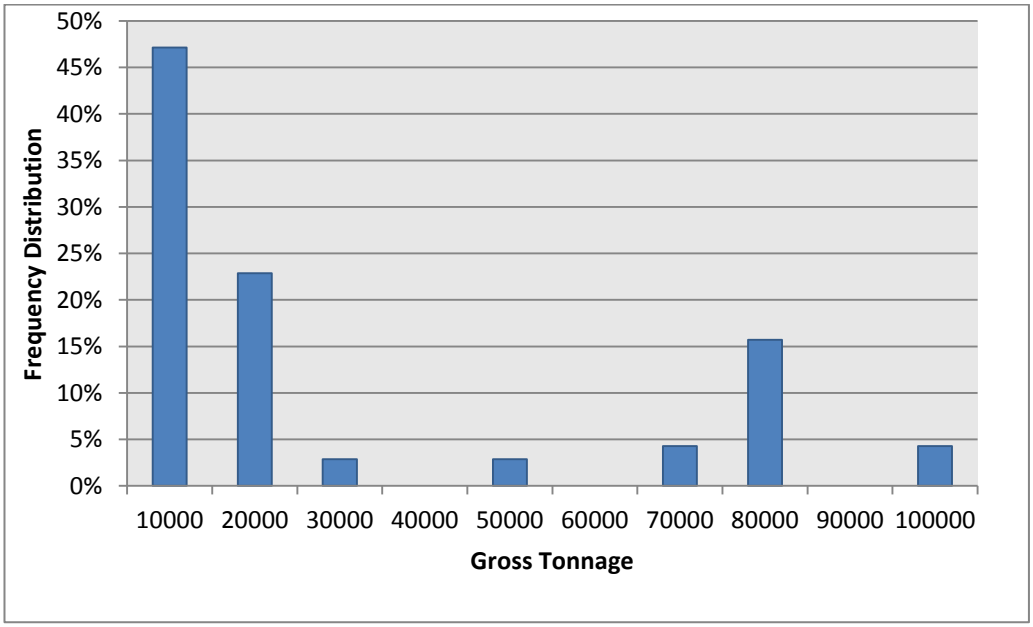


Figure 6-16 : Tonnage Distribution through Traffic Gate

6.9 CONCLUSIONS – INTERNATIONAL VESSELS – TRAFFIC ANALYSIS

1. The volume of traffic transiting the waters of Vanuatu is greater than expected.
2. Vanuatu has a varied trade profile by vessel type. The volume of SOLAS general cargo vessels is approximately steady, with a drift towards marginally larger vessels entering the trade.
3. SOLAS general cargo vessels only visit Port Vila and Luganville. The only known anomaly to this may be Malakula where a small bulk carrier was reported to have delivered bagged cement and loaded copra at anchor in 2012. Vessels only transiting Ni-Vanuatu waters either pass to the west or transit in a north-west south-east direction through the islands. Some fishing vessels take similar routes.
4. There is a significant growth in SOLAS cruise-vessel visits, not only in terms of numbers, but also size. Some of the largest cruise vessels visiting New Zealand and Australia are also becoming regular traders to Vanuatu.
5. Cruise-vessel number growth year on year is such that in 2012, they form 30% of the traffic profile, analysed at a "GIS gate" between Malakula and Épi. General cargo vessels represent 50% of the traffic profile. However, as cruise vessels are by far the largest vessels transiting the waters of Vanuatu, their contribution to transit risk is significant.
6. Some islands are only visited by international cruise vessels. Cruise vessels transit in particular between Hog Harbour (Champagne Beach), Luganville, Wala Island, Port Vila and Aneityum (Mystery Island).
7. There are large tankers, over 10 metres draught, transiting through northern Ni-Vanuatu waters between the islands of Gaua and Vanua Lava. These tankers in particular influence transit risk in the northern part of Vanuatu. However the majority of the central islands traffic profile has a draught of less than 9 metres. Most modern cruise vessels are under 9 metres draught.
8. There are vessels of significant length (over 300m) transiting between the islands, which reflect the cruise vessel profile.
9. Superyachts are regular visitors to Ni-Vanuatu waters. Popular destinations for this type include Lamen Bay (Épi), Maskelyne Islands (Malakula), Ranon (Épi), Port Stanley (Malakula), Homo Bay (Pentecost), Champagne Beach (Espiritu Santo) and a number of the northern islands.

7 ECONOMIC ANALYSIS RELEVANT TO THE RISK ANALYSIS

7.1 INTRODUCTION

The hydrographic risk methodology relies on evidence of economic growth as well as vessel transit risk, to conclude a need for improved charting. The evidence of economic activity is stronger if directly linked to the shipping sector. However, if an economy is growing in general, so is the shipping demand to move goods to markets.

In this section the overall economics of Vanuatu are considered in relation to tourism and the contribution made by the cruise industry.

7.2 VANUATU ECONOMIC OVERVIEW

In a 2009 ADB/AusAID report (VER-2009), Vanuatu had a population of 235,000[50], with an annual growth of about 2.4%. The population is expected to reach circa 270,000 by 2015.

Vanuatu has made significant economic and social gains since 2003, enjoying economic growth averaging 6% between 2003 and 2008. The main recorded drivers for growth are construction, tourism and general services. It is assumed that general services are unrelated to manufacturing or agriculture.

Vanuatu's economy is small and dominated by subsistence farming. The majority of the population is involved in agriculture which is the second largest contributor to GDP. There were around 175,000 people in agricultural households – about 80% of the national population (2009 data). It provides commodity exports and meets the subsistence needs of most of the population. The main agricultural exports are copra, kava and cocoa.[51]

Vanuatu has a basic domestic shipping transport sector. As the country is scattered over 80 islands, this creates particular challenges for domestic shipping transport. The geography, combined with relatively low cargo volumes, provides difficulty in achieving economies of scale. This may be beginning to change with coastal copra shipments rising to supply local biodiesel production plants.

Vanuatu is an attractive tourist destination due to its natural attributes. In the VER 2009 economic analysis, tourism related sectors accounted for

[50] Vanuatu Economic Report 2009-ADB/AusAID (VER 2009)
[51] Vanuatu Economic Report 2009, Accelerating Reform (ADB/AusAID)

nearly 67% of GDP and about 70% of the increase in economic growth. The potential of tourism is considered still to be realised, even though tourism is a major part of the economy.

The 2009 report reflects that the Vanuatu taxation system relies on import duty and sales tax[52]. Wages and salaries absorbed more than 76% of the goods and services bill of the government and accounted for more than 60% of recurrent expenditures. Therefore, funding for operational activities and public investment in infrastructure is limited. Costs for electricity, water, and port services in Vanuatu are amongst the highest of all Pacific island countries.

Vanuatu is a signatory to the Pacific Island Countries Trade Agreement, with an objective to remove all import tariffs by 2021. Vanuatu has free-trade access to Australia and New Zealand markets under the South Pacific Regional Trade and Economic Cooperation Agreement.[53]

7.3 VANUATU TOURISM OVERVIEW

Vanuatu's pristine ecosystem and its cultural diversity make it an attractive tourism destination. As Vanuatu's main export industry (ADB, 2009), tourism accounts for an estimated 5,000 jobs and offers good prospects for employment and growth. This industry contributes to both rural and urban economies and its importance to Vanuatu is highlighted when comparison is made with other South Pacific nations. In terms of employment alone, tourism is much more important to Vanuatu than many of its South Pacific neighbours. As the largest contributor also in terms of GDP, tourism is vital to the republic's economy.

The bulk of the country's visitors come from Australia and New Zealand, which together account for 75% of tourism demand.[54] Australia dominates arrivals to Vanuatu and accounts for 58% of the market, followed by New Zealand (17%), New Caledonia (10%), Europe (5%) and North America (3%).[55]

Tourism is principally driven by the private sector, yet the planning of its development appears to be in the public sector. It is estimated that tourism, defined as foreign tourism, generates about 75 per cent of the total foreign exchange earned by Vanuatu. According to the 2004 Vanuatu Visitor Survey, of those who came on holiday, approximately 29 per cent were repeat visitors. This indicates an encouraging level of visitor satisfaction.[56]

[52] Value Added Tax (VAT) is a GST equivalence.
[53] Vanuatu Economic Report 2009, Accelerating Reform (ADB/AusAID)
[54] IUCN – Fishing and Tourism in Vanuatu (2012)
[55] Millennium Challenge Account (MCA) Vanuatu – Tourism Survey – Baseline Study (June 2008)
[56] MCA Vanuatu – Tourism Survey – Baseline Study (June 2008)

Visitor arrivals to Vanuatu have been increasing significantly in the last decade, especially those travelling by sea. In 2002, cruise visitors totalled 50,027 doubling to 106,138 in 2008[57]; significant growth by people numbers. Strong growth continues. The most recent Quarterly Economic Report of the Vanuatu Ministry of Finance and Economic Management, identifies that in 2011, 147,514 visitors arrived by cruise ship, a rise of 39% in just three years.

Visitors travelling by air and booking Vanuatu accommodation are also staying longer; the average length of booking for such visitors has increased from 8.2 to 10 days.

Table 21, below, provides a comparison of international visitors, their average stay in Vanuatu and their estimated average daily expenditure during 2007.[58] Although this data is old, the picture it is painting remains relevant.

SEGMENT	TOURIST NUMBERS 2007	AVG STAY (DAYS)	AVG DAILY EXPENDITURE (Vatu ($US))
International Air	81,345	7.7	15,542 (170)
Cruise Ship	85,922	1.0	20,160 (225)
Yacht	924	59.6	4,711 (55)
Domestic	75,000	10.1	3,920 (45)

Table 24 : Visitor Arrivals by Cruise Ship (2007)

It is obvious that international visitors who arrived by air have the highest level of overall expenditure into the economy, although cruise ship visitors have the highest level of expenditure per day. These figures strongly suggest that it would be worthwhile considering a tourism strategy, with the help of cruise vessel stakeholders, that encourages some passengers to take an optional Vanuatu excursion for a couple of days, and then pick up the next scheduled cruise vessel. Thus expenditure into the economy from such visitors would rise. This would be feasible from Port Vila, which in 2012/13 can boast two cruise ship calls a week. Examples are; offering a visit to the Tanna volcano with overnight stays in Tanna and Port Vila; or offering a return charter flight and overnight stay to islands not visited by the cruise ship.

[57] Vanuatu Economic Report 2009, Accelerating Reform (ADB/AusAID)
[58] MCA Vanuatu – Tourism Survey – Baseline Study (June 2008)

This is not reflected in any of the tourism development plans available to each province. Nor is it considered in the cruise ship strategy documents reviewed.

In 2006, Vanuatu was pronounced the "happiest country in the world" by an OECD study. This appears to have provided a beneficial influence as far as tourism is concerned. Cruise ship visits are increasing and it has been seen as a safe destination with a relaxed life style. This has contributed to Vanuatu's increasing popularity as a tourist destination in recent years.[59]

International visitors by air arrive at Port Vila and Luganville. Many tourists visit other sites on these islands, for example, some 59% indicated travelling to other parts of Éfaté from Port Vila. For cruise visitors and for yacht visitors the respective figures were 40% and 63%. The percentages of tourists who visited key locations in Éfaté in 2008 were as follows:[60]

SITES	AIR TOURIST PER CENT	CRUISE VISITORS PER CENT	YACHT VISITOR PER CENT
Hideaway Island	33	10	33
Mele Cascades	28	14	26
Round Island Tour	20	10	26
North Éfaté	13	1	0
Other sites	22	11	11

Table 25 : Vanuatu Tourism Survey Data (June 2008)

According to a 2007 visitor survey, more than 75% of visitors to Vanuatu are tourists. Spend estimates from tourism were about Vt17.9 billion (US $169 million) during 2009[61].

The government developed the Vanuatu Tourism Action Plan (VTAP) which is a blueprint for the further development of tourism. The Vanuatu Economic Report, 2009 recommended that high priority be given to this plan. As an observation out of the data gathering visit, it appears that the provincial tourism plans would benefit from tailoring more to the needs of each province; each contain much common material. The point, above, about attracting cruise passengers to take a longer break in Vanuatu is relevant.

[59] Vanuatu Economic Report 2009, Accelerating Reform (ADB/AusAID)
[60] MCA Vanuatu – Tourism Survey – Baseline Study (June 2008)
[61] Vanuatu Economic Report 2009, Accelerating Reform (ADB/AusAID)

7.3.1 Tourism – Cruise Related

The Vanuatu cruise market is dominated by Carnival Australia, which operates several brands including P&O Cruises, Cunard, Carnival Cruise Line, Seabourne and Holland America Line. Carnival Australia accounts for more than 90% of total cruise visitor arrivals in Vanuatu. Their vessels were booked to make 116 calls at destinations in Vanuatu during 2012 and are expected to make an estimated 133 calls in 2013. Total visitor numbers in 2013 from Carnival operations are expected to be 260,000.

