

TWENTY ONE (AND WE HOLD THE KEYS TO THE FUTURE?)

FOLLOWING THE ADAPTATION PATH

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Abstract

At 21 we can confidently look to the future and to exploring the big world out there, but the future is a foreign county, and for any foreign country we can't exactly see what is ahead of us in our travels but we can prepare. We know in law the difference between the unknown (or uncertain) and what is reasonably foreseeable, so what can we do to foresee what might be ahead of us?

The SCCG has carried out three projects under the Australian Government's Coastal Adaptation Program, which have included 11 separate case studies. The projects deal with assessing and managing existing small seawalls; the management of interconnected water infrastructure; and prioritising coastal adaptation and development options for Local Government. The case studies broadly cover the three 'levels' of project, programs, and policies, and deal with issues of scale and complexity, risks and vulnerability, and the need for holistic management based on the contributions of stakeholders. We will draw upon these case studies and the learnings from them, to start to develop our 'guide book' to the future.

An important question and distinction we need to think about is whether we are preparing for the present or the future. Are some of our options ("no regret" and "low regret") really part of our journey to the future or just marking time? We will explore the need to define the problem space, ways to find an adaptive pathway (if not a "solution") and what it means to be "flexible", how we monitor and evaluate our progress, and the tools that have been developed under the CAP projects to assist Local Government staffs develop adaptation programs.

Introduction

SCCG has had a long involvement with Climate Change Adaptation. [The Systems Approach to Regional Climate change Adaptation Strategies in Metropolises](#) looked at adaptation barriers associated with infrastructure in terms of:

- Context:** The social and political context is always with us and as well there is the legacy of past decisions (planning, development, and infrastructure)
- Structure:** A lack of clear and useful guidance for Local Government. Multiple stakeholders and owners of infrastructure with different values and priorities
- Process:** Different responsibilities ("silos") within and between Local and State Governments;
- Outcomes:** Few examples of good, productive, long-term adaptations.

This paper provides:

- an overview of three projects carried out by the SCCG and its funding partners under the Australian Government’s Coastal Adaptation Program (CAP),
- a summary of key learnings from the projects, and
- suggestions for ways forward to develop and implement Flexible Adaptation Pathways (FAPs)

Projects

To address these issues the SCCG has, the aims of which were “*To demonstrate decision and investment pathways to effectively manage future climate risk to coastal assets and communities*”.

The SCCG projects are:

1. [Assessment and decision frameworks for Seawall Structures](#)
2. [Demonstrating Climate Change Adaptation of Interconnected Water Infrastructure](#), and
3. [Prioritising Coastal Adaptation Development Options for Local Government](#).

The case studies broadly cover the three ‘levels’ of project, programs, and policies, and deal with issues of scale and complexity, risks and vulnerability, and the need for holistic management based on the contributions of stakeholders.

Case studies

We developed eleven case studies, and all started and ended at different places. The important thing with case studies is not that they provide universal truths but that they allow opportunities for learning that can inform other cases. The cases, covering a great diversity of scales and contexts reinforce the common elements and provide insight into the particularities that inform all situations.

Assessment and Decision Frameworks for Seawall Structures	Demonstrating Climate Change Adaptation of Interconnected Water Infrastructure	Prioritising Coastal Adaptation Development Options for Local Government
Field data collection Seawalls assessment <ul style="list-style-type: none"> • Bilgola Beach • Clontarf Beach Gold Coast A-Line seawall	Sydney’s CBD (existing development, Sydney’s Green Square (urban renewal), Cooks River catchment, Wollongong interconnected coastal assets, Berry Creek – North Sydney.	Sunshine Coast Sydney Coastal Councils Bega Valley

Assessment and Decision Frameworks for Seawall structures

Partners: Coastal Environment Pty Ltd, Griffith Centre for Coastal Management.

Aim

The Assessment and Decision Framework for Seawall Structures project aims to assist Local and State Governments' coastal managers to understand, from a practical perspective, the issues relating to small seawalls that are not certified.

The objective of the project is to identify information relating to the evaluation of the effectiveness of existing revetments constructed to protect properties where no design details are available.

The intent is to raise awareness of the potential issues arising from the existence of these structures and, where appropriate, to alert the coastal manager to potential signs of failure that might require detailed and expert professional assessment.

