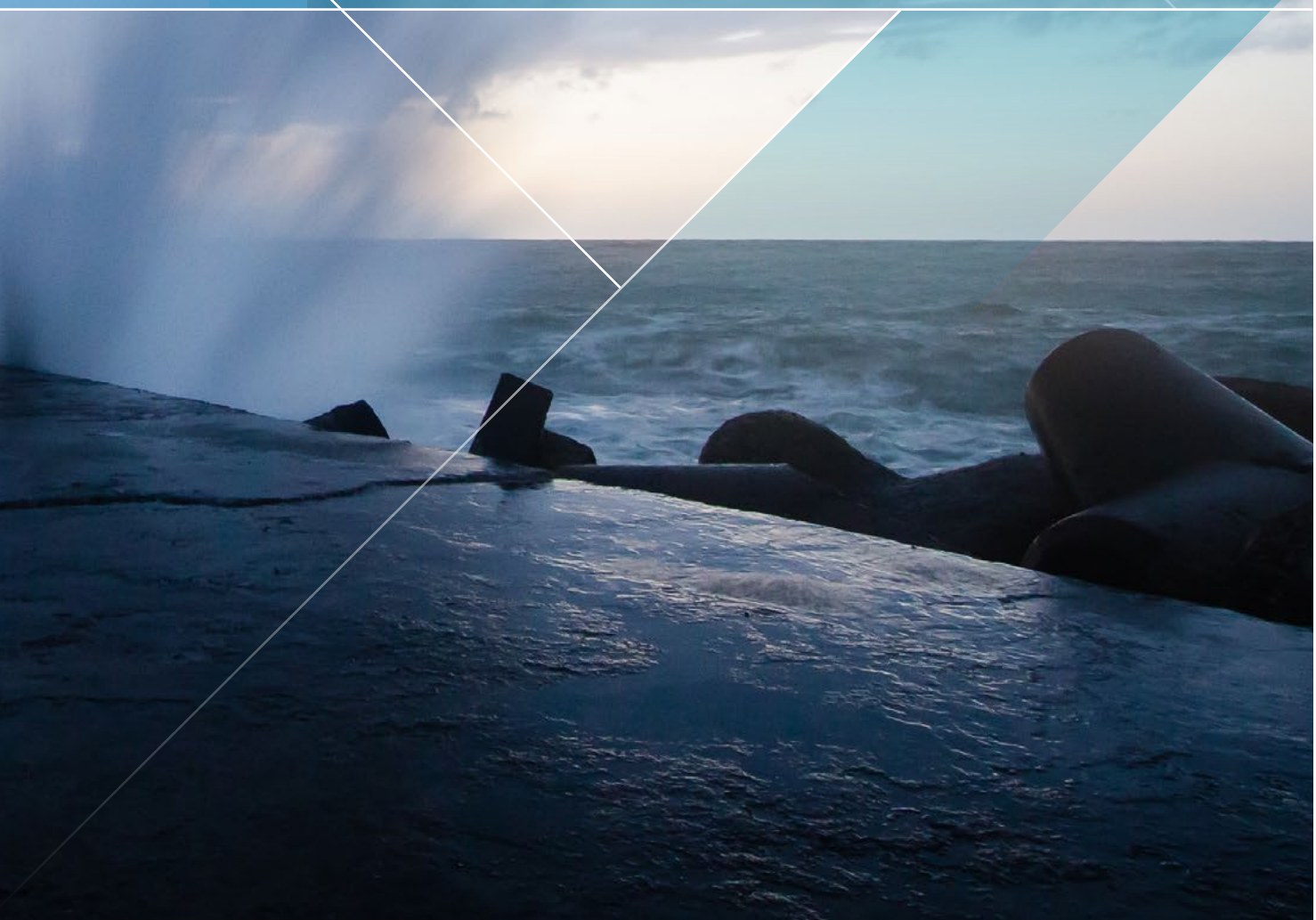
Climate Change Adaptation
Good Practice - Case Study

Developing Flexible Adaptation Pathways for the Peron Naturaliste Coastal Region of Western Australia 2011 – 2012



About Adaptation Good Practice

Adapting to climate change is a relatively new concept to many. It is important to learn from practitioners who are undertaking adaptation activities that are beginning to have tangible outcomes. Documenting examples of good practice and identifying the criteria that makes them work, enables those interested in adaptation to learn about how to take action.

