Integrating Climate Change into Coastal Planning & Management in the Republic of Mauritius

Recommendations for Mainstreaming Climate Change into the Current ICZM Framework

Prepared by Coastal Zone Management Pty Ltd
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Chapter 1: Introduction

This Report has been produced as a summary of recommendations to integrate climate change within the existing framework for Integrated Coastal Zone Management (ICZM) in the Republic of Mauritius (ROM). The work has been undertaken as a component of a wider Project to Integrate Climate Change into Sustainable Development for the ROM.

The information in this report deals with overriding governance arrangements and institutional architecture with respect to environmental policy, planning and legislation in RoM with a specific focus on the coastal zone. It provides a brief overview of existing issues, followed by a summary of good practice with respect to integration of climate change into coastal planning and management from elsewhere. This is followed by recommendations to integrate climate change within the existing framework for ICZM. Further recommendations to integrate climate change within the development approvals process, with a specific focus on the EIA process in-country are provided in a supplementary report and a series of associated guidance documents.

While the focus has been on incorporating climate change considerations within ROMs framework for ICZM, a number of polices, plans and tools that influence coastal management extend beyond the coastal zone. For example, integrating climate change within the Building and Land Use Permit (BLUP) process and the EIA process contribute to enhanced sustainable coastal development, whilst also contributing to sustainable development objectives more broadly. Therefore, the recommendations for climate integration, while developed through a coastal lens, have broader implications for climate resilient sustainable development in Mauritius (Figure 1).

The recommendations provided in this report are the product of a desktop study that was supplemented by workshop discussions held in-country in November 2012. As such, the initial report recommendations have been amended to reflect participant feedback during the workshop. In particular, the need for further more targeted work to make generic recommendations provided more applicable to the ROM context is highlighted. It is recognized that there are many challenges and barriers to implementing ‘best practice’ with respect to climate change adaptation in the coastal zone of ROM. Despite these challenges it will be important for Government of Mauritius and the range of stakeholders using the coastal zone to recognize the likely risks they may be susceptible to in the face of a changing climate.

While it is acknowledged that an appreciation of this risk is unlikely to lead to a radical change in coastal usage (e.g. a relocation of hotel developments from vulnerable zones) it will allow stakeholders to consider what constitutes an ‘accetible’ level of risk. For example, if a development is located within a high risk zone, what are the indictors of change that should be monitored within this area and at what point will impacts sustained trigger adaptive action?. This understanding should form the basis for regulatory planning control and proactive adaptation planning discussed further in the ‘Close Out Report’ that should be considered in conjunction with this document.

MOTIVATION

The coastal zone in Mauritius plays a fundamental role in the economic, social and environmental well being of the Nation. In particular, the coastal-based tourist industry creates important national revenue and is built upon a strong foundation of coastal environmental assets.

The coast in Mauritius, as around the world, is a naturally variable and dynamic interface between the land and the sea. Coastal change occurs at a range of temporal and spatial

scales in response to physical process drivers (wind, waves and water levels). Natural variability and patterns of change are generally only considered problematic when they impinge on the built human environment impacting coastal assets or interfering with the provision of environmental services. In areas where an adequate coastal buffer is provided cyclic and episodic physical change may occur within the coastal margin generally, establishing a pattern of dynamic equilibrium. Where development has occurred within the 'active' margins of the coastal zone negative impacts on human assets are likely. This is the case in Mauritius where rapid development along coastal margins, over the last 25 years in particular, has resulted in increased pressure on the environmental services provided by the land-ocean interface. This development has been unplanned and unregulated in many instances leading to exacerbated physical impacts (e.g. erosion/inundation) on coastal ecosystems and the services they provide as well as jeopardizing the sustainability of the existing built coastal environment and its considerable economic asset base for the people of Mauritius.

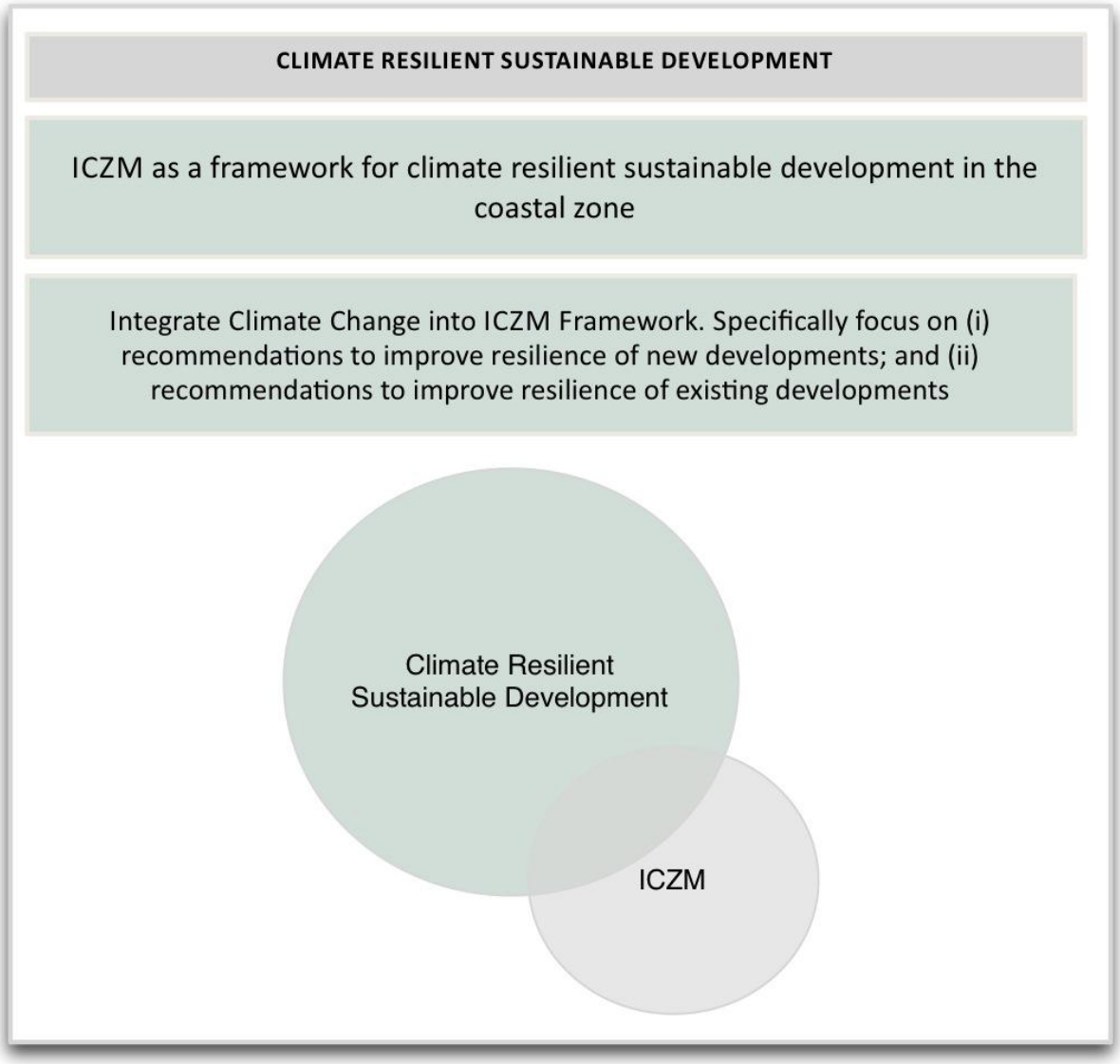


Figure 1: Contribution of existing work to increase climate resilience development in ROM

The Government of Mauritius (GoM) clearly recognise this issue and have identified the need for coastal development to be undertaken in a way that conserves and manages natural resources and environmental services by maintaining natural system functioning (Landall Mills, 2009a). Additionally, the GoM is acutely aware of the importance of the tourism sector to the national economy, and the reliance of the tourism sector on the coastal environmental assets.

BOX 1: UNDERLYING PROBLEM

- Unplanned, unregulated development in coastal zone;
- Continued pressure on coastal resources;
- Likely impacts of climate change on coastal zone compounding existing issues; and
- Threat to resilience of coastal assets that are required to ensure ongoing sustainability and longevity of the tourism industry.

To this end, the Government have invested significant time and effort in undertaking previous, comprehensive work in-country to formulate a framework for ICZM, as well as aligning responsibilities of key deparments within the Government's Ministeries to the planning and management of the coastal zone:

In 2007 the Ministry of Environment and National Development Unit (Government of Mauritius) commissioned a study to develop an ICZM Framework. The study involved three (3) core activities (Table 1):

- Development of an ICZM Strategy for Mauritius;
- Review and Preparation of a National Policy and Comprehensive Legislative Framework; and
- Preparation of ICZM Area Plans for Pressure Zones in Mauritius.

Overall, the 2009 Framework and the supporting institutional arrangements in-country provide a useful backbone for the effective management of coastal resources. However, a number of barriers and limitations have been identified with the existing system in terms of delivering the country's vision for sustainable development in the coastal zone. The key consideration, in the context of the current work, is the lack of consideration of climate change within the framework of coastal policy and planning.

The natural variability of the coastal zone and existing patterns of erosion and/or inundation are likely to be exacerbated by the impacts of a changing climate, in particular the effects of rising sea levels that will effectively shift the coastal zone in a landward direction. Thus it is clear that a consideration of climate change is paramount in a comprehensive and inclusive system for coastal planning and management.

Additional issues associated with the existing planning and management framework for the coastal zone relate to a lack of country specific guidance, in particular in the recommendations for ICZM proposed through the work undertaken in 2009. Wider issues such as capacity (human and financial) as well as challenges in connecting high-level strategic recommendations (theoretical guidance) with operational direction to implement recommendations on the ground have also been identified.

Table 1: Institutional arrangements and issues relevant to ICZM. Adapted from Landell Mills (2009a, pg 14, 41 – 43)

Authority	Responsibilities and Issues pertinent to ICZM
Ministry of Environment	**Responsibility:** Issue of licenses (Environmental Impact Assessments, Preliminary Environmental Reports) is the main regulatory instrument that the Ministry has to manage built environment. Also responsible for enforcing compliance with respect to the terms of EIA licenses. **Issues:** • Mandate of the Pollution Prevention and Control Division is broad. Responsibilities include, inter alia: monitoring of emissions, advice on pollution abatement and cleaner production, promoting ISO 9001 and ISO 14000, implementing Integrated Pollution Prevention and Control Licence (IPPC) licensing systems, acting as a secretariat to environmental liaison officers in other ministries, attending to public complaints, as well as their mandate for post-EIA monitoring. • Understaffed: Insufficient human resources to fulfill mandate (e.g. unable to conduct post-EIA monitoring effectively, respond to complaints from the public).
Local Authority	**Responsibility:** The planning division of the relevant local authority is responsible for post-construction inspection and compliance monitoring with respect to Building Act, 1999, and the Town and Country Act, 1954. Responsible for assessing and approving Building Land Use Permits (BLUPs). **Issues:** • Understaffed: Insufficient human resources to fulfill mandate (e.g. follow up on complaints, monitoring and evaluation is lacking). • Lack of prosecution based on non-compliance (approval from Business Committee to prosecute can take up to three months)
Police de l'Environnement	**Responsibility:** Enforcing compliance of environmental regulations. **Issues:** • Time is consumed by following up on minor complaints (e.g. illegal littering), rather than enforcing non-compliance of matters relevant to development.
Three Key Players in terms of ROM ICM	
Fisheries Division	**Responsibility:** Ensuring industry participants comply with fishery regulations. Includes coverage of the six fisheries reserves located at Black River, Grand Port, Port Louis, Post Lafayette, Poudre d'Or and Trou d'Eau Douce, as well as the two Marine Parks, at Balaclava and Blue Bay. **Issues:** • Understaffed: Insufficient human resources to fulfill mandate, making enforcement of standards difficult.
Ministry of Housing and Lands	**Responsibility:** Administers the *pas géométriques,* the leasehold lands that comprise most of the coastal margin on the landward side (above HWM). It also has legal responsibility for taking the lagoon bottom out of the *domaine publique*, when a leasehold of a specific lagoon area is required (e.g. for aquaculture). **Issues:** • Staff lack competency in utilizing Geographical Information Systems (GIS).
Beach Authority	**Responsibility:** Control and management of all public beaches (89 in total), with their authority extending 100m seaward from the low water mark. The public beaches are in total some 40 km of beach front, which represent approximately 15% of the total coastline and some 25% of the total sandy beachfront available on the island of Mauritius. **Issues:** • Understaffed – five enforcement officer, two beach inspectors and one technical officer.

BOX 2: INSTITUTIONAL ISSUES

- Lack of mainstreaming of environment and climate change issues across sectors;
- Weak institutional capacity, mainly related to environment and sector policymaking and enforcement of policies;
- Unclear division of responsibilities between sector ministries and national/local authorities;
- Ineffective monitoring and reporting systems;
- Insufficient environmental financing; inefficient economic policy instruments; and
- Low awareness among policy makers and the public related to environment and climate change issues.

BOX 3: EXPLORING POTENTIAL SOLUTIONS

This Project aims to address the aforementioned issues through a consideration of how the current Policy setting can be enhanced to improve coastal management, whilst being cognizant of the need to consider likely impacts of a changing climate for both existing and future development.

APPROACH AND REPORT STRUCTURE

The work to integrate climate change into existing coastal planning and management frameworks in RoM has been delivered through the following Components (Table 2):

1. Consideration of Good Practice for Integrating Climate Change into ICZM.
2. Recommendations to incorporate climate change within the existing ICZM framework.
3. Recommendations to enhance resilience of planned developments in the coastal zone.
4. Recommendations to enhance resilience of existing development in the coastal zone.

A review of best practice and lessons learned from global efforts to integrate climate change within coastal planning and management frameworks, together with an understanding of the exiting institutional architecture in the RoM[1], informed recommendations to integrate climate change within coastal planning and management.

Specific amendments to the existing framework of ICZM have been proposed. A focus within these recommendations is management tools that govern future and existing coastal development. Importantly, the recommendations provided herein are based on an analysis of existing literature and have not been informed by extensive in-country consultation. In-country training that will be delivered post submission of this report provides an opportunity to ground truth the recommendations and direct future integration activities.

[1] The analysis undertaken was a desktop-based exercise. A comprehensive 'needs' assessment or stakeholder consultation and engagement program was beyond the scope of the current work. However, the Climate Change Policy expert undertook a series of meetings with key government staff and officials and the outcomes of these discussions were used to inform the work undertaken.

Table 2: Components of the Current Report

Component 1	Good Practice	Summary of good practice for integrating climate change into ICZM including identification of pertinent entry points for RoM.	Chapter 2
Component 2	Recommendations for ICZM Framework	Recommended amendments to the existing ICZM framework to integrate climate change.	Chapter 3
Component 3	Recommendations for Future Development	Opportunities to integrate climate change with sustainable coastal management – specific focus on policy and regulatory frameworks for development and planning in the coastal zone.	Chapter 4
Component 4	Recommendations for coastal management with respect to existing development	Recommendations on good practice for increasing reliance of existing infrastructure.	Chapter 5

Chapter 2: Good Practice to Integrate Climate Change into ICZM

The principles governing ICZM are, in general, universally accepted, facilitating wide spread consensus on what constitutes 'Best Practice' (Olsen et al. 1997; Olsen et al. 2002; Olsen 2003a; Olsen 2003b). Although the specifics of implementation of this integrated process may vary from place to place dependent on their unique circumstances, three elements are considered key, namely:

- Appropriate direction-setting guidance;
- Adequate institutional arrangements; and
- Comprehensive coastal management planning.

Effective ICZM systems have, at their core, a well-developed hierarchy of documents that provide direction and guidance. These documents (e.g. strategies, polices, guidelines, manuals) cascade from strategic levels through to those that guide specific operational activities. These documents are referred to herein as 'Direction Setting Guidance' (DSG) elements.

Element	Details	Reference
Direction-setting guidance	Provide direction to decision making at all levels, from national-level activities through to guiding individual officers to make specific coastal management decisions, such as whether or not to approve a sea-wall application. Establishes a clear link between high-level goals, through key objectives, to specific management actions to support effective climate change adaptation on the coast.	Cicin-Sain & Knecht 1998; Kay & Alder 2005
Institutional arrangement	Should have a basis in legislative or executive mandate and an institutional identity (it is identifiable as either an independent organization or a coordinated network of organisations linked together by functions and management strategies). Must be resilient. Must be capable of accommodating a sufficiently broad range of externally driven changes to be able to maintain the system in a long-term, sustainable manner.	Sorensen & McCreary 1990; Kay and Alder 2005
Coastal management plans	Formulated based on direction setting guidance within a set of appropriate institutional arrangements, to develop and guide the implementation of on-ground management actions for specific sections of coast. An important component of effective coastal management planning systems is to develop an overall coastal management-planning framework that helps guide the choice and application of plans and their sequence of development and priority for implementation.	Clark, 1996; Hinrichsen, 1998; Kay & Alder, 2005

Effective ICZM should include consideration of each of the levels of the hierarchy shown in Figure 2 and a consideration of how best to fit these levels together (Cicin-Sain and Knecht 1998). In this sense, there is an emphasis on both 'vertical' integration between hierarchy levels and also 'horizontal' integration (Kay and Alder 2005) to ensure that policies, plans, manuals, targets and so on developed within a particular level are integrated effectively across government operations.

Figure 2: A simple hierarchy of direction setting statements in ICZM (Kay & Alder, 2005)

The multifaceted nature of the effort required to undertake adaptation to climate change in the coastal zone requires tools that allow for analysis and interrogation across sectors and disciplines. The principles and practices of ICZM are perfectly suited to such an approach.

There is now a significant body of literature regarding the process of developing adaptation strategies that outlines a clear process and mechanism for the preparation of an adaptation initiative through a series of sequential steps (Box 4). This process of iterative assessment, planning and implementation can be viewed as an additional element of the ICZM process. The assessment outputs inform both immediate on-ground adaptive action and the update and implementation of coastal management plans.

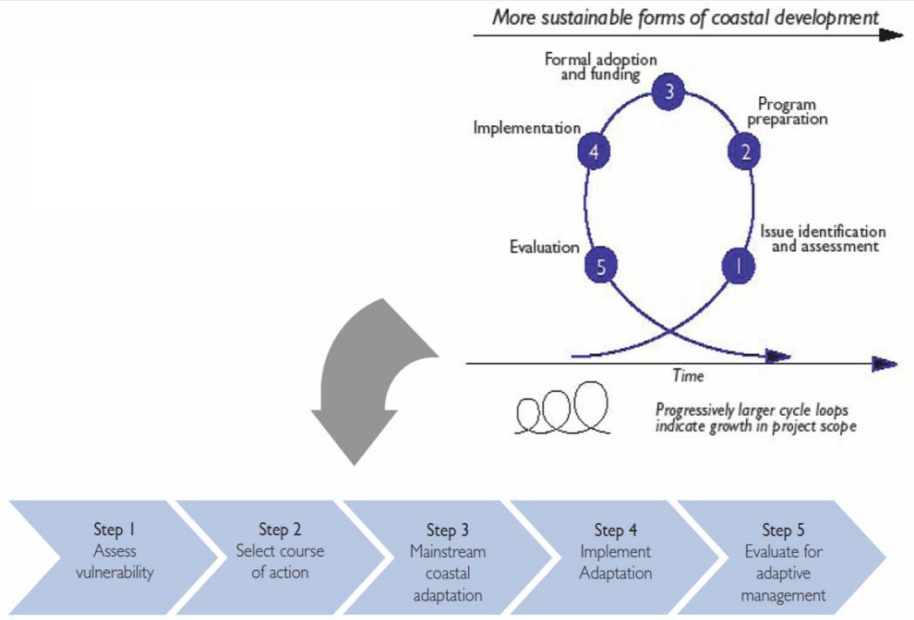
The integration between what may be termed coastal climate change vulnerability and adaptation assessments and the broader ICZM framework is shown in Figure 3. This approach embeds what may fundamentally be viewed as a vulnerability and adaptation assessment within an Integrated Decision-Making (IDM) process in order to maximize the potential for success. As illustrated in Figure 3, climate change adaptation (CCA) is a component of ICZM, rather than a standalone method to achieve an integrated decision-making process.

Integrating climate change means that climate concerns and adaptation responses are integrated into relevant development policies, plans, programs, and projects at national, sub-national, and local scales. From a coastal perspective, a number of entry points for climate integration have been identified (Box 5). The entry points range from national to local scales, with each level of integration reinforcing the elements across scales (Box 6). ICZM in RoM will be enhanced via an integration of climate change considerations across the elements of good practice ICZM (i.e. direction setting guidance elements, institutional arrangements and coastal management planning) and across all scales of entry point.

