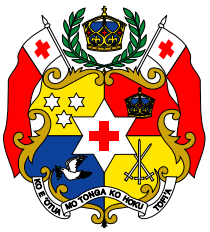
Kingdom of Tonga

SIRA Risk assessment for Taufaʻahau Port, Haʻapai, Tonga



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SIRA Risk assessment for Taufaʻahau Port, Haʻapai, Tonga

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Contents

Summary

Tonga is a signatory to the International Convention for the Safety of Life at Sea (SOLAS), of which Chapter V, Regulation 13.1 requires contracting governments to provide “such aids to navigation as the volume of traffic justifies and the degree of risk requires.”

Tonga is one of the 13 targeted Pacific Island countries and territories (PICTs) of the Pacific Safety of Navigation Project implemented by the Pacific Community (SPC) and funded by the International Foundation for Aids to Navigation (IFAN), whose aim is to improve safety of navigation in the Pacific region through enhanced aids to navigation (AtoN) capacity and systems.

In 2017, during Phase 1 of the project, the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) and SPC developed the Simplified Risk Assessment Model (SIRA), a simple qualitative tool to enable smaller states to meet their international obligation of providing AtoN by conducting waterways risk assessments.

In August of 2019, during Phase 2 of the project, one Ministry of Infrastructure officer was trained as a certified IALA Level 1 Manager. In June 2021, the Ministry of Infrastructure conducted a risk assessment of the Taufa'ahau port area using the SIRA tool, with financial and technical support from SPC's Safety of Navigation project. This report details the risks identified, the estimated costs in the event of an incident, then suggested risk control options and their costs.

Taufa'ahau Port, being the major port in the Ha'apai group, was identified as a priority for the risk assessment by the Ministry of Infrastructure. The port consists of one international and domestic jetty and one patrol boat jetty. Two cruise ships call to port each year but stay in the anchorage area and do not come alongside the wharf. There are six domestic ferries to Ha'apai and they berth at both the international and domestic wharfs.

Ha'apai maritime stakeholders identified five possible grounding scenarios in the vicinity of Taufa'ahau Port. For each scenario, the cost of the incident was estimated and a risk score was assigned, considering the probability of the incident happening and its potential impact on the country. Risk control options were then identified. The risk scores for the scenarios under the current situation were then compared with the new risk scores if the risk control options were put in place.

Maritime stakeholders in Ha'apai

1 Background

In early 2016, with support from IFAN, SPC launched the Pacific Safety of Navigation Project in 13 PICTs. The project aims to improve the safety of navigation in the Pacific region through enhanced aids to navigation (AtoN) capacity and systems, and support economic development, shipping and trade in the Pacific region through safer maritime routes managed in accordance with international instruments and best practices.

During Phase 1, which ended in July 2018, SPC worked in close collaboration with IALA to conduct technical, legal and economic assessments in the 13 PICTs, to identify needs and gaps in these areas. Another significant output of Phase 1 was the development of a new tool for risk assessment in small island developing states (SIDS): the simplified IALA risk assessment tool (SIRA). In June 2018, IALA trained personnel in 12 out of the 13 PICTs on the use of SIRA to conduct AtoN risk assessments in their countries.

Phase 2 of the project builds on the Phase 1 assessments and tools developed, to further assist in building capacity to develop and maintain AtoN in PICTs. Activities include conducting risk assessments (as required by Regulation 13 of the International Convention for the Safety of Life at Sea—SOLAS); developing safety of navigation policy and a legal framework; improving budgetary management; and supporting regional coordination related to safety of navigation in the Pacific. In August 2019, one officer from the Marine and Ports Division attended and successfully passed the IALA Level 1 Manager Course organised by SPC in Suva (Fiji), thus becoming a certified IALA Level 1 Manager.

In 2020, the Tongan Ministry of Infrastructure invited SPC to assist in conducting a risk assessment of Taufa'ahau Port, but due to the Covid-19 pandemic, all travels in the region were cancelled. SPC decided therefore to provide funding and technical support to assist the Tongan Ministry of Infrastructure certified IALA Level 1 Managers to carry out the SIRA risk assessment.

Tonga is a signatory to the International Maritime Organization (IMO) Safety of Life at Sea (SOLAS) Convention. Regulation 13 of Chapter V of the 1974 SOLAS Convention (as amended) states that "each Contracting Government undertakes to provide, as it deems practical and necessary either individually or in co-operation with other Contracting Governments, such aids to navigation as the volume of traffic justifies and the degree of risk requires."

The SIRA risk management process comprises five steps that follow a standardized management or systems analysis approach:

SIRA is intended as a basic tool to identify risk control options for potential undesirable incidents that Tonga should address as part of its obligation under SOLAS Chapter V, Regulation 12 and 13. The assessment and management of risk is fundamental to the provision of effective AtoN services.

The assessment involved a stakeholder meeting as a first step, to gather views on hazards and risks in the Taufa'ahau Port area from those directly involved with or affected by AtoN service provision. Tonga AtoN Officer and IALA SIRA-certified Officer, Mr Eric Vaka'uta, delivered the risk assessment consultation and completed the full risk assessment matrix, based on four identified possible scenarios.

2 Description of the waterway

Taufaʻahau port in Haʻapai was identified as the priority by the Ministry of Infrastructure for the risk assessment. The port has one international and domestic wharf and one patrol boat wharf and is surrounded by nine AtoNs. It includes very shallow depths, ranging as low as 2–5 metres, which pose a major challenge for domestic and foreign vessel access at low tide. Visibility can be reduced to 0.2 nautical miles in bad weather conditions, which often occurs between October and April. There are several hazards such as shoals and the narrow, shallow passage can pose problems for maritime traffic.

