Flood Resilience and Climate Adaptation: Practical Delivery for the Pacific

Daniel Rodger, JB Pacific

Eric Clem Groves, SUCON International

DOI: 10.5281/zenodo.20550933

ABSTRACT

This presentation outlines the strategic partnership between **SUCON** International and JB Pacific to deliver practical, climate-resilient infrastructure solutions across the Pacific region. Combining **SUCON**'s strong local delivery capability with JB Pacific's specialist expertise in flood modelling, coastal processes, disaster risk reduction, and climate adaptation, the collaboration addresses growing climate and natural hazard risks affecting Pacific communities and infrastructure. Through a series of regional case studies from Samoa, American Samoa, Fiji, Papua New Guinea, Palau, and Vanuatu, the presentation demonstrates how integrated engineering, hazard assessment, and resilience planning can support sustainable, fundable, and buildable infrastructure outcomes. The partnership aims to strengthen local capacity, improve long-term asset resilience, and support governments and development partners in moving from climate risk assessment to practical implementation of resilient infrastructure projects throughout the Pacific.

SUCON International + JB Pacific

Flood Resilience and Climate Adaptation: Practical Delivery for the Pacific

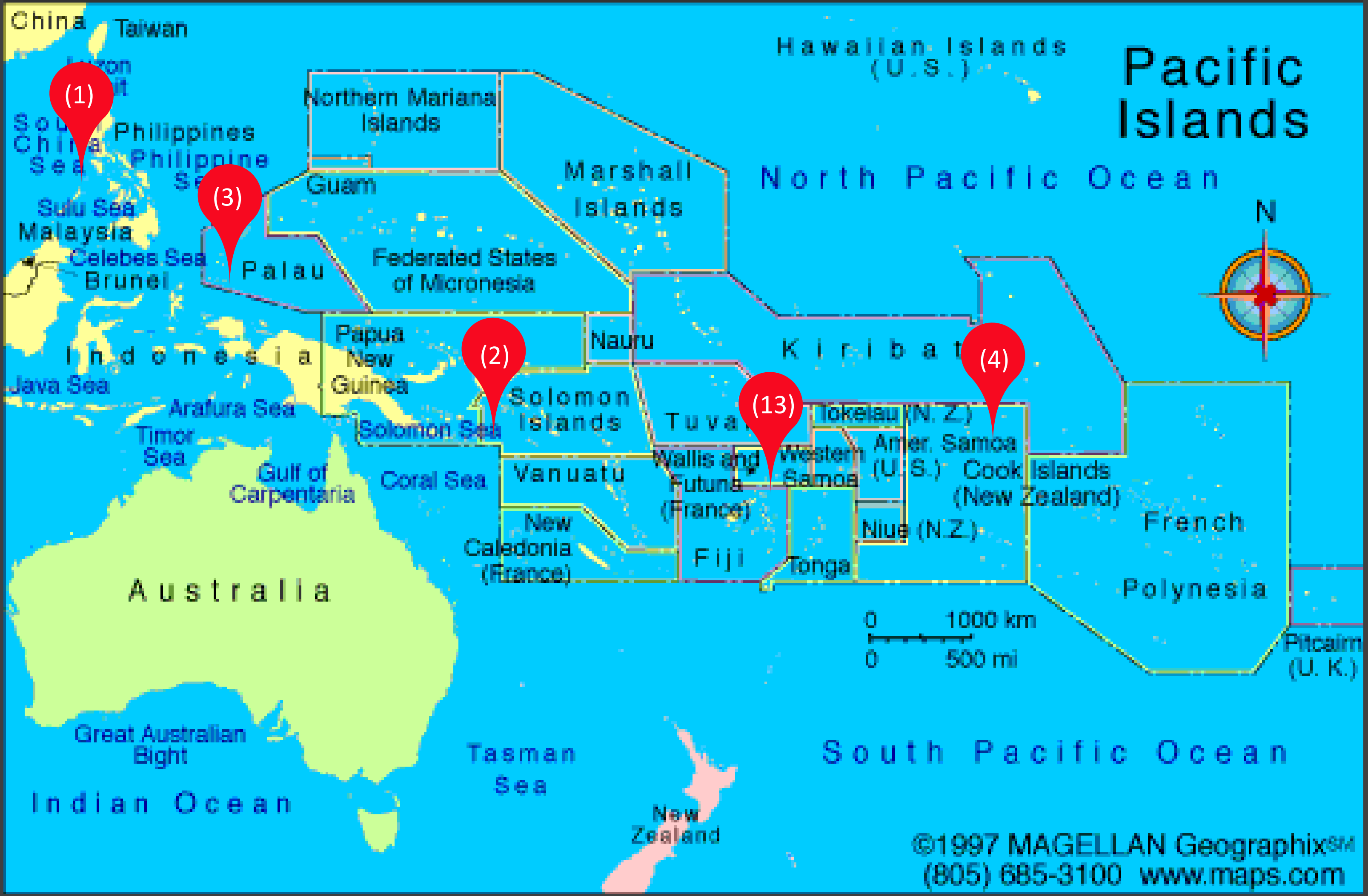
SUCON International
January 2026

CONTENTS

JBP
scientists
and engineers

BRIEF BACKGROUND

- Est. 2018 in Samoa
- Engineering Firm – Design & Supervision
- Multidisciplinary Consultancy
- Extension Office – American Samoa, Fiji, Philippines & Solomon Islands



Active Work Highlights (23)

- 3 World Bank Projects
- 4 ADB Projects
- 2 Government of Samoa
- 2 JICA Projects
- 2 SPREP Projects
- 4 US Federal Funded Projects
- 6 Private Clients

WHAT SUCON BRINGS

- LOCAL DELIVERY CAPABILITY
- ENGINEERING DESIGN, BUILDABLE & COMPLIANT
- PROJECT COORDINATION FROM PREFEASIBILITY TO CONSTRUCTION (TURN-KEY)
- OTHER INFRASTRUCTURE SOLUTIONS – ENVIRONMENTAL, ARCHAEOLOGY, & TECHNOLOGY

ISSUES & CHALLENGES – WHAT WE'VE LEARNED

"THIS IS ONE OF THE CORE REASONS WE HAVE PARTNERED WITH JB PACIFIC, AS THERE IS A LOT WE CANNOT DO IN THE PACIFIC IN TERMS OF FLOODING AND CLIMATE WORKS, AND THE EXPERTS WE BRING IN FOR SHORT STINTS COST A FORTUNE AND LEAVE BEHIND NO CAPACITY FOR EITHER US OR OUR CLIENTS"

Paletasala Faolotoi – Founder, SUCON International

- Evolving climate risks are impacting more projects than before

- Climate resilience is not yet fully embedded across all project types

- Data and capacity gaps slow down decision-making

- Long-term maintenance is often the biggest risk

- Significant gaps in Pacific capacity and consulted experts tend to leave with the knowledge after completion of assignments

JB Pacific

Extreme weather engineering.

Focusing on natural disaster analysis, prediction, and protection

JBP
scientists
and engineers

Our work

Core work:

Natural hazards: Coastal, flood, tsunami, landslip, seismic, drought

Economics: Losses, damages, projections

Resilient: DRR Plans, Strategies and early warning systems

Engineering: Seawalls, harbours, dams, NBS

Training:

Climate Crises through Early Warning Systems Training Course (United Nations Institute for Training and Research; UNITAR)

Design of Coastal Nature-Based Solutions

Coastal Processes and Wave Overtopping

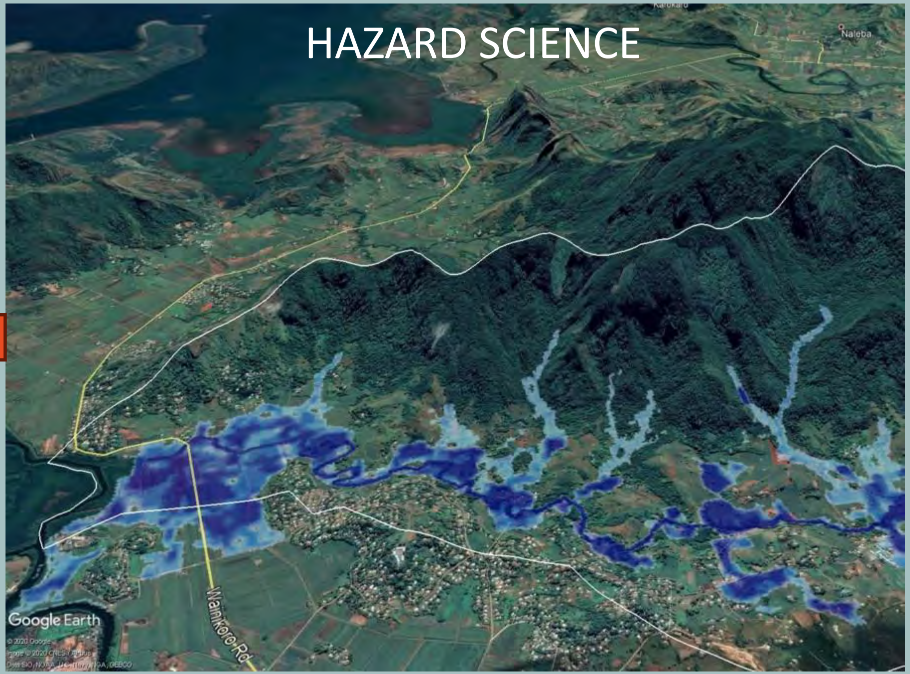
Climate Training and Capacity Building for Pacific Meteorological and Hydrological Services (Secretariat of the Pacific Regional Environment Programme, SPREP; UNITAR)


Saved to this PC
00:04.34

Climate resilient infrastructure

- Science and engineering – two inter-related, yet separate topics
- Along with risk management, planning, economics; are central to climate resilient infrastructure

Climate resilient infrastructure



Climate resilient infrastructure

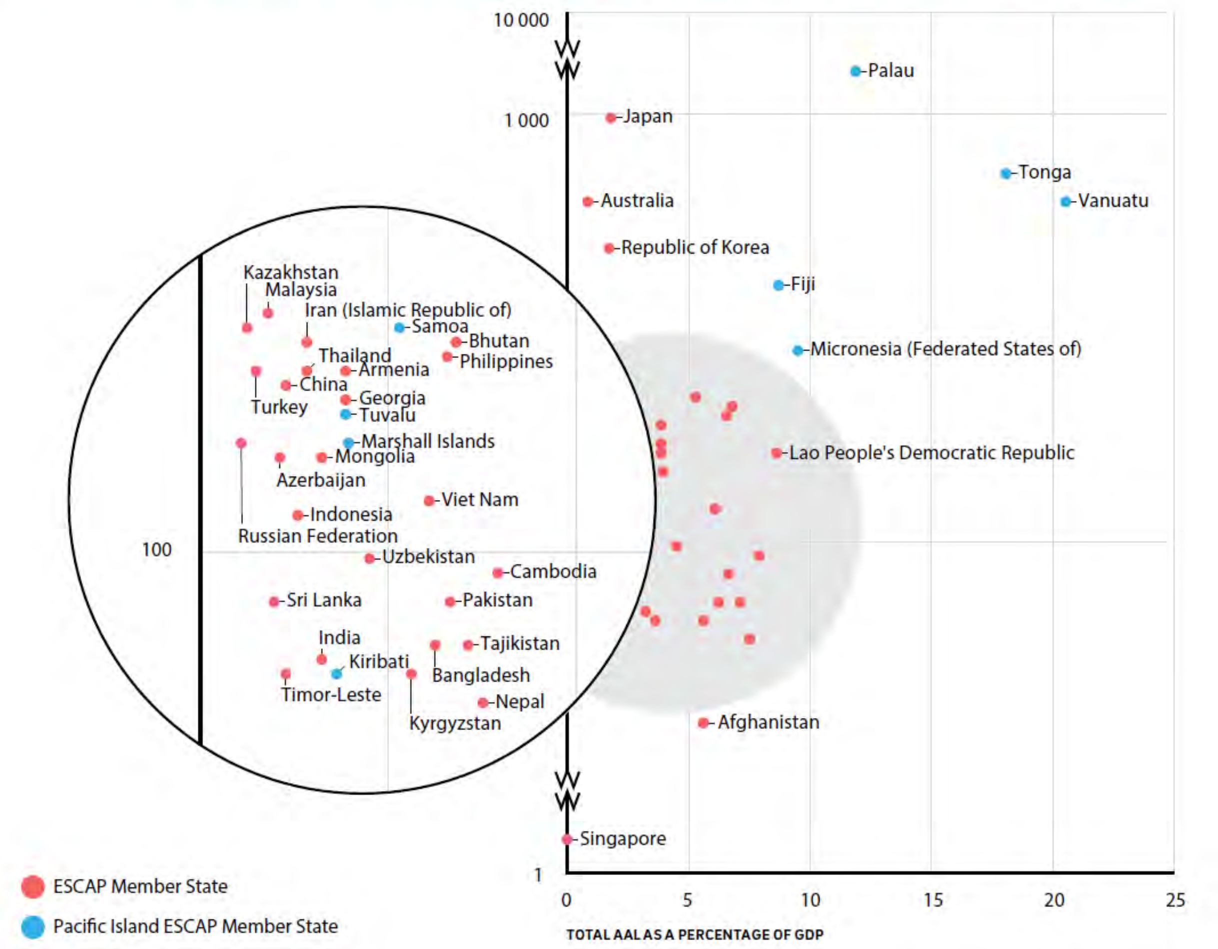
Why Infrastructure Resilience Matters

- Pacific Island Counties unique geographic, economic, and climatic constraints
- Infrastructure underpins livelihoods, connectivity, health, and sovereignty
- Climate impacts are amplifying long-standing structural vulnerabilities

Some Pacific Islands are at risk of losing more than 10 per cent of their GDP, annually, due to disasters.

- This means they can have a wider impact at a whole-island scale

FIGURE 3 Distribution of AAL per capita and AAL as a percentage of GDP

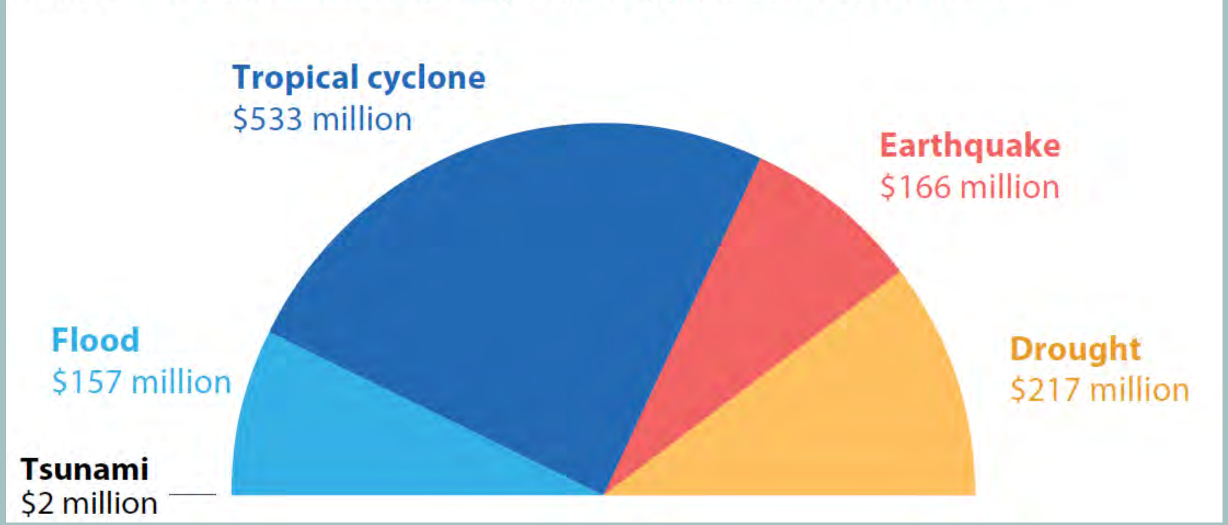


Climate resilient infrastructure

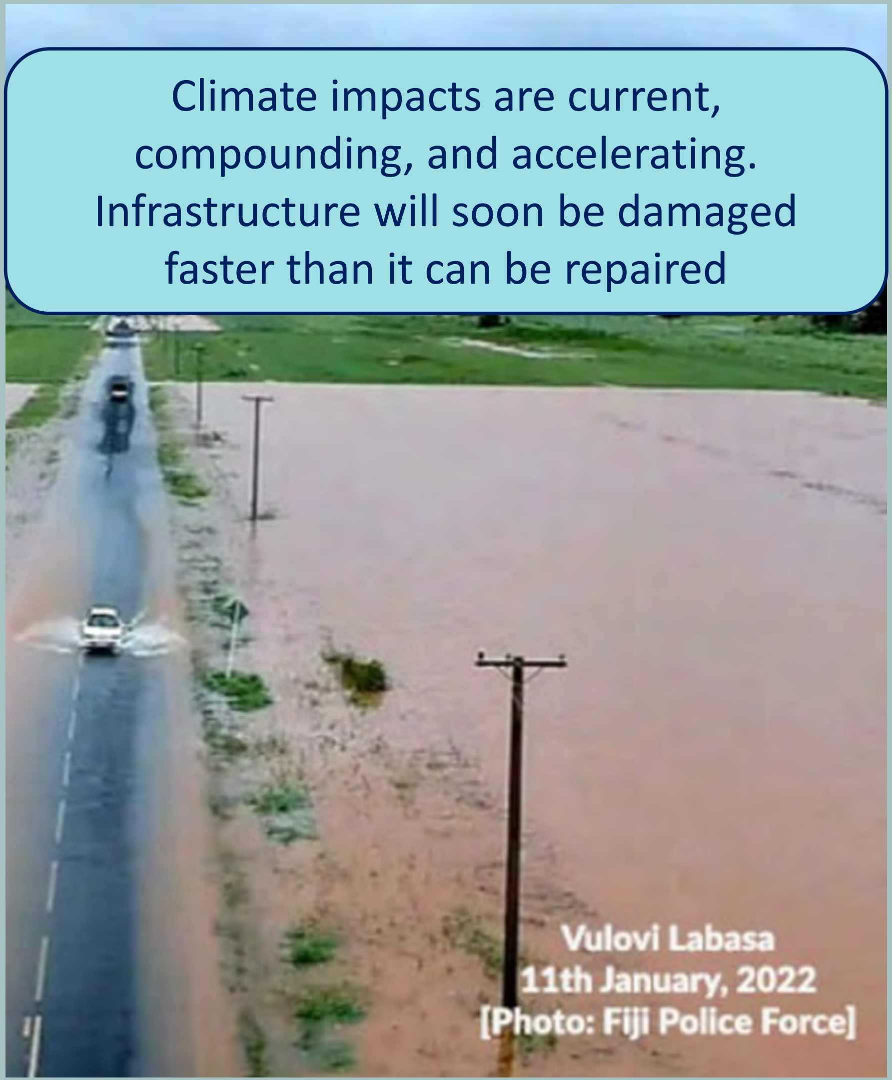
Climate Change Is Already Here (Its not a Future Risk)

- There is only a narrow window to increase resilience to natural disasters before socioeconomic impacts outpace climate change.
- Current damages are all forecast to increase.
- Disaster-related losses are particularly dangerous to **infrastructure sectors**, in addition to agriculture and energy.

