Torres Strait Regional Adaptation and Resilience Plan

2016-2021

Australian Government

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Acknowledgements
The Torres Strait Adaptation and Resilience Plan has been developed by the Torres Strait Regional Authority in collaboration with the Torres Strait Island Regional Council and Torres Shire Council.

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This Plan will be reviewed in 2021.

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2016-2021

The people of the Torres Strait are sea people. Photo: John Rainbird

Foreword

For many years now, our communities have noticed changes in the seasons and tides that indicate different patterns to our traditional knowledge. Since 2007 we have been undertaking scientific investigations of key climate related changes in our region. We are already seeing changes in sea levels, coastal erosion,shifts in seasonality of weather patterns and impacts on our sea country. These trends are expected to continue into the future and have the potential to cause significant disruptions to our wellbeing, culture and environment. It is timely to take serious action to address the impacts that climate change will continue to bring to the Torres Strait. This Plan considers those impacts and proposes a number of strategies and actions that will prepare the region for the future.

Climate change impacts are greater in vulnerable communities compared to those that are better resourced and less vulnerable and so the challenge for the Torres Strait is significant, putting us on the front line of climate change impacts. It is for this reason this Plan focuses both on climate impacts as well as reducing our vulnerability through building our resilience .

This is not the start of the journey for Torres Strait. We have had the Torres Strait Climate Change Strategy in place since 2010, which was recently updated in 2014. This Plan delivers on a number of actions in that Strategy. It focuses on the activities that will build resilience in Torres Strait communities and help them prepare for the impacts climate change and other drivers of change are likely to bring.

While this Plan sets out a course of action for the future, it highlights that there are some actions that need to occur immediately. The decisions and investments we make today will determine to a large degree how well our region will be able to respond to climate change. Whilst the challenges before us are great, so is our resolve to meet them to ensure a strong and vibrant future for our communities. In this Plan we have rigorously assessed the risks we face and identified the actions we need to take to proactively respond to them. There is significant interest nationally and internationally in our willingness to look closely at the future, and implement innovative and collaborative strategies. Governments across Australia as well as Canada, the USA and Europe have examined our approach to adaptation planning and how they can draw on aspects of it for their regions.

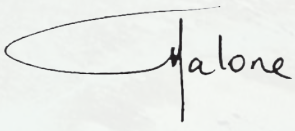
We recognise that we cannot do things the same way we used to, but that we will need to change. Delivery of the actions in the Plan will require unprecedented cooperation between all organisations and people who live in, or have influence on, the region. Our commitment to jointly endorse this plan represents an example of this cooperation. We will also actively seek to partner with both the Australian and Queensland Governments to implement this Plan.

Local Adaptation and Resilience Plans nested under this Plan are also being developed to support action at the local scale.

Torres Strait Islander and Aboriginal people of our region are here for the long term, and we will continue to demonstrate our capacity to respond to whatever challenges we face. This Plan represents the positive steps we will take to ensure a viable future for our region and our children's future.

Chairperson
Napau Pedro Stephen AM
Torres Strait
Regional Authority

Mayor
Fred Gela
Torres Strait Island
Regional Council



Mayor
Vonda Malone
Torres Shire Council

Contents

Photo: John Rainbird

List of Figures

Crested Terns. Photo: Matt Dunn

List of Tables

Icons used in this plan

Climate change

Social capital – represents the value added to activities and economies from human relationships, co-operation and *Ailan Kastom*

Adaptation to climate change – represented by accommodate (raise houses) and defend (seawall) options to sea level rise

Physical capital – infrastructure

Resilience – represented by a coconut palm – strong yet flexible, able to survive extreme weather and bounce back

Financial capital – economy and enterprise

Natural capital – land and sea country

Monitoring and evaluation of actions

Human capital – represents human knowledge and skills

Poruma jetty under water. Photo: TSRA

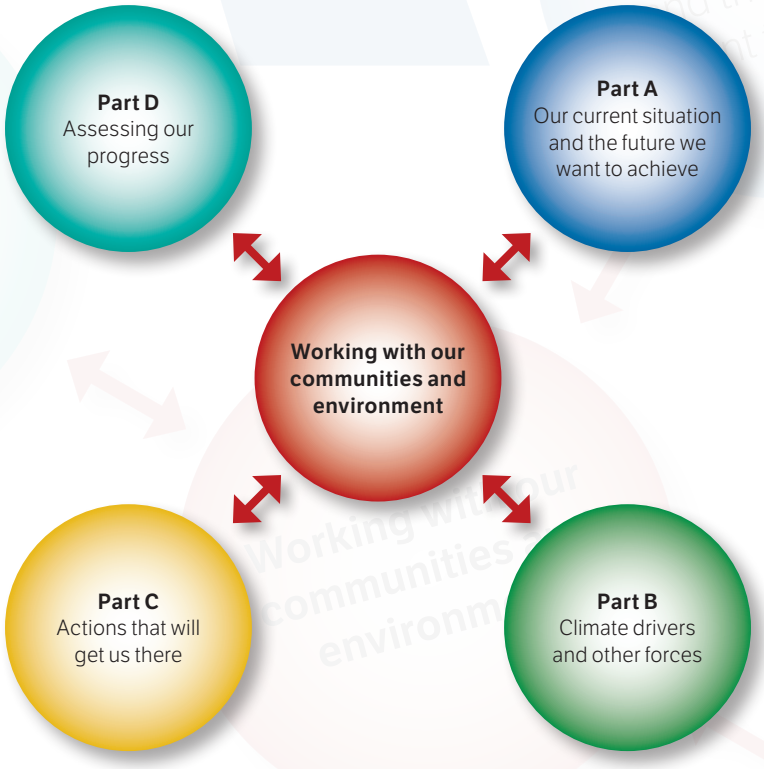
A Summary

What is this document?

This Torres Strait Regional Adaptation and Resilience Plan details how climate change will impact the region's communities and land and sea country, and what steps can be taken to reduce the likely impacts in order to ensure the region has a strong viable future. This summary outlines the key elements and findings from the Plan.

What is in the Plan?

This diagram illustrates the key elements of the plan. Part A examines our current situation and discusses the future we want to achieve. Part B examines the climate forces and other drivers that are shaping our region into the future. Part C details the actions and activities we will undertake in response to those changes that will deliver the future we want. Part D outlines how we will measure our progress towards our desired future.



At the heart of the Plan is our communities and our environment. The Plan has been developed in conjunction with the communities of the Torres Strait, and with an understanding of the environment and its role in supporting the future of the region.

What can I do?

You can support climate adaptation and resilience action in the region by.

- Reading the Plan and becoming familiar with the climate impacts
- Tell others about this Plan (see the Key Messages section below)
- Contribute to the actions in the Plan where you can
- Participate in your Community level climate adaptation and resilience planning and actions

Core proposition

The plan begins with a statement that embodies the philosophy of what we seek to achieve. It is called the core proposition:

> *Torres Strait is the ancestral homeland of our people and is inseparable from our culture. Therefore we strive to remain here, to retain the achievements of the present and regain the good ways of the past for a future that is resilient to change, in particular to the effects of climate change. The ability to be responsive and adaptable is important in attaining the goals of individual and community happiness and wellbeing.*

Adapting to climate change is an ongoing learning process. It will require a different way of thinking that better appreciates how all parts of the Torres Strait are inter-connected. It will require bold thinking and decision making to choose a path that is in the best long term interests of the region. Fast-tracking community sustainability and resilience will need to be high level strategic priorities for communities and governments alike.

What are the key climate change and other forces of change happening in our region?

The increasing concentration of greenhouse gases in the atmosphere is driving changes in the skies and oceans. Apart from climate, there are other forces in the economy and society that are shaping our future. For the Torres Strait the most important changes are:

Rising sea levels – Sea levels in the region are currently increasing at a rate of between 6-8 mm per year, and will continue to rise into the future.

Changes to the ocean environment – The oceans are becoming warmer, which also reduces how much oxygen the water can hold. As carbon dioxide (CO_2) levels in the atmosphere increase, more CO_2 is taken up by the oceans, causing the oceans to become more acidic.

More hotter days – As global average temperatures increase, we will continue to see an increase in periods of hotter than normal days and more hot days per year.

More intense rainfall – While overall annual rainfall is unlikely to change very much, when it does rain it is likely to come in more intense shorter bursts. If we are not prepared for this, it can lead to localised flooding and damage.

A longer dry season – Conversely the period when it does rain is likely to shrink and the dry season is likely to be longer. Overall variability in the weather and seasons is likely to increase.

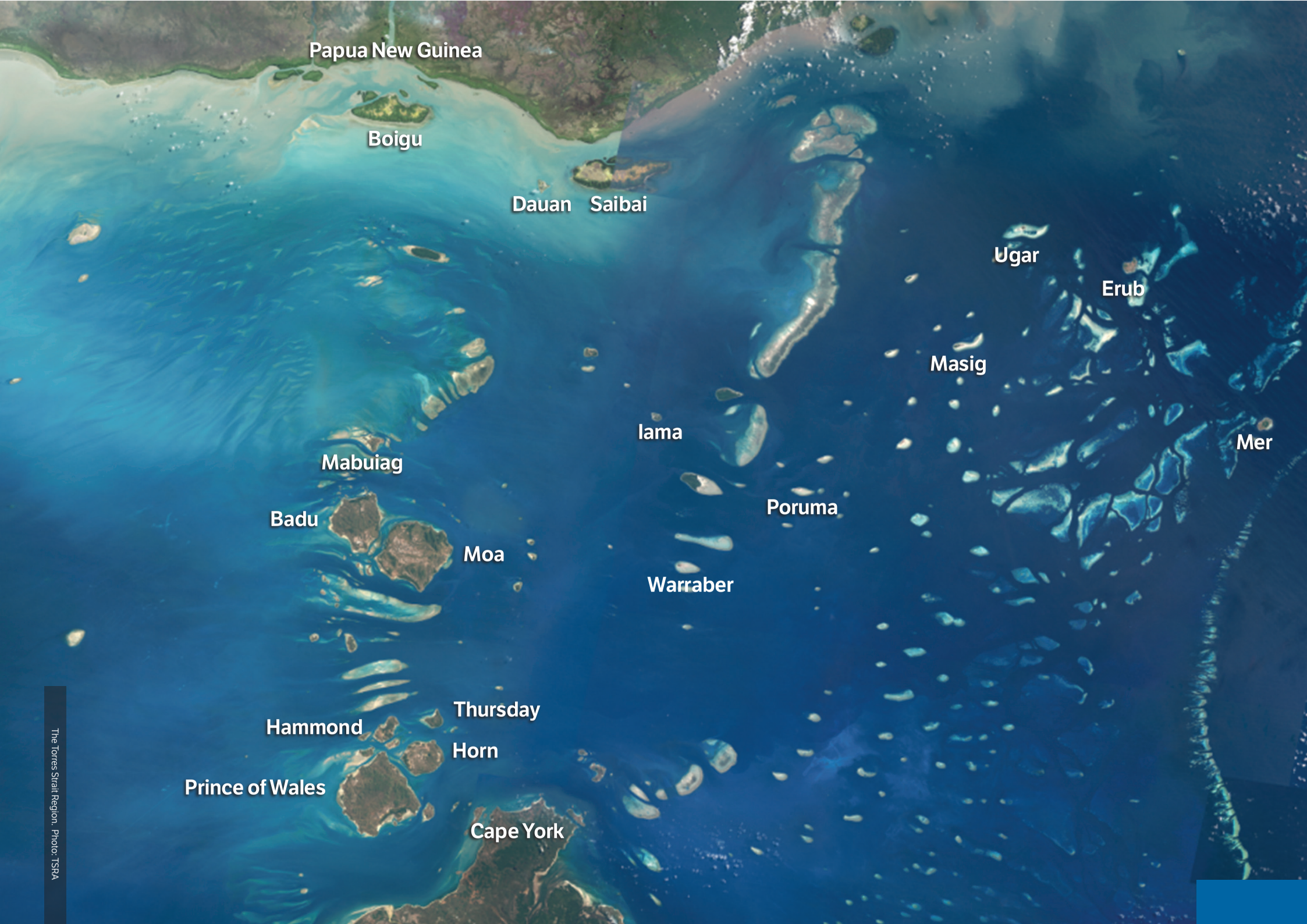
Increasing oil prices – As the amounts of available oil diminishes, the long-term prices of fuel for the region will continue to rise. This will impact how the region produces electricity and fuels transport. It will have flow on effects to the costs of transporting goods and services into the region.

Neighbouring PNG – The Western Province village communities of Papua New Guinea share many marine resources with people of the Torres Strait. Besides poor health, low living standards, rapid population growth and food security challenges, they are also highly exposed to climate change impacts being remote, low-lying coastal communities.

Demographic and social changes – increased education, access to technology and better communications have all changed how we live in the Torres Strait. These forces will continue to drive change in our communities and the region.

The broad trend of increasing demand on state and Commonwealth government budgets: This has implications for the region to maintain key services at desired levels as well as the capacity of the region to adapt to the above forces of change.

Aspects of the region most exposed to climate change impacts include low-lying settlements, water security, community health and ecosystem health.



The Torres Strait Region. Photo: TSRA

What are the main climate change impacts for the Torres Strait?

The impacts below come mostly from within or close to our region. There are also likely to be impacts that come from how climate change affects Australia and the broader global community.

The way these forces will affect the region is examined from five perspectives. This is a methodology called the Five Capitals approach.

Human Capital – The outlook for health and wellbeing

- Increased heat stress from more hotter days.
- Increased transmission of diseases, such as mosquito borne diseases, and increased reliance on better hygiene standards.
- Mental stress arising from the possibility of future displacement from some islands or other climate stressors.
- Broader disruptions to economies and infrastructure that divert resources from the health sector and undermine heath resilience.

Financial Capital – The outlook for enterprise and the economy

- Declines in local availability and or productivity of key fisheries species.
- Storm and sea-level impacts on infrastructure that underpins economic activities.
- Increased cost burden for replacement, repair and maintenance of infrastructure.
- Damage to potential tourism assets (natural and built).
- Impacts on productivity from health impacts.

Natural Capital – The outlook for land and sea

- Changes in ocean temperature and chemistry will negatively impact many marine species and ecosystems, in particular coral reefs (**Figure 1**), seagrass meadows (and therefore dugong) and turtles.
- Increased rainfall in PNG catchments may lead to reduced water quality in the northern Torres Strait.
- Changes in rainfall and seasons and hotter days and increased risk of bushfires will negatively impact terrestrial (land) plants and animals.
- Sea-level rise is a major threat to mangroves, coastal areas, coastal ecosystems and coastal amenity.

Physical Capital – The outlook for infrastructure and services

- Extreme weather is likely to disrupt services and damage infrastructure.
- Changing temperatures, increased variability and changes in air and ocean chemistry will decrease the lifespan of infrastructure.
- Sea-level rise and storm surge threatens some key maritime, aviation and road transport infrastructure.
- Warmer temperatures and mosquito borne disease pose a risk to water security.
- Increased fire risk is also a threat to some infrastructure.

Social Capital – The outlook for community and *Ailan Kastom*

- Outdoor activities will become increasingly restricted to cooler times or cooler locations.
- The number of people experiencing financial stress will increase without substantial efforts to reduce cost of living and expand local economies.
- The demand for emergency services will continue to increase in response to direct and indirect impacts of climate change.

- Access to some key marine food resources are likely to decline over time and increased climate variability may impact local food production.
- There is a risk community services may suffer due to increased demand coupled with reduced financial and human resources to support effective delivery.

What are the outcomes we want to see?

The approximately 120 proposed actions in the Plan are grouped under outcomes statements. Each outcome statement describes an element that will improve the resilience of the region and reduce the impacts of climate change. The Plan highlights the need for both adaptive and transformative actions. Actions tables consider priorities, lead and supporting agencies, timeframes to implementation and group actions under business activities of *Information, Implementation, Education and Awareness, Policy and Planning and Monitoring*. Adaptation and resilience pathway maps are included.

Adaptation Outcome 1: Coastal communities and infrastructure are protected from sea-level rise and coastal impacts, and communities have options in responding to long-term sea-level rise.

Adaptation Outcome 2: Communities and infrastructure are protected from extreme weather impacts (disaster risk management).

Adaptation Outcome 3: Reduced the impacts of hotter days and more hot days on community health and wellbeing.

Resilience Outcome 1: The governance arrangements for the Torres Strait Region and for each community enable development of responsive, resilient and sustainable communities with climate change and resilience fully integrated into development planning and policy development.

Resilience Outcome 2: Health risks are managed and reduced through holistic health and well-being strategies and interventions.

Resilience Outcome 3: The community is strong, confident and capable and has increased its capacity to respond positively to change and impacts.

Resilience Outcome 4: The infrastructure and services in the Torres Strait are fit for purpose, systems have built-in redundancy, have low operation and maintenance costs and meet the needs of the local and regional community .

Resilience Outcome 5: The land and sea are healthy and are able to adjust to the changing climate without losing diversity or productivity.

Resilience Outcome 6: Enterprise in the region and in each community aligns with community values and is meeting the majority of the communities' local needs.

> **“Climate change calls for a different approach to development – not business as usual. Climate change can and will knock countries off their development goals.”**
>
> The World Bank – the Economics of Climate Resilient Development

The boat ramp at Iama is a low point, allowing high tides to enter the community. Photo: John Rainbird

Key recommendations – early actions

Part C of the plan details the full list of actions that will be undertaken to address these issues and build the desired future for the region. Some of these actions are already underway or about to commence in the region. These include:

- Develop a pilot project that uses a sustainable development approach to community development that targets key vulnerabilities to build self-reliance, resilience and sustainability.
- Develop a sustainability and adaptation decision making framework to inform future planning and investment decisions. Key adaptation and resilience principles should be actively incorporated into local decision making processes.
- Initiate a Resilience Champions program to be based on each community to provide local capacity for development and delivery of adaptation and resilience planning and associated actions.
- The role of land tenure and its role in enabling or blocking certain adaptation options needs to be more closely examined.
- Work with communities, local and state governments to address climate change risks to water security and supply.
- The legal implications of climate change on native title rights and the legal ramifications of climate change impacts on island communities needs to be investigated to gain a clearer understanding of these issues.
- Monitoring processes need to be established or continued in key areas such as health and environment in order to track change that may have a climate component. This will also help inform the risk levels as well as potential effectiveness of adaptation strategies.
- Adaptation planning should link in with disaster risk reduction/disaster management arrangements to ensure alignment off effort and approaches.
- Whilst a number of impacts are likely to only occur in a significant way in the mid to long term, planning and preparation should begin now to ensure communities and agencies are prepared and to help ensure investment can be secured.

Key messages – What can I tell others about this Plan?

These key messages provide the overarching story about what climate change means for the region, and why we need to take action.

1. The Torres Strait does face risks due to climate change, but the region still has a strong future.
2. The region will respond proactively to climate change and relocation of communities will be a last resort.
3. Important climate related impacts on the region might also come from outside the region such as security and migration and impacts on the price and availability of food.
4. Integration of climate adaptation, resilience and community development will benefit the region.
5. Building community resilience through building local adaptive capacity, fostering appropriate local economies, improving health and well-being standards and building greater self-reliance should be a priority.
6. Remoteness, extensive low-lying coastal zones, Indigenous disadvantage and modest economic base are key contributing factors to island community vulnerability to climate impacts.
7. Adaptation can reduce the impacts of climate change, but there are limits to the reduction of risks and to the scale of changes to which human and natural systems can adapt.
8. Infrastructure and land use planning should factor in possible migration of people and communities within the region in response to sea-level rise and other climate change impacts.
9. Community members have highlighted cultural renewal, local sustainable food production, water security and increased use of renewable energy technologies as issues of importance.

10. We should learn from the experiences of other regions facing these challenges and where appropriate consider collaboration where it delivers benefits to the region.

11. We cannot assume the resources required to implement longer term adaptation strategies will easily be available in coming decades as demand for government support to respond to climate impacts across Queensland and Australia increase.

We would encourage you to use these key messages when talking about the Plan.

The values expressed by regional leaders and communities include:

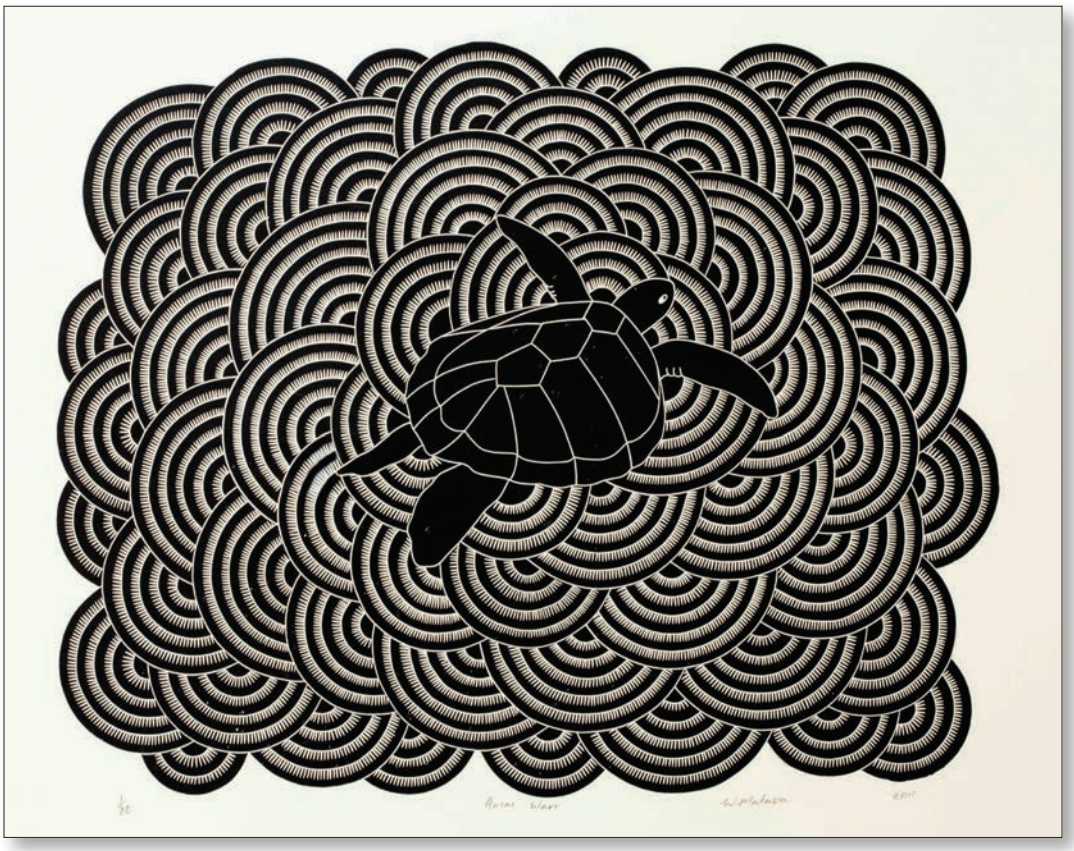
Healthy environment: A healthy environment underpins every aspect of the Torres Strait – its community, economy and culture. Anything done in the region must not compromise the health of this asset.

Local decision making: This is the foundation for cultural maintenance and self-determination. By empowering the people of the region, there will be greater motivation to participate and better integration of local knowledge in decisions.

Strong and healthy community: Having a strong community leads to the best outcomes for the Torres Strait. The best way for us to respond to the future is to focus on building the strengths of our community to work together.

Resilient economy: A resilient economy reflects the values, capacity and resources of the region. It is diverse, innovative and resourceful, flexible and able to withstand and recover from internal and external shocks. Such an economy would have reduced welfare dependence, increased training and education opportunities, would actively support innovation, and would develop diverse and appropriate economic activities.

Preservation and enhancement of culture: The culture of the people of the Torres Strait is unique and one of our greatest strengths. We need to preserve those practices that we value the most and want to give to our children, while embracing the new opportunities the future presents.



Amai Warr by Weldon Matasia

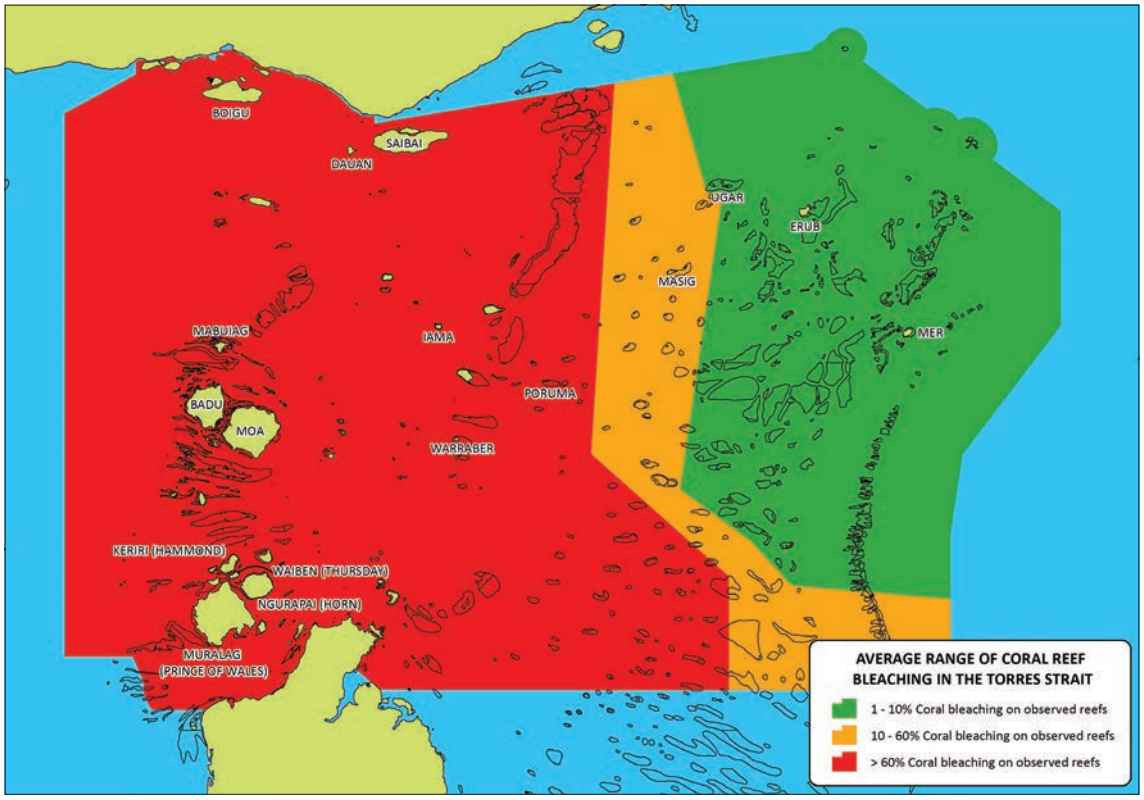
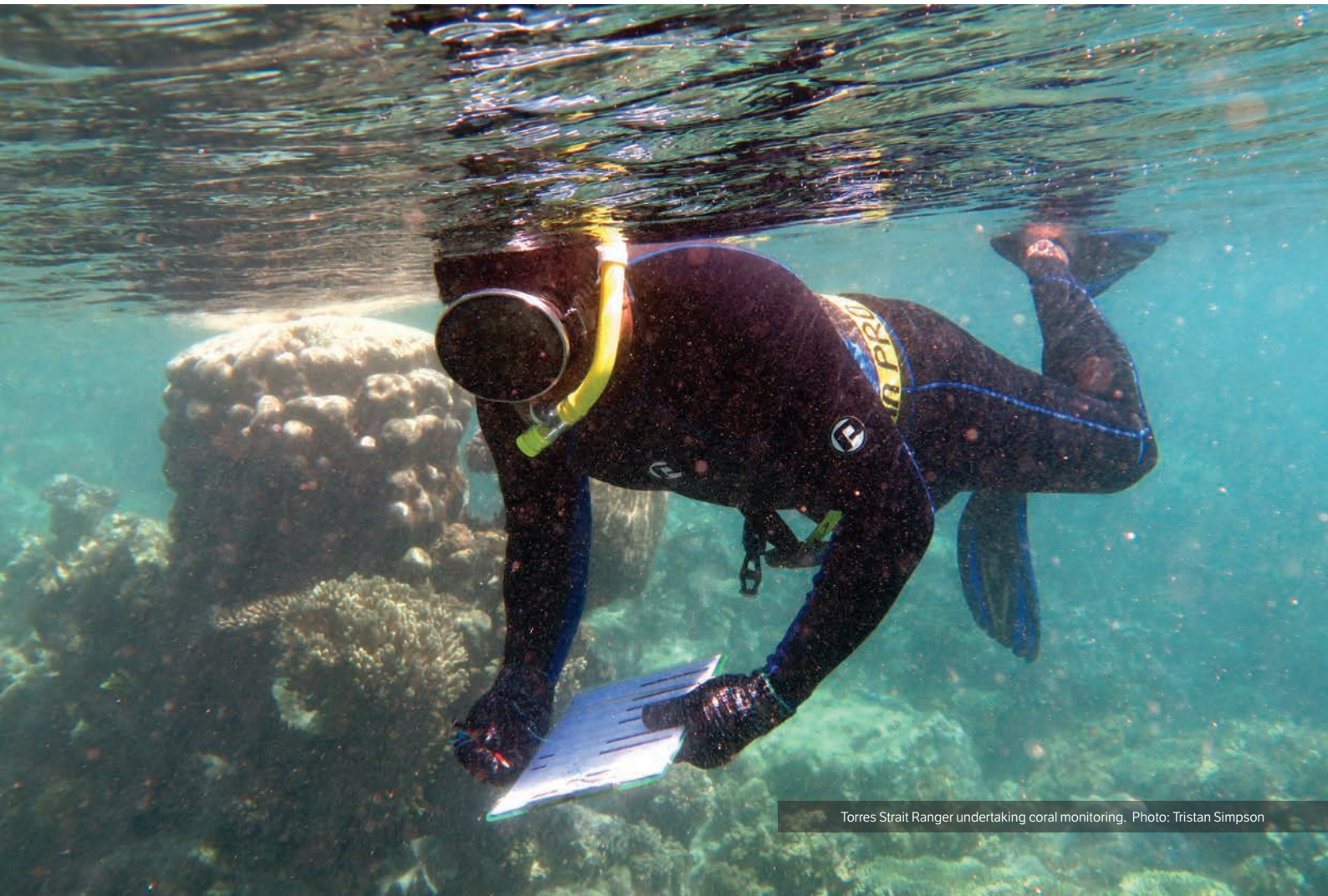


Figure 1: Extensive bleaching of coral reefs occurred across the Torres Strait in early 2016 due to warmer than normal water temperatures. Eastern reefs in deeper water suffered on minor direct impact. Map: TSRA based on TSRA and Australian Research Council Centre of Excellence for Coral Reef Studies aerial surveys



Torres Strait Ranger undertaking coral monitoring. Photo: Tristan Simpson

Horn Island (Narupai) is the gateway to the Torres Strait, but low-lying wharf and community facilities are exposed to flood risks. Photo: John Rainbird

B The Case for Action

Introduction

Torres Strait is the ancestral homeland of our people and is inseparable from our culture. Therefore we strive to remain here, to retain the achievements of the present and regain the good ways of the past for a future that is resilient to change, in particular to the effects of climate change. The ability to be responsive and adaptable is important in attaining the goals of individual and community happiness and well-being.