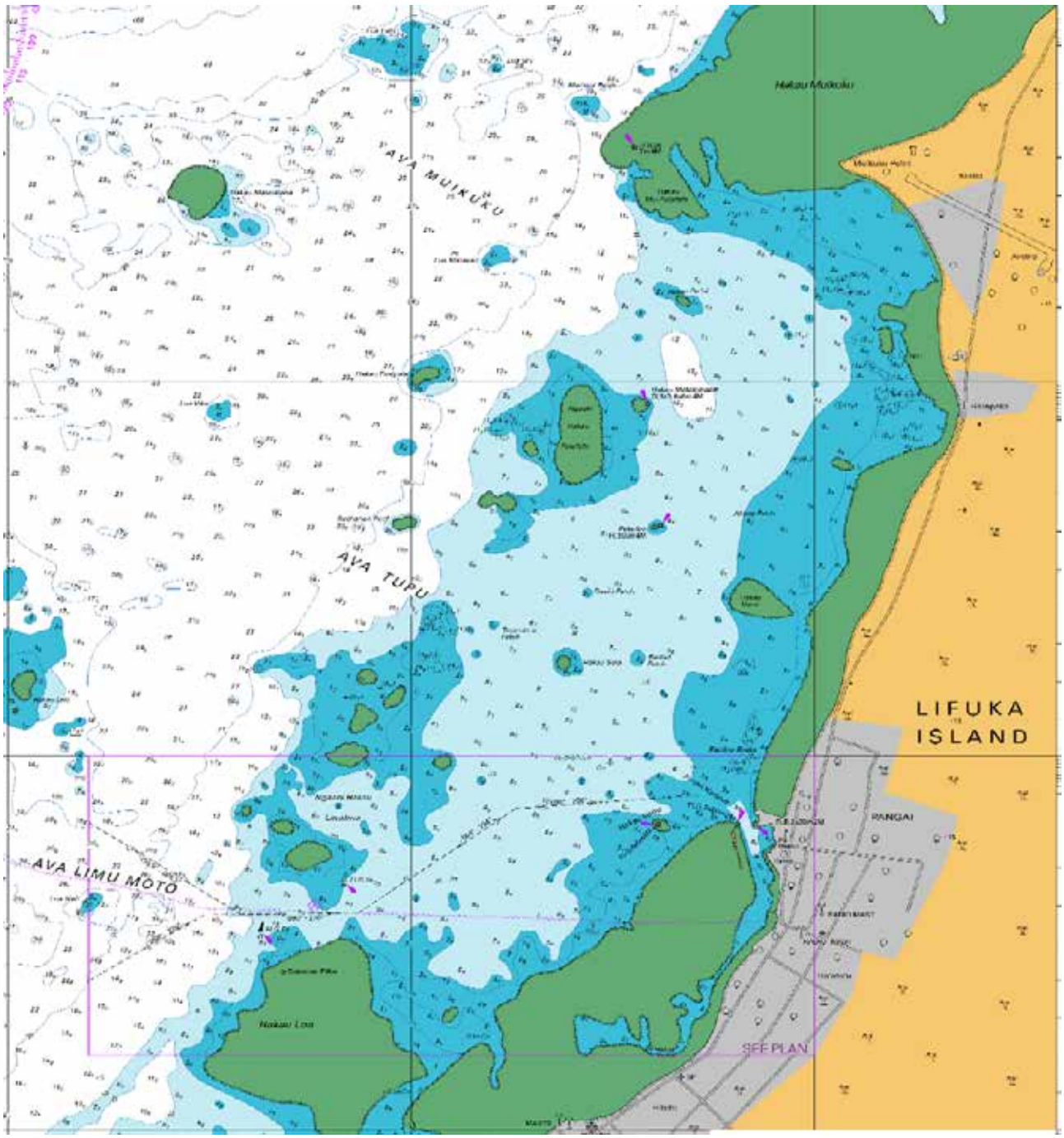


Figure 1. TO 404 shows Taufaʻahau Port at a scale 1:15000

3 Stakeholder meeting

As the first step of the SIRA process, a stakeholder meeting was organised in Pangai, Haʻapai on 3 June 2021, which aimed to gather the points of view of individuals, groups and organisations involved with or affected by AtoN service provision in Taufaʻahau Port. The stakeholders included fisheries officers, shipping agents, police officers, maritime safety administrators, the Tongan Maritime Force and others (see Annex for the full participant list). During the meeting, the participants were divided into groups according to their experience and backgrounds. Potential hazards and possible scenarios in Taufaʻahau Port were then identified using the latest chart of the port, other tools such as marine traffic data and the stakeholders own experience.

4 Hazards and risks

A hazard is something that may cause an undesirable incident. Risk is the chance of injury or loss as defined as a measure of 'probability or likelihood' and 'severity or impact'. Examples of injury or loss include an adverse effect on health, property, the environment or other areas of value.

The stakeholder meeting generated a prioritised list of hazards specific to Taufaʻahau Port (see Annex B). For the risk assessment, the AtoN officer worked together with the stakeholders to discuss the risks associated with the identified hazards and identify risk control options and provide recommendations.

4.1 Types of hazards

Five hazards were identified that could be grouped into the following six categories:

i. Natural hazards, such as floods, storms, earthquakes, biological hazards and other natural phenomena;
ii. Economic hazards such as inflation, depression, and changes in tax, fees and levies;
iii. Technical hazards such as system or equipment failure, fire, explosion, obsolescence, air/water pollution, failure of communications systems and degradation of data quality;
iv. Human factors such as errors or omissions by poorly trained, fatigued or stressed persons, linguistic challenges, violations, sabotage and terrorism;
v. Operational hazards such as groundings, collisions, striking and other unwanted events; and
vi. Maritime space hazards, such as competing uses for maritime space leading to increasingly crowded waterways.

The aforementioned six types of hazards have the capability to generate seven different types of losses:

i. Health losses including death and injury;
ii. Property losses including real and intellectual property;
iii. Economic losses leading to increased costs or reduction in revenues;
iv. Liability loss resulting when an organisation is sued for an alleged breach of legal duty; such cases must be defended even if no blame is assigned. Liability losses are capable of destroying or crippling an organisation;
v. Personnel loss when services of a key employee are lost;
vi. Environmental losses including a negative impact on land, air, water, flora or fauna; and
vii. Loss of reputation or status.