FIGURE 5 Composition of AAL by hazard type, millions of US dollars



Climate impacts are current, compounding, and accelerating. Infrastructure will soon be damaged faster than it can be repaired



Climate resilient infrastructure

Exposure: Why Pacific Infrastructure Is Uniquely Vulnerable

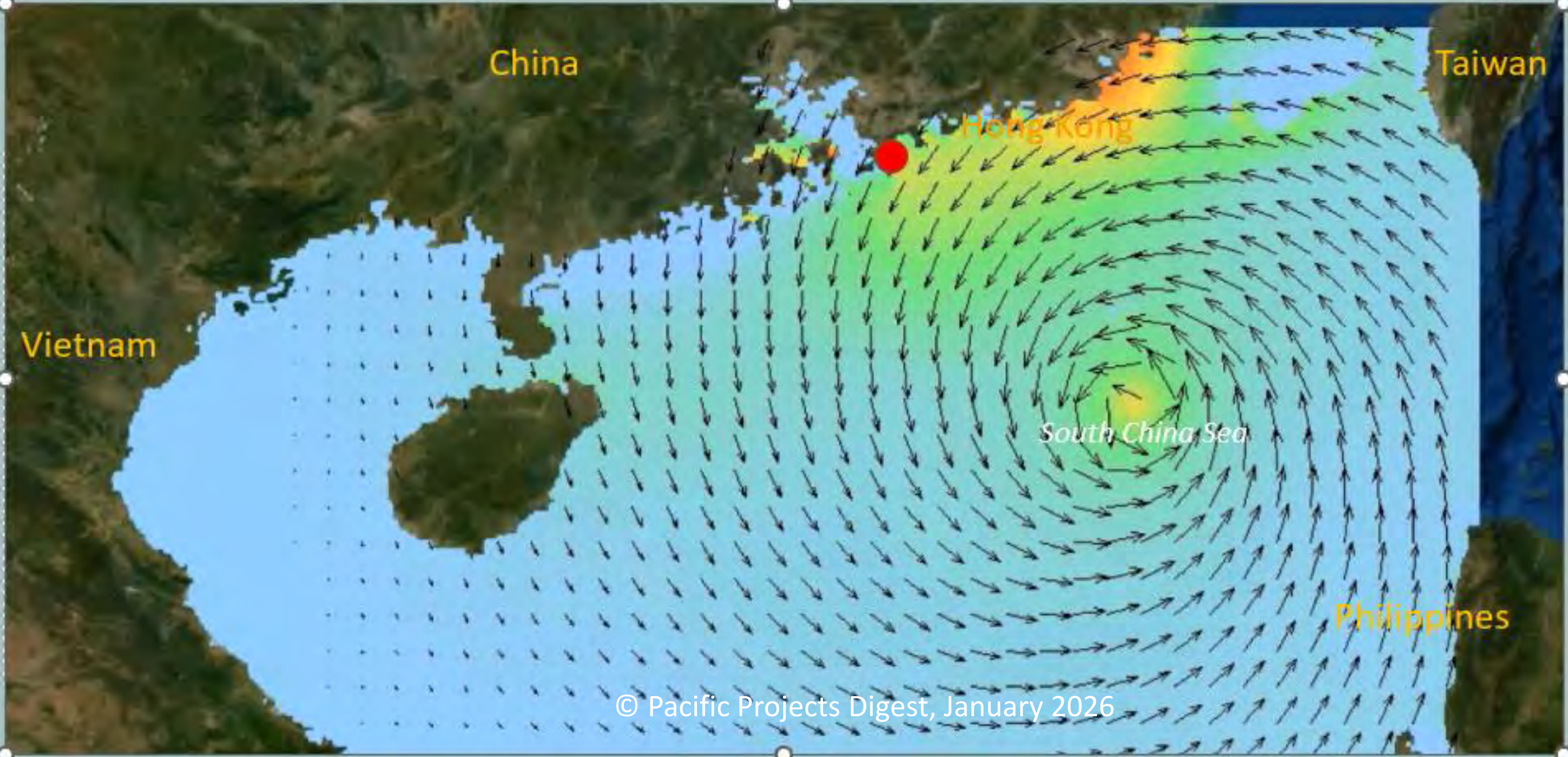
- Pacific infrastructure failure has “outsized consequences”
- High coastal concentration of assets (ports, roads, power, water)
- Many single-point failures (one port, one road, one power station)
- Risk of cascading failures
- Remote locations and difficult logistics

High exposure + limited redundancy = systemic risk.

Climate resilient infrastructure

CYCLONE AND STORM SURGE MODELLING (HONG KONG AIRPORT)

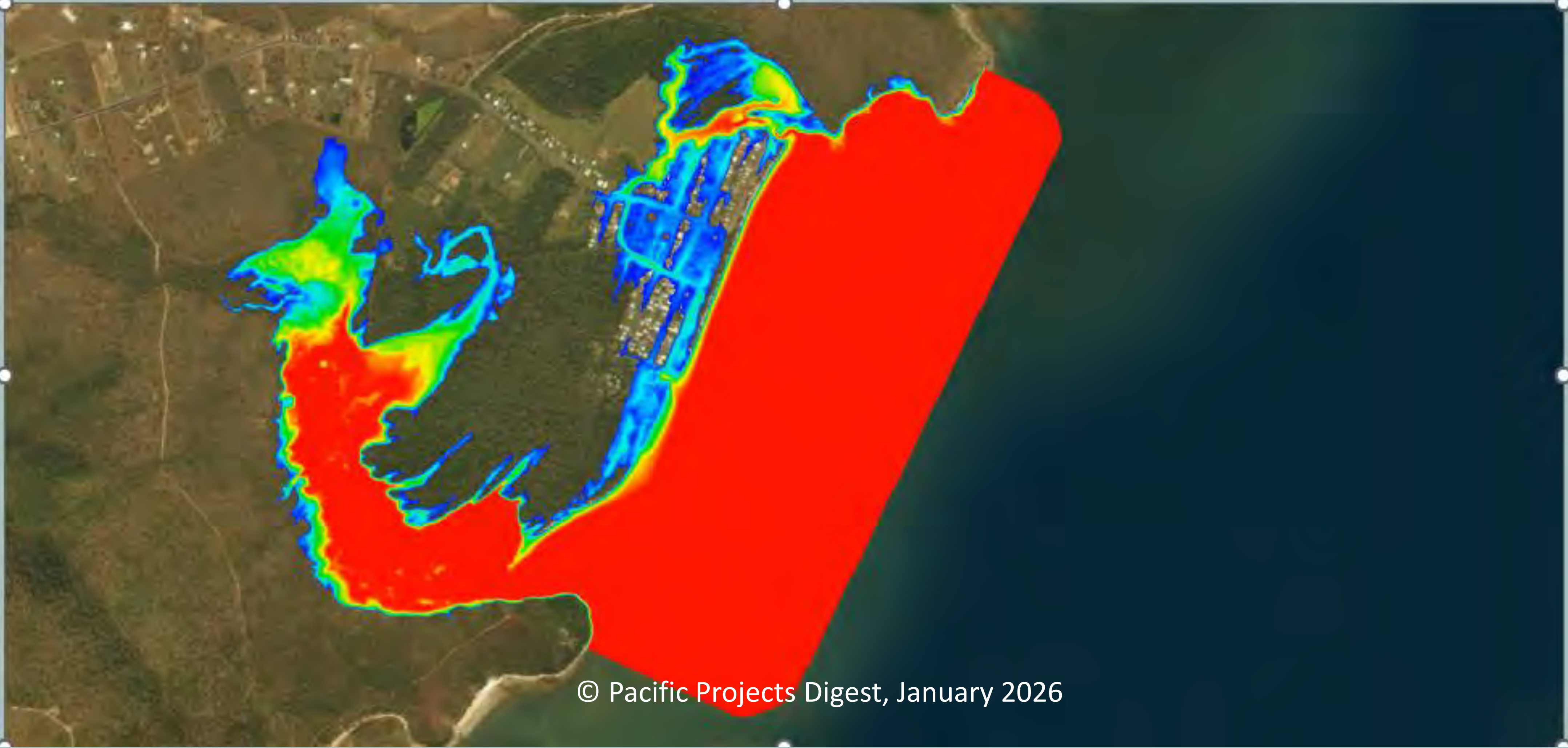
Delft3D



Climate resilient infrastructure

CYCLONE AND STORM SURGE MODELLING (TROPICAL QLD)

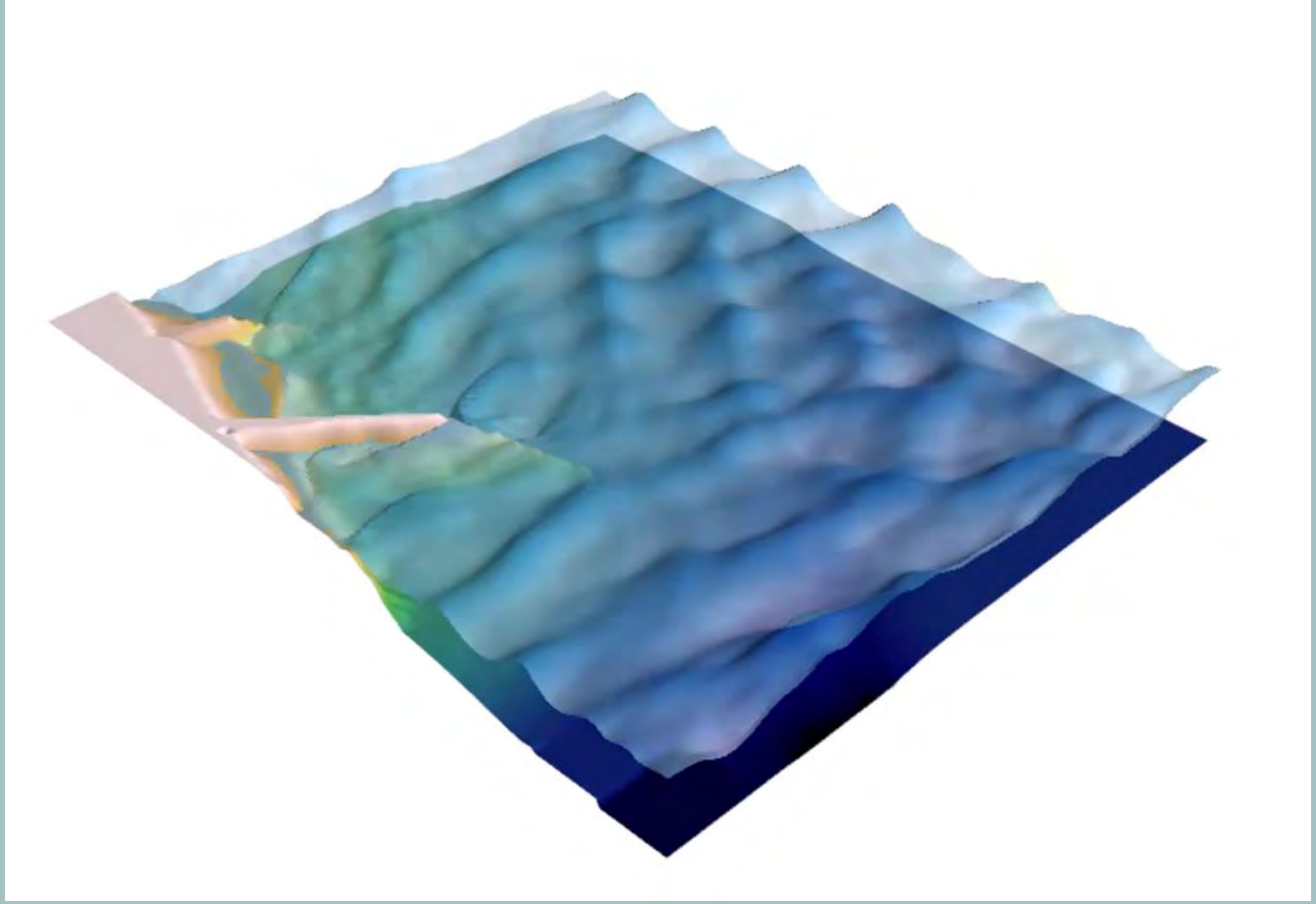
Tuflow

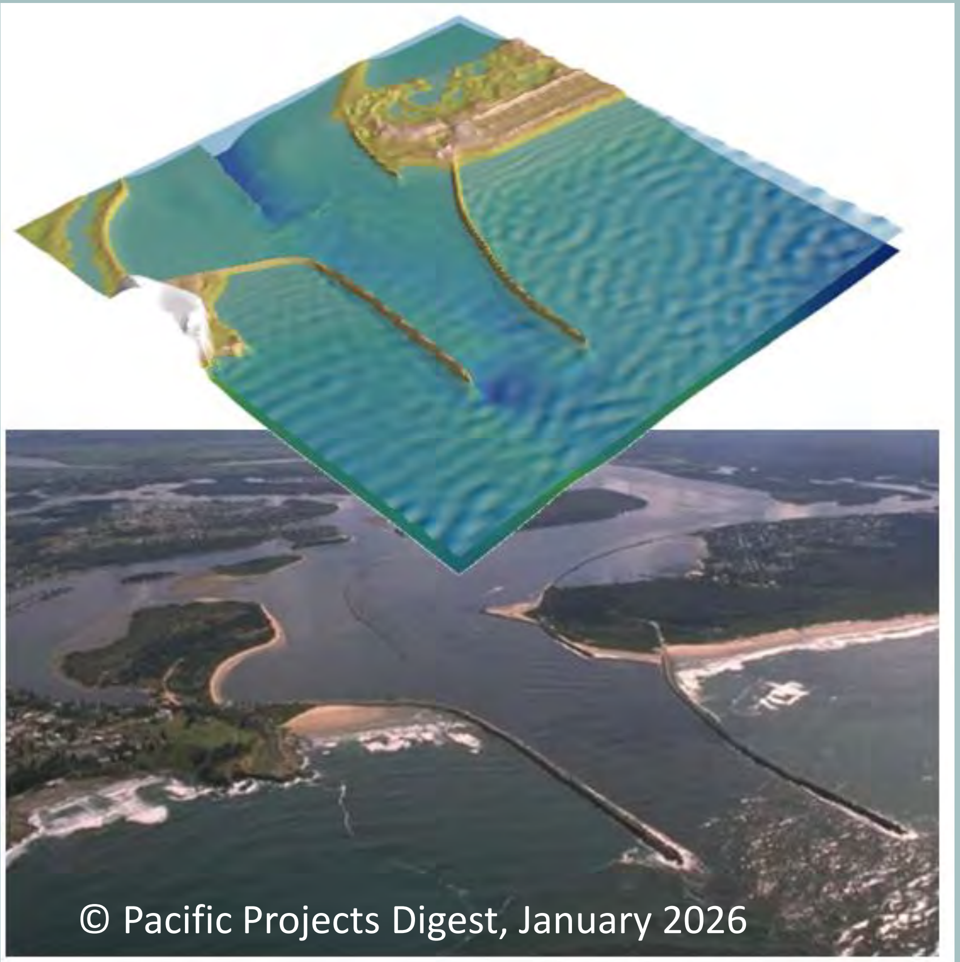


Climate resilient infrastructure

HARBOUR MODELLING
(PHILIPPINES, AUSTRALIA)