Seawalls and protection structures are found at many locations around the 30,000 kilometres of the Australian coast. For many of these protection structures construction details are unknown and the capacity of the structures to withstand existing (or future) storm and inundation events is not well understood. Seawall and asset owners and managers (usually Local Government) may be faced with determining development applications in areas protected by structures of unknown quality and origin (some approved and some not). Frequently there is conflict between the coastal managers and the community who have varying impressions of their effectiveness.

The guidelines in this report do not replace the need for that expert advice, but will assist the coastal manager to identify the issues and risks requiring professional assistance, and to ask the appropriate questions in the subsequent briefing process.

Methods

This project has used:

1. Literature Review of existing seawall type, remote sensing techniques, options for upgrading, and certification requirements
2. Geotechnical report providing guidance on seawall stability and assessment, including a proforma checklists and assessment sheets for use by local government staffs.
3. Economic aspects of the appraisal of the effectiveness of seawalls assuming that a seawall already exists
4. Site Field Data Collection to investigate methods available to assess the nature and extent of existing (often buried and not readily inspected) protection structures.
5. Field assessment to identify the effectiveness or otherwise of existing structures based on available site inspections, records, and other evaluation processes identified. Trials undertaken at two Sydney Metropolitan areas:

- a. Bilgola Beach (exposed ocean beach, two revetment types) and
 - b. Clontarf Beach (harbour beach, three revetment types)
6. Gold Coast A line seawall case study.

A key feature of the project methodology was the establishment of a Technical Reference Group (TRG) to provide feedback on the various aspects of the project. This reference group included leading practicing engineers and government coastal managers from most jurisdictions. It comprised relevant and appropriately experienced personnel from local government, state government, and professional associations around Australia.

Outcomes

This project discusses available methods to determine the construction and condition of existing structures (including remote and innovative techniques as applicable):

- the key design parameters for small seawalls
- the way these may change into the future with changing climate
- the primary failure modes for various types of walls
- opportunities for upgrading existing structure as appropriate
- key triggers for initiating upgrading/replacement/removal, and
- the inclusion of these structures and ongoing condition and performance monitoring within Local Government asset management registers.

The Report includes:

- templates for assessing the suitability, monitoring, and maintenance of existing walls, and
- advice in determining investment strategies for coastal defences.

Importantly the project heightens Local Government awareness of the difficulty posed by these structures and the need to identify and record key components of these structures as part of asset management.

Demonstrating Climate Change Adaptation of Interconnected Water Infrastructure

Partners: Sydney Water Corporation, Office of Environment and Heritage

Aim

Based on earlier work by the SCCG that demonstrated a lack of guidance for the management of Interconnected Water Infrastructure, the project aimed to:

- Demonstrate effective adaptation strategies to address direct and indirect impacts of climate change in situations where there are challenges due to interconnected infrastructure.
- Produce guidance and frameworks that assist asset managers mitigate the impacts of climate change on water infrastructure.

Methods

The project adopted a case study approach to develop appropriate guidance through consideration of real-world scenarios. Five case studies were used to explore particular aspects of adaptation to climate change impacts on interconnected water infrastructure.

The following underlying assumptions frame the case study approach:

- each case has individual characteristics
- some characteristics would be transferable, therefore
- greatest learning would be achieved by investigating the different circumstances of more case studies.

The Selection Panel chose five cases:

1. City of Sydney CBD (Existing infrastructure)
2. Green Square (Urban redevelopment)
3. Cooks River (Catchment planning and management)
4. Wollongong (Coastal Hazards)
5. Berry Creek (Natural environment)

The case studies, selected to offer a range of climate problems, governance structures and political/social context, and interconnectedness. Due to practical restraints of resources and time, each focused on one climate change event, and one system within the total network, and limited climate change adaptation options.

This approach, if applied outside a learning environment, could result in the selection of options leading to maladaptation, and the results of the Case Studies are intended to illustrate different aspects of the development of Flexible Adaptation Pathway rather than to provide a recommended option for development.

Outcomes

The project developed and applied a step-wise framework for adaptation decision making using principles of risk management, evaluation of options and economic analysis. Flexible adaptation pathways are the main feature of managing climate change uncertainty.