The primary attraction of the South Pacific is the ability to visit remote, unspoilt, tropical island paradises. Cruise vessels have the capability to take considerable numbers to pristine areas that are inaccessible by other means of transportation. However, remoteness also acts as a deterrent due to the time and fuel required to get to and travel between destinations.

Vanuatu has the advantage that it is relatively close to Australia and can thus be visited on short cruises. There is a noticeable trend in passenger taste for shorter cruises of seven to ten days and Vanuatu is well situated to take advantage of that. This advantage is lost to the northern islands of Vanuatu, where a longer cruise schedule is needed. Cruise stakeholders[62] advise that passenger bookings maximise at a seven day cruise, but fall off considerably as the cruise schedule lengthens. The cut off economically is said to be a maximum cruise of 16 days.

Cruises up to the central isles of Vanuatu, originating in Brisbane, can achieve sufficient island port calls within a seven day cruise, whilst Sydney and Auckland provide a 9-10 day schedule to the same areas.[63]

An important aspect of regional cruising is the increasing size of the vessels involved. Within five years, cruise ships visiting Vanuatu are likely to be up from the current 250m and 70,000GT range, to vessels of around 300m and 100,000GT, carrying up to 3,000 passengers. Cruise ship arrivals are set to increase in short to medium term, and any infrastructure development will further support tourism growth.

Most cruise vessels visiting Vanuatu are based in Australia, operating primarily out of Brisbane and Sydney. Cruise operators move additional and larger ships in Australia during the summer months. For example *Radiance Of The Seas* (90,090 GT; length 293m; passenger capacity 2,501) was based in Sydney for the 2011/2012 season and *Voyager Of The Seas* is a 2012/13 addition (138,000GT, length 311m; passenger capacity 3,840). These vessels additionally carry a crew complement of about 1000.

[62] In the experience of the Carnival operating model
[63] National Cruise Tourism Action Plan 2012-2020

Table 26 shows the recorded Vanuatu visitor numbers by cruise ship, during each quarter from June 2009 to the quarter ending Dec 2011.[64]

Visitors	2009		2010				2011			
	Sep09 (Q3)	Dec09 (Q4)	Mar10 (Q1)	Jun10 (Q2)	Sep10 (Q3)	Dec10 (Q4)	Mar11 (Q1)	Jun11 (Q2)	Sep11 (Q3)	Dec11 (Q4)
Visitor Nos.	22,914	26,419	33,930	33,316	32,186	41,036	33,541	51,119	31,986	30,866
Visitors (% year on year change)	22.7	-32.0	-24.4	8.9	40.5	55.3	23.7	53.4	-0.6	-24.8

Table 26 : Visitor Arrivals by Cruise Vessel

In the summer season, 2007-2008, there were 96 recorded port calls by cruise vessels to the islands of Vanuatu. Passenger numbers were 160,790, crew 96,474 and the total passenger spend was estimated at US$8.8M (800M Vatu). Vanuatu was the most popular cruise destination in the South Pacific islands after Tahiti, which had 257 port calls.[65]

The South Pacific overall has a small share of the international cruise market. This was 1.30% in 2002 but had increased to 1.78% in 2006, an increase of 36.9%. It indicates the long term growth potential of the region. However, the region is far from North America and Europe, the main source of cruise passengers, and the long haul flight and extra cost of fly/cruise holidays is a disincentive for visitors.

The main cruise-vessel agent in Vanuatu is South Seas Shipping. The agency handles all but a few small cruise vessels. South Seas statistics for 2009 to 2013 are shown in **Table 27,** below, which shows the dramatic increase in cruise-vessel visits with an increase of 171% in the four years 2009 to 2012. This is at September, 2012, so the figures are in part based on bookings.

[64] Vanuatu Economic Report 2009, Accelerating Reform (ADB/AusAID)
[65] South Pacific Cruise Shipping Development Strategy, Dec 2007.

Port	2009	2010	2011	2012	2013
Port Vila	50	57	73	111	126
Mystery Island	23	21	57	55	74
Wala Island	9	11	15	18	18
Champagne Beach	6	4	13	17	16
Pentecost	3	5	5	3	2
Luganville	2	2	6	15	16
Total	93	100	169	219	252

Table 27 : South Seas Shipping - Passenger Vessel Statistics

The hydrographic risk methodology relies on evidence of economic growth as well as vessel transit risk, to conclude a need for improved charting. The economic case for hydrographic risk is made on cruise-vessel growth alone, but it should be noted that outside of Port Vila and Luganville, cruise-vessel stakeholders are also the only port user. Their participation in charting improvements is acknowledged and encouraged.

7.3.2 Tourism and Urban Economy

The economic activity of tourism is predominantly concentrated in the urban areas of Vanuatu, principally the capital, Port Vila, and most tourists stay on the main island of Éfaté (DTIS, 2008). The urban economy is the largest recipient of tourism dollars largely because tourists frequent urban areas for their amenities. Access to the country's rural areas is poor or non-existent and most rural communities lack tourism infrastructure. Some estimates suggest only 10-18% of tourists travel to outer islands and even then Tanna and Espiritu Santo attract most of the tourist traffic.

7.5 IMPEDIMENTS TO ECONOMIC DEVELOPMENT

This section is influenced by a review of other consultancy work undertaken in Vanuatu, which is consistent with the findings of the Vanuatu deployment during this study[66].

7.5.1 Impediments Associated with Cruise Operations

Concern has historically been raised that the Vanuatu islands' economy needed to develop in a balanced manner, reflecting the difficulty for infrastructure development that cruise vessels provide, with a single and sudden large influx of tourists, who leave just as suddenly. Cruise ship visits are established as a significant contributor to the Vanuatu tourism sector; this based on analysis by authoritative reports, which conclude a need for accelerated reform[67].

There were questions of over-dependence on a micro-economic level also. It was noted that, at present, there was market dominance by one major cruise operator.

7.5.1.1 FUNDING OF SHORE INFRASTRUCTURE FOR CRUISE OPERATIONS

Larger vessels were beginning to service the islands, and facilitating this has involved cruise stakeholders electing to invest in jetty infrastructure by negotiation. The net result is that jetty infrastructure is ultimately paid for by a (set time period) reduction in Vanuatu national marine safety charges for the operator providing the infrastructure. These marine safety charges would normally be funding the development of a centralised Marine Safety Authority, whose role is to improve and maintain standards of navigation and navigational related infrastructure nationally. Such infrastructure would provide and maintain coastal aids to navigation. Jetty infrastructure should be provided by a ports system. Presently there is a port authority in place for Port Vila and Luganville only.

This is not to say that the cruise industry is not prepared to pay its way. The cruise vessels were also paying anchorage dues in trust to local Ni-Vanuatu interests, in lieu of any port or harbour organisation being able to provide necessary hydrographic and port safety and interface services. There remain wider public-interest needs of marine safety and long term port infrastructure development, which port dues paid by visiting ships should provide for.

[66] State of Play Assessment for Vanuatu, International Finance Corporation, June 2010.
[67] Vanuatu Economic Report 2009, Accelerating Reform (ADB/AusAID)

Setting up port systems that are self-funding to deliver the appropriate marine interface infrastructure should be a priority.

7.5.1.2 CRUISE SHIP VISITS TO NORTHERN VANUATU ISLANDS

Cruise vessels operating out of Australia can offer passengers a seven day cruise, which is popular and demand is reportedly increasing. Longer cruises attract lower passenger volumes. A seven day cruise out of Australia practically prohibits a cruise-vessel from visiting the northern islands of the Vanuatu group, as well as out of the way locations beyond the central triangle between Islands[68].

Tourism plans in each province overlook the above as the cruise market is not understood.

There are a small number of "boutique" cruise vessels serving the Vanuatu cruise passenger market, some of which transit the globe. These cruise vessels attract different passenger types and in many respects are better sized (smaller) for the present infrastructure of Vanuatu. Similarly there are larger cruise vessels in the global transit market that pass Vanuatu. These vessels are much more likely to visit the more remote islands of the Vanuatu group.

Large cruise-vessel operators do see the potential for the northern Vanuatu islands to be included in an Australia-PNG-Solomon Islands-Vanuatu cruise. It was suggested that this would make a 14-16 day cruise, but this could not commence without infrastructure development in the Solomon Islands.

For operational safety reasons, cruise-vessel operators prefer their vessels being alongside to facilitate passenger excursions, than using their tenders at anchorages. Vanuatu port infrastructure development is only at the planning stage to facilitate this, but the islands of Espiritu Santo and Éfaté may benefit significantly from fruition of such plans.

7.5.2 Impediments of Marine and Port Infrastructure

The Vanuatu tourism industry is affected overall by inadequate transport infrastructure and services, particularly domestic air, road and maritime infrastructure. Port and local transport services meet some aspects of tourism industry demand, but there are limitations. The cruise-vessel data shows that the rate of vessel-calls has increased significantly, but more importantly that the length of some cruise vessels are significantly in excess of the length of the available port wharves in Vanuatu. Some of the world's

[68] Land Diving is a separate attraction but limited in timescales.

largest cruise vessels have begun regular calls to Port Vila, as well as anchorages in the Vanuatu EEZ. The condition of wharves, or more specifically, the condition of mooring arrangements to suit such large vessels are in need of attention. Some of this is urgent.

Luganville wharf is small for major cruise vessels, and this is reflected in the limited number of calls. Many of the outer island jetties are in a state of disrepair, which is related to historical cyclone damage. Construction strategies need to be informed by understanding of sea conditions, as well as a need for uniform public rights of access, and rights of cargo transit.

Main Wharf at Port Vila wharf is increasingly congested with cruise vessels and general cargo vessels. The facilities are in poor condition and unsuitable for large passenger movements. Tourism at Port Vila could also benefit from improvements in marina facilities for recreational vessels[69], although it was noted that there are berths with both good moorings and power in the area of Balland Wharf. In 2012, there were also marina developments at various stages in other coastal locations on Éfaté.

On the face of it, much of the infrastructure capability gap appears (to authors) to be related to the needs of cruise-vessel operators and it is hardly surprising to see both cruise industry and other tourist stakeholders advising this as an impediment to tourism development. However, consideration also needs to be given to the roads and other support that needs to be provided to a vessel with the capability to deliver circa 3,200 people into Port Vila, or Luganville. There is an IFC report[70] of 2010 which recommends priority to finalising the Vanuatu Cruise Shipping Strategy.

Port Vila's inadequate container-handling facilities reportedly make it the worst performing port in the Pacific, since more than 80% of the cargo entering the port is containerised. There is a need to increase the wharf capacity and probably in the long term, a terminal with a section dedicated to containers will be required[71].

In summary, marine infrastructure needs financial investment, but it needs vessels visiting Vanuatu to be funding this. For Port Vila, the government of Vanuatu was reviewing options for alternative wharves with AID support, recognising the operational constraints affecting the current main wharf.

[69] State of Play Assessment for Vanuatu, International Finance Corporation, June 2010.
[70] State of Play Assessment for Vanuatu, International Finance Corporation, June 2010.
[71] Vanuatu Economic Report 2009, Accelerating Reform (ADB/AusAID)

7.5.2.1 DOMESTIC INTERISLAND TRAVEL BY CRUISE TOURISTS

Cruise ship operations have enjoyed significant expansion in recent years, both in vessel and passenger numbers. Ni Vanuatu has also benefited as additional islands have received cruise vessel calls. However, little domestic travel has been undertaken by tourists arriving via ship. Vanuatu is currently well served by cruise ships and international shipping, but scores poorly in relation to internal shipping and passenger services suitable for tourist use. Domestic coastal shipping services are unsuitable for tourist travel and air travel to remote islands is infrequent. This is an impediment to tourism development in rural areas.

7.5.3 Impediments by Geographic Location

Vanuatu is remote from major trade and commerce centres. It is therefore, at a disadvantage in trying to use international trade to overcome the limitations of its small domestic market. Although shipping costs are high, this is not because of long distances from ports of call but due to small and imbalanced cargo flows associated with a high merchandise trade deficit.

7.6 Port and Harbour Infrastructure

7.6.1 Key Ports

There are 22 ports and wharves in Vanuatu. However, the vast majority of international and domestic shipping operations are centred at only two, Port Vila (Éfaté) and Luganville (Espiritu Santo). Approximately 70% of all imports and 30% of all exports are handled at Port Vila, Main Wharf. This has already been improved as the result of an ADB-funded Urban Infrastructure Project.

Main Wharf is owned by the Vanuatu Port Authority. It has been selected to benefit from further rehabilitation under a Japan International Cooperation Agency (JICA) grant of US$17million (1,544 Million Vatu). Cargo stakeholders have expressed growing dissatisfaction with the queuing procedures at Main Wharf. Because of wharf space shortage, cruise ships are given preference over cargo vessels, halting container movements and warehousing operations in the international terminal area.

Port Vila's privately operated domestic wharves are also in poor condition and unsafe for cargo or passenger operations.