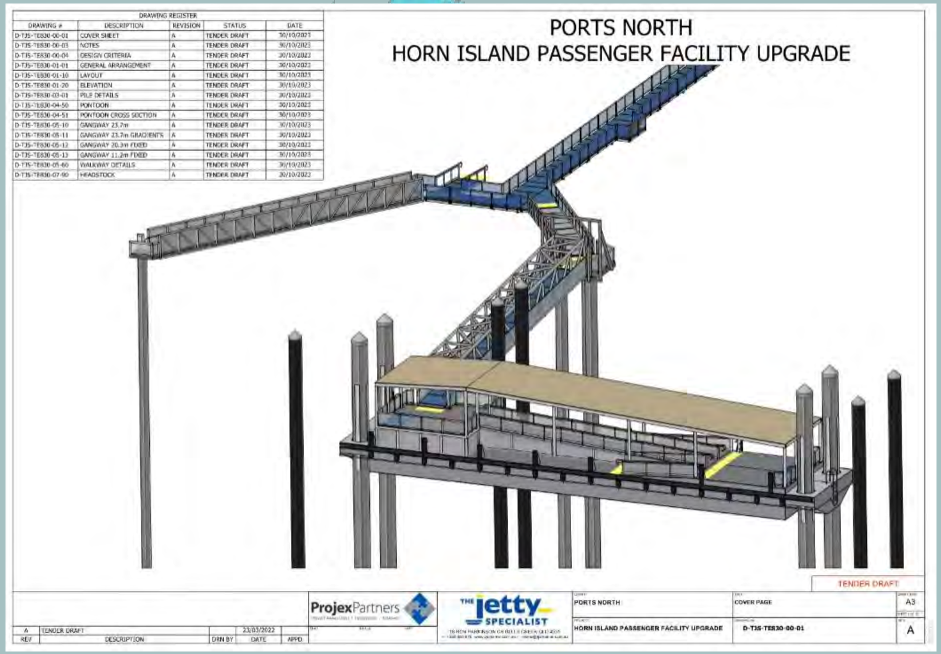
XBeach



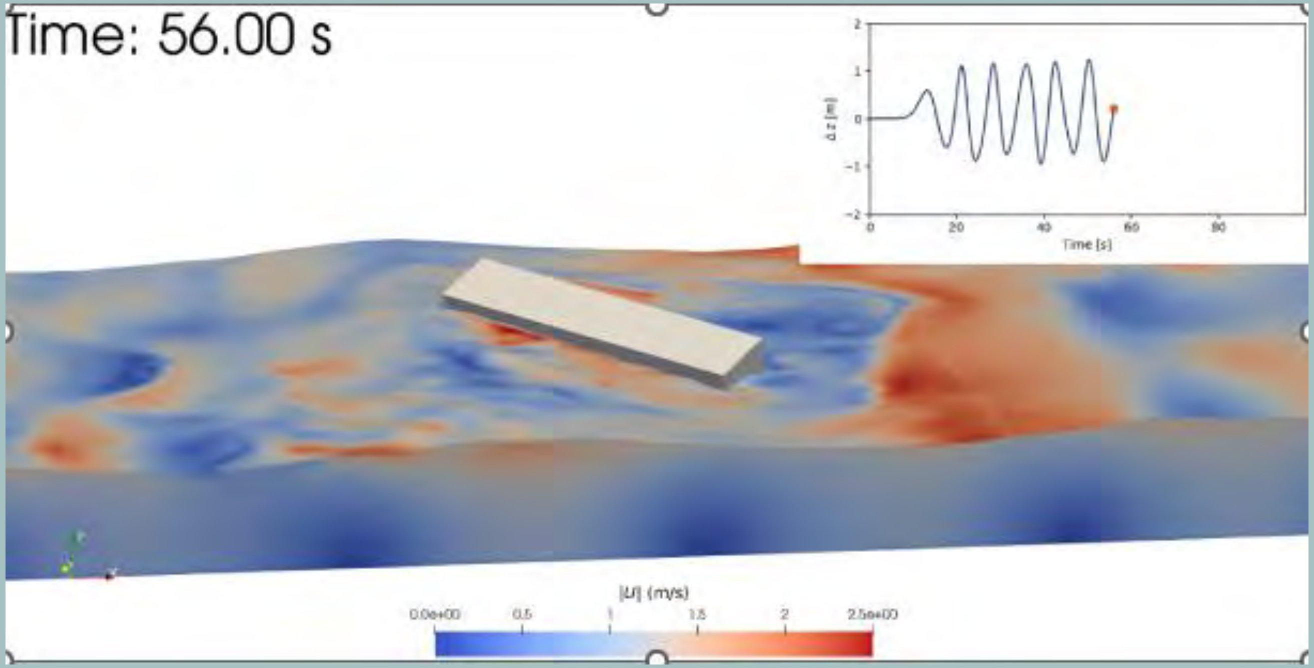


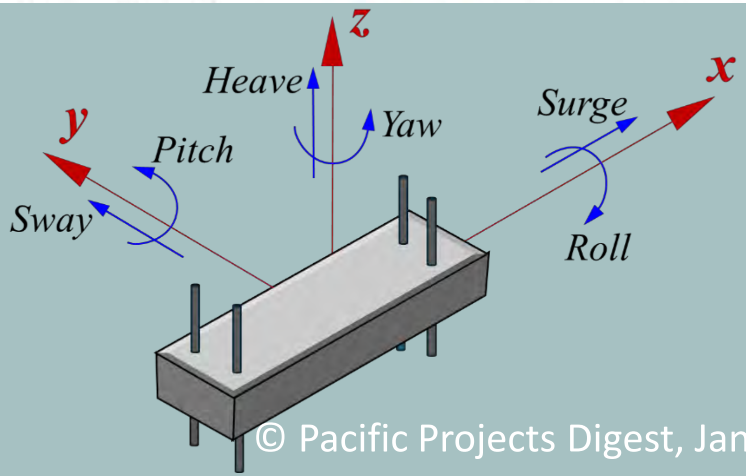
Climate resilient infrastructure

HARBOUR MODELLING
(PHILIPPINES, AUSTRALIA)



FLOW3D,
WAVE3D

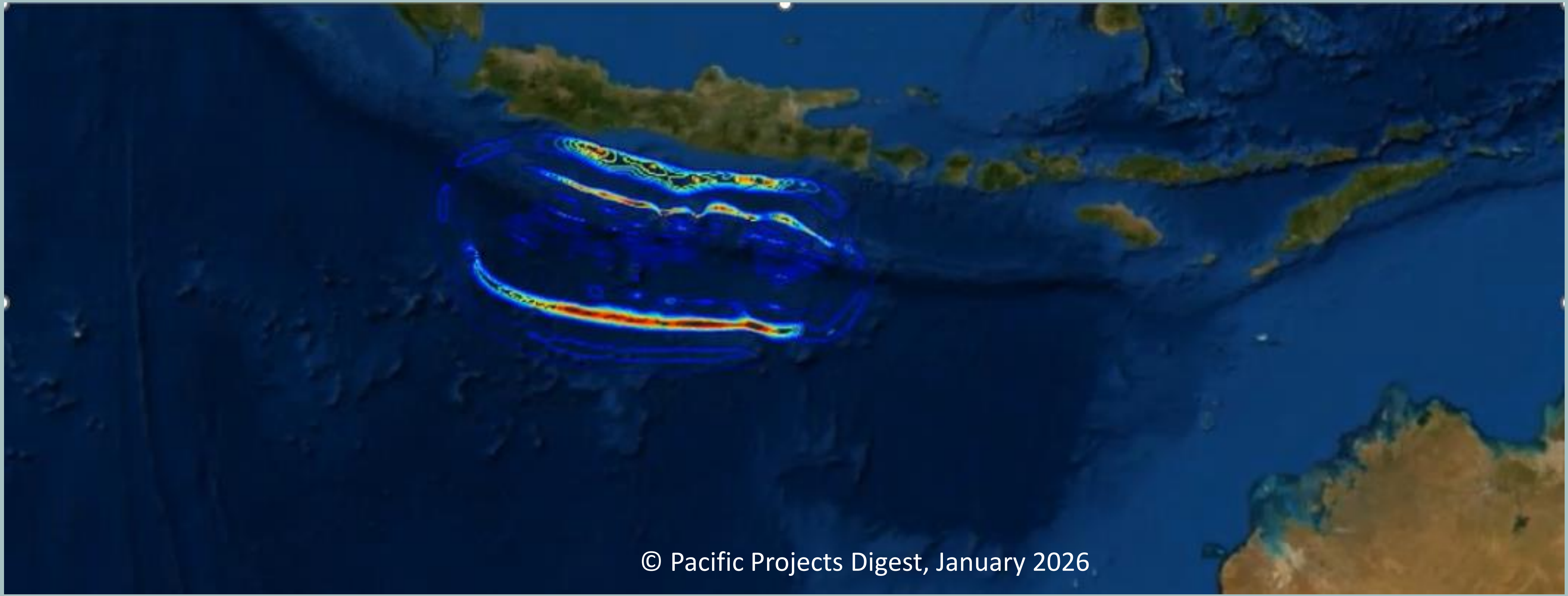




Climate resilient infrastructure

TSUNAMI MODELLING (JAVA)

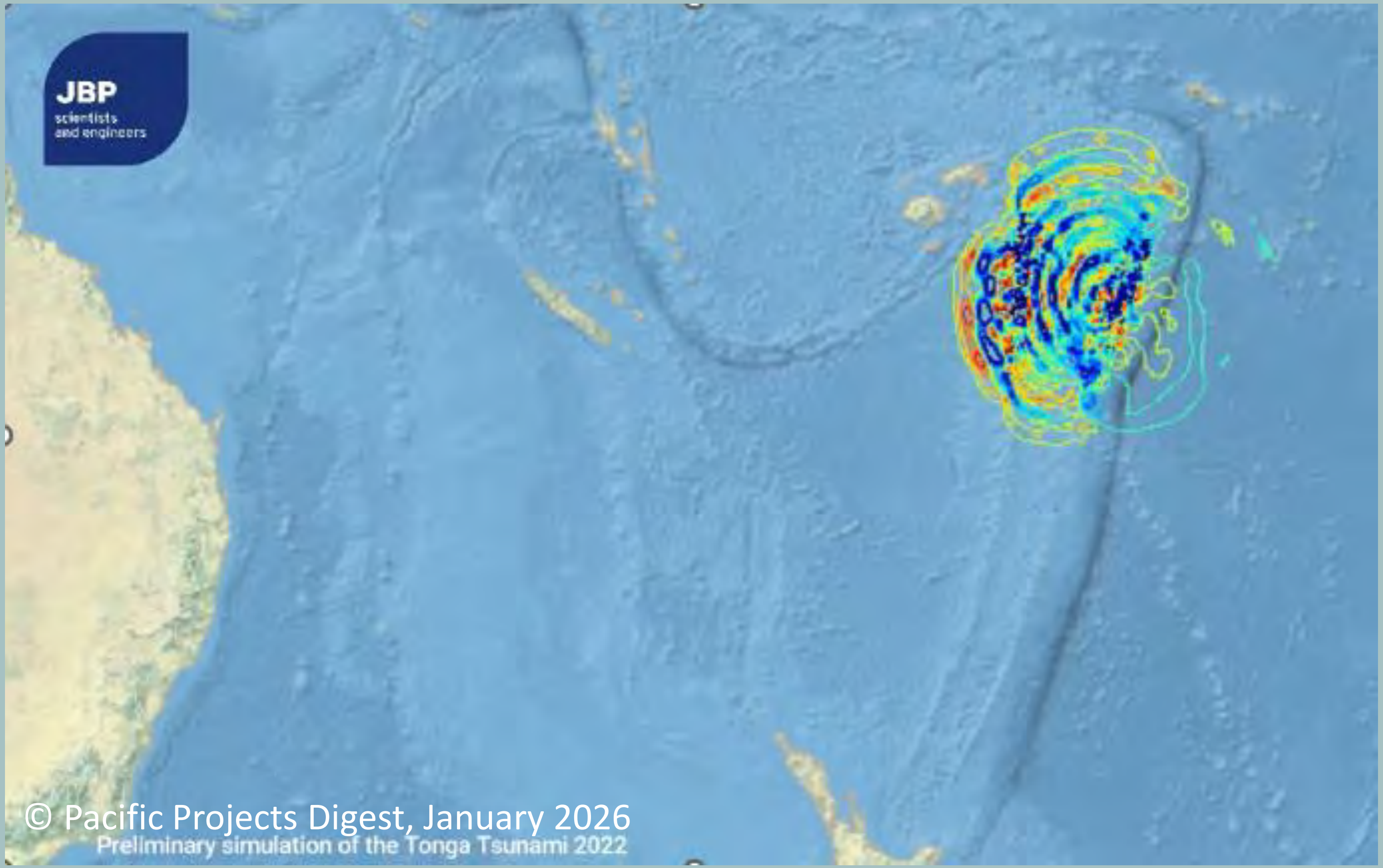
Delft3D



Climate resilient infrastructure

TSUNAMI MODELLING (TONGA)