4.2 Risk factors

Any risk analysis needs to consider the range of factors that contribute to the overall risk exposure. Table 1 lists some of the factors that could be taken into consideration when identifying hazards for waterways and ports.

Table 1. Risk factors relating to marine navigation

Ship traffic	Traffic volume	National conditions	Waterway configuration	Short-term consequence	Long-term consequence
Quality of vessels	Deep draught	Night/day	Depth/draft/ under-keel clearance	Injuries to people	Health and Safety impacts
Crew competency	Shallow draught	Sea state	Channel width	Oil spill	Lifestyle disruptions
Traffic mix	Commercial fishing vessels	Wind conditions	Visibility obstructions	Hazardous material release	Fisheries impacts
Traffic density	Recreational boats	Currents (river, tidal, ocean)	Waterway complexity	Property damage	Impacts on endangered species
Nature of cargo	High speed crafts	Visibility restrictions	Bottom type	Denial of use of waterway	Shoreline damage
Participation rate in routing systems, such as VTS	Passenger ships	Ice conditions	Stability (siltation)		Reef damage
		Background lighting	AtoN mix and configuration		Economic impacts
		Debris	Quality of hydrographical data		

Risk is evaluated to allow attention to be focused on high-risk areas, and to identify and evaluate factors which influence the level of risk. Once all the risks have been assessed, they are then evaluated in terms of the documented needs, issues and concerns of the stakeholders, and the benefits and costs of the activity, to determine the acceptability of the risk.

Zero risk is not often realised, unless the activity generating the risk is abandoned. Rather than striving to reduce risk to zero, authorities should reduce risk to as low as reasonably practicable (ALARP).

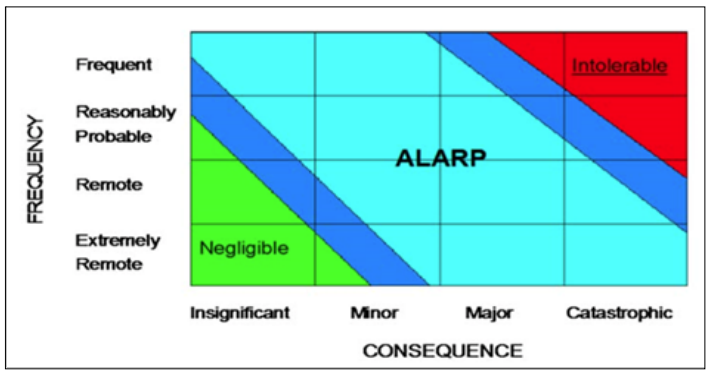


Figure 2. Graphical representation of the levels of risk. The risk level boundaries (negligible/ALARP/ intolerable) are purely illustrative

It is important to remember that, when communicating with stakeholders about risk, perception is usually different to reality. People make judgments on the acceptability of a risk based on their perceptions, rather than on scientific factors, such as probability. The public's perception of a risk may be influenced by many things, including age, gender, level of education and previous exposure to information about the hazard. Public perceptions of risk may therefore differ from those of technical experts.

5 Scenarios

The five hazards identified for Taufa'ahau Port at the stakeholder meeting were considered carefully and five different scenarios, under the category of grounding, were identified and recorded.

The probability of grounding depends on many factors including bathymetry around the port area, draft of the vessels accessing the port and meteorological conditions such as prevailing wind speed and direction. The five grounding scenarios identified for Taufa'ahau Port were:

1 Grounding of vessels on the 3-metre unmarked shoal at the port-hand side of the channel entrance, especially at night.
2. Grounding of vessels at the hard bottom of the entrance to Pangai Channel.
3. Grounding of vessels on the 2-metre unmarked Rachel patch.
4. Grounding of vessels on 1.2-metre unmarked shoal at the Hakau Pooi.
5. Grounding of vessels on 2.6-metre unmarked Luasi'i shoal.

6 Probability and impact

SIRA specifies five levels of probability (Table 2) and five levels of impact that each type of scenario would create (Table 3). Each scenario is allocated a score for both probability and impact, and the risk value is calculated from the product of these scores. In this step of the process, the probability and consequences associated with each scenario were estimated and discussed with the AtoN officer.

Table 2. Five levels of probability as specified by SIRA

Classification	Score	Probability
Very rare	1	Very rare or unlikely, will occur only in exceptional circumstances and not more than once in 20 years.
Rare	2	Rare, may occur every 2-20 years.
Occasional	3	Occasional, may occur every 2 months to 2 years.
Frequent	4	Frequent, may occur once every week to every 2 months.
Very frequent	5	Very frequent, may occur at least once every week.

Table 3. Five levels of impact as specified by SIRA

Description	Score	Service disruption criteria	Human impact criteria	Financial criteria	Environmental criteria
Insignificant	1	No service disruption apart from some delays or nuisance	No injury to humans; possible significant nuisance	Loss, including third-party losses, of less than USD 1000	No damage
Minor	2	Some non-permanent loss of services such as closure of a port or waterway for up to four hours	Minor injury to one or more individuals, may require hospitalisation	Loss, including third-party losses, of USD 1000–50,000	Limited short-term damage to the environment
Severe	3	Sustained disruption to services such as closure of a port or waterway for 4–24 hours	Injuries to several individuals requiring hospitalisation	Loss, including third-party losses, of USD 50,000–5,000,000	Short-term damage to the environment over a small area
Major	4	Sustained disruption to services such as the closure of a major port or waterway for 1–30 days or permanent or irreversible loss of services	Severe injuries to many individuals or loss of life	Loss, including third-party losses, of USD 5,000,000–50,000,000	Long-term to irreversible damage to the environment over a limited area
Catastrophic	5	Sustained disruption to services such as the closure of a major port or waterway for months or years	Severe injuries to numerous individuals and/or loss of several lives	Loss, including third-party losses, of over USD 50,000,000	Irreversible damage to the environment over a large area

7 The acceptability of risk

Having determined probability and impact scores by consensus, the risk values are calculated by multiplying these scores, as shown in the matrix in Table 4. To determine whether the risks are acceptable or not, SIRA specifies four colour-banded levels of risk (Table 5), which are also incorporated into Table 4.