BOX 4: STEPS IN DEVELOPING AN ADAPTATION STRAGEGY

1. Defining the problem
2. Identifying the causes of the problem
3. Identifying and articulating the normative response
4. Identifying key barriers
5. Designing project responses to overcome key barriers
6. Reviewing the first five steps and completing checklists to ensure due diligence in meeting source of fund requirements

These steps represent a minimum set of activities to define an adaptation strategy within a logical structure. They are presented as a management cycle because adaptation should be seen as an iterative process that is modified and/or adapted as circumstances change and/or knowledge becomes better refined.



Source: USAID ' Adapting to coastal climate change a guidebook for development planners' (USAID, 2009).

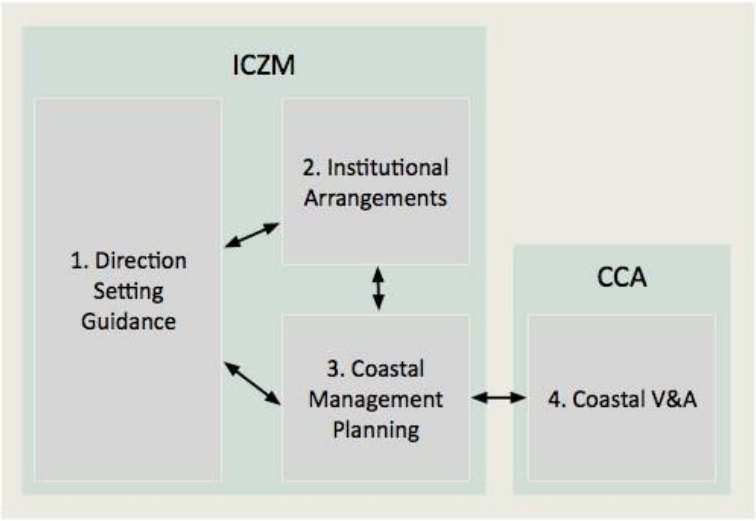


Figure 3: Relationship between climate change adaptation and integrated coastal zone management (Elrick and Kay 2009)

BOX 5: ENTRY POINTS FOR CLIMATE CHANGE INTEGRATION

Entry Point I: National & regional settings e.g. National Adaptation Programme of Action; National coastal management programs; Hazard mitigation or disaster preparedness; Poverty reduction strategies; and National budgeting processes.

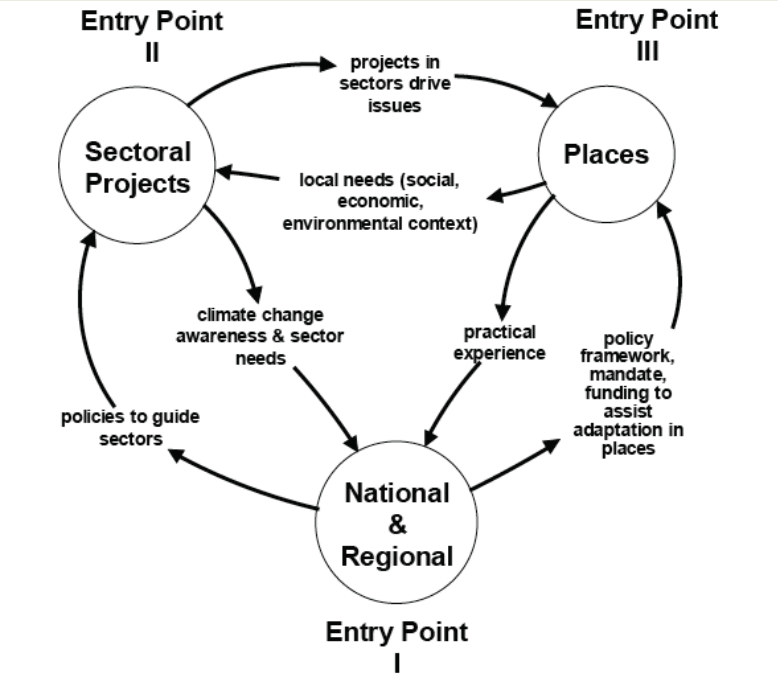
- National climate change adaptation strategies need to be mainstreamed into other development initiatives such as poverty reduction strategies, country strategies and sector plans.
- By mainstreaming climate change adaptation into development initiatives, there is ready access to the pool of resources already budgeted/identified for those initiatives.
- While there are many possible entry points at the national level, it is essential to have a focal agency with the authority and capacity as the champion of an adaptation initiative. This helps ensure effective coordination and avoids redundancy and/or inefficiencies amongst the various agencies involved.

Entry Point II: Sectoral investments and projects e.g. Tourism development in specific sites – Mariculture, Fisheries and Freshwater supply.

- Protecting existing and future economic development is an intrinsically strong and salient motivation for mainstreaming coastal adaptation. For example, tourism development investments in specific coastal sites need to account for dynamic shoreline processes, natural hazards such as potential flooding and storm events, and the effects of climate change that can accelerate, intensify or alter the coastal conditions required for successful tourism.

Entry Point III: Coastal places, e.g.: - Municipalities, districts, provinces; Ecosystems (estuaries, rivers); Coastal watersheds; and Marine protected areas.

- Place-based entry points are not restricted to existing administrative entities. Ecosystems such as coral reef systems, estuaries, coastal watersheds and wetland habitats, are compelling focal points for adaptation planning, as they also form the logical unit for scientific studies.



Source: USAID ' Adapting to coastal climate change a guidebook for development planners' (USAID, 2009).

BOX 6: GOOD PRACTICE: INTEGRATING CLIMATE CHANGE AND ICZM

A number of good practice principles can be followed when integrating climate change adaptation, including adopting an inclusive, equitable and stakeholder driven approach.

Stakeholder engagement and consultation concerning proposed policy measures

- Use pilot projects to test how a bundle of policy measures might contribute to societal benefits; then use the results of these pilots to inform the broader audience that will be essential to getting adaptation measures adopted and implemented more widely.

Focus on desired societal outcomes

- Move the debate from one focused on rights and narrow issues that focus on individuals being asked to modify their use of the coast, to one focused on a common search for desired societal outcomes—e.g., healthy coastal ecosystems that support livelihoods.

Undertake Confidence building through iteratively addressing issues

- Build confidence by addressing a simple issue first; this sets the stage for then tackling issues that are more controversial or less clearly defined.

Adopt Stakeholder driven scientific research basis

- Conduct directed scientific research (vulnerability assessment) that adopts stakeholder concerns as real, and tests their hypotheses about the source of problems and their solutions.

Inclusive issue and measure identification

- Encourage a focus on interests and common threats, rather than on particular measures that might foster a hardening of positions.

Encompass equality and fairness

- Encourage a focus on interests and common threats, rather than on particular measures that might foster a hardening of positions.

Source: Modified from USAID (2009)

CASES OF GOOD PRACTICE

The section above outlined principles of good practice in ICZM. In this Section examples of good practice climate change integration are explored (refer to Case Study boxes). The case studies demonstrate mainstreaming of climate change into coastal planning policy (i.e. Western Australia); the enhancement and maintenance of natural protection features (i.e. Louisiana and the City of New Orleans); and the inclusion of regulatory conditions that are cognisant of a changing climate (i.e. Fiji). In all cases, the adaptation options are integrated within the ICZM framework, across policy (direction setting guidance); altered operational mandates (institutional arrangements) or couched within existing coastal management plans (coastal management planning).

CASE STUDY 1: ADAPTATION TO EXTREME EVENTS IN COASTAL TOURIST RESORTS

Measure(s) applied: Enhancement of Building Standards, Change in Setback

To prevent damage from storm surges and sea-level rise, resorts are now built at least 2.6 m above mean sea level and 30 m off the high tide mark (these standards might be reviewed in the future). The building code prescribes that structures need to withstand wind speeds of 60 km per hour. Individual businesses (at least the larger resorts) should have evacuation plans, insurance coverage and procedures before the start of the cyclone season, such as staff training, water and food storage, first aid kits, trimming of trees and a direct line to the Meteorological Service for early warnings. These efforts are being developed and implemented in coordination with government departments and tourism businesses.

Involvement: A range of Government Departments (e.g. Town and Country Planning, Ministry of Health, Fiji Meteorological Service) and tourism businesses.

Source: (Simpson et al. 2008, 55)

CASE STUDY 2: PRESERVING WETLANDS TO INCREASE CLIMATE CHANGE RESILIENCE

Measure(s) applied: Development of new coastal authority (Coastal Protection and Restoration Authority (CPRA), Updating coastal management plans

Following the failure of structural flood defences during Hurricane Katrina in 2005, the State of Louisiana and the City of New Orleans have undertaken steps to increase the resilience of the city to sea level rise, hurricanes and river flooding. An approach utilising many lines of defence has been adopted, involving structural and non-structural defences.

One of the key protection measures is the conservation and restoration of wetlands as a buffer zone between the sea and the city. Detailed actions aimed at the promotion of wetlands are included in the New Orleans Masterplan (developed by CPRA) under the headings of green infrastructure and city resilience. Inclusion of wetland conservation and restoration activities in the New Orleans Masterplan signals a significant change of flood-defence tactics in the region from an emphasis on levees and floodgates to the incorporation of more natural solutions. The focus on wetlands as a natural buffer responds to the calls of research emphasising the importance of wetlands in flood protection. The implementation of objectives outlined in the Masterplan are ongoing.

Involvement: New Orleans City Planning Commission, Environmental Affairs, City Council,

Source: (Kazmierczak & Carter 2010, 53)

CASE STUDY 3: ADAPTATOION TO SEA LEVEL RISE VIA PLANNING POLICY

Measure(s) applied: Policy development – coastal planning.

Western Australia's population is highly concentrated along the coastal zone, and as a result coastal development is exposed to climate change impacts such as sea level rise. In response, the Western Australian Planning Commission has drafted the *State Coastal Planning Policy 2.6* making allowance for a vertical sea level rise of 0.9m to 2110. Furthermore, the allowance for erosion by future sea level rise on sandy coast was calculated as a default of 90 metres (100 times the adopted sea level rise value of 0.9m) with a provision for detailed local impact assessments as required.

The draft policy falls under the Planning and Development Act 2005, which requires local governments, when preparing or amending a local planning scheme, to have due regard to this State Coastal Planning Policy. Consequently this adaptation measure may climate-proof future coastal development by taking into account sea level rise and enhanced coastal erosion.

The draft policy is currently being reviewed, and has been released for public consultation.

Involvement: Western Australian Planning Commission, Western Australia Local Government Association

Source: (WAPC 2012)

CASE STUDY 4: COUNTRIES UNDERTAKING CLIMATE CHANGE INTEGRATION WITH ICZM

A number of countries are currently tackling the challenge of integrating climate change within ICZM:

Africa - Adaptation to Climate Change in the Nile Delta through Integrated Coastal Zone Management.

Kiribati - Kiribati Adaptation Program Phase II: Developing a Coordinated and Integrated Climate Change Coastal Hazard Risk Diagnosis and Planning Framework.

Albania - Identification and Implementation of Adaptation Response Measures in the Drini-Mati River Deltas. Developing an ICZM framework incorporating climate change considerations is a key output of the project.

Uruguay - Implementing Pilot Climate Change Adaptation Measures in Coastal Areas of Uruguay.

Integrating Climate Change into ICZM, the Case of Kiribati

Through the Kiribati Adaptation Program, the Republic of Kiribati has commenced development of a coordinated response to coastal hazard risk diagnosis and planning through a transition towards ICZM. Drawing on good practice in ICZM globally, the Kiribati Adaptation Program conducted a comparative analysis of good practice and the current institutional and operational approach to coastal management in country and suggested strategies to transition towards ICZM. However, it was recognised that capacity constraints, financial and human, would influence the implementation of recommendations. Consequently, it was deemed appropriate to develop a staged approach to institutional and regulatory change to enable progress in achieving a coordinated approach to ICZM under recognised constraints.

A three-staged approach to achieving ICZM was developed with the first stage capable of implementation within the current capacity and resource environment; therefore reducing the reliance on external support to progress towards ICZM. The subsequent recommendations were to be implemented as capacity was built, experience gained and additional resources became available. At each level, recommendations were made under the core components that contribute to ICZM, including:

- Institutional structures;
- Coastal planning;
- Direction setting guidance elements;
- Regulation and enforcement; and
- Capacity building.

SUMMARY

A consideration of good practice in ICZM generally as well as integrating climate change with ICZM more specifically provide lessons learned to be applied in the current work for RoM. Essentially, ICZM in ROM will be enhanced via an integration of climate change considerations across the elements of good practice ICZM (i.e. direction setting guidance elements, institutional arrangements and coastal management planning) and across all scales of entry point. The concept of integration across the hierarchy of elements required for 'effective' ICZM, informed recommendations for change to the existing ICZM framework, summarized in the remainder of this document.

Chapter 3: Recommendations to incorporate climate change within the ICZM framework

INTRODUCTION

In 2007 the Ministry of Environment and National Development Unit commissioned a study to develop an ICZM Framework. The resulting 2009 ICZM Framework provides a solid foundation for effective management of coastal resources. However, the framework does not consider climate change and the lack of country specific guidance, capacity (human and financial) constraints and the disconnect between high-level strategic recommendations (theoretical guidance) and operational direction to implement recommendations on the ground, mean that the 2009 recommendations have not been implemented in full. Despite this, there is a strong drive for improvement in coastal management and planning and the 2009 framework is considered a vital basis from which such progress can be achieved. Consequently, the 2009 framework was reviewed to provide recommendations to (i) mainstream climate change; and (ii) address barriers to implementation, where possible. Recommendations focus on addressing climate change gaps whilst promoting approaches, in particular for existing and future coastal development, that are country relevant.

APPROACH

The approach adopted to define recommendations for improvement in the ICZM framework can be summarised as follows:

- The 2009 ICZM framework was reviewed and updates were sought from in-country stakeholders[2] on progress and barriers to implementing the 2009 recommendations.
- The recommendations proposed in 2009 were individually reviewed and strategies to incorporate climate change were proposed. This activity was undertaken on the basis that the recommendations outlined in the 2009 report remained valid and aligned to good practice ICZM.
- The strategies to incorporate climate change were categorized into those that could be addressed within the current program of works and those that would require further analysis and treatment through other mechanisms. The recommendations are coded through simple 'traffic light' colours (green, amber and red) as follows:
    - Green - Recommendations addressed in the current project. These recommendations are addressed in full in Chapter 4 and Chapter 5.
    - Amber - Recommendations addressed, in part, by other in country activities. Existing country activities and initatives addressing these recommendations are outlined. The information provides a reference point for ongoing in-country initiatives to ensure climate change priorities are addressed.
    - Red - Recommendations assigned to subsequent phases of research. Mainstreaming climate change into coastal management is an ongoing area of investigation within Mauritius. For example, Mauritius recently received financing through UNDP to *Adapt Coastal Zone Management in Mauritius to*

[2] A short survey listing select recommendations from the 2009 report was submitted to in-country stakeholders. Stakeholders were requested to advise on progress and barriers to implementation of the selected recommendations. Representatives from the ICZM and EIA Units completed the survey.

Address the Impact of Climate Change. These recommendations provide direction on priority activities for such initiatives.

FINDINGS AND RECOMMENDATIONS

This section summarises the key recommendations to integrate climate change within the existing ICZM framework. Full recommendations, aligned to the individual elements of the ICZM framework drawn from the 2009 review, are presented in Annex 1.

Coastal Vulnerability

The 2009 review noted that coastal zones at high risk of erosion and other coastal changes had not been systematically identified and policies for development and planning in the coastal zone take a blanket approach regardless of the current or future sensitivity of the coastal zone. This remains a critical gap to progress towards sustainable coastal management.

Recommendations to address this gap are outlined in Chapter 4 and Chapter 5. In short, coastal management and planning occurs within a context of limited understanding of the nature of the coastal zone. There is an urgent need for a national assessment and prioritization of the vulnerability of the coastal zone. Based on such an assessment, planning, policy and management tools can be tailored to development types and coastal sensitivity; progressing beyond blanket controls for development. Tools to support prioritisation of coastal vulnerability are summarised in Annex 2.

Coastal Planning and Development

Environmental Impact Assessments (EIAs) are the primary tool supporting sustainable development in the ROM. However, guidelines for EIA reporting and evaluation do not incorporate climate change considerations. Whilst this issue was not identified in the 2009 report, it is of critical importance to mainstreaming climate change within ICZM. Therefore, recommendations to integrate climate change within EIA guidelines, Preliminary Environmental Report (PER) guidelines and supplementary guidelines have been proposed. This will ensure that future developments are assessed, designed and evaluated with a consideration of future climate conditions.

A select number of coastal management plans (6) were produced as a component of the ICZM 2009 review. These plans outline strategies to manage the coastal margin in six select areas. However, the plans are not based on a consideration of projected climate changes. Drawing on the outputs of a national vulnerability assessment of the coastal zone, it would be possible for the ROM to update the area and action plans to ensure strategies are cognizant of climate change risks. For example, the technical details for construction of the promenade, jetty and boat ramps in Grand Baie may require amendment to ensure infrastructure is resilient under scenarios of climate change. Completion of a national vulnerability assessment, to inform such an update, should be the focus of future technical assistance.

Acts, Plans and Strategies for Integrated Coastal Zone Management

In its review, the 2009 report identified that the FMRA Act (2007) and the EPA (2002) required broadened scope to ensure adequate coverage of the range of management issues facing the coastal zone. Consultations are currently underway within the Prime Ministers Office to address recommendations for update to the Maritime Act (*pers comm.* July 2012). However, recommendations to update the EPA 2002 to provide a mandate beyond pollution prevention to ecosystem management and strengthened environmental law have not been addressed and remain an outstanding barrier to environmentally sustainable development. Further, the 2009 assessment highlighted the need for a comprehensive set of regulations on coastal development, addressing issues such as set-backs and seawalls, among others. To support the recommendations, draft regulations where proposed (entitled, *Proposed Regulations to Be Made Under the Planning and Development Act 2004*), which contained stipulations on the following elements:

- Coastal developments to be well-designed;
- Position of coastal structures and roads;
- Residential coastal development standards;
- Resort hotel development standards;
- Tourism apartment development standards;
- Application for coastal development permits;
- Layout plans; and
- Visual impact assessment.

While the coastal development guidance document and the associated proposed coastal development recommendations have several helpful elements, their key limitation, in the context of the current work, is their lack of consideration of climate change. Recommendations to address this gap and incorporate climate change are presented in Chapter 4.

Vertical integration, enhancing local to national decision making for the coastal zone

Examples of vertical integration in coastal management planning in Mauritius were identified in the 2009 ICZM review. Further, activities to improve vertical integration for coastal management are currently in train, through the Mauritius Ile Durable (MID) project and the preparation of an updated National Climate Change Adaptation Plan.

The impacts of climate change will increase the requirement for enhanced links between local and national coastal planning and management. The Maurice Ile Durable (MID) project identified awareness raising for climate risks as an element of its program of works; and therefore, will play a critical role in enhancing vertical integration. In addition, Mauritius is updating its National Climate Change Adaptation Plan (*pers comm.* July 2012). This plan provides an entry point for incorporating actions that raise awareness and increase

collaborative decision making from local to national scales.

Cross-sectoral decision making with respect to the coastal zone

Institutional arrangements to enhance the role of the ICZM in decision-making across sectors, as proposed in the 2009 report, will facilitate the implementation and enforcement of climate change considerations. However, to date these recommendations are yet to be implemented[3]. Future initiatives should explore the barriers to improving cross-sectoral decision-making, focusing on enhancing ICZM engagement across sectors.

Vertical and horizontal integration of coastal management and planning would be enhanced via the incorporation of representatives of the Climate Change Committee and Climate Change Division into the ICZM executive panel. However, during consultations it was noted that the Climate Change Committee is not longer operational, and therefore, the capacity of the Climate Change Division to fulfill this role in isolation should be investigated. Targeted actions to build capacity in the division to meet this role may then be developed.

Further, information needs to enhance cross-sectoral decision making extend beyond coordination, to accessing information that guides decision-making. From a climate change perspective, this includes defined scenarios and projections for change, advocated at the national level, to ensure consistent evaluation and prioritization of climate risks in sector-based planning. Further, guidance on the tools and approaches to analyze climate risk should be available to decision-makers and planners. Future initiatives should address this recommendation as a priority activity.