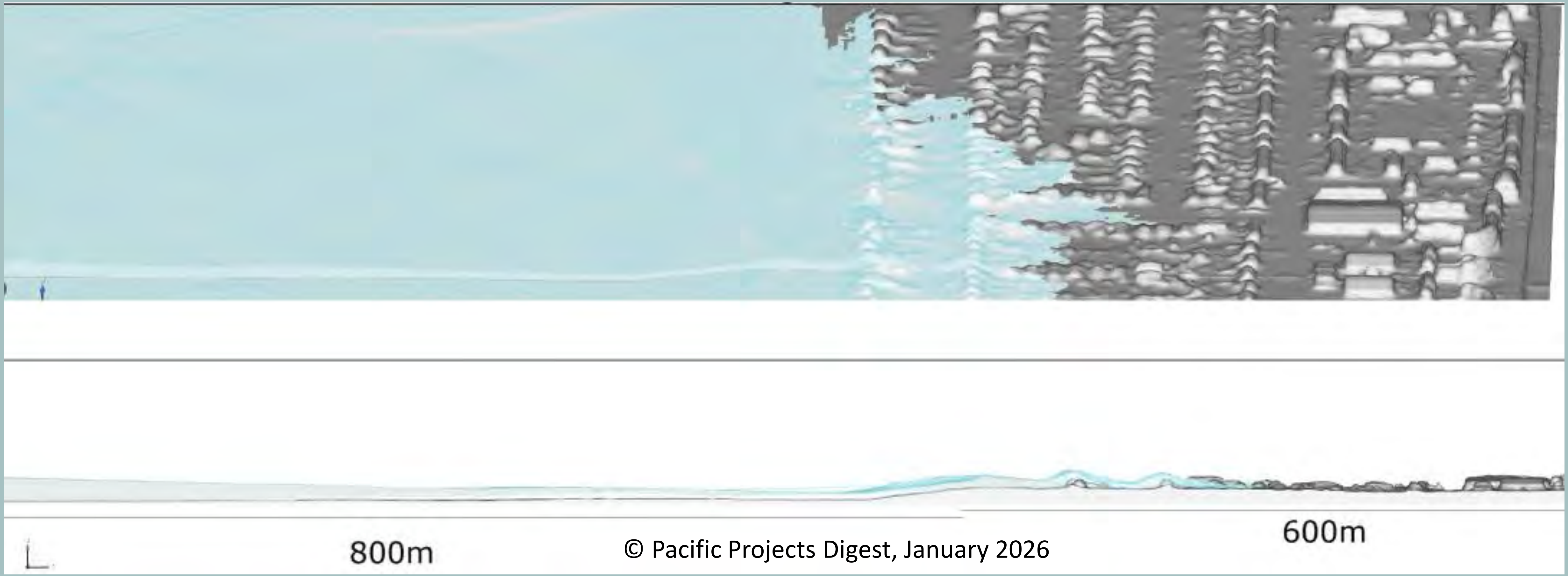
Delft3D



Climate resilient infrastructure

TSUNAMI MODELLING

Flow3D



Climate resilient infrastructure

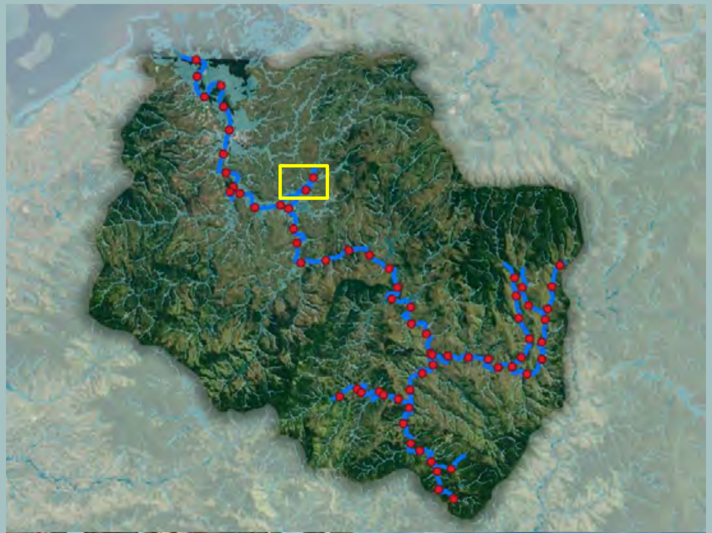
FLOODING

Climate resilient infrastructure

FLOODING

Pacific Island Flood Maps

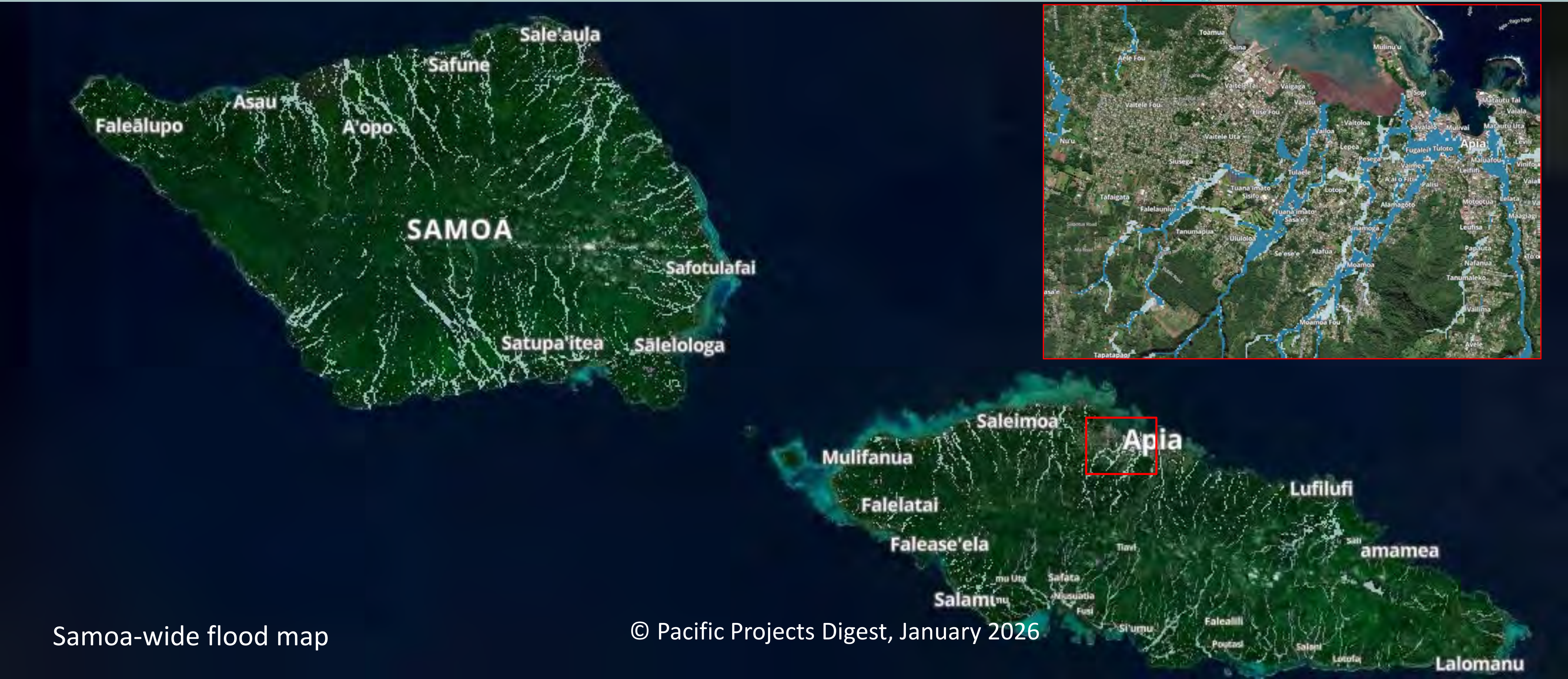
Flood Risk Mapping has been completed flood mapping for every Pacific Island, which includes six return periods (20, 50, 100, 200, 500 and 1,500-year) for both surface water and waterway inundation. Used for flood risk assessments, early warning systems, asset prioritisation and screening of new development sites.



Fiji Flood Maps, showing the Ba Catchment

Climate resilient infrastructure

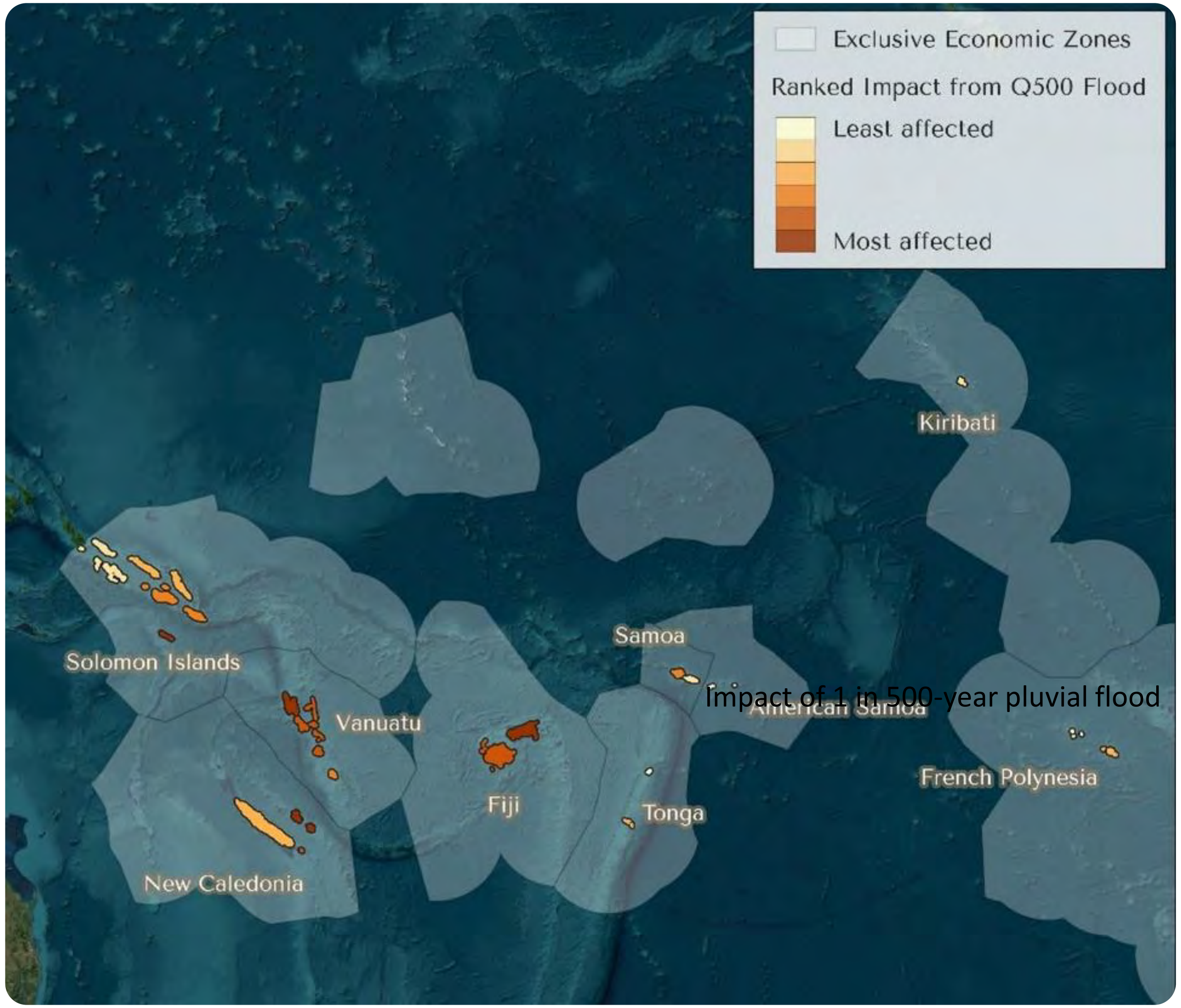
FLOODING



Samoa-wide flood map

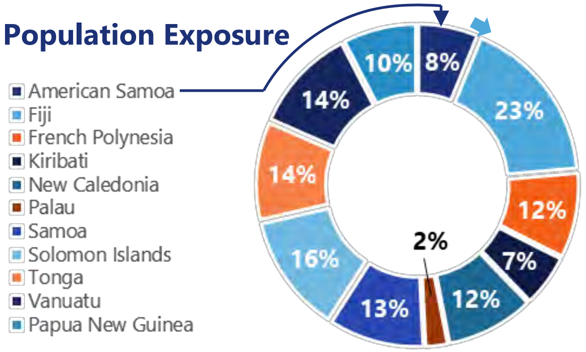
Climate resilient infrastructure

FLOODING



Impact of 1 in 500-year pluvial flood

Population Exposure

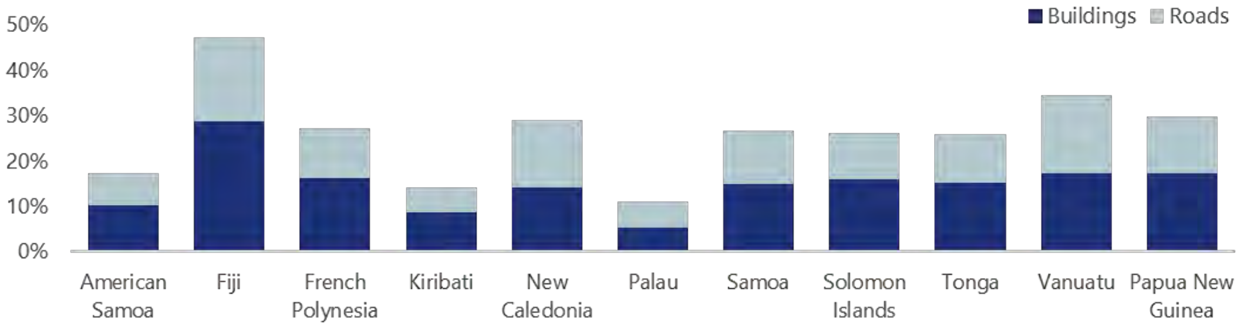


0.46 M people with flood risk

138,000 impacted buildings in 100-year flood

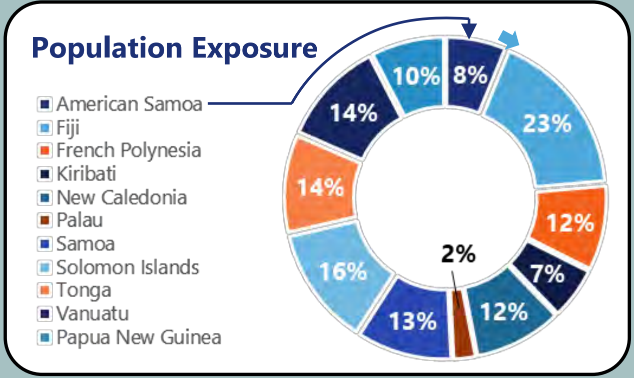
9000 km flood-prone roads

1 in 100-year Flood Exposure Summary



Climate resilient infrastructure

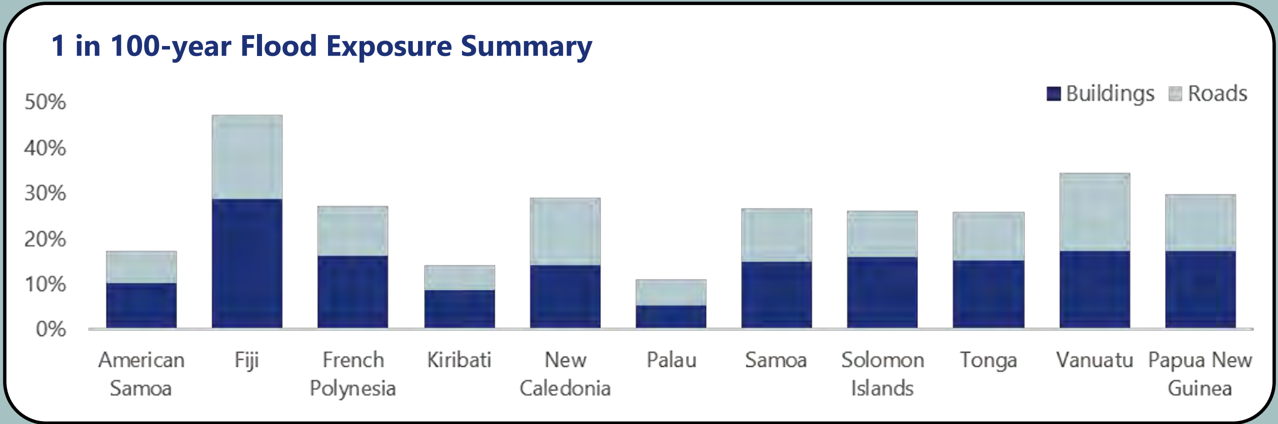
FLOODING



0.46 M
people with flood risk

138,000
impacted buildings in 100-year flood

9000 km
flood-prone roads



CASE STUDIES

- Building designs have always needed to incorporate disaster risks.
- But even so, we see our work adapting.
- Buildings now need to include protection from hazards; future events, sea levels and flood levels.
- The need for multi-hazards (above + wind, earthquake, seismic events) is increasing
- Now a significant shift towards:
  - ‘green’ designs – nature based solutions/adaptation, working with natural processes, etc
  - Water-related economics – business cases for strategic infrastructure plans

JBP
scientists
and engineers

CASE STUDIES

Notable projects currently include:

- PNG - multi-hazard assessment of the Gazelle Power Grid (WBG)
- Savusavu, Fiji, pre-feasibility study for coastal & NbS protection (GiZ)
- Fatumaru Bay Coastal NbS Rural Road Protection Project - Greater Port Vila Urban Resilience Project (ADB)

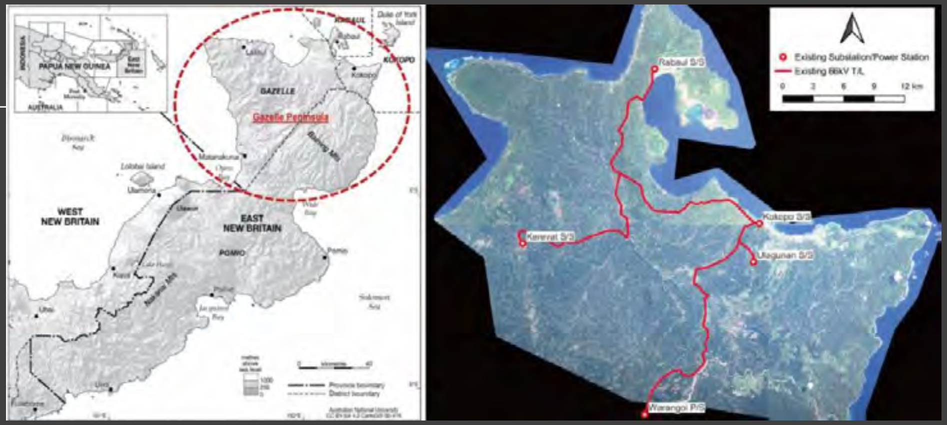
PNG: multi-hazard assessment of the Gazelle Power Grid (WBG)

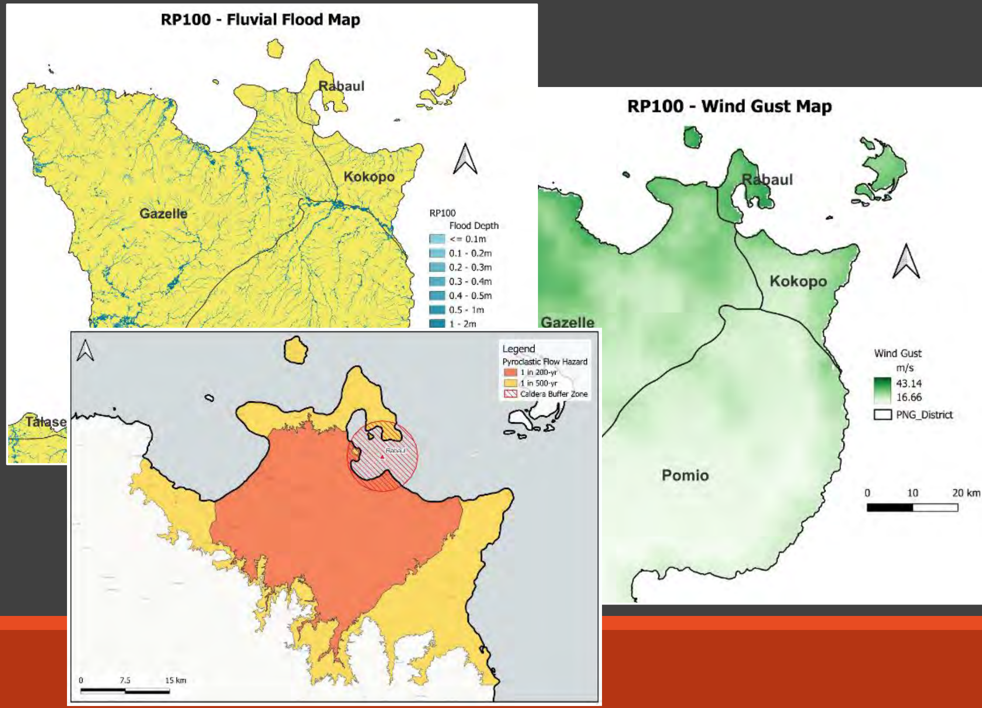
PNG: multi-hazard assessment of the Gazelle Power Grid (WBG)

Located on New Britain Island, the Gazelle power system includes Warangoi Hydropower Station and Ulagunan and Kereval Thermal Power Stations, is particularly susceptible to extreme weather events. This project develops a climate resilient energy plan for the network.

