



## LAND INFORMATION NEW ZEALAND (LINZ)

# PACIFIC REGIONAL HYDROGRAPHY PROGRAMME HYDROGRAPHIC RISK ASSESSMENT - VANUATU

## EXECUTIVE SUMMARY

Report Number : 12NZ246-1  
January, 2013

MARICO MARINE NZ LIMITED

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**Land Information New Zealand (LINZ)  
Pacific Regional Hydrography Programme  
Hydrographic Risk Assessment - Vanuatu**

**EXECUTIVE SUMMARY**

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Satellite AIS data (S-AIS) provided by  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** of the main report.

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

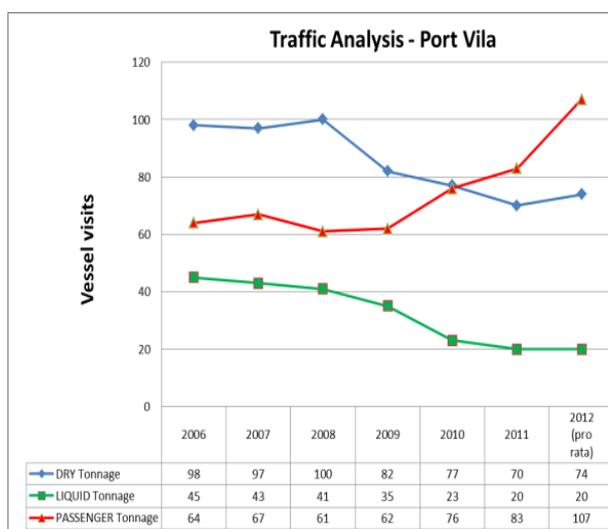
The risk approach is reliant on quality of input datasets. A number of sources were used with some augmentation. In particular, this was required for the satellite derived (S-AIS) data before it could be employed in the GIS modelling process. S-AIS data can only be received when an appropriate satellite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



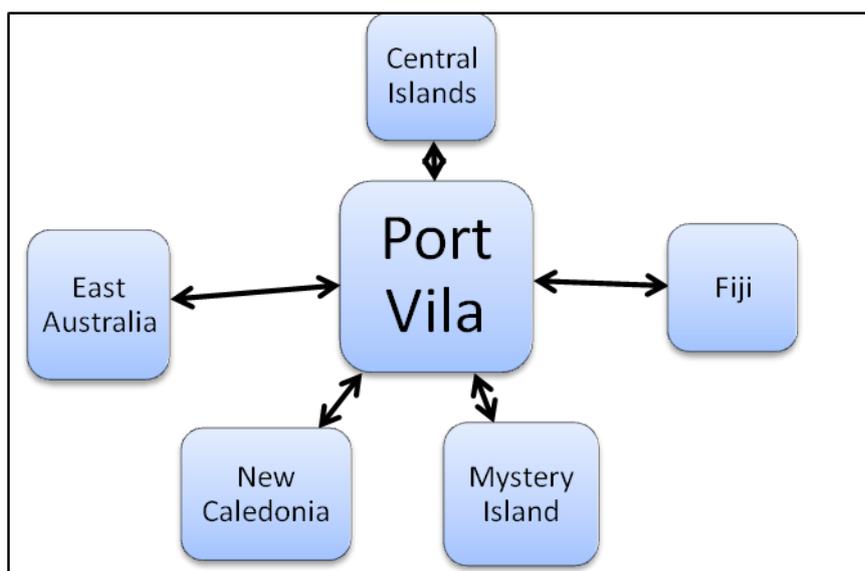
The expansion is confirmed by analysis of the numbers of vessels using Port Vila, by ship type, 2006-2012; the red line is cruise vessels. There were 62 such vessel-calls in 2009, 76 in 2010, 83 in 2011, with 2012 showing over 100 cruise vessel-calls. Cruise vessel arrivals are set to increase further 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 through 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<sup>1</sup> 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

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<sup>1</sup> Competence is a combination of training and experience.

domestic coastal vessels on this route, again measured by GT. The East Coast of Malakula is similarly busy, as are the central islands of Vanuatu. **Figures 5.4 and 5.5, pages 63 and 64**, of the main report 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 Maweo present no risk on their east coasts, as there are presently no domestic services there. However, Pentecost and Maweo 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 Epi 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 Lamén 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 Epi. 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 Lamén 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**