The case studies were also in different stages in terms of the progress already made in establishing adaptation pathways. The outputs include the:

- [Synthesis Report](#), which includes an
- [Adaptation Resource Centre and User Guide](#)

Prioritising Coastal Adaptation Development Options for Local Government

Partners: Oak Ridge National Laboratory (USA), University of the Sunshine Coast

Aims

The '*Prioritising Coastal Adaptation and Development Options for Local Government*' sought to explore a range of analyses and tool development activities to progress more focused evaluation of coastal adaptation options and the design of flexible adaptation pathways.

The project used three case studies:

1. The Sunshine Coast (Queensland)
2. Sydney Coastal Councils (NSW), and
3. Bega Valley (NSW)

The project was designed with two key considerations in mind.

- Decision-making regarding adaptation in the coastal zone fundamentally hinges upon the reconciliation of multiple societal values that influence perceptions regarding the costs and benefits (market and non-market) of different options.
- Achieving success over the long-term is contingent upon the ability to monitor progress toward management goals, evaluate the extent to which specific policies and measures are contributing to that progress, and revisit past decisions to address challenges that are standing in the way of success.

Methods

Literature review The literature review informed adaptation options and strategies, and supported the development of MCA, and M&E tools.

GIS database development SCCG and ORNL staff elicited various data resources from councils, state government agencies (particularly in New South Wales), as well as federal agencies. ORNL staff compiled these data into a spatial database for use in the project.

Online survey An online survey conducted between 15 November and 14 December 2011 that investigated the relative importance of different values in council decision-making, the factors triggering changes to coastal risk management, limits to council decision making and monitoring evaluation processes.

Stakeholder workshops Three workshops (one each at the Sunshine Coast, Bega Valley, and Sydney) provided input the Stage 1 multi-criteria analysis (MCA) to inform to understand council preferences regarding different adaptation options over different time scales. The Bayesian model for adaptation evaluation incorporated that information to undertake the spatial evaluation of adaptation options. The analysis of the data from the workshops is included in '*A Multi-Criteria Analysis of Coastal Adaptation Options for Local Government*'.

Development of Bayesian Belief Networks (BBN) The BBN was constructed as a transparent network that represented the flow of information in the analysis among independent and dependent variables, each represented by a node in the network.

Information emerging from the Bayesian model was visualized in a GIS environment to enhance accessibility of the information to stakeholders.

Development of a Monitoring and Evaluation Framework The Framework includes a simple, reporting oriented format, and a more comprehensive format for practitioners to work through the process of designing and implementing appropriate M&E investigations.

In particular, the framework constitutes three components to assess:

1. adaptation processes
2. organisational adaptive capacity, and
3. adaptation outcomes.

Outputs

Prioritising Coastal Adaptation and Development Options for Local Government developed an approach to Multicriteria analysis for coastal adaptation that incorporated Local Government knowledge and preferences for adaptation options. This participatory approach enabled normative perspectives of Local Government staff to drive the MCA (rather than investigator assumptions) while also providing opportunities for shared learning among staff. This MCA was undertaken within each of three case study regions (Sunshine Coast; Sydney Coastal Councils; Bega Valley).

The MCA was applied both as a general planning tool as well as specifically for thousands of properties within these regions potentially vulnerable to coastal hazards (see Figure 1).