There are expectations that Adaptation Good Practice (AGP) includes a definite start and finish to a project. However climate change practitioners' experiences show that adaptation projects are often steps in longer learning journeys. There are no golden rules on how to adapt and often practitioners across Australia are inventing the wheel that drives future AGP.

This case study of local governments collaborating to undertake a project, 'Developing Flexible Adaptation Pathways for the Peron Naturaliste Coastal Region of Western Australia 2011 – 2012', is part of a series of 16 case studies that recognise exemplars for AGP in Australia. Through the development of these stories of successful adaptation it was refreshing to see an emergence of similar experiences and challenges regardless of the project or location. A synthesis of these stories can be seen in the Synthesis Report, 'Climate Change Adaptation Good Practice: Key lessons from practitioners experiences' which will help practitioners to understand that they are not alone in their challenges and to see some of the clear lessons learned about what drives good practice in adaptation.

Following the Snapshot there is a more in depth narrative of the experiences, learnings and network links to stimulate further engagements and knowledge sharing among the growing community of adaptation practitioners.

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Acknowledgements : Ailbhe Travers, Matt Eliot, Joanne Ludbrook and Craig Perry are gratefully acknowledged for their input to this case study.

References: **1.** Kay R, Eliot I & Klem G. (1992) *Analysis of the IPCC Sea-level Rise Vulnerability Assessment Methodology using Geographe Bay, SW Western Australia as a Case Study*; a report from Coastal Risk Management to the Department of Sports, Arts, the Environment and Territories. **2.** Department of Environment, Sport and Territories. (1995) *Australian Coastal Vulnerability Assessment Case Studies*. **3.** Kay RC, Eliot I, Caton B, Morvell G & Waterman P (1996) A review of the Intergovernmental panel on Climate Change's Common Methodology for assessing the vulnerability of coastal areas to sea-level rise. *Coastal Management*, 24: 165-188. **4.** Jones A. (2005) Potential coastal erosion of the Swan Coastal Plain due to long term sea level rise. Chapter 7 in: Jones A, Middelmann M & Corby N. (Eds) *Natural hazard risk in Perth, WA, Geoscience Australia*. **5.** Department of Climate Change (2009) *Climate Change Risks to the Australian Coast. A first-pass national assessment*. Department of Climate Change, Australian Government. **6.** Cowell P & Barry S. (2012) *Coastal recession risk in the Busselton-Rockingham coastal cell due to climate change*. University of Sydney draft report to Geoscience Australia. **7.** Fountain L, Sexton J, Habili N, Hazlewood M & Anderson H. (2010) *Storm surge modelling for Bunbury, Western Australia*. In-confidence professional opinion 2010/04, Geoscience Australia. **8.** Booth, P, and Cox, RJ, (2012) 'Final Stage 1 Report: Case Studies of Climate Change Adaptation Tools and Application Processes used by Local Government Practitioners'. Research and evaluation conducted in collaboration with the Australian Local Government Association (ALGA) and State and Territory counterparts. Publicly available from the ACCARNSI website http://www.nccarf.edu.au/settlements-infrastructure/. **9.** Steele, W, and Burton, P, (2010) 'Adaptive governance and climate change: the challenge for cities.' Presentation to the Climate Change Adaptation and Governance Workshop convened by the institute for Environmental Studies and NCCARF Adaptation Research Network for Social, Economic and institutional Dimension, UNSW, Sydney, 16-18 November 2010.