Table 4. Risk-value matrix

		PROBABILITY / (LIKELIHOOD)				
		Very Rare (1)	Rare (2)	Occasional (3)	Frequent (4)	Very frequent (5)
CONSEQUENCE (IMPACT)	Catastrophic (5)	5	10	15	20	25
	Major (4)	4	8	12	16	20
	Severe (3)	3	6	9	12	15
	Minor (2)	2	4	6	8	10
	Insignificant (1)	1	2	3	4	5

Table 5. Risk categories

Risk Value	Risk Category	Action Required
1 – 4	Green	Low risk not requiring additional risk control options unless they can be implemented at low cost in terms of time, money and effort.
5 – 8	Yellow	Moderate risk which must be reduced to the *"as low as reasonably practicable"* (ALARP) level by the implementation of additional control options which are likely to require additional funding.
9-12	Amber	High risk for which substantial and urgent efforts must be made to reduce it to "ALARP" levels within a defined time period. Significant funding is likely to be required and services may need to be suspended or restricted until risk control options have been actioned.
15-25	Red	Very high and unacceptable risk for which substantial and immediate improvements are necessary. Major funding may be required and ports and waterways are likely to be forced to close until the risk has been reduced to an acceptable level.

8 Risk control options

The objective of the risk assessment was to identify risk mitigation options for each undesirable incident that would, if implemented, reduce the risk to a level ALARP and which would be acceptable to stakeholders. Before any risk control decisions were made, they were communicated through the stakeholder consultation process. The risks were evaluated in terms of the overall needs, issues and concerns of the stakeholders.

The mitigation options include:

i. New or enforcement of existing rules and procedures;
ii. Improved and charted hydrographical, meteorological and general navigation information;
iii. Enhanced AtoN service provision;
iv. Improved radio communications; and
v. Improved decision support system.

Below, Table 6 shows the risk scores for the scenarios under the current situation and the new risks scores after mitigating the risk. Detailed risk control options for Taufa'ahau Port are shown in the risk assessment matrix in Annex D.

Table 6. Risk control options for Taufa'ahau Port, Ha'apai, and changes in risk score

Scenario	Risk score	Risk control option	New risk score
Grounding of vessels on the 3-metre unmarked shoal at the port-hand side of the channel entrance, especially at night.	6	Install a port-hand-lit buoy on the shoal.	2
Grounding of vessels on the hard bottom at the entrance of Pangai Channel.	15	Install a North cardinal mark.	12
Grounding of vessels on the 2-metre unmarked Rachel patch.	16	Install Isolated Danger Mark.	9
Grounding of vessel on 1.2-metre unmarked shoal at the Hakau Pooi.	6	Install port-hand-lit buoy on the shoal.	2
Grounding of vessel on 2.6-metre unmarked Luasi'i shoal.	6	Install starboard-hand-lit buoy on the shoal.	2

9 Costing the risk control options

The outcomes of the risk assessment are essentially qualitative and subjective, based on the expert opinions of the stakeholders. The next step is to reach consensus on which risk control options are to be actioned. The risk control options are prioritised to facilitate the decision-making process.

Costing of the options is part of this process. Most of the control options identified require funding. Costs must cover capital, labour and other resources needed for planning and implementation, as well as costs of operation and maintenance throughout the life cycle under consideration. Maintenance is important to ensure that AtoN equipment and systems continue to perform at the levels required for mariners to safely navigate the waterways.

The control measures need to be effective in reducing risk, but also cost-effective. The cost of the measures should not normally exceed the reduction in the expected value of the loss.

The cost of the options should be evaluated over a time frame equivalent to the economic or useful life of the facilities and assets associated with the option.

10 AtoN Budget (2021–2022)

Currently, the Tongan Ministry of Infrastructure has an allocated budget for its navigation section. In 2020-2021, this amounted to TOP 80,000, which covered spare AtoN parts, equipment hire, communications and travel costs. This allocation funds the Ministry's mandated work for AtoN services. The AtoN budget submission of the Marine Division is scrutinised according to the Ministry's priorities as decided by the Director of the Marine Division.

Light dues of 0.05 cents per GT (gross tonnage) are collected from foreign ships that call at Taufa'ahau Port and are deposited into the general government consolidated fund. There is currently no dedicated account for AtoN.