Climate change is already a major force of change across the world, and the magnitude and pace of this change is predicted to increase over the coming years.

Whilst there is uncertainty regarding the rate and scale of expected changes and impacts, uncertainty in itself is not a reason for delaying action. Successive climate reports highlight climate change has been occurring faster than initially predicted (Bauer and Beckman, 2015; Carey, 2012). The rate of change of non-climate risks to the environment and human endeavours is also escalating (**Figure 2**). From a risk management perspective we would be prudent to assume the rate and scale of climate-driven change will escalate for the foreseeable future.

Responding to this challenge is essentially good risk management. There is increasing expectation in many parts of the world that communities and agencies; in particular local governments, develop appropriate adaptation planning as a risk management tool to reduce their exposure to costs, impacts on health and productivity and possible future litigation (for example, the United States (US) Federal Emergency Management Agency is now expecting States to factor in risks posed by climate change or risk losing access to emergency funding).

This Plan represents a synthesis of information collected at the Torres Strait Regional Adaptation and Resilience workshops (July 2014 and June 2015), existing research material and other expert and community workshops.

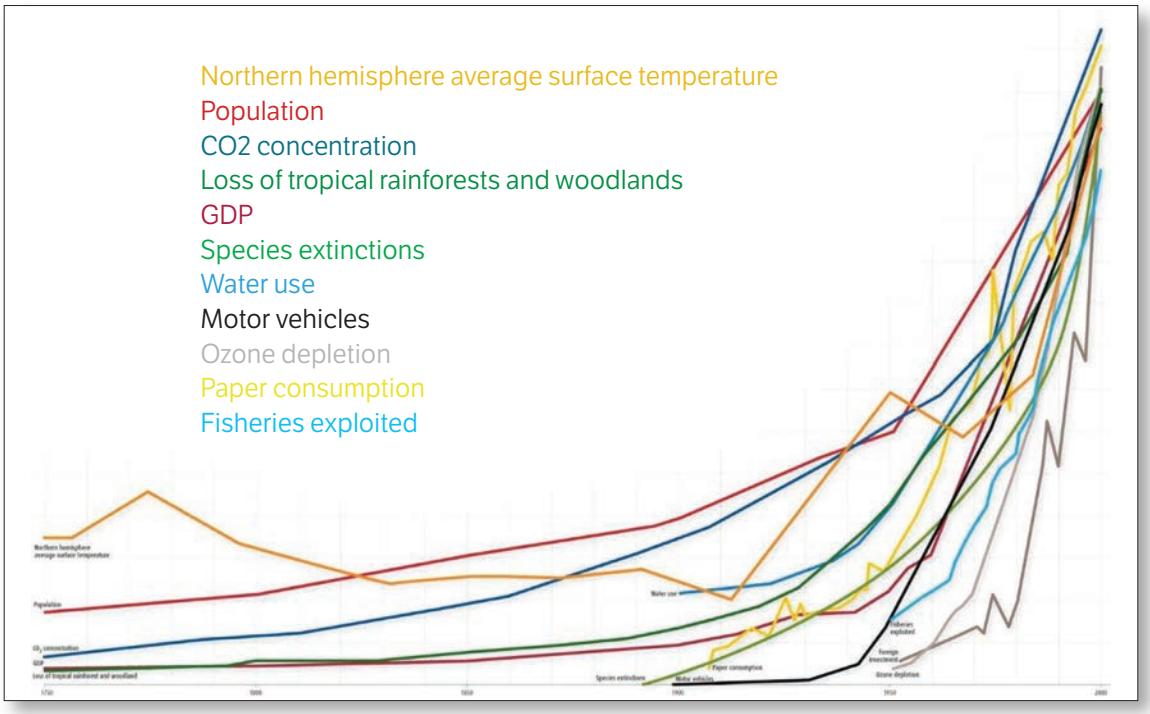


Figure 3: Trends in a number of global issues indicating accelerating rate change (Source: New Scientist, 2008)

It highlights high level climate change impacts across key aspects of the Torres Strait and proposes a number of actions and strategies to minimise risks, build capacity and enhance resilience.

Community-based adaptation and resilience planning is being conducted throughout the region and will feed into the regional adaptation planning process. This is just the beginning of a long-term process of planning, implementation and evaluation.

Whilst some Torres Strait communities are highly exposed to sea-level rise, a strategic planning process is addressing how these impacts will be addressed. The region still has a strong future, despite the significant challenges before it. Bearing a disproportionate burden of climate change impacts whilst having contributed little to the cause, the people of the Torres Strait are deserving of the support they need to adequately respond to the challenges climate change brings.

It is well recognised that communities that are less resourced with higher levels of vulnerability will be impacted harder by climate change. As such this Plan recognises both the need to adapt to emerging climate impacts and the need to strengthen regional and community resilience to reduce vulnerabilities. The Plan addresses how climate change will impact the region and what measures can be taken to reduce or eliminate those risks. Successfully responding to climate change equally requires that communities and ecosystems must be healthy and resilient to anticipate and sustainably respond and adapt to climate change impacts.

Current and future development of the region can only be successful if it adequately builds in adaptation efforts and focuses on building resilience. It is essential that current and future development projects are supportive of and aligned to these objectives.

Ideas proposed in this document will need to be developed and assessed further, and there are many actions that are already at various stages of development and implementation. As the information develops, and actions are assessed, this process will help guide prioritisation and investment strategies.

New knowledge and conditions are constantly emerging and evolving, and we are very much in a learning phase as to how we respond to this “new normal”.

As such, adaptation to climate change is an ongoing learning process and the intention is to develop a dynamic planning process that is truly adaptive and innovative to reflect the approach needed to move communities even closer to greater resilience and self- determination, and to prepare them for the challenges that climate change is already bringing to this unique and special region.

> “...the people who are least responsible for raising the Earth’s temperature may suffer the gravest consequences from global warming. That is fundamentally unfair.”
>
> Jim Yong Kim, President of the World Bank

The Transfiguration church on Ugar is exposed to coastal impacts. Photo: John Rainbird

> **“In the real world, different impacts of climate change will frequently overlap and interact. The difficulty of anticipating such interactions…may mean that the risks arising from them are easily overlooked.”**
>
> King et al, 2015

Coral bleaching impacted most reefs across the region in 2016. Photo: TSRA

The region

The Torres Strait is a collection of island communities and associated sea country located between the tip of Cape York Peninsula and Papua New Guinea. The region has national and international significance for its unique cultural and environmental values. It is strategically of great importance for biosecurity, international shipping and border security.

As small island communities, the Torres Strait islanders have a great deal in common with their Pacific Island neighbours. The small size of the islands and low lying communities, their remoteness, and issues of Indigenous disadvantage mean that the people of the Torres Strait are particularly vulnerable to many climate change impacts and sea-level rise in particular. However, the communities have strong culture and values and their country includes healthy and rich marine environments, both of which enhance their resilience.

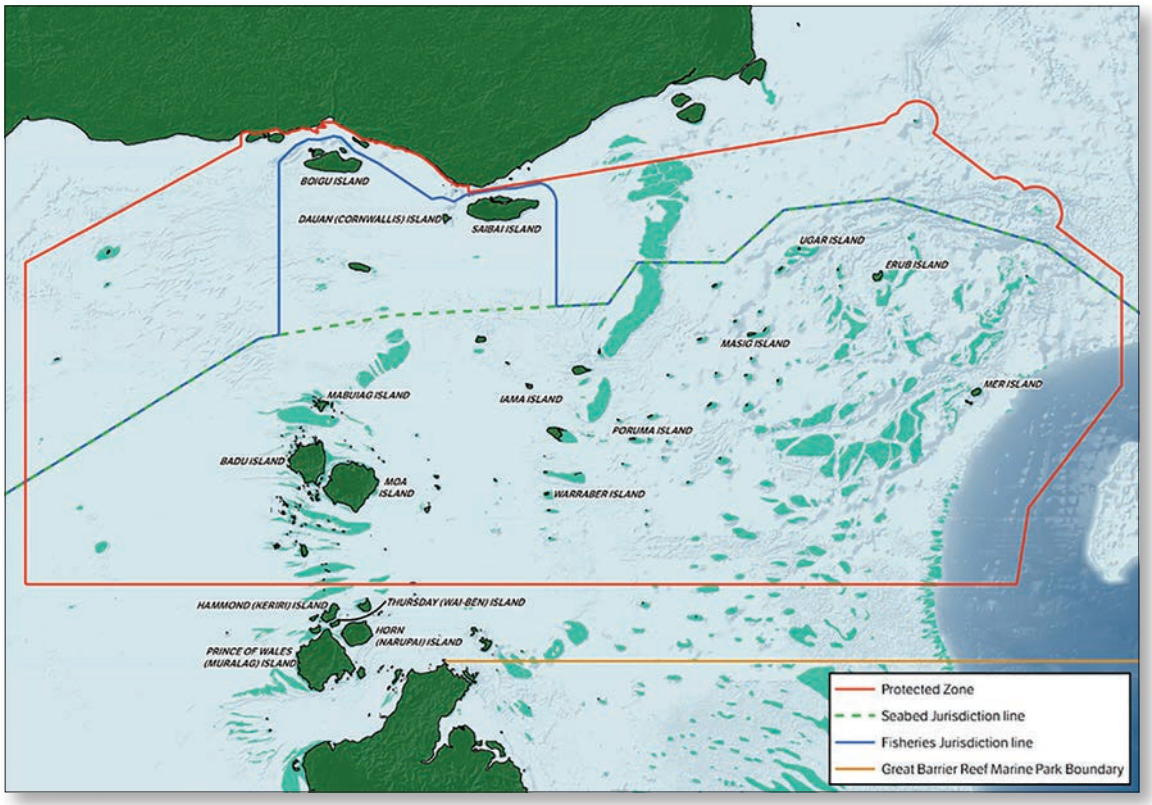


Figure 3: The Torres Strait region, showing reefs, international boundaries, the Torres Strait Protected Zone (TSPZ) and Torres Strait inhabited islands (Source: TSRA)

Approximately 7,000 people inhabit 20 communities over 18 islands. Approximately 40,000 Torres Strait Islanders live in mainland Australia. The region has both Torres Strait and Aboriginal Traditional Owners. Thursday Island is the administrative centre and there are two local government councils, the Torres Strait Island Regional Council (15 outer islands) and the Torres Shire Council (5 inner islands). Native title rights have been determined for most of the region, including most islands and 44,000 square kilometres of sea country. Torres Strait culture (*Ailan Kastom*) and community livelihoods are strongly linked to the land and sea country.

There are four main types of island – western continental islands, northern alluvial islands, central coral cays and eastern volcanic islands. The region has very dynamic tides due to the interaction of influences from the Arafura Sea in the west and the Coral Sea in the east. The climate is dominated by southern westerly trade winds during the dry winters and north western monsoonal influences during the wet summers. The current mean maximum and minimum annual temperatures are 29°C and 24°C respectively.

The region has very extensive and healthy seagrass meadows, mangroves and coral reefs and globally significant dugong and marine turtle populations.

Forces of change

What influences are affecting the region?

Global development over the past 200 years has been defined by access to cheap energy (oil and coal) and a relatively stable climate. Current knowledge indicates future development cannot assume these trends will continue. As the world moves to a low carbon economy and a time of relatively rapid change in many issues, future development will need to assume change as the key certainty. Wise et al. (2014) argue that as the world seems increasingly likely to face a future with more than 2°C average warming, it becomes increasingly important to move beyond impacts and vulnerabilities to adaptation action. Global CO_2 levels in the atmosphere have now exceeded the 400 parts per million level, a level not experienced for over 3 million years (**Figure 4**).

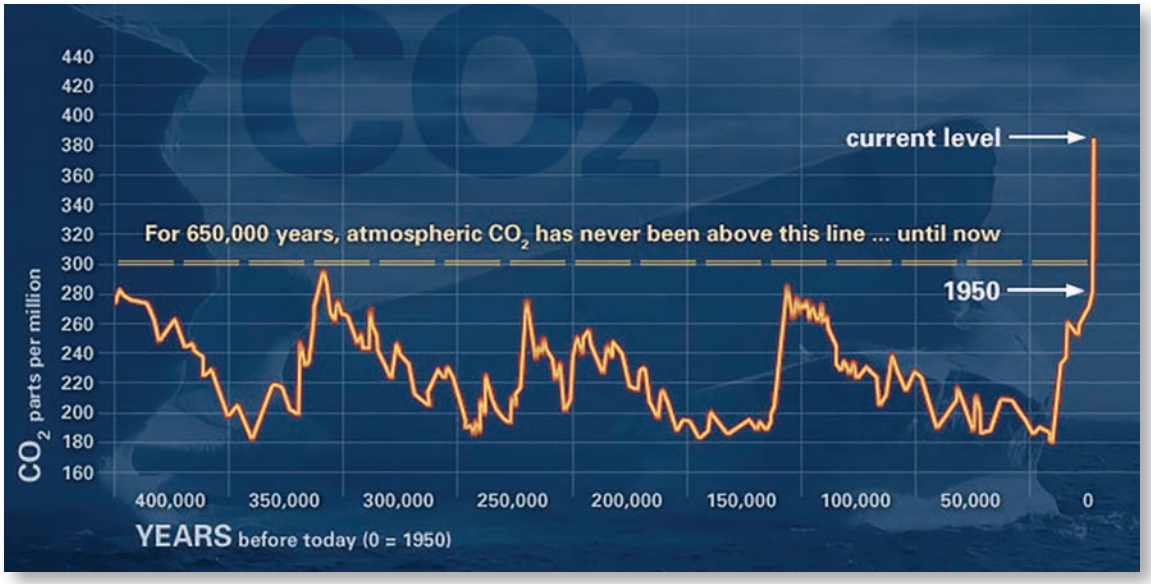


Figure 4: Changes in atmospheric carbon dioxide over the past 650,000 years. (Source: NASA)

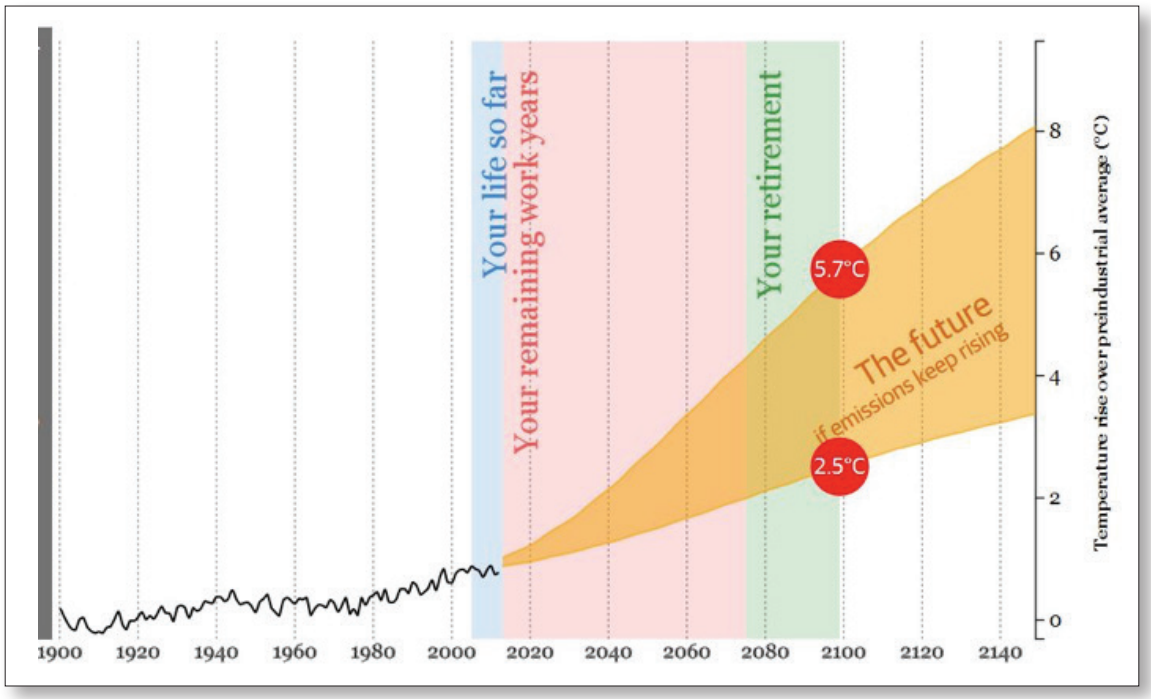


Figure 5: Temperature projections for a child born in 2005 under current emissions projections (Source: Clark, 2013)

Communities and environments in the Torres Strait are significantly exposed to climate change (**Figures 5** and **6**). Communities have undergone a wide array of changes over previous decades as islands have been fitted with modern services and infrastructure. These changes have had both positive and negative implications for the culture, health and well-being of communities. Impacts on culture are of particular concern, as are impacts on health and well-being from shifts in diet and lifestyle. Like many Indigenous communities across Australia, Indigenous welfare provides an important safety net but also undermines efforts to build community self-reliance. Unemployment and health statistics indicate there is still a lot to do in order for communities to achieve the levels of resilience needed to adequately deal with climate change and other impacts. The out migration of young people due to limited economic and life opportunities is a related and critical issue that undermines regional resilience.

In order to meet this challenge, it is essential that key climate change risks are properly assessed and responded to through investment (**Figures 7** and **8**) and on-ground action, and that future development occurs in the context of building community resilience. This will require a reassessment of current approaches to community development in some sectors.

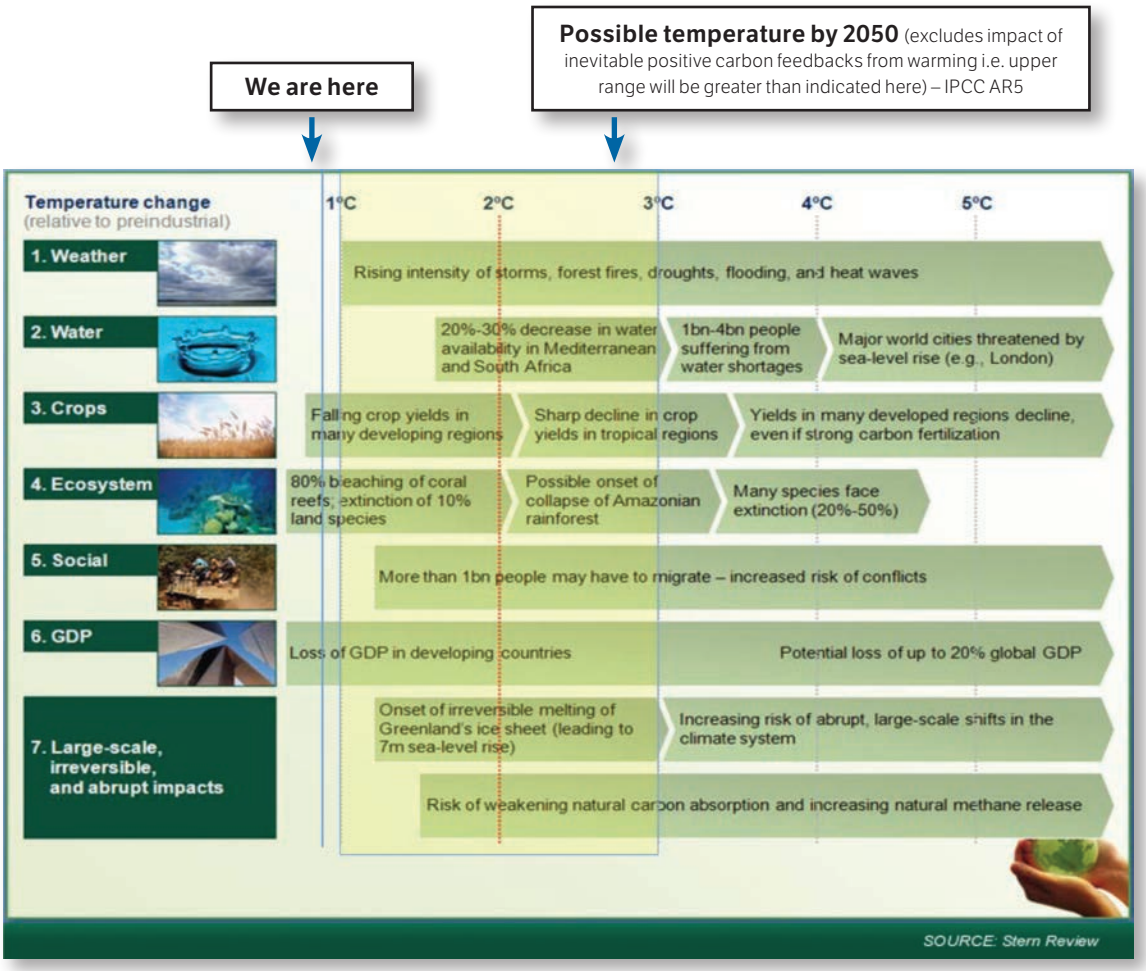


Figure 6: The impact of increasing temperature on key areas of global concern (Source: Stern, 2007).

Photo: Matt Dunn

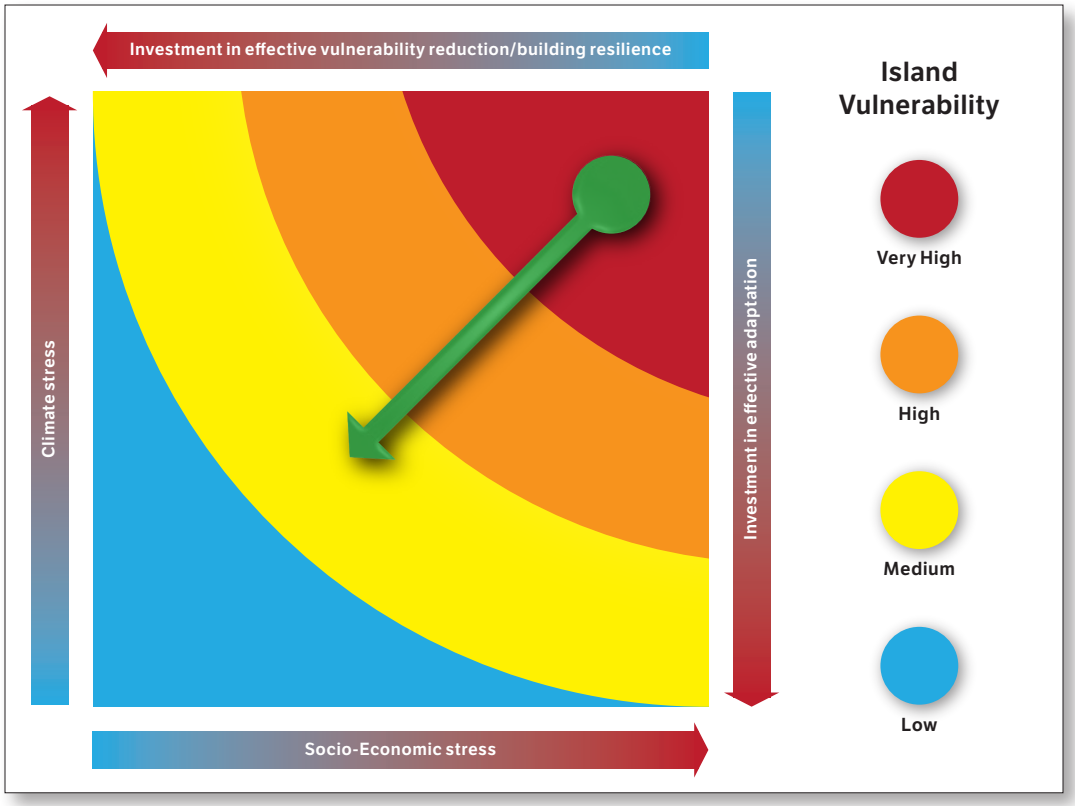


Figure 7: The impact of investment in climate change adaptation and vulnerability reduction on community vulnerability (modified from Nurse et al 2014)

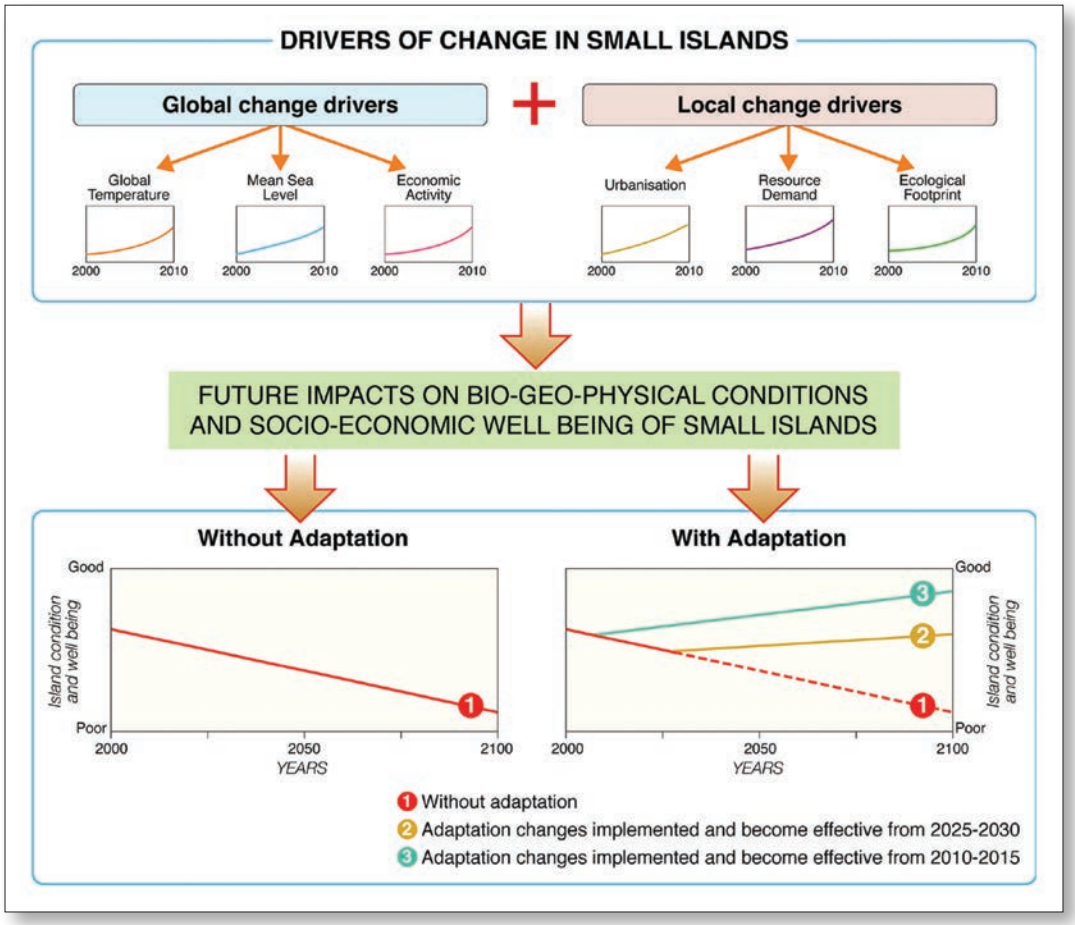


Figure 8: Drivers of change in small islands and implications for island condition and well- being under no adaption and the near-term and mid-term implementation of adaptation (Source: Adapted from Harvey et al 2004, IPCC WGII AR4, Chapter 16, p. 704). Taking early action to adapt improves the ability of communities to respond to mid and long term impacts

Climate change in the Torres Strait

Currently, many coastal communities are vulnerable to current conditions, such as king tides and storms which drive erosion and inundation events. A significant amount of research has been undertaken to try to assess how climate change will exacerbate existing risks and affect future weather and the environment of the Torres Strait.

Situated in the tropics, certain climate variables such as temperature are not likely to change as significantly as they would in more temperate areas. However, because tropical systems have evolved in a relatively stable and narrow spectrum, they are less adapted to variability compared to temperate systems. The high latitude of the region also means the risk of tropical cyclones passing directly through the region is low.

Appendix A includes a range of climate projections for the region from 2030 to 2090. These are based on the highest emissions scenario, which is what we are currently tracking against, and are most relevant from a risk management perspective. For this Plan, climate projections for the year 2050 were used. This period was chosen as it is less than 35 years from now, and it is possible to imagine how decisions made today will still have impact. Although this is only a little way off into the future, the amount of climate change that will have occurred is significant enough that the impacts can be assessed and adaption options identified.

Important points to bear in mind on climate projections:

- Climate projections provide an indication of likely changes – the focus should be on the trend and general magnitude of change rather than adhering to the specific values.
- There are many positive feedbacks (cycles that further amplify the trends towards warming and sea level rise) in the climate system that have not yet been included in climate models due to a lack of sufficient data. This means the projections are likely to be lower compared with what is actually happening.
- The values listed in the projections table are averages. A major risk with climate change is increased variability in the climate and higher likelihood of extremes. Average rainfall might not change, but may hide the important variability within a year of extreme wet and extreme dry seasons. It is the extremes and increased variability in the climate that is likely to have the biggest impacts.
- The projections used here are based on the highest emissions scenarios, which are the ones we are currently tracking against most closely in reality. If significant cuts are made to global emission levels soon, the mid to long term impacts of climate change should be less severe.

A summary of key changes in climate can be found on page 2.

Other key drivers of change

What else is causing change in the Torres Strait?

Climate change is a major force for or driver of change, but there are other drivers that will determine the future of the Torres Strait. Adaptation planning that fails to factor in other key influences runs the risk of developing strategies based on false assumptions about future conditions and resources .

Neighbouring PNG

The Western Province village communities of Papua New Guinea are within sight of the northern Torres Strait islands. These communities are amongst the poorest in the world, ranked 157 out of 187 countries on the Human Development Index rating (Butler et al. 2012). They share many marine resources with people of the Torres Strait. Besides poor health, low living standards, rapid population growth and food security challenges, they are highly exposed to climate change impacts being remote, low-lying coastal communities.

There is also considerable expansion of resource development and replacement of native forest with palm oil plantations in PNG which brings increased pollutions risks, potential coastal development pressures and heightened shipping risks to the region. There are indications of increasing, and in some cases unsustainable, pressures on fisheries resources in the region from subsistence and commercial fishing operations off the PNG coast (Busilacchi et al. 2015) which has important implications for both PNG and Torres Strait communities and the health of sea country. Poor health care in neighbouring PNG villages also increases the exposure of Torres Strait communities to vector borne and communicable diseases such as tuberculosis (TB). Rapid population growth and the expansion of development in southern PNG are likely to be increasingly important influences on the Torres Strait region over the coming decades.

Children on Saibai playing during a king tide. Photo: John Rainbird

> **“Adaptation to climate change generates larger benefit to small islands when delivered in conjunction with other development activities, such as disaster risk reduction and community based approaches to development.”**
>
> IPCC AR5 Chapter 29 p.1616

The old community seawall on Saibai. Photo: TSRA

Global Trends

Challenges such as peak oil, fluctuating economic conditions and issues of migration, food cost and security, and national security will also have complex positive and negative impacts on local livelihoods and capacity.

Currently, the Torres Strait is heavily reliant on diesel for transport and for electricity. The costs associated with both these key services inhibit local development and place significant cost pressure on community and government alike.

The region is an internationally significant shipping route, and the risk of a shipping incident poses potentially significant threats to communities and the environment. The North East Shipping Management Plan (2014) has increased focus on the reduction of shipping risks in the Torres Strait and Great Barrier Reef region, but capacity to effectively respond to any major incident in the region is limited.