Case study snapshot

Developing Flexible Adaptation Pathways for the Peron Naturaliste Coastal Region of Western Australia 2011 – 2012

The Peron Naturaliste Partnership (PNP) is a collaboration of nine local governments (Bunbury, Busselton, Capel, Dardanup, Harvey, Mandurah, Murray, Rockingham and Waroona) between Cape Peron and Cape Naturaliste in the southwest of Western Australia. The overall objective of the PNP is to provide a regional mechanism to facilitate effective and timely adaptation responses to climate change. The Partnership recognises the potential vulnerability of this coastline to the impacts of a changing climate in its vision statement to "empower a resilient regional community to reduce risks and optimise opportunities presented by climate change."

Building on previous work undertaken in the region, the PNP, with the support of the Western Australian State Government, undertook an economic-based analysis of coastal climate change adaptation options for the PNP region. The project was largely funded through the Australian Government's Coastal Adaptation Pathways Program (CAP) and was executed between mid 2011 and late 2012.

This collaborative project has explored flexible current and future adaptation options for the nine coastal Councils in the Peron Naturaliste Partnership (PNP). The project has identified that within a time-frame extending to 2100, the region faces these key issues:

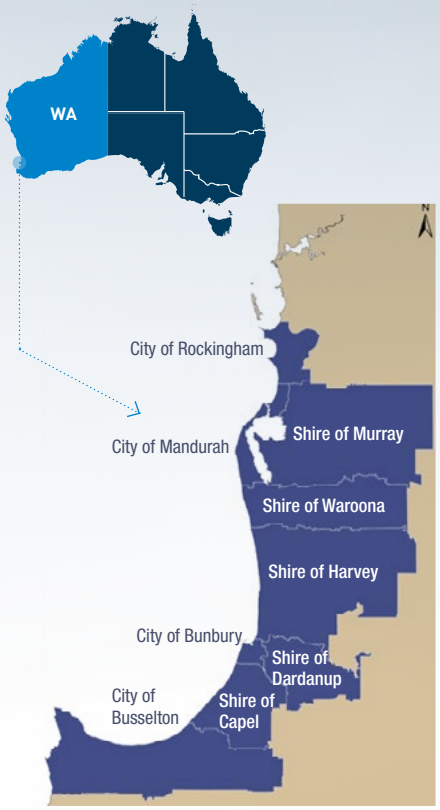
- Erosion is a far more pervasive issue than flooding;
- 800 hectares of residential land would be subject to increased flooding risk;
- Close to a 200 m wide strip along the whole extent of the coastline is at risk from erosion;
- The value of the affected assets at risk along this section of coastline is approximately $1.2 billion, and $1.1 billion of assets are worth saving, at a cost of around $120 million;
- Ownership of coastal protection assets need to be clarified; and
- There is a need to request funding to address limitations highlighted in report.

The project journey

A key strength of the Peron Naturaliste Partnership (PNP) was the teamwork among the nine member Councils in this project. They shared a clear vision to build capacity for coastal climate change adaptation through the region and to work collaboratively, sharing knowledge and resources to achieve this vision.

From the wisdom of hindsight, the scope of the work undertaken was overly ambitious for the life of a single project executed between mid 2011 and late 2012. This was largely due to the considerable difficulties experienced in trying to 'downscale' regional hazard data to interpret local coastal change. These difficulties were unforseen given this is an emerging field of enquiry with few documented examples using similar methodologies.

The PNP is already building on the work already undertaken, with new geo-technical studies and investigations to take place over 12-month period to improve the understanding of coastal processes and risks. In moving forward, the PNP has started the community engagement phase of the project, with the Communication Strategy 2013-2015 and Pilot Community Engagement Strategy 2013-2015 now in place.



Source: PNP

Figure 1: The coastal zone between Cape Peron and Cape Naturaliste in the southwest of Western Australia including the local governments of Bunbury, Busselton, Capel, Dardanup, Harvey, Murray, Rockingham, Waroona and Mandurah approximately 400 km long.