The port of Luganville (Espiritu Santo) is also owned by the Vanuatu Port Authority, but it is operated privately. It handles the remainder of the overseas traffic and serves as an international collection point for the

northern islands. An ADB-funded rehabilitation project for the port in the late 1990s enhanced its performance significantly, reducing average turnaround time by 50%. Expansion of the international facilities at Main Wharf, Luganville was then considered as not required. This is true of cargo vessels; however, in order to securely berth the large cruise vessels of 2012, significant upgrading of mooring bollard capacity and disposition is required, as well as structural improvements, see, **Figure 8-1**, below.

Figure 7-1 : Mooring Bollards Need Upgrading at Main Wharf, Luganville for Large Vessels The Berth has been Undermined and Washed out at its Eastern End.

7.6.2 Port Management

The Department of Ports and Harbours (DPH) is responsible for the management and operation of Port Vila and Luganville ports. DPH is charged with provision of Harbour Master and pilotage services,

administering the government-owned wharves, and maintaining aids to navigation[72]. It is also responsible for national shipping and ports administration, legislation, control of shipping, and maritime safety. Maritime safety has previously been the responsibility of the Vanuatu Maritime Authority (VMA) which was established in 1999 and abolished in 2007. VMA's functions were taken over by the DPH. It was noted in an ADB report of 2002, providing a Vanuatu Infrastructure Master-Plan that DPH was understaffed. It remains the case in 2012.

The provincial governments are responsible for the operation and management of the domestic ports in their areas of authority. In practical terms, this means bays and jetties.

Given the limitations of the DPH and the lack of an effective maritime regulator, it may be over simplistic to say that owner-operators of the nation's wharves are not meeting maintenance and repair obligations. There needs to be port authority type arrangements in place for cargo landings and jetties throughout Vanuatu, providing common law rights of vessel/cargo access, as well as maintenance obligations funded by charges for use.

Domestic ship operators typically arrange their own stevedoring services, often using ship's crew.

7.6.2.1 ISLAND COASTAL INFRASTRUCTURE

The domestic coastal island wharves in Vanuatu are badly in need of rebuilding. With assistance from ADB and NZAID, the government is developing a strategy for improved domestic interisland shipping services, which should complement investment in ship-to-shore infrastructure. The government has also piloted a method to subsidise uneconomic routes, through a bidding process.

NZAID Interisland shipping project would include the provision of regular shipping services to islands and locations that were not commercially viable. In addition to subsidising some of the routes, other considerations will be reliability and "safety".

Landing craft and lightering operations are used in the outer islands because few jetties or wharves are still operational. Inadequate initial site planning in relation to prevailing weather, poor design and construction, a lack of ownership, lack of port authority legal obligations, as well maintenance are all relevant contributory factors. Cyclone damage has also taken its toll on the country's rural wharves, with an unreasonable number damaged beyond

[72] The provision of maritime safety information is the responsibility of the Vanuatu Government. Such information should be passed to the UKHO, the Primary Charting Authority for Vanuatu chart maintenance.

repair. Consequently, domestic, interisland shipping services are hampered by significant loading and discharging times.

Asian Development Bank (ADB) and the New Zealand Ministry of Foreign Affairs and Trade (MFAT) will be focusing on domestic maritime transport.

7.7 DOMESTIC TRADE - COASTAL SHIPPING VALUE ASSESSMENT

Vanuatu's domestic shipping trade is served by cargo and cargo/ passenger vessels. Its value in sustainable support of domestic coastal vessel services is unknown. If just the value of shipping key commodities can be estimated, it provides a lower (conservative) bound to the economics of the domestic coastal trade.

In the absence of any recorded data, an estimate of the cargo quantities moved on domestic coastal trades is provided below. This is taken from information obtained from the various provinces during the Vanuatu data gathering visits:

- Cocoa – 1000 tonnes per year (main movement being of two shipments per week from Lambubu);
- Copra/Meal – 6000 tonnes per year (main movement is of 100 tonnes per week from Norsup Jetty. Copra is moved from Litslits also);
- Kava – 2000 tonnes per year (basis three shipments per week from Pentecost).

Cargo is shipped in bags, which vary between 50-70kg, a size allowing man-handling. From this information, it is estimated that about 150,000 bags were transported around the coast by domestic vessels in 2012.

In a number of different islands a shipment cost of 1000Vatu (US$11.0) per bag was advised. The congruency of advice from different independent sources supports that this is accurate.

Therefore, in conservative terms, the estimated domestic market freight had a funding of about 150million Vatu (US$1.64million). This equates to almost two million New Zealand dollars.

This estimate is conservative as it ignores other vessel freight earnings capability by concentrating only on volume trades. Other freight earnings such as from passengers; supermarket produce and fuels delivery provide additional income.

This provides good standing that there is financial reality underlying the ability of the domestic coastal trade to expand.

7.8 AGRICULTURE

Vanuatu has experienced stagnation in commercial agriculture. Its exports are limited and, in most cases, declining. On the other hand, imports have grown in line with the construction boom, the greater use of private credit, and increasing transportation services.

Agricultural exports (coconut products, cocoa, kava and beef) account for about 80% of Vanuatu's total exports by value. The table below gives the percentage change of exports basis year on year for copra, beef and cocoa[73].

EXPORTS	Sep 09	Dec 09	Mar 10	Jun 10	Sep 10	Dec 10	Mar 11	Jun 11	Sep 11	Dec 11
Copra	-78.3	8.8	-84.9	82.7	-5.4	141.9		320.0	68.9	-44.6
Beef	-20.9	-24.3	-8.8	-57.2	31.4	24.8			-12.5	-7.3
Cocoa	-5.4	6.8	-32.0	40.8	-22.2	35.7			-12.0	-41.5

Table 28 : Exports % Year on Year (Copra, Beef and Cocoa)

7.8.1 Cocoa

The oldest cocoa industries in the South Pacific belong to Vanuatu and Samoa[74]. Over the last decade [1999-2009], Vanuatu's production oscillated around 1,000 to 1,200 tonnes. Cocoa exports, as with copra and coconut oil, have shown a downward trend. Vanuatu exported 1,058 tonnes of cocoa during 2008, for a *free on board*[75] value of 240million Vatu (US$2.63million). This represented 6% of Vanuatu's total export earnings, lying behind coconut products, beef and kava.

In October 2009 with the average world cocoa price for the month at US$ 3,142 per-tonne (287,000Vatu per tonne), the Vanuatu Organic Cocoa Growers Association (VOCGA) growers received 174Vatu per-kg (US$1.9 per-kg) for dried bean increasing to 184Vatu per-kg (US$2.0 per-kg) from November 2009. In December 2011, the cocoa export price was 222Vatu per kilo (US$2.43 per kilo), in line with the world price.

As per the VOCGA (2009) report, despite the improvement in export price, the yields from cocoa farming remains low, i.e. around 500 kg/ha.

During the 1970s, cocoa was promoted as the major diversification crop for copra. The Vanuatu cocoa industry was concentrated in three provinces,

[73] Ministry of Finance and Economic Management – Quarter Four Eco Report (Dec 2011)
[74] VOCGA: A Case Study of Agricultural Growth in the Pacific (Nov 2009)
[75] Free on board: The seller loads the goods and the trans-shipment is the responsibility of the buyer.

Sanma, Penama and Malampa. The island of Malakula in Malampa Province was the main producing area, accounting for around 70% of the total production.

The table below gives the cocoa production figures for each province from 1995 to 2004, the latest figures available from the Ministry of Finance.[76]

YEAR	TORBA	SANMA	PENAMA	MALAMPA	SHEFA	VANUATU	5 YR AVG
1995	1	464	167	1148	6	1786	1561
1996	1	237	72	623	6	939	1477
1997	2	447	135	1180	2	1766	1599
1998	2	380	113	998	8	1501	1436
1999		138	59	692	2	891	1377
2000		294	164	1098	1	1557	1331
2001		155	101	539	1	797	1302
2002		168	115	584	1	868	1123
2003		281	193	871	1	1346	1092
2004		257	40	695	4	996	1113

Table 29 : Cocoa Production Figures in Tonnes for Each Province (1995 To 2004)[77]

7.8.2 Copra

The most important agricultural product, in terms of cash production in the villages and in terms of export, is copra. Copra is the dried flesh of coconuts, produced by individual households and on large-scale plantations. According to the "Encyclopaedia of Nations", production of copra is variable year to year, depending on weather conditions and world prices. However, a general downward trend in production has been apparent since the 1980s. One explanation is that the price in real terms paid to producers has declined over this period.

However, the onsite data gathering visits to Vanuatu have determined a dramatic variance to the historical statistics. Feedback from coastal trading interest show that although poorly paying in both value and freight costs, the volume of copra being shipped around the coast has begun to rise. This

[76] VOCGA: A Case Study of Agricultural Growth in the Pacific (Nov 2009)
[77] Source: Vanuatu Annual Statistical Indicators, 2004

rise is driven by biofuel production, which uses copra as its source material. This is beginning to revive coastal trade but is likely to remain an internal trade to Vanuatu and thus not necessarily going to be obvious in statistics measuring export volumes. It will be measured in reducing fuel tanker transits and volumes of imported fossil fuels. The economics of coastal trading infrastructure, such as installation of jetties and clear rights of way for cargo transit need to take account of this information.

7.8.3 Coconut Oil

Coconut oil is derived from copra. The Department of Finance and Treasury Quarterly Economic Report of December 2011 advises an increase production of coconut oil, following an increase in export price to 132Vatu per kilo (US$1.45). Indications were that copra supplied for oil production had increased more than production for direct export. This is evidenced by an 11% increase in copra received by oil producers by end of 2011. During 2011 coconut oil increased by 4.6 per cent over 2010 in value terms.

This is important information for the hydrographic risk assessment as it independently confirms the increasing demand in domestic coastal shipping.

7.9 FISHING

7.9.1 Industry Overview

Vanuatu has a large area of marine resources encompassing an exclusive economic zone (EEZ) of approximately 680,000 square kilometres. The fishing industry has exploited the country's marine resource through the offshore-commercial and artisanal-subsistence fisheries. Both fisheries have made distinct contributions to the Vanuatu's economy whilst targeting different marine species. The offshore commercial fisheries contribute to the urban economy while the artisanal-subsistence fisheries contribute primarily to the rural economy by the harvest of reef fish[78].

The International Union for Conservation of Nature and Natural Resources (IUCN) in 2012 report concluded that Vanuatu's offshore commercial fishery had a fleet of 127 vessels (DTIS, 2008)[79]. It harvests the country's tuna and deep-water snapper fish stocks. Most vessels are foreign owned and the catch processed abroad. The fishery employs about 60 people, on vessels and in processing facilities. As a result of the low domestic investment and employment numbers, the industry's contribution to the GDP is small. The

[78] Fishing and Tourism in Vanuatu Economy: IUCN (2012)
[79] Vanuatu Diagnostic Integration Study – World Trade Organisation

commercial fishing industry contributed less than 0.2% to GDP in 2007, although its contribution is reported to be growing.

The principal offshore fishery is reported to be tuna and is undertaken by mainly foreign long-line and *purse-seine* vessels operating under permit in Vanuatu waters. The allowable catch was estimated to be 8,250 tonnes in 2008.

7.10 ECONOMIC ANALYSIS – CONCLUSIONS

7.10.1 Overall

1. In terms of overall trade expansion, Vanuatu appears likely to remain in a steady state as far as exporting is concerned. That is not to say that the economy is not expanding; it is.
2. Tourism is the exception to this, where dramatic growth in cruise vessel visits, both in terms of numbers and in terms of vessel size has already occurred. This growth is likely to continue, but directly affects only the southern and central parts of Vanuatu.
3. There is a successful economic case to address the present limitations of charting and currency of hydrographic surveys - traffic risk also justifies this. The economic case is made on cruise-vessel growth alone. However it should be noted that beyond Port Vila and Luganville, cruise-vessels are the only large vessels visiting.

7.10.2 Cruise Operations

4. A tourism strategy with respect to cruise visitors needs to be developed further to the benefit of Vanuatu. This will only be successful if underpinned by cruise stakeholders' confidence in official nautical charts. Options include visitors being encouraged to spend time ashore, visiting attractions, leaving one cruise vessel and continuing on another arriving later in a week. This would be feasible from Port Vila.
5. The northern provinces of Vanuatu may equally benefit from cruise passenger visits if PNG and the Solomon Islands become favoured cruise destinations.

7.10.3 Domestic Coastal Shipping Economics

6. The domestic shipping trade along the coast of Vanuatu has already grown, fuelled in part by a revival of the copra trade and its use domestically in biofuel production. The economic case to invest in

shore based facilities (jetties and other such infrastructure) is justified by the need to improve efficiency of cargo loading, as well as the potential for passenger numbers on board any domestic coastal vessel.

7. In conservative terms, the estimated domestic market by freight provides a fleet income of about 150million Vatu (US$1.64million). This estimate is conservative as it ignores other vessel freight earnings capability, but coastal trade is viable and capable of further expansion.