Enforcement and compliance

In combination with the need to broaden the scope of coastal management planning tools and regulations (as outlined above) the 2009 review also recommended significant strengthening of enforcement of environmental law, via entrusting the power to investigate and initiate judicial proceedings for any breech of environmental law within officers of the Environmental Enforcement Agency. This recommendation is critical to ensuring sustainable management of the coastal zone. Without the recommendation in force, the recommended changes to policies, plans and strategies to integrate climate change (as recommended in Chapter 4) will not result in the improved coastal management sought via its integration. Therefore, it is recommended that barriers to enforcement be addressed as a national priority, to ensure that the sustainable management objectives sought can be achieved.

Monitoring and Evaluation

Montioring and evaluation is critical to informing effective coastal management. Monitoring and evaluation outputs provide insight into coastal behvaiour and response, which is vital to informing adaptive management. The 2009 ICZM review developed an Environmental Monitoring System containing environmental indicators for the coastal zone. The 2009 review proposed recommendations to ensure that an Environmental Information System (EIS) be applied as a respository for all EIAs and BLUP information and data to enable

[3] For instance, an ICZM executive panel has not been established.

tracking of development in the coastal zone and to facilitate cumulative impact assessments. Such an approach will provide valuable information to inform coastal management in the ROM. In addition to the recommendations proposed in 2009, it is recommended that the Environmental Indicators incorporated within the report be reviwed to ensure they capture climate changes. This recommendation aligns to Chapter 40 of Agenda 21 that calls on countries and the international community to develop indicators of sustainable development. Such indicators are required to increase focus on sustainable development and assist decision makers at all scales to adopt sound national sustainable development policies. Linking climate change and sustainable development indicators reduces duplication of effort, helps identify linkages between the two concepts and reduces reporting burdon. Therefore, while the focus is on the coastal zone, indicators for climate change should be identified across the realm of sustainable development reporting. It is recommended that this activity be undertaken as a component of the MID work plans (currently under development).

Capacity

Capacity constraints were recognized as a critical barrier to effective ICZM within the ROM. The Environmental Impact Assessment (EIA) unit is chronically understaffed, while there is also limited monitoring (and enforcement) of compliance to Building and Land Use Permits (BLUPs) and implementation of sea-walls on private land and. Barriers to implementing measures to strengthen the EIA division and collaboration between the Ministry of Environment and the Ministry of Housing and Lands to improve compliance should be investigated as a priority, to ensure mechanisms to address the barriers can be implemented.

Further details are provided in Annex 1.

SUMMARY

The outcome of the review was two priority focus areas for climate change integration to be addessed in the current project (green dots above), including:

Increase the resilience of new developments in the coastal zone

Building on the recommendations for amendments to the Land Use Planning and Development Act (2004) as proposed in the 2009 review, the aim is to ensure integration of climate change within the range of planning mechanisms (polices, plans, strategies) that guide coastal planning and management, with specific focus on Environmental Impact Assessments. This involved an overview of the current policy and legislative context for coastal management, in conjunction with a consideration of the 2009 recommendations, and climate change integration good practice (see Chapter 4).

Increase the resilience of existing development in the coastal zone

The coastal zone of the RoM is already widely developed. Therefore, in addition to recommendations that enhance resilience of new developments, it was also vitally important to consider opportunities to enhance resilience of existing developments. This involved review of current management approaches, in conjunction with a consideration of the 2009 recommendations, and good practice (see Chapter 5).

Chapter 4: Recommendations to enhance resilience of new developments in the coastal zone

INTRODUCTION

Tools that support coastal zone management can take various forms (e.g. planning guidelines, setback policies) and offer a range of mechanisms through which to manage climate change. The elements that guide development in the coastal zone in ROM extend across sectors, from tourism, to fisheries, and land-use planning.

Recommendations to enhance resilience of new developments in the coastal zone are two-pronged; first, recommendations for amendments to existing acts, strategies, policies and plans are outlined. The recommendations focus on policies and plans currently governing coastal management in the ROM. Second, recommendations to advance integration of climate change considerations within coastal planning for new developments are outlined. These recommendations rely on the completion of a national prioritisation of coastal vulnerability, but will ensure more detailed specifications to guide proponents and evaluators in planning and approvals of coastal development.

The recommendations focus on integration within the coastal zone. However, the policies, plans and on-ground management tools (such as BLUPs and EIAs) also inform management beyond the coastal fringe. Therefore, the recommendations to mainstream climate change contribute to sustainable development more broadly.

APPROACH

Commenced by identifying the acts, policies, plans, strategies and tools (referred to as direction setting guidance elements) that guide coastal planning in the RoM. Subsequently, a four-category taxonomy for climate change integration was established and applied to review the degree of existing and required climate change integration (Figure 4). The taxonomy was created based on the understanding that not all directing setting guidance documents require direct integration of climate change. However, climate change is a cross-cutting issue that effects all sectors. Therefore, acts, policies and strategies were assigned to one of the four following categories:

1. Decisions made under the Act or Regulation should be cognisant of climate change; however, direct integration of the climate change specific recommendations is not required.
2. Policies, strategies or plans referenced within the document should have climate change directly integrated; however, direct integration of the climate change considerations within the Act, Policy or Strategy itself, is not required.
3. Direct integration of climate change is required.
4. Climate change is already integrated.

The taxonomy refined the elements that required climate integration to enhance resilience of new developments in the coastal zone.

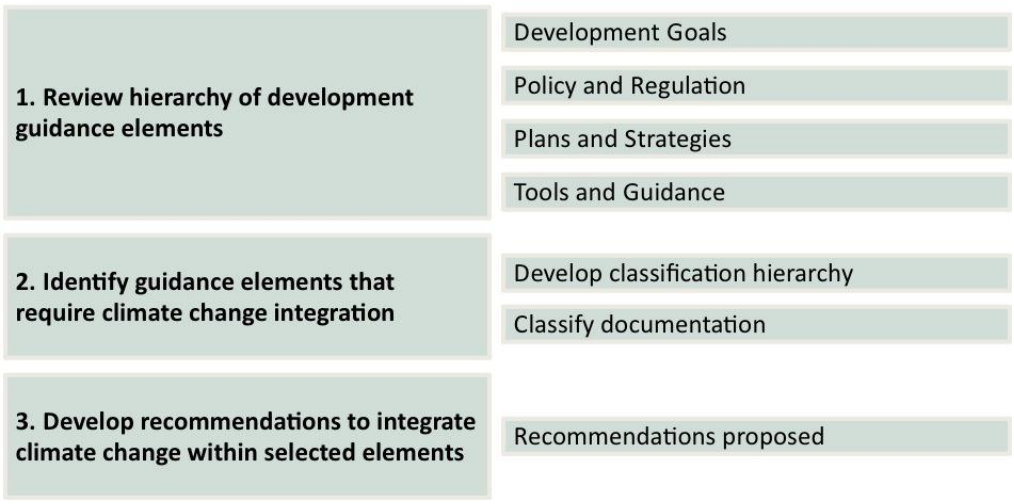


Figure 4: Approach to integrate climate change considerations into future development

FINDINGS

There is a hierarchy of elements that guide development in ROM's coastal zone, cascading from high level development goals to on-ground tools that provide guidance for individual developments (Figure 5) (see Annex 3 for full details on the categorisation of policies and plans). A description of the primary tools is provided below; this is followed by recommendations to integrate climate change considerations to ensure sustainability of planned (future) coastal developments.

LEVEL	DOCUMENT
DEVELOPMENT GOALS	National Development Strategy
LAND USE POLICY AND REGULATION	Land Use Planning and Development Act (2004) *Draft* Land Use Planning and Development Bill (2009) Environmental Protection Act (2002) Building Act (1994) Town and Country Planning Act
LAND USE PLANS	Outline Schemes Local Plans Action Area Plans Subject Plans
TOOLS AND GUIDANCE FOR INDIVIDUAL DEVELOPMENTS	Building and Land Use Permit Environmental Impact Assessment Preliminary Impact Assessment Planning Policy Guidance

Figure 5: Links between mechanisms informing land use planning and development in ROM

Four acts, from a coastal planning perspective, manage development within the coastal zone, and include the Land Use Planning and Development Act (2004)[4]; the Environmental Protection Act (2002); the Building Act (1994) and the Town and Country Planning Act[5].

[4] Provides overarching guidance on the content and focus of local plans and outline schemes, action area plans and subject plans

[5] The Town and Country Planning Act will be repealed following adoption of the currently *Draft* Land Use Planning and Development Bill.

Further, a number of tools support coastal management and development, including Planning Policy Guidance (PPG), Environmental Impact Assessments (EIAs) and Building and Land Use Permits (BLUP).

Documents that inform coastal planning and development created in the late 2000s integrate climate change considerations. For example,

- Energy Efficiency Act 2006
- National Environmental Policy 2007
- Strategic Budgeting in the Government of Mauritius April 2009 to December 2011
- Long-term Energy Strategy 2009-2025
- Industrial & SME Strategic Plan 2010-2013
- DRAFT MID Policy and Strategy 2012

However, key documents that govern coastal land use and planning that are yet to integrate climate change considerations, include:

- Beach Authority Act 2002
- Land Use Planning and Development Act 2004
- Planning Policy Guidance 2004
- Building Land Use and Permit (BLUP) guide

Climate change has been considered in the National Development Strategy, which encourages 'economic growth in the conurbation, the countryside and the coast, whilst maintaining and enhancing the quality of the environment and striving for a more sustainable pattern of development' (Muelex 2008). Secondly, the Maurice Ile Durable project (MID), initiated in 2008, articulates a long-term vision for sustainable development in Mauritius. A series of Working Groups (e.g. Energy, Preservation of Biodiversity and Natural Resources) have made recommendations relevant to coastal management. For example, Working Group 2 (Preservation of Biodiversity and Natural Resources) recommend development of a national Climate Change Adaptation Plan and increased monitoring of coastal developments to ensure strict compliance with EIA licensing, planning guidelines and other national strategies (MID 2011a). Working Group 1 (Energy) recommends that minimum energy performance standards for equipment be enforced and that existing policies and regulations be made stricter for new developments (MID 2011b). While it is unclear whether the outputs of the MID Working Groups will be legislated or implemented, the ideas and visions formulated prove beneficial for sustainable development in the ROM.

The Planning and Development Act (2004) aims to modernise town and country planning and make comprehensive provision with respect to land use planning and development. Part III of the Act refers to the core documents that inform planning within the ROM, including the National Development Strategy, Planning Policy Guidance (PPG) and Development Plans. The National Development Strategy incorporates climate change considerations; however, the Planning Policy Guidance and Development Plans do not.

Planning Policy Guidance (PPG) was formally issued to local authorities in 2006 and covers four areas of development: commercial, industrial, residential and hotels and resorts. The PPG outlines the physical characteristics and constraints of proposed developments that proponents must abide by (e.g. design, building materials, setbacks). The Building Land Use and Planning (BLUP) Guideline, and the accompanying BLUP permit, is similar in that proponents are instructed to follow a prescribed approach to the development of structures

and settlements. Finally, Development Plans also play a significant role in dictating how the urban form is controlled (e.g. zoning) at different scales[6].

Development plans describe the intended use of land in an area and provide an objective basis for the consideration of planning applications. The National Development Strategy sets the strategic framework for national land use planning, while development plans (or Outline Planning Schemes) are regional plans for a Municipal Council or District Council area, which provide the framework for local authorities to plan, shape and control the use of land. In short, they translate the national strategy to the local level.

The *draft* Land Use Planning and Development Bill 2009 may alter the existing development approval and planning process at various scales. Most notably, the Bill will repeal and replace the Town and Country Planning Act (1982) and the Planning and Development Act (2004), with the broad aim of streamlining ROM's planning framework (LUPD 2009). Currently in draft form, the Bill incorporates a number of changes to the existing planning process, including the establishment of a Department of Land use Planning and Development (LUPB) responsible for the development of Planning Policy Guidance. If the LUPD Bill (2009) is promulgated into law, aspects of ICZM may be altered. Notable amendments include: changes in the relation to the development and definition of Outline Schemes; the enforcement of BLUPs; and more broadly, the creation of a new Department responsible for land use planning. Further details are outlined in Annex 4.

A vital planning tool to facilitate effective coastal management planning in the ROM was developed in as a component of the ICZM review in 2009, entitled *Good Practice Guidance for Coastal Activities* (Landell Mills 2009b). The guideline covers methods and good practice associated with design, construction and installation of developments on the coastal zone, however it does not include climate change considerations. Principles applied in this guide were drawn from international examples, and then tailored to accommodate local conditions. Key aspects of the general and technical guidance contained in the guideline are outlined in Table 3. A recent survey of ICZM representatives, found that this guide is currently being utilised, however the process of application and/or barriers to implementation were not specified (pers comm, Ministry of Environment, July 2012).

Table 3: Contents of the Good Practice Guidance for Coastal Activities (Landell Mills 2009b)

No	Key Components
1	General Considerations: Limiting ecological impact; Drainage of development; Minimising disturbance of vegetation; Setbacks; Pedestrian accessibility; Construction Materials.
2	Coastal Environment, Beach Erosion and Deposition Dynamics
3	Building Guidelines (e.g. standards and constraints – 30m setback from HWM)
4	Coastal Protection: Seawalls, Revetments, Groynes and Breakwaters
5	Construction and Engineering Activities in the Lagoons
6	Beach Management Plans (e.g. Managing dunes and waste)
7	Other Shoreline Structure (e.g. Boat ramps. Jetties, promenades

[6] Local, Action Areas, and Subject Plans are outlined in the Planning and Development Act 2004.

Environmental Impact Assessment (EIA) supports sustainable coastal development in the RoM. RoM's EIA guideline sets out prescribed contents of the EIA study relevant to the coastal zone (e.g. required setback from high water mark, the need to maintain natural drainage). The EIA process makes provisions for the development of mitigation measures to ameliorate potentially significant environmental impacts, and therefore, gives RoM authorities the ability to control coastal activities in the private sector. Unfortunately the EIA process does not currently integrate climate change considerations such as sea level rise.

The Permits and Business Monitoring Committee process applications for a Building and Land Use Permit and, in processing the application, have regard to the provisions of the Building Act, the Town and Country Planning Act and the Planning and Development Act 2004 and the guidelines issued under those Acts. The Building Act specifies that, "No new building shall be inhabited, used or occupied, until it has been inspected and approved by the Authority."

Overall, while RoM has a number of policies, plans and strategies relevant to ICZM, they currently lack integration of climate change considerations required to sustainably manage future coastal development. Consequently, a refined list of policies, plans and strategies for which climate change integration is vital to enhance the resilience of new coastal developments includes:

- Planning and Development Act (2004)
- Building and Land use Permit (BLUP)
- Planning Policy Guidance (PPG)
- Coastal Protection Guidelines
- Environment Protection Act (2004)
- Environmental Impact Assessment (EIA)
- Preliminary Environmental Report (PER)
- *Draft* Planning and Development Bill (2009)
- Building Act (1994)
- Town and Country Planning Act
- Monitoring and Compliance

Recommendations to integrate climate change within the above documentation are outlined in the next section. Importantly, these recommendations are designed to align to the plans, policies, strategies and plans currently in operation and do not specifically address documents drafted as components of Technical Assistance, which may not be operational.

RECOMMENDATIONS

Recommendations are presented here in two components: first, recommendations for amendments to existing acts, strategies, policies and plans are outlined. The recommendations focus on policies and plans currently governing coastal management in the RoM. Second, recommendations to advance integration of climate change considerations within coastal planning for new developments are outlined. These recommendations rely on the completion of a national prioritisation of coastal vulnerability

prior to implementation; however, will ensure more detailed specifications to guide proponents and evaluators in planning and approvals of coastal development.

Climate Change Recommendations for Existing Documentation

Existing land use policy, plans and tools inter-relate to guide planned coastal development; for example, the Land Use Planning and Development Act (2004) prescribes contents for Development Plans. Knowledge of the interrelationships between the hierarchy of documents highlights the optimal points for climate integration (Figure). Climate integration within elements at the upper end of the hierarchy ensures that those in lower levels indirectly consider climate change. This approach enhances climate consideration across the elements that inform future coastal development, whilst minimizing the degree of change required in existing documentation. For example, by integrating climate change directly within the Planning and Development Act (2004), local plans, action area plans and subject plans will incorporate climate change considerations. The documents in which direct climate integration has been proposed include:

- Planning and Development Act (2004)
- Building and Land Use Permit (BLUP) guidelines
- Planning Policy Guidance (PPG)
- Coastal Protection Guidelines
- Environment Protection Act (EPA 2002)
- Environmental Impact Assessment (EIA) guidelines
- Preliminary Environmental Report (PER) guidelines

The elements in which climate change will be indirectly integrated based on the inclusion of climate change considerations within the above documentation include:

- *Draft* Planning and Development Bill (2009)
- Building Act
- Town and Country Planning Act
- Monitoring and Compliance

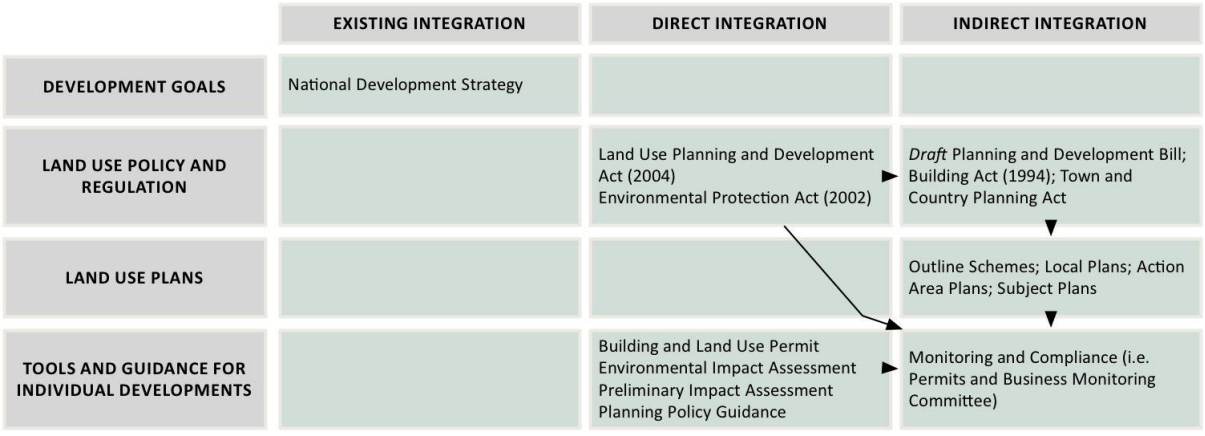


Figure 6: Relationship between documents that guide planning and development in the coastal zone

Direct integration of climate change involves the inclusion of text that ensures climate change issues are considered as a component of the guidance element. Importantly, the text included is detailed to the same level as the existing text within the select guidance element. This necessitates the provision of high-level guidance that should be supported through the more detailed tools and mechanisms, including training, awareness raising activities and development of vulnerability assessment standards. These activities have been highlighted as critical next steps in the integration of climate change within ICZM and are covered in more detail in Chapter 3.

Direct Integration

Planning and Development Act 2004

The Planning and Development Act (2004) provides guidance on the purpose, content and review process for development plans. Development plans are the primary tools guiding development in the coastal zone and beyond. Therefore, it is recommended that Section 14, Section 15 and Section 20 of the Planning and Development Act (2004) be updated to incorporate reference to climate changes as a critical component of Development plan production (Table 4). The recommendations in Table 4 are necessarily broad, to ensure consistency with the remainder of the Act. Supporting tools will be required to facilitate interpretation and implementation of the climate relevant contents of the Act. For example, risk based or vulnerability assessment tools would be required to determine the projected impacts of climate change, so that these could be detailed within the Action Area Plan. The objective is to ensure that land use plans are developed based on an understanding of current and future climate hazards.

It is suggested that the amendments to the Planning and Development Act (2004), as oultined in the ICZM 2009 review, entitled *Proposed Regulations to Be Made Under the Planning and Development Act 2004,* will signficantly enhance sustainable development in the coastal zone. However, in the absence of these regulations being promulgated into law, the recommended amendments to the Planning and Development Act (2004) are stipulated below. If promulagated into law, climate change considerations should be incorporated within the Proposed Regulations (refer to the section covering *Further Climate Change Intergration Recommendations* for details).

Table 4: Recommended amendments to the Planning and Development Act 2004, to integrate climate change (green text represents a suggested amendment).