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→ Adaptation action

This case study highlights the trade-offs between providing a robust, prescriptive project methodology at the initial funding stage versus exploring an emerging pathway that enables project partners to achieve intended project outcomes. This is difficult because often good practice only becomes apparent during project implementation.

The key aim of this project was to develop a scientifically rigorous, adaptive framework with an economic basis for deciding adaptation options in the Peron Naturaliste coastal region. The project identified flexible adaptation options to mitigate adverse impacts of climate change, particularly threats of coastal inundation or erosion associated with sea level rise.

Drivers for adaptation action

Previous studies identified the region as highly susceptible to the potential impacts of erosion and coastal inundation due to climate change. This prompted Local, State and Australian Government agencies to undertake a detailed 'second pass' study, as a targeted area for the National Coastal Vulnerability Assessment.

Risks and impacts addressed

Impact of sea level rise storm events and riverine flooding to 2100.

Outcomes achieved

Phase 1 regional hazard assessment incorporated erosion into hazard modelling, identified 'hot spots' at risk and confirmed case study sites for Phases 2 and 3.

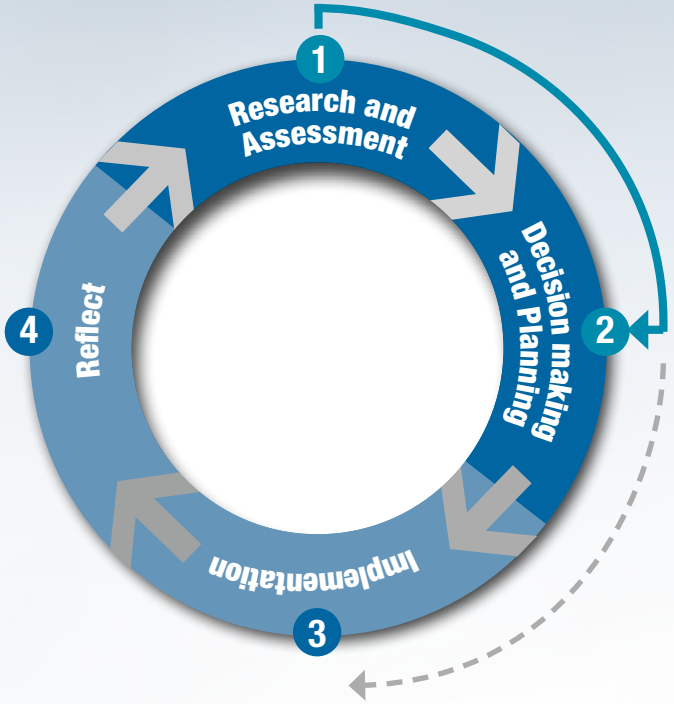

Figure 2: Peron Naturaliste Coastal Region Adaptation Good Practice phase

Emerging outcomes

Phase 1 has formed the basis of an ongoing program of work to be undertaken by the PNP to refine and improve coastal erosion including estimates through geotechnical investigations to determine the location of underlying stabilising rock within the coastal zone

The project

Previous studies have identified the region as potentially subject to erosion and coastal inundation due to climate change[1,2,3,4,5]. This situation prompted Local, State and Australian Government agencies to look at the region as one of the target areas for the 'second-pass' of the National Coastal Vulnerability Assessment. A preliminary set of studies were coordinated by Geoscience Australia, evaluating the coastal recession risk, and the potential for coastal flooding under a set of sea level and storm surge scenarios[6,7]. Natural extension of the 'second-pass' coastal vulnerability studies was their application to coastal risk studies, in such a way as to facilitate decision-making with respect to climate change adaptations.