New technologies are rapidly adopted where available, and increased capacity for communication through social media, smart phones and the internet bring both positive and negative influences to community cohesion, but do expand possibilities for local economies and skills development.

The high level of reliance on government support does buffer the region to some degree from fluctuating global market forces, but does expose them to shifts in government policies and spending.

The adaptation and resilience action planning process

How does this Plan respond to these changes?

The approach to planning

The adaptation planning process adopted here includes a "top down" regional approach as well as a "bottom-up" community approach. This reflects the regional and local scales at which the region operates and is designed to assess and respond to issues at both these interlocking scales. The process also takes a systems approach, considering the intersections of drivers and regional cross-linkages, and to consider these in the development of adaptation pathways.

The community-based planning approach has been built on work funded by the Australian Government's National Environmental Research Program focused on adaptation in the region - Building Resilient Communities for Torres Strait Futures. The project, led by CSIRO in partnership with the TSRA, explored a livelihoods approach to development of adaptation and resilience plans. This approach was trialled on three island communities (Masig, Erub and Mabuiag). A number of elements of this approach have been built into or modified for the ongoing community workshop process to be conducted across the region. Actions identified in this project will be incorporated into respective community adaptation plans. A summary of the community-based planning approach is contained in Appendix A.

The Torres Strait Adaptation and Resilience Action Plan (this Plan) adopts an integrated climate change risk and vulnerability assessment (IVA) approach, focusing on vulnerability of key indicators across the five capitals (Natural, Financial, Human, Social and Physical). It deliberately avoids a sectoral approach, as this is a poor reflection of how the world actually works, and often fails to highlight the linkages between various parts of the "system" under consideration.

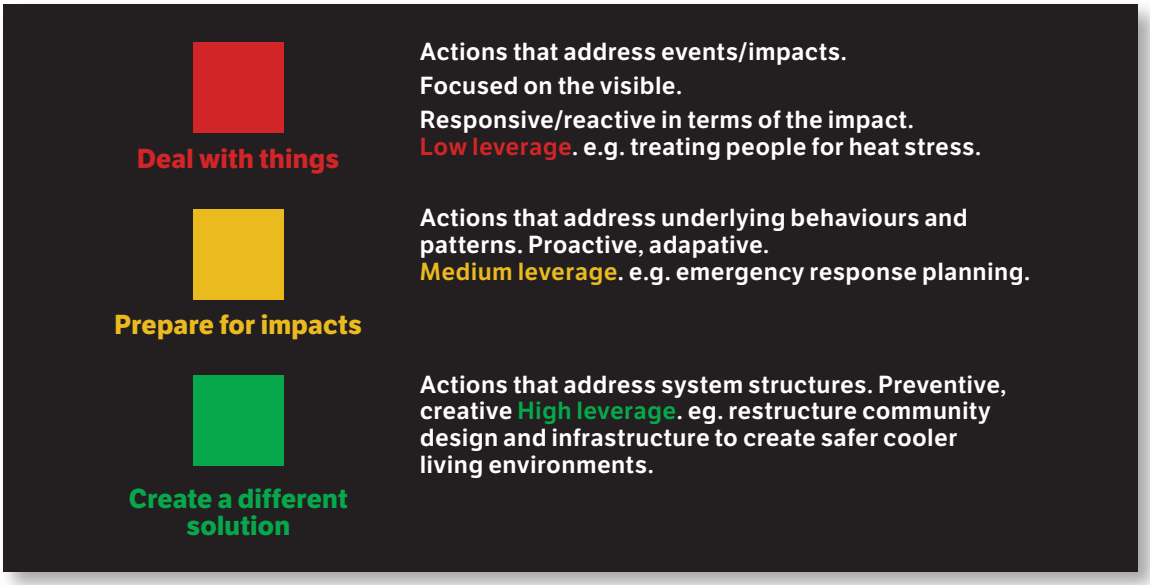
Coupled with this is a focus on general resilience. This is critical to addressing broader vulnerability and capacity issues that will determine community capacity to respond to and absorb climate impacts. Resilience assessments are undertaken at regional and local scales to create a baseline and to help identify areas for prioritisation. Using resilience principles, practical recommendations are made to help move the region towards greater resilience.

Climate change adaptation requires consideration of disaster and emergency management preparedness and recovery, and this Plan also highlights linkages and needs in this area to ensure the region is prepared to meet the impacts of extreme weather and other risks.

This Plan provides an initial list of actions under the themes of Adaptation (3 Outcomes) and Resilience (6 Outcomes).

The actions assembled under each Outcome were captured from a range of sources, particularly from a regional workshop held as part of the planning process. The collected actions have been sorted firstly by their contribution to the management cycle - information & knowledge gathering, policy & planning, implementation, building education & awareness, and monitoring. Secondly, the actions have been sorted by priority for implementation, with a multi-criteria analysis process used to prioritise those actions remaining after identifying those that are already being implemented or are essential for implementation.

Actions can also be grouped into three main themes in relation to how they address causes and symptoms of climate change and vulnerability:



In order to most effectively respond to the challenges of climate change and building resilience, it is important there are actions at all three of these levels.

Implementation of the Plan will be informed by, influence or take effect through various other reports and instruments including:

- Torres Strait Development Plan
- Torres Strait Regional Plan
- Torres Strait Island Regional Council Planning Scheme
- Torres Shire Planning Scheme
- Land and Sea Management Strategy for Torres Strait
- Various Evacuation Plans
- Torres Strait Local Disaster Management Plan
- Community Disaster Management Plans
- Relevant State programs in the Torres Strait

Decision Lifetimes

What decisions have long term consequences for the region?

Climate change is a major force for or driver of change, but there are other drivers that will determine the future of the Torres Strait. Adaptation planning that fails to factor in other key influences runs the risk of developing strategies based on false assumptions about future conditions and resources .

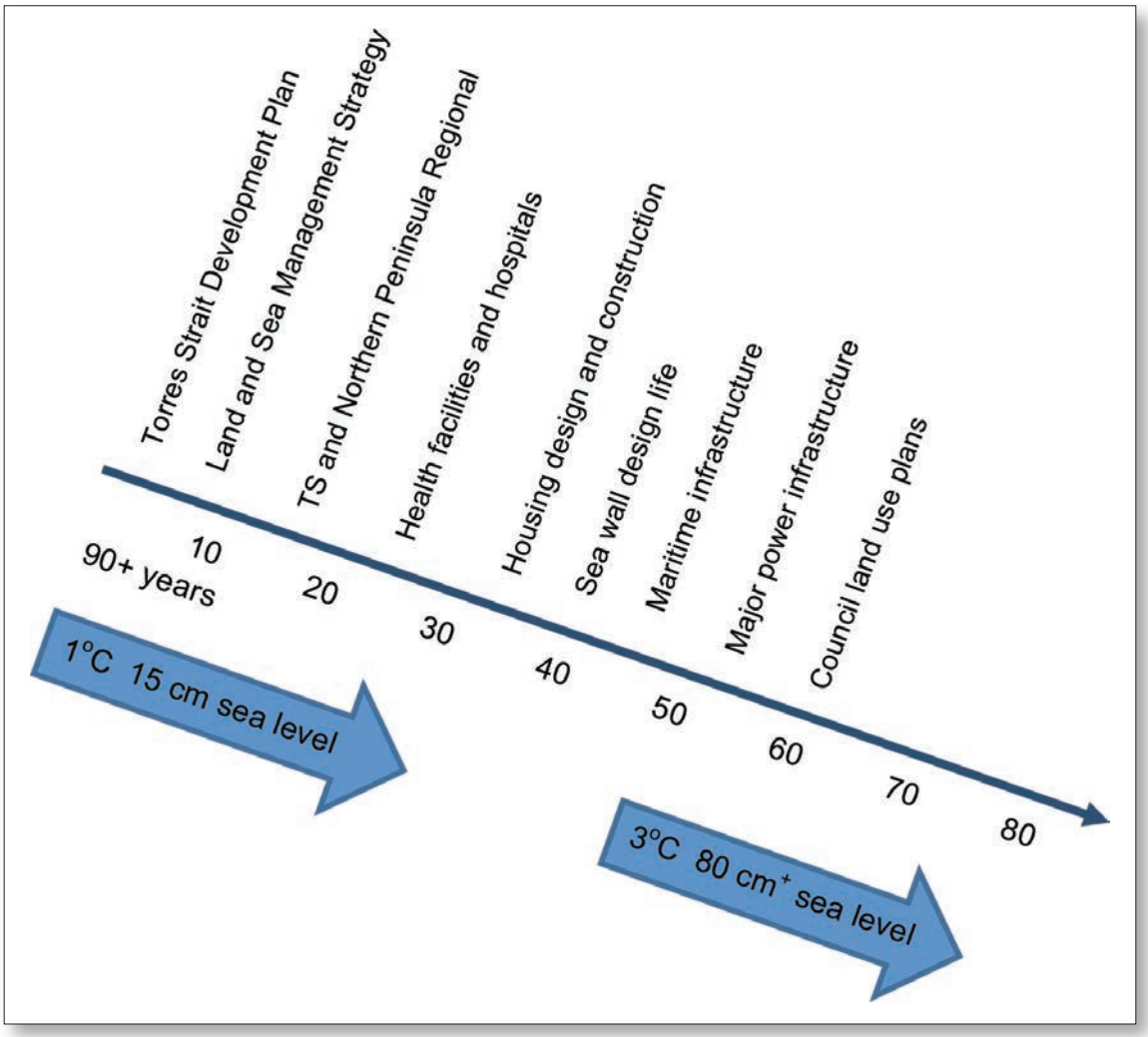


Figure 9: Lifetime of impact of some key decisions and planning instruments in relation to expected sea level and temperature projections

Successful adaptation in the region is going to require early consideration of what type of infrastructure is best suited to meet current and future conditions and where it should be located to ensure future generations are benefiting rather than being compromised by decisions made now.

Another example is in coastal protection. The installation of seawalls is critical to provide immediate protection of some communities from the impacts of sea-level rise, waves, tides and storms. However in the mid to long term, the installation of seawalls in some communities may well have impacts well beyond their initial design life. Seawalls act to protect communities from waves and sea-level rise. Safe behind the sea wall, construction and investment in infrastructure and housing occurs, further increasing the number of people who need to be protected. As seas continue to rise, the existing seawall is no longer adequate and will need to be built higher, most likely at greater cost, or may fail catastrophically exposing the community behind it to flooding. Ongoing investment in defence options may reduce available investment in other options such as staged retreat which may be a better longer-term strategy. A clear long term pathway needs to be considered that factors in relevant costs and benefits in order to decide which the best option is – defend, accommodate or retreat.

In 2009, the British medical journal the Lancet stated climate change as

“the biggest global health threat of the 21st century”

Adaptation principles

How do we make decisions that will deliver the future we want?

While values will determine what future we seek to achieve, any decisions that are made need to be guided by principles. Adherence to these principles will mean that decisions ultimately move us closer to achieving our vision. Adaptation in the Torres Strait is guided by principles that describe how adaptation responses at all levels will be prioritised, developed and delivered.

- Any adaptation needs to be sustainable. This means that our responses should not add to climate change, or limit the ability of other parts of the natural environment, society or business to carry out adaptation elsewhere. Our responses must avoid any detrimental impacts on other parts of society, the economy or the natural environment.
- Actions should be flexible. Although there is still uncertainty over the future climate, we should consider options now and make decisions that maximise future flexibility – in many cases it is failure to take decisions that locks us into inflexible pathways.
- Our response to climate impacts should be prioritised – for example, by focusing more attention on policies, programmes and activities that are most affected by the weather and climate, those which have long-term lifetimes or implications, where significant investment is involved or high values are at stake, or where support for critical infrastructure is involved.
- Adaptation measures need to be effective (reducing the risks from climate change without introducing perverse effects), efficient (the long-term benefits of adaptation actions should outweigh the costs), and equitable (the effects of the activity on different groups and where the costs should fall should be taken into account).
- Adaptation measures should promote resilience – for example delivery of new infrastructure should where possible prioritise appropriate technologies that do not place an unnecessary maintenance and operation cost burden on communities, thus further increasing their reliance on external support.
- The Torres Strait is a special place: the unique characteristics of the region and its people should be explicitly recognised and protected. Adaptation and resilience options (including development of economic opportunities) should be culturally appropriate.
- Relocation as a last resort: island communities do not want to leave their ancestral homelands as the islands and the sea that surround them are an inseparable part of their physical and spiritual identity.
- Management of climate change is complex, multi-faceted and needs an holistic approach to address complex inter-relationships between physical, biophysical, socio-economic and cultural factors. The interactions between climate and non-climate stressors also need to be considered.
- Local decision-making: Torres Strait Islander and Aboriginal peoples as Traditional Owners of the region have an inherent right to self-determination, including deciding upon the acceptability of potential risks. Building awareness and understanding of climate change is an integral part of this process. Communities should be provided with the full range of options relating to any decision.
- Short and long-term thinking: management needs to consider immediate, medium and long-term implications, and should serve the needs of both current and future generations.
- Responsiveness to local conditions: management actions should take into account local variations in the physical, ecological, social and economic characteristics of specific communities.
- Evidence-based: adaptation options should make full use of the latest research, data and practical experience so that decision-making is well supported and informed. It should also identify knowledge gaps and drive research where necessary.
- Integration: climate adaptation and resilience must be fully integrated into all levels of policy, planning and action to be most effective.

Poruma community members highlight the need for action to address erosion. Photo: Francis Pearson

Barriers to adaptation

What are the main barriers that slow down or prevent action?

In responding to climate change we need to understand the barriers to action. The key barriers to successful development and implementation of adaptation options for climate change include:

- Lack of community support: highlighting the need for effective community engagement and communication.
- Existing institutional and legislative frameworks: practical strategies at a local level can be inhibited by higher level legislation or processes; overly complex institutional arrangements can inhibit collaboration and the effective flow of information.
- Capacity and resource constraints: building local and regional adaptive capacity is critical.
- Lack of adequate external funding: strategies may require funding partnerships with external stakeholders that are complex or unattainable.
- Lack of system understanding: lack of understanding of thresholds and the interactions within a system can limit effective adaptation options.
- Lack of access to good quality relevant climate change projections.
- Inadequate assessment of adaptation options and poor prioritisation processes.
- For most natural systems there is a threshold beyond which adaptation is no longer possible. Human systems have greater flexibility in many ways, but we also face a range of physiological, economic and social thresholds which limit our capacity to adapt to change.

Barnett et al. (2015) highlight that the way institutions function in relation to the governance of natural resources and public goods is a deep driver of barriers and limits to adaptation. This is a key point for consideration by organisations in relation to their efforts to implement adaptation actions.

A number of the strategies and action identified in Part C of this Plan seek to address these barriers.

The effects of the changing climate in the Torres Strait

Climate change will have a range of impacts in the Torres Strait. The key direct impacts include sea level rise, heat impacts, extreme weather and ocean acidification. Aspects of the region most exposed to these impacts include low-lying settlements, water security, community health and ecosystem health.

To understand how and what it will impact, and what can be done about it, this next section draws on the Forum for the Future's Five Capitals Model and looks at five areas considered to be important for a functional and sustainable community which should aim to enhance all of these capitals rather than deplete or degrade any of them. These are:

Human Capital – Human capital incorporates the health, knowledge, skills, intellectual outputs, motivation and capacity for relationships of the individual. Human Capital is also about joy, passion, empathy and spirituality

Financial Capital – Enterprise and the economy

Natural Capital – Land, sea and climate

Physical Capital – Infrastructure and manufactured goods

Social Capital – The value added to activities and economies from human relationships, co-operation and *Ailan Kastom*.

(For more information on the Five Capitals see www.forumforthefuture.org).
A detailed analysis has been undertaken in each of these areas. Previous studies and research papers provided the background information. The impacts of climate change were assessed, and the results tested at an adaptation planning workshop involving regional decision makers.

The discussion below is a summary of the key themes arising from this analysis. It sets the scene for the nature and scale of changes to which the region will need to adapt. It also identifies where the impact can be partially managed with existing resources in the region. It begins with an assessment of the impacts on health and wellbeing.

Human capital: the outlook for health and wellbeing

How will our health be affected?

Human capital captures the skills, health and education of the people in the region. Of these, the analysis identified that the changing climate is likely to have the greatest impact on the health of people in the region.

Health: The median age of Aboriginal and Torres Strait Islander people in the region is 22 years. ABS 2011 data indicate death rates in the region continue to be higher than in mainland Australia, with cardiovascular disease, Type 2 diabetes, mental illness and substance abuse, accident and injury, cancer and chronic respiratory disease being responsible for over 64% of the burden of disease in the region.

> **“...climate change will have a significant impact on child health by the 2030s.”**
>
> World Health Organisation 2014

- Indigenous children are more likely to start school with twice as many developmental challenges
- Indigenous children are eight times more likely to be the subject of substantiated child abuse and neglect
- 20 -24 year old Indigenous people – four times more likely to commit suicide (male), five times more likely (female)
- Life expectancy is cut short by 9.5 years for Indigenous women and 10.6 for Indigenous men
- In 2012–13, Aboriginal and Torres Strait Islander rates for diabetes/high sugar levels were between three and five times as high as the comparable rates for non-Indigenous people in all age groups from 25 years and over
- Obesity rates for Aboriginal and Torres Strait Islander females and males were significantly higher than the comparable rates for non-Indigenous people in almost every age group.

Cleary addressing community health is a critical component of addressing underlying vulnerability to climate impacts and building community resilience. The Queensland Government has yet to assess climate change impacts on health, and the National Aboriginal and Torres Strait Islander Health Plan 2013-2023 makes no reference to climate change.

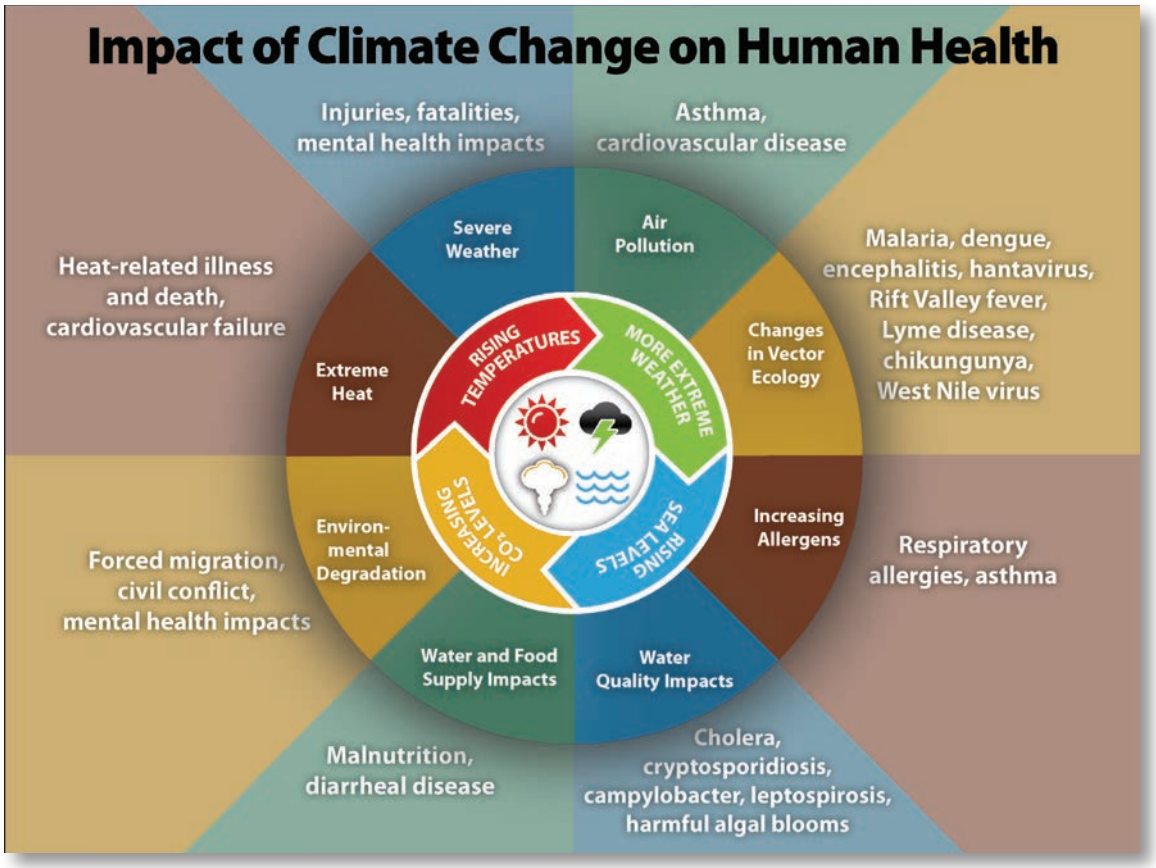


Figure 10: Climate change impacts on health. The inner circle represents the physical environment. The first ring is the four main manifestations of climate change. These interact with human and natural systems to result in impacts in the third ring. The outer diagram represents the resultant health impacts. Note – not all of the diseases listed are relevant to the Torres Strait. (Source: National Research Council,2015)

> **“For many Indigenous people, a connection with ‘country’ – a place of ancestry, identity, language, livelihood and community – is a key determinant of health. If community-owned country becomes ‘sick’ through environmental degradation, climate impacts, or inability of the traditional owners to full cultural obligations through ongoing management and habitation of their land, the people of that land will feel ‘sickness’ themselves.”**
>
> Green et al. 2009

Iama – dwellings exposed to wave impact. Photo: John Rainbird

Climate change impacts on health

Increased disease risk was identified as the most significant factor. The warmer temperatures will lead to greater risk of heat stress. As temperatures rise the number of very hot days will increase, leading to an increase in the likelihood of getting heat stress during those periods. Young children and those aged over 65 are considered most vulnerable. However, with a lower proportion of elderly in the community, when compared to the rest of Australia, the impact on this age group is less overall. In very dry conditions people can work outside in temperatures of up to 40oC, but the safety cut off drops below 30oC in very high humidity conditions due to a reduced ability to cool the body through evaporation of sweat (**Figure 11**).

Other disease risks arise from inundation which has already caused some low lying sewerage infrastructure to be flooded, polluting the sea around the affected island. As sea-levels continue to rise, the number of flooding-related sewerage discharge events is likely to increase. The pollution can linger in the waters around the island creating a direct risk for those swimming in the water. There is also some potential it could be taken up by some seafood species. Flooding of refuse sites and mobilisation of waste also creates a health risk.

The change in weather may also increase the likelihood of mosquito borne diseases. The warmer temperatures may lead to more favourable conditions for mosquitoes to breed. Indeed, hygiene standards overall will need to improve to combat the risk of transfer of communicable diseases due to the warmer and more humid conditions.

Climate change also increases the incidence of respiratory conditions such as asthma through impacts on air quality and impacts on the ozone.

Mental health impacts were also identified as a significant risk. Background issues such as the future possibility of relocation and impacts of sea level on sites of cultural significance add to people's unease and stress levels (Bowers, 2009). Climate impacts on physical health, economies, environment and infrastructure all have the possibility of increasing mental health impacts.

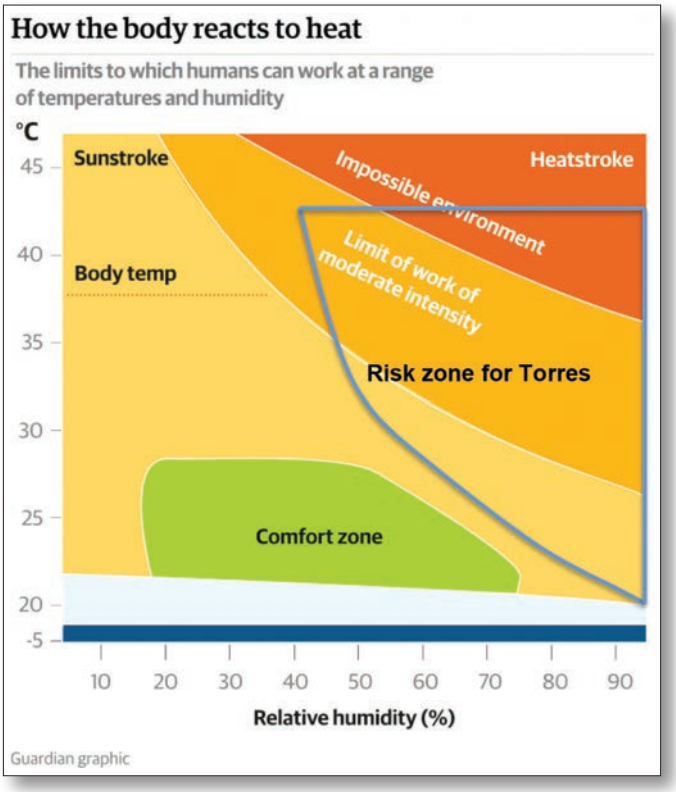


Figure 11: How excess heat will affect communities in the Torres Strait. (Source: de Lange, 2015)

Related to this is the possibility of an increase in anti-social behaviour arising through disruption to communities. If communities are displaced there is a possibility that there will be an increase in theft and violence arising from resentment, anger and disempowerment. These issues were considered less significant than other impacts identified above, as it is not yet a major issue and can be managed through current resources.

A less tangible risk is that the harsher weather may make it harder to attract health professionals to the region. This has the potential to reduce the quality of health care provided locally, and increase transport costs as those with severe illnesses will likely need to be taken to health centres elsewhere.

Engaging communities in positive and proactive activities will help counter such stresses, and whilst a major risk, climate change does also have the potential to help galvanise communities to collaborate to address a common threat.

> **“A recent study published in Nature Climate Change estimates that heat stress has already reduced global labour to 90% of capacity during the hottest months of the year. Under the most dire climate change projections, this could fall as low as 40% by 2200. The regions predicted to be worst affected include India, northern Australia and the south-east of the US.”**
>
> Source – The Guardian, 2 June 2015

The impact of climate on education was rated as less significant. The number of hotter days and increased inundation will affect educational facilities. These effects could be managed with minimal disruption within existing resources. Classroom outdoor activities can be rescheduled to avoid the hottest periods over summer. There can also be greater reliance on internet based learning. Adaptations such as renewable energy sources potentially could be employed to drive responses such as cooling technologies, and other building design and technologies that might have local application.

In summary, the key climate impacts identified from a human capital perspective were:

- Increased heat stress
- Increased transmission of diseases
- Discharge of sewerage increasing risk of disease transmission
- Mental stress arising from the possibility of displacement from some islands or other climate stressors
- Increase in respiratory conditions such as asthma
- Broader disruptions to economies and infrastructure that divert resources from health sector and undermine heath resilience.

Part C of this document outlines some of the strategies identified to address these issues.

The next area to be examined is the outlook for enterprise and the economy.

	2030	2050	2070	Adaptive Capacity
Infectious disease risk				**L**
Heat stress				**M**
Asthma				**M**
Mental health				**L**
Approximate timing of severity of impacts and indcation of adaptive capacity				

Financial capital: the outlook for enterprise and economy

What will be the effect on the economy of the region?

The economy of the Torres Strait provides the financial basis for the future of the region.

The region's economy is dominated by government and private sector services and commercial fisheries. This limited diversity, coupled with a range of barriers that undermine the development of a more diversified and resilient appropriate local economy, places the region at heightened risk to the impacts of climate change.

Tourism is currently a very minor component of the regional economy, but there is some potential for this sector to expand in niche markets associated with eco- and cultural tourism and recreational fishing tourism in particular.

Given the geography of the region, air and sea transport and freight are another significant component of the regional economy. The high cost of living pressures (driven mostly by freight costs) for food, retail goods and transport create additional economic challenges. Micro economies for individual islands have yet to be properly explored, but face challenges associated with local capacity and issues related to welfare dependence.

Climate change is likely to affect the regional economy on a number of fronts, including impacts on natural resources, labour productivity (from health impacts and shifts in working patterns related to hot weather), impacts on community, personal infrastructure and assets and increasing competition for government support from affected mainland communities.

Four indicators have been selected that represent the critical areas that are likely to be affected by the changing climate:

- Income from fisheries
- Income from tourism
- Investment in construction and engineering services
- Operation and maintenance of critical infrastructure

Income from fisheries

Key fisheries in the region include the Tropical Rock Lobster (TRL), Finfish, Beche de mer/sea cucumber, trochus, prawn and pearl oyster. There is currently focused effort on expanding local Indigenous participation in commercial fisheries.

Climate risks for fisheries: An assessment of the relative vulnerability of Torres Strait fisheries to climate change found that when comparing fisheries' importance and vulnerability to climate change, the TRL, pearl oyster and trochus fisheries are priority fisheries in relation to climate impacts (Welsh & Johnson, 2013).

Rising sea surface temperature, rising sea-level and ocean acidification are likely to have significant impacts on fisheries in the medium to long term, with a number of climate related changes in marine systems already documented around Australia and internationally (Hobday et al., 2006). Key vulnerabilities include the sensitivity of coral reef systems to temperature and acidification, vulnerability of key fish breeding habitats such as mangrove systems to sea-level rise, and a shift in distribution and abundance of target species to cooler waters. Increased storm intensity and higher storm surge can increase turbidity. Increased wet season rainfall coupled with ongoing land clearing in PNG might also increase runoff into the region, further affecting some aspects of fisheries.

Weather patterns are also likely to change. Some local fishers have already reported a shift in the monsoon by up to two months and changes in wind patterns that are making them less predictable. Such changes may impact the amount of time available to fishers to operate.

Infrastructure that supports fishing, such as jetties and wharves, is at risk from sea-level rise and storm surge. There are also complex interactions between rainfall, seasonality, water quality and other variables that impact the lifecycle and productivity of systems important to fisheries in the region.

Movement of fish to deeper waters may increase costs for fishers who already face high fuel and operating costs.

There is potential that certain fish stocks may increase in value as demand for good quality seafood increases. There is currently scope to increase the number of local fishers in the industry and still keep the industry within sustainability limits. An increase in the value of these stocks, however, carries the increased risk of illegal, unregulated and unreported fishing practices, and so the requirement to increase surveillance and compliance efforts.

Income from tourism

This has been identified as a potential opportunity for the region. There is currently limited tourism in the region, but it is recognised that the region has much to offer. Tourism provides an opportunity for local employment and can help to stem the potential flow of young educated people out of the region. Tourism would need to be developed in a way that aligns with community values and addresses any of their concerns. As a fledgling sector, there is still adequate scope to build a degree of climate resilience into future tourism development. The key climate change risks to future tourism are the changes in the ocean leading to declining reef health and increased coastal erosion, increased temperatures and disease risks and increased storms. All of these combine to make the region less attractive to tourists.

Risks that need to be managed include the loss of beaches, disease risks and damage to transport infrastructure from sea-level rise and storm surge.

Increased storms and runoff could increase turbidity of the seas and reduce the quality of the experience on the reef systems, dugongs and sea turtles. Conversely, a lengthening of the dry season may expand the region's tourism season.

Tourism provides an opportunity for local employment and can help to stem the potential flow of young educated people out of the region. Tourism would need to be developed in a way that aligns with community values and addresses any of their concerns.

Investment in construction and engineering services

Climate change impacts are likely to see a rise in investment in infrastructure and engineering services in the region. Increased sea-levels, rising temperatures, storms and changes in rainfall will all require increased investment in infrastructure construction and repair. Extreme weather events are likely to inflict damage on infrastructure, changes in background environmental conditions will tend to decrease the lifespan of many materials, and sea-level rise will ultimately force some communities to embark on staged relocation to higher or safer ground.