Section	Recommended Amendments
Section 14 Development Plans	(3) (a) An action area plan shall set out – (i) detailed programmes and proposals for the future development of an area for which the plan is being prepared; and (ii) a detailed plan for the implementation of such programmes and proposals. (b) Every action area plan shall be prepared – (i) by the Minister; (ii) by the Minister and the relevant local authority jointly; (iii) by the Minister and one or more landowners who jointly own the whole area; (iv) by the Minister, a local authority and one or more landowners; or (v) with the approval of the Minister, by the relevant local authority and

		one or more landowners who jointly own the whole area. (vi) with a consideration of future social, economic and environmental conditions (including, for example, projected impacts of climate change). (c) An action area plan may apply to the whole or part of the area under the jurisdiction of one or more local authorities.
	Section 15 Purpose and Content of a Development Plan	(2) A development plan shall include such of the following matters as the Minister, or other planning authority, may deem necessary – (a) a report on the principal physical, economic, environmental and social conditions, resources and facilities of the planning area (including a consideration of future economic, social and environmental circumstances, including projected climate change, and how these will be accommodated within the development plan); (b) the principal purposes for which land is used in the area; (c) the size, composition and distribution of the population of the area; (d) the communications and transport systems of the area; (e) a statement, explanation and justification of policies and proposals for the future sustainable development of the area; (f) identification of areas of land to be set aside for special planning and development measures, including any programmes of land readjustment; (g) maps, plans, diagrams, tables and other visual aids showing present and proposed future uses of land, buildings and other resources in the area; (h) such other matters as the Minister may direct or as may be prescribed.
	Section 20 Review and revision of development plan	(3) In determining whether an approved development plan or any part thereof requires a revision, the planning authority or the Commission shall have regard – (a) to any significant change in any policy of Government, which renders any policy, or proposal in the approved development plan, out of date or otherwise unnecessary or undesirable to pursue; (b) to the extent to which the development that has taken place since the approved development plan was first prepared complies with or departs from such plan; (x) to the extent to which social, economic or environmental conditions have changed, or information is available to better project future changes, that would enhance robustness of the plan. (c) in any case where the development that has taken place represents a departure from the approved development plan, the extent and type of such development that has taken place, where it has taken place and its effect on the economy, the environment and the social development of the local planning area; (d) to whether there is any significant pressure for development within the local planning area and if so, for what kind of development; (e) to any development and pressure for development in areas contiguous to the local planning area; (f) to the views of the community representatives in the local planning areas on the need for, or desirability of a revised development plan;

BLUP Guideline and PPGs

It is recommended that the Building and Land Use Permit guidelines are updated to provide additional details on the required content of a development layout. Additional detail would include an assessment of the site context, demonstrating consideration of the impacts of

projected climate change on the proposed development; whilst also providing evidence of the suitability of proposed building materials given projected climatic changes (Table 5).

The Planning Policy Guidance (PPG) consists of a number of development specific guidelines that support proponents through the design phase of development preparation. Design guidelines are provided for four categories of development: commercial development, hotels and resorts, industrial development, and residential development. The recommended entry points for climate change integration into specific PPGs are outlined in Table 6.

Importantly, PPGs and the BLUP guidelines provide operational guidance to inform development in the coastal zone and beyond. However, the guidelines are not regulatory instruments and therefore proponents may choose to align to elements of the guidance as they deem appropriate. Without regulatory backing, there is limited incentive to ensure compliance and further, limited regulatory backing to monitor compliance. It is recommended that the provisions contained in the PPG be incorporated in a comprehensive set of regulations dealing with coastal development and building; including provisions setting out setbacks for construction on coastal frontage lands and sanctions for breach of any such regulation. The *Proposed Regulations to Be Made Under the Planning and Development Act 2004*, provide a solid basis for such change.

Table 5: Recommendations to integrate climate change within the BLUP guidelines (green text indicates a recommended addition to the BLUP guidance).

Section G: **Pg 6**	The design of a development layout involves consideration of the following issues: • Analysing the site context, including consideration of potential climate change impacts on the development. • Determining the appropriate intensity of development based on existing, and anticipated future, social and environmental context. • □□□□□□□ □building materials required for the development, including an assessment of their suitability to changing environmental conditions (e.g. climate change). • Establishing the broad framework, including consideration of connectivity and cohesiveness • Establishing development types and plot sizes • Determining the requirements for community facilities • Incorporating traffic management systems • Planning for visual and acoustic privacy
Checklist – Location Plan	Accurate location plan, showing distance of site from specific or prominent landmarks to be submitted (e.g. Environmentally Sensitive Areas). Incorporate information regarding the location's sensitivity and exposure to climate change (e.g. sea level rise, areas prone to coastal erosion). For Comm/Indu/SE/Serv Projects, location plans should show all existing buildings/development in the immediate vicinity of the site (on side, rear boundaries and on opposite side) with details on the height, set backs and character of buildings in that area. In addition This will help the Authorities to determine whether flexibility to guidelines in the PPG can be applied.
Guidelines for Residential Development – Technical Guidelines	(xiv) Buildings to be not less than 30m from High Water Mark, and setback to be defined following PPG Guidelines (refers to climate integrated PPD guidelines).

Table 6: Policy Planning Guidance, recommendations for climate change integration

PPG Type	Guidance Document	Existing Climate Change Integration	Climate Change Integration Points per Section
Introduction, Approach and Design Principles		None	**Section 1.1: Land Use Design Guidance, include:** "In addition, these guidelines are intended to assist proponents in designing developments that take full account of changing environmental conditions (i.e. climate change)" **Section 2.1: Quality and Design in Planning – a Design Led Approach** (End of 2nd paragraph) "A considered approach to design can also reduce the ecological footprint (e.g. via solar passive design) and the livability of a development. **Section 2.3: Purpose and Aims of Design Guidance** Ensuring developments take into account the impact that changing environment conditions will have on the development over its life cycle. **Section 3.1 Design principles** The creation of schemes that are integrated with the natural and manmade landscape, and that respond positively to climate, landform and ecology, both now and in the future. **Section 3.2: Urban Design Qualities (pg. 9): Include characteristic** 'Adaptive' –Structures with embedded features that increase its capacity to respond to changing environmental conditions (e.g. sea level rise). **Section 3.3.1: Urban Design Process, Context.** Assessment of current and future climatic conditions relevant to the development site.
Commercial Development	Commercial Development	4.3 Energy Efficiency of Buildings	**Section 3.1.1: Design Process** The following issues should also be included in the design considerations: Determining the appropriateness of the design, and building materials, in withstanding changing environmental conditions (e.g. climate change). **Section 4.4. Building Design** Attention should be paid to the following criteria: The structural integrity of the building to future climate conditions, i.e. altered wind speeds, subsidence risk etc.
	Tall Buildings	None	*Design Considerations – refer to BLUP guideline recommendations, in addition to EIA recommendations in accompanying report.*

PPG Type	Guidance Document	Existing Climate Change Integration	Climate Change Integration Points per Section
Hotels and Resorts	Eco Tourism Development	*No climate change specific considerations – PPG guidelines propose general considerations for development rather than specific requirements. Therefore, climate change considerations are best captured through the EIA process in this instance.*	
	Golf Development	*No climate change specific considerations – PPG guidelines propose general considerations for development rather than specific requirements; focused on golf course size and location of buildings in relation to course. Climate change considerations are best captured through the EIA process in this instance.*	
	Marina development	None	**Design Guidance (pg. 2):** Technical feasibility studies should include (i) assessment of the projected changes in climate and associated effects on wind, wave action and storm surges, for a range of climate change scenarios. Ensure technical specifications, i.e. shoreline stabilization, water flushing, are climate proofed. While these considerations may be captured within the EIA process, it would also be important to stress the additional considerations here. **Design Factors (pg. 3):** Assess if these specifications (e.g. basin depth, pier specs) are appropriate given projected climate change impacts.
	Resort Hotels	None – although 30 m setback is noted in the design guidelines. 15 m setback for 'removable' facilities.	**Setbacks (pg. 6**): 'Setback from HWM should be determined on a site by site basis but should be a minimum of 30 metres'. Site-by-site assessment to define set back should involve a coastal vulnerability assessment that considers projected changes in climate, including sea level rise, sediment transport and deposition, and storm impacts. Refer to Annex 5 for example.
Industrial Development	Industry Development	Detailed guide – with setbacks for Environmentally Sensitive Areas and linked to other setback technical specifications; but no specific climate change considerations incorporated.	*Climate change considerations are best captured through the EIA process in this instance.*
	Industry adjacent to sensitive uses	*No climate change specific considerations – PPG guidelines propose general considerations for development rather than specific requirements. Climate change considerations are best captured through the EIA process in this instance.*	
	Industry in the	*No climate change specific considerations – PPG guidelines propose*	

PPG Type	Guidance Document	Existing Climate Change Integration	Climate Change Integration Points per Section
	countryside	*general considerations for development rather than specific requirements. Climate change considerations are best captured through the EIA process in this instance.*	
Residential Development	Design for sloping sites	No climate change specific considerations – however, for areas with >10% slope, a Site Constraint Analysis is required (geological constraints, vegetation, drainage).	*Design Considerations – refer to BLUP guideline recommendations, in addition to EIA recommendations in accompanying report.* Site Constraint Analysis should include consideration of projected climate change impacts and how associated variables are affected (e.g. drainage, topography).
	Individual household development	None	*Design Considerations – refer to BLUP guideline recommendations, in addition to EIA recommendations in accompanying report.*
	Residential coastal development	No climate change specific considerations – although 30 m setback from HWM is noted. Setback to be well landscaped with coastal vegetation to limit erosion. Removal of rocky outcrops should be avoided – provides protection.	*Design Considerations – refer to BLUP guideline recommendations, in addition to EIA recommendations in accompanying report.* Site-by-site assessment to define set back should involve a coastal vulnerability assessment that considers projected changes in climate, including sea level rise, sediment transport and deposition, and storm impacts.
	Residential development	3.6 Design for Climate – Emphasizes consideration of energy efficiency (i.e. solar passive design principles).	*Design Considerations – refer to BLUP guideline recommendations, in addition to EIA recommendations in accompanying report.* Section 2.1.3 Design Process: Include climate change as key consideration.

Coastal Planning Guidelines

The ICZM review undertaken in 2009 provided an overview of the current situation in-country with respect to coastal development guidelines and specifically setbacks and building heights. As of 2009, plans for buildings on the coastal zone had to satisfy the requirements of the Planning Policy Guidance in order to receive a Building and Land Use Permit. A review of the appropriateness of these requirements for sustainable coastal

development was undertaken as well as an assessment of their application and enforcement in the existing development approvals process.

Essentially, the 30m blanket setback was deemed appropriate as a practical way to avoid the risk of wave attack during cyclones in low lying coastal margins. It was acknowledged that the procedure was arbitrary, but one that could be integrated easily with other planning concerns over coastal set-back. It was also suggested that enforcement of the setback regulations would be made easier if the first 15m of coastal margin were excluded from any new leaseholder agreements.

Recommendations with respect to setbacks and coastal development in general were provided in a document named *Good Practice Guidance for Coastal Activities*. This guidance document related largely to coastal structures and physical intervention on the coast and were intended to be of assistance in the assessment of EIA reports on coastal construction and allied actions. It was also envisaged that the guidelines would inform a process of developing standard designs or specifications for coastal structures or other physical interventions in the coast. A further bi-product of the ICZM Framework generation activities was the formulation of proposed Planning and Development (Coastal Development) regulations in 2010 (Box 7).

While the coastal development guidance document and the associated proposed coastal development recommendations contained several helpful elements, their key limitation, in the context of the current work, is their lack of consideration of climate change. Importantly, the blanket setback approach is not considered appropriate and while calculation of site specific setback was discussed the process advocated did not include a factor to account for sea level rise.

BOX 7: DEVELOPMENT APPROVALS REVIEW

The outcome of the review of the development approaches was a proposed amendment to the Planning and Development Act 2003; as follows:

Planning and Development Act 2004

Regulations made by the Minister under section 72 of the Planning and Development Act 2004

The objective of these regulations was to promote ecologically sustainable development and preserve the beauty of coastal landscapes by improving the design and control of developments within the coastal zone.

The proposed regulations contained stipulations on the following elements:

- Coastal developments to be well-designed
- Position of coastal structures and roads
- Residential coastal development standards
- Resort hotel development standards
- Tourism apartment development standards
- Application for coastal development permit
- Layout plans
- Visual impact assessment

In the absence of the Proposed Regulations promulgated into law (and excluded from the *Draft* Land Use Planning and Development Bill), the recommendations made here focus on integrating climate change considerations into the PPG and BLUP process. However, as stated, the recommendations outlined within the Proposed Regulations will enhance coastal

management, and upon their implementation, it is recommended that the above recommendations are re-evaluated in the context of the proposed next steps in climate integration for new developemtns in outlined in the next Section. In short, the 2010 proposed regulations should be amended to include a site specific setback calculation that incorporates climate change and update building height recommendations appropriately (See Annex 5 for an example).

Environmental Protection Act, EIA and PERs

Given the important role that the Environmental Impact Assessment process plays in ensuring sustainable development in the coastal zone, this has been the specific focus of further targeting recommendations to integrate climate change. The recommendations are captured in an accompanying report - *Environmental Impact Assessment in the Republic of Mauritius: Recommendations for Mainstreaming Climate Change Considerations in EIA.*

Indirect Integration

Development Plans

Development plans describe the intended use of land in an area and provide an objective basis for the consideration of planning applications. They provide the framework for local authorities to plan, shape and control the use of land and translate the national strategy to the local level.

There are three types of development plans (Table 8):

- Local Plans (replacing Outline Schemes)
- Action Area Plans; and
- Subject Plans.

Integration of climate change within the Land Use Planning and Development Act (2004) will ensure subsequent consideration and integration of climate change within Development Plans (Local, Area and Subject). Note, that if the *draft* LUPD Bill is brought into effect, the climate change considerations as outlined in the Planning and Development Act 2004 (refer to Table 4) should be incorporated within the draft LUPD.

Monitoring

The Permits and Business Monitoring Committee process applications for a Building and Land Use Permit and, in processing the application, have regard to the provisions of the Building Act, the Town and Country Planning Act and the Planning and Development Act 2004 and the guidelines issued under those Acts. Recommendations to incorporate climate change within the Planning and Development Act are presented (Table 4). Further recommendations to improve monitoring and compliance are outlined under the recommendations for climate integration into the ICZM framework, as outlined in Chapter 3.

Further Climate Change Integration Recommendations

The Section above focused on recommendations to integrate climate change within existing documentation that guides coastal planning and management within the coastal zone. However, upon implementation of the suit of recommendations outlined in Chapter 3, in particular, the completion of a national prioritisation of coastal vulnerability, additional amendments to documentation that informs coastal planning and development should be undertaken.

Table 7: Development Plans

Type	Details
Local Plan	A local plan shall set out the policies, programmes and proposals for the future direction of development of the area of jurisdiction of a local authority.
Action Area Plan	An action area plan shall set out – (i) detailed programmes and proposals for the future development of an area for which the plan is being prepared; and (ii) a detailed plan for the implementation of such programmes and proposals
Subject Plan	A subject plan shall set out policies, programmes and proposals for the future direction and development in respect to a specific subject matter.

This is a two-pronged approach to delivering recommendations, ensuring that the initial changes as outlined for existing documentation can be implemented immediately. Following the completion of vulnerability assessment activities (that may be funded through technical assistance received in-country to improve climate integration into coastal management), the next phase of recommendations can be implemented, enhancing the sustainability of future coastal developments.

Recommendations include:

1. Specifications for building design and placement should be made based on an understanding of the sensitivity and vulnerability of the coastal zone in which a development is taking place. Zoning coastal areas based on sensitivity and vulnerability to change enables planning controls to be aligned to each zonation. This ensures that controls on building and development are specific to the nature of the coastal zone in which development takes place. Such action eliminates a blanket approach to planning and design controls. An example of planning controls assigned to risk zonation of the coastal zone is presented in Box 8.

2. The updated EIA guidelines that integrate climate change (as outlined in the accompanying report entitled, *Environmental Impact Assessment in the Republic of Mauritius: Recommendations for mainstreaming climate change into the EIA process*) recommend proponents conduct a vulnerability and adaptation assessment to inform development design and mitigation measures. It is important proponents are provided with the information required to complete such an assessment. Proponents may adopt the example climate risk screening tools presented in Annex 2, for example. In addition, the Mauritius Standards Bureau has tools that may be leveraged to integrate climate change, such as the Risk Management Standard (Annex 6). A robust process will ensure proponents are acutely aware of the adaptation mechanisms required to enhance the sustainability of the proposed investments.

BOX 8: EXAMPLE PLANNING CONTROLS BASED ON COASTAL RISK ZONATION

The example below demonstrates an approach to zonation specific regulations for development based on prioritized coastal vulnerability. This example is drawn from a local government in New South Wales, Australia. Within the following Sites, various planning controls are specified.

Immediate Risk Sites

(a) No new residential, commercial or industrial development.

High Risk Sites

(a) No new sub-divisions;

(b) No net increase of residential densities in high risk areas

(c) Proponents will need to provide a report from a suitably qualified coastal engineer and structural engineer to support any claims for development

(d) No net increase of residential densities in high risk areas;

(e) Time limited development such as tourist camping and cabin accommodation considered on merit;

(f) Time limited residential development such as modular and/or re-locatable homes (moveable dwellings) considered on merit;

(g) Proponents must demonstrate retreat strategy for sit through appropriate building design, methods for removal of buildings and infrastructure, site remediation and commitment to meeting costs;

(h) Council will not meet the costs for implementing any retreat plans for private developments within high risk sites

(i) Maintenance of existing buildings will be permitted in accordance with the definitions outlined in

Medium Risk Sites

(a) Infill, new residential and commercial development assessed on merit

(b) Proponents need to provide a report from a suitably qualified coastal engineer and structural engineer to support any claims for development

(c) Maintenance of existing buildings will be permitted in accordance with the definitions outlined in Development Guidelines.

d) Renovation of existing buildings will be permitted in accordance with the definitions outlined in Development Guidelines.

Low Risk Sites

(a) Standard building codes apply

(b) Any development allowable within applicable zoning outlined in the planning controls.

SUMMARY

Recommendations to integrate climate change within the guidance documents that support planned development in the coastal zone have been provided. The recommendations are incorporated within the hierarchy of documents that inform coastal planning, from land use planning to tools and guidelines that inform individual future developments. Given the fluid

nature of recommendations for change in the documents that guide coastal planning and management in RoM (for example, the *draft* Land Use Planning and Development Act and the Proposed Regulations to be made under the Planning and Development Act 2004), recommendations align to documents currently applied in practice. However, further details on an approach to enhance integration of climate considerations relevant to the place-based nature of coastal sensitivity are advocated. This ensures that as documentation, such as the Land Use Planning and Development Act (2004) are updated, there is a clear pathway for incorporating climate relevant aspects to ensure sustainability of coastal investments.

Importantly, incorporating climate change considerations into guidance documents does not address issues of compliance and the other institutional barriers to sustainable coastal management that have been identified. Therefore, the recommendations should be viewed as a package of activities that together, rather than in isolation, will achieve an integrated coastal zone management system that is best placed to face the considerable challenges posed by climate change.

Chapter 5: Recommendations to enhance resilience of existing developments in the coastal zone

INTRODUCTION

Plans for buildings in the coastal zone must satisfy the requirements of the Planning Policy Guidance in order to receive a Building and Land Use Permit. Unfortunately, as reported in the work undertaken to formulate the 2009 ICZM framework for ROM, there are many examples where existing guidelines have not been complied with, especially with respect to the lack of adherence to designated development setbacks. While broader issues of institutional failure need to be addressed with respect to follow-up and monitoring of construction practices and in enforcement of the existing Policy and Planning Guidelines (as highlighted in foregoing sections of this report), there is also a pressing need to consider a process for 'climate proofing' the development that has already occurred within the coastal buffer. This development is currently exposed to the potential impacts of a changing climate as well as the natural variability synonymous with the coastal zone.

Available guidance on mechanisms to improve the resilience of existing development in country appears to be limited. In light of this, the information provided in this Section addresses this issue through the provision of recommendations for an approach to facilitate adaptation planning activities for existing coastal development in RoM. Importantly, the provision of prescriptive guidelines is beyond the scope of the strategic recommendations outlined here and case-specific or site-specific guidance are not presented. Rather, a process for effective adaptation decision-making is outlined in recognition of the need to adopt a cost-benefit perspective towards proactive activities to best manage the likely impacts on existing coastal assets.