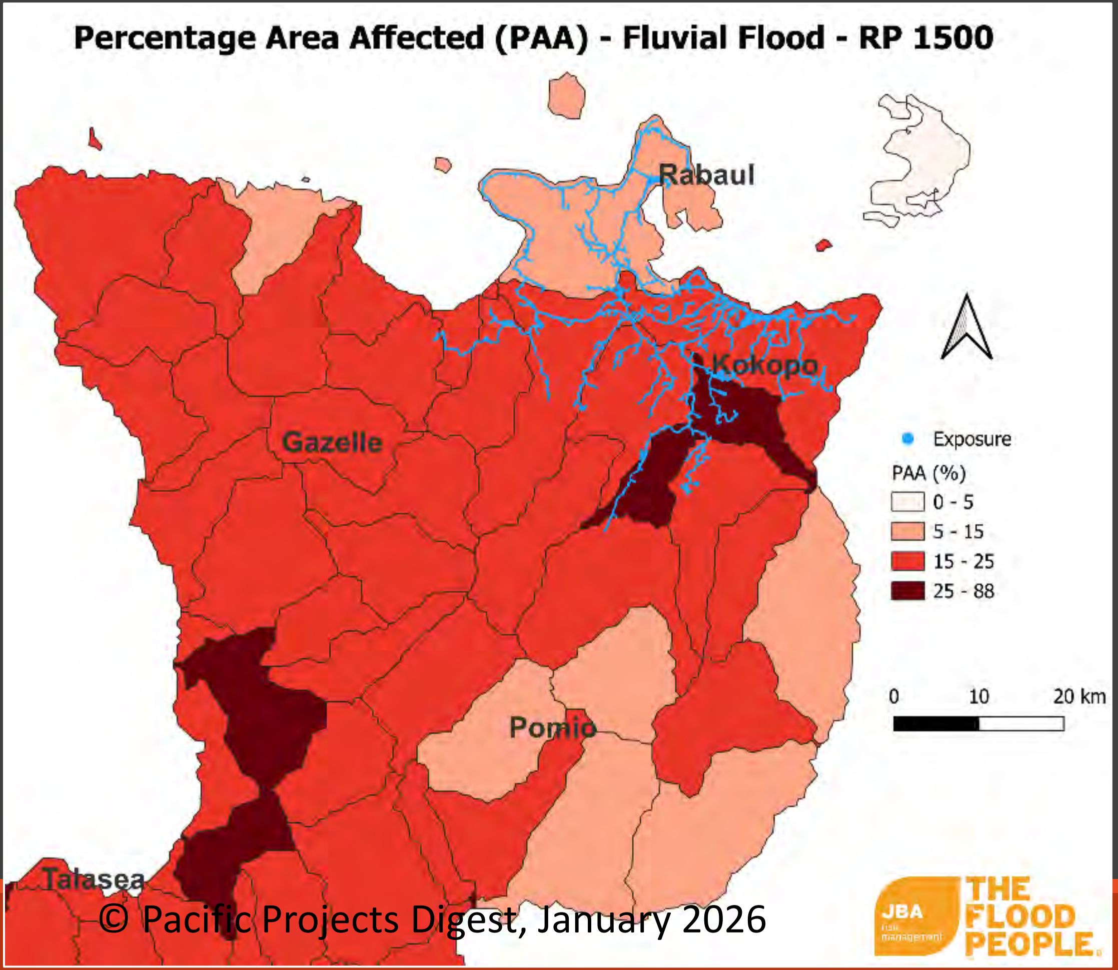
Seven new weather/climate hazard assessments completed with risk analysis to assess the potential impact on energy infrastructure.

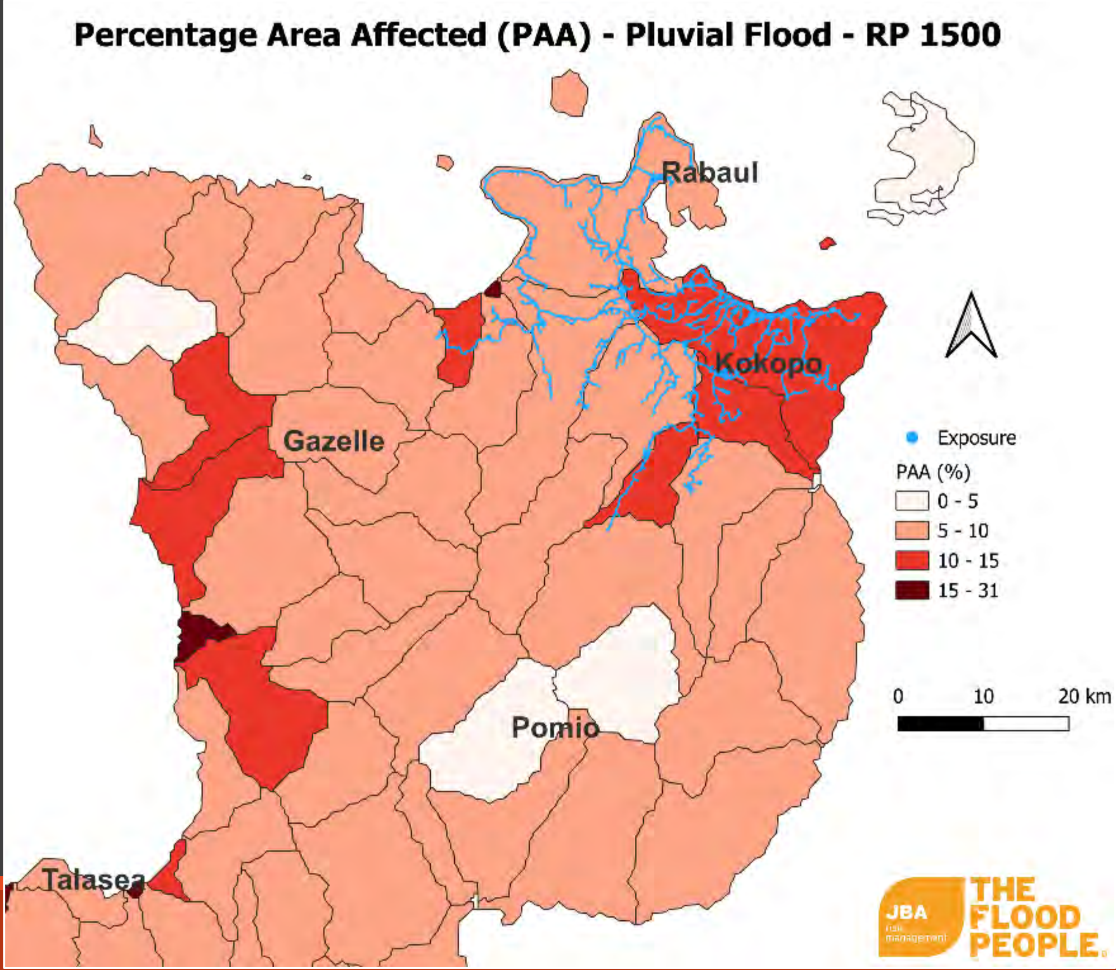
- *Fluvial flooding – which includes flooding from rivers*
- *Pluvial flooding – which includes flooding from high-intensity rainfall*
- *Coastal flooding – which incudes tides and storm surges*
- *Wind – which includes non-cyclonic and cyclonic conditions*
- *Earthquake – which considers ground movement*
- *Volcanos – which includes ashfall and pyroclastic flows*





PNG: multi-hazard assessment of the Gazelle Power Grid (WBG)





Fiji: Coastal protection economic analysis in Savusavu (GiZ)

Savusavu (Vanua Levu) has a population of around 5,000 people, but a hotspot for regional businesses, markets, agriculture, and tourism (2% of Fiji's total tourism value), with new marinas and services under construction.

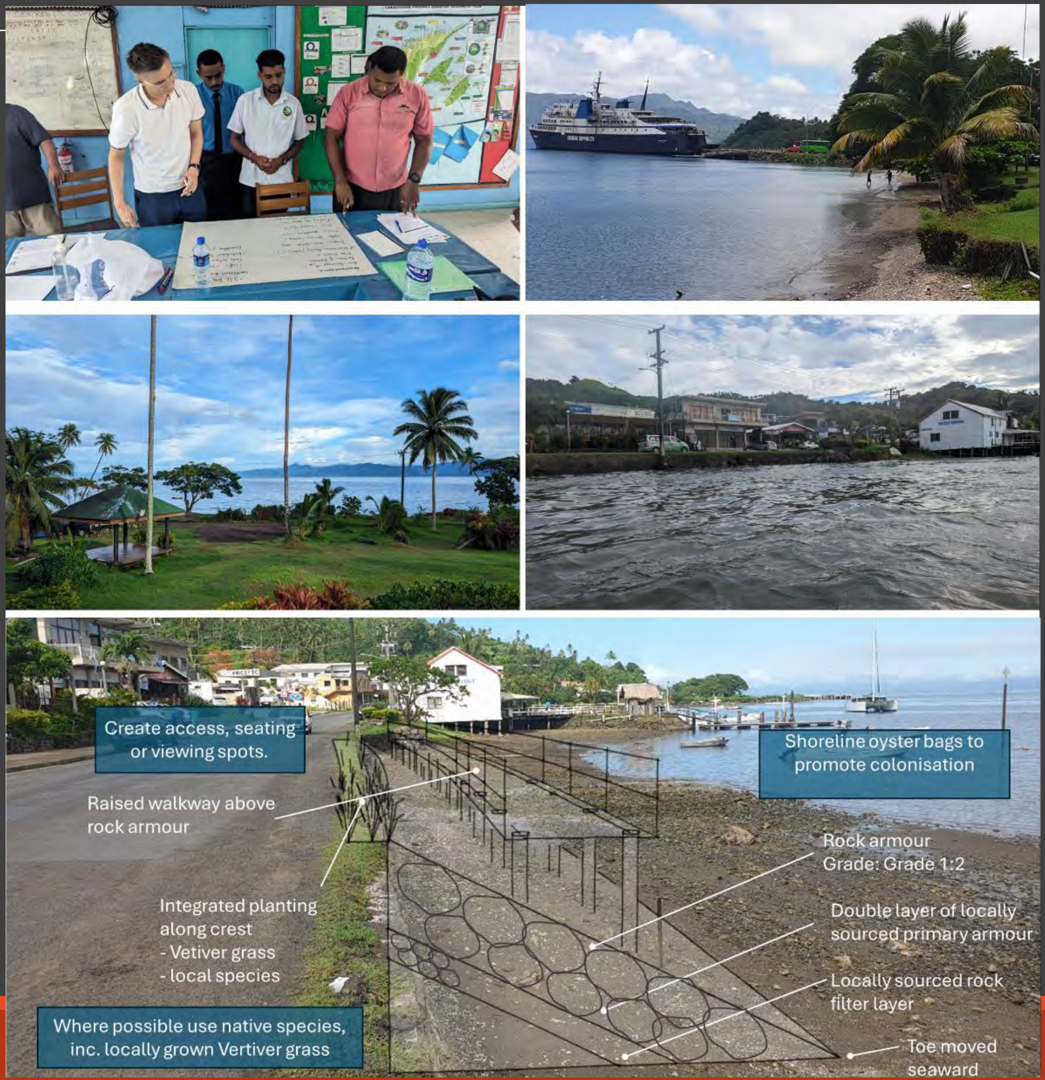
This feasibility assessment considered socio-economic benefits of new coastal protection, with an emphasis on Nature-Based Solutions.

Outputs :

NbS Concept Designs

Hazard maps (coastal inundation, flooding)

Economic business case



Multi-hazard review:

- Erosion
- Coastal inundation
- Flood Inundation

Economic framework

'Economic and Fiscal Impacts of Disasters in the Pacific' (ADB 2018)

Stakeholder values and risk mapping workshops

Direct Damages: Immediate effects on people and assets

- **Repairs to existing coastal protection** (1277m of various coastal protection structures)
- **Road repairs**: 956m of road positioned within 10m of shoreline
- **Damage to services**: Electricity lines positioned between the road and shoreline, often overhanging into the coastal area

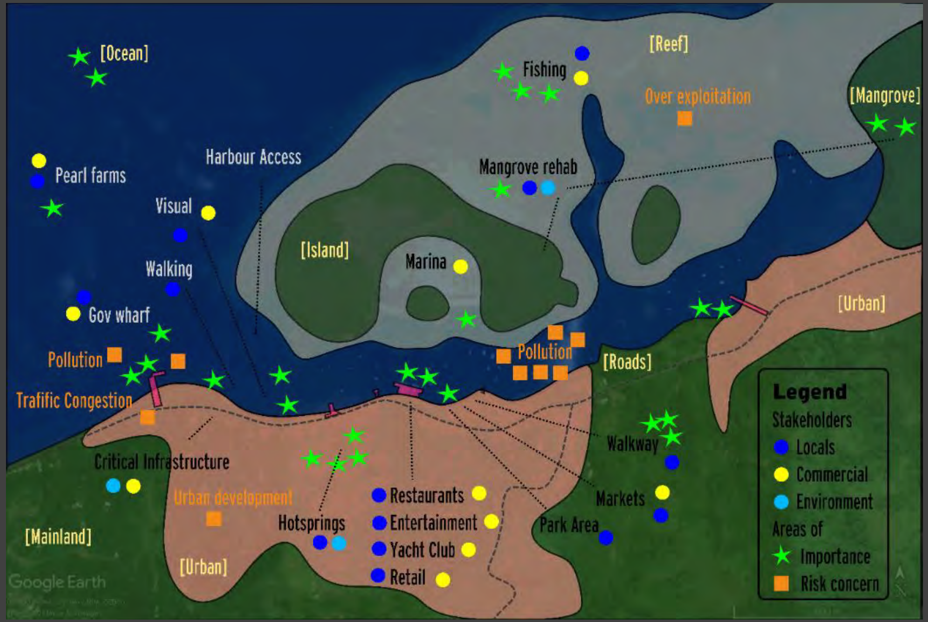
Type	Costs (USD)
Full seawall construction costs	\$6,780 /m
Nominal wall repair costs. **After large cyclone: 10%** **After minor cyclone: 5%**	Based on seawall construction costs • large cyclone: 10% • minor cyclone: 5%
Road repairs	\$150 /m
Services repairs: powerlines	\$60 /m

The PRIF (2017) Guidance for coastal protection works in Pacific Island countries. (Comparable costs for Natewa West Coast Road, Vanua Levu)
PRIF (2020) Condition Assessment of Public Sector Infrastructure Assets
Fiji Ministry of Tourism and Civil Aviation (2023) International Visitor Survey, Fiji

Indirect damages

Impacts causing secondary or prolonged hardship for communities in months and years following a disaster. Includes halted or slowed economic activity in sectors directly affected by damages, as well as broader disruptions to economic flows.