An innovative 'value at risk' methodology was applied in this project, funded by the Coastal Adaptation Decision Pathways (CAP) program, to analyse to analyse real options and adaptation measures at regional and local scales. This methodology quantifies the value at risk of traded market assets (houses, farms etc) and non-traded public assets such as beaches and parks. It also informs a 'decision relevant' approach that enables local government officers to make use of scarce resources more efficiently to manage short term and longer term economic impacts of coastal hazards, by protecting assets at risk whose value exceeds the costs of protection, and strategically retreating elsewhere.

Source: Peron-Naturaliste Partnership

Figure 3: Existing coastal issues along the PNP coast. Showing high water levels during a flood event and coastal erosion in three locations.

Risks and impacts addressed

The CAP study considered coastal erosion and inundation hazard as a result of sea level rise and storm impacts due to climate change. The project also looked at riverine flooding risk, where that was relevant along the PNP coast. Coastal inundation hazard was identified through a series of 'low', 'medium' and 'high' estimates of extreme water level for 12 different zones between Cape Naturaliste and Rockingham. Extreme water level estimates were added to the sea level rise projection curve to provide coastal inundation hazard levels from present day to 2110. The hazard mapping conducted as part of the project used supplementary information to direct interpretation of the Cowell & Barry (2012) coastal erosion recession lines. This information was used to define low, medium and high recession distances for 2010, 2030, 2070 and 2110. The 2010 and 2110 distances were mapped to provide a basis for an economic assessment undertaken in subsequent phases of the project.

The 'decision relevant' approach enabled local government officers to make use of scarce resources more efficiently and to manage short and longer term economic impacts of coastal hazards

Source: Peron-Naturaliste Partnership

Figure 4: Shows the 4 Case study Areas being: Mandurah (top left), Siesta Park-Marybrook (top right), Peppermint Grove Beach (bottom left) and Eaton-Australind (bottom right)

Implementation phases

Three project phases were identified and used as the basis of project implementation:

- Phase I - synthesis of coastal hazards affecting the region;
- Phase II - a regional-based assessment of impacts, specifically comparing present day conditions with those projected for 2100;
- Phase III - a locally-based assessment of impacts and responses at four case study locations.

An additional study was commissioned by the Department of Transport (DoT) to feed directly into the PNP-CAP project. This aimed to identify (open) coastal sediment cells, which were intended to facilitate up scaling and downscaling between regional and more local studies.

Phase I developed coastal hazard mapping upon which to base the economic assessment of adaptation options at the regional and local case study scales in Phases II and III. Hazard maps projected coastal inundation and provided estimates of which measures would provide a net benefit (the reduction in value at risk it provides minus the cost of the option) and at what time periods they would. Optimal timing for investing in the measures was also revealed. Compared to more 'traditional' benefit cost assessment, this real options approach better addresses the dual adaptation issues of: the need to be able to encapsulate the ability of decision-makers to wait before acting (e.g. making a final adaptation investment decision closer to when it is actually needed and

erosion up to 2110. Phase 2 provided a high level regional scale indicative estimate of the spatial extent of the PNP coastline that may be vulnerable to coastal erosion/inundation and riverine flooding, and what categories of land use comprised that extent. Associated with that spatial extent, it provided temporal analysis and indicative estimates of the total value at risk of the land involved at four time periods over the next 100 years.

In addition, a rough estimate of the total cost of a implementing a select number of generic adaptation measures to address erosion and coastal inundation risks was calculated. This provided a first-ever regional scale estimate of the total value of land at risk from these hazards and an indicative estimate of the scale of funding required in the scenarios where various adaptation measures were implemented.

Importantly, these estimates enable decison-makers to get beyond dealing with the cost of 'saving every inch of the coastline' but rather the cost of protecting those assets where the value at risk exceeds the cost of protection.