Increased investment in infrastructure will require that scarce resources be prioritised to critical areas. Good planning and risk assessment is required to ensure optimal investment.

There are opportunities to continue to build the capacity of local people to undertake the planning, design, construction and / or repair of infrastructure to help build the local economic base and to reduce the region's dependence on outside support. There are risks for the region associated with the high cost of infrastructure in remote areas and local capacity to meet the demand on skilled labour and professionals in this area.

Many buildings suffer from the use of sub-standard materials that do not last in the harsh environment of the region. This increases the risk of damage from extreme weather and increases operation and maintenance costs over the life of the infrastructure.

Building hazard areas into local planning schemes and planning for future development to occur in safer areas through a staged relocation process will help to significantly reduce many risks to infrastructure and services. There is adequate time to undertake this process to ensure all options are considered and that future plans are well considered, appropriate, and have the required support and investment, although it would be prudent to commence this planning and analysis process soon.

Operation and maintenance costs of critical infrastructure

Increased temperatures will increase demand for air conditioners, putting stress on the power networks. Lengthening of the dry season will put stress on water supplies dependent on rainfall. Increased sea-level will potentially lead to salinisation of groundwater supplies and increased flooding of sewerage systems. Extreme

> **“The economic impacts are likely to be severe, but could bring opportunities.”**
>
> **Climate Change Issues and Impacts in the Wet Tropics Cluster Region, 2014**

weather events are likely to inflict damage on infrastructure. Changes in background environmental conditions will tend to decrease the lifespan of many materials. There will also be increasing maintenance requirements for sea walls and other coastal and maritime infrastructure as sea-levels and storm surges increase.

In most areas, there is limited backup for current utilities, particularly power supply and sewerage. The remoteness of communities can also mean delays occur in getting parts, materials and expertise out to site to repair services.

There are opportunities to increase local power generation through solar, wind and tidal technologies to increase resilience of power supplies and reduce ongoing power costs. Tidal energy produces base-load power and can also be used to produce desalinated water, for example.

The current operation and maintenance costs of environmental health infrastructure are beyond the capacity of councils to cover, and are economically unsustainable in the longer term. Current technologies, whilst of a high standard, may expose communities to service failures due to their centralised and complex nature. There are opportunities related to developing infrastructure that is better suited to remote island locations that have lower economic and environmental costs and build greater resilience into communities.

Construction of energy efficient housing for example, while having a higher upfront cost, will have significant benefits in the long term by reducing demand for power. Where possible, decentralised low technology waste water management options may be a better option on suitable islands compared with the current high technology energy intensive systems which are expensive to build and operate and are highly exposed to saltwater intrusion.

In summary, the key climate impacts identified from a financial capital perspective were:

- Declines in local availability and or productivity of key fisheries species
- Storm and sea-level impacts on infrastructure that underpins economic activities
- Increased cost burden for replacement, repair and maintenance of infrastructure
- Damage to potential tourism assets (natural and built)
- Impacts on productivity from health impacts

	2030	2050	2070	Adaptive Capacity
Impacts on fisheries				**L**
Impacts on tourism				**M**
Impacts on infrastructure				**M**
Impacts on productivity				**M**
Approximate timing of severity of impacts and indcation of adaptive capacity				

TSRA in collaboration with AIMS and communities have established a network of marine monitoring stations and temperature data loggers to monitor changes in sea surface temperature across the Torres Strait

Natural capital: the outlook for land and sea

How will the natural environment respond?

The natural environment of the Torres Strait underpins every aspect of the region. The region is still relatively pristine, with diverse marine and coastal ecosystems of national and international significance. Besides climate change, the main threats to the region's environments are resource and plantation development pressures in neighbouring PNG, excessive extraction of marine resources by foreign fishers along the PNG coast and the possibility of a major shipping incident. Commercial and traditional fisheries in the region are considered to be sustainably managed.

Torres Strait culture and livelihoods are still very strongly linked to the region's natural environments and resources (**Figures 12** and **13**).

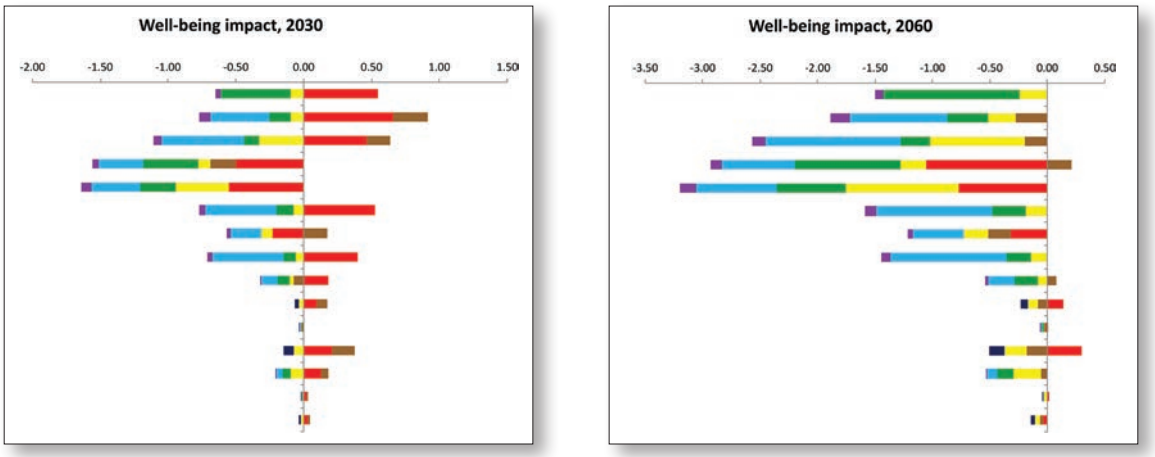


Figure 12: The relative contributions of climate change and population-derived impacts on human well-being for Badu Island ecosystem goods and services in 2030 under the Business as Usual scenario (Bohensky et al. 2014). For some species and systems initial small increases in temperature show a positive impact on the resource, but this changes to a mostly negative impact as temperatures continue to climb beyond 2030 (see **Figure 13**). These results are derived using the Assets Drivers, Well-being Interaction Matrix (ADWIM) developed by CSIRO

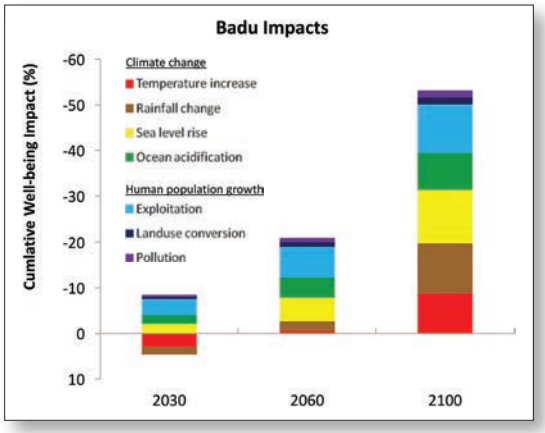


Figure 13: Example of projected impacts of climate change and other threats community well-being through their impacts on ecosystems goods and services. Based upon Representative Concentration Pathway 8.5 (Source: Bohensky et al. 2014)

Eight indicators have been selected by the project team that represent the critical areas that are likely to be affected by the changing climate. These are:

1. State of coral reefs
2. Mangrove health and extent
3. Dugong population and distribution
4. Sea turtle population and distribution
5. Impact of invasive species
6. Extent of coastal erosion
7. Extent of inundation
8. Diversity of terrestrial biodiversity

State of coral reefs

Coral Reefs of the Torres Strait are relatively healthy and highly diverse, suffering very little in the way of human impacts. However, there are established temperature thresholds beyond which corals will suffer bleaching, and current projections indicate many reefs will experience seasonal conditions past these thresholds by 2050. If bleaching events occur too frequently, corals will not have a chance to fully recover, leading to permanent decline in some reefs. Increased ocean acidification will reduce the capacity of corals to lay down carbonate skeletons and reduce their capacity to recover from damage.

Significant warming will promote reef-associated species migration, potentially putting key ecosystem functions at risk. Large increases in sea-level will limit light penetration to deeper coral reefs in areas where water has high sediment levels.

Increases in extreme weather (storms) will increase structural damage to corals and potentially reduce the topographic complexity and habitat diversity available on affected reefs. Increased rainfall in PNG catchments may lead to greater sediment and freshwater intrusion into eastern Torres Strait with impacts on coral reefs.

Declines in water quality can facilitate outbreaks of coral disease and crown-of-thorns starfish (COTS) in some regions, which can both have significant impacts on coral health.

If the rate of change is too fast, coral reefs are limited in their capacity to adapt (Hoegh-Gulberg et al, 2007). Coral spawn is mobile so some migration of species can occur to areas where conditions may be less hostile. Ocean acidification is a major long-term threat to coral reefs. Corals of the Torres Strait region are likely to have a higher temperature threshold than species in cooler waters.

Mangrove health and extent

Currently the mangrove systems in the region are very healthy, diverse and extensive with only minor localised impacts. Mangroves play a key role as habitat, nursery and food for many marine species, and impacts on mangroves are likely to ripple through parts of the marine ecosystem. However mangroves and associated coastal wetlands are amongst the most at risk ecosystems in the region to the impacts of climate change.

Sea-level rise is the biggest climate threat to mangroves which will ultimately drown out mangroves that colonise the lower limits of the coastal zone (Duke, McKenzie & Burrows, 2012). Mangroves can colonise new areas fairly rapidly, but soil type, topography and human settlements might limit the ability of mangroves to expand their distribution landwards in response to sea-level rise. Coastal ecosystems on the very low-lying islands of Boigu and Saibai have no real options for retreat.

Changes in marine and ambient conditions may negatively impact keystone species (species critical for the health of the community) in mangrove communities with flow on implications for the broader health and functionality of mangrove communities.

Increased storm surge and lighting will negatively impact mangroves but extended dry seasons may favour mangrove growth. Potentially more and or longer periods of decreased coastal salinity due to runoff may increase stress for mangroves.

Dugong population and distribution

The Torres Strait is the dugong capital of the world, with healthy and stable populations of dugong supported by some of the world's most extensive seagrass meadows. Dugong populations along the east coast of Queensland have however suffered significant declines due to development impacts on seagrass environments.

Dugong are impacted by climate change primarily through impacts on seagrass. As a fairly specialist feeder, dugong are highly vulnerable to any impacts on their feeding grounds. Dugong are relatively slow breeders and, as such, are more vulnerable to impacts on their numbers.

Longer term sea-level rise will reduce available light to seagrasses in some circumstances. Chances in ambient conditions may lead to shifts in seagrass community composition and distribution, with flow on impacts for dugong. Severe storm events can reduce seagrass cover and increase the risk of dugong strandings.

Warmer oceans with higher carbon dioxide content may potentially lead to expansion in distribution and or increase productivity of some seagrass species.

Whilst dugong is an important food culturally in the region, extensive scientific population surveys indicate no significant decline in numbers due to Indigenous hunting. Population numbers are substantial and sustainability is aided by the establishment of a dugong sanctuary in the eastern Torres Strait (Marsh, Grech & Hagihara, 2011).

Sea turtle population and distribution

The Torres Strait is home to one of the world's largest breeding populations of green turtles, as well as being an important feeding and breeding locality for hawksbill, olive ridley, loggerhead, flatback and leatherback (rare) turtles. Turtles are fairly generalist as feeders and so have greater adaptive capacity in relation to securing food than species such as dugong. They are also highly mobile and able to move to new areas if required. Turtles are long lived and produce many eggs, which increases their capacity to recover from population declines.

However, climate change poses several key threats to turtle species, principally associated with their breeding success. Incubation of sea turtle eggs is strongly influenced by sand temperature. As the sand temperature rises the gender of the eggs is skewed towards females. Sea-level rise has the potential to inundate important breeding beaches and cays, resulting in the drowning of eggs or loss of breeding sites from inundation or erosion. Storm surge also has the potential to expose breeding grounds and damage eggs.

Broader impacts of warming and acidification on oceans may have indirect impacts on turtles, some of which might be positive (e.g. possible increase in food species such as jellyfish), but are overall likely to be negative.

Impacts of erosion and inundation on critical nesting sites could see a catastrophic decline in the northern green turtle population over coming decades.

Impact of invasive species

Located between mainland Australia to the south and PNG to the north, the region is susceptible to invasive species coming in from both these landmasses. Most of the region still has healthy, intact ecosystems that are less susceptible to invasion by pest species than disturbed environments.

Currently the main invasive plant species in the region are Leucaena and Lantana, although a number of other invasive weeds are present and require management. Cane toads have become well established on Thursday Island and have also been sighted on Horn Island. Climbing perch, a highly invasive fish, has established on Boigu and Saibai. There are some feral pigs, goats, deer and livestock on some islands. Domestic and feral cats and dogs can pose a significant risk to island fauna and nesting turtles (dogs). Currently, no known marine invasive species of concern have been detected in the Torres Strait (Neil, Hilliard, Russell & Clark, 2008), but as a major shipping route there is increased risk of the introduction of such pests. Several other pest species and diseases such as Asian Honey Bees and Black Sigatoka threaten both the terrestrial environment and food producing capability of the region.

Likely climate impacts on invasive species include the possible expansion of the distribution of pest species from areas north and south of Torres Strait into the region. Stressed ecosystems will become more susceptible to weed and pest animal invasion and new climatic conditions may be suitable to a broader range of potential invasive species.

Shifts in fire regimes may favour some weeds. Wind dispersed species will become more of a threat.

> “Climate changes that degrade ecosystem quality will significantly affect the cultures, identity, and psychosocial well-being of Torres Strait Islanders. The costs of such impacts cannot be understated, nor adequately compensated.”
>
> McNiven, 2004

Green turtle hatchling. Photo: Tristan Simpson

CASE

Coastal erosion and inundation

Coastal erosion and inundation are of particular concern and significance to Torres Strait communities, and sea level rise is a very serious medium to long-term risk for low lying island communities. A significant amount of research and activity has occurred to help fully assess the risks and to develop response options, much of it focused on the exposed communities of Saibai, Boigu, Iama, Masig, Warraber and Poruma. Work to date includes:

- State government assessment of erosion and inundation risks on the six most exposed islands
- Detailed erosion and inundation studies for all inhabited island
- Detailed modelling of sea level and storm surge risks for all inhabited islands
- Developing of coastal hazard mapping that includes local storm surge factors and sea level rise up to 1.1 metres (**Figures 14** and **15**)
- Installation of four tide gauges across the region for real-time tide and storm surge monitoring

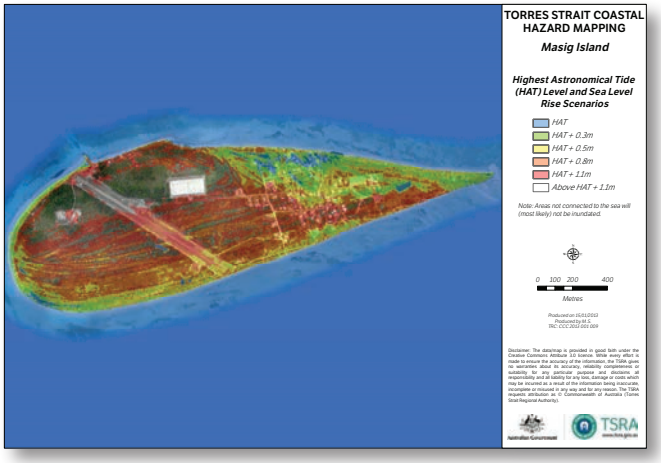


Figure 14: Sea level rise mapping for Masig showing levels of inundation at highest astronomical tides from current sea level to 1.1 m above current levels (Source: TSRA)

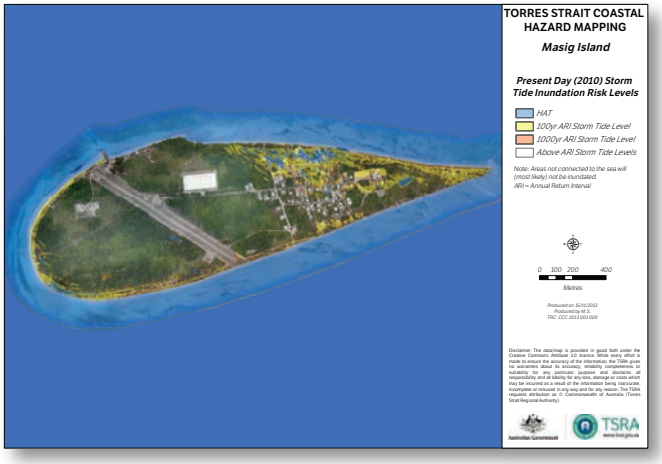


Figure 15: Storm tide mapping for Masig (Source: TSRA)

Figure 16: Saibai seawall under construction. Photo: TSIRC

STUDY

- Installation of a National Tidal Centre sea level gauge for long-term monitoring of changes to sea level
- Coastal engineering studies to develop management options for most at risk communities
- Securing $26.2 million from State and Commonwealth Governments to progress the installation of coastal defences (**Figure 16**)
- Development of a coastal vulnerability assessment model (Harper, 2014) to assess cost/ benefits and timing of defend or planned retreat options (**Figure 17**)
- Assessment of sea level rise that would result in annual inundation of around 20 times per year based on astronomical tides as a possible threshold (**Figure 18**)
- Establishment of beach profile monitoring by Ranger groups to monitor coastal erosion and accretion at key sites.

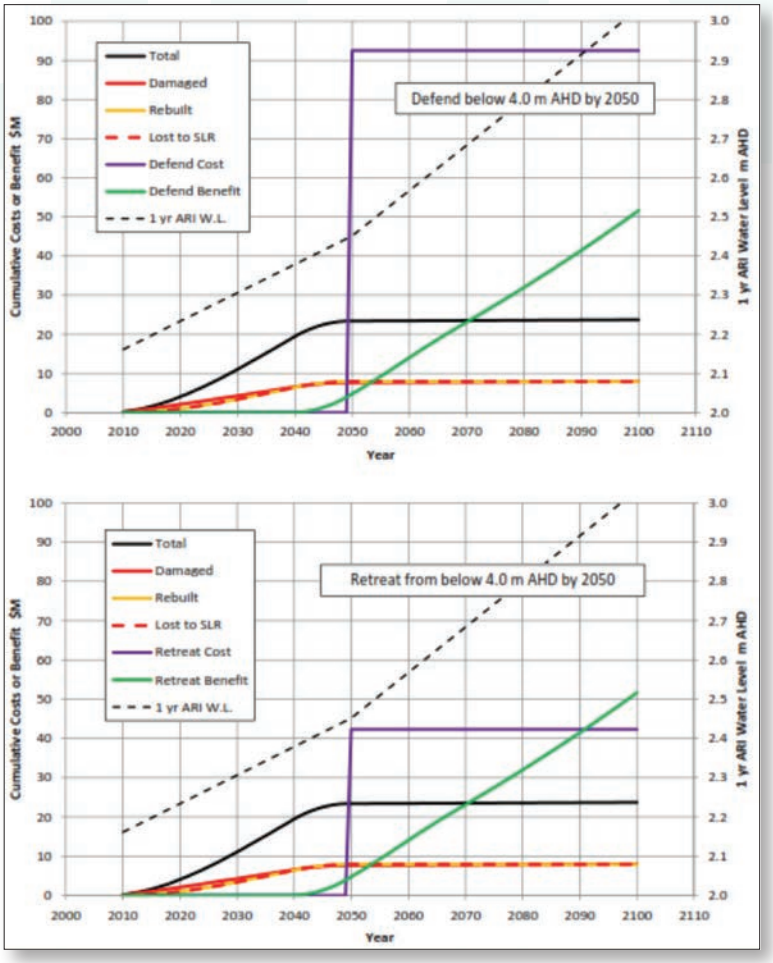


Figure 17: Cumulative damage and SLR costs under a Defend (top) and Planned Retreat (bottom) sample case example (Source: Harper, 2014)

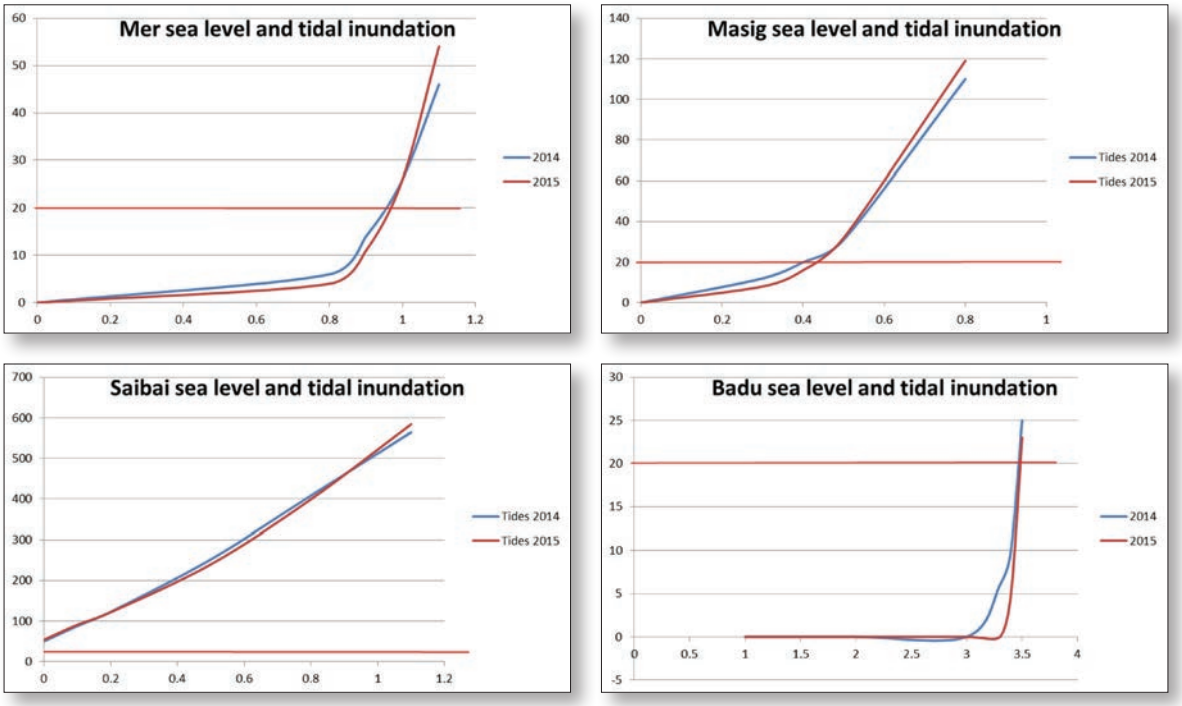


Figure 18: Sea levels that would result in annual inudation around village areas of around 20 times per year based on still water astronomical tidal flooding for four communities using 2014 and 2015 astronomical tides (Source: TSRA). (Note: Based on no seawall at Saibai)

Detailed studies have been done across the region to assess erosion and inundation risks and to inform coastal hazard assessment

Extent of coastal erosion

Coastal erosion is an ongoing natural process that impacts many island communities. However with regional sea-levels rising two to three times faster than the global average rate of 3.2mm per year, communities are increasingly impacted by big tidal and storm events that exacerbate erosion. Traditionally, communities were able to relocate their dwellings to accommodate changing coastlines, but infrastructure is now more permanent. Erosion is a high priority issue for coral cay communities and communities located immediately adjacent to eroding beaches (Parnell, Smithers & Ischenko, 2013). Whilst it has its disadvantages, sometimes hard engineering solutions are the only effective response available to protect vulnerable infrastructure. Maritime infrastructure such as barge ramps and access channels has in many cases exacerbated local erosion.

Many islands in the region are low lying and small, which significantly increases the relative impact of erosion.

There is capacity to reduce the impacts of erosion through installing hard and soft erosion control measures, moving infrastructure away from the coast or avoiding settlements in erosion prone areas. AECOM (see pg 54) have developed a coastal hazard assessment approach to help prioritise adaptive responses (accommodate, relocate, defend) to coastal impacts. Leaving mangroves intact helps to reduce erosion impacts. Planting mangroves in erosion prone areas is not likely to succeed as mangroves rarely establish in these conditions. Low cost interim measures can assist in the short term, such as protecting upper beach areas with wooden or bamboo fences to help retain sand.

Extent of inundation

A number of the region's communities are located in low-lying coastal areas that are likely to suffer increasing inundation on high tides as sea-levels rise. Sea-levels are now expected to continue to rise for at least several centuries and will cause gradual permanent loss of low-lying coastal areas to inundation and will also compound erosion problems.

Some of the very low-lying islands will eventually suffer inundation at a frequency that reduces their liveability. However, at current rates of sea-level rise, communities on these islands are very likely to have at least several decades before inundation impacts the viability of services and amenity.

In the short to medium term, there is capacity to respond to sea-level increases through raising buildings and installing coastal defences. The costs associated with adequately responding to more significant sea-level rise through extensive seawalls and raising communities are likely to be progressively more prohibitive over time and will at best buy time rather than being a permanent solution.

Some communities have capacity to move to higher ground, but some do not have this option and may need to consider relocation within or beyond the region. Relocating entire communities is a much more significant proposition with major social, cultural, economic and environmental considerations, and is a last resort.

What is required is a well-considered, community led strategy to assess risks, identify thresholds, options and priorities. This will enable the development of a clear pathway for communities and governments to respond to risks from sea-level rise as they unfold. This requires significant discussion and planning to ensure community aspirations and priorities are adequately considered. All options need to be assessed, land tenure issues will need to be addressed, both relocated families and host communities should not feel disenfranchised, and adequate provision must be made for housing, land access and services to areas where families are relocated.

Diversity of terrestrial biodiversity

The knowledge base of the region's terrestrial fauna is growing, with a number of excellent biodiversity surveys being conducted on key islands. There are still significant knowledge gaps on terrestrial and freshwater invertebrate fauna and on the biogeography of the region to identify any critical sites or resources for the migration of waders and other birds and internal movement and dispersal of species within the region.

	2030	2050	2070	Adaptive Capacity
Impacts on coral reefs				L
Impacts on dugong				L
Impacts on turtles				L-M
Impacts on invasive pest				M
Impacts on mangroves				M
Impacts on coastal erosion and inundation				M
Approximate timing of severity of impacts and indcation of adaptive capacity				

Climate change impacts: Shifts in rainfall timing and intensity will impact terrestrial species and ecosystems, primarily through changes in vegetation and food availability. Shifts in seasons can cause disruptions to breeding cycles and plant phenology (flowering and fruiting). Extended dry season and higher summer temperatures may increase the risk of bush fires, which can be very significant for small island ecosystems. An increased risk of pest invasions associated with climate change can cause significant disruption to some ecosystems. Increased evaporation potential can stress vegetation during dry seasons, and also increase fire risk. Reduced free surface water in the dry season may also lead to stress on terrestrial fauna.

Island ecosystems have little adaptive capacity to deal with rapid change. Some species such as bats have the ability to migrate, but most island vertebrates have limited capacity to move off islands.

Due to the small size of many islands, they are more susceptible to shocks and disturbances, and there is less scope for refugia to provide a haven during times of duress. Low lying island and coastal ecosystems such as wetlands are at risk of temporary or permanent submersion due to sea-level rise.

In summary, the key climate impacts identified from a natural capital perspective were:

- Changes in ocean temperature and chemistry will negatively impact many marine species and ecosystems, in particular coral reefs
- Losses of seagrass meadows and turtle nesting areas are significant threats to dugong and turtle populations
- Increased rainfall in PNG catchments may lead to reduced water quality in the northern Torres Strait
- Changes in rainfall and seasons and an increased risk of bushfires will negatively impact terrestrial fauna and flora
- Sea-level rise is a major threat to mangroves, coastal areas, coastal ecosystems and coastal amenity

Coastal hazard mapping has been completed for all inhabited islands. Mapping considers both local storm surge factors and sea level rise

The outlook for infrastructure and services

Will infrastructure and services be seriously affected?

The infrastructure and services of the Torres Strait are critical for community well-being and function. The region has a relatively good standard of infrastructure for waste, energy, transport and water.

Climate change will exacerbate risks to infrastructure through damage from extreme weather events, inundation from sea-level rise and reduced lifespan of materials due to temperature and chemistry changes in the atmosphere and oceans. There are indications the lifespan of steel reinforced cement could be substantially reduced in some regions, increasing repair and maintenance costs.

Five indicators have been selected that represent the critical areas that are likely to be impacted by the changing climate. These are:

1. Water supply
2. Functioning transport networks
3. Functioning power generation
4. Functioning communications networks
5. Functioning waste management services

Water supply

Fresh water is a limited resource on most of the islands and most communities already experience significant water restrictions during drier months. A range of water management options are used to supply and manage fresh water, including the use of covered water catchment areas, desalination plants, domestic rainwater tanks and Council led water conservation programs. In most cases, community wells are no longer used due to access to mains water and or previous contamination of ground water from previous septic tanks or saltwater intrusion.

Drinking water supply is threatened by a likely shortening of the wet season coupled with possible increased demand. Coastal erosion is already a risk to some desalination plants. The increased risk of mosquito borne diseases may impact on the use of rainwater tanks if they are not properly managed. The high costs of running and maintaining the current water supply infrastructure is an economic risk. Some island water tables, especially those on the low lying coral cays, are at risk from saltwater intrusion, which may impact their capacity to be a future source of fresh water. Hotter summers will increase water stress and increased fire risk may also put a strain on water resources. Planning for improve water security and reducing the costs of water supply is a high priority.

Functioning transport networks

Sea freight is the main mode of transport of goods into the region and between islands. Air services are the main mode of passenger transport into the region and between communities. Inhabited islands have a road networks for travel within communities. Maritime infrastructure (wharfs, jetties and barge ramps) is an important component of maritime transport infrastructure.

There are a number of climate variables that will impact transport networks. High temperatures can cause bitumen roads to soften. This can increase the rate at which potholes and rutting can form, and increases the maintenance costs of road networks.

Sea-level rise will impact wharves and jetties, roads and pavements, and ocean acidification will reduce the life of concrete structures in the ocean. Road infrastructure in low lying areas is particularly sensitive to sea water inundation. Coastal maritime infrastructure is also sensitive to more frequent and permanent flooding from sea-level rise and storm surge.

One positive impact is that deeper water into the future will facilitate movement of vessels through shipping channels currently too shallow to use, and may increase barge access to communities where high tides are needed to traverse the reef platform.

State and Federal government policies aimed at reducing carbon emissions may increase the cost of diesel and petrol and aviation fuel.

> “Adapting to more frequent damage to infrastructure in general will require budgetary provision for more frequent maintenance, repair and replacement.”
>
> Moran, Turton & Hill, 2014

Saibai foreshore with old seawall and wetlands behind the houses. Photo: John Rainbird

Functioning power generation

All islands except Prince of Wales (Muralug), an inner island situated next to Thursday Island, are currently serviced by diesel generators for electricity. Thursday Island has two wind turbines and a number of the buildings have grid connect solar PV systems. The cost of provision of electricity is very high per household due primarily to the diesel supply costs. Without further investments in upgrading the generators and grids there are likely to be increased interruptions to power supply, particularly during times of peak demand such as when the network is stressed to cope with air conditioning and refrigeration on very hot days. As global oil reserves continue to decline, the cost of diesel based power is likely to continue to increase.

Increased storm risk can disrupt supply through damage to power lines and other infrastructure. Sea-level rise will eventually inundate low lying power generation infrastructure. Periods of excessive heat can cause grid failures.