8 RISK ANALYSIS RESULTS

8.1 INTRODUCTION

The GIS based risk assessment methodology has been presented in full at **Annex D,** with the details of the supporting traffic analysis presented at **Annex C**. **Annex D** is vital reading as it both lays out the 29 types of risk data overlays that were used to derive the risk result, alongside the scoring criteria for each, but also provides transparent details of how the result was achieved. It also presents methodology to assist in understanding.

This section presents the result overlays, which highlight the areas that decision makers need to consider for hydrographic survey. It should be clearly noted that this is a comparative risk assessment, so the risk scales are drawn and highlighted to differentiate areas presenting different levels of risk. The result includes areas already identified from an opinion based assessment of hydrographic need. There would be something wrong if the analysis did not show all these areas as needed attention; it shows the methodology works. However other areas have also been highlighted as the risk methodology is able to take account of a much larger number of factors influencing risk and also factual data sets, than a purely judgemental approach can use.

Conclusions from this section are presented in **Section 9,** which follows.

8.2 RISK MATRIX AND TRAFFIC

The derived risk matrix used in the GIS overlay analysis is shown in **Figure 8-1**, below. It shows that in order to have a risk there must be a combination of traffic, likelihood criteria and consequence criteria. This is a key feature of the methodology; the traffic type, size and volume is assessed by a grid of geographic cells in the GIS. The traffic profile then influences the risk levels associated with each of the criteria. In terms of hydrographic risk, no traffic logically results in a no-risk result for a cell. This approach is dependent on a representative pool of traffic data. To be sure the traffic data set was representative, two extracts were taken, the second to reflect traffic visiting Homo Bay, Pentecost during the May-July land diving season.

The matrix also shows the influence of each of the GIS overlays on the risk results, which follow.

Risk Scores: 0 | 1 | 2 | 3 | 4 | 5

Increasing Risk ---------->

	Risk Criteria		1	2	3	4	5	Factor Importance (1st, 2nd or 3rd)	Derived Factor Importance	Importance of Category Contribution to Frequency and Consequence	Factor Weight in Model Category	Weighting Balance of Frequency and Consequence in Model	Derived Variable Weighting used in GIS Model
Traffic	**Vessel Traffic**												
	Potential Loss of Life (Vessel Type + GT Weighed)		Insignificant	Low	Moderate	High	Catastrophic				0.5000	0.2500	0.1250
	Pollution Potential (Vessel Type + GT Weighted)		Insignificant	Low	Moderate	High	Castastrophic				0.5000		0.1250
Likelihood Risk Criteria	**MetOcean Conditions**												
	Prevailing Conditions Exposure		Sheltered at most times	Mainly Sheltered	Moderate Exposure	Mainly Exposed	Exposed on most days	3.0000	0.5000	0.3000	0.1500	0.2500	0.0375
	Spring Mean Current Speed	Open Sea (Current insignificant)	1-2 knots	2-3 knots	3-4 knots	>5 knots	>5 knots	2.0000	0.3333		0.1000		0.0250
	Visibility	Unknown	Poor Visibility Very Unlikely	Poor Visibility Unlikely	Occasional Poor Visibility	Often Poor Visibility	Poor Visibility Common	1.0000	0.1667		0.0500		0.0125
	Navigational Complexity												
	Type of Navigation Required		Open Sea >10nm	Offshore Navigation (5-10nm)	Coastal Navigation (1-5nm)	Port Approaches	Constrained Navigation (Within 1nm)	3.0000	1.0000	0.1500	0.1500		0.0375
	Aids to Navigation												
	ChartZoc		A	B	C	D	U	3.0000	0.6000	0.3000	0.1800		0.0450
	Proximity to Non Working AToNs (Nav Lights)	No Lights	100% effective range	80% effective range	70% effective range	60% effective range	Within 50% effective range	2.0000	0.4000		0.1200		0.0300
	Bathymetry												
	Depth of Water 15m Contour	>10nm	5-10nm	2.5-5nm	1.5 to 2.5nm	1 to 1.5nm	Within 1nm	3.0000	0.6000	0.1000	0.0600		0.0150
	Bottom Type		Soft				Hard/Rocky	2.0000	0.4000		0.0400		0.0100
	Navigational Hazards												
	Proximity to Known Reefs	>10nm	5-10nm	2.5-5nm	1.5 to 2.5nm	1 to 1.5nm	Within 1nm	2.0000	0.2222	0.1500	0.0333		0.0083
	Proximity to Sub-Sea Volcanic Activity	>10nm	5-10nm	2.5-5nm	1.5 to 2.5nm	1 to 1.5nm	Within 1nm	2.0000	0.2222		0.0333		0.0083
	Proximity to Known SeaMounts	>10nm	5-10nm	2.5-5nm	1.5 to 2.5nm	1 to 1.5nm	Within 1nm	1.0000	0.1111		0.0167		0.0042
	Proximity to WW2 Military Sites	>2.5nm	2-2.5nm	1.5-2nm	1-1.5nm	500m-1nm	Within 500m	1.0000	0.1111		0.0167		0.0042
	Proximity to Charted Tidal Hazard (Overfalls/Race)	>2.5nm	2-2.5nm	1.5-2nm	1-1.5nm	500m-1nm	Within 500m	3.0000	0.3333		0.0500		0.0125
Consequence Risk Criteria	**Environmental Impact**												
	Proximity to Large Reef (High Quality / or Isolated Shoreline	>20nm	10-20nm	5-10nm	2.5-5nm	1-2.5nm	Within 1nm	3.0000	0.1579	0.5000	0.0789	0.5000	0.0395
	Proximity to Key Offshore Reef (Cooks Reef or Rowa Island)	>20nm	10-20nm	5-10nm	2.5-5nm	1-2.5nm	Within 1nm	2.0000	0.1053		0.0526		0.0263
	Proximity to Large Wetlands Resource (Mangroves) (Large Volume or Small Volume)	>20nm	10-20nm	5-10nm	2.5-5nm	1-2.5nm	Within 1nm	3.0000	0.1579		0.0789		0.0395
	Proximity Small Wetlands Resource (Mangroves) (Large Volume or Small Volume)	>20nm	10-20nm	5-10nm	2.5-5nm	1-2.5nm	Within 1nm	2.0000	0.1053		0.0526		0.0263
	Proximity to Important Breeding Grounds	>20nm	10-20nm	5-10nm	2.5-5nm	1-2.5nm	Within 1nm	3.0000	0.1579		0.0789		0.0395
	Proximity to World Biological Protected Sites	>20nm	10-20nm	5-10nm	2.5-5nm	1-2.5nm	Within 1nm	3.0000	0.1579		0.0789		0.0395
	Proximity to Regional Biological Protected Sites	>20nm	10-20nm	5-10nm	2.5-5nm	1-2.5nm	Within 1nm	2.0000	0.1053		0.0526		0.0263
	Proximity to Local Biological Protected/Important Sites	>20nm	10-20nm	5-10nm	2.5-5nm	1-2.5nm	Within 1nm	1.0000	0.0526		0.0263		0.0132
	Culturally Sensitive Areas												
	Proximity to World Cultural Protected/Important Sites	>20nm	10-20nm	5-10nm	2.5-5nm	1-2.5nm	Within 1nm	3.0000	0.5000	0.1500	0.0750		0.0375
	Proximity to Regional Cultural Protected/Important Sites	>20nm	10-20nm	5-10nm	2.5-5nm	1-2.5nm	Within 1nm	2.0000	0.3333		0.0500		0.0250
	Proximity to Local Cultural Protected/Important Sites	>20nm	10-20nm	5-10nm	2.5-5nm	1-2.5nm	Within 1nm	1.0000	0.1667		0.0250		0.0125
	Economically Sensitive Areas												
	Proximity to Sites of High Economic Contribution	>20nm	10-20nm	5-10nm	2.5-5nm	1-2.5nm	Within 1nm	3.0000	0.2857	0.3500	0.1000		0.0500
	Proximity to Sites of Moderate Economic Contribution	>20nm	10-20nm	5-10nm	2.5-5nm	1-2.5nm	Within 1nm	1.0000	0.0952		0.0333		0.0167
	Proximity to Key Infrastructure (Ports)	>20nm	10-20nm	5-10nm	2.5-5nm	1-2.5nm	Within 1nm	3.0000	0.2857		0.1000		0.0500
	Proximity to Tourist Diving Sites	>20nm	10-20nm	5-10nm	2.5-5nm	1-2.5nm	Within 1nm	1.5000	0.1429		0.0500		0.0250
	Cruise Ship Stops	>20nm	10-20nm	5-10nm	2.5-5nm	1-2.5nm	Within 1nm	2.0000	0.1905		0.0667		0.0333

Figure 8-1 : Derived Risk Matrix Used for GIS Analysis

8.3 VANUATU HYDROGRAPHIC RISK - OVERALL

The overall comparative risk result is shown in **Figure 8-2.** Areas of heightened and significant risk affect the following Islands

- The south-eastern corner of Espiritu Santo and parts of its eastern coastline.
- The eastern coastline of Malakula;
- The northern coastline of Épi
- Efate where risk areas extend beyond Port Vila, to its surrounding coastline.

There is a localised area of heightened risk in Tanna and an isolated area of heightened risk at Aneityum (Mystery Island).

The two key large offshore coral reefs, Cooks Reef and Rowa Island are influencing assessed risk levels associated with any vessels transiting past them.

The island of Erromango has provided a nil or low risk result, which is in part related to the lack of vessels of any significant size visiting its shores, as well as relatively low numbers of domestic coastal vessels (from schedules and GT capacity on the trading route).

8.3.1 Decision Making Criteria

If a recommended criterion to act on areas that evince heightened or significant risk is accepted, then it is possible in broad terms to specify recommended areas for hydrographic survey.

This part of the report next looks in more detail at the hydrographic risk in each province.