The regional analysis found that a strip roughly 200 metres wide along the whole extent of the projects coastline is at risk from erosion, (about 3410 ha). The value at risk of the affected assets along this section of coastline is approximately $1.2 billion. Of these, a little more than $1.1 billion of assets are worth saving, at a cost of around $100 million, giving a benefit cost ratio of approximately ten to one if the protective structures are built right now. The analysis suggested that around $100 million in assets are not worth saving. In land area terms, this equates to around 85 per cent of the affected region. At the regional level, erosion is a far more pervasive issue than flooding; around 800 hectares of residential land would be subject to an increase in flooding risk (from one in 500 to one in 100). The analysis confirms that the economic and social significance of the coastal climate change risks for the region are substantial and that methodically incorporating climate change adaptation planning into land use decision making and on-going coastal management will be important.

Phase III of the project undertook one of the first (perhaps the first) robust economic analysis to evaluate real options for adaptation at a local scale in Australia. This innovative real options analysis methodology is at the heart of this CAP project and is also a unique value-adding dimension of it. For each of the four case studies it involved identifying:

- The land at risk and any change in its value due to the coastal climate change impacts each year over 100 years, for a large number of scenarios generated from climate change models.
- A range of feasible adaptation measures for each of the land assets at risk, including protection measures, and the capital and operating costs of those measures.
- The optimal year for implementing the option and the net benefit (the reduction in value at risk it provides minus the cost of the option) it produces.

The annualised change in value at risk was calculated by comparing with the 'no action' scenarios. The analysis incorporating the up-to-date knowledge at that time); and to better account for the considerable uncertainty associated with climate change impacts and adaptation.

The four case studies included temporal and spatial elements and were conducted from Mandurah, Siesta Park-Marybrook, Peppermint Grove Beach and Eaton-Australind.

Outcomes achieved

The project achieved a number of outcomes:

An economic-based regional test of adaptation options to treat identified impacts of coastal climate change

Detailed demonstration of several coastal adaptation pathways at a local scale. The CAP project contributes to knowledge and practice in the field of climate change adaptation, through its application of a methodology for developing Flexible Adaptation Pathways in four test sites. The project trialled this methodology and documented lessons learned and recommendations for applying the methodology to other locations, nationally or internationally.

Another key outcome from the project is a set of recommendations for adaptive action through the PNP coastal region. These recommendations are provided in a timed and prioritised manner to cover actions that need to be immediately addressed versus those for which the PNP should seek additional funding. In particular, a number of areas were identified where site-specific geotechnical investigations are required before further adaptive decision-making is undertaken. The PNP is confirming a scope of works for these undertakings at present and will

use the outputs as a means to ground-truth some of the more contentious findings of the technical analysis conducted through the CAP project.

A further important outcome from the project is the strong working relationship forged among the members of the PNP and an extended key stakeholder group. This relationship is invaluable as the PNP move forward on their adaptive journey. It provides a tried and tested means of collaboration and cooperation facilitating complex problem solving and conflict resolution.

The regional scale and local case study economic analyses helped provide to the PNP members a long term perspective on the implications of land use planning decisions and future development in the context of future climate change risks. It also provides indicative estimates of the value at risk of land from coastal erosion, coastal inundation and riverine inundation, and also estimates of the scale of cost of investing in adaptation measures to respond to these threats, including protection measures. While additional analysis is needed before decisions are made, this project confirmed the significant of the climate change risks and the need to do further collaborative adaptation planning.

Emerging outcomes

The PNP project is one of a series of test cases for developing methodologies of coastal hazard assessment across Australia. A successful element of the study that will provide benefit elsewhere is the economic model specifically created to deliver the project objectives.

Additionally, there is significant value in identifying some of the challenges associated with the project processes, and consequently what could be done better if a similar methodology were to be applied elsewhere.

A final emerging outcome that will provide significant ongoing benefit is the innovative economic analyses methods developed for this project by consultants Acil Tasman. It provides a useful step forward in adaptation evaluations to inform adaptation investment decision making.

Critical success factors

AGP analysis of the project

Success of this approach has been driven by strong leadership in PNP partnerhip, engagement and good connectivity between all stakeholders and a sustainable vision.