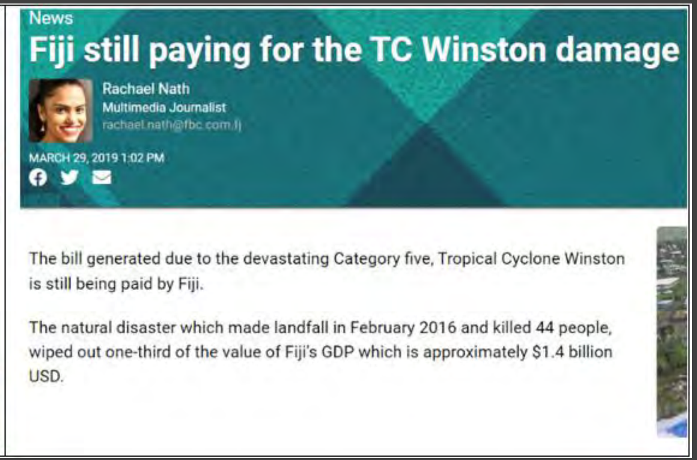
- **Tourism loss** (average USD $1,572 spend per person per year)
- **Reduced visitors estimated based on:**
  - Media coverage
  - Physical gaps in road network



Additional benefits

Mangrove impact on fisheries and biodiversity

Cyclone damage in Fiji estimated to cost $US2.8m


News

Fiji still paying for the TC Winston damage

Rachael Nath
Multimedia Journalist
rachael.nath@fbc.com.fj

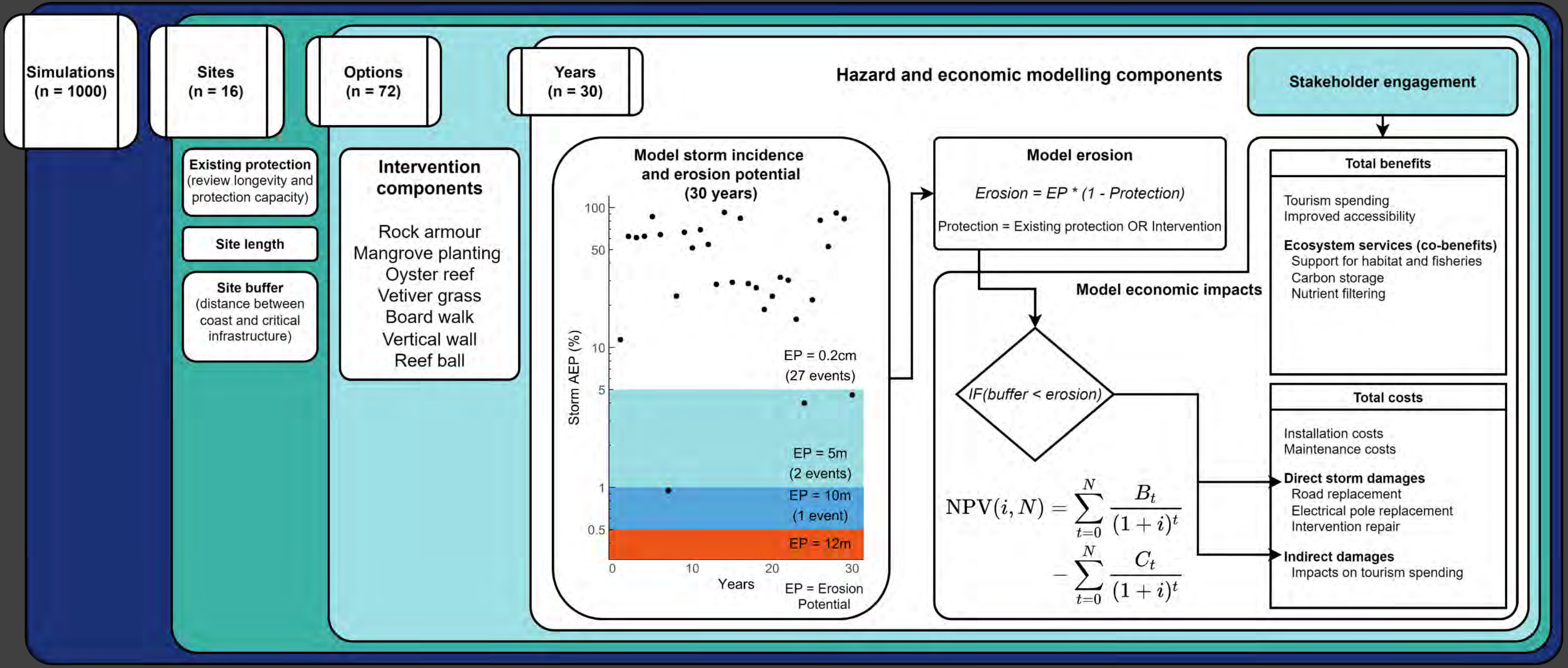
MARCH 29, 2019 1:02 PM

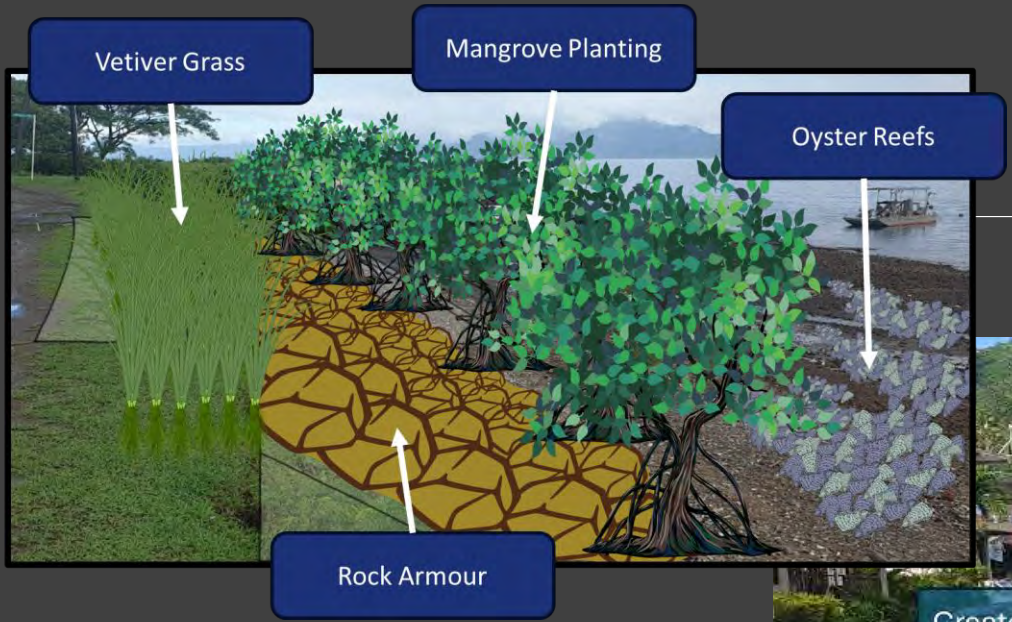
The bill generated due to the devastating Category five, Tropical Cyclone Winston is still being paid by Fiji.

The natural disaster which made landfall in February 2016 and killed 44 people, wiped out one-third of the value of Fiji's GDP which is approximately $1.4 billion USD.

Researched but not considered:

Health benefits due to improved footpaths and coastal walk


Simulations (n = 1000)
Sites (n = 16)
Options (n = 72)
Years (n = 30)
Hazard and economic modelling components
Stakeholder engagement
Existing protection (review longevity and protection capacity)
Site length
Site buffer (distance between coast and critical infrastructure)
Intervention components
Rock armour
Mangrove planting
Oyster reef
Vetiver grass
Board walk
Vertical wall
Reef ball
Model storm incidence and erosion potential (30 years)
Storm AEP (%)
Years
EP = 0.2cm (27 events)
EP = 5m (2 events)
EP = 10m (1 event)
EP = 12m
EP = Erosion Potential
Model erosion
Erosion = EP * (1 - Protection)
Protection = Existing protection OR Intervention
Model economic impacts
IF(buffer < erosion)
$\mathrm{NPV}(i,N) = \sum_{t=0}^{N} \frac{B_t}{(1+i)^t} - \sum_{t=0}^{N} \frac{C_t}{(1+i)^t}$
Total benefits
Tourism spending
Improved accessibility
Ecosystem services (co-benefits)
Support for habitat and fisheries
Carbon storage
Nutrient filtering
Total costs
Installation costs
Maintenance costs
Direct storm damages
Road replacement
Electrical pole replacement
Intervention repair
Indirect damages
Impacts on tourism spending



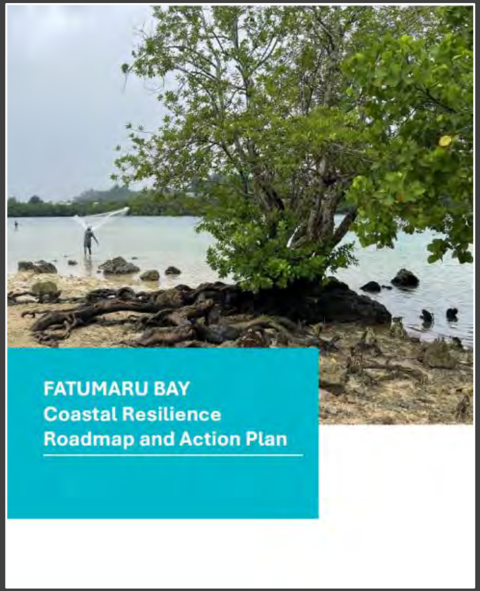
Early concepts

Advanced concept along road pinchpoint

Nature-based solutions in Vanuatu (ADB)

Nature-based solutions in Vanuatu (ADB)

Phase 1: Strategic plan for coastal resilience work and NBS to protect rural roads and community infrastructure.



Nature-based solutions in Vanuatu (ADB)

Phase 2: Fatumaru Bay Coastal NbS Protection Project pushes the limits of coastal NBS as an alternative to traditional rock armour.

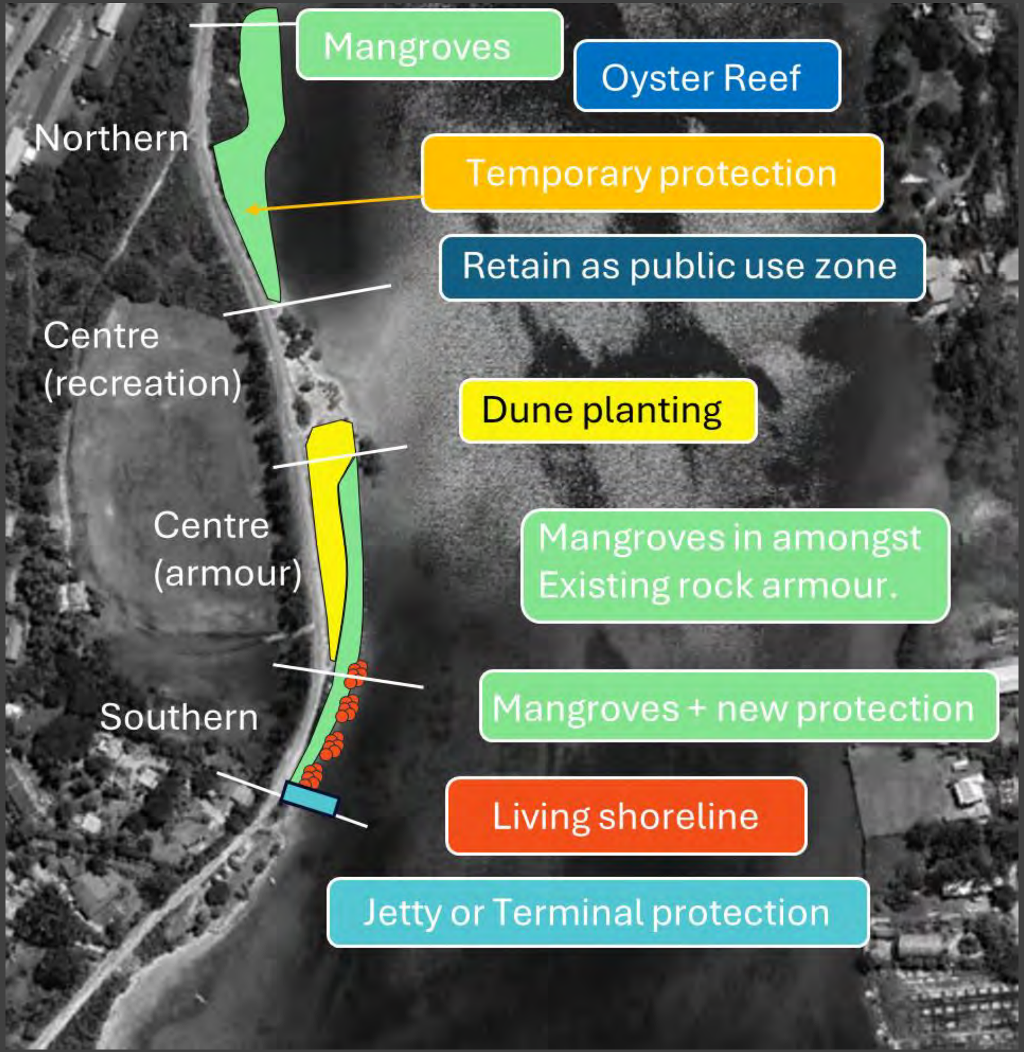
Outputs available:

For Tender Package

Concept and Detailed Designs

Technical Specifications

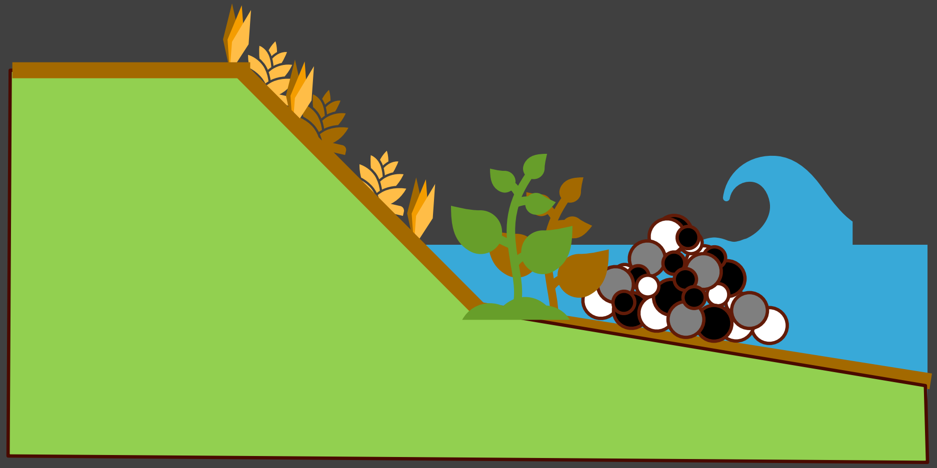
2 years of detailed M&E data



Nature-based solutions in Vanuatu (ADB)

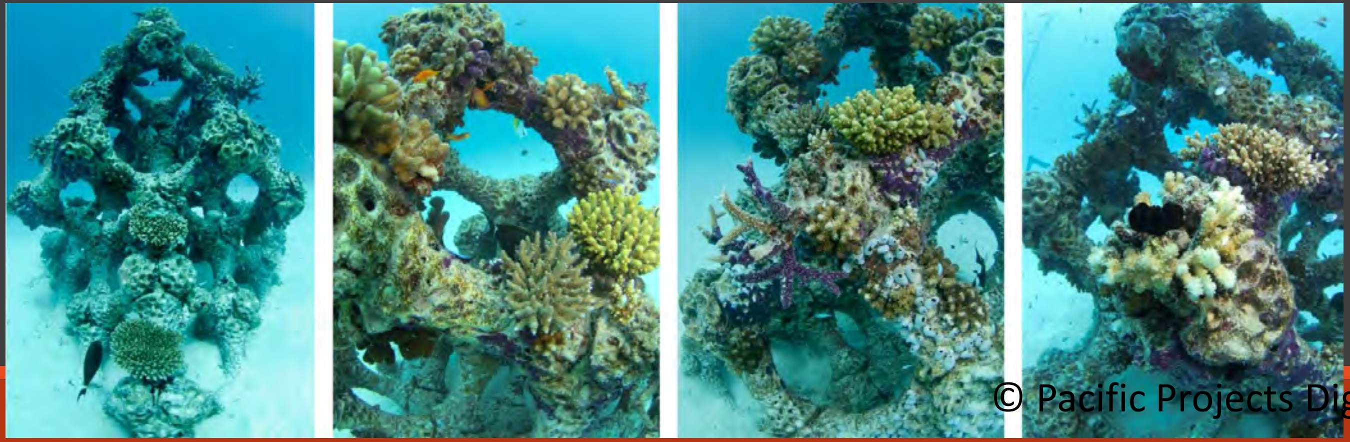
Change in the way we do coastal protection

- Earlier intervention
- Cheaper investment
- Building resilience to avoid and delay large scale works



Nature-based solutions in Vanuatu (ADB)

Nearshore: Coastal reefs for wave protection



SUCON & JB PACIFIC APPROACH

- Integrated Pacific partnership combining technical expertise and local delivery experience
- Climate-resilient, buildable solutions grounded in local context and community consultation
- Early integration of engineering, safeguards, and funding requirements
- Clear division of roles with shared quality assurance and risk management
- Focus on practical, fundable projects that serve education, disaster response, and community needs

JBP
scientists
and engineers

CASE STUDY ONE – AMERICAN SAMOA

- Client – Department of Marine and Wildlife
- Design of Boat Shelter Facilities, Security Boundary and Strengthening and reinforcing Dock and Coastal Protection
- Site sits between the highlands and the sea.
- Face potential risks of downpour and high tides
- Joint efforts on conducting flood modelling with JBP