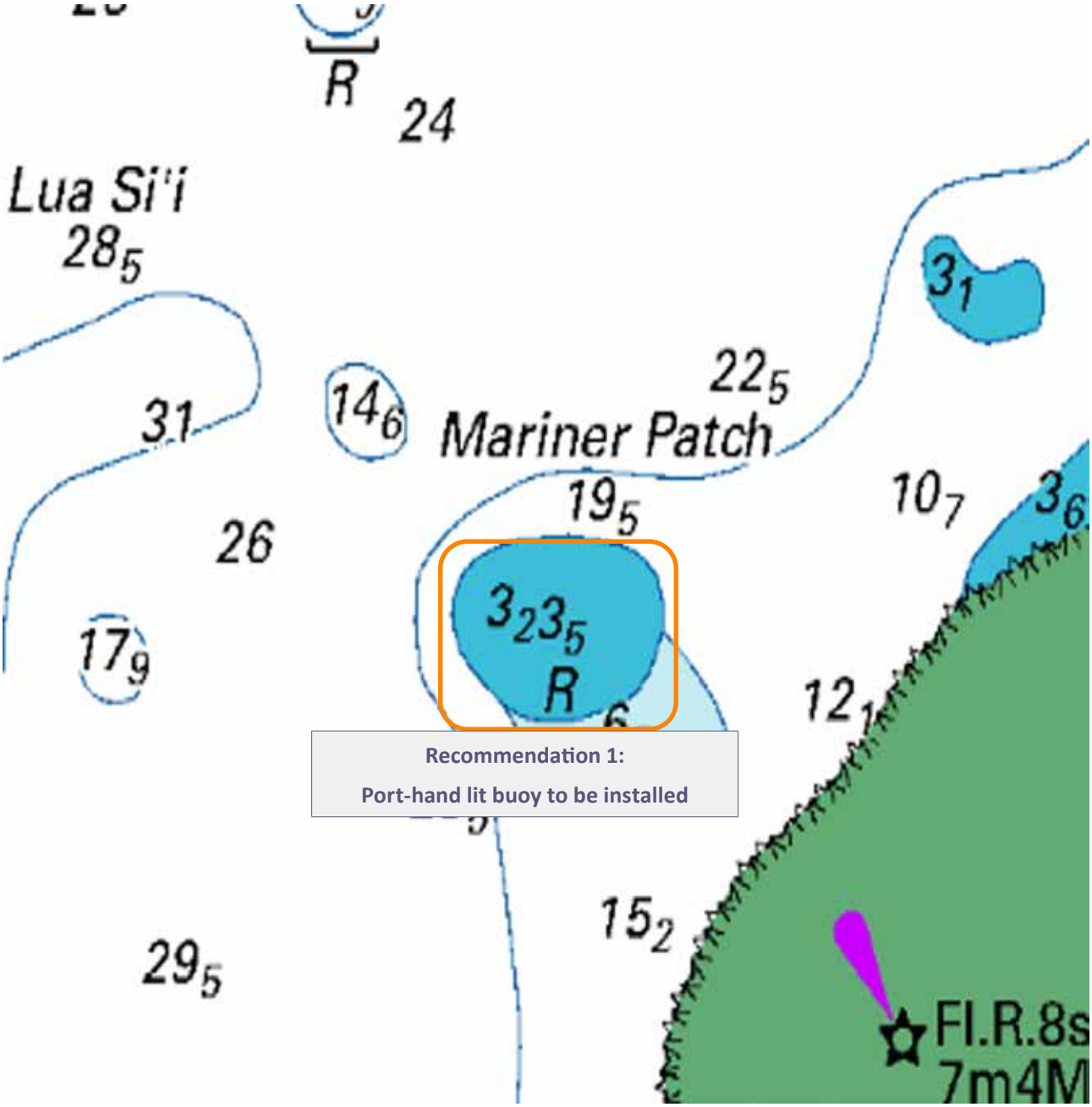
11 Recommendations

A key outcome of the risk assessment undertaken at Taufa'ahau Port was four recommendations aimed at reducing the risks to safety of navigation to an acceptable level for stakeholders.

Recommendation 1

To reduce the risk of grounding on the Marina Patch shoal, it is recommended to install a port-hand lit buoy.

Cost	
Port-hand lateral Mark	TOP 10,000
Maintenance	TOP 1,000



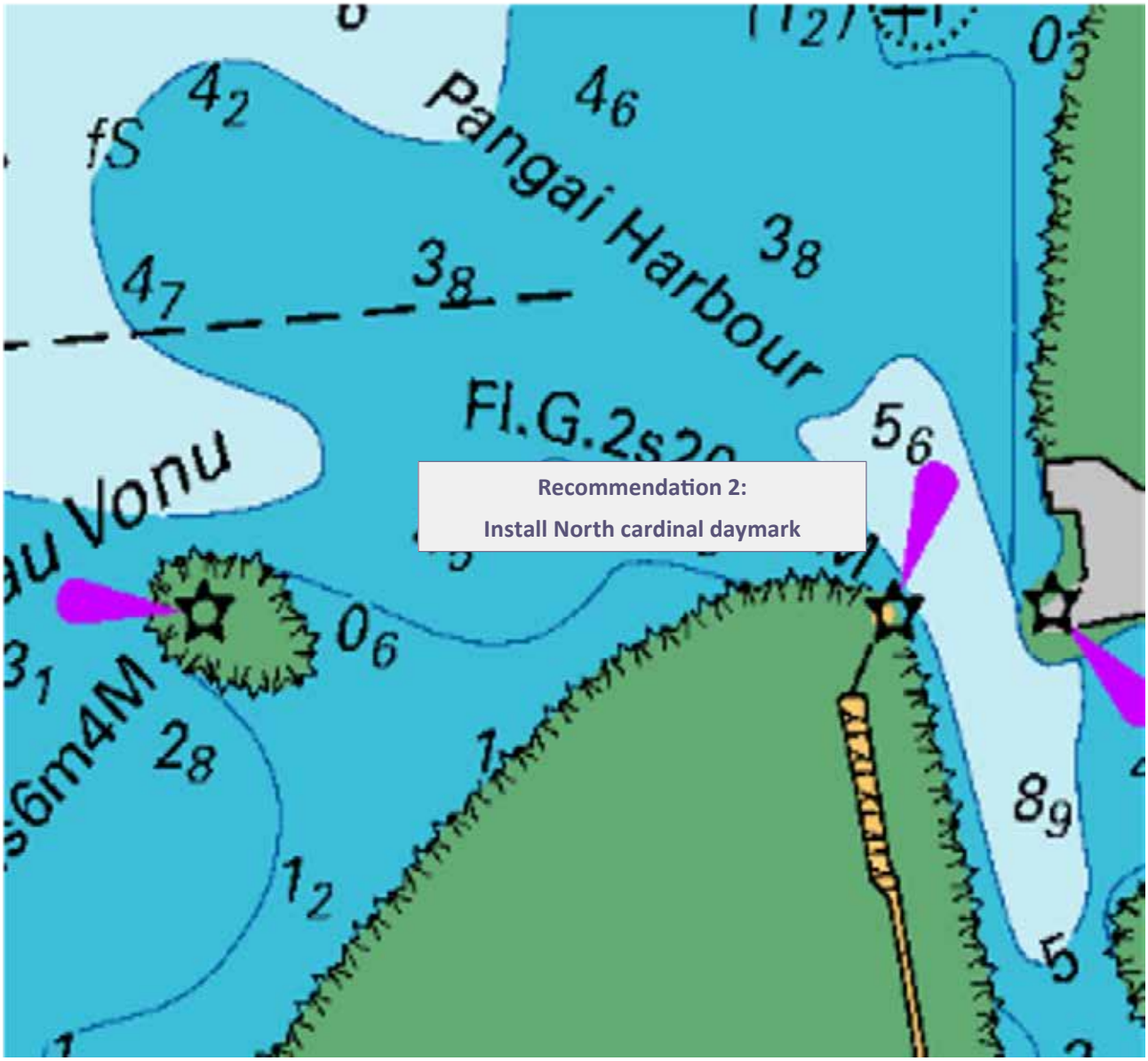
Recommendation 1:

Port-hand lit buoy to be installed

Recommendation 2

To reduce the risk of grounding at the very shallow area at Pangai Channel near the wharf, it is recommended to install a North cardinal daymark.

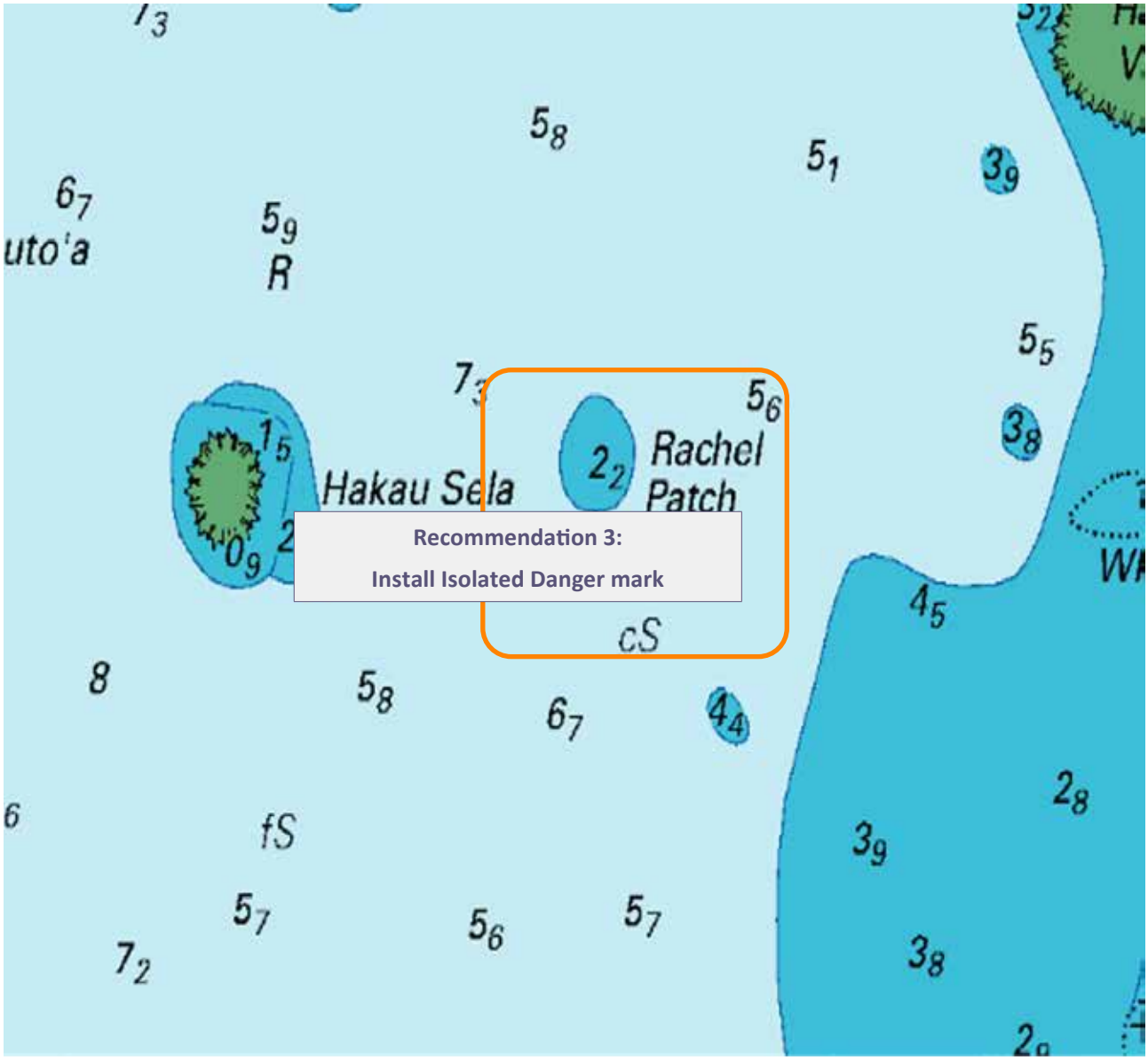
Cost	
North cardinal daymark	TOP 20,000
Maintenance	TOP 2,000



Recommendation 3

To reduce the risk of grounding on the unmarked shoal at Rachel Patch, it is recommended to install an Isolated Danger mark.