THEORETICAL BASIS

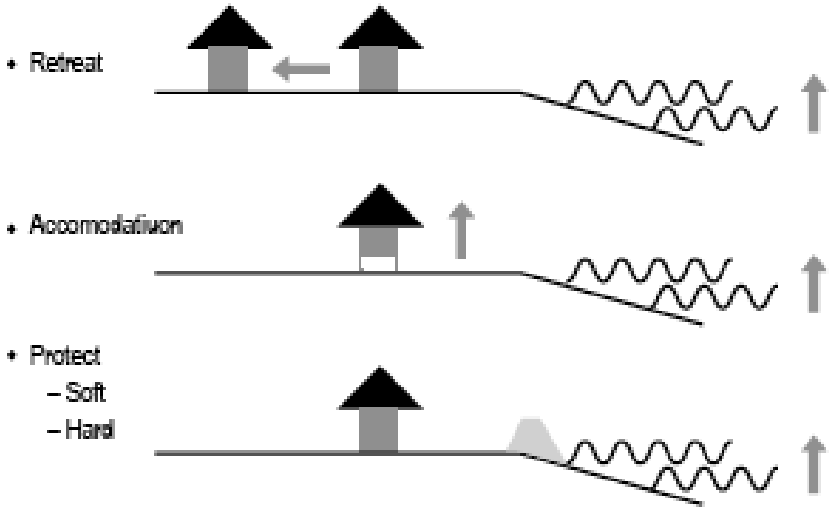
The theoretical basis for climate change adaptation and the processes associated with planning and designing projects and programmes for adaptation have been the focus of numberous investigations over recent years (see Annex 2). In light of this, it is not the intention of the current report to provide a comprehensive overview of adaptation theory, but rather to introduce the approaches and options routinely used by adaptation practitioners and decision makers to assist in increasing the resilience of existing built assets within the coastal margin. This has been informed by a consideration of examples of international approaches to climate proof coastal development (Table 8**Error! Reference source not found.**).

The range of adaptation strategies available to 'climate proof' coastal development are routinely considered under three generic headings: Adapt; Accomodate; and Retreat (e.g. Klein, 2011). These three generic strategies are outlined in Table 9 and Table 10 with specific reference to the coastal zone and alignment to associated tools to facilitate the chosen mode of adaptation. Importantly, the tools that are employed to deliver adaptation are generally not 'new'. That is, they constitute tried and tested tools and techniques for sustainable coastal management that are now being operationalized through a climate change lens.

Table 8: International Approaches Adopted to Climate Proof Coastal Development

Country / Policy	Case study	Approaches / Tools
Western Australia State Planning Policy 2.6 - State Coastal Planning Policy (Draft)	Policy formulated on the basis of a review of latest coastal planning information locally, nationally and internationally; learning gained over 10 years of application of the policy, and an extensive internal and targeted external consultation. The draft revised policy proposes revisions and additions that provide more robust guidance to the Western Australian Planning Commission, State Government bodies and local governments for land use and development on or adjacent to the coastline. *This is a State Planning Policy made under Part 3 of the Planning and Development Act 2005. This Policy may be cited as State Planning Policy No. 2.6 State Coastal Planning Policy.*	**Policy Development:** *Policy objective* 1. Ensure that the location of coastal facilities and development takes into account coastal processes, landform stability, coastal hazards, climate change and biophysical criteria; 2. Ensure the identification of appropriate areas for the sustainable use of the coast for housing, tourism, recreation, ocean access, maritime industry, commercial and other activities; Relevant detail: - Pg. 16. The allowance for sea level rise should be based on a vertical sea level rise of 0.9 metres over a 100-year planning timeframe to 2110. *5.5 Coastal hazard risk management and adaptation planning* Outlines how adaptation planning should be undertaken by the management authority and/or proponent. Adaptation planning hierarchy is provided: - Avoid development - Planned or managed retreat from an area subject to intolerable risk of damage from coastal hazards over the planning timeframe. - Accommodate: Measures that involve/design or management strategies to reduce impact - Protection:
European Union	EU-funded project DINAS-COAST (Dynamic and Interactive Assessment of National, Regional and Global Vulnerability of Coastal Zones to Climate Change and Sea-Level Rise) was to develop a CD-ROM-based tool that enabled its users to produce quantitative information on a range of coastal vulnerability indicators, for user-selected climatic and socio-economic scenarios and adaptation policies, on national, regional and global scales, covering all coastal nations. This tool is called DIVA - Dynamic and Interactive Vulnerability Assessment (Vafeidis et al., 2003; McFadden et al., 2007).	ICZM Assessment Models - **Technical Tool** The DIVA methodology used a database of features, both physical and socio-economic, based on segments of the coastline, within integrated modules to assess adaptation options under future climate change scenarios. The modules were flooding, relative sea level rise, erosion, wetland change, wetland evaluation and river effects. Generalized example outputs of the model are numbers of people flooded, wetlands lost, adaptation costs (including those relating to flood protection and beach protection) and the amount of land lost under the specified relative sea level rise scenario. DIVA can be applied by the software's authors and is seeking funding for public use.
London, UK	Greater London Authority (GLA) checklist aims to make sure that the effects of climate change are taken into account in the design and allocation of new developments and constructions. It provides guidelines to designers and planners, for example on the types of	GLA (2005): Adapting to climate change. A **checklist** for development: Guidance on designing developments in a changing climate, Greater London Authority

Country / Policy	Case study	Approaches / Tools
	construction, suitable materials, and sustainable urban drainage systems that could be used	
	In the UK, the national government has adopted the national 'Planning Policy Statement 25: Development and Flood Risk' (CLG 2010) which should be taken into account by regional and local communities in any development activities in flood prone areas. The document provides an overview of the approach to assess the risks, the decision-making principles and how tasks and responsibilities are divided between the stakeholders. Local government can also select National Indicator 189 as self-assessment instruments for flood risks management.	
New South Wales, Australia	NSW Coastal Policy State Environmental Planning Policy (SEPP) No. 71 - Coastal Protection commenced on 1 November 2002. The Policy has been made under the Environmental Planning and Assessment Act 1979. Regional Strategies for coastal areas. Draft policy plan for 0.9 m sea level rise to 2100	The definition of the coastal hazards takes into account the impact of sea level rise and future shoreline recession. Regional strategies require councils to consider increased coastal hazards when developing new LEPs. NSW Coastline Management Manual To guide for local councils, CMA and communities develop coastal zone



Source: van Koningsveld and others, 2008.

Figure 7: Protect, Accommodate, and Retreat

Table 9: Adaptation strategies for Existing Infrastructure

Adaptation Strategy	Detail	Tool
Planned Retreat	The impacts of sea-level rise are allowed to occur, and human impacts are minimized by pulling back from the coast.	Land use planning, development control, set-back zones, etc.
Accommodation	The impacts of sea-level rise are allowed to occur and human impacts are minimized by adjusting human use of the coastal zone to the hazard.	Increasing flood resilience (e.g., raising homes on pilings), early warning and evacuation systems, risk-based hazard insurance, etc.
Protection	Climate change impacts are controlled by soft or hard engineering - reducing human impacts in the zone that would be affected without protection.	Hard Engineering (e.g. seawalls, groynes) Soft Engineering (e.g. vegetation buffers).

Each of the strategies are associated with discrete options (e.g. Table 10) whose applicability must be determined through a consideration of the temporal and spatial scale within which an option is being employed, the impact an option is being used to address and the physical conditions at the area in which the adaptation option will be implemented. For example, the options that are potentially suitable within a mangrove are not likely to be the same as those for an open-ocean high-energy erosive sandy beach and dune system.

Table 10: Three strategies for adaptation to SLR and storm surges (a combination of policy and technological options)

Protect	Manage	Retreat
• Dikes, levees, floodwalls • Seawalls, bulkheads • Groynes • Floodgates and tidal barriers • Detatched breakwaters • Wetland restoration • Afforestation • Wooden walls • Stone walls	• Emergency planning • Insurance • Modification of buildings to cope with floods (Strengthen and raise) • Improved drainage • Strict regulation in hazard zones • Modification of land use planning	• Increase of establish retreat zones • Relocate threatened buildings • Phase out or ban development in areas susceptible to flooding • Rolling easements, erosion control easements • Upland buffers

The challenge for coastal decision makers in RoM will be to:

a. Decide 'if' and 'when' adaptation will be necessary for development that already exists within the coastal margin; and

b. Select an appropriate option to fulfill the identified need.

These questions are explored further in the Sections that follow through a consideration of:

- An approach to undertake screening assessments for existing developments to identify likely climate change impacts and associated risks (deciding 'if' and 'when' adaptation is necessary); and

- An approach to conduct an adaptation options analysis to inform robust decision making with respect to adaptation planning.

Table 11: Selection of Potential Coastal Adaptation Options (Travers et al 2011)

Options	Benefits	Limitations	Indicative Cost (*Where available)*	Further Information
Beach nourishment	• Reduces impacts of erosion • Provides storm buffer • Increases beach amenity • Potential ecological benefits i.e. enhanced nesting sites • Low visual/aesthetic impact	• Not a permanent solution to shoreline erosion • Requires significant re-investment and maintenance • Potential impacts on biodiversity through direct burial and increased turbidity	• USD$3-15/$m^3$ with transport costs being significant component of total cost	http://tech-action.org/Guidebooks/TNA_Guidebook_AdaptationCoastalErosionFlooding.pdf http://pdf.usaid.gov/pdf_docs/PNADO614.pdf
Artificial Sand Dunes and Rehabilitation	• Buffer against coastal inundation and flooding • Reduces impacts of erosion • Provides coastal habitats for many plants and animals • Are natural elements of the beach system	• Requires significant area/physical footprint • Impedes beach access	• USD$3-15/$m^3$ depending on how and where sediment is sources	http://tech-action.org/Guidebooks/TNA_Guidebook_AdaptationCoastalErosionFlooding.pdf
Seawall	• Modify the potentially destructive action of tides and waves such that areas of human habitation, conservation, leisure and economic activities, are protected in the long term from the effects of erosion and / or flooding	• Isolation of dune sand reserves from the remainder of the active beach system and narrowing or loss of high tide beach natural character, amenity values, and public access along the beach • Reinforce the misunderstanding that all erosion is abnormal or a problem that must be stopped rather than natural erosion being part of a coastal process central to the natural behaviour and values of most beaches • Maintenance (and eventually replacement) is an ongoing requirement if they are to provide effective long term defence	• Properly engineered seawalls on exposed coasts typically cost $1500-$2000 USD per linear metre or more	http://tech-action.org/Guidebooks/TNA_Guidebook_AdaptationCoastalErosionFlooding.pdf
Breakwaters	• Reduce coastal erosion. • Deposition occurring in these	• Can disturb the local sediment transport patterns such as longshore drift resulting in	• $250,000 - $4,000,000 USD	http://tech-

Options	Benefits	Limitations	Indicative Cost (*Where available)*	Further Information
	waters and beaches can be built up or extended in these waters	nearby erosion of unprotected sections of the beaches that are not protected by the structure	per 100m (dependent on local water levels)	action.org/Guidebooks/TNA_Guidebook_AdaptationCoastalErosionFlooding.pdf
Gabions	• They are resistant to being washed away by moving water. Gabions also have advantages over more rigid structures because they can conform to ground movement, dissipate energy from flowing water, and drain freely. • Their strength and effectiveness may increase with time in some cases, as silt and vegetation fill the interstitial voids and reinforce the structure	• Design life of approximately 10-15 years • Can be prone to interference by humans (i.e. removal or rock fill material)	• $200-400 USD m^3	http://tech-action.org/Guidebooks/TNA_Guidebook_AdaptationCoastalErosionFlooding.pdf
Groynes	• Encouraged beach widening as a result of deposition of longshore sediments • If correctly designed, then the amount of material it can hold will be limited, and excess sediment will be free to move on through the system • Extremely cost-effective coastal defence measures, requiring little maintenance	• Accelerated erosion of the downdrift beach, which receives little or no sand from longshore drift (this is known as terminal groyne syndrome, as it occurs after the terminal groyne in a group of groynes). Groynes do not add extra material to a beach, but merely retain some of the existing sediment on the updrift side of the groynes • Groynes do not control cross shore sediment transport hence during storm events sediment can be deposited offshore		http://tech-action.org/Guidebooks/TNA_Guidebook_AdaptationCoastalErosionFlooding.pdf
Revetment	• Preserve the existing uses of the shoreline and to protect the slope, as defence against erosion	• Generally require a large amount of space as they are laid at a relatively flat angle (1:3 or less)		

Options	Benefits	Limitations	Indicative Cost (*Where available)*	Further Information
		• Potential scour of adjacent shoreline		
Rock Armour	Rock amour has a limited lifespan, it is not effective in storm conditions, and it reduces the recreational value of a beach. Rock amour is relatively low cost	• Boulders and rocks are wired into mesh cages and usually placed in front of areas vulnerable to heavy erosion: sometimes at cliffs edges or jag out at a right angle to the beach like a large groyne. When the seawater breaks on the gabion, the water drains through leaving sediments, also the rocks and boulders absorb a moderate amount of the wave energy. • Gabions need to be securely tied to prevent abrasion of wire by rocks, or detachment of plastic coating by stretching. Hexagonal mesh distributes overloads better than rectangular mesh. • Downsides include wear rates and visual intrusiveness.		
Revegetation	• Re-established local native flora • Increases dune stability by reducing Aeolian (wind-blow) erosion • Reduces turbidity • Habitat creation	• Limited to areas that are protected from active erosive forces and have appropriate slopes • Vulnerable to human and environmental pressures (heavy traffic, river flows & wave action)	• Low	http://pdf.usaid.gov/pdf_docs/PNADO614.pdf
Wetland Restoration	• Reduction of incoming wave and tidal energy • Habitat creation • Water quality regulation	• May require large physical footprint • Requires a degree of expertise	• Low - Costs should be calculated on a case-by-case basis.	http://tech-action.org/Guidebooks/TNA_Guidebook_AdaptationCoastalErosionFlooding.pdf
Mangrove	• Reduction of income wave and tidal energy	• Not applicable in all areas (generally only in tropics and sub-tropic regions)	• Low – Costs vary between sites.	http://tech-

Options	Benefits	Limitations	Indicative Cost (*Where available)*	Further Information
forestation and conservation	• Able to cope with high levels and types of stress • Habitat creation • Water quality and regulation • Potential source of fuel and fibre	• Can require large physical footprint	• A project in Vietnam in 2009 required approx. $USD41 per hectare of mangrove planted	action.org/Guidebooks/TNA_Guidebook_AdaptationCoastalErosionFlooding.pdf
Coral Reef Rehabilitation and Restoration	• Improved ecosystem structure and function • Increased productivity (i.e. fishing)	• Coral reef restoration is in its infancy • Can require significant resources and investment	• Medium-High depending on context	http://www.gefcoral.org/
Artificial Reef Construction	• Provision of marine habitat • Potentially reduce erosion through dissipation of incident wave energy • Potentially provide a recreational site for diving, fishing etc	• Can require significant capital investment • Requires significant expertise in design and construction	High US$100,000-1,000,000 per hectare	http://www.gefcoral.org/ http://www.reefball.org/

SCREENING ASSESSMENT FOR EXISTING DEVELOPMENT

An issue highlighted through consultation with RoM officials with regard to existing guidance for coastal setbacks is the application of a 30m-blanket exclusion zone across the entire coastal zone. As suggested in Chapter 4 (p31), the site specific characteristics of the coastal zone should be considered to inform designation of a locally relevant setback that takes into account the natural variability of the area under consideration to inform projections for changes into the future that incorporate climate change. The same principles should be carried over to a consideration of appropriate management responses for areas of the coast where inappropriate development already exists.

For example, as a first pass, any development that currently exists within the current 30 m buffer should be subject to a screening assessment to establish the likely climate change impacts to which it may be subject. The arbitrary 30 metre buffer zone should be supplemented by information on risk ratings as and when it becomes available – for example, specific adaptation planning controls should apply to existing development within risk thresholds similar to development planning for proposed development (refer to further recommendations in Chapter 4).

Table 12: Indicative Screening Assessment Requirements for Discrete Coastal Areas[7] Corresponding to Draft Coastal Building Regulations

Coastal Area	Details	Indicative Screening Assessment Requirements
A	Coastal frontage land (A) which consists of plots adjacent to the high-water mark commonly known as "pieds dans l'eau	Screening Assessments Required for All Development All existing development within this area should be subject to a screening assessment to identify potential climate change impacts and likely risks (See approach outlined in text). On the basis of this assessment an adaptation options analysis should be undertaken indicating priorities and timeframes for adaptive action through a collaborative decision making process including all key stakeholders. The output of this work should be an adaptation plan with indicative costs and timings (see Section below for details on process to conduct an adaptation options analysis).
B	Coastal frontage land (B) which consists of plots inland of coastal frontage land (A) which are partially or wholly situated within the area commonly known as "Pas Géométriques" which extends a minimum of 81.25 metres inland of the high-water mark	Recommendation for a Screening Assessment - unless area is identified as being 'high risk' in which case a screening assessment should become a requirement (on the basis of the national vulnerability profile recommended in Chapter 3 and 4 is conducted). In the absence of this information on prioritised 'risk' areas within the coastal margin, development should be subject to a baseline assessment to establish monitoring benchmarks upon which an ongoing climate change monitoring and evaluation programme should be based. In conjunction with this programme, coastal managers and decision makers would be required to consider likely tipping points for change in the natural physical system and trigger points for adaptive action (i.e. level of unacceptable change/impact to coastal assets that would necessitate and adaptive response).

As per the Planning and Development Act 2004

C	Coastal road area (C) which consists of the plots adjacent to the sea with edge of a coastal road but inland of coastal frontage land	No immediate screening assessment required but decision should be revisited on the basis of vulnerability assessment and prioritisation of at risk areas – for example, if a coastal area within area C is designated as high risk area the process undertaken within Area A should be followed.
D	Coastal road area (D) which consists of the plots adjacent to the inland edge of a coastal road	As at C above.

The process for undertaking a climate change screening assessment has been covered in the literature with a summary of tools and toolkits as well as examples of their application provided in Annex 2 to this document.

More broadly, aspects to consider when delineating the vulnerability of coastal areas to inform consideration of a 'theory of change' is presented in Boxes 9 and 10. Based on the identified impacts a coastal area is likely to be susceptible to, the implications for existing development should be established. The 'risk' associated with these impacts should then be established in a proactive fashion mindful of asset protection – i.e. instead of seeing the need to adapt as an unfair imposition, it should be treated as a cost benefit analysis to allow owners and custodians of coastal assets protect their investments.

BOX 9: ASPECTS TO CONSIDER WHEN IDENTIFYING POTENTIALLY VULNERABLE AREAS

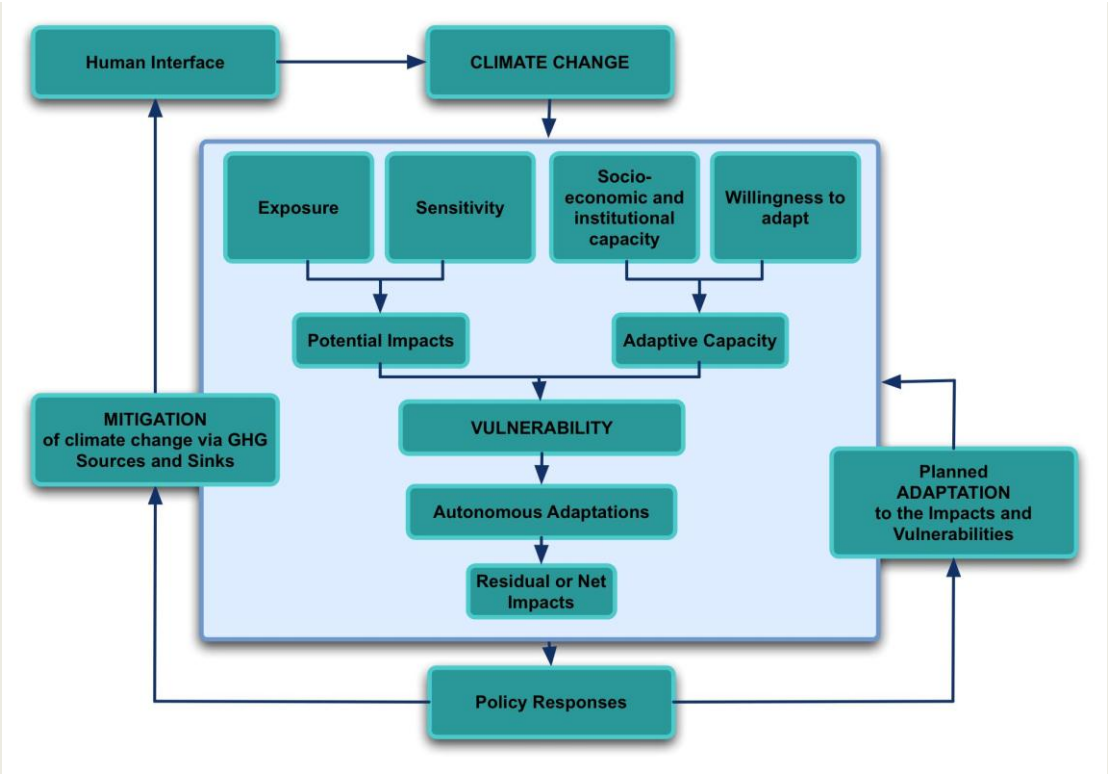
1. How exposed is the area to the influence of climate change?
2. How sensitive is the area to the influence of climate change?
3. What is the capacity of the system to manage the impacts of concern?