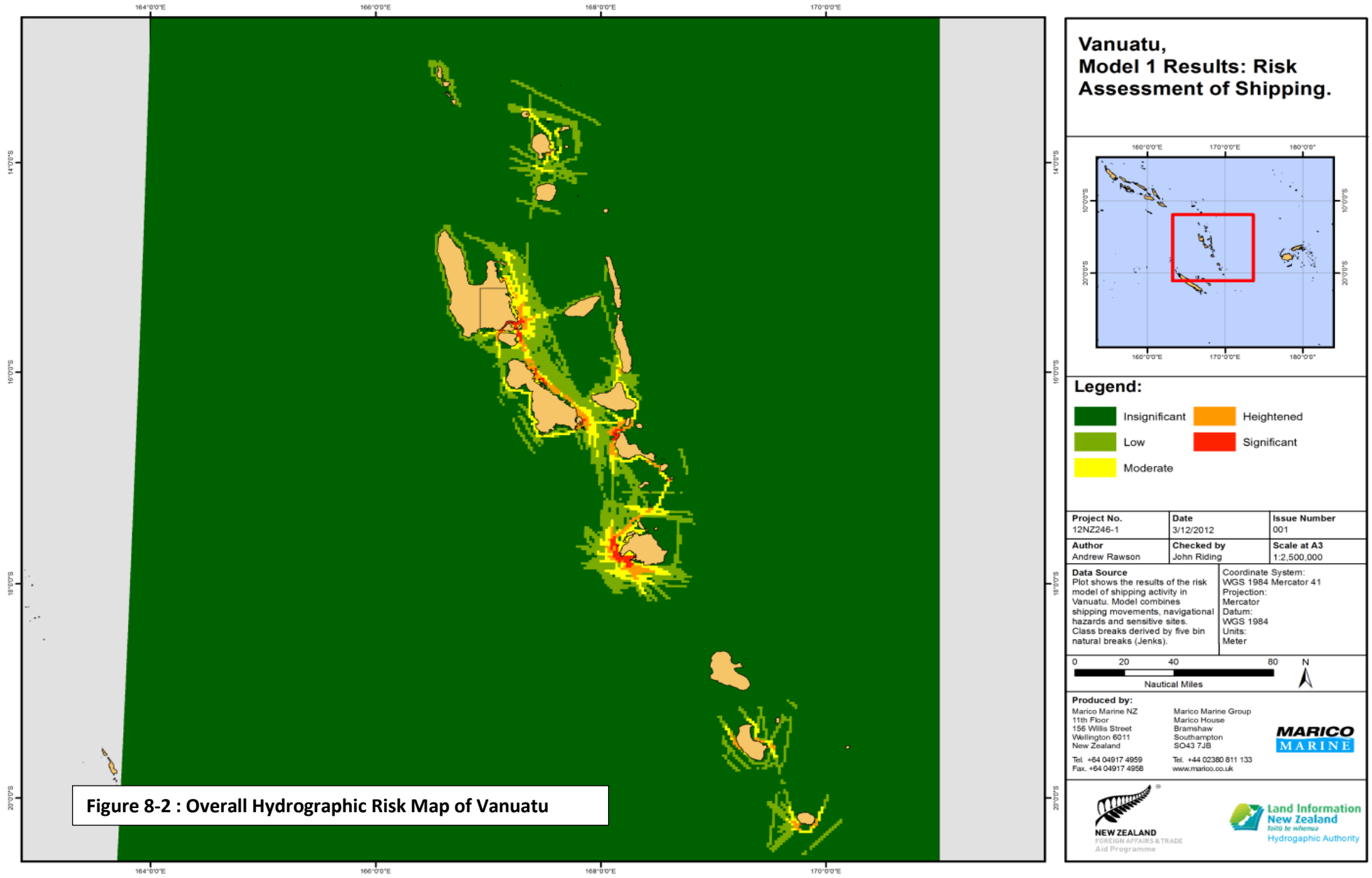


Figure 8-2 : Overall Hydrographic Risk Map of Vanuatu

Figure Reference Number: 12NZ246-1_ModelResults_v1

8.4 VANUATU HYDROGRAPHIC RISK – TORBA PROVINCE

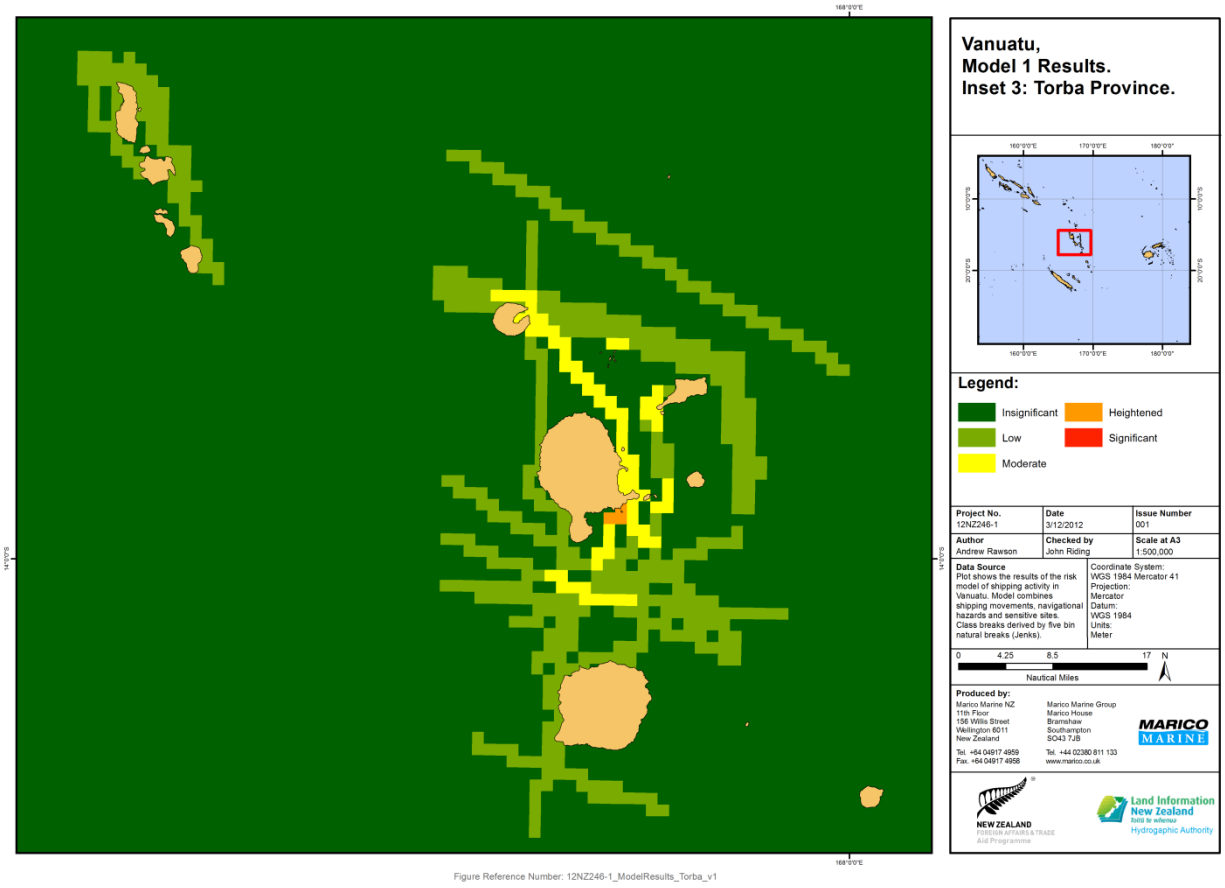


Figure 8-3 : Hydrographic Risk Profile for Torba Province

Torba Province provides an interesting result (**Figure 8-3)**, which is driven locally almost totally by domestic coastal vessels, combined with the key environmental importance of Rowa Reef and a large protected area of mangrove and reefs at Sola, Vanua Lava.

However, there is an underlying influencing factor caused by a number of vessels, including large tankers, which transit past these waters.

Risk levels at Ureparapara Island are similarly influenced, with moderate risk recorded into Lorup Bay. There are two small cruise vessels that are regular callers (almost annually) into Lorup Bay, which is unsurveyed. As neither vessel was in the S-AIS traffic dataset, a single representative caller (*Bremen*) was manually added[80]. Lorup Bay is a destination option for larger cruise vessels, but it is unlikely to eventuate before islands groups to the north are established as cruise destinations.

[80] There is reason to have done this as *Bremen* was scheduled to make a further call to Lorup Bay in the 2013 cruise season.

8.5 VANUATU HYDROGRAPHIC RISK - SANMA PROVINCE (ESPIRITU SANTO)

The hydrographic risk profile result of Sanma Province, Espiritu Santo is shown in **Figure 8-6**. As is expected, the highest risk occurs at Luganville and its approaches, reaching the significant level. The Luganville port area has the uncertainly of its former use as a WW2 large American base; recommendation have been made for this to be researched further. However, heightened risk levels extend up the adjacent south east coastline, with risk levels reflecting that this is an economically vibrant, but also an environmentally important area. There is a large marine reserve in the southeast of this island, which has both important coral reefs as well as fertile turtle breeding grounds.

Transit risk is affected off the eastern shore towards Ambae because of the regular nature of the domestic coastal vessel trades.

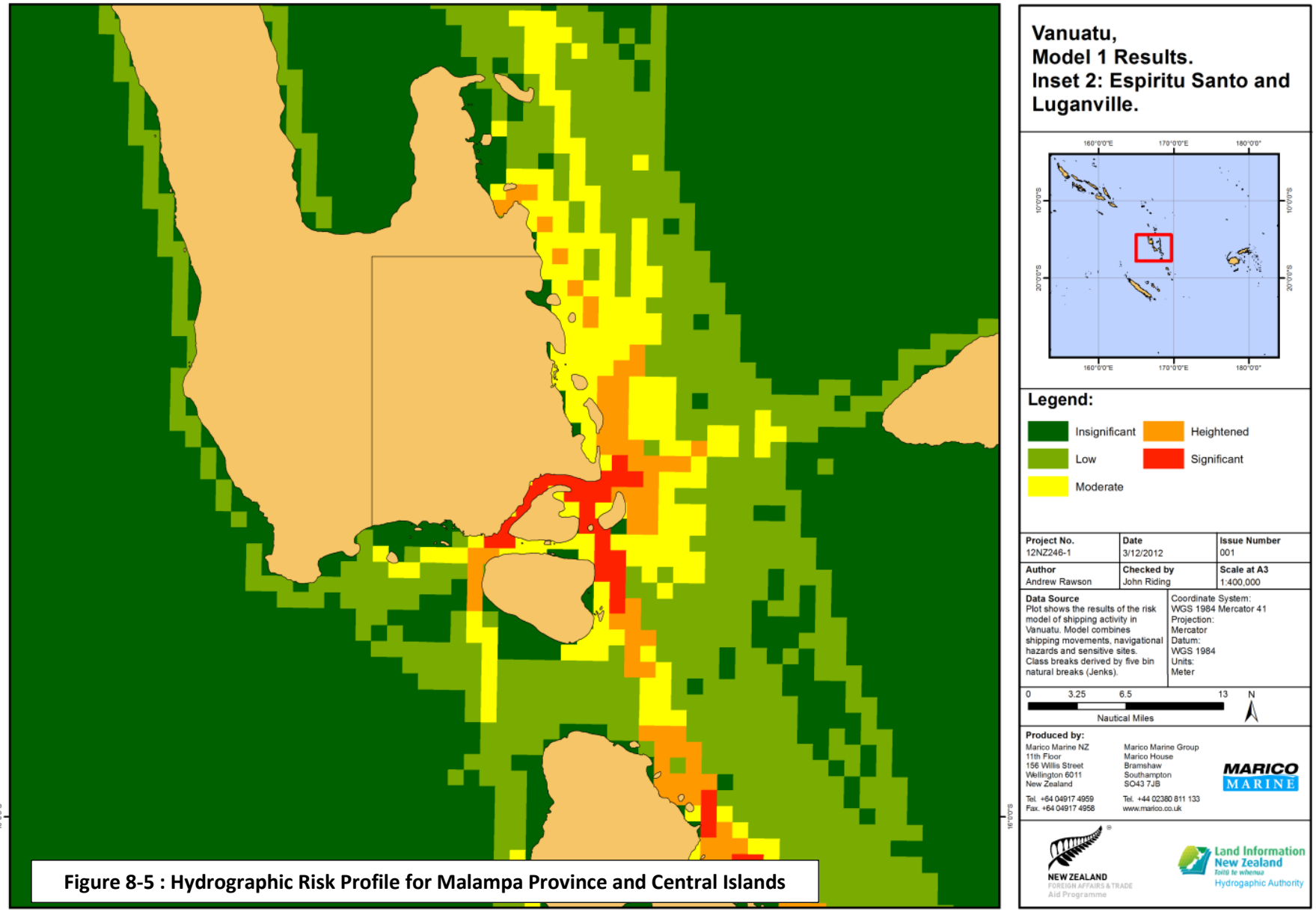


Figure 8-5 : Hydrographic Risk Profile for Malampa Province and Central Islands

Figure Reference Number: 12NZ246-1_ModelResults_Santo_v1

8.6 VANUATU HYDROGRAPHIC RISK – PENAMA PROVINCE

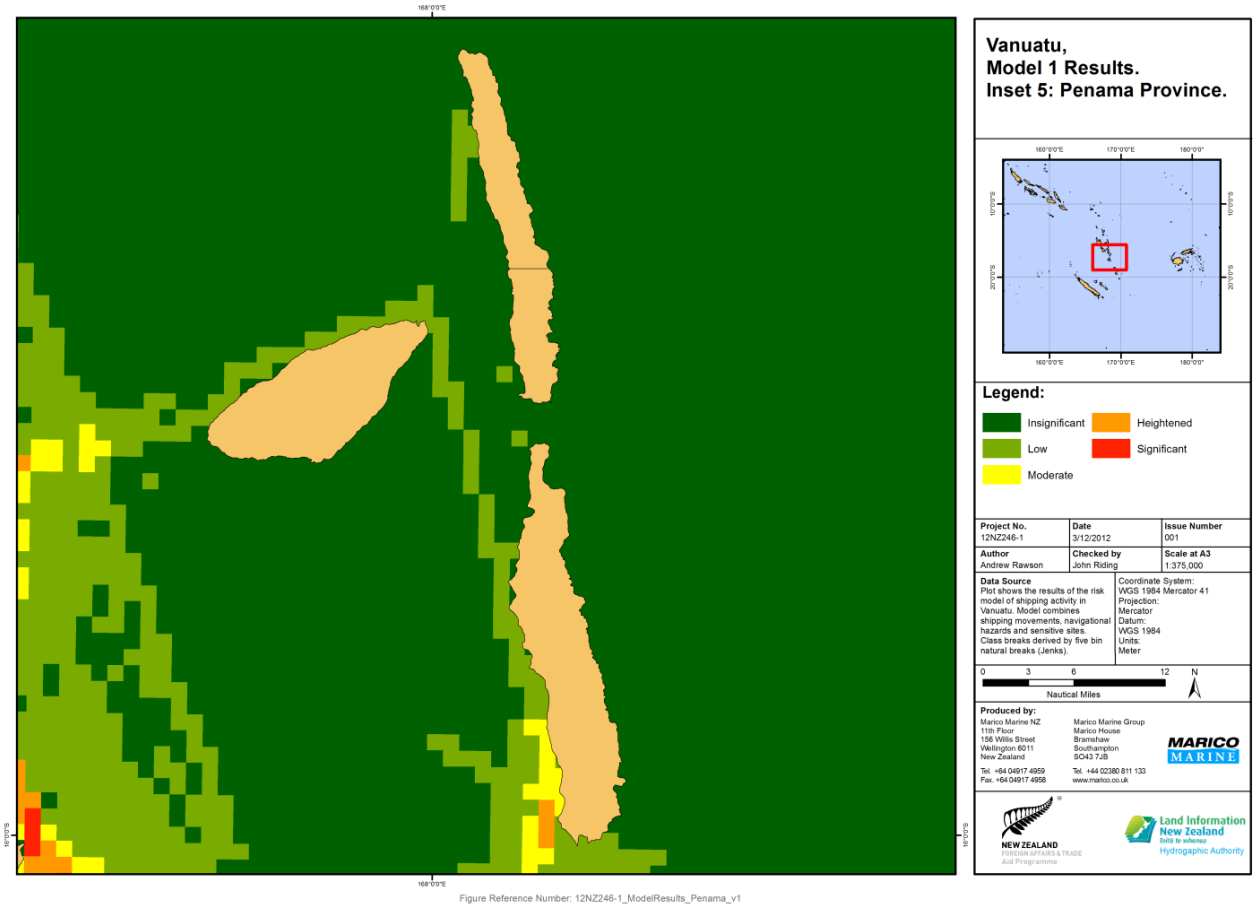


Figure Reference Number: 12NZ246-1_ModelResults_Penama_v1

Figure 8-6 : Hydrographic Risk Profile for Penama Province

Penama Province provides a low hydrographic risk result overall, with a small area of heightened risk being concentrated at Homo Bay, Pentecost. This is a cruise-vessel anchorage, where a jetty for passenger transfer ashore has been constructed for the land diving ceremonies. Despite its status, the risk in that area remains localised around Homo Bay (**Figure 8-4**). The risk levels derived reflect the record of only three large cruise vessel calls in the 2012 season. This is fewer than previous years (and both AIS data and cruise operator records cross relate). The risk profile extends northwards partly because of the domestic coastal vessels, but also because there are a number of larger yachts with passenger capacity attending the land diving events. Smaller cruise vessels are also reported to attend, but there were none in the records for 2012.