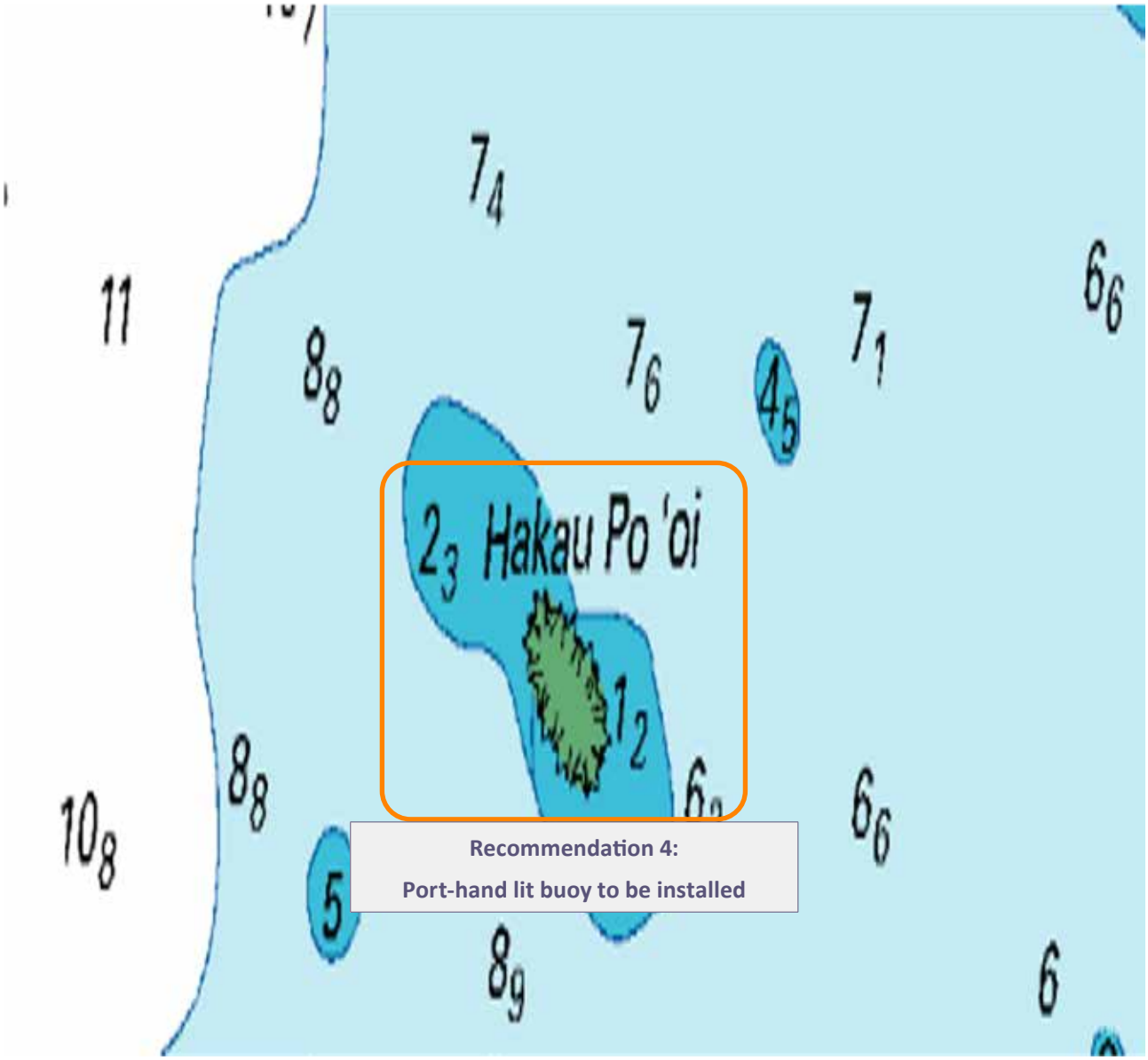
Cost	
Isolated Danger mark	TOP 10,000
Maintenance	TOP 1,000



Recommendation 4

To reduce the risk of grounding on the unmarked shoal, Hakau Pooi, it is recommended to install a port-hand lit buoy.

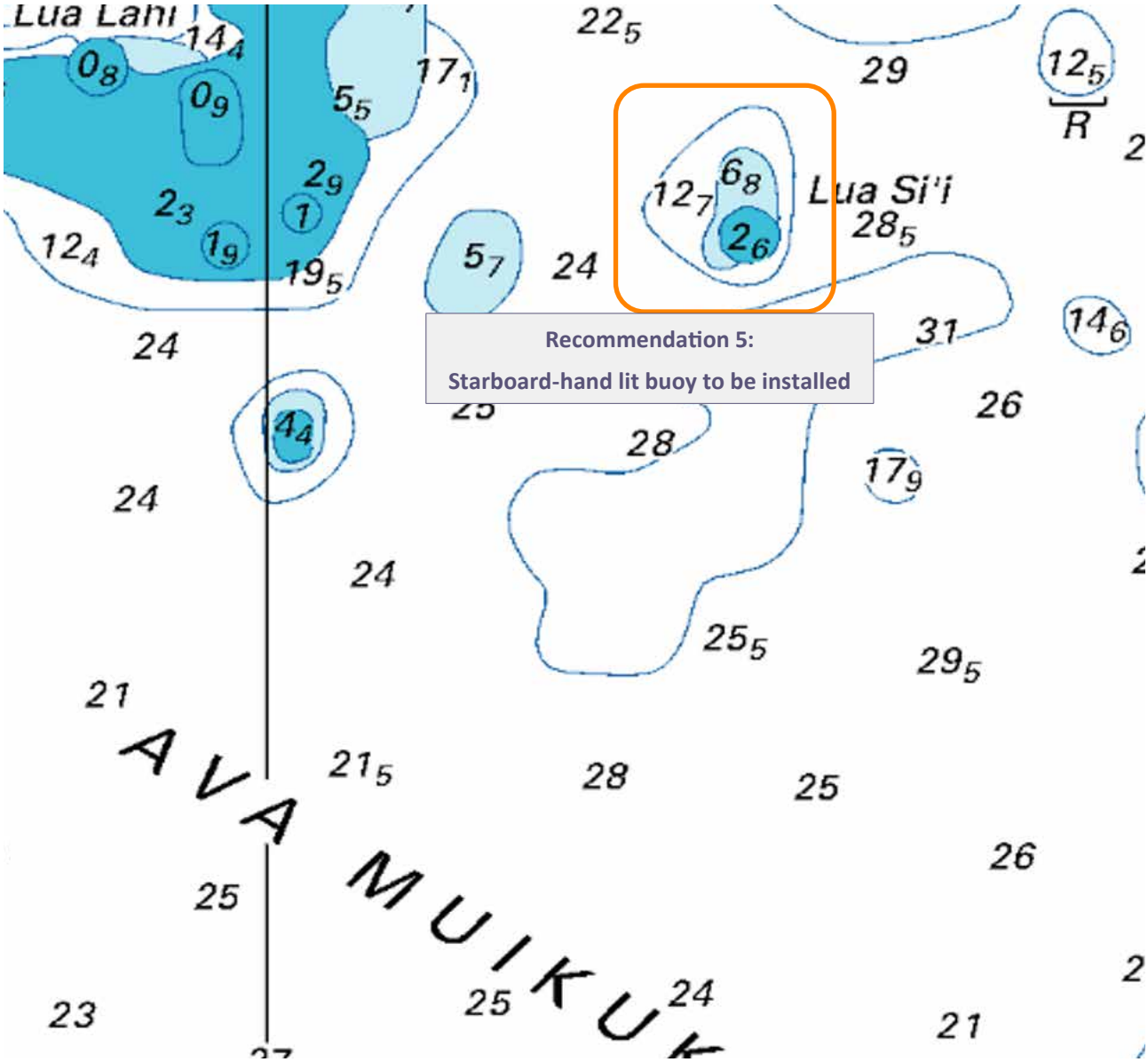
Cost	
Port-hand lit buoy	TOP 10,000
Maintenance	TOP 1,000