Increased deployment of renewable energy technologies is a more logical fit for island communities over continued reliance on imported diesel. The region has very good wind, solar and tidal resources which are currently barely used. Stronger winds will increase the available wind resources for power generation.

Functioning communications networks

Most of the region has access to a mobile telecommunications network, for which there is a proposal to further upgrade and extend this network to cover all inhabited islands. Satellite phone and UHF radios are also used for emergency and vessel communications.

Increased storm and bushfire activity has the potential to disrupt communications networks.

There is limited redundancy in the telecommunications networks. Telecommunications are critical to support commerce, health services and emergency management. An increased likelihood of emergency situations will test communications capabilities.

Functioning waste management services

Waste management is a major issue in the region. Islands have limited space to store and manage waste. Quarantine restrictions inhibit the movement of certain organic waste materials. There are very few local opportunities for recycling non-putrescible materials. Islands have tertiary waste treatment plants to manage sewerage. Freight costs also add a barrier to removal of waste such as old white goods and vehicles. Strong prevailing winds blow plastic waste into the marine environment. Goods imported into the region are often excessively packaged, compounding local waste management issues. Warraber Island has a trial waste recycling program that also produces compost from organic waste streams. The cost of freight together with

	2030	2050	2070	Adaptive Capacity
Extreme weather impacts on infrastructure				**M**
Temperature and chemistry change impacts on infrastructure				**M**
Sea-level impacts on services and infrastructure				**M**
Impacts on Fire risks to infrastructure				**M**
Approximate timing of severity of impacts and indcation of adaptive capacity				

quarantine restrictions and low volumes preclude the use of high-technology waste-to-energy options.

Storm surge and rising seas are impacting some landfill sites, washing contaminated materials and potential dangerous items out into the broader community and environment.

Saltwater inundation disrupts the functioning of waste water treatment plants, resulting in the plants needing to pump the salt-contaminated raw waste out into the coastal waters in order to "reboot" the system. This creates a public health risk and reduces the lifespan of the plants.

Warmer temperatures will favour the recycling of putrescent waste into compost.

In summary, the key climate impacts identified from an infrastructure and services perspective were:

- Water supply is threatened by various climate impacts including sea level rise, increased heat and longer dry seasons
- Extreme weather is likely to disrupt services and damage infrastructure
- Changing temperatures, increased variability and changes in air and ocean chemistry will decrease the lifespan of infrastructure
- Sea-level rise is impacting some landfill and waste treatment facilities
- Sea-level rise and storm surge threatens some key maritime, aviation and road transport infrastructure
- Warmer temperatures and mosquito borne disease pose a risk to water security
- Increased fire risk is a threat to some infrastructure

Social capital: the outlook for community and *Ailan Kastom*

How will our communities change in response to climate change?

The region has a unique culture and unique languages, and the importance and continued practice of *Ailan Kastom* is one of the region's greatest strengths. However, like many other Indigenous cultures, traditional culture has in many ways been negatively impacted by western cultural influences and technologies. Climate change poses additional threats to both cultural sites and cultural practice.

Whilst communities have access to a broader range of food through the community store, this has also helped to undermine the need for local food production and collection, with flow-on impacts on community collaboration, health and well-being.

Students of high school age have to go to Thursday Island or the mainland for schooling, which also impacts cultural and community cohesion. Many Islanders are still tied to the welfare system due to limited local employment opportunities.

Emergency management planning and capability are improving, but the dispersed and remote geography of the region coupled with under-resourcing of this sector pose significant risks and challenges.

Six indicators have been selected that represent the critical areas that are likely to be impacted by the changing climate. These are:

1. Number of outdoor sporting and cultural events
2. Rates of community participation
3. Demand for emergency management
4. Proportion of people under financial stress
5. Access to affordable nutritional food
6. Sufficient community services and support staff

> “Indigenous people have an inherently high capacity for resilience through their traditional, adaptive knowledge systems.”
>
> Moran et al., 2014

> “Strengthening communication, trust and social support networks will build community adaptive capacity.”
>
> Moran et al. 2014

Use of concrete slabs at Masig to reduce erosion. Photo: John Rainbird

Number of outdoor sporting and cultural events

Outdoor activities are likely to be curtailed by hotter temperatures, longer hot spells and an increase in apparent temperature. Increased evaporation potential may also exacerbate the risk of dehydration. Intense wet season rainfall may also reduce opportunities for outdoor activities during summer months. However, extended winter dry seasons may allow for greater outdoor activity subject to temperatures.

Rates of community participation

This indicator is influenced by complex interactions related to shifts in community demographics, culture, well-being and needs. Climate change will likely drive some reduction in community participation through impacts on the health of individuals and possible declines in the populations on some islands, but may also drive an increase in participation through a sense of common purpose to tackle challenges and the need for greater collaboration to maintain community function and well-being.

High rates of community participation exist through community run meetings and workshops around certain themes. Community led workshops allow communities to really examine their own values and frame the discussion around these. High rates of attendance by young people correlate with community ownership of issues. Meetings cover a diverse range of issues, including fisheries, housing, and governance. However, community members expressed concerns that the number of community meetings has decreased since council amalgamation.

Demand for emergency management

Hotter days, more hot days, severe storms, increased coastal flooding, increased fire risk and intense rainfall are all likely to increase demand on emergency services.

The remoteness and relative isolation of Torres Strait communities increases their vulnerability to disaster. Certain sections of communities such as the elderly, very young, sick and financially stressed are likely to be more vulnerable to disaster situations.

There is currently some uncertainty as to who on the islands is responsible for mobilising communities and implementing disaster management plans, and development, coordination and implementation of disaster management is not adequately resourced given the geography of the region. Some communities do not have emergency shelters to go to. Not all State Emergency Service (SES) groups are active, well trained and equipped. There is still a need to improve emergency communications capacity when the telephone network fails and cloud cover precludes the use of satellite phones.

Most people have no insurance for personal loss due to disasters.

Local capacity to respond to house and building fires is very limited.

Ship groundings or fuel spills are considered to a major risk to both the local environment and communities. There is a need to integrate local disaster management with Maritime Safety Queensland (MSQ) and the Australian Maritime Safety Authority (AMSA) emergency response planning.

Proportion of people under financial stress

Temperature and acidity impacts on marine life could impact people economically. Sea-level rise, storms, and intense rainfall could also contribute to financial stress through loss or damage to property and income. Heat stress could contribute to lost productivity and opportunities to earn money.

Currently there is limited opportunity within communities for employment outside of government services. Cost of living pressure are high, and combined with low income, give families very little financial margin. The cost of electricity and fresh food both have a major impact on family budgets.

The lack of local opportunity combined with many youth getting a good education in mainland cities is leading to a potential brain-drain as people move south to seek opportunities for employment and career development.

Current regional economic development initiatives should continue to foster entrepreneurship, address systemic blockages to employment and enterprise, and support small scale (micro) local economies which contribute to community function.

Access to affordable nutritional food

Welfare, combined with a well-stocked local supermarket has negatively impacted community food production and many traditional food growing skills are disappearing. Efforts are underway to assist communities to improve local food production and to rebuild gardening skills and traditional knowledge.

Changes to ocean temperatures and acidity are likely to negatively impact a community's capacity to collect local fresh seafood. Increased climate variability, including more intense rainfall and longer dry seasons will impact communities' capacity to grow certain foods. Climate impacts on mainland and international food production is also likely to result in an increased cost of purchased foods.

The main community supermarkets (IBIS stores) have increased their focus on promoting nutritional foods, but costs are still high.

Lack of space and poor soils in some communities will require innovative solutions for high yielding food production.

Many homes still grow an array of local foods, and most schools run a food garden program. There is a lot of adaptive capacity to expand local food production that will achieve multiple outcomes for food security, health and well-being, community participation and collaboration, reducing financial stress and improved waste management.

Sufficient community services and support staff

Trends towards a hotter, more variable climate in the region may negatively affect community services and support staff through impacts on community viability, movement of people out of the region, increased health risks for workers and more challenging working conditions.

Remoteness of communities increases their vulnerability to funding cuts and ease of access to services and diminishes their capacity to encourage workers to live out on communities.

The church in each community is integral to community life and cohesiveness, as are the local community groups and networks which also help reinforce traditional protocols and maintain community cohesion and function.

In summary, the key climate impacts identified for social capital are:

- Outdoor activities will become increasingly restricted to cooler times or cooler locations
- The number of people experiencing financial stress will increase without substantial efforts to reduce costs of living and expand local economies
- The demand for emergency services will continue to increase in response to direct and indirect impacts of climate change
- Access to some key marine food resources are likely to decline over time and increased climate variability may impact local food production
- There is a risk community services may suffer due to increased demand coupled with reduced financial and human resources to support effective delivery

	2030	2050	2070	Adaptive Capacity
Restriction on outdoor outdoor activities				**M**
People experiencing financial stress				**M**
Demand for emergency services				**M**
Impacts on local food production				**M**
Approximate timing of severity of impacts and indcation of adaptive capacity				

> “Emergency management measures based on historic experience will not be adequate in a changing climate.”
>
> Louise Michell, 2010

Sassie Island. Photo: John Rainbird

Dowar – erosion control of cemetery. Photo: John Rainbird

C Responding to Climate Change

How this section works

Resilience[1] is all about the ability of a community or a system to respond to change or impacts in such a way that negative impacts are minimised and the community continues to function well under stress. Resilient communities and systems tend to recover quickly from shocks and can often turn challenges into opportunities. They are more self-reliant but still keep strong connections with other local and distant communities. **Adaptation strategies should be implemented in a way that helps to build resilience**. The overall capacity of a system to respond to climate change and other drivers of change will be enhanced if the system is resilient.

Resilience provides a very practical and useful approach to community development because resilient systems tend to have a number of qualities and characteristics which can be actively developed. Part of this project looks at benchmarking where the region and individual communities sit in relation to a number of attributes as a guide to where increased focus in needed to build resilience. Resilience thinking also highlights the interconnection between communities and natural systems, and recognises sustainable community development needs to recognise the role of land and sea contributions to community livelihoods, health, security and culture.

We cannot assume the approaches and methods we have used in the past to survive and adapt are still going to work for us in future; as the world changes some of these approaches may in fact become a hindrance. We need to grasp the current challenges and develop approaches that recognise our current circumstances.

Resilience principles

The Stockholm Resilience Centre (**www.stockholmresilience.org**) has identified a number of resilience principles, five key principles are summarised below:

1. **Diversity and redundancy**
   Systems with lots of different parts (e.g. many species, diverse sources of knowledge and skills, diverse economies) tend to be more resilient than simple systems. Redundancy (having spare capacity in case part of the system fails, e.g. having a back-up generator in the power supply system), provides insurance against a loss of function if part of the system fails. Redundancy is even more valuable if the parts providing this capacity react differently to change and shocks, so they are not subject to the same stressors that caused the initial failure.

2. **Connectivity**
   Well connected systems can overcome and recover from disturbances more quickly. For example if a community has good connections with the communities around it, skills and resources can more easily be brought in if needed. However, high levels of connectivity can also increase risks. For example, infectious diseases can spread more rapidly in highly connected communities. These risks can be managed if recognised. For example, monitoring a network of disease transition helps limit spread through the system.

3. **Complex adaptive systems thinking**
   The reality of the world is that it is built up of a web of complex interactions operating over different time frames and spatial scales. Having some understanding of the how the different parts of our communities and environments interact, where their limits might lie, what things enable action and what things inhibit action, is an important step towards developing effective responses to complex challenges. Because the world is complex and dynamic and undergoing increasing rates of change, we need to be adaptive in how we respond to challenges to ensure new information is considered and to be able to change our approach or direction if needed.

[1] *It should be noted that sometimes resilience can be a negative thing when it relates to the resistance to change of destructive circumstances such as poverty traps or welfare dependance.*

4 **Learning and innovation**
Adaptive management and adaptive governance all have learning as a core focus. Learning involves not just collecting new information, but also being prepared to try new things and to learn from the failures and successes (learning by doing). Different types and sources of knowledge need to be valued and considered when developing solutions.

5 **Broad participation**
Broad and well-functioning participation can build trust, create shared understanding and uncover perspectives that may not be gained through conventional processes. Having a diverse range of people engaged in an issue helps to build legitimacy and increase the depth and diversity of knowledge.

There are of course more general characteristics that are important for resilience – good standards of health and well-being, employment and livelihood opportunities, healthy and productive environments, access to good education and development opportunities, and community cohesion.

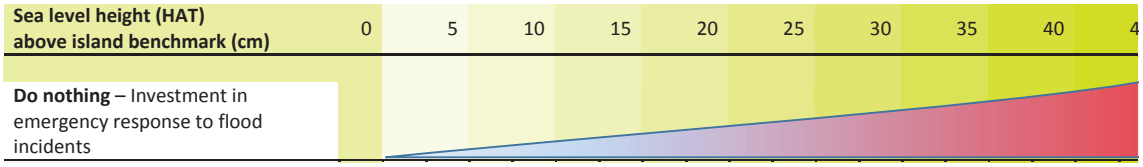
Six key Outcomes are identified below for building resilience. The actions to achieve these Outcomes can be characterised according to how they intervene to adjust the way in which the current 'system' works.

For each Outcome, the actions can be arranged in sequence to move from the current situation towards the desired future situation expressed in each Outcome. This maps the 'pathway' to the Outcome, showing where precursor dependencies occur and relating the implementation of essential steps to the actual changing situation (such as higher sea level) that make them necessary.

How to interpret pathways maps

Each pathways map presents a range of adaptation options in relation to a specific climate impact or area of concern. Not all options need to be taken. Instead the pathways map highlights that there are several ways to address issues. The arrows between the options show that there are multiple pathways to address the issue over time.

The top of the pathways map shows the change that is being adapted to. In this case, sea level rise will cause flooding to communities over time. Each community has its own benchmark, above which sea level rise starts to cause a problem.

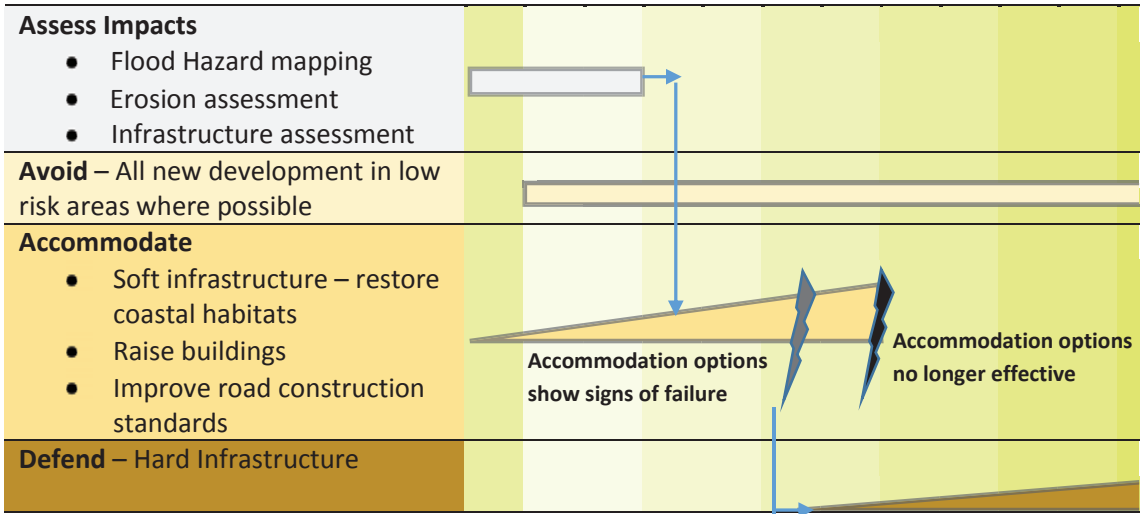


The next part of the diagram illustrates the consequences of doing nothing, that is, not undertaking any of the adaptation actions. It demonstrates that as the climate driver changes, the problem will get worse and cause significant impact. This is illustrated by the shape getting bigger as sea level rise increases (a trigger). In this example, the cost of emergency response will escalate to the point that living in the community will no longer be viable (a threshold).

This is indicated by two symbols:

A Trigger is an event or condition that provides a signal that new adaption options should be considered. For example, a sea wall may start to have an increased frequency of overtopping. While this does not represent a failure of the sea wall, it does signal that at some point in the future new actions will need to be taken.

A Threshold indicates that an event or circumstance is so severe that it has immediate consequences. For example, the frequency of inundation becomes so frequent that communities are forced to relocate.



The various adaptation options are listed down the left hand side of the pathways maps. The shapes of the actions indicate how much effort or investment is required to do the action. In this example, Assess Impacts needs to happen immediately, but can stop once the action is completed. The Accommodate option begins at some point in the near future, and requires increased effort and investment as the seas rise. However, there comes a point at which seas are so high it is no longer viable to accommodate the flood waters, and other options will need to be taken.

Finally, the bottom of the pathways map shows the accrued benefit and cost of taking action. In this example, it illustrates that there is a cost for undertaking the assessment process, but this diminishes as the work is completed. It also shows that rising seas will initially cause emergency response costs to rise, but these costs will diminish as action is taken to protect communities.

Windbreak made from coconuts on Erub. Photo: John Rainbird

Adaptation Outcome Tables Legend

Priority (P)	Timeframe to commence action (T)	System effect (SE)	Vulnerability target (VT)
High	Current-3 yrs	Event	S - Sensitivity
Medium	3-5 yrs	Adapt	Ex - Exposure
Low	5-10 yrs	Transform	AC - Adaptive Capacity

Status

Not yet started	In progress – partially complete
In progress – on-going	Mostly complete/complete

Adapting to climate change

Adjusting to the effects of sea-level rise; more extreme weather events; more hot days and hotter hot days.

Action that address events/impacts

Actions that are adaptive

Actions that are transformative

Adaptation Outcome 1:
Coastal communities and infrastructure are protected from sea-level rise and coastal impacts, and communities have options in responding to long-term sea-level rise.

Background

Sea-level rise and storm surge will have multiple impacts across the region. Current rates of sea-level rise in the region are 2-3 times greater than the global average rate of 3.2 mm per year. Whilst this is still a relatively small amount, the rate is predicted to increase, with estimates of around one metre sea-level rise by 2100. This will have progressively increasing impacts on communities, infrastructure and services over time.

Seawalls are to be installed at priority sites, which will buy those communities some time. A serious focus area will be on how sea-level rise impacts critical services as this is likely to be the key determinant that triggers the future direction of the community. Besides impact on infrastructure and services, impacts on graves and other key cultural sites are likely to cause significant distress to affected communities, and it is important communities are properly supported to deal not only with the physical impacts but also the social and psychological impacts of climate change.

The relocation of communities from low-lying islands is unlikely to be necessary for at least several decades. If managed poorly, this will be highly disruptive to those communities, and to the communities on the islands where they move to. It is important to commence discussions and planning early to minimise these impacts.

Current baseline

A significant numbers of houses, business premises and other substantial buildings, critical infrastructure and roads are exposed to high-water inundation each year.

Seawalls have been approved and construction is being progressed, subject to funding, for priority communities under the Torres Strait Seawall Program, jointly funded by the Queensland Government and the Commonwealth.

Sets of sea level rise response options that are capable of practical implementation for each community have not yet been prepared.

Table 1: Adaptation Outcome 1 – Sea level rise

See page 56 for description of Table Legends

Task	P	Lead Agency, Support Agency	T	Management Element	SE	VT	
Assess suitable sites for community settlement outside of hazard zones		**TSIRC**, **TSC**		Information		–	
Undertake a full strategic assessment of sea-level rise impacts on infrastructure and cultural sites across the region		**TSRA**, TSIRC, TSC		Information		–	
Model cost benefits of defend versus relocation in relation to infrastructure damage and replacement costs		**TSIRC**, **TSC**, TSRA, DTMR		Information		–	
Assess impact of tenure on adaptation options		**TSIRC**, **TSC**, PBC		Information		–	
Develop agreed thresholds for action for progressive impacts of sea-level rise on community well-being and functionality		**TSRA**		Information		–	
Investigate the feasibility of accessing offshore sand resources for beach re-nourishment		**TSRA**, TSIRC		Information		–	
Develop local coastal management plans, including buffers and management of dunes/berms and their vegetation, to reduce possible community impacts and build coastal resilience		**TSRA**, TSIRC		Policy & Planning		Ex	
Work with communities on contingency planning for worst-case sea-level rise scenarios. Staged relocation of communities and infrastructure and important cultural sites in hazard zones to higher ground to be built into land use and infrastructure planning		**TSRA**, TSIRC, DILGP, DATSIP		Policy & Planning		Ex	
Install hard infrastructure to protect key sites where no other cost-effective options exist		**TSIRC**, **TSC**, TSRA		Implement		Ex	
Improve soft infrastructure to protect key areas e.g. protect and rehabilitate coastal habitats that provide natural barriers		**TSRA**, TSIRC, TSC		Implement		Ex	
Establish community support process for community members to be able to discuss their concerns and gain support as required		**Qld Health**, DATSIP		Implement		S	
Continue to build community awareness about climate change, coastal processes and the pros and cons of various adaptation options		**TSRA**		Education & Awareness		AC	
Community leadership to start the dialogue about mid to long term options for sea level response		**TSIRC**, **TSC**, TSRA		Education & Awareness		AC	
Assess impacts of sea level rise on ground water		**TSIRC**, **TSC**, TSRA		Monitoring		EX	

Note – actions listed may still need discussion with partner agencies and programs regarding resourcing and implementation. Refer to www.tsra.gov.au for updated action tables.

Responding to coastal hazards – accommodate/defend/retreat

AECOM have developed an approach to the assessment of coastal risks and response options. The diagnostic questions used in this approach are:

- **a** Does the study site experience long-term (decades) coastal recession, or short-term episodic erosion (or both)?
- **b** With projected climate change (especially sea-level rise), what is likely to be the future recession/erosion likelihood at the study site?
- **c** Is there an existing coastal adaptation strategy in place?
- **d** Has there been any previous coastal protection works and how successful have they been?
- **e** What assets are at risk now, and in the future?
- **f** What are the projected useful life and criticality and value of these assets?

Working through this set of questions leads to clarity on the need for action and the relative urgency, and provides a useful framework for assessing coastal management options.

Value of assets potentially at risk

In assessing the value of assets potentially at risk it was assumed that assets needed to be in a flood prone area to be considered at risk. Criteria for asset value are defined as:

- **High** value assets are critical to the community function/existence. This includes houses when it is a significant percentage of the community
- **Medium** value assets are houses and less critical services. This is important to some but not many/all
- **Low** value assets include shacks, sheds, low value buildings, vacant land, etc

Need for Action

- **High** – High value assets facing a medium to high likelihood or medium value assets at serious impeding likelihood of loss
- **Medium** – High value assets facing a low likelihood of loss or medium value assets facing a moderate likelihood of loss
- **Low** – Medium value assets facing a minor likelihood or Low value assets

Urgency

- **High** – There is a real likelihood that assets will soon be lost
- **Medium** – Moderate or minor erosion today is threatening assets or significant erosion in the future will threaten assets
- **Low** – No erosion likelihood now but is expected to have a Minor erosion risk in the future
- **Nil** – No erosion likelihood now or in the future (e.g. permanent seawall)

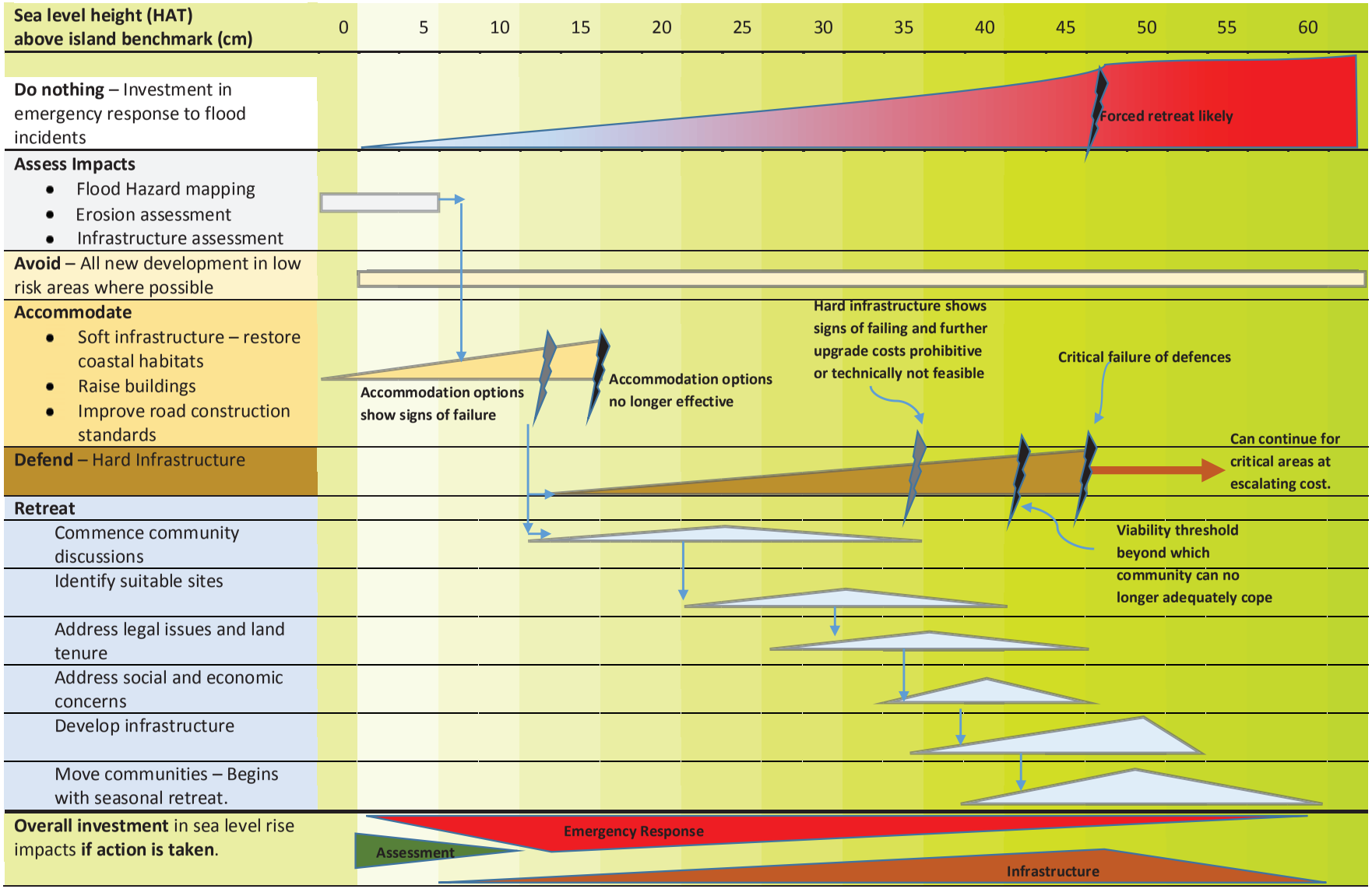


Figure 19: Pathway Map – Adaptation Outcome 1: Responding to Sea Level Rise

Adaptation Outcome 2:
Communities and infrastructure are protected from extreme weather impacts (disaster risk management).

Due to its location close to the equator, the Torres Strait directly experiences relatively few cyclones. However, they have occurred in the region before, so they cannot be discounted as a possible risk. Nearby Cape York and Gulf regions experience frequent cyclones, some of which produce extreme winds, waves and water levels that may also impact the Torres Strait. Historical cyclones in the Gulf have produced damaging storm surges in the Torres Strait. Cyclones and major storms disrupt telecommunications and transport within and into the Torres Strait. As a major shipping channel, extreme weather events in the region could also increase the risk of shipping incidents.

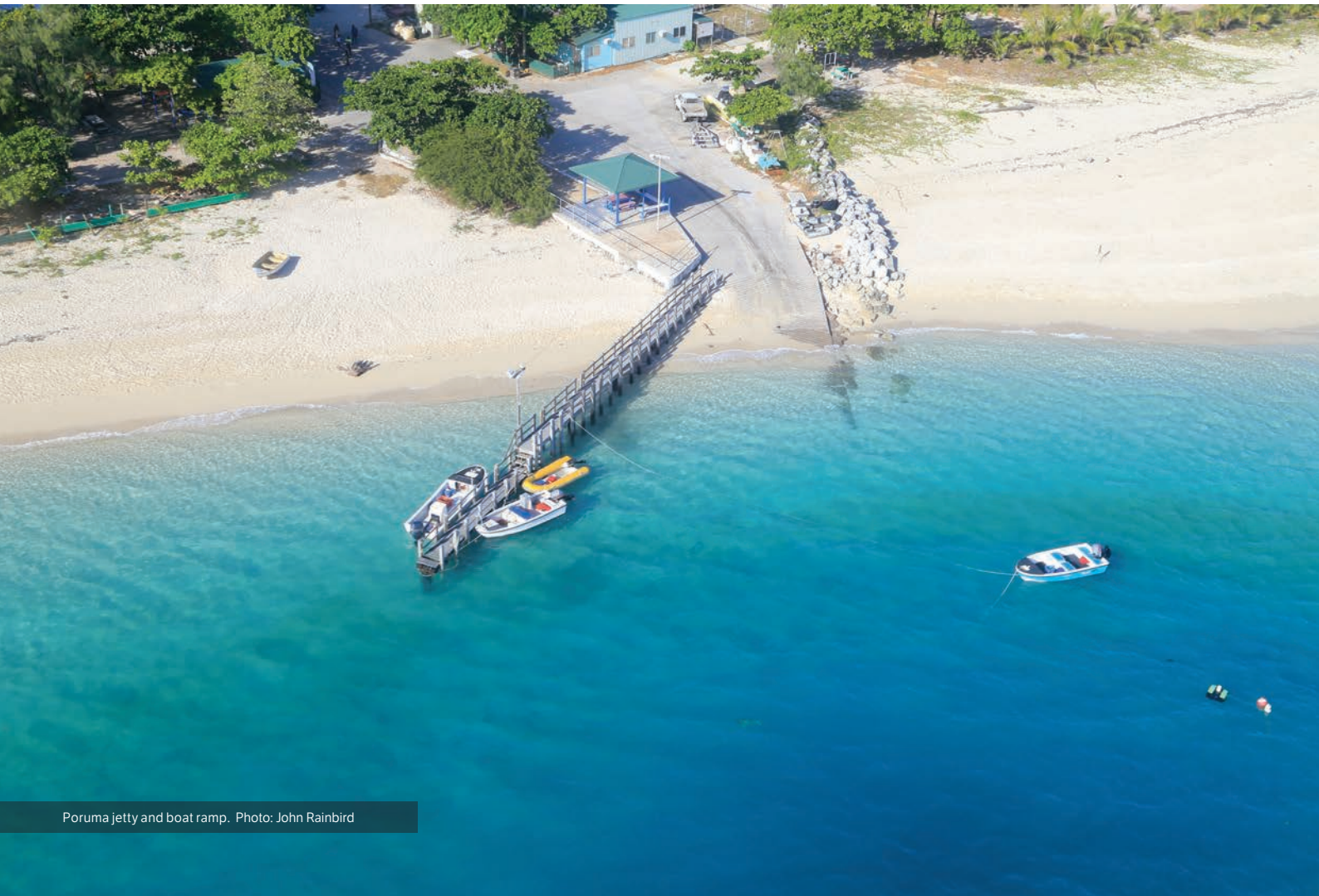
Shifts in rainfall intensity are expected to result in more extreme rainfall events with associated risks to infrastructure, health and productivity.