American Samoa Site Location

JBP
scientists
and engineers

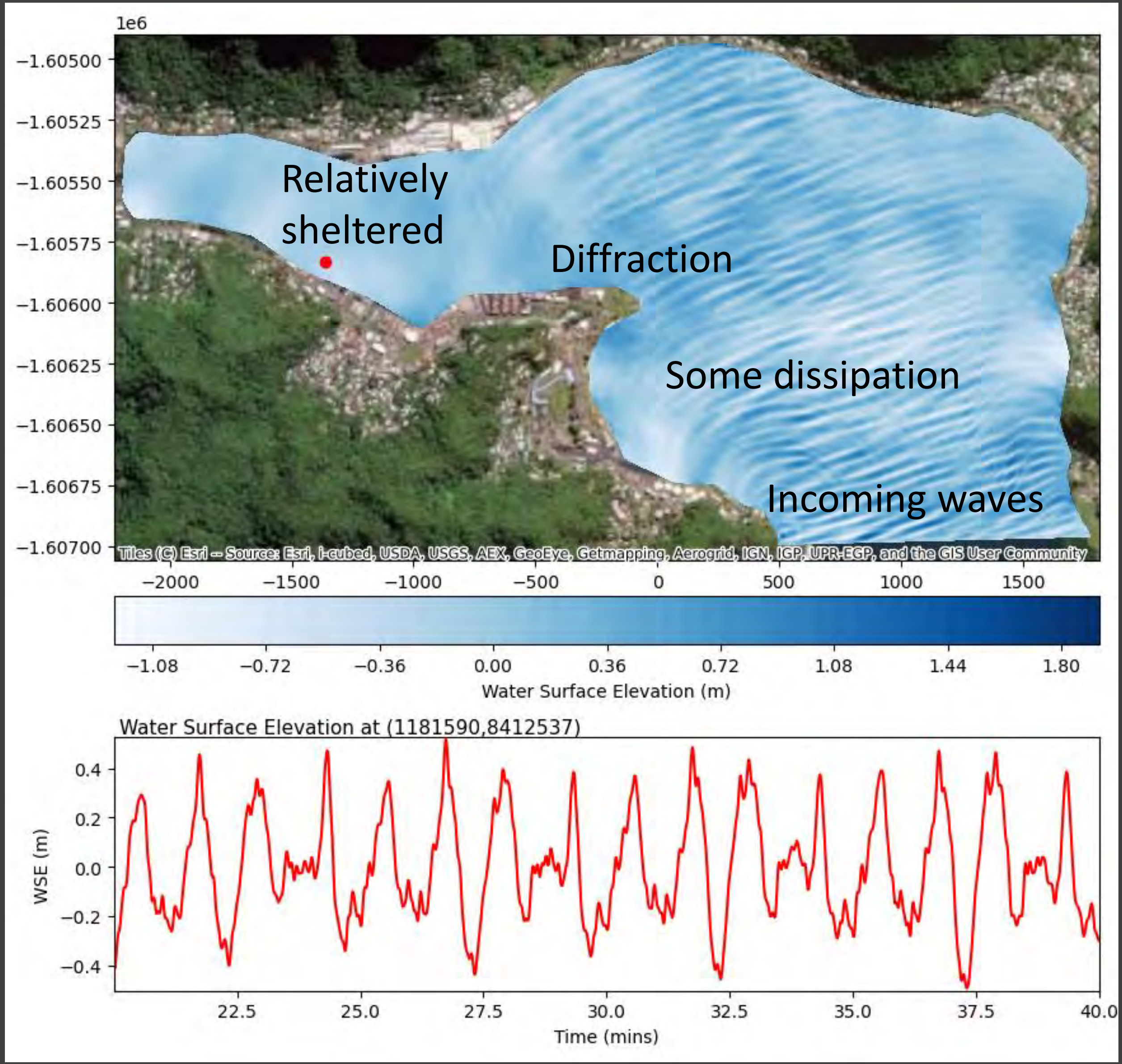
Climate resilient infrastructure

Hazard-related questions for Dan:

- What extreme weather and climate hazards should be included in the design process

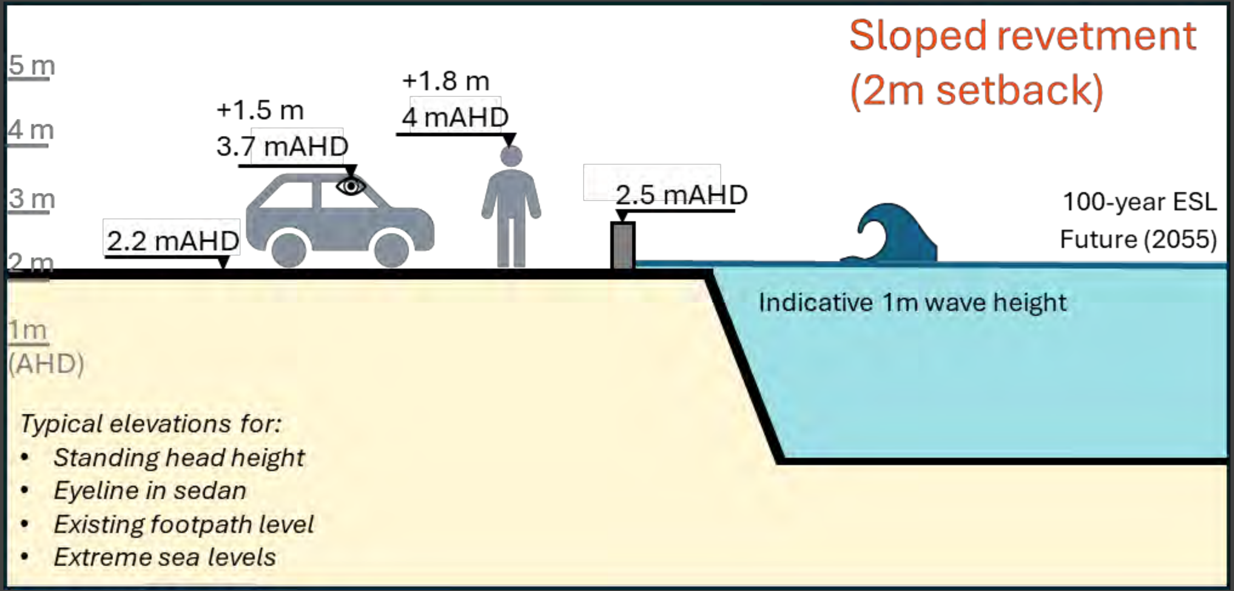
- What are other *additionality* considerations? What else could be addressed through the building to have a net positive outcome for the region?

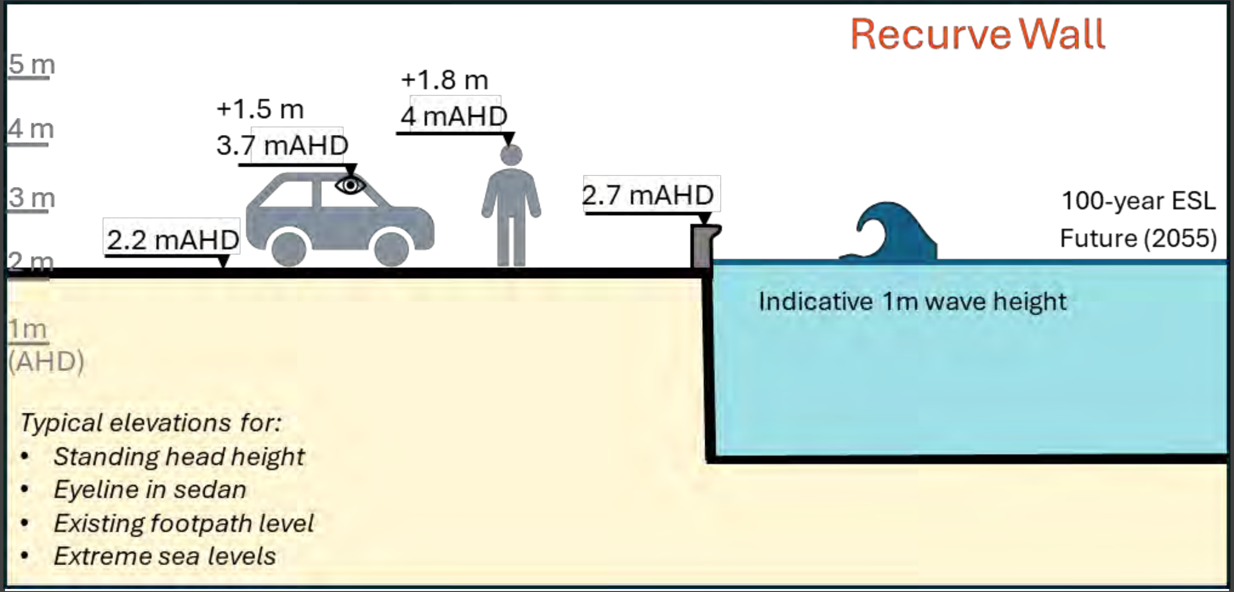
Coastal Hazards



Coastal Hazards

Building floor levels
OR
Coastal frontage upgrades

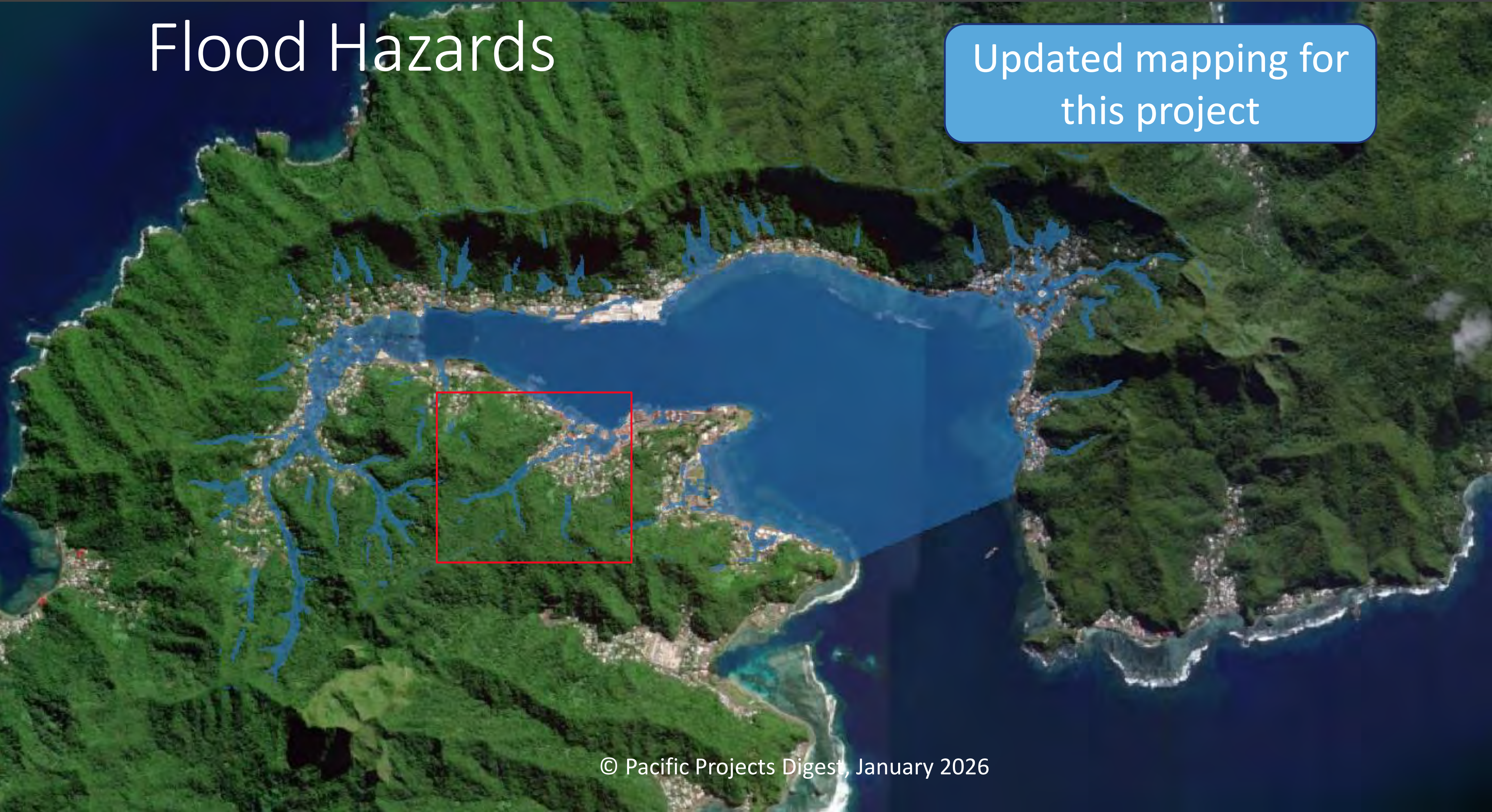




Flood Hazards

National-scale maps

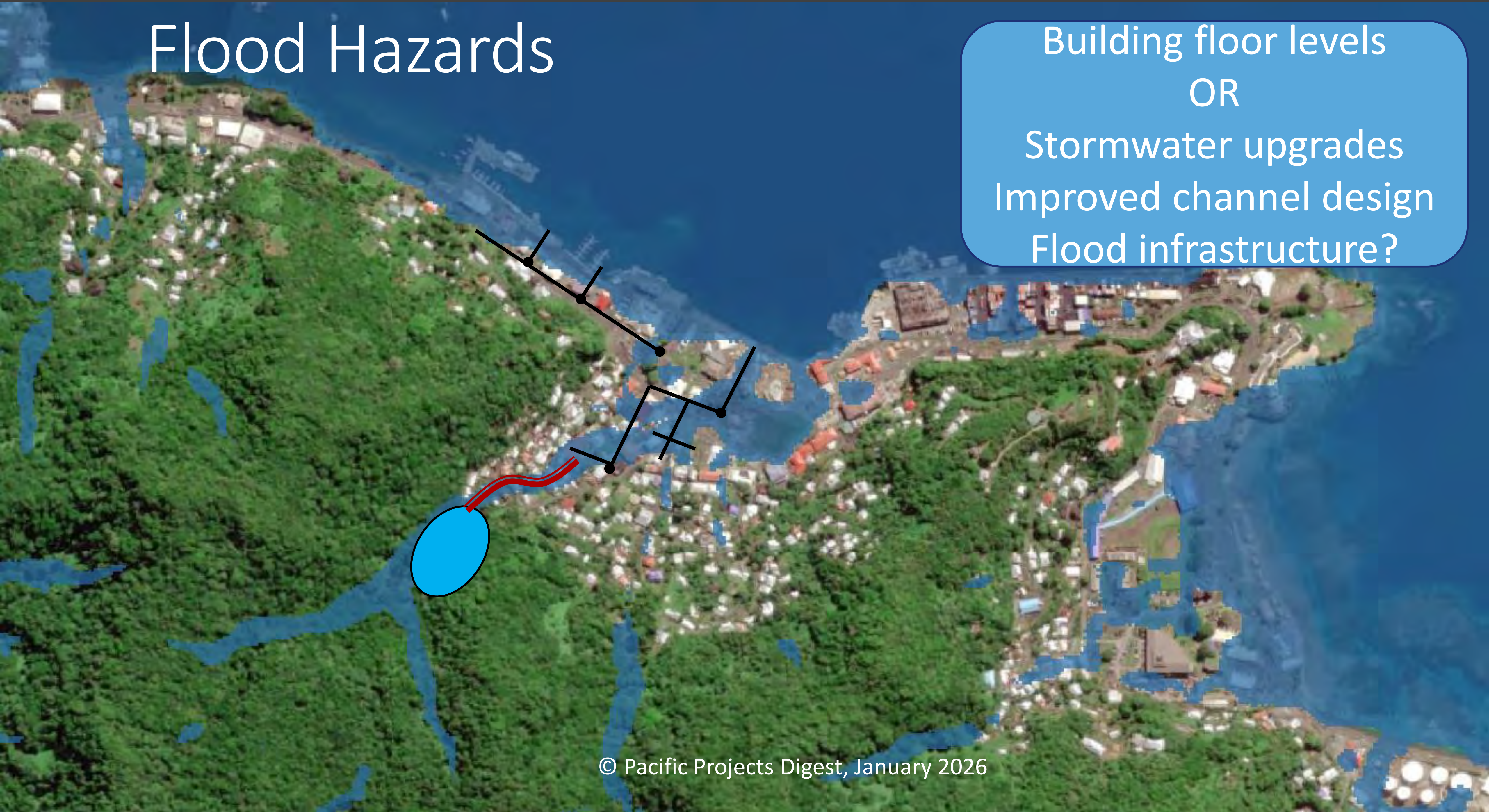
Flood Hazards



Flood Hazards

Updated mapping for this project

Flood Hazards



Climate resilient approach

Hazards can be integrated within building design:

- Increased floor / freeboard for coastal inundation, wave overtopping, high hazard floodways and CC/SLR

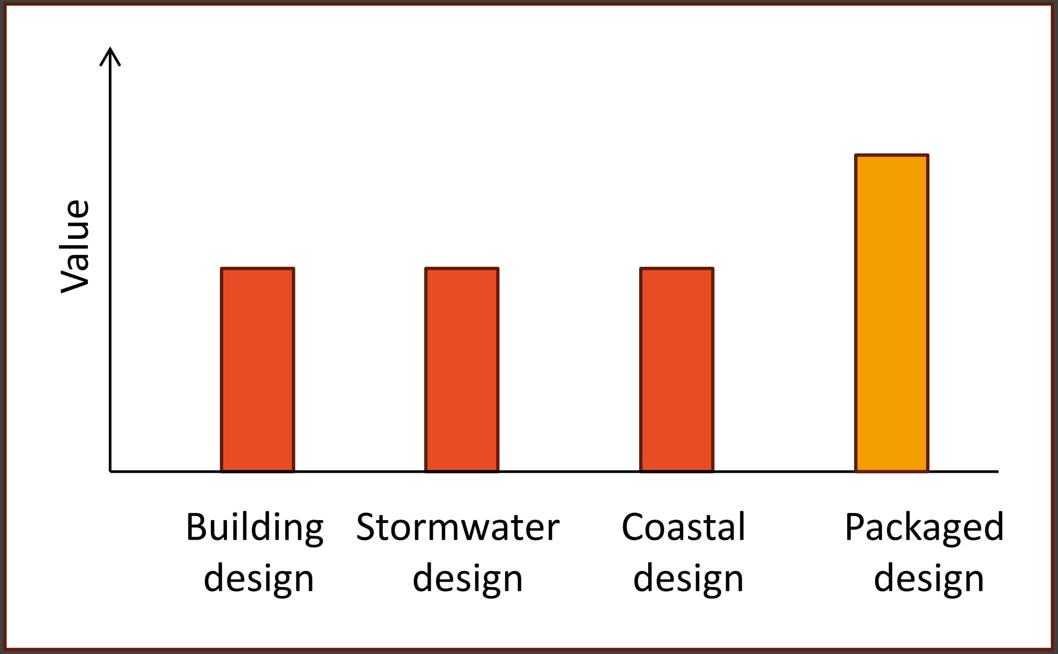
Climate resilient approach

Hazards can be integrated within building design:

- Increased floor / freeboard for coastal inundation, wave overtopping, high hazard floodways and CC/SLR

Going further: Additionality refers to the extra benefit generated by an action compared with what would have happened anyway, while requiring little or only marginally higher costs.