As there are presently no east coast services to Pentecost and Maewo, there is by definition no risk. Pentecost and Maewo though do produce a majority

of the kava, and copra was reported to be growing in volume. The risk would need to be reviewed if an east coast trade materialised.

8.7 VANUATU HYDROGRAPHIC RISK – MALAMPA PROVINCE (MALAKULA)

The hydrographic risk in the central islands provides a surprise (**Figure 8-7**). Épi is benefitting from its central location in terms of domestic coastal vessel-calls, and two domestic coastal passenger ships call there on a weekly basis. There are mangroves at the northern tip of Épi and an informal reserve, which increases the consequence side of the GIS risk model. Although cruise calls there have been suspended due to land disputes, there are still a number of large yacht visits. If cruise vessels elected to call once again at Lamen Bay, this would enhance its status as a candidate for survey.

Épi also has an operational biofuel mill, and copra must therefore be shipped into this area to feed the biofuel process.

The northern tip of Ambrym has an interesting profile (showing moderate risk). Its risk level is linked to the Pentecost land diving events, when large passenger vessels route along the northwest coast. It also benefits from the vibrant domestic coastal vessel trades in the area.

It can be deduced from the "gross tons per month" capacity of domestic coastal vessels on that coast that Malakula makes a significant contribution to the economy of Vanuatu. It is a volume copra producer as well as cocoa and the trade appears to be discharged at Luganville. The now regular and growing volume of visits by cruise vessels to Wala Island, combined with the environmental significance of the site, provide a risk result locally to equal that of the coastline of Éfaté.

Given decision-making criteria, the need for hydrographic work along the coastline is compelling. However this may be concentrated in the southeast and Wala Island area as far as large vessels are concerned. What may benefit the domestic coastal traffic though is a review of the scales of the official nautical charts for this area. If chart scales cannot be increased, due to poor underlying hydrography, it may, in turn, assist hydrographic decision-makers in determining the need for surveys all along east Malakula coast.

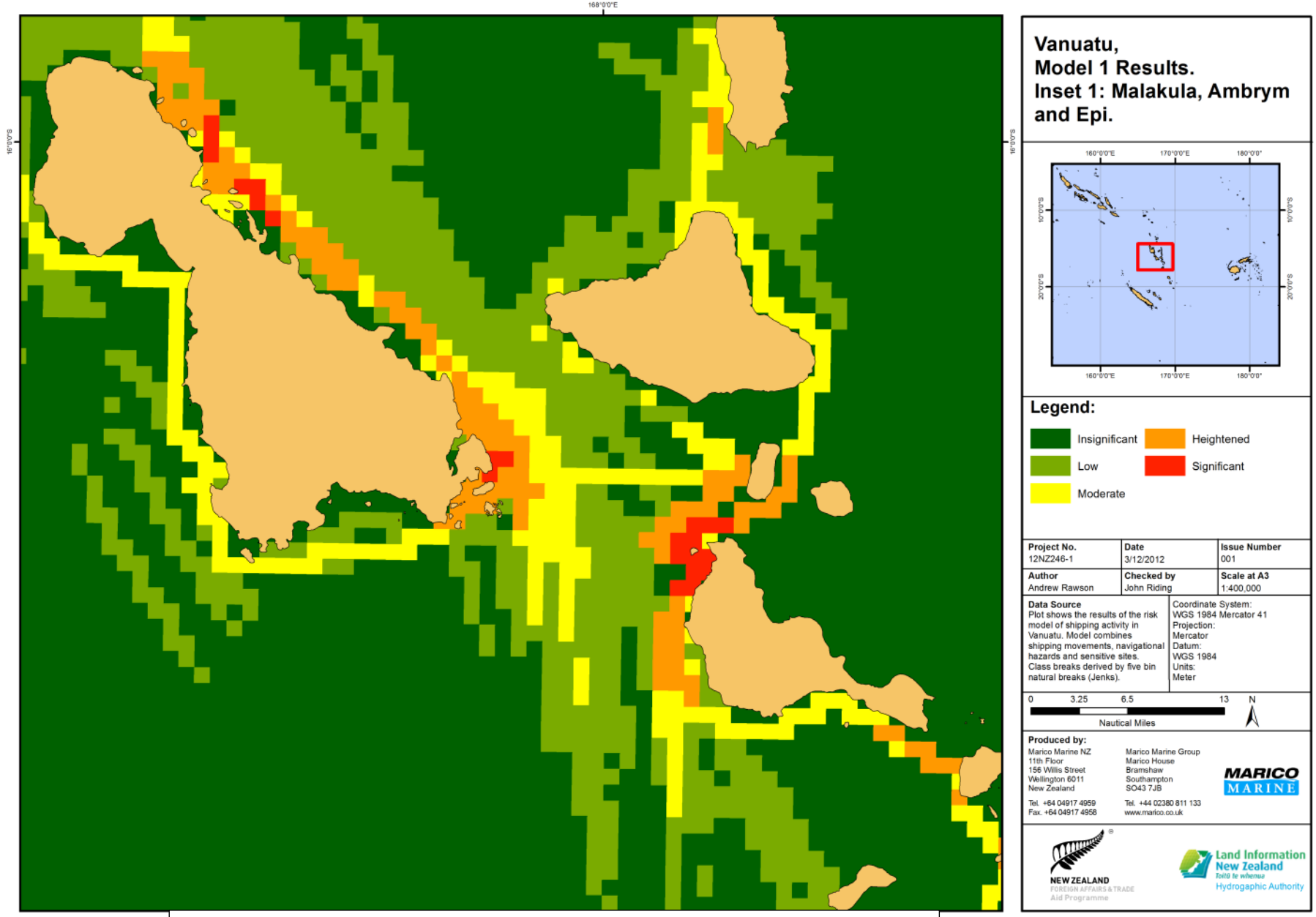


Figure 8-7 : Hydrographic Risk Profile for Malampa Province and Central Islands

8.8 VANUATU HYDROGRAPHIC RISK – SHEFA PROVINCE (PORT VILA)

The result for Éfaté and Port Vila (**Figure 8-8**) clearly shows the need to consider the coastal zone to the west of the island. Port Vila is by far the busiest port in Vanuatu, both for SOLAS vessels and domestic coastal vessels. The port is also benefiting most from the significant rise in cruise-vessel traffic, both in numbers and vessel size.

The risk on the northern coast is equivalent to that of the Tanna coastline (Tafea Province), which is being influenced by the growing number of coastal vessel transits, but also the reports of informal reserves in the Shepherd Group, as well as a key offshore coral reef (Cook Reef). Diving sites, such as the Tonga Wall are also relevant. The region includes two submarine volcanoes, Kuwae, and Makura.

8.8.1 Decision Making – Shefa Province

If recommended criteria of acting on areas that evince heightened or significant risk is accepted, then it is possible in broad terms to specify recommended areas for hydrographic survey.

The result suggests that on the basis of risk Port Vila itself should be considered, including the coastal approaches, with a shipping lane being defined in the area of heightened risk and surveyed. Moderate risk areas, e.g. Port Havannah or Undine Bay, Efate, should be evaluated on a vessel-need case. This would alert cruise operators of the need to survey in the event it was planned as a cruise destination.

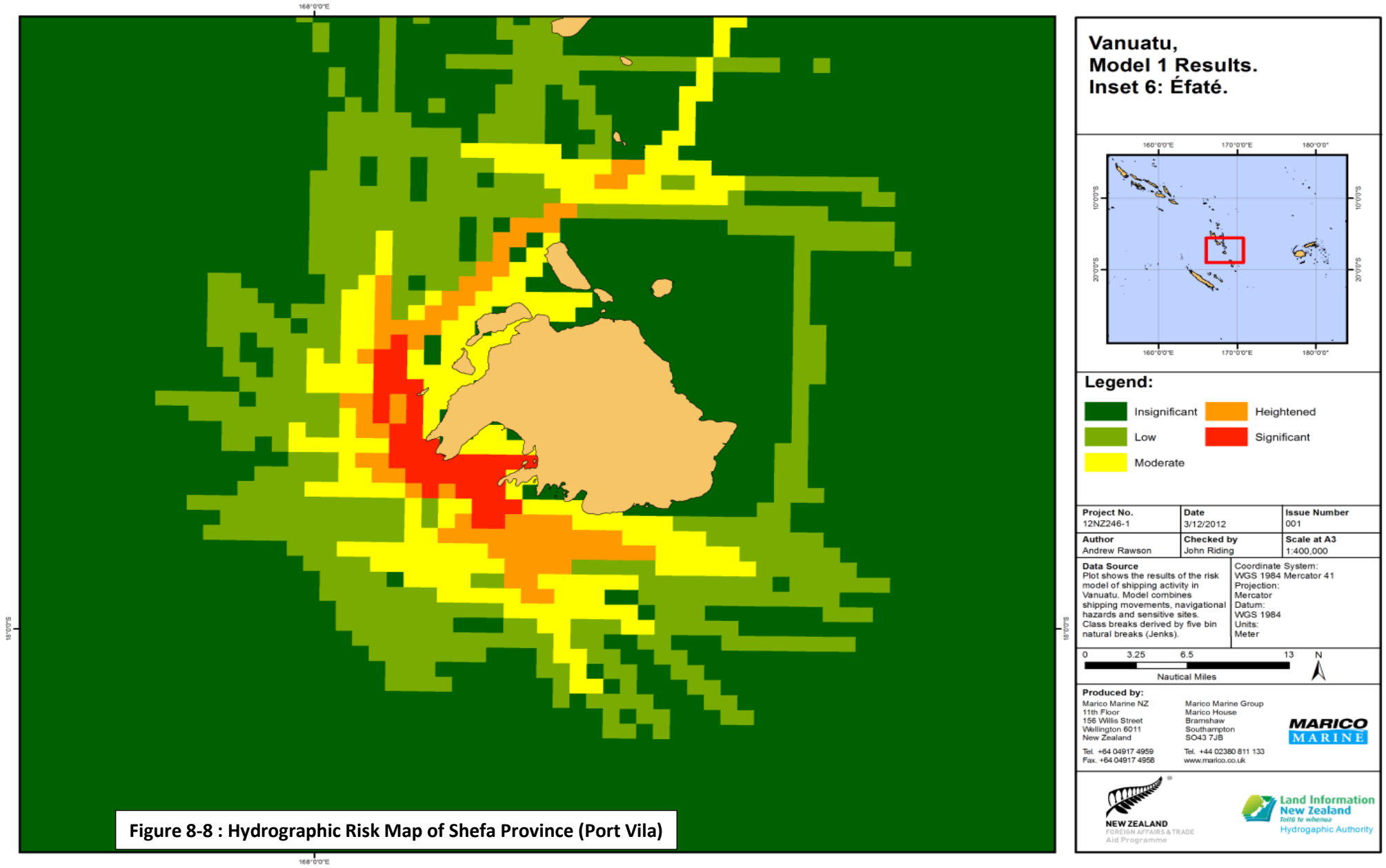


Figure 8-8 : Hydrographic Risk Map of Shefa Province (Port Vila)