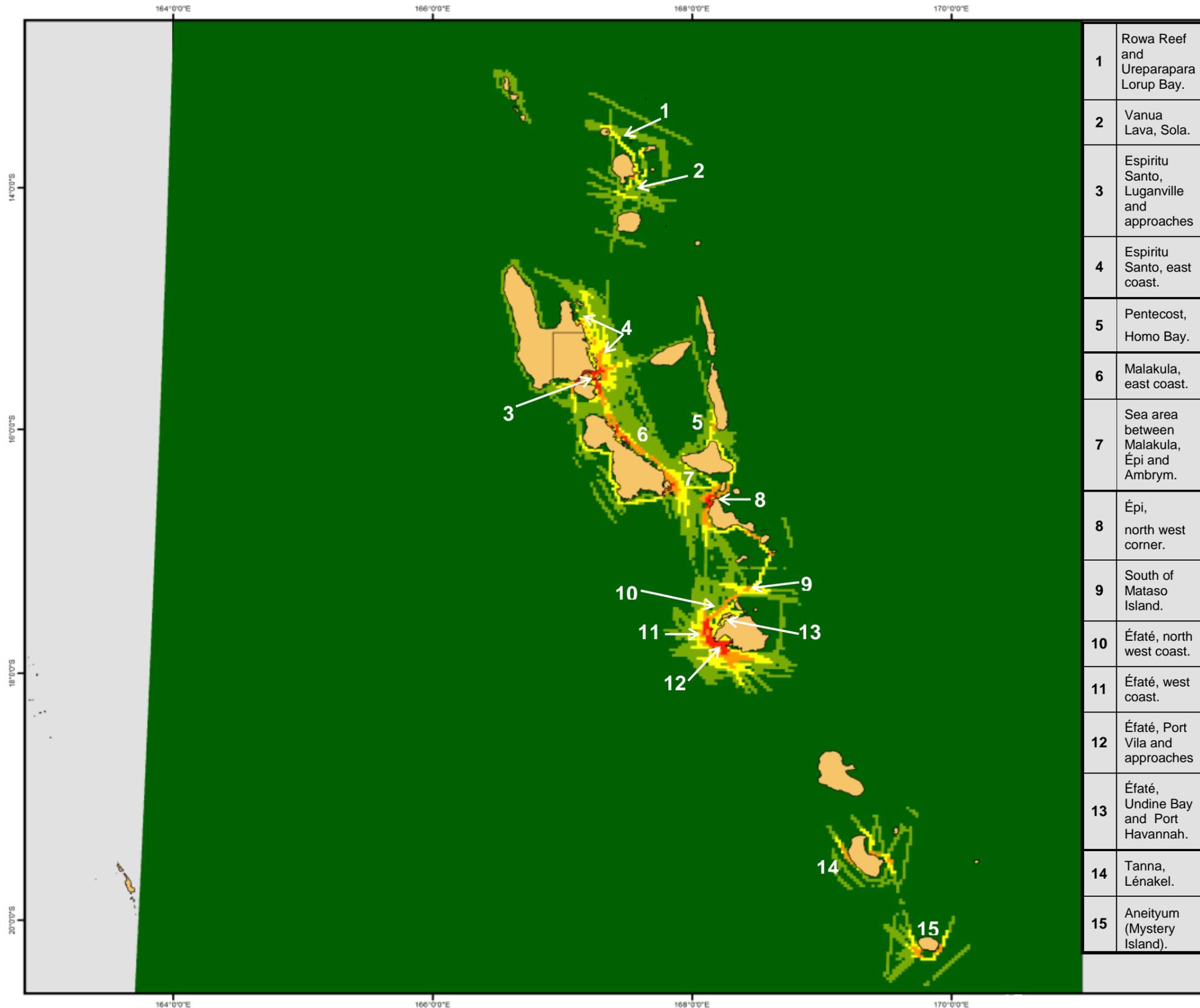
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Area by Province (N to S)		Comparative Risk Level			Comments
		Moderate	Heightened	Significant	
<b>TORBA PROVINCE</b>					
1	Rowa Reef and Ureparapara, Lorup Bay	✓			<ul style="list-style-type: none"> <li>• Considerable areas of environmental significance, corals and wetlands.</li> <li>• Visited annually by small boutique cruise vessels.</li> <li>• Risk influenced by Rowa Reef, an environmentally key surface breaking reef.</li> <li>• Some underlying risk contribution from domestic coastal vessels.</li> <li>• Possible future destination for large cruise vessels.</li> </ul>
2	Vanua Lava, Sola.		✓		<ul style="list-style-type: none"> <li>• Risk contribution from transiting vessels, including large tankers transiting east west through Vanuatu waters, between Vanua Lava and Gaua.</li> <li>• Sola has a large inventory of protected mangroves and corals in a marine reserve.</li> <li>• Localised area of heightened risk as mangrove area is a domestic coastal vessel anchorage for cargo (jetty at Sola damaged).</li> <li>• Possible future destination for large cruise vessels.</li> </ul>
<b>SANMA PROVINCE</b>					
3	Espiritu Santo, Luganville and approaches.			✓	<ul style="list-style-type: none"> <li>• High potential for loss of life and pollution.</li> <li>• Relatively narrow channel (especially the south west) significant tidal streams.</li> <li>• There are non-functioning Aids to Navigation.</li> <li>• WW2 former mined areas and dumped artefact locations.</li> <li>• Proximity to a number of sites of environmental importance including coral, breeding grounds and important informal marine reserves.</li> <li>• Proximity to sites of high cultural value.</li> <li>• Port of high economic value.</li> </ul>
4	Espiritu Santo, east coast.		✓		<ul style="list-style-type: none"> <li>• Espiritu Santo, east coast is an established tourist area of high economic value.</li> <li>• Proximity to corals and turtle breeding grounds.</li> <li>• Informal marine reserve.</li> </ul>
<b>PENAMA PROVINCE</b>					
5	Pentecost, Homo Bay.	✓			<ul style="list-style-type: none"> <li>• Mostly moderate risk, but localised area of heightened risk in Homo Bay.</li> <li>• Risk dominated by cruise vessels, but relatively low traffic.</li> </ul>
<b>MALAMPA PROVINCE</b>					
6	Malakula, east coast.			✓	<ul style="list-style-type: none"> <li>• Considerable amount of coastal traffic passes close to a moderately exposed lee-shore with non-functioning Aids to Navigation and breaking reefs.</li> <li>• Traffic passes close to a large amount of coral and wetland resources with informal reserves.</li> <li>• Coast is popular with tourists and a number of large cruise vessels call at Wala Island.</li> <li>• Significant risk concentrated in the south east and Wala Island.</li> <li>• Second highest concentration of domestic coastal vessel GT capacity by schedule.</li> <li>• Domestic traffic will benefit from a review of chart scales.</li> </ul>