Exposure is defined as 'degree of climate stress upon a particular unit analysis; it may be represented as either long-term changes in climate conditions, or by changes in climate variability, including the magnitude and frequency of extreme events' (IPCC, 2001)

Sensitivity is the degree to which a system will be affected by, or responsive to climate stimuli (Smith et al., 2001).
Sensitivity is basically the biophysical effect of climate change; but sensitivity can be altered by socio-economic changes. For example, new crop varieties could be either more or less sensitive to climate change.

Adaptive capacity refers to the potential or capability of a system to adjust to climate change, including climate variability and extremes, so as to moderate potential damages, to take advantage of opportunities, or to cope with consequences (Smit and Pilifosova, 2001). As the name suggests, adaptive capacity is the capability of a system to adapt to impacts of climate change.

Conceptual diagram showing the interrelation between climate change exposure, sensitivity, adaptive capacity, vulnerability and adaptation



BOX 10: FORMULATING A THEORY OF CHANGE

Consider the following focus questions:

1. What are your existing issues?
2. What are the relevant projections for changes in climate and socioeconomic situation?
3. How will the projected changes impact coastal developments?

ADAPTATION OPTIONS ANALYSIS FOR EXISTING DEVELOPMENT[8]

It is important to note that 'hard' adaptation measures implemented as a direct risk reduction method (e.g. seawall), typically require significant financial investment and are often seen as an option of last resort – as is the case in Western Australian coastal policy (as outlined above). More broadly, many of the adaptation strategies outlined in Table 11 may generate additional social, economic and environmental disruption. For example, managed retreat of developments might include the displacement of homeowners or businesses, while the construction of a seawall may amplify coastal erosion in adjacent areas.

Nonetheless, these concerns can be ameliorated via a comprehensive analysis of costs and benefits of the respective option (e.g. cost benefit analysis (CBA), multi-criteria analysis (MCA)). This analysis will assist decision-makers in determining the most effective adaptation option whilst also ensuring maladaptive outcomes are reduced (where the option fails to meet its objective and/or generating unexpected additional costs).

Note that approach outlined here does not provide a discrete CBA/MCA methodology[9] tailored to RoM but rather a decision making tool to assist coastal planners and managers in identifying the most appropriate options for their context to subsequently investigate further.

The approach to adaptation options analysis outlined here is built upon a number of Focus Questions that consider:

- The identification of context-appropriate interventions;
- Evaluation of the applicability of specific interventions to address adaptation goals; and
- Prioritisation of options for further consideration by key stakeholders.

Context specific interventions are selected from the range of available options (examples provided in Table 11) based on consideration of a set of locally relevant evaluation criteria. These criteria should be defined through a collaborative, stakeholder driven process involving coastal decision makers, coastal asset managers and coastal asset owners within RoM. An example of criteria that may be used and an associated evaluation scale is provided in Box 11. An example of how the evaluation criteria and scale may be applied in the consideration of discrete interventions is provided in Table 13. This information is then evaluated to inform which options are considered further for implementation and within what timeframes (see an example of how this information has been used to produce 'report cards' to support adaptation decision making for a UNDP Project in Mozambique).

[8] A brief overview of an approach to facilitate adaptation options analysis for existing coastal development is provided here with a view to further elucidating this process through the in country training held in ROM as a component part of this Project. This training will be targeted at technical staff within relevant ROM government departments in order to refine and contextualize a fit-for-purpose approach to evaluating adaptation options for ROM.

[9] An example of a costing support tool that may assist ROM authorities in evaluating adaptation options has been developed by the United Kingdom Climate Impact Programme (UKCIP)

BOX 11: IDENTIFYING CONTEXT SPECIFIC INTERVENTIONS

SAMPLE EVALUATION CRITERIA

- Suitability - How does the solution meet the identified 'need'? How suitable is the solution for dealing with the impacts identified for the site and does it assist in achieving the overall management goals.
- Impact - Considers negative impact on habitat, landscape and physical processes.
- Livelihood benefit - direct and indirect benefit an adaptation option has for health/functioning marine and coastal ecosystems benefits.
- Ecosystem benefit - direct and indirect benefit an adaptation has for healthy/functioning marine and coastal ecosystem benefits.
- Capital costs and maintenance/operational cost -
- Implementation capacity - How implementable a solution is given what is currently known about adaptive capacity of the local community.

SAMPLE EVALUATION SCALE

	Low	Medium	High
The identified need	The option will not actively treat the issues faced	The option will in part treat the issues faced	The option will actively treat the core issues faced
Institutional	The ROM will require significant support	The ROM will require some support	The ROM can implement the option with limited external support
Livelihoods	The option will not enhance local livelihoods	The option will indirectly enhance local livelihoods	The option will directly enhance local livelihoods
Ecosystems	The option will not contribute to ecosystem benefits	Moderate ecosystem benefits	High ecosystem benefits
Implementation affordability	The option will require significant investment $ Insert Thresholds	The option will require moderate investment $ Insert Thresholds	The option will require minor investment, but is affordable $ Insert Thresholds
Maintenance costs	The option will require significant investment to ensure ongoing maintenance costs are met	The option will require minor investment to ensure ongoing sustainability.	The option will be self maintained post completion of the project

Table 13: Sample Adaptation Option Evaluation (source Travers 2010)

Option	Suitability	Impact	Livelihood Benefits	Ecosystems Benefits	Affordability		Implementation Capacity
					Capital Costs	Maintenance \Operation Costs	
Do nothing	Low	Nil	Low	Medium	Nil	-	-
Managed Realignment	High	High	High	High	Medium	Low	Medium
Dune Management	High	Low	High	High	Low	Medium	High
Sandbag Structures	Low	Medium	Low	Low	Low	Low	Medium
Revetments	Medium	High	Low	Low	High	Low	Low
Seawall	Low	High	Low	Low	High	Low	Low
Breakwaters	Low	High	Low	Low	High	Low	Low
Fisheries best practice	High	Low	High	High	Low	Low	Medium
Sustainable coastal forestry	High	Low	High	High	Medium	High	Medium
Sustainable ecotourism	High	Low	High	High	Medium	Medium	Medium

Paquite (Pemba)

Overriding Management Goal: Human Safety & Built Infrastructure Exposure

Recommended options (with indicative costs and timings)

	Timing	Cost
1. Managed realignment	X	X
2. Coastal protection		
- Sandbags	X	X
- Revetment	X	X
- Seawall	X	X

Timing		
0-10 years	10-20 years	>20 years

Cost		
>$50,000	>$10,000	<$10,000

Physical Setting

- Embayed beaches, largely perched on rock and eroding cliffs and promontories
- Sediment feed in the area is quite limited
- Relatively protected due to fringing reef; low wave energy, strong long shore drift in keeping with locally generated wind waves
- Predominantly impacted by water level fluctuations

Coastal Landuse

- Coastal road runs the length of the northern sector and varies between 10m-150m distance landward of the shoreline
- Touristic lodgings and complexes occure within 50m of the shoreline
- Moving east population density increases dramatically and residences become urban dwellings
- The road is less than 10m from the shoreline/cliff edge and dwellings are directly landward of the road

Livelihoods

- Agriculture not as widespread due to urban location; mixture of other livelihoods such as trades, services and government employees.
- Business = (36%)
- Fishing = (21%)

Community Structure

- Population of 13,000. Wooden sticks and caked mud but also a significant number of cement houses with zinc roofs. Unplanned and unorganised development with no functional drainage canals or latrines

Existing Issues (from a physical coastal perspective)

- Highly exposed to episodic coastal erosion and inundation during high water levels
- History of tidal inundation
- Very low capacity to cope with new patterns of environmental change and existing variability
- Directly impacted by sea level rise and coastal erosion - inundation will be key issue at this location

Likely Climate Change Impacts

- Issues will be exacerbated with projected changes in climate and lead to the overall degradation of the amenity value of the beach and ultimately its complete loss due to coastal 'squeeze' Additionally the coastal road in this area will be damaged in more than 10 years and likely destroyed in more than 30 years.

Issue Summary

- Geotechnical instability as a result of erosion of the coastal road. A relatively high population density with a lack of nearby vacant land

Source: Travers (2011)

SUMMARY

For ROM, the adoption of any of these adaptation options should be integrated within the existing ICZM framework. Therefore it is essential that decision makers consider which ICZM element (DST, Institutional Arrangements, Coastal Management Planning) will need to be addressed to ensure successful implementation and integration across sectors and institutional hierarchies. For example, increasing the minimum setback for new developments may require a series of interventions across ICZM elements:

- Direction Setting Guidance - Amendment of design guidelines for developers (e.g. Planning Policy Guidance), Compliance and enforcement guidelines for relevant authorities.
- Institutional Arrangements - Amended planning policies and regulations (E.g. EPA 2002)
- Coastal Management Planning – Increased capacity (human resources) to monitor/map sea level rise, and enforce new set back policies.

Chapter 6: Conclusions & Recommendations

The consultancy was tasked with delivery of recommendations to integrate climate change within the existing ICZM framework and EIA process. It is important to reinforce that the specific work undertaken through the consultancy summarised in the current report was necessarily strategic in nature. The provision of explicit recommendations that align to the local context must be based on a spatially based understanding of risk (discussed further below).

The information contained in this report formed the basis of a workshop held in ROM over two day in November, 2012. During this workshop the recommedations for mainstreaming climate change within the existing ICZM framework were discussed with particular focus on the issue of site specific setbacks.

A general comment during the workshop was that participants felt that the advice provided was not applicable to the ROM context and that many of the suggestions for 'best practice' would be met with significant challenges and barriers in-country. This was especially true with respect to site specific setbacks due to the fact the majority of coastal land is highly developed at present and generally right up to the water mark. Participants expressed concern that the current 30m setback was, in many cases, not being enforced and therefore suggestions to supplement this with a further site specific element would be impractical. However a number of important points should be reinforced in the context of the disuccions both during the workshop and at a meeting held with key ROM government officials in its aftermath:

- Firstly, while it is recognised that locally relevant setbacks may not be practically enforceable in ROM at this time, this does not mean that coastal stakeholders should remain unaware of likely hazards they face as a result of naturally variability through time which will enevitably be exacerbated by climate change. Rather, it is extremely important that the Government of Mauritius and coastal developers alike understand the margins of risk they are accepting by choosing to either a) build new development or b) maintain existing development within the existing coastal buffer.

- Secondly, an awareness of likely hazard (based on an understanding of 'best practice' with respect to setback) could then be used as a basis to define 'acceptible' risk that would be acknowledged in conjunction with production of an associated adaptation plan. That is, a proponent understands the likely hazards to which they are subject, appreciates the potential risks to their assets and undertakes to monitor the rate at which change occurs and plan for adaptive action at appropriate trigger points.

- Finally, the effects on climate change on different categories of coastline were not examined. This is an extremely important point and forms the basis of the recommendation to conduct spatially relevant planning. That is, it will be crucial for the ROM to collate all existing information on coastal classifications and their associated sensitivity to change (including climate change) and use this as the basis to consolidate coastal hazard risk diagnosis. This point is discussed further in the project closeout document that has been produced to address comments and concerns raised by workshop participants.

Reflecting on the aforementioned points, a key finding/recommendation of the work presented here is that a prioritised system of coastal hazard risk diagnosis should act as the framework on which locally relevant planning decisions are made. It is not possible to be prescriptive about adaptation options without a case specific understanding of the impact to

be treated, the overriding adaptation goals of those involved and the 'value' system of decision makers in the given context. In light of this, an overview of a decision support system for adaptive action was outlined in the ICZM report with additional information on the range of adaptation options available and criteria for their assessment provided in supporting appendices. This information has been provided as a guide to inform next steps with respect to robust adaptive decision making and should be explored further along with other potential alternatives, in forthcoming projects.

In conclusion, the work produced through this consultancy and discussed during the in-country workshop should act as the basis for ROM to move forward with a process of spatially relevant environmental planning that accounts for vulnerability in the face of a changing climate. The first step in this repect will be consolidation of a country-wide vulnerability profile to allow designation of 'low', 'medium' and 'high' risk areas that could act as the basis for regulatory planning controls.

Overall, it is clear that the ROM faces a marked challenge in balancing the risks associated with climate change and ongoing investment in the coastal zone. An important element of this trade off will be further exploration of the legal requirement for collaboration and leasing. It is recognised that sustainable coastal planning in ROM will require a holistic approach but this must be supplemented by a supporting legal framework for implementation and enforcement. In addition building staff capacity and capitalising on newly funded projects will be crucial to facilitate a move from the current generic recommendations proposed to more locally applicable actions to deliver a climate proofed, sustainable coastal zone capable of deliverying its valuable range of goods and services for generations to come.

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Annex 1: Review of the 2009 ICZM Recommendations, opportunities to integrate climate change and overview of actions taken

ID	Issue	ICZM 2009 Recommendations	Climate Change Consideration/ Recommendation	Potential Entry Points	Actions Undertaken
Direction Setting Guidance Elements					
1	Ministries and departments representing different coastal sectors develop their own policies, regulations, master-plans and visions for the future. While the ICZM Committee aims to ensure integration across departments, it is not a decision-making forum and can only provide advice to the Minister of Environment. The committee does not meet on a regular basis and is not an effective institutional for carrying out the tasks assigned to it under the EPA (2002). Consequently, horizontal integration is limited.	The present ICZM committee should be replaced by an executive panel with respect to the tasks of: a. developing an Integrated Management Plan b. coordinating regional and international projects. Developing an integrated management plan is interpreted to mean ensuring cross-sectoral compatibility in terms of strategies, policies and plans of individual sector ministries and departments with respect to the coastal zone. The ICZM Executive Panel (ICZMEP) would ensure that sectoral policies and programmes comply with the various Multi-lateral Environmental Agreements that Mauritius is signatory and “coordinate regional and international projects”. The current ICZM Committee should be renamed the ICZM Advisory Committee[1] and should serve as an advisory forum to the Executive Panel.	The modifications to the ICZM institutional structure, as outlined, would facilitate the implementation and enforcement of climate change relevant considerations, as captured within the updated policies and guidelines that support implementation of climate change in ICZM and EIA. A key consideration would be to ensure consistent application of climate scenarios within risk assessments across all ministries and departments. The ICZM Executive Panel could play a role in supporting Ministries and private agencies in selecting and implementing scenarios to assess climate risk.	The Entry Point is at the **National** Level; with the establishment of an Executive Panel for ICZM. However, the Executive Panel will develop policies that guide sectors in the implementation of **Sectoral** projects that align to the overarching ICZM national and regional objectives.	Activities to implement recommendation should be a focus of the next phases of Project Implementation. For example, consultation to establish defined scenarios for use in risk and vulnerability assessments that inform management of coastal zone.

ID	Issue	ICZM 2009 Recommendations	Climate Change Consideration/ Recommendation	Potential Entry Points	Actions Undertaken
2	While there are examples of good practice delivery of vertical integration on a project-by-project basis (for example, the Grand Baie refurbishment, it is unclear whether such a good practice approach, which involved stakeholders and agencies across scales, with overall direction and oversight from the ICZM body, is a practice uniformly adopted in ROM	The model adopted in the Grand Baie refurbishment should be adopted in all other planning processes.	Vertical integration is best achieved when all stakeholders are adequately engaged in the decision making process. Increasing community and private sector awareness of the impacts of climate change, and increasing the expertise of government staff to address climate risks, will ensure a platform for informed decision-making across scales	**Places:** Tools to communicate the value of coastal areas and links to sustainable local livelihoods, along with potential climate impacts, to promote engagement in coastal planning and decision-making at the local scale. **Sectoral:** Policies and strategies for each sector informed based on an understanding of the links between natural and social systems, as well as climate risks, to guide planning and decision-making in partnership with local communities **National:** Promotes a collaborative approach to planning and development - as per the Maurice Ile Durable (MID)	Enhancing vertical integration is a focus of other in-country sustainable development programs. For example, the MID has identified a program of works to enhance awareness of climate risks. In addition, sectoral policies and strategies that should be cognizant of climate change, but do not require direct climate integration have been identified. This provides a baseline for further work in building climate awareness across sectors. Finally, a new National Climate Change Adaptation Plan is under preparation (*pers comm*. July 2012) and provides an entry point for incorporating recommendations proposed here.
3	The amendments to the FMRA 2007 to account for aquaculture are an improvement; however, there remains the need for a legal framework to manage the provision of leases for other uses of the ocean environments.	Update the Maritime Zones Act 2005 so that rules governing the leasing of sea areas are spelled out in a legislation of general scope rather than in a specialised legislation applicable only to aquaculture activities. The goal is to set universal rules applicable to any types of activity to be undertaken. The power to grant leases of sea areas in the internal waters and the territorial sea be vested in the Prime Minister	In addition, the Maritime Zones Act should be updated to incorporate regulation for the completion of a climate change impact assessment as a component of the EIA. In addition, considerations for changing climate should inform the approvals process for granting leases to sea areas, for example, projections for change in fish habitats and species abundance should inform the provision of leases.	**National:** In addition, further to the 2009 recommendations the technical unit would be responsible for ensuring climate change considerations have been incorporated as a component of the application, and subsequent authorisation, process. It is vital to ensure that any developments in the marine zone take into account changing climatic conditions, this can be achieved through amendment EIA process to consider climate change impacts.	Progress in updating the Maritime Act to broaden its agenda was assessed. Consultations within the Prime Ministers Officer are currently underway (pers comm July 2012). In addition, the FMRA was identified as an act that should be cognizant of climate change, but does not require direct integration.

ID	Issue	ICZM 2009 Recommendations	Climate Change Consideration/ Recommendation	Potential Entry Points	Actions Undertaken
4	The EPA 2002 does not provide overall guidance for the management of the coastal zone.	Update the EPA 2002 to include, among others, a broadened scope for coastal management beyond pollution protection to ecosystem management and habitat protection, include principles for environmental management, alter section on administration to capture the recommendations outlined in the 2009 ICZM framework, strengthen the concept of environmental law and improve its definition, provide authority to the EEA to implement environmental law, improve enforcement powers and reporting, and the penalties.	It is unclear the extent to which the 2009 recommendations have been implemented. However, without the adequate basis for environmental management in law, progress in ICZM will be limited. Consequently, it is strongly advocated that the recommendations of the 2009 report be implemented. This will also provide the basis for ensuring that updates to BLUPs and other regulations that will contain climate specific recommendations, are enforced.	**National:** strengthening environmental law to promote sustainable management of the coastal zone.	Review revealed that the recommended updates to the EPA 2002 had not been implemented. Despite this, recommendations have been developed to integrate climate change considerations into the EPA 2002. Refer to Report 2 for details.
Institutional Arrangements					
5	There is a need to recognise the peculiarity of the coastal zone in the legal framework and to develop regulations for this zone, particularly for building and construction in the coastal zone.	Develop a comprehensive set of regulations on coastal development, building and structure addressing, inter alia, issues such as setbacks, spacing of construction to allow public access to the seashore and beaches, seawalls and groynes (circumstances under which such structures could be erected, material to be used for their construction, placing etc.	The guidelines should contain information on good practice approach to climate change risk assessment and adaptation planning. Climate change risk assessment should be conducted as a component of all development approvals in the coastal zone. The level of assessment may vary depending on the nature of the development, and guidelines to advise proponents on the most appropriate assessment type for their development should be provided – for example, development undertaken in protection zones, or zones identified as highly vulnerable to the impacts of climate change would require a greater level of detail than those undertaken in lower risk areas.	**National:** Providing the policy and legislative framework to assist in adaptation planning in **places,** while also guiding **sectors** on good practice approaches to incorporate climate change into decision-making.	Climate change considerations have been integrated into the Planning and Development Act (2004), Planning Policy Guidance (PPG), the Building and Land Use Permit (BLUP), and the Environmental Impact Assessment (EIA).