This project is strong in:

- **Leadership**
- **Engagement**
- **Connectivity**

Leadership

The key success factor in the PNP CAPS project has been the PNP's excellent regional leadership to support effective advocacy at all levels of government and facilitate decision-making in a collaborative and adaptive manner through the project's lifecycle. Good governance has been demonstrated through the project with the early establishment of a reference group and strong representation of the community through Councillors and senior advisors. The ongoing role of the steering committee has been pivotal in implementing the project as efficiently and effectively as possible, in particular, in the context of unforseen methodological difficulties and necessary changes in project scope.

The Partnership's decision to employ a dedicated climate change officer during the EOI stage was critical in the successful delivery of this project. This early engagement allowed the officer to take important ownership and drive the project from its initial design phase, and also gave continuity throughout the project lifecycle. The climate change officer acted as a focal point for all project management both with the funder, the service provider and within the PNP itself. This was extremely important given the complex nature of the project and the need for widespread engagement with stakeholders among and between local governments, the State Government and the private sector.

All nine member Councils felt they could trust that their perspectives were included in the decision-making process, this was important for their ownership of the project and its outcomes.

The project officer's facilitation role was crucial for the success of the project, to achieve good, well informed, inclusive and timely decisions. All nine member Councils felt they could trust that their perspectives were included in the decision-making process, this was important for their ownership of the project and its outcomes.

In 2012 an additional project officer joined the PNP team. This has allowed a timely transition towards preparation of applications for grants and other submissions to support appropriate adaptation responses and fill knowledge gaps.

Leadership lesson learnt:

Good governance and dedicated resources allowed for continuity during unforseen difficulties and changes in scope.

Engagement

Engagement between member councils has been crucial to the ongoing success of the PNP. The shared vision to build climate-resilient communities across the region built a strong foundation for wider engagement with key stakeholders and the community. The focused involvement of the State Government, in particular the DoT, Department of Planning and Department of Environment and Conservation, has been crucial in facilitating shared knowledge and experiences to support and inform appropriate adaptation responses. For example, the supplementary work commissioned by Department of Transport (DoT) concurrent to the PNP project made a significant contribution in overcoming dramatic differences between the regional recession study and local-scale assessments.

While direct community engagement has been less of an emphasis in the initial technical work undertaken through the CAP project, PNP officers are currently focused on the next two years for strategic actions to implement the 2013-2015 PNP Business Plan, Communication Strategy and Pilot Community Engagement Strategy. The PNP is also working on a Coast West-funded project to communicate CAP outcomes and support future public participation in decision-making process.

Engagement lesson learnt:

Working together to build climate-resilient communities across the region, member councils forged a strong foundation for wider engagement with key stakeholders and the community.

The closer decision-making is to the concerns of key stakeholders and grass roots community issues and local contexts, the better for relevance and buy-in.

Connectivity

The PNP project was one of 13 nationally funded projects concerned with the economic assessment of adaptation at a local government scale. The Coast West-funded Peron Naturaliste Partnership Coastal Community Adaptation Awareness Plan is a Busselton-based project that proposes to act as a pilot for the other local government areas to communicate the findings of the CAP project and more importantly engage the local community in the wider debate to build resilience and develop a Coastal Community Adaptation Awareness Plan. This approach and subsequent Plan will then be 'rolled out' to the other local government areas which will adopt their own Plan to suit their own individual local physical variables and issues.

The PNP includes local government areas such as the City of Mandurah (CoM) which is a leader in climate change adaptation. CoM is undertaking adaptation planning and actions at a finer scale in addition to the PNP approach.

→ Connectivity lesson learnt:

By using The Coast West-funded Peron Naturaliste Partnership Coastal Community Adaptation Awareness Plan as an example, other local government areas can adapt the plan to suit their needs.