Significant progress has been made in the area of disaster management planning in the region, but this sector still suffers from having insufficient resources to fully implement disaster management planning and response capability.

Current baseline

The current situation information provided in the Plan under the Outlook for Human and Physical Capital sections is relevant to the baseline for this Outcome.

As noted in Outlook for Physical Capital, the development, coordination and implementation of disaster management is not fully implemented. Some communities do not have designated emergency shelters and not all volunteer disaster response groups (State Emergency Service (SES), Rural Fire Brigade, Volunteer Marine Rescue) groups are active, trained and equipped.



Poruma jetty and boat ramp. Photo: John Rainbird

Table 2: Adaptation Outcome 2 – Summary of Actions

See page 56 for description of Table Legends

Task	P	Lead Agency, Support Agency	T	Management Element	SE	VT	
Review disaster management processes to identify outstanding critical needs		**TSIRC**, **TSC**		Information			
Document current housing and building capacity to withstand cyclonic winds and develop climate-appropriate and culturally sensitive house design		**Dept Housing**, DATSIP		Information			
Investigate options to develop local property insurance schemes		**TSRA**		Information			
Convene shipping risk forum to: • Assess risks to Torres Strait communities and environments • Identify any gaps in prevention and response planning • Align shipping response plans with local government disaster plans • Consider incorporation of predictive models to identify communities and environments most at risk from shipping incidents Undertake a desktop drill of a shipping incident		**TSRA**, AMSA		Policy & Planning			
TSRA to assess its potential role and support for disaster management		**TSRA**		Policy & Planning			
Seek to amend National Disaster Relief and Recovery Arrangements to allow for a focus on building local capacity combined with disaster management across hazards.		**TSIRC**		Policy & Planning			
Disaster Management Plans: • DMPs are reviewed and kept up to date as information and circumstances change • Communities, agencies and NGOs are aware of DMPs and know what to do in case of an event • Have an identified and equipped regional disaster coordination centre on Thursday Island • Post disaster recovery plans are in place • Ensure communities are trained and equipped to deal with bush and building fires • Seek additional resourcing required for effective local and regional disaster management • Communications technologies and other response equipment are kept maintained • Disaster drills are practiced in communities • Communities have emergency reserves of food, water, medical supplies and fuel		**TSIRC**, **TSC**, SES **Rural Fire Service**		Implement			

Note – actions listed may still need discussion with partner agencies and programs regarding resourcing and implementation. Refer to www.tsra.gov.au for updated action tables.

Table 2: Adaptation Outcome 2 – Summary of Actions *(continued)*

See page 56 for description of Table Legends

Task	P	Lead Agency, Support Agency	T	Management Element	SE	VT	
• Disaster Management Planning is integrated into regional and local adaptation and resilience planning process • Manage fuel loads in and around communities to reduce fire risk • Community safety havens exist and are equipped with emergency supplies • Ensure several means of communications are available (including HF Radios) to ensure communication capability is not lost during events • Each community has a trained local disaster coordinator.		**Rural Fire Service** **SES**					
Communities have well-prepared and equipped local emergency and health services and trained volunteers		**TSIRC**, **TSC**		Implement			😐
Assess and improve the ability to quickly and efficiently evacuate people from communities • Evacuation plans and maps completed • Availability of suitable transportation craft Suitable equipped evacuation centres identified		**TSIRC**, **TSC**		Implement			😐
Have back-up power generators to ensure emergency equipment is kept functional during disaster events.		**Ergon**		Implement			☺
Develop an emergency credit system to allow people to buy goods when banking communications fail and they cannot access cash.		**DCCSDS**		Implement			☹
Ensure early warning systems are in place where possible.		**TSRA**, **BoM**		Implement			😐
Households to have ability to plug back-up generators into switchboards.		**Ergon**		Implement			☹
Install local weather stations across the region to provide community with local weather information and to collect long term meteorological data		**TSRA**, BoM		Monitoring			☺

Note – actions listed may still need discussion with partner agencies and programs regarding resourcing and implementation. Refer to www.tsra.gov.au for updated action tables.

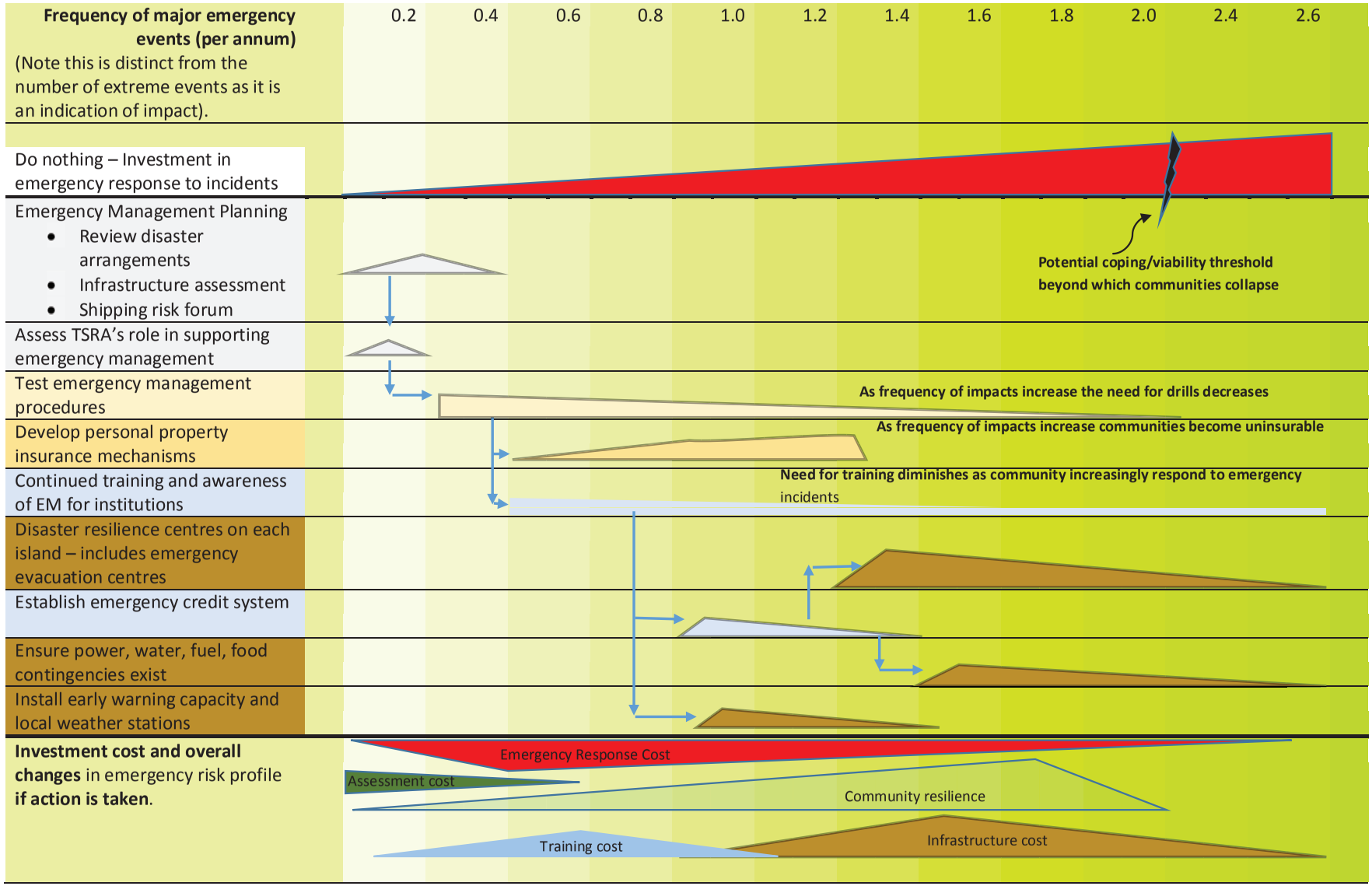


Figure 20: Pathway Map – Adaptation Outcome 2: Responding to Extreme Weather

Adaptation Outcome 3:
Reduced the impacts of hotter days and more hot days on community health and well-being.

Whilst temperature increases in the tropics are relatively small compared to temperate regions, high levels of humidity mean that the apparent temperature (indicator of comfort) is set to climb from current annual averages of around 38.4°C (with current wet season average of 43.8°C) to around 41.1°C by 2030 and 42.2°C by 2050 (high emissions scenario).

Higher humidity increases the risk of heat stress and heat stroke at lower temperatures compared to drier climates due to the bodies reduced ability to cool itself through evaporation. The very young, elderly and people with additional health complications are most at risk if they do not have access to temperature controlled environments. Days of extreme heat can also pose risks to electricity generation and supply required to run air-conditioning.

Hotter days and more hot days will also increase the fire risk and can increase the rate of deterioration of certain materials used in products and construction.

Current baseline

The current situation information provided in the Plan under the Outlook for Human Capital section is relevant to the baseline for this Outcome.

No trend has yet been observed in the incidence and impacts of climate related health impacts– asthma and allergy; heat stress.

Saibai children playing on the seawall. Photo: Tristan Simpson

Table 3: Adaptation Outcome 3 – Summary of Actions

See page 56 for description of Table Legends

Task	P	Lead Agency, Support Agency	T	Management Element	SE	VT	
Assess heat stress risks to communities and identify key risk thresholds		**Qld Health**, TSRA		Information		–	
Assess current impacts of very hot days on health and productivity		**Qld Health**, TSRA		Information		–	
Assess passive cooling requirements under Queensland Development Code to determine if they adequately meet local needs		**DATSIP**, TSRA, TSIRC, TSC		Information		–	
Develop a Torres Strait Extreme Heat Response Plan that includes a focus on vulnerable sectors of the community, in particular the elderly and people in aged care facilities		**TSRA**, TSIRC, TSC		Policy & Planning		–	
Monitor impacts on health during heat events		**Qld Health**		Monitoring		–	
Maintain greater flexibility of working hours to avoid having to work under excessively hot conditions		All agencies		Implement		Ex	
Build community awareness and understanding of climate risks to health, well-being and property (including increased fire risk during heat events)		**Qld Health**, TSRA, TSIRC, TSC		Education & Awareness		Ex	
Educate communities on management of heat stress and dehydration risks		**Qld Health**, TSIRC		Education & Awareness		Ex	
Develop a Torres Strait Cool Community Plan that includes passive design, micro climate management and community awareness • Review green infrastructure around villages to ensure optimal shading and reduction of heat effects • Assessing active and passive cooling options • Assess critical points of system failure (e.g. reliance on power) • Review passive cooling requirements for existing and new homes, including use of heat reflective roof paint, optimisation of natural breezes, development of "cool zones", optimising external shading and mechanisms to remove excess heat • Monitor and map temperatures across key locations in select communities over warm periods to identify risk areas and inform built and green infrastructure planning and heat wave response		**TSRA**, TSIRC, TSC		Policy & Planning		Ex	

Note – actions listed may still need discussion with partner agencies and programs regarding resourcing and implementation. Refer to www.tsra.gov.au for updated action tables.

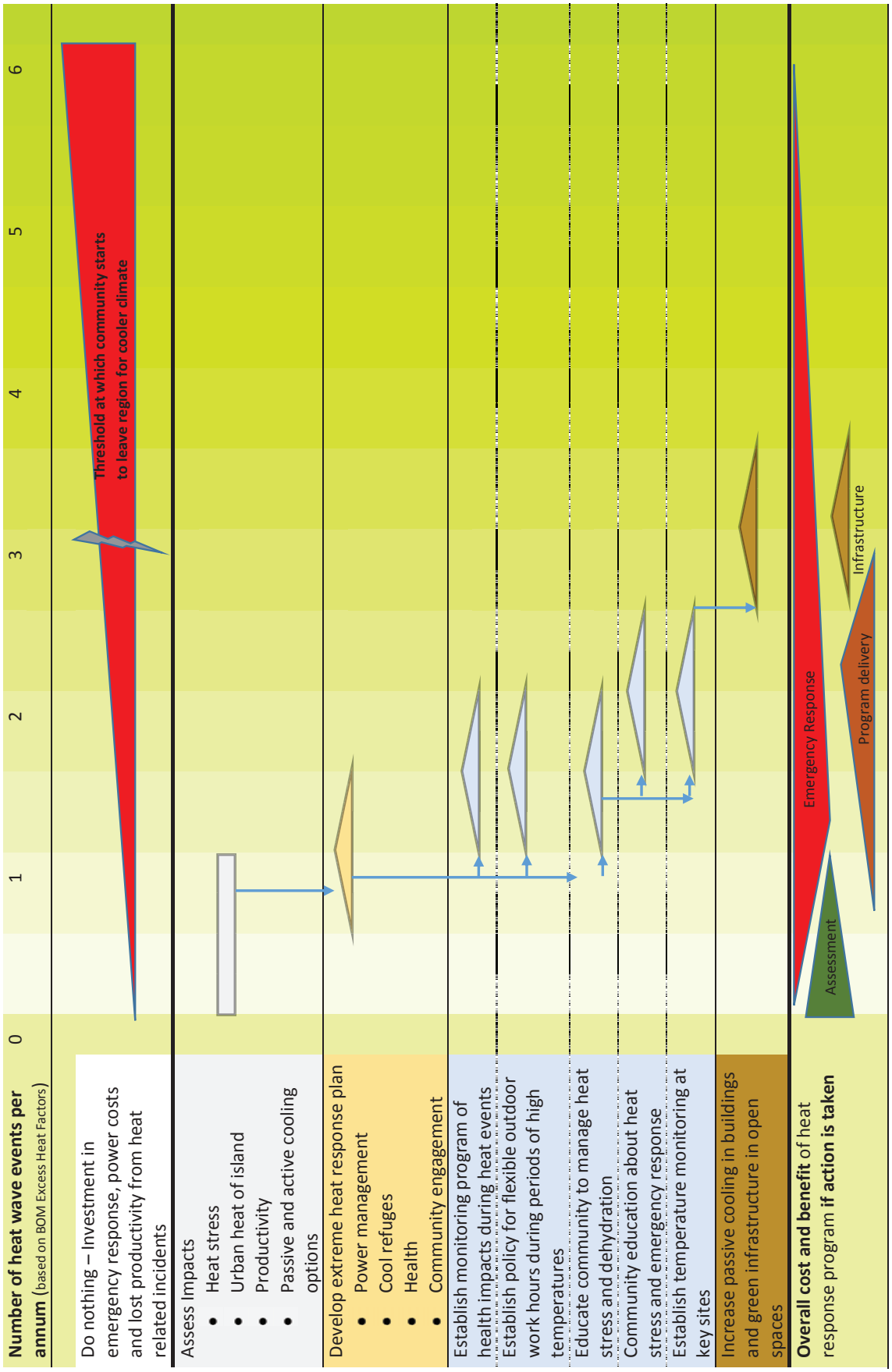


Figure 21: Pathway Map – Adaptation Outcome 3: Responding to Higher Temperatures

Strengthening resilience

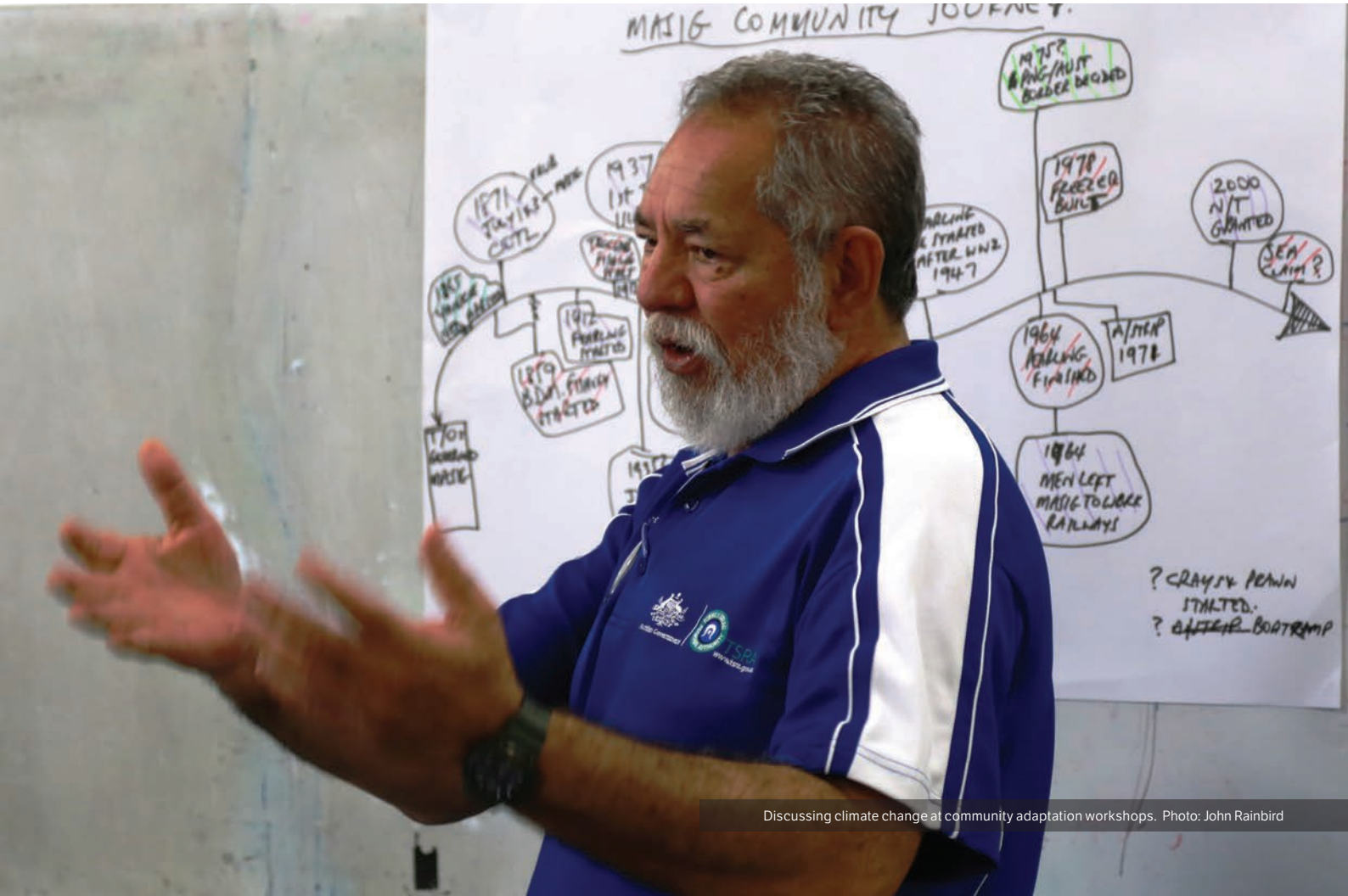
Resilience Outcome 1:
The governance arrangements for the Torres Strait region and for each community enable development of responsive, resilient and sustainable communities with climate change and resilience fully integrated into development planning and policy development.

Having strong and adaptive governance at local and regional scales is a critical component of building resilience and implementing climate adaptation actions. Resilient governance systems are needed to respond adequately to increasing levels of change and complexity. They require a good balance between "conservative" governance that is stable and seeks equilibrium and "dissipative" governance, which is more flexible and responsive. Key elements that help to achieve adaptive governance include building trust, having a richness of formal and shadow networks, and support for adaptive and innovative leadership. These governance systems need to be able to incorporate new information, to be able to respond in a timely and effective manner to emerging challenges and understand the implication of decisions across a range of interconnected parts of the system.

Current baseline

The governance arrangements for the Torres Strait region and for each community is well established in the development of responsive, resilient and sustainable communities as evidenced by the shared commitment to the updated Torres Strait Climate Change Strategy 2014-2018 released in July 2014.

Explicit reflection of climate change and resilience considerations in decision-making for the region and for individual communities is not yet fully integrated into planning and management. Notable exceptions include the seawall project and the integration of coastal hazard risks into local government planning schemes where the degree of connection is strong. However, the significant effort and investment in the current climate adaptation and resilience action planning at the regional and community levels is a substantial foundation for future decision-making in pursuit of this Outcome.



Discussing climate change at community adaptation workshops. Photo: John Rainbird

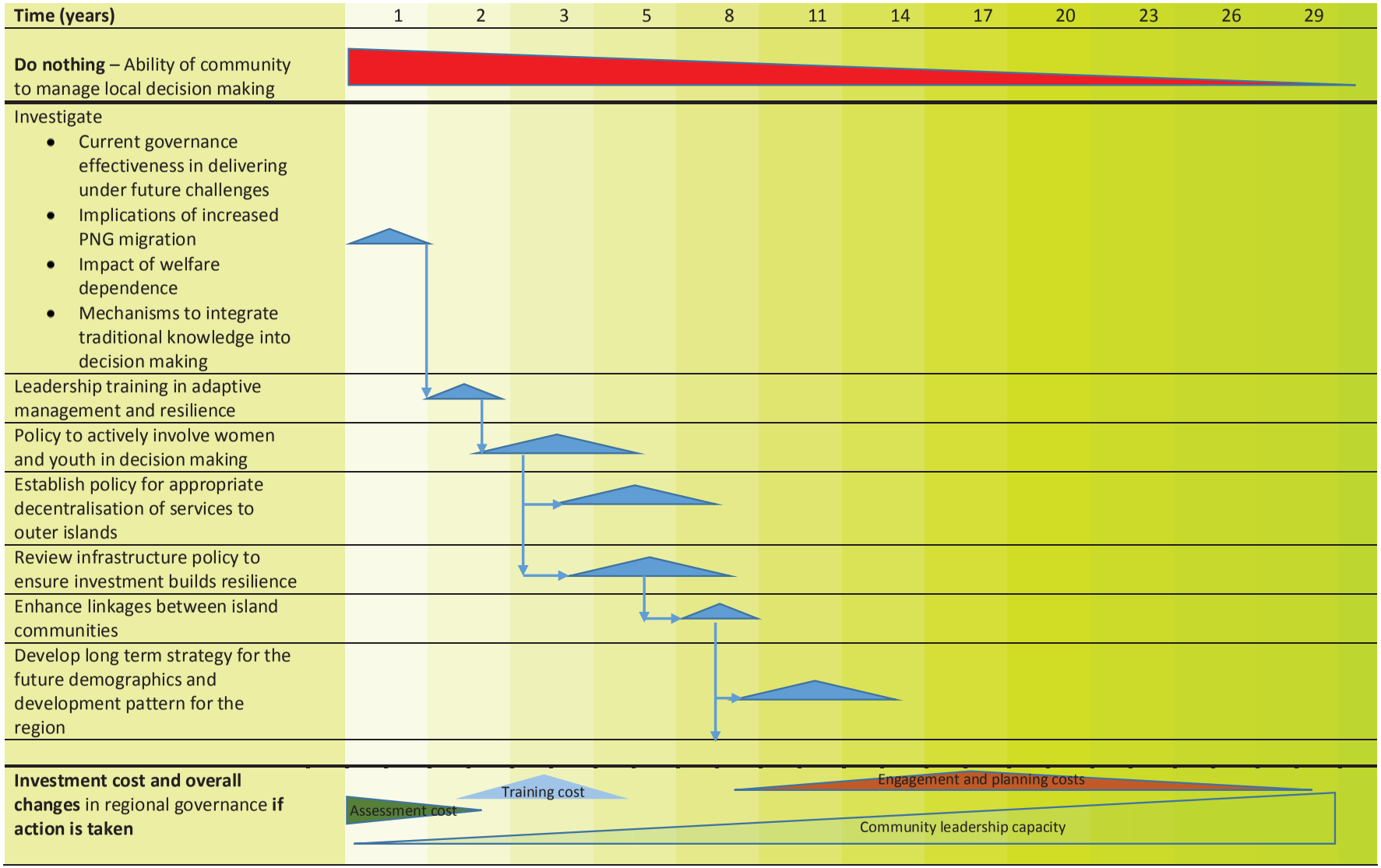
Table 4: Resilience Outcome 1 – Summary of Actions

See page 56 for description of Table Legends

Task	P	Lead Agency, Support Agency	T	Management Element	SE	VT	
Investigate the probability and implications of increased migration of displaced PNG nationals seeking better food and water security and a higher standard of living on the natural, economic and social resources of the Torres Strait region		**DFAT**, TSRA, TSIRC		Information		Ex	☹
Investigate extent to which welfare dis-incentivises people from participating in governance process		**TSRA**, DSS		Information		Ex	☹
Ensure leadership have the knowledge and skills needed for adaptive management and building resilience • Assess current governance models to identify how to increase capacity for adaptive governance • Develop adaptive management and resilient governance information and training packages and events • Incorporate resident thinking and practice into governance processes • Embed adaptation and resilience principles formally into decision making processes. For example, local decision making should, where relevant, include factors external to the island or the region to ensure information and issues at various scales are considered ("*need to identify how islands can make decisions about their own future, but not ignore the outside world*")		**TSRA**, DATSIP		Implement		AC	☹
Support community leaders to talk about climate change and resilience within their communities with training and resources		**TSRA**, TSIRC, TSC		Education & Awareness		Ex	😐
Actively involve women and youth in all levels of planning and strategic processes (bearing in mind cultural considerations)		**DATSIP**, **TSIRC**, **TSC**, TSRA		Education & Awareness		AC	😐
Enhance capacity of outer islands through decentralisation where practical to do so ("*fund more positions that are outer-island based that are supporting community governance and key services - stop being TI centric*")		**TSRA**		Implement		AC	😐
Review service and infrastructure delivery into the region to ensure it is focused on building local capacity, resilience and self-reliance, and not entrenching dependency		Service & Infrastructure working groups		Education & Awareness		Ex	😐
Develop a sustainable development framework for the future demographics and development patterns for the region (see economics)		**TSRA**,TSIRC, TSC, DILGP		Policy & Planning		Ex	☹
Strengthen and build regional networks through inter-island events knowledge and information sharing and governance structures		Communities, TSIRC, TSC, DATSIP		Implement		AC	😐

Note – actions listed may still need discussion with partner agencies and programs regarding resourcing and implementation. Refer to www.tsra.gov.au for updated action tables.

Figure 22: Adaptation Pathway – Resilience Outcome: Governance



Resilience Outcome 2:
Health risks are managed and reduced through holistic health and well-being strategies and interventions.

Many of the health challenges in the region are highly preventable. Health issues are strongly linked to many other factors including lifestyle choices, employment, education, cost of living pressures and availability of healthy alternatives. Climate change will add pressure to the health system, but there are significant opportunities to continue to improve the well-being and quality of life of Torres Strait Islanders through positive well-targeted support, preventative measures and interventions that will reduce the prevalence and severity of ailments. Establishing monitoring programs to track climate impacts on health will be important to fully assess how this risk will impact health outcomes in the region.

Current baseline

There are no health and well-being programs in place in the Region that are currently characterised as being holistic. The prevalence of diabetes within the Torres Strait communities (11% of the population[2]) is generally comparable to that in communities in Samoa (7.6%) and Fiji (10.9%) and favourably comparable to communities in the Solomon Islands (16.1%), Vanuatu (23.7%) and Kiribati (26.4%)[3]. Life expectancy at birth (69-74 years) is generally comparable with communities in Samoa, Solomon Islands, Fiji, Vanuatu and Kiribati[4]. However, this is some 10 years less than for non-Indigenous Australians[5].

As noted by Laurence, Meyer Steiger and Richie (2014, p.2) "In the Torres Strait, mosquito species involved in the transmission of diseases, especially in relation to dengue, Japanese encephalitis, and malaria, have been studied for short intensive periods since the 1980's". Baseline information may be able to be compiled from the National Notifiable Diseases Surveillance System for future trend monitoring.

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[2] *Australian Indigenous HealthInfoNet (2007) Review of diabetes among Indigenous peoples. Retrieved 6 July 2015 from* http://www.healthinfonet.ecu.edu.au/chronic-conditions/diabetes/reviews/our-review

[3] *Diabetes prevalence (% of population ages 20 to 79) Retrieved 6 July 2015 from* http://data.worldbank.org/indicator/SH.STA.DIAB.ZS

[4] *3302.0.55.003 - Life Tables for Aboriginal and Torres Strait Islander Australians, 2010-2012 LATEST ISSUE Released at 11:30 AM (CANBERRA TIME) 15/11/2013 Retrieved 6 July 2015 from* http://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/832DD8C90AAC63F5CA257C230011C69A?opendocument

[5] *Retrieved 6 July 2015 from http://data.worldbank.org/indicator/SP.DYN.LE00.IN*

Table 5: Resilience Outcome 2 – Summary of Actions See page 56 for description of Table Legends

Task	P	Lead Agency, Support Agency	T	Management Element	SE	VT	
Queensland Health to work with research organisations and other health and well-being providers to identify specific future health risks associated with climate change in the Torres Strait (e.g. heat-related illness, increased disease incidence, new disease vectors and extreme weather events)		**Qld Health**, TSRA		Information		Ex	☹
Investigate the physical and psychological health impacts of frequent coastal inundation events on affected communities		JCU, CSIRO		Information		Ex	☹

Table 5: Resilience Outcome 2 – Summary of Actions *(continued)*

See page 56 for description of Table Legends

Task	P	Lead Agency, Support Agency	T	Management Element	SE	VT	
Trends and current state of health and well-being (statistics, programs and services, infrastructure) is compiled for each community		**Primary Health Care Network, Torres and Cape Hospital and Health Service**		Information		S	
Queensland Health and partners develop appropriate socioeconomic programs and services to address impacts on community health and well-being caused by, or associated with, climate change based on risks and outcomes of monitoring programs		**Qld Health**		Implement		Ex	
Develop community stress management and support strategies		**Torres and Cape Hospital and Health Service, Primary Health Care Network**		Policy & Planning		AC	
Expand programs for preventative health including the production of affordable healthy local produce and programs for mental and physical well-being and fitness. Work with IBIS to explore how to reduce costs of healthy food		**Primary Health Care Network**, TSRA, IBIS		Implement		Ex	
Increase awareness and training on emerging community health issues (managing risks from mosquitoes, avoiding heat stress)		**Qld Health**, TSIRC, TSC		Education & Awareness		Ex	
Establish community temperature monitoring program to assess hot and cool spots in key community locations during periods of high temperature		**TSRA**		Monitoring		S	
Review and expand monitoring of disease vectors to ensure risks are understood and appropriate management actions are in place		**QLD Health**, JCU, TSIRC, TSC		Monitoring		Ex	
Ensure post-event monitoring programs are developed to monitor community recovery (mental and physical health and well-being) from major impacts		**TSIRC**, **TSC**, Department of Communities, Child Safety and Disability Services Qld Health		Monitoring		AC	
Establish monitoring of climate related impacts on health including incidence of heat stress, asthma and allergies, water and food-borne diseases, vector-borne diseases and health impacts of extreme weather events		**Torres and Cape Hospital and Health Service**, TSRA		Monitoring		S	

Note – actions listed may still need discussion with partner agencies and programs regarding resourcing and implementation. Refer to www.tsra.gov.au for updated action tables.