ID	Issue	ICZM 2009 Recommendations	Climate Change Consideration/ Recommendation	Potential Entry Points	Actions Undertaken
6	While guidelines support the implementation of strategies and plans, and increase awareness of environmental issue, they have no legal binding.	Two approaches were recommended to address this issue: (i) Regulatory provisions contained in PPG1 should be incorporated in a comprehensive set of regulations dealing with coastal development and building. It would include provisions setting out setbacks for construction on coastal frontage lands and provide sanctions for breach of any such regulation. (ii) Adopt an approach similar to the above with respect to the PDA, 2004 by way of schedule or regulation, inserting language to make it an offence to contravene the PPG and give the Minister the power to make regulations to create an offence and corresponding sanction.	Review the recently developed draft Land Use Planning and Development Act to assess the degree to which the recommendation posed by the ICZM review (2009) has been addressed. Further, ensure climate change considerations are captured within the draft Land Use Planning and Development Act as a mechanism to enable Permit and Business Monitoring Committee to evaluate permits for building and development (both in the coastal zone and more broadly).	**National:** Providing the policy framework and mandate to support mainstreaming of climate change for **Sectoral Projects** and **Places.**	Recommendations to incorporate climate change considerations within the Planning Policy and Guidance (PPGs) have been developed. Therefore, the Permit and Business Monitoring Committee may make reference to specifications within the Planning and Development Act 2004 when processing applications to ensure climate elements have been considered. However, there remain concerns that the PPGs are not regulatory instruments and therefore are not legally binding. While recommendations to integrate climate change are also captured within the Planning and Development Act (2004), further investigation of available mechanisms to strengthen legal enforcement of guidelines is required. Review of the draft BLUP Act indicates that this has not been addressed and will require extensive consultation prior to development of recommendations.

ID	Issue	ICZM 2009 Recommendations	Climate Change Consideration/ Recommendation	Potential Entry Points	Actions Undertaken
7	A number of committees have been established to address identified gaps and problems within the existing institutional framework. However, often the committees formed do not meet regularly and their ability to guide decision-making and operations level may be limited.	Assess the performance of every commission and committee, established under the EPA 2002, to determine whether they fulfill their mandate satisfactorily. Three critical issues to be examined include (i) functions, (ii) membership and (iii) decision-making process.	During this process, the role, membership and decision-making processes of the Climate Change Committee should also be examined in detail.	**National**: Improving adequate horizontal and vertical integration via a reassessment of the value added to integrated decision making processes of the established committees and commissions.	Consultations highlighted that the Climate Change Committee is no longer operational (pers. comm July 2012). However, there remains the need to ensure that the role of existing committees is fulfilled.
8	There is the need to improve the enforcement of environmental law.	Entrust the power to investigate and initiate judicial proceedings for any breach of any environmental law in the officers of the Environmental Enforcement Agency (EEA). Since the competence of EEA officers will rest on the nature of the enactment that has been infringed, it is critical that clear-cut and objective criteria are defined to determine which legislation, regulation or part thereof should be listed as an environmental law.	While this recommendation does not require a direct climate change relevant consideration, it is worth noting that the climate change considerations should be adhered, as contained within relevant components of environmental law.	**National:** Providing the mandate to increase enforcement of environmental law.	No actions required. Original recommendations (ICZM 2009) should be implemented as a priority.
9	Overall, vertical and horizontal integration of coastal management decision making could be improved.	An example of the recommended institutional structure for ICZM, which would improve vertical and horizontal integration, is outlined in the ICZM 2009 Report.	A key amendment to this institutional structure would be the incorporation of the representatives from the Climate Change Division (situated within the Ministry of Environment). The climate change division could provide expert input to the ICZM Executive Panel in collaboration with the ICZM Advisory Committee. Further, the ICZM Executive Panel should have representation from the Climate Change Division within the Department of Environment.	**National and Sectoral**: Establishing the integrative framework for decision making in ROM	The Climate Change Committee was originally allocated roles to improve vertical and horizontal integration; however, as the Committee is no longer operational (pers comm. July 2012) it is recommended that the ability of the Climate Change Division to fill this role be investigated. Targeted actions to build capacity of the division to meet this role could then be developed.

ID	Issue	ICZM 2009 Recommendations	Climate Change Consideration/ Recommendation	Potential Entry Points	Actions Undertaken
10	The EIA unit does not have the capacity to deliver licence applications within the curtailed timeframe of 56 to 98 days.	It is recommended that the Government of Mauritius take the necessary measures to strengthen the Environmental Assessment Division so as to enable it to perform its functions effectively.	Addressed in Report 2: *Integrating Climate Change into EIA in the Republic of Mauritius.*	**National:** providing the institutional capacity to ensure sustainable development of the coastal zone	Original recommendations (ICZM 2009) should be implemented as a priority.
Coastal Management					
11	Limited monitoring is undertaken on the implementation of sea-walls on private lands, further, there is limited monitoring of the implementation of, and compliance to, Building Land Use Plans (BLUPs)	Ministry of Environment work with the Ministry of Housing and Lands and local authorities to improve monitoring of compliance	The amendments to the draft Land Use Planning and Development Act may in part address this issue – this should be further investigated. As outlined above, ensure climate change considerations are captured within the draft Land Use Planning and Development Act as a mechanism to enable Permit and Business Monitoring Committee to evaluate permits for building and development (both in the coastal zone and more broadly).	**National**: strengthening environmental legislation and guidelines to promote sustainable management of the coastal zone.	Recommendations to integrate climate change considerations within the Planning Policy and Guidance (PPGs) have been developed. The Permit and Business Monitoring Committee may make reference to specifications within the Planning and Development Act 2004 when processing applications to ensure climate elements have been considered. However, this will only in part address the issue highlighted in the ICZM 2009 report. Capacity and enforcement will need to be further enhanced via other mechanisms.

ID	Issue	ICZM 2009 Recommendations	Climate Change Consideration/ Recommendation	Potential Entry Points	Actions Undertaken
12	Coastal zones at high risk of erosion and other coastal changes have not been systematically identified and policies for development and planning in the coastal zone adopt a blanket approach regardless of current or future sensitivity of the coastal zone	Planning authorities, i.e., DoE, MoHL, and the Fisheries Division of the Ministry of Agro-Industry, Food Production and Security should: (i) identify areas at risk from coastal erosion; (ii) set out the policies which will be applied to the location of new developments in areas at risk; (iii) refuse planning permission for development in areas at risk from coastal erosion, particularly where the potential erosion would impact on downstream users or would require expensive engineering works to protect that investment; (iv) identify the implications for development plan policies and development control decisions; and (v) outline a strategy for coastal defence. Strategic Environmental Assessment (SEA) of planned coastal development could provide decision makers with an opportunity to address coastal erosion issues, associated with sectoral plans / programmes. SEA could provide a clear framework to rank and choose amongst strategic development options.	A systematic approach should be adopted to identify at-risk areas and to subsequently develop policies for development of such areas. A national coastal climate change vulnerability assessment would be an initial step in guiding such an approach. The applicability of adopting ESAs as tool to define areas of social and ecological risk, should be investigated.	Sectoral	Building on the review of coastal relevant policy, the ability to adopt EIAs and ESAs as a tool to inform support climate change vulnerability assessment was investigated. The ESAs are useful tool for assessing EIAs and BLUPs. A national coastal vulnerability assessment is recommended to guide systematic approach to development in more vulnerable areas (refer to Section XX for further details); in combination with the investigation and promotion of vulnerability and adaptation planning tools that can be applied across scales.
13	The primary tool for coastal management is Environmental Impact Assessment. However, the EIA process does not currently incorporate a consideration of climate change as a component of the evaluation process.	NA	Update the EIA process to mainstream climate change.	**National**: Providing the policy framework and mandate to mainstream climate change into planning and development	Addressed in Report 2: *Integrating Climate Change into EIA in the Republic of Mauritius.*

ID	Issue	ICZM 2009 Recommendations	Climate Change Consideration/ Recommendation	Potential Entry Points	Actions Undertaken
14	ICZM aims to achieve sustainable development within the coastal zone. ROM has taken action to promote a sustainable approach to development. However, to date, there are limited links between the work undertaken as a component of the sustainability agenda, ie Maurice Ile Durable (MID), and the ICZM framework.	NA	Explore opportunities to integrate the action plan to be developed through MID with the work to transition towards the proposed ICZM framework.	**National:** Providing the policy framework and mandate to support mainstreaming of climate change and sustainable development	Promote investigation of links between the MID work plans (under development) and the priority activities here to enhance sustainable management of the coastal zone.
15	Preliminary action has been taken to develop coastal management plans for selected areas within ROM. Six plans were developed as a component of the ICZM 2009 report. However, the approach adopted to generate the plans did not incorporate a consideration of climate change considerations. Therefore, the actions within the plans may be prone to climate risk.	NA	There was no consideration of projected climate impacts in the elucidation of pressure zones. Therefore, it is recommended that a national climate change vulnerability assessment be undertaken (building on the work completed for the Second National Communication to the IPCC), the outputs of which would provide an additional layer of information to update the pressure areas and the associated area and action plans to ensure strategies are cognizant of climate change risks. For example, the technical details for construction of the promenade, jetty and boat ramps in Grand Baie may require amendment to ensure the infrastructure is climate proofed. Financial assistance could be sought to undertake such an assessment.	**National and Sectoral and Place-based**: Coastal management plans inform planning and decision-making across scales and are integral in achieving ICZM. Recommendations to include climate change considerations within the existing coastal plans will be vital in ensuring sustainable development despite a changing climate.	Recommendations to integrate climate change into the Coastal Management guidelines have been developed. Additional recommendations, i.e. a National Vulnerability Assessment to update existing management plans, should be the target of investment in later stages of project implementation or through alternate funding mechanisms.

ID	Issue	ICZM 2009 Recommendations	Climate Change Consideration/ Recommendation	Potential Entry Points	Actions Undertaken
16	The guidelines for coastal management as developed in the ICZM 2009 report do not take into account climate change considerations.	NA	The adoption of the guidelines for coastal design and management should be investigated - which agencies currently apply the guidelines generated through the ICZM 2009 report in their decision making. Following review, the most appropriate documentation to mainstream climate change considerations into coastal design and management will be identified, for example, BLUPs, the Guidelines for Coastal Activities. Climate change considerations should then be incorporated within this documentation. For example, building guidelines should be updated to ensure that they cater for climate change and promote sustainable development, i.e. evaluation of minimum floor height specifications.	**National and Sectoral**: Establishing the guidance material to promote a coordinated approach to sustainable management in the coastal zone. Whilst set at the National level, Sectoral Projects will adopt and apply the guidelines.	A survey of ICZM and EIA divisions indicated that the Coastal Management Guidelines are currently applied to inform approvals of individual developments. Recommendations to integrated climate change and the existing Coastal Management guidelines were developed

ID	Issue	ICZM 2009 Recommendations	Climate Change Consideration/ Recommendation	Potential Entry Points	Actions Undertaken
17	Improvements to coastal monitoring and evaluation	Development of an environmental monitoring and evaluation system using Environment Indicators for the Coastal Zone was promoted to allow a standard approach to environmental assessment and analysis (an Environmental Information System - EIS). It was noted that a majority of the information required to implement such an Environmental Monitoring System is available within ROM. It was recommended that the EIS be a repository for all EIAs and BLUP information and data, to enable tracking of the development of the coastal zone and to facilitative cumulative impact assessments	In addition to the recommendations put forward in the ICZM 2009 report, it is recommended that Environmental Indicators adopted be reviewed to ensure that they incorporate climate considerations. Chapter 40 of Agenda 21 calls on countries and the international community to develop indicators of sustainable development. Such indicators are required to increase focus on sustainable development and assist decision-makers at all levels to adopt sound national sustainable development policies (UN, 2009).	**National and Sectoral:** Spatial information and indicators to assess progress in sustainable development are valuable tools supporting integrated decision making. Ministries should collaborate to confirm existing data availability and collection processes to reduce duplication.	Linking climate change and sustainable development indicators reduces duplication of effort, helps identify linkages between the two concepts, reduces reporting burden, and increases coherence among indicator sets (Bruckner, 2009). Therefore, while the focus is on the coastal zone, indicators for climate change should be identified across the realm of sustainable development reporting. It is recommended that this activity be undertaken as a component of the MID work plans, currently under development.

ANNEX 2 Example Tools and toolkits for Climate Change Risk Screening

The information contained in this Annex is drawn from work undertaken for the United Nations Environment Program (UNEP) entitled, *Ecosystem-based Adpatation Guidance: Moving from principles to practice* (Travers et al, 2011).

The table below provides a summary of the key tools, toolkits and additional resources that can be used by ROM to assess climate change impacts in the coastal zone. . Resources relate to generic climate risk screening tools, ecosystem specific screening tools and climate scenario development tools. The introductory sections of many of these documents also provide theoretical discussions of climate change adaptation.

CLIMATE RISK SCREENING TOOLS	DESCRIPTION	WEBSITE OR REFERENCE
Assessment and Design for Adaptation to climate change – A Prototype Tool (ADAPT)	Carries out risk analysis at the planning and design stage, through a five level flag classification and proposes options to minimise risks + guides project designers to appropriate resources. The focus thus far is on agriculture, irrigation and bio-diversity	http://sdwebx.worldbank.org/climateportal/
Adaptation Wizard	5-step process to assess vulnerability to climate change and identify options to address key climate risks. Needs to take developing country context into consideration in order to be of real use for developing countries.	http://www.ukcip.org.uk/?option=com_content&task=view&id=147&Itemid=297
Climate change adaptation through integrated risk assessment (CCAIRR)	The approach constitutes of five main components: Capacity assessment and strengthening, review of knowledge data and tools, Rapid Risk Assessment, mainstreaming, and monitoring and evaluation	http://www.adb.org/Documents/Reports/Climate-Proofing/chap8.pdf
Climate change and Environmental Degradation Risk and Adaptation assessment (CEDRA)	The tool assists to prioritise which environmental hazards may pose a risk to existing project locations and supports the decisions to adapt projects or start new ones	http://tilz.tearfund.org/Topics/Environmental+Sustainability/CEDRA.htm
Climate-FIRST (Climate Framework Integrating Risk screening tool)	Climate risks screening software tool for rapid assessment of projects/programmes risk potential	Not yet available
Climate Risk Impacts on Sectors and	Structuring framework developed for the portfolio screening of DFID activities in Kenya. Assesses climate impacts at the sector level	http://www.dewpoint.org.uk/Article.Aspx?ArticleID=901

CLIMATE RISK SCREENING TOOLS	DESCRIPTION	WEBSITE OR REFERENCE
Programmes (CRISP)		
Climate Proofing for Development	The tool enables an analysis of policies, projects and programmes and identifies risks and opportunities posed by climate change, and helps to identify measures to tackle these changes	http://www.gtz.de/en/themen/29037.htm
The Community base Risk Screening tool – Adaptation and Livelihoods (CRiSTAL)	User-friendly conceptual framework aimed at raising awareness on climate change adaptation and facilitate the identification and organisation of an adaptation strategy	http://www.cristaltool.org/
Climate Vulnerability and Capacity Analysis (CVCA)	The methodology provides a framework for analysing vulnerability and capacity to adapt to climate change at the community level	http://www.careclimatechange.org/index.php?option=com_content&view=article&id=25&Itemid=30
Designing Climate Change Adaptation Initiatives: A Toolkit for Practitioners	The toolkit aims to provide support for developing countries to move to low emission climate resilience growth paths while mobilizing financial resources to scale-up good practices with sufficient speed and where most needed	http://www.undp-adaptation.org/projects/websites/docs/KM/PublicationsResMaterials/UNDP_Adaptation_Toolkit_FINAL_5-28-2010.pdf
CoastCLIM and SimCLIM	SimCLIM is an “open-framework” modelling system that can be customised, maintained and applied by users for the purpose of examining impacts and adaptations to climate variability and change, including extreme climatic events	http://www.climsystems.com/simclim/
NOAA CSC Roadmap	The Roadmap for Adapting to Coastal Risk is a participatory process for assessing a community’s vulnerability to hazards—and for incorporating relevant data and information about hazards and climate into ongoing local planning and decision-making.	http://www.csc.noaa.gov/digitalcoast/training/roadmap/index.html
Reef Resilience Toolkit	The toolkit (developed by TNC) provides guidance on how to integrate and build the principles of resilience to climate change into the design of MPAs and daily management activities. The toolkit includes guidance on management strategies such as conserving fish spawning aggregations, MPA network design, and developing coral reef monitoring programs	http://www.reefresilience.org/Toolkit.html
WEAP - Water Evaluation and Planning system	WEAP operates on the basic principle of a water balance and can be applied to municipal and agricultural systems, a single watershed or complex transboundary river basin systems. Moreover, WEAP can simulate a broad range of natural and engineered components of these systems, including rainfall runoff, baseflow, and groundwater recharge from precipitation; sectoral demand analyses; water conservation; water rights and allocation priorities, reservoir operations; hydropower generation;	http://www.weap21.org/

CLIMATE RISK SCREENING TOOLS	DESCRIPTION	WEBSITE OR REFERENCE
	pollution tracking and water quality; vulnerability assessments; and ecosystem requirements. A financial analysis module also allows the user to investigate cost-benefit comparisons for projects	
UNDP CapNet: IWRM as a Tool for Adaptation to Climate Change: Training Manual and Facilitator's Guide	Training material providing introduction to IWRM as an instrument for adaptation to climate change. Also provides links to national-level resource centers that provide education, training, research and consultancy services in the field of water.	http://www.cap-net.org/
ClimateWizard	The ClimateWizard is an online tool developed by The Nature Conservancy designed to provide instant national level projections for temperature and precipitation for a range of SRES emission scenarios	http://www.climatewizard.org/
Pacific Climate Futures Tool	The Pacific Climate Futures web tool is designed to provide projections for 10 different climate variables for 15 countries across the Pacific	http://www.pacificclimatefutures.net/
Temporal and Spatial Analogues	Involves the construction of temporal or spatial analogues using historic climate data. The data used as temporal and spatial analogues is either from the past or from another location.	http://content.undp.org/go/cms-service/download/publication/?version=live&id=3259633
PRECIS	PRECIS (Providing Regional Climates for Impacts Studies) provides high-resolution regional climate projections. A typical PRECIS experiment can take several months hence the system is not designed to provide instant climate scenarios. Workshops and training are regularly conducted through institutions around the globe in developing nations	http://www.metoffice.gov.uk/precis/
MAGICC/SCENGEN	MAGICC/SCENGEN is a coupled software package that allows users to investigate future climate change and its uncertainties and the global-mean and regional levels. MAGICC calculates energy balances whereas SCENGEN effectively presents the results of MAGICC to produce spatially detailed information on future changes in key climate variables	http://www.cgd.ucar.edu/cas/wigley/magicc/
Statistical DownScaling Model (SDSM)	SDSM is a software tool designed to implement statistical downscaling methods to produce high-res monthly climate information from GCM simulation	http://co-public.lboro.ac.uk/cocwd/SDSM/

Further Information

Adaptation Assessment planning and practice (http://unfccc.int/files/adaptation/nairobi_work_programme/knowledge_resources_and_publications/application/pdf/an_overview_from_the_nairobi_work_programme_on_impacts,_vulnerability_and_adaptation_to_climate_change.pdf)

More publications on adaptation can be found at:

http://unfccc.int/adaptation/items/4159.php

This table provides links to a number of projects/applications of the climate risk screening tools outlined in the previous table (adapted from Traerup and Olhoff, 2011).