Sustainability

The real options analysis methodology has enabled this project to encompass the key sustainability principle of intergenerational equity, by carrying forward some non-urgent decisions to several decades ahead, when the next generations of decsion-makers will be able to draw on better sources of knowledge and longitudinal data sets.

The subsidiarity principle is also embodied in the collaborative decision-making processes among the nine member Councils. This principle emanates from the Rio Earth Summit and Agenda 21[8,9] and is a driver for locating power and responsibility for climate change adaptation strategies and action plans at the lowest appropriate spatial scales of governance. The closer decision-making is to the concerns of key stakeholders and grass roots community issues and local contexts, the better for relevance and buy-in.

→ Sustainability lesson learnt:

Engaging with key stakeholders in the community increases relevance and buy-in and increases the likelihood that long-term sustainable outcomes will be achieved.

Cost

The regional partnership established through PNP has established the shared ability to deliver beyond a 12-month project due to longer commitment from council to be involved in delivering coastal adaptation work. The working model adopted by the PNP to deliver the CAP project has allowed them the ability to look further than the project lifecycle to determine what longer-term costs need to be addressed and establish an ongoing resource in terms of funding and access to knowledge and information through their established networks.

→ Cost lesson learnt:

Ongoing resources in terms of funding and knowledge can be established through partnership networks and allows for results beyond that of the project lifecycle.

Conclusion

The CAP project provided many lessons for other local areas facing similar coastal hazard issues.

Through this regional collaboration Council staff were able to share their experiences with respect to climate change adaptation and remain actively involved and engaged with both the State Government and their counterparts across other local governments in the area. This collaborative approach is seen as a good model to address constraints and to promote local government concerns in regards to climate change.

Gaps and future challenges

The key constraint for the work conducted through the CAP project was the lack of wholly meaningful projections of coastal change. The study relied strongly on the outputs of a regional assessment of coastal change commissioned by the State Government[6]. Local variations in coastal process were not taken into account in this regional assessment due to the scale at which it was conducted. The use of this regional data in the CAP project subsequently resulted in an overestimation of likely coastal change for many locations within the study area. Recommendations of the study must be considered within this context when determining timeframes for implementation of proposed adaptive actions.

Several of the specific issues relating to delivery of the project relate to the fact that the 'required' input to work Phases II and III was a set of hazard lines, which were then used to interrogate economic information. Much of this economic information is obtained from Geographic Information System (GIS) sources. Through execution of the project it was determined that a more appropriate approach would have been to directly link economic GIS databases with a LiDAR (Light Detection And Ranging) GIS query. This is an important lesson learned that should be transferred to future projects attempting analysis of this kind.

A second issue is the fundamental requirement for the analysis to be valid at multiple scales. Essentially this causes the project to bridge a technology gap between GIS (good for 'querying' large datasets, but difficult to use for data manipulation) and Computer-Aided Design (CAD) (good for data manipulation on smaller datasets).

The final CAP report provides a useful and pragmatic discussion of the challenges and limitations of valuing assets. particularly non-market assets. The lack of reliable data on social and environmental values of, and community attitudes to, land and assets at risk was a limitation of the project that future further studies and community consultation will be able to address.

Links to more information and projects

www.peronnaturaliste.org.au

www.planning.wa.gov.au/674.asp

- Gozzard JR. (2009) *WACoast – A geological framework for coastal planning*. 5th Western Australian State Coastal Conference 2009.
- Gozzard JR. (2011) *A geological framework for coastal planning*. Annual Review, Geological Survey of Western Australia.
- Damara WA, Geological Survey of Western Australia & Department of Environment and Conservation. (2011) *Coastal Compartments of Western Australia: A Physical Framework for Marine & Coastal Planning*. Report 80-02-Rev0.
- Damara, (2012). *Coastal hazard mapping for economic analysis of climate change adaptation in the Peron-Naturaliste Region*. Damara WA, August 2012. Report 169-01-Draft

Australian Government

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NCCARF
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