Figure Reference Number: 12NZ246-1_ModelResults_Efate_v1

8.9 VANUATU HYDROGRAPHIC RISK – TAFEA PROVINCE

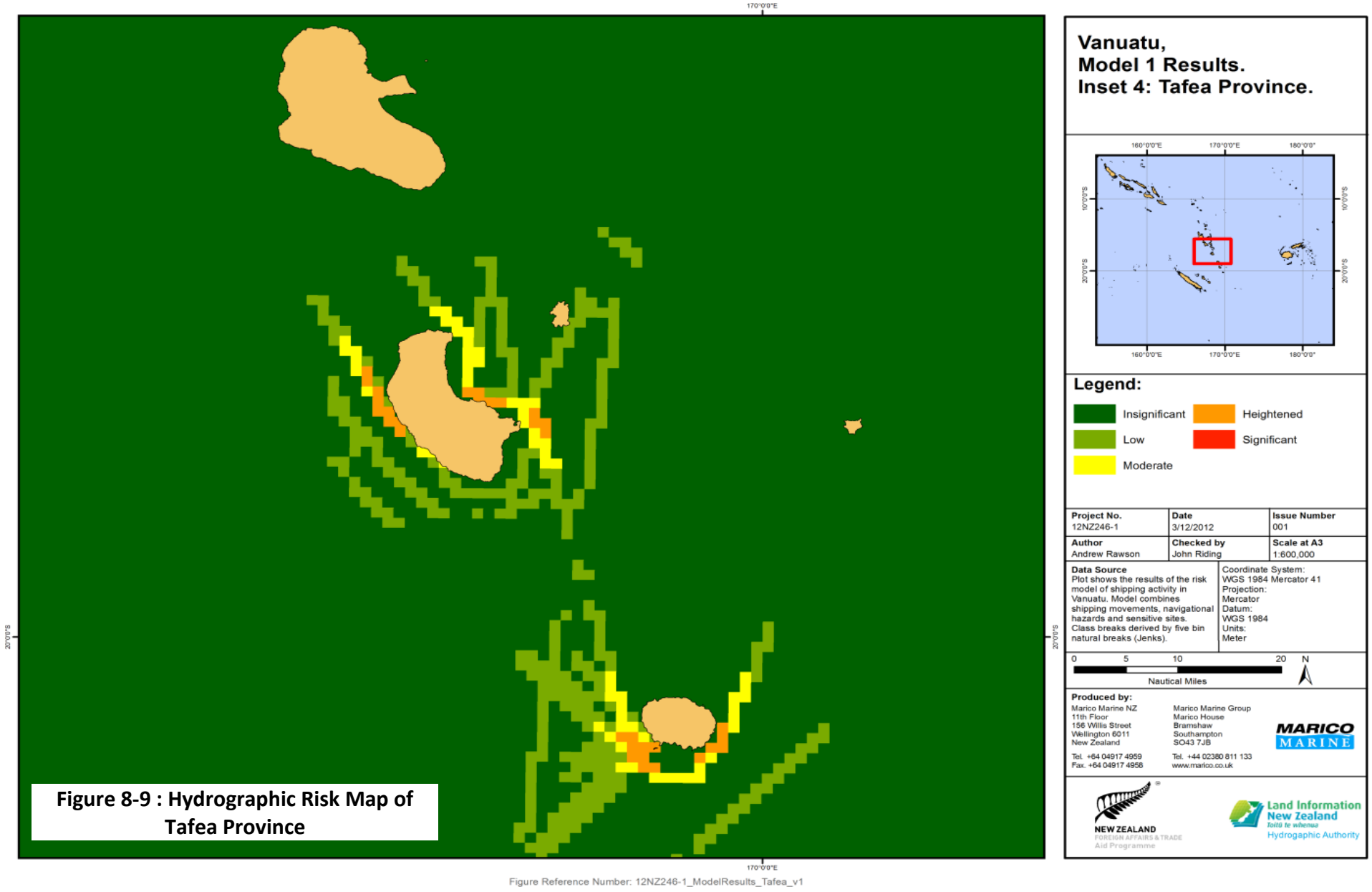


Figure 8-9 : Hydrographic Risk Map of Tafea Province

Figure Reference Number: 12NZ246-1_ModelResults_Tafea_v1

The result for Tafea Province (**Figure 8-9**) shows the combined effect of coastal trade on Tanna, which has only one recoded cruise-vessel visit in the timescales of the S-AIS vessel data set. The cargo capacity (by GT) and frequency of domestic coastal vessels trading to Lénakel wharf is significant and surprising; coastal trade to the east coast of Tanna is also influencing risk. Some of the largest domestic coastal vessels are trading to Tanna, which may also be related to the sea conditions off Lénakel wharf, resulting in only larger vessels in the trade (the risk assessment had to be based around vessels size as that actual volume of cargo being carried per voyage is unobtainable). However, the fact the heightened risk is resulting in this area suggests this would need investigating further in any decision to survey in that area. Given that Lénakel wharf is due for an upgrade by aid investment, those planning that package of work may wish to include hydrographic work after the upgrade. Similarly, an upgrade of facilities at Waisisi is likely to influence cruise stakeholders to land passengers for visits to Mt Yasur, which has a crater viewing platform of limited capacity.

However, it should be clearly noted that shipping risk levels in Tanna Province are a magnitude lower than is indicated for Éfaté and the Malakula coastline.

Aneityum (Mystery Island) shows some heightened risk and therefore is a candidate to consider for official nautical chart improvements. However the risk levels have not reached the significant scale based on the traffic levels in the data. It should be clearly recognised that the risk contribution is dominated by cruise vessels, as domestic coastal services are relatively infrequent. Stakeholder participation in hydrographic work in that area could be considered.

8.10 VANUATU HYDROGRAPHIC RISK - DOMESTIC COASTAL VESSELS

The domestic coastal fleet provided a surprise in risk terms, with the licenced capacity for carrying passengers. They influence the risk to life scale quite significantly. This is because smaller passenger vessels in difficulty, on the balance of probability, suffer greater loss of life than do large passenger vessels of modern design compliance. As domestic vessels are a separate data set in the GIS model, the risk profile associated with their transits, on a total GT per route basis can be presented as an image and is show in **Figure 8-10**.

This confirms that the moderate risk levels off the north coast of Éfaté are quite significantly influenced by domestic coastal vessel transits (risk is also influenced by the consequence side of the equation, because of the important environmental sites in the area).

Épi has a similar result when domestic coastal vessels are considered, as does the east coast of Malakula.

This suggests that there are choices for hydrographic decision-makers to consider improving the chart scales in the Lamen Bay area of Épi and the west coast of Malakula, undertaking hydrographic survey of sufficient standard to establish a sea lane that has sufficient data quality to support the chart scales selected.

However it does lend support to the conclusion that improvements in hydrographic data and official chart coverage/scaling, need to be considered with the domestic coastal trades in mind.

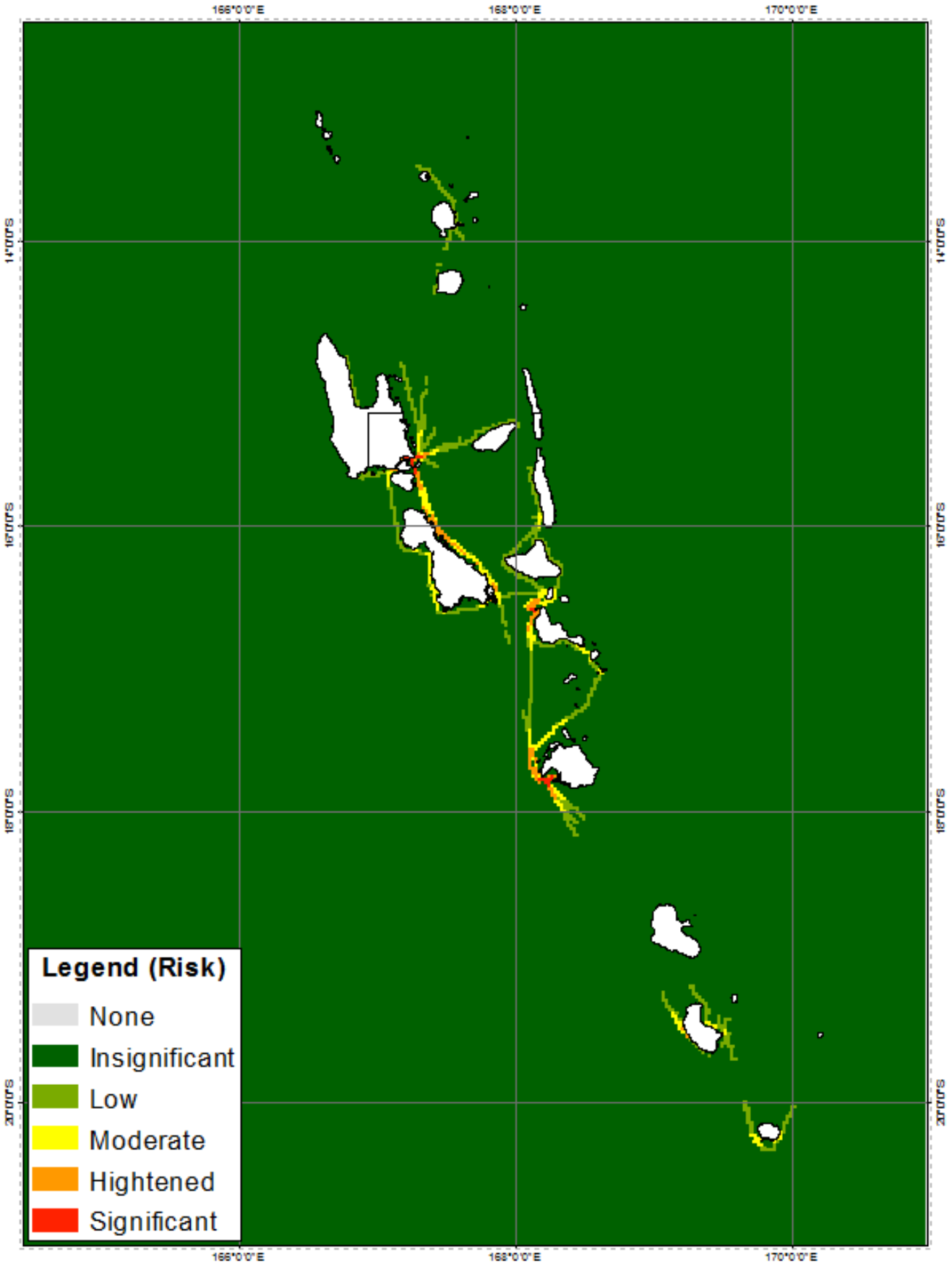


Figure 8-10 : Vanuatu Transit Risk Profile Associated with Domestic Coastal Vessels

9 CONCLUSIONS AND RECOMMENDATIONS

9.1 CONCLUSIONS - GIS RISK ANALYSIS

1. The risk assessment has successfully derived a risk based prioritisation of areas where charting should be upgraded to modern standards.
2. **Torba Province** experiences some heightened risk at Sola, Vanua Lava, with surrounding area of moderate risk. An underlying influence is vessels transiting through Vanuatu waters, including large tankers. This is combined with the presence of corals and mangroves as well as the environmental significance of Rowa Reef. The same risk influence occurs at Lorup Bay, Ureparapara. This destination is an option for the larger cruise lines, but it is unlikely to eventuate before island groups to the north are established as cruise destinations.
3. In **Sanma Province**, the Luganville port area, Espiritu Santo, is an obvious candidate for survey, evincing significant risk. It has the uncertainty of its former use as a large, WW2 American base, with recommendations made to have this researched further. This port is of high economic value to Vanuatu. Heightened risk levels extend up the adjacent south east coastline of Espiritu Santo, with risk reflecting both economic and environmental importance.
4. **Penama Province** shows a confined area of heightened risk at Homo Bay, Pentecost, but moderate risk levels overall. Risk levels derived reflect only three large cruise vessel calls in the 2012 season (both AIS data and cruise operator records cross-relate). The risk profile extends northwards because of domestic coastal vessels and large yachts with passenger capacity attending land-diving events. Smaller cruise vessels are reported to attend, but none were recorded for 2012. A hydrographic survey here would need to be prioritised only with cruise stakeholder input.
5. The islands of Pentecost and Maewo present no risk on their east coasts, as there are presently no domestic services there. However, Pentecost and Maewo produce a majority of their kava and copra in the east, which is shipped out on the west coast. The risk would need to be reviewed if an east coast trade materialised.
6. In **Malampa Province**, the need for hydrographic work along the east coastline of Malakula is compelling. There is the second highest concentration of domestic coastal vessel GT capacity by schedule. However, work could be focused in the southeast and then Wala Island. Domestic coastal traffic may benefit from a review of current

chart scales which may require an extension of surveys along the Malakula east coast.

7. The sea area between Malakula, Ambrym and Épi provides an area of significant risk, due to traffic and environmental importance. This sea area experiences a relatively high volume of traffic, including large SOLAS vessels and small domestic coastal vessels.

8. In **Shefa Province**, Port Vila, Éfaté, and its west coastal approaches are clear candidates showing an area of significant risk. Ship transits to the north-west of the island define a further area of heightened risk. Port Vila is the capital of Vanuatu; it is the largest port and the premier tourist destination, therefore of high economic value. Moderate risk areas, e.g. Port Havannah or Undine Bay should be evaluated on a vessel-needs basis. This would alert cruise operators of the need to survey in the event either are planned as cruise destinations.