Area by Province (N to S)		Comparative Risk Level			Comments
		Moderate	Heightened	Significant	
7	Sea area between Malakula, Épi and Ambrym.		✓		<ul style="list-style-type: none"> <li>High volume of traffic including large SOLAS vessels and small coastal traders passing round the tip of Malakula, with non-functioning Aids to Navigation.</li> <li>Vessels navigating close inshore with a number of breaking reefs and tidal hazards.</li> <li>Area of high wetlands value, high coral value and significance for local communities.</li> <li>Localised heightened risk with area of moderate risk.</li> </ul>
<b>SHEFA PROVINCE</b>					
8	Épi, north west corner.			✓	<ul style="list-style-type: none"> <li>Density of domestic coastal vessels and super yachts with passenger capacity/recreational vessels.</li> <li>Vessels navigating close to the shore with breaking reefs and non-functioning aids to navigation.</li> <li>Considerable area of environmental significance, turtle breeding ground, corals, wetlands and mangroves.</li> <li>Review if cruise vessels elect to call at Lamén Bay again.</li> </ul>
9	South of Mataso Island.		✓		<ul style="list-style-type: none"> <li>Density of transiting domestic coastal vessels.</li> <li>Risk associated with Shepherd Group, submerged volcanic activity.</li> <li>Risk influenced by Cooks Reef.</li> <li>Pristine diving attraction.</li> </ul>
10	Éfaté, north west coast.		✓		<ul style="list-style-type: none"> <li>Density of transiting domestic coastal vessels.</li> <li>Risk partially influenced by Cooks Reef.</li> <li>Corals and mangroves on north west coast of Éfaté.</li> <li>Vanuatu's World Heritage Site, Eretoka, Port Havannah.</li> </ul>
11	Éfaté, west coast.			✓	<ul style="list-style-type: none"> <li>Density of marine traffic approaching the largest port in Vanuatu, both international and domestic.</li> <li>High potential for loss of life and pollution.</li> <li>Moderate exposure to prevailing conditions in an area of breaking reefs and rocky bottom.</li> <li>Traffic risk is influenced by Vanuatu's World Heritage Site, Eretoka, Port Havannah, corals and breeding grounds.</li> </ul>
12	Éfaté, Port Vila and approaches.			✓	<ul style="list-style-type: none"> <li>High potential for loss of life and pollution.</li> <li>Proximity to shallow depths and breaking reefs.</li> <li>Proximity to corals, wetlands and mangroves.</li> <li>Port of high economic value and premier tourist destination.</li> </ul>
13	Éfaté, Undine Bay and Port Havannah.	✓			<ul style="list-style-type: none"> <li>Evaluate on a vessel-needs case if planned as a cruise destination.</li> <li>Vanuatu's World Heritage Site, Eretoka, Port Havannah.</li> <li>WW2 former mined area in Undine Bay.</li> </ul>
<b>TAFEA PROVINCE</b>					
14	Tanna, Lénakel.		✓		<ul style="list-style-type: none"> <li>Lénakel to Port Vila route has the greatest scheduled domestic vessel capacity by GT.</li> <li>Area of coral reefs, breaking reefs and rocky bottom.</li> <li>Coastline local to Lénakel exposed to prevailing conditions, surge and swell.</li> </ul>
15	Aneityum (Mystery Island)		✓		<ul style="list-style-type: none"> <li>Heightened risk based on traffic levels.</li> <li>Localised area of risk associated with cruise vessel approach and anchorage.</li> <li>Environmentally sensitive areas, corals and breeding grounds.</li> <li>Risk dominated by cruise vessels.</li> </ul>

**Table 2 – Commented Risk Summary**

### 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 (Green)
- Low (Light Green)
- Moderate (Yellow)
- Heightened (Orange)
- Significant (Red)

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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

**Produced by:**  
Marico Marine NZ  
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