Could this work be used to set a wider stormwater strategy, can design scope be expanded to include coastal frontage upgrades?



CASE STUDY TWO: PALAU VS. SAMOA

- Palau Client – SPREP & Ministry of Education
- Samoa Client – JICA & Ministry of Education
- Palau Site - Melekeok Primary School
- Samoa Site – Aleipata Primary School
- Both within 100 meters from the ocean
- Both have consistent history of flooding
- Both facilities are run-down.
- Both Schools have opted for relocation in-land to higher ground.

Melekeok & Aleipata Site Locations

Climate resilient infrastructure

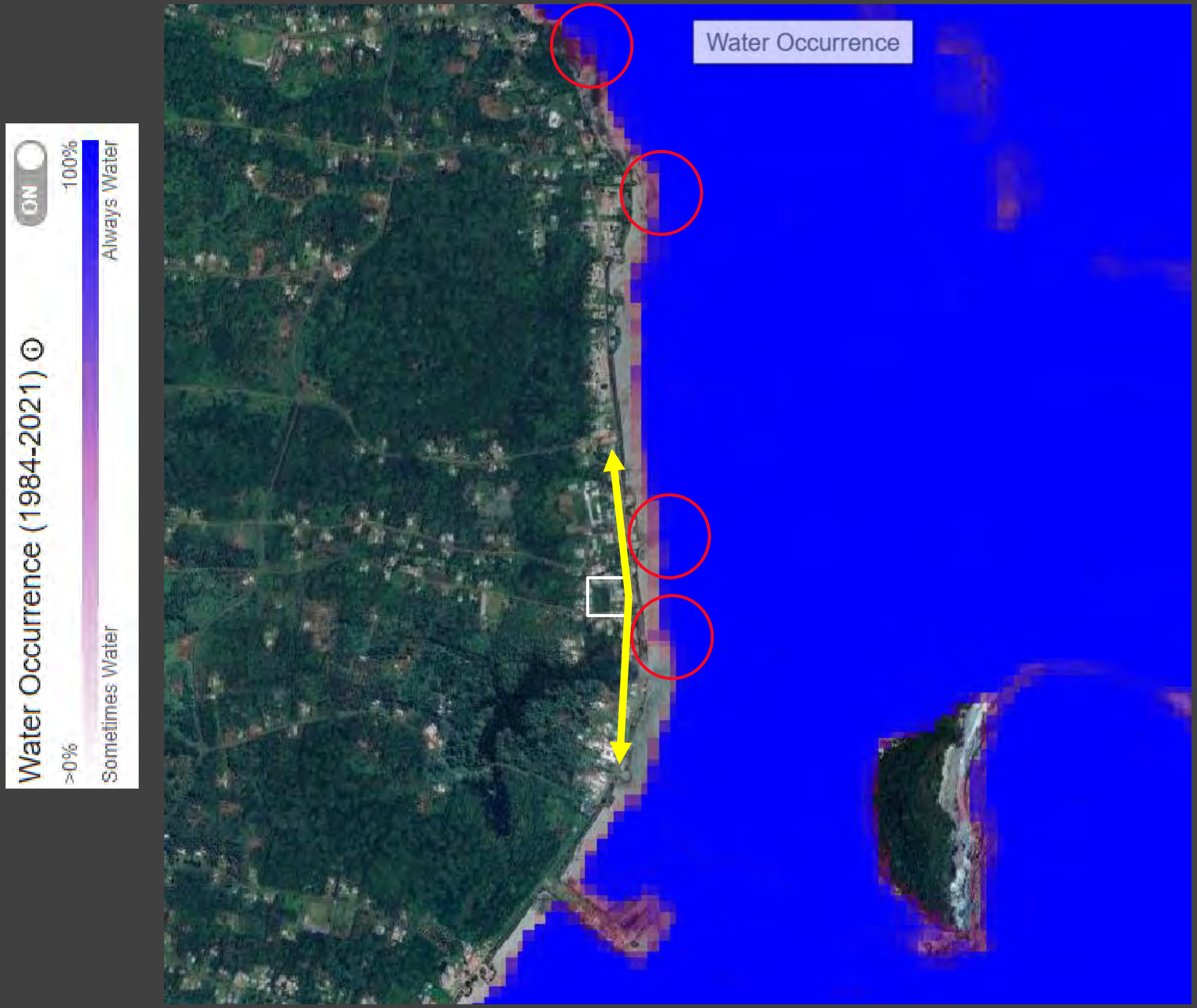
Hazard-related questions for Dan:

- Both schools are nominated for relocation – which needs to go first? When should the second shift?
- How can we support funding applications?
- What is the ideal timeframe for relocation of assets to balance budget and risk?

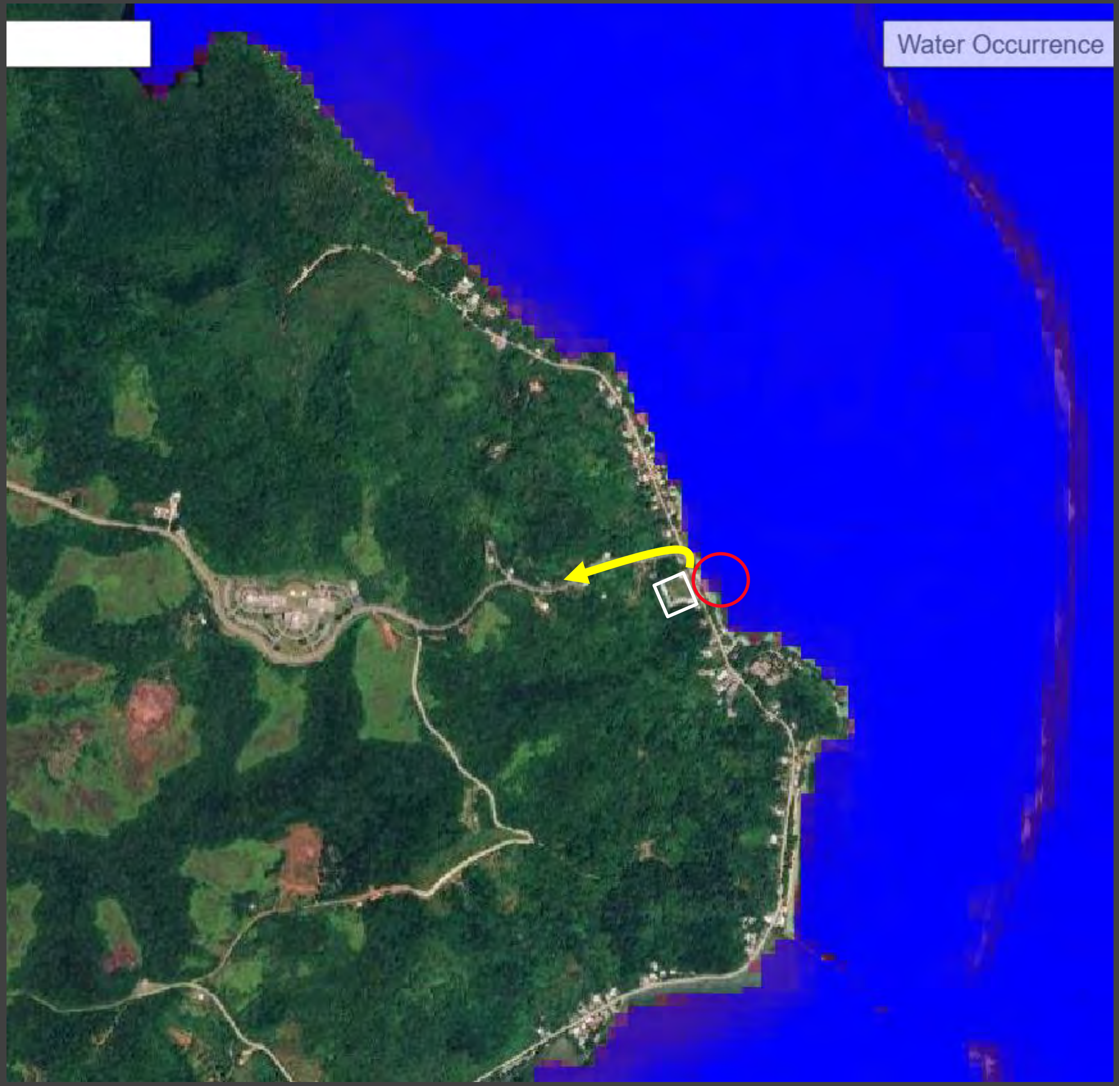
Erosion hazards

Tidal and tsunami hazards

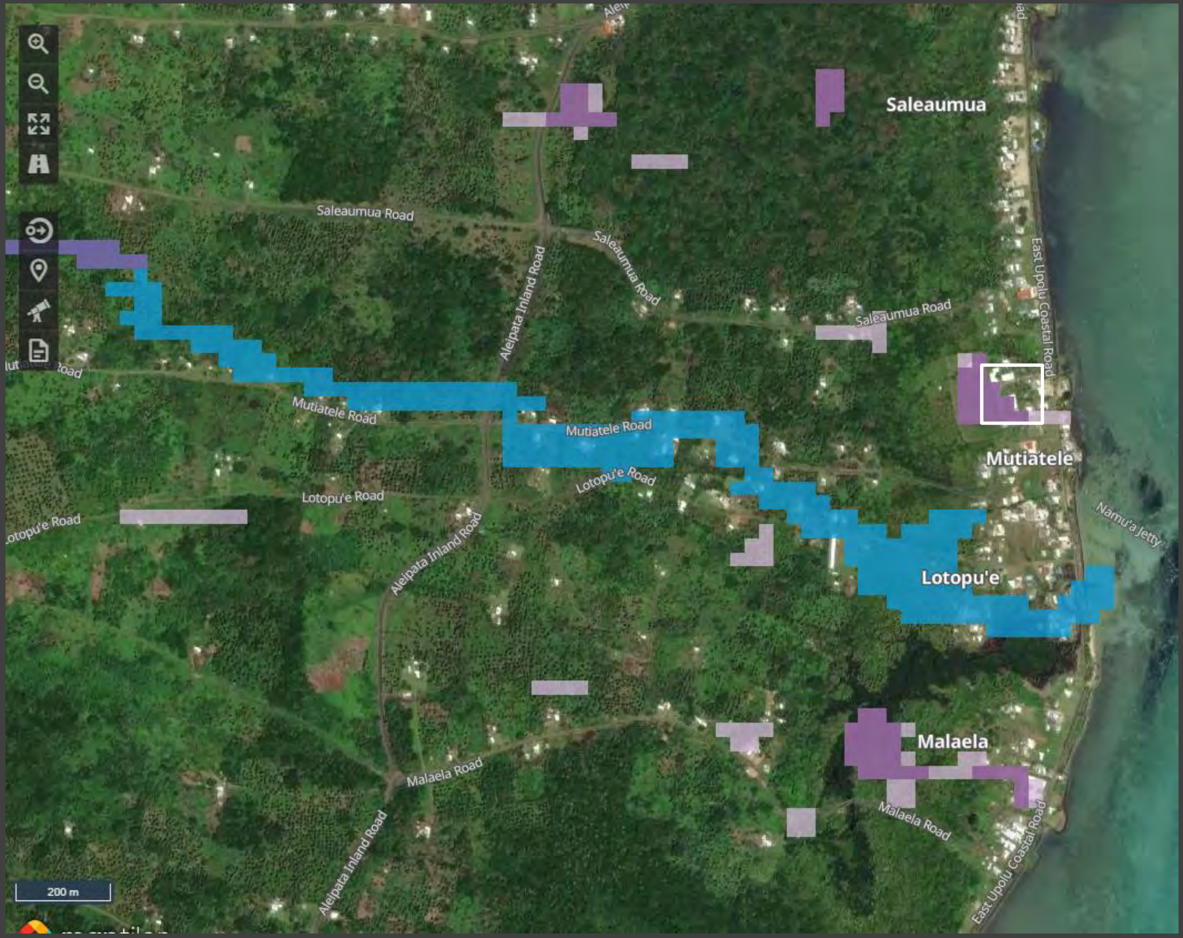
Samoa



Palau



Flood hazards



Samoa

Palau

Climate resilient approach

Quick hazard reviews can support funding decisions:

- Palau: Higher coastal erosion risk, more degradation

- Samoa: Higher coastal inundation, tsunami, flood risk

Climate resilient approach

Quick hazard reviews can support decisions:

- Palau: Higher coastal erosion risk, more degradation

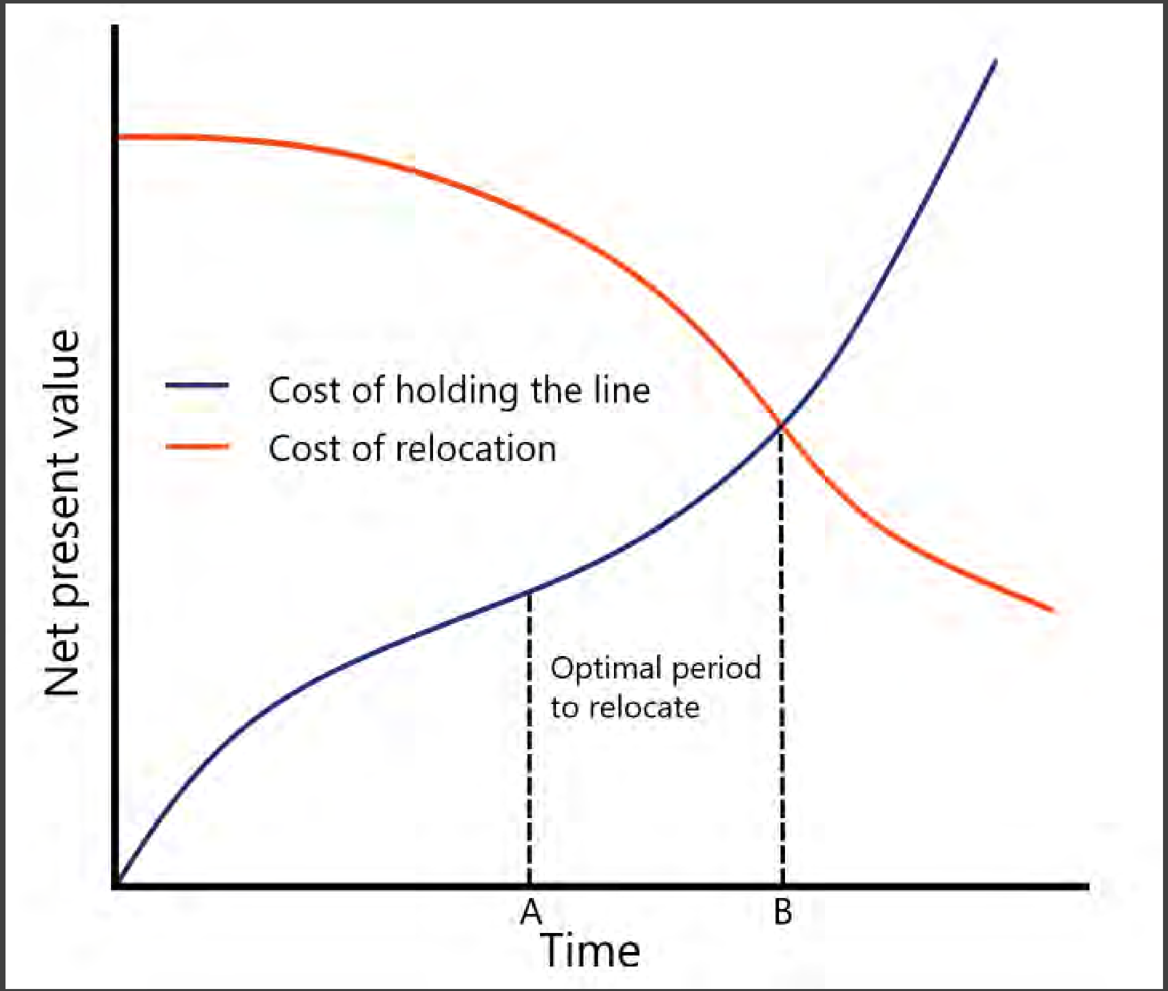
- Samoa: Higher coastal inundation, tsunami, flood risk

Going further: DRR inputs can further support grant applications to suggest the ideal timing to relocate vs maintain.

- Both scenarios include ongoing maintenance costs

- The cost of natural hazard repairs has an increasing function and will be more frequent

In this case, a business case can balance ongoing maintenance and relocation.



ROUND TABLE

- What are your own experiences of floods and climate hazards being incorporated into engineering projects?

- Is the industry doing enough?

- How can we do more?

CLOSE & CALL TO ACTION

- The need is clear and the risks of inaction are increasing
- The solution is practical, achievable, and aligned with national priorities
- The groundwork has been done through consultation, assessment, and prefeasibility
- What is needed now is coordinated commitment to move from planning to delivery
- Agreement to progress to the next stage: detailed design, funding submission, and implementation readiness