9. If cruise vessels elected to call once again at Lamen Bay, Épi, this would enhance its status as a candidate for survey. This is an area of significant risk as it forms part of the sea area between Malakula and Ambrym, with relatively high traffic volume. There are important mangrove sites, corals and breeding grounds.

10. In **Tafea Province**, Tanna, risk levels are heightened locally to Lénakel, but a magnitude lower than is indicated for Éfaté and Malakula. Risk extents are also local, unlike the Malakula coastline. The risk level at Lénakel arises from domestic coastal vessels as the route to Port Vila has the greatest scheduled domestic vessel capacity by GT; the jetty is also exposed to sea conditions of surge and swell. The decision to build a jetty at Waisisi Bay will doubtless influence cruise vessel calls but, practically, these may need to be limited in size (Mt Yasur).

11. Aneityum (Mystery Island) shows heightened risk at its southern end, but not significant risk, based on traffic levels in the data. It should be clearly recognised that risk contribution is dominated by cruise vessels.

9.2 CONCLUSIONS FROM ECONOMIC ASSESSMENT

12. In terms of overall trade expansion, Vanuatu appears likely to remain in a steady state as far as exporting is concerned.

13. Tourism is the exception to this, where dramatic growth in cruise vessel visits, both in terms of numbers and in terms of vessel size has already occurred. This growth is likely to continue, but directly affects only the southern and central parts of Vanuatu.

14. The northern provinces of Vanuatu may equally benefit from cruise passenger visits if Papua New Guinea and the Solomon Islands become new cruise destinations.

15. The domestic shipping trade along the coast of Vanuatu has already grown, fuelled in part by a revival of the copra trade and its use domestically in biofuel production. The economic case to invest in shore based facilities (jetties and other such infrastructure) is justified by the need to improve efficiency of cargo loading, as well as the potential for passenger numbers on board any domestic coastal vessel.

16. There is a successful economic case to address the present limitations of charting and currency of hydrographic surveys - traffic risk also justifies this. The economic case is made on cruise-vessel growth alone. However it should be noted that beyond Port Vila and Luganville, cruise-vessels are the only large vessels visiting.

17. A tourism strategy with respect to cruise visitors needs to be developed further for the benefit of Vanuatu. This will only be successful if underpinned by cruise stakeholders' confidence in official nautical charts.

9.3 CONCLUSIONS FROM VESSEL TRAFFIC ANALYSIS

18. The volume of traffic transiting the waters of Vanuatu is greater than expected.

19. Vanuatu has a varied trade profile by vessel type. The volume of SOLAS general cargo vessels is approximately steady, with a drift towards marginally larger vessels entering the trade.

20. SOLAS general cargo vessels only visit Port Vila and Luganville. The only known anomaly to this may be Malakula where a small bulk carrier was reported to have delivered bagged cement and loaded copra at anchor in 2012. Vessels only transiting Ni-Vanuatu waters either pass to the west or transit in a north-west south-east direction through the islands. Some fishing vessels take similar routes.

21. There is a significant growth in SOLAS cruise-vessel visits, not only in terms of numbers, but also size. Some of the largest cruise vessels visiting New Zealand and Australia are also becoming regular traders to Vanuatu.

22. Cruise-vessel number growth year on year is such that in 2012, they form 30% of the traffic profile, analysed at a "GIS gate" between Malakula and Épi. General cargo vessels represent 50% of the traffic profile. However, as cruise vessels are by far the largest vessels

transiting the waters of Vanuatu, their contribution to transit risk is significant.

23. Some islands are only visited by international cruise vessels. Cruise vessels transit in particular between Hog Harbour (Champagne Beach), Luganville, Wala Island, Port Vila and Aneityum (Mystery Island).

24. Port Vila is the most significant Vanuatu port (and therefore trading centre) by ship-traffic volume.

25. Port Vila has recorded a marginal fall in tanker visits. This may be the result of larger tankers in the trade or a beneficial effect of renewable power initiatives; i.e. that the copra to biodiesel project is already influencing demand for external supplies of fuel.

26. Port Vila shows a dramatic growth in cruise vessel visits. A 34% increase in vessel numbers in three years has been recorded, despite a recessionary period. Forecast data strongly suggests this increase will be sustained in future. Note that cruise vessels are becoming significantly larger, placing pressure on infrastructure in and around the port.

27. Large tankers are transiting through Ni-Vanuatu waters between the northern islands of Gaua and Vanua Lava. These tankers in particular influence transit risk in Torba Province.

28. Luganville shows a steady traffic profile, with a moderate increase in dry-cargo vessels being sustained in 2012. Cruise activity at Luganville is well below the level at Port Vila.

29. Most cruise vessels calling at Espiritu Santo visit Hog Harbour, bypassing Luganville. This is partly due to the condition of mooring arrangements at Luganville Main Wharf, which are in urgent need of attention.

30. Large superyachts are regular visitors to Ni-Vanuatu waters. Popular destinations include Lamen Bay (Épi), Maskelyne Islands and Port Stanley (Malakula), Ranon (Épi), Homo Bay (Pentecost), Champagne Beach (Hog Harbour, Espiritu Santo) and a number of the northern islands.

31. Within the islands themselves, a number of deep draught (over 10m) vessels pass through Torba Province. The majority of the central islands traffic profile has a draught of less than 9 metres which reflects that most modern cruise vessels are less than 9 metres draught.

32. There are vessels of significant length (over 300m) transiting between the islands, which reflect the cruise vessel profile.

9.4 CONCLUSIONS - DOMESTIC COASTAL VESSEL

33. The loss of life that would occur from an incident involving small domestic coastal vessels is greater than expected. They are licensed to carry a large number of passengers which significantly influences the risk profile. Some have reported passenger capacity greater than the dedicated passenger vessels on the coastal trade.

34. There are a relatively large number of domestic coastal vessel losses. Although causal reasons are many, including breakdown and cyclone loss, there is a link to crew competency assurance and quality of nautical charting for coastal use.

35. There is an established domestic coastal trade, with both scheduled and chartered vessels in operation. Coastal trade appears to be growing strongly, with scheduled vessels sometimes fully laden with copra early in their trading sequence.

36. Domestic vessels provide a cost effective solution to interisland travel for the Ni-Vanuatu. However, given the number of wrecks, it follows that as trade grows, likelihood of an incident of significance is incrementally rising.

9.5 CONCLUSIONS - OFFICIAL NAUTICAL CHARTS

37. The present official nautical charts use historical names, even for the major islands, which is a cause of confusion and a potential maritime safety issue. Updating official nautical charts with official Vanuatu nomenclature should be undertaken with urgency.

9.6 CONCLUSIONS FROM KEY ITEMS OF RISK ASSESSMENT RELEVANCE

9.6.1 Conclusions - Culture and Land Ownership

38. Centralised rights of cargo passage into and out of coastal ports and jetties are needed if domestic coastal shipping is to have full access to all available landings. This is normally addressed by the concept of a local port or harbour authority providing freedom of traffic and cargo transit.

39. Local marine reserves, policed by the tabu system, are common in Vanuatu. These reserves cover some very important ecological areas and it provides a problem for a risk assessment as essentially these

are informal arrangements. They were incorporated into the risk model, with similar risk prioritisation given to those that are formally recognised.

40. There are cultural locations of importance to Ni-Vanuatu that could be affected by oil pollution arising from a shipping incident. Locations in direct contact with coastal areas have been incorporated into the risk assessment.

9.6.2 Former Mined Areas and WW2 Artefacts

41. Request, at inter-governmental level, access to information from US military archives for records of equipment disposal for the south-eastern part of Espiritu Santo and the northern shores of Éfaté. Render information to the Vanuatu Primary Charting Authority to update official nautical publications and charts.

10 GLOSSARY AND DATASET CONFIDENCE

Definitions in risk management disciplines are not absolute and are, to some extent, still evolving and dependent on the nature of the study.

AIS	Automatic Identification System – A ship transponder based system where ship-identify and positional information are transmitted and received. Vessel over 300gros tons are required to carry AIS transponders.
S-AIS	Satellite (received) Automatic Identification System
Aid to Navigation (AtoN)	A shore based light or mark that may be lit, that assists a passing vessel in its positional awareness. Equipment fitted on a vessel to aid positional or situational awareness are known as Navigational Aids. It is an important differentiation.
Consequence	Positive (particularly in a planned event) or negative (particularly in the case of an accident). Consequences can be expressed in terms of “most likely” and “worst credible” and a combination of the two gives a balanced overview of the risk. Note that “worst credible” is quite different from “worst possible”. For example, in the case of a passenger ship grounding on a reef at high speed the “worst credible” result might involve the death of 10% of the complement. The “worst possible” result would be the death of 100% of the complement. The latter is so unlikely to occur that it would not be helpful to consider it.
Event	Unwanted or unplanned occurrence with consequential harm (i.e. accidents).
Frequency	The measure of the actuality or probability of an adverse event occurring. It can be expressed descriptively (e.g. frequent, possible, rare) or in terms of the number of events occurring in a unit of time (e.g. more than one a year, once in every 10 years, once in every 100 years). Frequency can be absolute, i.e. derived entirely from statistics, or subjective, i.e. an informed estimation of the likelihood of an event occurring, or a combination of the two.
GIS	Geographic Information System
GT	Gross Tons: A measure of a ship’s cargo carrying capacity. It is a volumetric measurement based system and not one of mass. The unit is therefore Tons and not Tonnes. Historically the unit arises from the English word Tun, which was a barrel used to transport wine in sailing vessels, the unit originally being related to the number of Tuns a vessel could carry. GT is universally used for port dues and shipping registry charges.
Ha	Hectares
Km	Kilometres
Nm	Nautical miles

VHF	Very High Frequency
Risk	Defined for GIS use as the product of the frequency and consequences of an event.
Risk analysis	The systematic use of available information and expert judgment to identify hazards and estimate their risks to people, property, environment and stakeholders
Risk Assessment	Risk analysis and professional evaluation
Risk Evaluation	Establishing the tolerability level of a risk and an analysis of risk control options.
Risk management	Decision making on the implementation of controls stemming from risk assessment and monitoring the efficacy of the controls.

10.1 GIS RISK OVERLAY DATASET CONFIDENCE

There were 22 different risk criteria overlays used in the Vanuatu Hydrographic risk assessment, some of which were broken down further to provide 29 sets of criteria. This table provides information about the level of confidence the risk assessment team have in the accuracy of each GIS overlay.

Dataset	Confidence	Reason
Vessel traffic patterns	Moderate/ High	Use of satellite derived AIS and port records provide very good understanding of vessel movements.
Prevailing Conditions	Moderate	Absence of a universal and accurate digital dataset of Vanuatu's meteorological conditions required approximation using other sources. Modeled conditions are basic without wave propagation or refraction.
Tidal Conditions	Low	No dataset available, conditions approximated using nautical charts and sailing directions.
Navigational Complexity	N/A	Qualitative Assessment based on distance from shore.
Chart Quality Assessment	High	CATZOC ratings derived from S-57 charts. Where a CASTOC rating of U (Unassessed) was recorded, CATZOC was assumed to be D.
Fixed Aids to Navigation	High	All lights in Vanuatu digitised from charts and consultation during site visit marked each light operational or non-operational.
Depth	Moderate	Depth datasets drawn from admiralty charts and S-57. Dataset as accurate as the CATZOC score for that chart is.
Bottom Type	Low	Use of a global dataset does not accurately reflect localised changes in geology.
Significant Charted Reefs	Moderate/ High	Most significant reefs awash at low tide are accurately charted during historical surveys.
Seamounts	Moderate	Seamount locations drawn from a variety of different sources
WW2 Military Sites	Moderate	Known WW2 sites are referenced in sailing directions, however most are approximated, with some sites not known.

Dataset	Confidence	Reason
Sites of Volcanic Activity	Low	Digitised from nautical charts and so reliant on their accuracy, charts indicate uncertainty and so dataset is uncertain.
Tidal Streams	Moderate	Significant tidal streams as charted were used.
Coral Reefs	High	Multiple sources used to accurately map coral reef locations; scoring undertaken with local consultation. Global datasets available.
Wetlands Resource	Moderate	Literature review required to find most locations, some derived from site visit. Locations are therefore approximate.
Breeding Grounds	Low	Only breeding grounds for selected species are marked. Sites chosen are only those marked during local consultation.
Environmental Protected Sites	Moderate	Global protected sites well-marked, local, informal sites digitised using consultation.
Culturally Protected Sites	Moderate	Global protected sites well marked; local informal sites digitised using consultation.
Key Infrastructure	High	Only two ports operate in Vanuatu.
Tourist sites	Moderate	Consultation with local stakeholders used to map the most important tourist sites.
Sites of economic contribution	Low/ Moderate	Broad areas used without regional datasets.
Cruise ship destinations	High	Consultation with cruise ship operators, traffic analysis and local stakeholders provide all cruise ship destinations.