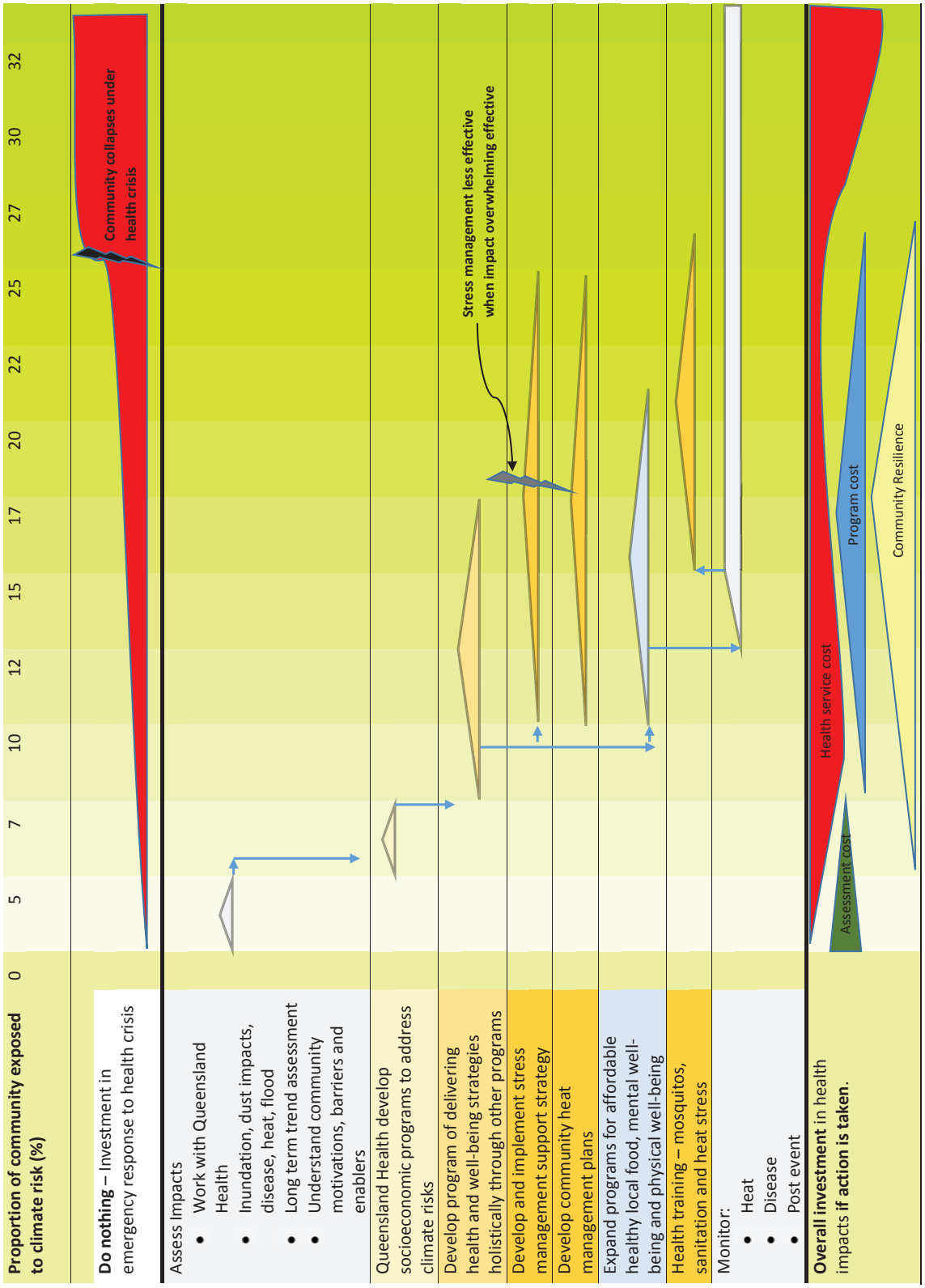

Figure 23: Pathway Map – Resilience Outcome 2: Healthy Communities

Resilience Outcome 3:
The community is strong, confident and capable and has increased its capacity to respond positively to change and impacts.

At the heart of resilience is a strong, vibrant and confident community. Despite current and future challenges, Torres Strait communities are strong in many important respects. Whilst modern ways have impacted culture, there are also ways to manage these impacts and continue to build a strong culture that can adapt to meet current and future challenges. Communities will need support to enhance their capacity and resilience, and a solutions focused approach is likely to be more successful than approaches focused on problems.

Current baseline

The current situation information provided in the Plan under the Outlook for Human Social Capital section is relevant to the baseline for this Outcome.

The community has enduring elements of strength, confidence and capability evidenced by active community groups, regular community meetings and events. There is a general perception that more people with family connections wish to come back to live in the Torres Strait rather than move away. Communities have endured significant change over past decades and many continue to endure annual tidal impacts but are still determined to remain on their islands into the long term, which are testaments to their inherent resilience.

The communities of the Torres Strait have a strong commitment to community participation with sporting and cultural events being well attended. No community members are yet trained in adaptation planning and project work. However, representatives from most communities have become actively engaged in the planning process.

Table 6: Resilience Outcome 3 – Summary of Actions See page 56 for description of Table Legends

Task	P	Lead Agency, Support Agency	T	Management Element	SE	VT	
Benchmark regional and local community resilience in order to help assess the value and impact of adaptation and resilience actions and strategies, including questions on attitudes and confidence relating to future conditions		**TSRA**, CSIRO, JCU		Information		–	😐
Investigate additional mechanisms beyond current measures to reduce welfare dependency		**TSRA**, DPMC, DATSIP		Information		Ex	☹
Develop the community Resilience Champion program as a core component of delivery of resilience and adaptation plans • Provide tools and support to help enable community projects to flourish and succeed • Offer training for communities to build their capacity to undertake and implement adaptation and resilience planning.		**TSRA**, **DATSIP**, TSIRC, TSC		Policy & Planning		AC	😐 ☹ ☹

Note – actions listed may still need discussion with partner agencies and programs regarding resourcing and implementation. Refer to www.tsra.gov.au for updated action tables.

Table 6: Resilience Outcome 3 – Summary of Actions *(continued)*

See page 56 for description of Table Legends

Task	P	Lead Agency, Support Agency	T	Management Element	SE	VT	
• Facilitate information sessions and adaptation and resilience workshops for each community to build their understanding of climate change, to identify appropriate community-based adaptation options and actions to enhance local resilience • Support communities to access and interpret environmental research and monitoring data, including modelling and mapping of projected climate change and sea-level rise scenarios, and to consider this data alongside cultural and historic datasets							😐 😐
Identify and document adaptive strategies that island communities have adopted in response to historic climate change or impact events		**TSRA**		Policy & Planning		Ex	☹
Document traditional knowledge and cultural practices relevant to climatic and seasonal variations to inform adaptation planning. Support Rangers and community members to record and access traditional ecological knowledge about climate change in the Torres Strait, including seasonal variations, weather patterns and historic sea-levels		**TSRA** (TEK Project)		Policy & Planning		Ex	😐
Expand education in community values and traditional culture through the school system and community activities		**TAGAI**, Education Queensland		Policy & Planning		Ex	😐
Ensure NGOs have an equal focus on building the capacity of local people rather than solely on delivering the services directly themselves		Agencies engaging NGOs		Policy & Planning		AC	😐
Increase access to remote education and training through the development of a Torres Strait education and training portal		**TAGAI**		Implement		AC	☹
Build community skills, knowledge and capacity through cadetships and mentoring programs		DATSIP and other relevant bodies		Implement		AC	😐
Facilitate more opportunities for intra- and inter-community collaboration to build participation and strengthen sharing and collaboration		**Communities**, **DATSIP**		Implement		AC	😐
Increase dialogue with diaspora (TSI on mainland) to engage them in regional issues, seek support for projects and using their skills to help the community		**Communities**, **DATSIP**		Policy & Planning		AC	☹

Note – actions listed may still need discussion with partner agencies and programs regarding resourcing and implementation. Refer to www.tsra.gov.au for updated action tables.

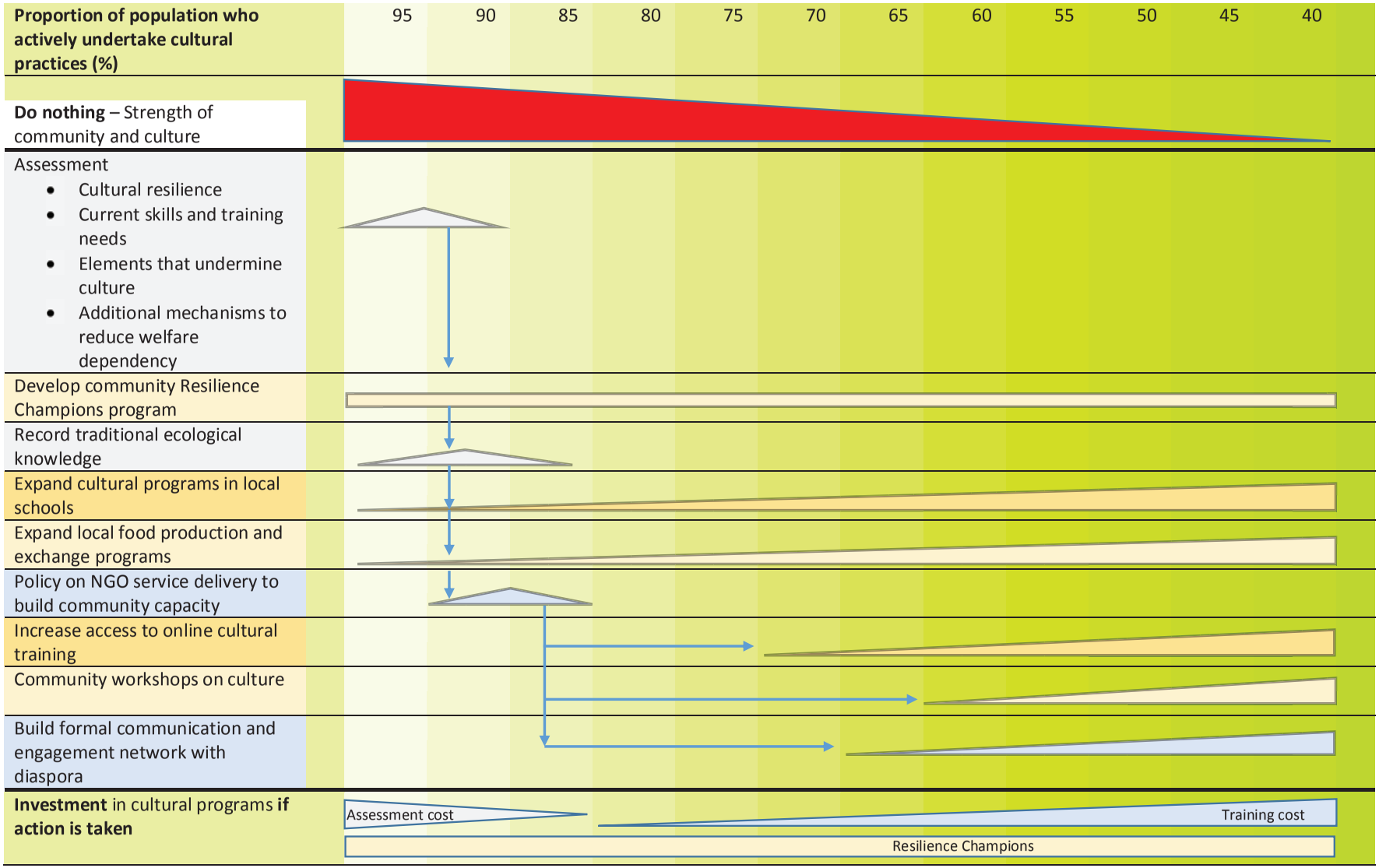

Figure 24: Pathway Map – Resilience Outcome 3: Strong Culture

Resilience Outcome 4:
The infrastructure and services in the Torres Strait are fit for purpose, systems have built-in redundancy, have low operation and maintenance costs and meet the needs of the local and regional community.

As remote island communities, it is important that development in the region recognises the cultural context and the geographic, financial and local capacity constraints. Ideally, technologies deployed should have low operation and maintenance costs and be appropriate for the location and local needs. Centralised systems have certain advantages, but this can be outweighed when they fail compared to decentralised systems. In the long term, a key focus should be on reducing community reliance on mainland funding and technical support for the operation and maintenance of infrastructure. Having some flexibility in the type and location of infrastructure and retaining culturally-based solutions and options will be important in addressing climate change risks.

Current baseline

The current situation information provided in the Plan under the Outlook for Physical and Financial Capital sections is relevant to the baseline for this Outcome.

The communities of the Torres Strait have attracted significant infrastructure and services owing to their remote location and the strategic importance of their international proximity to Papua New Guinea.

The *Torres Strait Options to Reduce Carbon Footprint* Report (2012) prepared for the TSRA by CAT Projects sets out the current situation, though not the costs of infrastructure and services related to this Outcome.

Imported fill and impacts of corrosion on machinery. Photo: John Rainbird

Table 7: Resilience Outcome 4 – Summary of Actions

See page 56 for description of Table Legends

Task	P	Lead Agency, Support Agency	T	Management Element	SE	VT	
Investigate the impacts of climate change for critical infrastructure		**TSIRC**, **TSC**, TSRA, relevant agencies		Information		Ex	😐
Identify the adaptation options for critical infrastructure • Assess options for renewable energy generation on each of the islands including opportunities for solar and wind energy to be installed on properties to minimise individual household energy costs • Review vulnerability of critical infrastructure to climate impacts • Model accommodate/ defend/ retreat options for exposed coastal infrastructure • Identify dormant wells and assess capacity for water supply and stormwater storage • Investigate desalination from tidal energy • Investigate new water supply options such as increased stormwater harvesting that can be used for non-potable purposes such as gardening and to support sewage treatment		**TSIRC**, **TSC**, TSRA, relevant agencies		Information		Ex	😐 ☹ 😐 ☹ 😐 ☹
Undertake an assessment of a regional service delivery vessel to provide community services that would otherwise require people to travel to access e.g. doctor, dentist etc		**TSRA**		Information		AC	☹
Monitor the impact of marine flooding on coastal infrastructure and services to quantify impacts and frequency		**TSIRC**, **TSC**, TSRA, DTMR		Monitor		S	☹
Assess the implications of increased ocean acidity on marine cement infrastructure		**DTMR**, **TSRA**		Information		S	☹
Develop guidelines and policies that favour and enable the uptake and use of fit–for–purpose climate resilient infrastructure		**TSRA**, DILGP		Policy & Planning		Ex	☹
Identify and encourage ways of increasing energy conservation and efficiency (e.g. installing insulation, applying green building codes, renewable technologies), including installation of alternative and renewable energy sources for Torres Strait communities		**Ergon**		Implement		Ex	😐

Note – actions listed may still need discussion with partner agencies and programs regarding resourcing and implementation. Refer to www.tsra.gov.au for updated action tables.

Table 7: Resilience Outcome 4 – Summary of Actions *(continued)*

See page 56 for description of Table Legends

Task	P	Lead Agency, Support Agency	T	Management Element	SE	VT	
Housing design is climatically and culturally relevant. Consider improvements in design and placement to promote better air flow, passive cooling (including painting roofs with heat reflective paints, windows at different heights, louvres), liveability and better use of outdoor areas. Use of green infrastructure for cooling. More sustainable materials used in construction. Ensure use of suitable materials for local conditions (e.g. rust resistant)		**DHPW**, **DATSIP**		Implement		Ex	
Ensure local government planning schemes incorporate hazard mapping, sea-level rise and storm surge for new developments in all planning regions. Up-to-date data and mapping of climate hazards at an appropriate scale continue to be available to inform planning scheme drafting		**TSIRC**, **TSC**, TSRA, DATSIP		Policy & Planning		Ex	
Planning schemes are updated regularly to keep pace with community decisions in respect of climate change adaptation and the latest scientific data		**TSC**, **TSIRC**, DATSIP		Policy & Planning		Ex	
Implement waste management strategy that addresses the disposal and recycling of goods brought to the islands, supports local recycling and reuse and production of compost from green waste. Whitegood disposal should be an early area of focus		**TSIRC**, **TSC**, TSRA		Implement			
Investigate and support the use of more sustainable and appropriate infrastructure and technologies to reduce operational and maintenance costs to Councils, minimise their ecological and carbon footprint and promote increased self-sufficiency		**TSIRC**, **TSC**, TSRA, DILGP, DATSIP		Information		AC	
Conserve water supplies and reduce reliance on desalination through effective and efficient water cycle management and adoption of appropriate technologies		**TSIRC**, **TSC**		Implement		S	

Note – actions listed may still need discussion with partner agencies and programs regarding resourcing and implementation. Refer to www.tsra.gov.au for updated action tables.

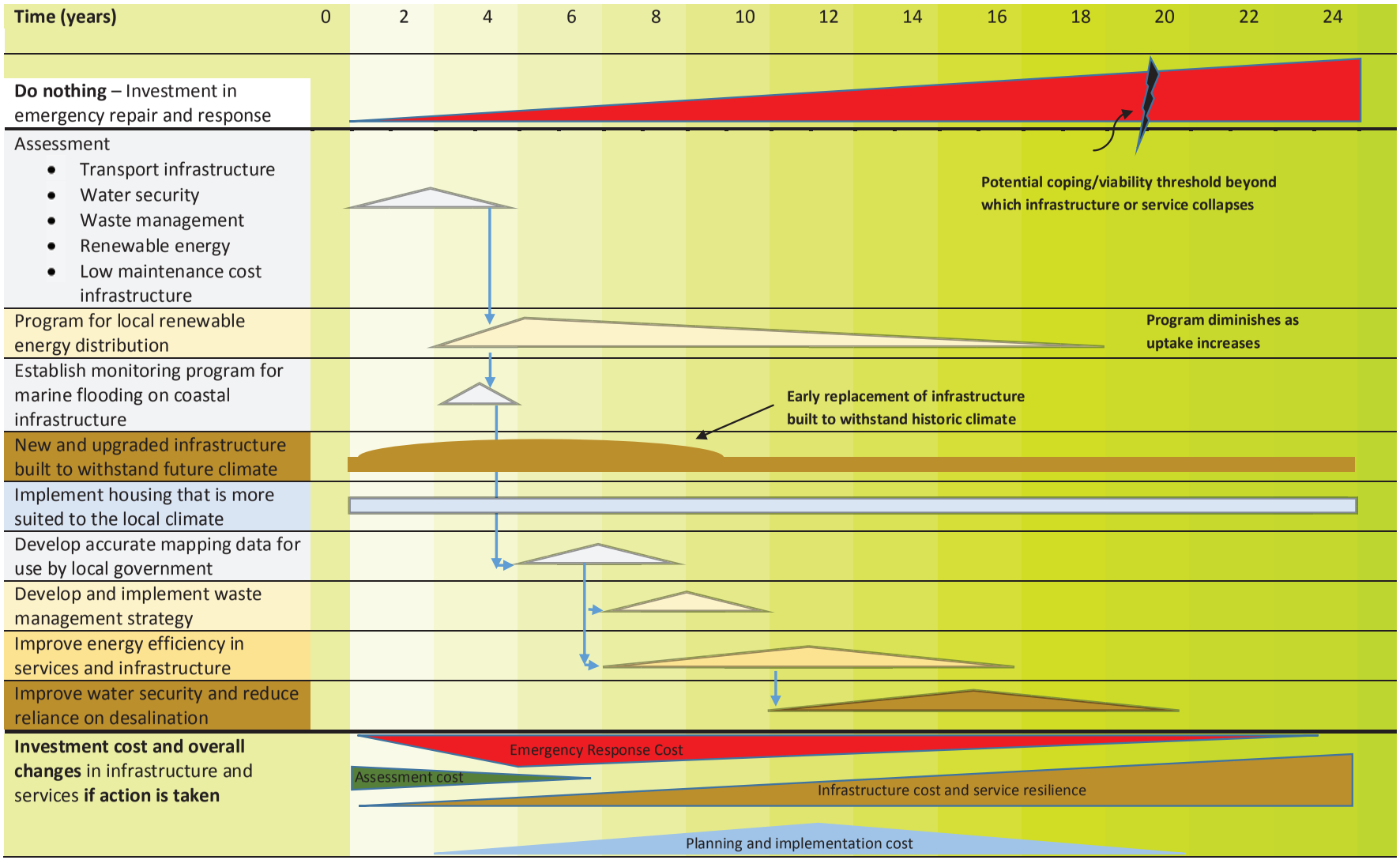

Figure 25: Pathway Map – Resilience Outcome 4: Infrastructure

Resilience Outcome 5:
The land and sea are healthy and are able to adjust to the changing climate without losing diversity or productivity.

While nature is highly adaptable, the rate and scale of current and projected climate change is likely to be greater than many species and ecosystems can properly respond to. The most important actions that should be taken (besides reducing greenhouse gas emissions) is to reduce pressures on the environment to reduce stress.

Current baseline

The current situation information provided in the Plan under the Outlook for Natural Capital section is relevant to the baseline for this Outcome.

The land and sea are currently healthy with optimal adaptive capacity reflected in healthy dugong and sea turtle populations, stable extent and condition of seagrass meadows, and limited coral and reef species decline from bleaching events, and no crown-of-thorns starfish population outbreaks or known marine invasive species incursions. Early indications for concern include some coral bleaching (2010), westward expansion of COTS, declines in turtle hatching success on Raine Island due to erosion and flooding, and heavy resource extraction on parts of the northern Torres Straits bordering PNG.

The current extent of weed and invasive animal presence is described in some detail in the Outlook for Natural Capital.

Table 8: Resilience Outcome 5 – Summary of Actions See page 56 for description of Table Legends

Task	P	Lead Agency, Support Agency	T	Management Element	SE	VT	
Review non-climate risks and stressors to the environment, including the risks imposed by oil spills and ship groundings, and identify if emergency response capability is adequate and that local response capacity is in place		**TSRA** with support from researchers		Information		Ex	
Identify threatening processes forced by climate change and map environments, habitats at risk and timing of risk, biogeographic characteristics and areas of high value to prioritise investment and management effort (e.g. identify and protect refugia for thermally tolerant coral species that will provide genetic stock for recovery)		**TSRA** with support from researchers		Information		AC	
Synthesise emerging scientific and traditional knowledge to underpin effective management decisions and improve capacity to adapt to climate impacts		**TSRA**, TEK		Information		AC	
Identify key marine and terrestrial species at risk from climate change and assess potential shifts in abundance and distribution		**TSRA** with support from researchers		Information		S	

Table 8: Resilience Outcome 5 – Summary of Actions *(continued)*

See page 56 for description of Table Legends

Task	P	Lead Agency, Support Agency	T	Management Element	SE	VT	
Identify thresholds beyond which climate change causes irreversible damage to vulnerable species (e.g. seabirds, marine turtles, dugongs, corals, fish and plankton), habitats (e.g. seagrasses, mangroves) and processes (e.g. productivity and connectivity)		**TSRA** with support from researchers		Information		S	
Assess impact of predicted changes in temperature and rainfall on vegetation communities		**TSRA** with support from researchers		Information		S	
Assess vulnerability of coastal ecological communities to sea-level impacts		**TSRA** with support from researchers		Information		S	
Assess synergies between climate and non-climate stressors on critical processes (such as productivity, connectivity, calcification and recovery potential) and synthesise results as the basis for revising management policies and targets		**TSRA** with support from researchers		Information		–	
Continue to build an understanding of the region's biogeographic and ecosystem processes		**TSRA** with support from researchers		Information		–	
Assess current and likely future fire risk to rare and threatened species and ecosystems.		**TSRA** with support from researchers		Information		S	
Develop spatial model of region to assess cumulative impacts		**TSRA**		Information		–	
Regional pest management strategies to ensure coordinated approach across the region and species of most concern prioritised		**TSRA**, TSIRC, TSC, DAFF		Policy & Planning		AC	
Active management and control of critical pest species through Council and Ranger programs		**TSRA**, **TSRIC**, **TSC**		Implement		AC	
Assess expansion of Indigenous protected areas to help to reduce human impacts on environmentally sensitive and important sites		**TSRA**		Policy & Planning		AC	
Continue moratorium on sea-bed mining				Policy & Planning		AC	
Consider how responsive management actions can be built into fisheries management to reduce fishing pressure on climate stressed reefs		**AFMA**		Policy & Planning		AC	
Implement strategies that ensure local fishing and hunting is undertaken in a sustainable way that takes into account the vulnerability of fisheries to climate change and future resource changes		**AFMA**		Implement		AC	

Note – actions listed may still need discussion with partner agencies and programs regarding resourcing and implementation. Refer to www.tsra.gov.au for updated action tables.

Table 8: Resilience Outcome 5 – Summary of Actions *(continued)*

See page 56 for description of Table Legends

Task	P	Lead Agency, Support Agency	T	Management Element	SE	VT	
Expand efforts to protect critical turtle nesting sites		**TSRA**, DEHP		Implement		Ex	
Expand the dugong sanctuary, potentially with bilateral cooperation of PNG into their territorial waters		**TSRA**, DOE		Implement		AC	
Research institutions and partners coordinate research projects that target species vulnerable to climate change (e.g. corals, fishes, crayfish, marine turtles, dugongs, seagrasses, pelagic foragers) to optimise the effectiveness of resilience-based management.		**TSRA** with support from researchers		Implement		AC	
Assess active relocation of key plants and animals to safer areas of refugia as a future management consideration.		**DEHP**, TSRA		Implement		AC	
Work with relevant agencies to ensure shipping risks (including grounding, marine pests, and impact of wake, fuel and toxic materials spills) are minimised and that adequate response capability exists to minimise any possible impacts.		**TSRA**, AMSA, MSQ, JCU		Implement		Ex	
Ensure that future development on islands does not increase hillside erosion and associated run off into the sea.		**TSIRC**, TSC		Implement		Ex	
Continue to build local community understanding of their land and sea country.		**TSRA**, Communities		Education and Awareness		AC	
Continue to educate fishermen on sustainable fishing practices (e.g. do not break the coral when extracting crayfish, minimising anchor damage to corals).		**AFMA**		Education and Awareness		Ex	
Establish a long-term monitoring program to track climate change related changes to island and marine ecosystems and key biophysical variables and processes (including ground water intrusion, ocean acidification, sea surface temperatures, tides, salinity, shoreline erosion, changes in fauna distribution, abundance, breeding success and behaviour, changes in flora composition and distribution, fire frequency, soil moisture and standard meteorological variables)		**TSRA**, AIMS, CSIRO, BOM		Monitoring		Ex	

Note – actions listed may still need discussion with partner agencies and programs regarding resourcing and implementation. Refer to www.tsra.gov.au for updated action tables.

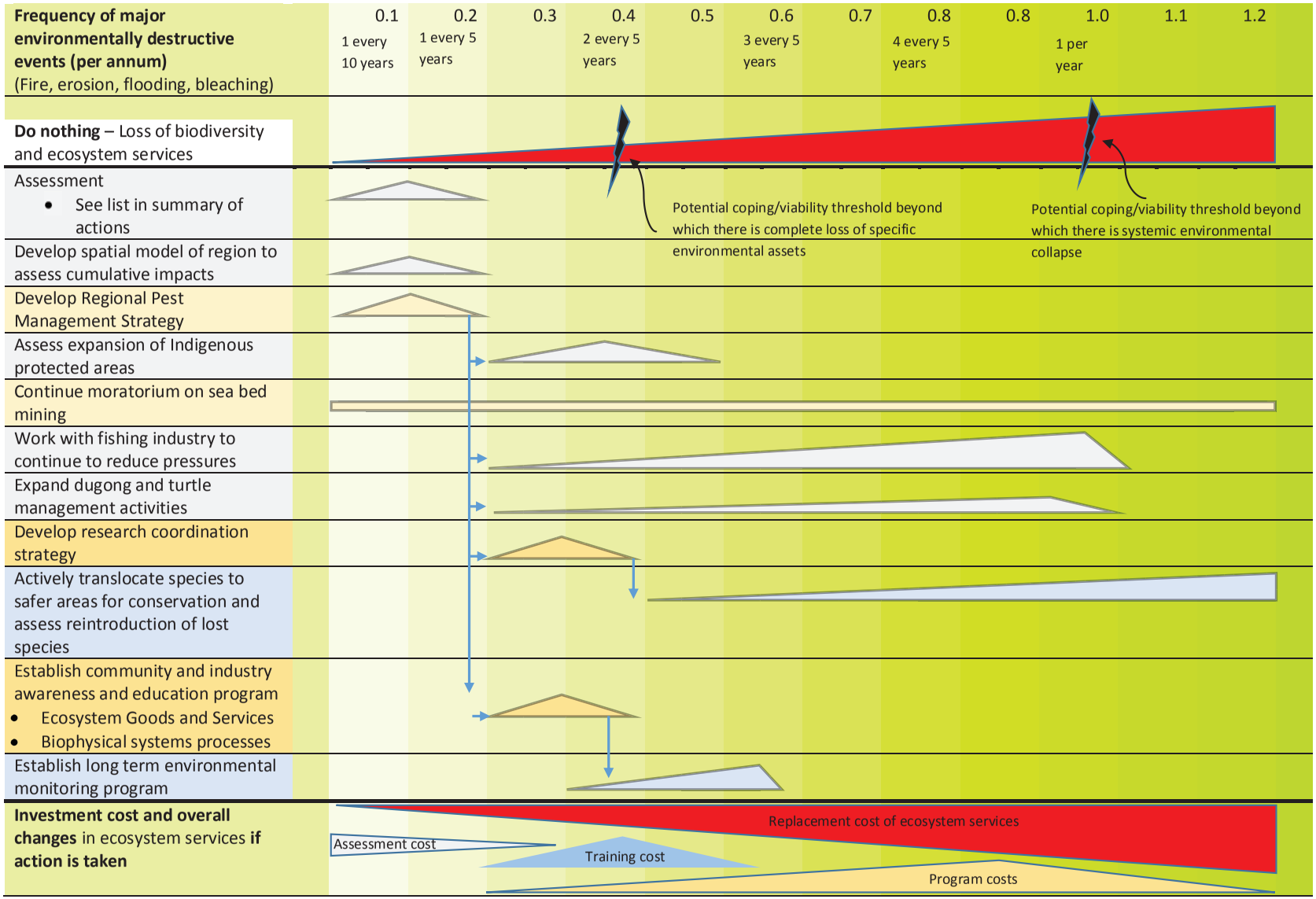

Figure 26: Pathway Map – Resilience Outcome 5: Healthy Land and Sea Country

Resilience Outcome 6:

Enterprise in the Region and in each community aligns with community values and is meeting the majority of the communities' local needs.

Building local community-based enterprise will be a critical plank in building community capacity and resilience and will have flow on benefits into health, food security, community confidence and self-reliance. Besides fostering and supporting business ventures there may also be opportunities through hybrid economy models such as Local Exchange Trading System (LETS) described below; as well as micro-enterprises to help meet community needs for services and goods currently imported.

Current baseline

The current situation information provided in the Plan under the Outlook for Financial Capital section is relevant to the baseline for this Outcome.

The TSRA is working with communities and financial institutions to support the establishment of micro-enterprises within the local communities.

Unemployment levels are still high due primarily to the lack of local enterprise. The Remote Jobs and Communities Programme (RJCP) aims to support people to move into more permanent job opportunities as they arise whilst providing a financial safety net.