Tool / Resource	Project / Application	Link / Reference
Strategic Planning		
Screening Matrix	Climate Change Screening of Danish Development Cooperation with Bhutan	http://www.danidadevforum.um.dk/en/menu/Topics/ClimateChange/ClimateAndDevelopment/ToolsAndReferences
Climate change adaptation through integrated risk assessment (CCAIRR)	Climate Proofing Sapwohn, a Coastal Community in Pohnpei, Federated States of Micronesia	http://www.adb.org/Documents/Reports/Climate-Proofing/chap6.pdf
	Climate Proofing the National Strategic Development Plans in the Cook Islands	http://www.adb.org/Documents/Reports/Climate-Proofing/chap6.pdf
	Climate Proofing Avatiu-Ruatonga, a community inland from Avatiu Harbour, Cook Islands	http://www.adb.org/Documents/Reports/Climate-Proofing/chap6.pdf
Climate Risk Impacts on Sectors and Programmes (CRISP)	Kenya: Climate Screening and Information Exchange	http://www.dewpoint.org.uk/Article.Aspx?ArticleID=901
Capacity Building		
CRiSTAL	C3D+ (Capacity Development for Adaptation to Climate Change and GHG Mitigation and Non Annex I Countries)	http://www.c3d-unitar.org/?q=node/11
	Integrating climate risk management into the Karonga District Development Planning System	http://www.ccdare.org
Agriculture		
CRiSTAL	Climate Change Vulnerable Communities and Adaptation – Central America, Nicaragua	http://www.iisd.org/pdf/2006/security_field_test_nicaragua.pdf
Climate Proofing for Development (GIZ)	Climate Proofing in Sustainable Land Management Projects - Mali	http://www.conservation-development.net/Projekte/Nachhaltigkeit/CD2/Klima/Links/PDF/10-03-27_Presentation_CP_and_PA.pdf
Local Development		
CRiSTAL	Climate Change Vulnerable Communities and Adaptation - Tanzania	http://www.iisd.org/pdf/2006/security_field_test_tanzania.pdf

Tool / Resource	Project / Application	Link / Reference
CliDR	Climate Risks and Development Project - Haiti	http://www.iisd.org/cristaltool/experiences.aspx
Climate Vulnerability and Capacity Analysis (CVCA)	Community Land Use Response to Climate Change (CLURCC)	http://www.comminit.com/en/node/321503
Forest and Natural Resources		
CRiSTAL	Climate change and development project - Zambia	http://cmsdata.iucn.org/downloads/climate_change_vulnerability_assessment_zambia.pdf
Climate Proofing for Development (GIZ)	Protected Area Management and Nature Conservation, and Desertification Control	http://www.conservation-development.net/Projekte/Nachhaltigkeit/CD2/Klima/Links/PDF/10-03-27_Presentation_CP_and_PA.pdf
Water Resources		
CRiSTAL	Climate Change Vulnerability Assessment - Kenya	http://www.iisd.org/cristaltool/experiences.aspx
ORCHID	Screening for Climate Change Adaptation in China	http://www.ids.ac.uk/go/idsproject/screening-for-climate-change-adaptation-in-china
Coastal Zone		
CRiSTAL	Livelihoods and Climate Change – Sri Lank	http://www.iisd.org/pdf/2006/security_field_test_srilanka.pdf
Reef Resilience Toolkit	Protecting marine processes, ecosystems and biological and genetic diversity in the Aldabra Atoll - Seychelles	http://www.reefresilience.org/Toolkit_Coral/C8_Aldabra.html
	Various other case studies	http://www.reefresilience.org/Case_Studies.html

Annex 3: Taxonomy of climate change integration within acts, policies and plans that guide coastal management in the ROM

A four-category taxonomy for climate change integration was established and applied to review acts, policies, plans and strategies in place, of relevance to coastal zone management in ROM. The taxonomy was created based on the understanding that not all policy documents require direct reference to climate change. However, climate change is a cross-cutting issue, that effects all sectors. Therefore, the categorisation was established to determine the 'type' of integration required.

Category 1: Decisions made under the act or regulation should be cognisant of climate change; however, direct integration of the climate change specific recommendations is not required.

Where relevant, specific decision points that should be cognisant of climate change are highlighted. However, more generally, all decisions made under the act, strategy or plan should be cognisant of climate change. To support climate cognisant decision making, it is vital to generate an information depository and detailed communication strategy to deliver climate related information that will support decision making across sectors. Projections for change in climate and anticipated impacts of key sectors of ROM have been identified through the Second National Communication to the UNFCCC. In addition, the food security strategic plan 2008-11 and the national stocktaking and stakeholder consultation for climate change, undertaken in 2006, provide a foundation from which to build such an information repository. The stocktaking and stakeholder consultation on climate activities provides an overview of projected vulnerabilities for a range of sectors, including forestry, health, agriculture and water resources. Further, the outputs of the Environmentally Sensitive Areas consultancy (such as maps indicating areas vulnerable to sea-level rise inundation, change in sea surface temperatures and the location of environmentally sensitive areas) are a valuable information source for decision-makers. Members of the Climate Change Unit should be engaged in supporting cross-sectoral decisions, providing a climate lens to discussions across sectors, where relevant.

Category 2: Policies, strategies or plans referenced within the document should have climate change directly integrated; however, direct integration of the climate change considerations within the Act, Policy or Strategy itself, is not required. And Category 3: Direct integration of climate change is required.

The elements within acts, strategies and plans assigned to category 2, and those documents assigned to category 3, were evaluated to integrate climate change. A number of Acts critical to management of the coastal zone do not incorporate climate change, including, but are not limited to; the Maritime Zone Act 2005, Local Government Act 2003, Tourism Authority Act, Planning and Development Act 2004, Fisheries and Marine Resources Act 2007. With the exception of the Energy Efficiency Act, documents that incorporate climate change are predominantly policies and medium to long-term strategies. The *Long-Term Energy Strategy 2009-2025* outlines renewable energy generation targets, while the *Industrial & SME Strategic Plan 2010-2013* emphasises the need to mitigate the impact of climate change to sustain a 'green' Mauritius (ROM 2010).

With regard to development of the coastal zone, two documents make explicit connection between climate change and planning. Firstly the *National Development Strategy 2003* focuses on 'encouraging economic growth in the conurbation, the countryside and the coast, whilst maintaining and enhancing the quality of the environment and striving for a more

sustainable pattern of development' (Muelex 2008). More broadly the strategy aims to clearly delineate areas of coastal development and urban growth in order to better manage zoning. Secondly, the Maurice Ile Durable project (MID), initiated in 2008, articulates a long-term vision for sustainable development in Mauritius. A series of Working Groups (e.g. Energy, Preservation of Biodiversity and Natural Resources) have made recommendations relevant to coastal management. For example, Working Group 2 (Preservation of Biodiversity and Natural Resources) have recommended that ROM develop a national Climate Change Adaptation Plan and strengthen monitoring of coastal developments to ensure strict compliance with EIA licensing, planning guidelines and other national strategies (MID 2011a). Working Group 1 (Energy) recommends that minimum energy performance standards for equipment be enforced and that existing policies and regulations be made stricter for new developments (MID 2011b). While it is unclear at this point whether the outputs of the MID Working Groups will be legislated or implemented, the ideas and visions being formulated may prove highly beneficial for sustainable development in ROM.

In addition, ROM holds a number of documents with a more specific focus on land use planning and development. For example, the Planning Policy Guidance (PPG), which was formally issued to local authorities in 2006, forms a key role in managing development in Mauritius. The PPGs cover four areas of development (Commercial, Industrial, Residential and Hotels and Resorts), and outline the physical characteristics and constraints of proposed developments that proponents must abide by (e.g. design, building materials, setbacks). Secondly, the Building Land Use and Planning (BLUP) Guideline, and the accompanying BLUP permit, is similar in that proponents are instructed to follow a prescribed approach to the development of structures and settlements. Finally, Development Plans also play a significant role in dictating how the urban form is controlled (e.g. zoning) at different scales[10].

Draft legislation such as the *Land Use Planning and Development Bill 2009* may alter the development approval and planning process at various scales. Most notably, the Bill will repeal and replace the Town and Country Planning Act 1982 and the Planning and Development Act 2004, with the broad aim of streamlining ROM's planning framework (LUPD 2009).

More broadly, findings indicate that while ROM has a number of documents that guide coastal zone management, they currently lack integration of climate change considerations required to manage the coastal zone effectively.

Category 4: Climate Change is already integrated.

There are a number of national documents that contain climate change considertaions. These documents are listed under Category 4.

[10] Local, Action Areas, and Subject Plans are outlined in the Planning and Development Act 2004.

Table 14: Taxonomy of climate change integration within acts, policies and plans that guide coastal management in the ROM.

Category 1: Acts and regulations where decisions made should be cognisant of climate change. Direct Integration of climate change is not required.	
ACT TITLE	**DESCRIPTION / DECISION POINTS RELEVANT TO CLIMATE CHANGE** Note: NS indicates that there is no specific decision point identified that links to climate change adaptation; however, decision making under the Act should be cognisant of existing and future climate risks
State Land Act 1982	NS
Fisherman Welfare Fund Act 2000	NS
Continental Shelf Act 1970	NS
Plant Protection Act 2006	NS
Non Sugar Sector Strategic plan 2003-2007	NS
Aquatic Business Activities Act 2007	Provision of leases (Section 6) and marked off areas (Section 7)
Maritime Zones Act 2005	Use of waters (Section 6-11)
National Coast Guard Act 1988	NS
Ports Act 1998	Section 27 and Section 30
Fisheries and Marine Resources Act 2007	Section 4: Allocation of Marine Protected Areas Section, 34-38: Allocation of licences Section 57: Implementation of international fishery and conservation and management measures (enforcement)
Pas Geometriques Act 1982	Conditions to safeguard Pas Geometriques. For example, Section 3: The breadth of the Pas Geometriques (currently 81.21 metres) Use of Pas Geometriques: Section 7: Grant leases Section 8: Lessee to plant trees Section 10: Leases of small portions Section 13: Permission to cut trees Section 20: Lease for coconut plantations
Tourism Authority Act 2006	Assignment of tourist activities and areas (safety, health and environmental concerns)
Tourism Authority Act 2008	
Mauritius Standard Bureau Act 1993	NS
Local Government Act 2003	Section 73-77: Acquirement of land and buildings Section 75: Power to acquire, sell or exchange land and buildings Section 97-112: Permits and licenses
Beach Authority Act 2002	Section 5 - all beach works
Merchant Shipping Act 2006	NS
Central Water Authority Act 1971	NS
River and Canals Act 1863, including 1968 amendment	Water withdrawal;
Fishermen Investment Trust Bill 2006	Section 4 (h) and (i)
Forest and Reserve Acts 1983	Section 3 and 3A; Control of access to land. Section 8: Removal of trees and brushwood Section 9: Planting of reserves Section 11: Destruction of trees in unsurveyed forest
Removal of Sand Act 1982	Section 9: Provision of sand removal permits
Ground Water Act 1970	Section 4: License to abstract ground water Section 5: Applications for licences
Morcellement Act 1990	NS
Investment Promotion Act 2000	NS
National Parks and Reserve Regulations 1996	Not available for review

Category 2: Policies, strategies of plans referenced within the document should have climate change directly integrated. Direct integration of the term 'climate change' within the Act, Policy or Strategy itself is not required.

ACT TITLE	ELEMENTS WITHIN DOCUMENT FOR CLIMATE CHANGE INTEGRATION
Business Facilitation Act 2006	BLUP
Town and Country Planning Act 1982	Outline Schemes (Although the new Draft Land Use Planning and Development Bill will repeal this act if passed)
Planning and Development Act 2004	Section 12: National Development Strategy Section 13: PPG Section 14: Development Plans
Local Government Act 2011	General policy guidelines; BLUP
Wildlife and National Parks Act 1993	Part IV: Section 12(2): Buffer zones for reserved land Section 13(a): Management plans for reserved land – contains information regarding buffer zones, objectives and prescriptions for the management of the subject land. Potential to include climate change considerations into management plan (e.g. prescribed objectives).
Revamping the Hotel Development Strategy	Planning Policy Guidance (PPG) – which outline conditions for new developments, such as Set-backs, building height etc.

Category 3: Direct integration of climate change is required

ACT TITLE	SECTION OF DOCUMENT FOR DIRECT INTEGRATION
Building and Land Use Permit (BLUP) Guide	Sections/Steps: Before submitting an application (site considerations) Step 2(A) – Location / Context Plan Step 2(B) – Site Analysis Plan Step 2(G) - Design Process
Planning and Development Act 2004	Section 14 (3) Makes reference to the role of the Minister but also provides an opportunity to ensure plans are developed cognisant of future conditions. Section 15(2) Ensure development plan is based on assessment of future climate risks associated with climate change Section 20 (3): The criteria applied during review and revision of the development plans should ensure climate change has been considered in the plan development
Planning Policy Guidance 2004	Planning Policy Guidance (effective since 2004): (proponents to follow these guidelines as per EIA process - EPA 2002) The guidance contains a range of performance criteria against which development proposals are designed, assessed and permits issued. It has the status of a National Planning instrument and constitutes a material consideration during appeals.

Category 4: Climate change is already integrated	
ACT TITLE	**COMMENTS IN ADDITION TO EXISTING CC INTEGRATION**
Energy Efficiency Act 2006	Establish links to the PER and EIA process, so that energy efficient criteria can inform developments within Mauritius.
National Environmental Policy 2007	NR
Strategic budgeting in the Government of Mauritius April 2009- December 2011	NR
Long-term Energy Strategy 2009-2025	NR
Industrial & SME Strategic Plan 2010-2013	NR
DRAFT MID Policy and Strategy	No additional comments. Rather, should be noted that a number of the recommendations outlined within the Energy, Environment (preservation of biodiversity and Natural Resources); Environment; and Employment and Economy will be integral in supporting the inclusion of climate change considerations into decision-making within the ROM.

Annex 4: Draft LUDP Overview

Issue	Details / Relation to existing legislation
Outline Schemes	Outline Schemes are not included in the draft bill. Under the Town and Country Planning Act 1982, Outline Schemes are a land management tool used to communicate plans and associated criteria for all aspects of development (e.g. roads, buildings, public utilities, transport and communication). Under the LUPD 2009 the *Development Plans* (3 types: Local, Area and Subject) fulfil the function of Outline Schemes. Development Plans are defined as a 'set out the policies, programmes and proposals for the future direction of development'. Since Local Development Plans are the responsibility of the Local Authority, as opposed to a Town and Country Planning Board, additional work may put pressure on their capacity to complete existing tasks. See Sections 14, 64 and the First Schedule of LUPD 2009 for more detail. Note: the Planning and Development Act (2004) makes reference the same *Development Plan* system. LUPD 2009 also makes reference to an 'Outline Planning Permission' – 'permission for the development of land sought from a local authority at an early stage and irrespective of whether a Building and Land Use Permit is to be granted or not and before any substantial costs are incurred in relation to the development of the land.' See Section 32 of LUPD 2009. **Legislation reviewed for comparison:** Town and Country Planning Act 1982, Planning and Development Act 2004, Local Government Act 2003
Planning Policy Guidance	The newly created Department of Land Use Planning and Development (DLPD) would be responsible for developing Planning Policy Guidance (which outlines, *inter alia*, the form, scale, intensity, built form, location and general development criteria for different classes of development). See Section 14 of LUPD 2009. Planning Policy Guidance is currently prepared by the Ministry of Environment and National Development Unit and issued to local authorities by the minister to whom the subject of planning matters is assigned. **Legislation reviewed for comparison:** Planning and Development Act 2004
Enforcement	More power granted to the Local Authority with regard to enforcement of development permits - stopping development or ordering cease of use order on a premise/owner. E.g. Stop Development Order. See Section 46(1) of LUPD 2009. **Legislation reviewed for comparison:** Town and Country Planning Act 1982
Compliance	Newly developed 'Compliance certificate' which owners would require prior to occupying or using a development. No equivalent tool is contained within Town and Country Planning Act or Planning and Development Act. These certificates are assessed and approved by the Local Authority. This tool may provide an opportunity to ensure compliance with EIA as well as BLUP. See Section 44(1) of LUPD 2009. **Legislation reviewed for comparison:** Town and Country Planning Act 1982

Annex 5: Example Coastal Processes Setback Calculation

This following body of text has been extracted from the *State Coastal Planning Policy No. 2.6*, developed by the Western Australian Planning Commission (WAPC 2003, pg. 2069-70). This guidance provides coastal planners with a method for calculating setbacks based on various physical processes.

Factors To Be Considered in Calculating Coastal Processes Setback

Each of the factors listed below is to be considered in calculating a setback to protect development from physical processes on the coast. The development setback for coastal processes will be the sum of the distances calculated for each of these independent factors. The value given for each factor has been based upon the best available data, a conservative estimate of that factor and includes allowance for uncertainty. Nonetheless, it is important to note that these values, particularly those for sea level change, are based upon an imperfect knowledge of the underlying physical processes. As knowledge improves, the WAPC in consultation with and agreement of the Department for Planning and Infrastructure (DPI) will update the values. More detail and or advice on the factors and the models used to calculate the value given for each factor can be obtained from the Senior Coastal Engineer, Asset Management Directorate of the DPI.

(S1) Distance For Absorbing Acute Erosion (Extreme Storm Sequence)

This distance requires the modelling of the impact of a sequence of storms on the shore at the development site. The use of models such as SBEACH is acceptable. In order to determine the storm sequence of 100-year recurrence, the model should be run with three successive runs of the recorded storm agreed by the WAPC and the DPI. Details of this storm are available from DPI. S1 shall be the total recession of the mean sea level contour.In the absence of modelling, such as when data is unavailable, the default value of S1 shall be ***40 metres****, based on modelling of a typical exposed sandy shore.*

(S2) Distance to Allow For Historic Trend (Chronic Erosion or Accretion)

The chronic erosion setback allowance S2 should be calculated as 100 times the assessed present longer-term annual rate of erosion. The assessment should be based on monitoring of shoreline movement over at least a 40-year term, preferably longer, with the position of the HSD being determined at about five-year intervals. On a relatively stable shore the minimum value of S2 should be a 'safety' allowance of ***20 metres****, except where there is evidence that chronic accretion in excess of that distance has been identified for the 100-year forward planning term when the value for S2 will be 0 metres.*

(S3) Distance to Allow for Sea Level Change

The setback to allow for sea level rise is based on the mean of the median model of the latest Assessment Report of the IPCC Working Group (currently, the Third Assessment Report of the Intergovernmental Panel on Climate Change Working Group, January 2001). The vertical change predicted by the current model between the years of 2000 and 2100 is 0.38 metres. A multiplier of 100, based on the Bruun Rule shall be used and gives a value for S3 = 38 metres for sandy shores. For other shore types, S3 shall be assessed in regard to local geography.

Example - Coastal Processes Setback Calculation

The sum of distances for S1, S2 and S3 provides the minimum setback distance, from the HSD, to allow for the protection of development from physical processes on exposed sandy shorelines in a given location. The recommended minimum values for each factor, as described in Section D, are based upon conservative estimates and include allowance for uncertainty. The practical application of these calculations is shown below.

Example 1: Development on an Undeveloped Sandy Shore With either No Clearly Defined Historical Evidence of Chronic Erosion or Accretion or An Established Historical Rate of Chronic Erosion or Accretion of Less Than 20m Per 100 Years.

Component for acute erosion	*S1 (40m) +*
Component for historic trend (minimum)	*S2 (20m) +*
Component for sea level rise	*S3 (38m) +*

Setback minimum from HSD of 98m

Example 2: Development on an Undeveloped Sandy Shore With an Established Historical Rate of Chronic Accretion Above 20m Per 100 Years.

Component for acute erosion	*S1 (40m) +*
Component for historic trend (accretion)	*S2 (0m) +*
Component for sea level rise	*S3 (38m) +*

Setback minimum from HSD of ***78m***

Example 3: Development on an Undeveloped Sandy Shore With an Established Historical Rate of Chronic Erosion Above 20m Per 100 Years.

Component for acute erosion	*S1 (40m) +*
Component for historic trend (erosion)	*S2 (Xm)** +*
Component for sea level rise	*S3 (38m) +*

Setback minimum from HSD of 78+Xm

*** Where X equals 100 times the predicted annual level of erosion based on an assessment of historical change (as defined in Section D.2 of this Schedule) applied to conditions pertaining at the present time and is a value of greater than 20m.*

Annex 6: Utilising Existing Tools to Integrate Climate Change

Existing standards available from the ROM Stanadards Bureau may guide coastal zone management. The following table outlines standards that may be leveraged (Mauritius Standards Bureau 2012) when developing guidance material for climate risk management.

Table 15: Standards that are applicable to the coastal zone.

ID	Title	Purpose
MS ISO 26000: 2010	Guidance to social responsibility	This standard is intended to assist organizations in contributing to sustainable development. It is intended to encourage them to go beyond legal compliance, recognizing that compliance with law is a fundamental duty of any organization and an essential part of their social responsibility.
MS ISO 31000:2009	Risk management -- Principles and guidelines	Provides principles and generic guidelines on risk management. It can be used by any public, private or community enterprise, association, group or individuals and can be applied to any type of risk.
MS ISO 31010:2009	Risk management -- Risk assessment techniques	Provides guidance on selection and application of systematic techniques for risk assessment. It introduces a range of techniques with references to International Standards where the concept and application are described in detail.
MS ISO 14001:2004	Environmental management systems – Specification with guidance for use	Specifies requirements for an environmental management system, to enable an organization for formulate a policy and objectives taking into account legal requirements and other requirements to which the organization subscribes and information about significant environmental impacts.
MS ISO 14004:2004	Environmental management systems – General guidelines on principles, systems and support techniques	Provides guidance on the establishment, implementation, maintenance and improvement of an environmental management systems and its coordination with other management systems.
MS ISO 14006:2011	Environmental management systems -- Guidelines for incorporating eco-design	This standard provides guidelines to assist organizations in establishing, documenting, implementing, maintaining and continually improving their management of eco-design as part of an environmental management system (EMS).

ID	Title	Purpose
MS ISO 14015:2001	Environmental management – Environmental assessment of sites and organizations (EASO)	Provides guidance on how to conduct an EASO through a systematic process of identifying environmental aspects and environmental issues and determining, if appropriate, their business consequences.
MS ISO 14031:1999	Environmental management- Environmental performance evaluation – Guidelines	Gives guidance on the design and use of environmental performance evaluation within an organization. It is applicable to all organizations, regardless of type, size, location and complexity.