Recommendation 5

To reduce the risk of grounding on the Luasi'i shoal, it is recommended to install a starboard-hand lit buoy.

Cost	
Starboard-hand lit buoy	TOP 10,000
Maintenance	TOP 1,000



Annexes

Annex A
Participant list

PACIFIC SAFETY OF NAVIGATION (SoN) STAKEHOLDERS MEETING
Aids to Navigation (AtoN)
Risk Assessment

Date: 03/06/2021 Time: 09:00 a.m.

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Annex B
Hazards identified in Taufa'ahau Port

	Hazard	Remarks
Natural	Shallow water	Shallow water is found at: 1. Mariner Patch 2. Hakau Pooi 3. Rachel patch 4. Pangai channel entrance 5. Luasi'I shoal
Economic	Insufficient AtoN funding	
Human	Poor voyage planning	
Operational	Poor response at marking new dangers	
	Poor maintenance plans	

Annex C
Possible scenarios at Taufa'ahau Port

	Scenario	Remarks
Grounding	Grounding of vessels on the 3-metre unmarked shoal, Marina Patch.	Vessels running aground due to unknown depths and shallow water/narrow passage on charts.
	Grounding of vessels on the hard bottom at the entrance of Pangai Channel.	As domestic vessels are approaching alongside the domestic wharf. This happens when the current is coming from the North-East.
	Grounding of vessels on the 2-metre unmarked Rachel patch.	
	Grounding of vessel on 1.2-metre unmarked shoal at Hakau Pooi.	
	Other	Groundings due to Navaid failures on board.

Annex D
Risk Assessment matrix for Port Taufa'ahau

Scenario		Description of incident	Root Cause(s) (Hazards)	Description of Consequences (Short term and long term)	Existing Risk Control Measures	Probability Score	Consequence Score	Risk Score	Cost of Incident (TOP)	Further Risk Control Options	New Probability Score	New Consequence Score	New Risk Score	Cost of Risk control option (TOP)	Remarks
				1. Grounding											
1.1	Grounding on Rock	Grounding of Domestic & foreign vessel while she enter this area	Shallow water depth (1m - 3.4m)	Short term: Vessel running aground and damage to the hull of the vessel. Long Term: Vessel sinking	Pilot services are always available. Domestic vesesel they mark this shoal on their navigation aid on	3	2	6	1.9 million	Install port hand lit buoy	1	4	4	210,000	ALARP
1.2	Groundig of the vessel at hard bottom the Pangai entrance.	Grounding of domestic & foreign vessel while they approached to the Ports	Shallow water depth on the starboard side of the entrance.	Short term: Vessel block the entrance due the running aground. Long term : vessel can remain in this area until the salvage operation conducting.	Pilot services are always availble	3	5	15	2.5 million	Install North Cardinal Mark	3	4	12	220,000	ALARP
1.3	Grounding on Rock	Grounding of Domestic & foreign vessel while they go in and out from the ports.	Shallow water depth (0.9m - 2.2m)	Damage to the ship underwater hull.	Pilot services are always available. Domestic vesesel they mark this shoal on their navigation aid on board.	4	4	16	1.9 million	Install Isolated Danger mark	3	3	9	210,000	ALARP
1.4	Grounding on Rock	Grounding of Domestic & foreign vessel while they change their heading.	Shallow water Depth (1.2m - 2.2m)	Short term: Damage to the hull of the vessel. Long term: Vessel running aground and sinking	Pilot services are always available. Domestic vesesel they mark this shoal on their navigation aid on board.	3	2	6	1 million	Install port hand lit buoy	1	2	2	210,000.00	ALARP
1.5	Grounding on Rock	Grounding of Domestic & foreign vessel while she enter this area	Shallow water depth (1m - 3.4m)	Short term: Vessel running aground and damage to the hull of the vessel. Long Term: Vessel sinking	Pilot services are always available. Domestic vesesel they mark this shoal on their navigation aid on board.	3	2	6	1.9 million	Install starboard hand lit buoy	1	4	4	210,000	ALARP

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