Table 9: Resilience Outcome 6 – Summary of Actions See page 56 for description of Table Legends

Task	P	Lead Agency, Support Agency	T	Management Element	SE	VT	
Explore alternative economic models such as the Blue Economy model (www.theblueeconomy.org/) that are well suited to holistic community development and cultural values and that deliver multiple benefits		**TSRA**, DATSIP		Information		AC	☹
Assess climate change risks to infrastructure that supports key economic activities such as transport and the fishing industry		**TSRA**, **DATSIP**		Information		Ex	☹
Assess the barriers and enablers to local economies and enterprise development		**TSRA**, DATSIP		Information		AC	😐

Thursday Island wind turbines. Photo: John Rainbird

Table 9: Resilience Outcome 6 – Summary of Actions *(continued)*

See page 56 for description of Table Legends

Task	P	Lead Agency, Support Agency	T	Management Element	SE	VT	
Assess current skills and training against community needs and opportunities		**TSRA**, DATSIP		Information		AC	
Map and model local and regional economies in relation to flow of funds and resources to inform opportunities to build greater regional and local financial resilience		**TSRA**, DATSIP		Information		AC	
Explore alternative livelihood options to broaden the income base to promote resilience		**CSIRO**, TSRA		Information		AC	
Assess the role of alternative supplementary economies such as LETS (Local Exchange Trading System) that enable greater participation in local economies and are strongly aligned to traditional values and practices ("traditional commodity trading - we need the best of both worlds. Go back and think about our ways" workshop participant)		**TSRA**, DATSIP		Information		AC	
Consider the role of Torres Strait diaspora in supporting the development of island-based economies		**TSRA**		Information		AC	
Review quarantine regulations and border policies that are a barrier to trade between islands with the Torres Strait and between the region and PNG Treaty villages		**DFAT**, DAF		Information		AC	
Assess the effect of ocean acidification on fishing stocks, particularly tropical rock lobster		**CISRO**, AFMA, AIMS		Information		S	
Establish mentoring program for small business owners to increase chances of success during start-up		**TSRA**		Implement		AC	
Investigate potential for aquaculture (or varying levels of climate controlled production of seafood) in the region		**TSRA**		Information		AC	
Investigate options for economic development through value adding to local seafood production		**TSRA**		Information		EX	
Investigate marketing strategies to improve value and economic return from seafood production		**TSRA**		Information		EX	
Implement skills and capacity building: • Local workforce to be able to undertake the full scope of construction and engineering services, from planning to implementation • Cadetships, mentoring and on the job training for key jobs e.g. reef pilots Audit interests of senior students for careers currently dominated by outside expertise (pilots, scientists, engineers, graphics and communications etc.) and develop career pathway opportunities		**DATSIP**, TSRA		Implement		AC	

Note – actions listed may still need discussion with partner agencies and programs regarding resourcing and implementation. Refer to www.tsra.gov.au for updated action tables.

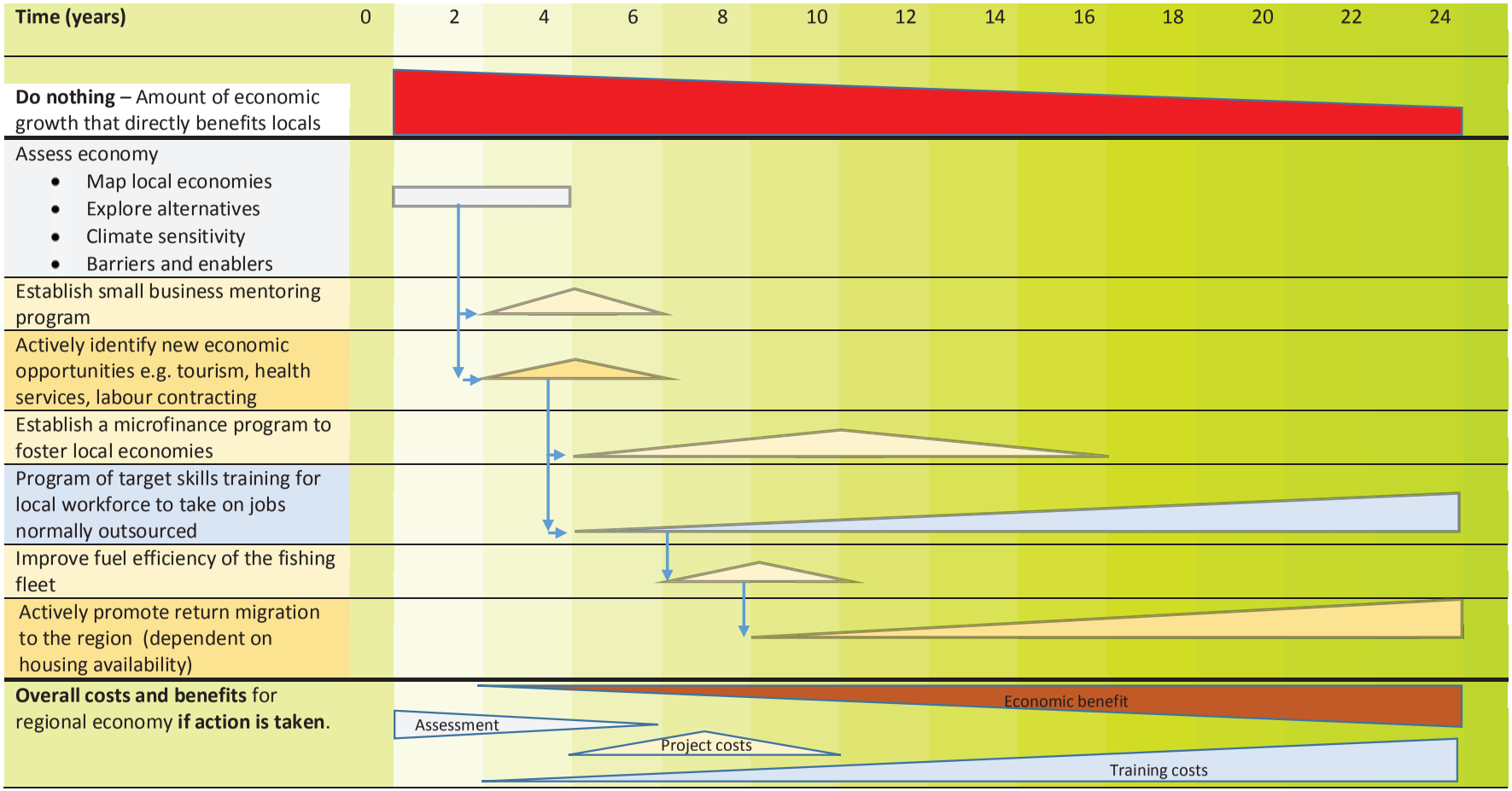

Figure 27: Pathway Map – Resilience Outcome 6: Strong Economy

D Monitoring, Evaluation and Adjustment of Adaptation Action Plan

Did we do what we said we would do and did it achieve the results we were looking for?

In order to be able to evaluate the usefulness of the actions taken to achieve the desired outcomes, it is necessary to monitor whether, and to what extent, those actions were actually implemented. The cost and resources consumed in implementation need to be measured so that an assessment can be made about the value of investing in these actions in comparison with the benefit gained. Finally, an assessment must be made of the actual contribution to be attributed to each action, and the combination of actions, in progressing towards or achieving the agreed outcomes. The findings of these assessments can then inform decisions about how to adjust the actions to better pursue the outcomes.

The commitment to report each year on the implementation of the actions drives a monitoring program to inform that report. The report simply states the current status of each action – that is, is it completed, partly completed or yet to be commenced? Appropriate detail explaining the extent and reasons for partial completion or the reasons for delayed commencement are needed to support understanding of any barrier to, or constraint on each action.

A statement of the actual or estimated cost of implementing each action should include both direct and indirect costs, and where appropriate, in-kind contributions to the cost of implementation. It is not always possible to fully anticipate the cost of implementation and hence an annual assessment of the funds and other resources actually expended or committed provides an important input into on-going adaptive management.

Although evaluation of the extent to which outcomes are being achieved generally extends across longer than annual timespans, it is necessary to track whether, and to what extent, actions being implemented to achieve those outcomes are actually contributing to progress. In some cases targets may be set because meeting the target could reasonably be assumed to have a beneficial effect on the desired outcome. For example, a target of relocating all hazardous materials at least three metres above mean high tide level could be assumed to be beneficial to an outcome of preventing pollution by hazardous materials during extreme tidal or storm events.

Tracking the implementation and contribution of the agreed actions supports the important task of evaluating management effectiveness. This evaluation assesses the extent to which the desired outcomes are actually being achieved. In other words, how much progress has been made in moving from the original situation to the desired situation that was agreed when the plan was being prepared?

To make it possible to assess such progress, both the original situation and the desired situation (or condition of the asset or system) needs to be described using the same indicators. For example, if the desired outcome is to have a situation where 50% of fresh vegetables are grown locally, then the original situation would be that perhaps 20% of the vegetables were grown locally. By using the same indicator for the original situation and the desired outcome, in this case the proportion of fresh vegetables grown locally, it is possible to measure at any time how close we are to achieving the outcome wanted.

For communities in the Torres Strait wanting to build resilience to the effects of climate change, the appropriate outcomes are those that describe important aspects of resilience – strong communities, good infrastructure, and so forth as set out in the Strategies in this Regional Adaptation Action Plan.

One way to keep people informed about the progress being made is to have a community scoreboard on display in each community with the Climate Champion keeping the scoreboard up to date in consultation with their community, the local governments and the Torres Strait Regional Authority.

This scoreboard would show progress for each of the Strategies, like showing a boat moving from where it set out towards the place the skipper wants to go. However, it could also show a 'traffic light' score for all the individual actions from the annual implementation report - green for on track, amber for having problems or

needing more effort and red for not progressing. Then everyone in the community can see how things are going and what needs some attention.

To make this work, during the planning process it needs to be clear where the resources are going to come from to do the actions and who is going to be responsible for making sure the actions are done. There needs to be agreement on accountability from the start so that everyone knows what is expected, the real cost of implementation is thought through, and there are no misunderstandings or unfounded assumptions that can cause problems as the Plan goes forward.

The American National Research Council (2012) identified four critical areas that should be considered in developing resilience indicators:

1. **Vulnerable Populations**
   Factors that capture the special needs of individuals and groups, related to components such as minority status, health issues, mobility and socio-economic status.
2. **Critical and Environmental Infrastructure**
   The ability of critical and environmental infrastructure to recover from events – components may include water and sewerage, transportation, power, communications and natural infrastructure.
3. **Social Factors**
   Factors that enhance or limit a community's ability to recover, including components such as social capital, education, language, governance, financial structures, culture and workforce.
4. **Built Infrastructure**
   The ability of built infrastructure to withstand impacts of disasters, including components such as hospitals, local government, emergency response facilities, schools, homes and businesses, bridges and roads.

Saibai Island warriors. Photo: TSRA

Evaluation of Management Effectiveness

Measuring achievement of outcomes: 3 - 5 yearly Report Card

Part C: Adapting to Change – Adjusting to the effects of sea-level rise; more hot days and hotter hot days and more extreme weather events		
	Parameter/indicator of status/ condition of the asset/system	**Measure & (*desired standard*)**
Adaptation Outcome 1: Coastal communities and infrastructure are protected from sea-level rise and coastal impacts, and communities have options in responding to long-term sea-level rise	Discrete alternative actions or sets of actions Period of interrupted normal activity, operation or occupation Critical infrastructure and houses in flood prone area	Number of actions or sets of actions that are capable of practical implementation (*number of sustainable or emerging options exceeds the number of options becoming unviable*) Land use planning considerations Financial considerations Land-tenure and Native Title considerations For housing - number of days (*not more than 3 days in any 30 day period*)
Adaptation Outcome 2: Communities and infrastructure are protected from extreme weather impacts (disaster risk management)	Level of preparedness	For essential infrastructure - number of hours out of operation due to extreme events (*not more than 12 hours in any 48 hour period*) Number of emergency drills to test disaster response across the region. (*Annual*) % of buildings compliant with *Category 5 cyclone* building standards Number of communities with fully functioning disaster management groups
Adaptation Outcome 3: Reducing the impacts of hotter days and more hot days on community health and well-being	Emerging climate-related health risks, e.g. heat stress, infectious diseases	Number of emerging risks that are controlled (*control strategies are satisfactorily implemented for all climate-related health risks*) Changes in incidence and impacts of climate related health impacts– asthma and allergy; heat stress; vector borne diseases; stress

Part C: Building resilience		
	Parameter/indicator of status/ condition of the asset/system	**Measure & (*desired standard*)**
Resilience Outcome 1: The governance arrangements for the Torres Strait Region and for each community enable development of responsive, resilient and sustainable communities with climate change and resilience fully integrated into development planning and policy development	Evidence of consideration of climate change and resilience in planning and decision-making	Degree of connection between identified climate risk and resilience information and planning processes and products and development decisions (*presence/absence and weak/ adequate/strong connection*)
Resilience Outcome 2: Health risks are managed and reduced through holistic health and well-being strategies and interventions	Health statistics, including monitoring of heat related illness and vector-borne diseases	Benchmarked across three Indigenous communities of comparable size elsewhere in Oceania ... ... the score on a range of standard health and well-being indicators (*similar or better*)
	Health and well-being programs characterised as holistic	The number of programs currently being implemented
Resilience Outcome 3: The community is strong, confident and capable and has increased its capacity to respond positively to change and impacts	Local newspaper stories	The number of articles about the community's performance and outlook (*steady or increasing*)
	People actively involved in adaptation planning and projects	Number of people trained in adaptation planning and practice
	Participation in service to the community – organisations and events	The proportion of the population participating (*steady or increasing*)
	Population trends	Number of people leaving or joining community
Resilience Outcome 4: The infrastructure and services in the Torres Strait are fit for purpose, systems have built in redundancy, have low operation and maintenance costs and meet needs of the local and regional community	Reliability	The frequency and duration of outages and service disruptions experienced (*not exceeded*)
	Financial sustainability	Changes in annual operations and maintenance costs
	Type of infrastructure or service	Indicators of fit for purpose – small community and environmental footprint; low operations and maintenance costs, system redundancy

Resilience Outcome 5: The land and sea are healthy and are able to adjust to the changing climate without losing diversity or productivity *Refer to the Torres Strait Land and Sea Management Strategy for more detail on status and trends and associated management, research and monitoring priorities*	Distribution and abundance of a suite of ecosystem health (structure and function) indicator species	The trends (*steady or increasing*) Dugong and turtle population numbers and breeding success Extent and condition of seagrass meadows and mangroves Number and extent of coral bleaching events Extent of weed and pest invasions
Resilience Outcome 6: Enterprise in the Region and in each community is in line with community values is meeting the majority of communities' local needs and is dynamic and thriving	Local enterprises that are conducting business in the Region and in each community Household income statistics Local employment participation Local economic activity	The number of Australian Business Numbers (ABNs) with their registered office in the Torres Strait, listed by the community or communities they serve (*steady or increasing*) ... the score on a range of standard household income indicators (*similar or better*) ... the score on a range of standard employment participation indicators (*similar or better*) The number of times a dollar circulates through a community Number of micro-enterprises
ADJUSTMENT AND REVIEW Adjusting management actions – in-progress and at end-of-project Adjusting outcomes – tracked for currency/continued relevance against changing circumstances and at scheduled review points (5 years)		

Appendices

These documents can be viewed and downloaded from www.tsra.gov.au/.....

Appendix A: Climate change projections for the Torres Strait or nearby regions for high emissions scenarios

Appendix B: Community-based Planning Process

Appendix C: Evaluation of Adaptation and Resilience Outcomes

Appendix D: Monitoring of Implementation Template

Communities such as Warraber improvise to address coastal erosion whilst they wait to secure funding for coastal works. Photo: TSRA

Appendix A: Climate change projections for the Torres Strait or nearby regions for high emissions scenarios

Year	Variable	Projection (High emissions scenarios)	Source
2030	Wind speed	Up by 2-5% (Average National Change)	CSIRO - CC in Australia report 2007
2030	Ave Annual Temp	+0.3-1˚C (1990)	CSIRO - CC in Australia report 2007
2030	Ave Annual Temp (Currently 26.8)	+1.2˚C	CSIRO Downscaled Suppiah 2011
2030	Ave Apparent Temp (currently 38.4)	+1.3˚C	CSIRO Downscaled Suppiah
2030	Pot Evaporation	+6.3%	CSIRO Downscaled Suppiah
2030	Ave Annual SST	+0.6-1	BoM
2050	Ave Annual Temp	+1.7˚C	Qld Govt CC Projections - CY
2050	Ave Annual Temp	+1.7˚C	CSIRO Downscaled Suppiah - 2011
2050	Pot. Evaporation	+ 9%	Qld Govt CC Projections - CY
2050	Pot. Evaporation	+6.4%	CSIRO Downscaled Suppiah
2050	Ave annual SST	+1.5-2˚C	BoM
2050	Ave Apparent Temp	+2.7˚C	CSIRO Downscaled Suppiah
2055	Ave Annual Temp	+1-1.5˚C	CSIRO NERP Downscaled
2055	Ave Annual Rainfall	Slight decrease in South, slight increase in north	CSIRO NERP Downscaled
2055	Seasonal rainfall	Slightly drier Feb-Mar, up to 20% wetter Oct	CSIRO NERP Downscaled
2070	Ave Annual Temp	+1-4˚C (1990)	CSIRO - CC in Australia report 2007
2070	Ave Annual Temp	+1-5˚C	Climate Commission The Critical Decade Qld Report 2013
2070	Ave Annual Temp	Up to +3.7˚C	Qld Govt CC Projections - CY - based on CSIRO and BoM 2007
2070	Ave Annual Temp	+2.4˚C	CSIRO Downscaled Suppiah
2070	Ave Annual Temp	+3-4˚C	BoM
2070	Hot spells – days above 35	Increase from current of 6 to 50 (Nat ave)	CSIRO - CC in Australia report 2007
2070 for Brisbane	Hot spells – days above 35	From 1 now to 21	CSIRO
2070	Hot spells – days above 35	55-189 days for Weipa, 97-210 for Palmerville	Qld Govt CC Projections - CY
2070	Pot Evaporation	+8.8%	CSIRO Downscaled Suppiah
2070	Pot Evaporation	+14%	Qld Govt CC Projections - CY
2070	Pot Evaporation	+8-12 %	BoM
2070	Ave SST	+2-2.5˚C	BoM
2070	Ave. Apparent Temp	+3.8˚C	CSIRO Downscaled Suppiah
2090	Ave Annual Rainfall	Decrease -10-15% , but increase up to 20% along north	CSIRO NERP Downscaled
2090	Ave Annual Temp	+2.5˚C	CSIRO NERP Downscaled
2090	Wind Speed	Decrease in wind speed (-3.5%)	CSIRO NERP Downscaled
2090	Average rainfall	-2.9%	CSIRO NERP Downscaled

Appendix B: Community-based Planning Process

Workshops are run on communities over 2 days. They are based upon a participatory action research approach. A local community adaptation and resilience plan is drafted based on results from both regional and community workshop processes.

Workshop objectives include:

1. Build awareness and understanding of key drivers of change for the community
2. Build understanding of climate change challenges
3. Establish a vision for the community
4. Establish the key risks and issues facing the community
5. Establish a benchmark of community resilience and vulnerability
6. Identify adaptation strategies and actions to build community resilience
7. Identify key barriers to implementation of proposed strategies

Session 1: Establishing context –how has the community changed over the past 50 years? Development of a community timeline. How have the changes impacted the community? What are the important issues for community now and what do community perceive as the key future risks to the community?

Session 2: Driver of change – unpacking what drives change. Non-climate drivers of change. Short, medium and long-term drivers, spheres of influence, low, medium and high impact changes.

Session 3: Establishing a vision for community. Where is the current development path likely to take the community? What is the preferred future for the Community? What exactly does that look like?

Session 4: Climate change and your community. What are the expected local impacts and how might they affect the community and environment. Assessment of priority ecosystem goods and services and their sensitivity to climate impacts.

Session 5: Community resilience – what is resilience. Benchmarking community resilience with 10 indicators.

Session 6: Actions that will increase adaptive capacity and resilience and reduce climate risks.

Session 7: Assessment of actions to determine priorities.

Session 8: Barriers and enablers – what is stopping actions from occurring and what enables change?

A rainbow, the symbol of hope, shines over the Torres Strait. Photo: John Rainbird

Appendix C: Evaluation of Adaptation and Resilience Outcomes

Outcome	Indicator / parameter	Source	Task
A1: Sea level rise 	The number of houses, business premises and other substantial buildings and the length of roadway exposed to high-water inundation	TSIRC & TSC	Finalise fine scale coastal hazard adaptation planning
	The number of seawalls approved, under construction or established in locations assessed as justified for protection	TSRA	Access the project records
	The number of communities with accepted sets of sea level rise management options	TSIRC & TSC	Finalise fine scale coastal hazard adaptation planning
A2: Extreme weather events 	The number of communities with approved disaster management plans under the State Natural Disaster Management Arrangements	TSIRC & TSC (District Disaster Management Groups)	Access the disaster management records
	The number of communities that have fully functional Local Disaster Management Groups	TSIRC & TSC (District Disaster Management Groups)	Access the disaster management records
	The recovery time in days for essential services to the communities following a natural disaster	TSIRC & TSC (District Disaster Management Groups)	Access the disaster management records
	The percentage of buildings in each community that are rated to withstand a category 5 storm	TSIRC & TSC, Dept Housing	Department of Housing records
	The percentage of communities that have at least one category 5 rated cyclone shelter in each community	TSIRC & TSC (District Disaster Management Groups)	Access the disaster management records
A3: Increased heat 	The number of reported heat-related health and wellbeing incidents per year	Torres and Cape Hospital and Health Service	Access the public health records
	The trend in the incidence and impacts of climate related health impacts– asthma and allergy; heat stress	Torres and Cape Hospital and Health Service	Access the public health records
	The number of heat-related excess deaths per calendar year	Torres and Cape Hospital and Health Service	Access the public health records

Outcome	Indicator / parameter	Source	Task
R1: Governance 	Decisions that mention climate change/resilience as relevant	TSRA records TSIRC records TSC record	Check records for the past full calendar year for main organizations and relevant committees. Note significant outlier decisions since the last review or currently pending
R2: Health 	• Number of holistic health and well-being programs • Incidence of diabetes percentage of population • Life expectancy at birth – all adults • Number of vector-borne infection cases per calendar year (deletions)	Queensland Health World Health Organisation http://data.worldbank.org/indicator	Gather the most recent data
R3: Community 	Positive local news stories every week	Torres News Published papers and editorial staff insights	Conduct random sample of five separate weeks' content over the previous fully calendar year Note significant outliers during that year
	Balance of people with family connections coming back to live in the Torres Strait over people moving away	Census data Local Government records Community champions	Analyse the available information
	Percentage of community members participating in community events that benefit the communities as a whole	Community champions	Record the number of community events (e.g. Sporting and cultural events) in the past calendar year by community and across communities; the number of people engaged in organising them and the number of people attending – expressed as a percentage of population pool (separated between school age/youth and adult Note significant outlier events since the last review or currently pending
	Number of people actively engaged in the adaptation/ resilience building process	Community champions	Record the number of people actively engaged in specific adaptation/ resilience building events, activities or projects
	Extent of anti-social and disruptive behaviour	Queensland Police Service	Gather data on the number and trend in anti-social and disruptive behaviour arrests per community per year

Outcome	Indicator / parameter	Source	Task
	Level of financial stress	Government agencies & NGO Banks (Commonwealth, Westpac, ANZ, NAB, Suncorp and Bank of Queensland)	Gather ancillary indicative information about financial stress from social service agencies Gather non-attributable data about distressed loans
R4: Infrastructure 	The annual costs of maintaining the electricity, water treatment, waste water treatment, waste management and telecommunications across the two Torres Strait local authority areas	Ergon Energy Telstra TSIRC & TSC	Gather annual capital and operating costs since the last review and average by year
	The annual costs of maintaining roads, aircraft landing facilities and vessel operating infrastructure and services.	Australian Government Agencies Queensland Government Agencies TSIRC & TSC	Gather annual capital and operating costs since the last review and average by year
	Duration of unplanned disruption of services in days/community	TSIRC TSC	Gather data on disruption of services
	The extent of the environmental footprint of the community infrastructure and services and the degree of useful built-in redundancy.	TSRA	Assess the environmental footprint of each community
R5: Land & Sea 	Sea grass extent and condition	TSRA LSMU	Gather the most recent sea grass mapping information
	Mangrove distribution and condition	TSRA LSMU	Gather the most recent mangrove mapping information
	Marine turtle abundance and nesting success	TSRA LSMU	Gather the most recent sea turtle survey information
	Dugong abundance and recruitment	TSRA LSMU	Gather the most recent dugong survey information
	Extend of bleaching and interval between coral bleaching events, in years	TSRA LSMU	Gather the most recent coral bleaching observation records
	Distribution & abundance of key weed species	TSRA LSMU	Gather the most recent survey and informal observation information
	Distribution & abundance of key feral animal species	TSRA LSMU	Gather the most recent survey and informal observation information
	Extent, severity and trend of coastal erosion	TSRA LSMU	Access the most recent erosion management information

Thong tree, Poruma. Photo: John Rainbird

Outcome	Indicator / parameter	Source	Task
R6: Enterprise 	The number of micro-enterprises currently operating within the local communities	TSRA	Maintain a register of micro-enterprises
	The volume and value of commercial fishery turnover	TSRA	Access the most recent industry turnover data
	The volume and value of commercial tourism turnover	TSRA	Access the most recent industry turnover data
	The extent of employment participation by persons aged 18 to 55 years	TSRA	Access the most recent employment participation data

Appendix D: Monitoring of Implementation Template

Monitoring management action effort and results – annual traffic light report and community scoreboard

- **a** Insert your adaptation actions in column A
- **b** Insert lead organisation in column B
- **c** Insert support organisation in column C
- **d** Insert potential resources and funding opportunities in column I to assist in feasibility and implementation
- **e** Insert a date (or date range) for when feasibility studies will commence to determine the appropriate means of implementation for the adaptation action in column D
- **f** Identify the tasks involved in undertaking the feasibility study and insert them in column E
- **g** Insert the date that work begins on implementation in column F
- **h** Identify tasks involved in implementing the adaptation action and insert them in column G
- **i** insert the date the adaptation action was implemented and handed over for monitoring and evaluation

Link to business plans and strategic plans

Adaptation Actions	Lead Organisation	Support Organisation	Feasibility Date	Feasibility Milestones	Implementation Date	Implementation Milestones	Delivered By	Resources/ Funding
Strategic assessment of SLR impacts across the regions	TSRA	TSC, Councils	1/06/2015	Scoping Document finalised $200K funding secured to undertake assessment	1/07/2015	Assessment of all islands including maps of inundation and floods, critical infrastructure, buildings and environmental assets	30/12/2015	Project management - TSRA Outsourced contract for works
Improve soft infrastructure to protect key areas	TSRA, Rangers	Local communities	Summer 2013	Experiment with different types of information to assess effectiveness	1/09/2014	Material developed	1/02/2014	Council grant
Upgrade housing to be more resilient to inundation								
Increase construction of hard infrastructure to protect areas								
Relocation of critical infrastructure and important cultural sites to higher ground								

Glossary

Adaptation – Adjustment or preparation of natural or human systems to a new or changing environment which moderates harm or exploits beneficial opportunities.

Adaptive capacity – The ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

Apparent temperature – The perceived outdoor temperature, caused by the combined effects of air temperature, relative humidity and wind speed. An indication of comfort levels of outdoor conditions.

Climate change – Climate change refers to any significant change in the measures of climate lasting for an extended period of time. In other words, climate change includes major changes in temperature, precipitation, or wind patterns, among others, that occur over several decades or longer. Causes of climatic changes are natural as well as human.

Coral Bleaching – The process in which a coral colony under environmental stress expels the microscopic algae (zooxanthellae) that live in symbiosis with their host organisms (polyps). The affected coral colony appears whitened.

Ecosystem – Any natural unit or entity including living and non-living parts that interact to produce a stable system through cyclic exchange of materials.

Ecosystem Service – Ecological processes or functions having monetary or non-monetary value to individuals or society at large (e.g. erosion control, pollination, water purification).

Exposure – The degree to which something experiences a climate related hazard.

Heat wave – A prolonged period of abnormally hot weather.

Heat stress – A general medical term that refers to the impact of excessive heat on body function, resulting in conditions such as cramp, exhaustion or heat stroke.

Livelihood – The way in which someone makes a living or sustains themselves.

Mitigation – A human intervention to reduce the human impact on the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks.

Ocean Acidification – Increased concentrations of carbon dioxide in sea water causing a measurable increase in acidity (i.e. a reduction in ocean pH). This may lead to reduced calcification rates of calcifying organisms such as corals, mollusks, algae and crustaceans.

Phenology – The timing of natural events, such as flower blooms and animal migration, which is influenced by changes in climate. Phenology is the study of such important seasonal events. Phenological events are influenced by a combination of climate factors, including light, temperature, rainfall, and humidity.

Resilience – The amount of change a system can undergo (its capacity to absorb disturbance) and remain within the same regime – essentially retaining the same function, structure and feedbacks.

Risk – The probability of an adverse event occurring.

Sea Surface Temperature – The water temperature close to the ocean's surface.

Sensitivity – Reflects to what degree a system is impacted by a climate event or shift

Vulnerability – Essentially the potential to be harmed. The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude and rate of climate variation to which a system is exposed (exposure); its sensitivity to the impacts; and its adaptive capacity.

Storm surge – A rising of the sea as a result of wind and atmospheric pressure changes associated with a storm.

Threshold - The magnitude or intensity that must be exceeded for a certain reaction, phenomenon, result or condition to occur or be manifested.

Transformation – A marked change in a system where it essentially moves to a new or substantially altered state.

Anglican Church, St Pauls Community, Moa. Photo: John Rainbird

Acronyms

ABS	Australian Bureau of Statistics
AIMS	Australian Institute of Marine Science
AMSA	Australian Maritime Safety Authority
BOM	Bureau of Meteorology
CAT	Centre for Appropriate Technologies
DAF	Department of Agriculture [Commonwealth]
DATSIP	Department of Aboriginal and Torres Strait Islander Partnerships [Queensland]
DCCSDS	Department of Communities, Child Safety and Disability Services
DEHP	Department of Environment and Heritage protection [Queensland]
DFAT	Department of Foreign Affairs and Trade [Commonwealth]
DHPW	Department of Housing and Public Works [Queensland]
DILGP	Department of Infrastructure, Local Government and Planning [Queensland]
DMP	Disaster Management Plan
DOE	Department of the Environment [Commonwealth]
DPMC	Department of the Prime Minister and Cabinet [Commonwealth]
DTMR	Department of Transport and Main Roads [Queensland]
EM	Emergency Management
HAT	Highest astronomical tide
IBIS	Islanders Board of Industry and Service
IVA	Integrated climate change and vulnerability assessment
LETS	Local Exchange Trading System
JCU	James Cook University
LSMU	Land and Sea Management Unit
MSQ	Maritime Safety Queensland
NGO	Non-Government Organisation
PNG	Papua New Guinea
QDES	Queensland Department of Emergency Services
RJCP	Remote Jobs and Communities Programme
RNTBC	Registered Native Title Bodies Corporate
SES	State Emergency Service
TEK	Traditional Ecological Knowledge
TSC	Torres Strait Council
TSIRC	Torres Strait Island Regional Council
TSRA	Torres Strait Regional Authority
USA	Unites States of America

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Notes

Photo: TSRA