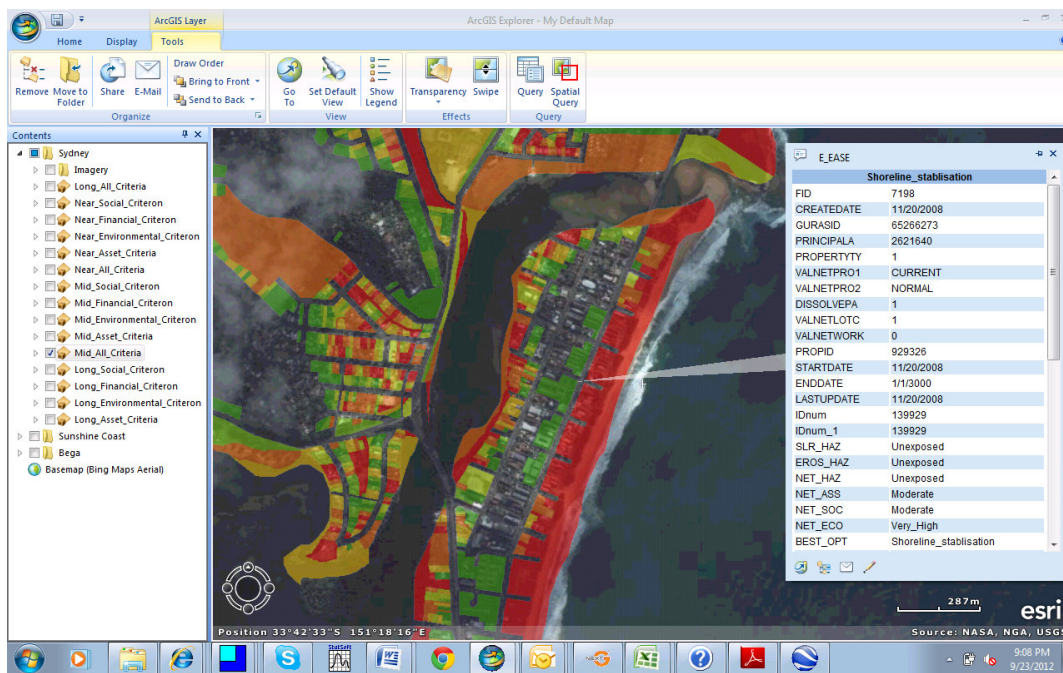


Figure 1 A screen shot showing a regional overview with lot-scale adaptation information

A Monitoring and Evaluation Framework accompanies the MCA, consisting of three templates that can be readily applied within a Local Government setting to track progress on adaptation objectives (Figure 2).

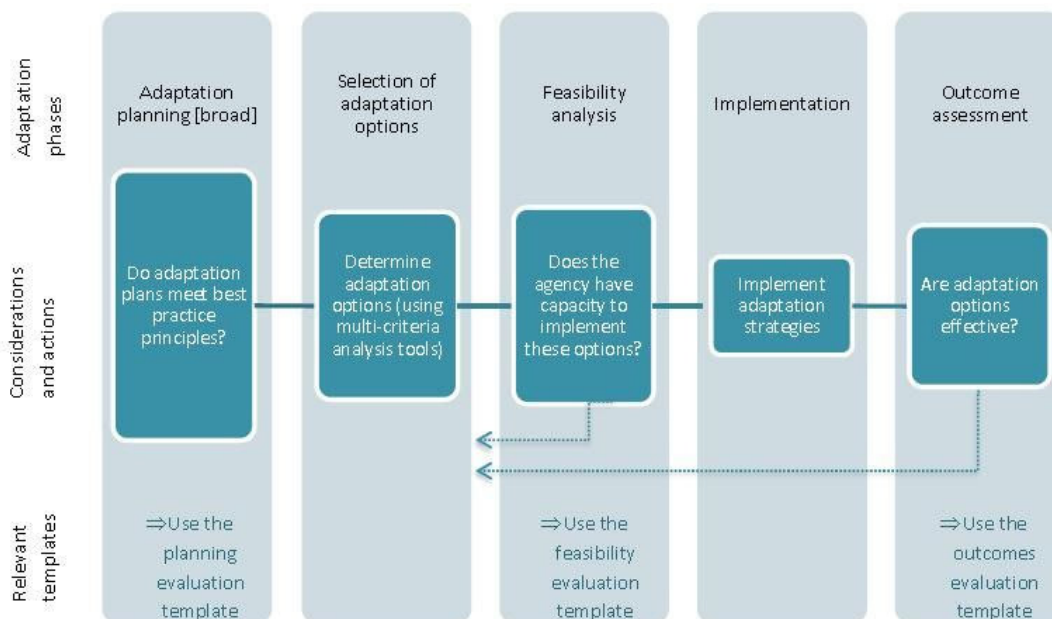


Figure 2 Schema of Local Government adaptation process indicating the role of evaluation and its uses.

Key learnings from the projects

Using existing guidance

There is a range of existing guidance developed to assist businesses and government in developing adaptation pathways in the context of climate change uncertainty. A colleague used to say “Greenies are mad” on the basis they think they have discovered all the problems of the world, but economists have nearly always already been there. After all, economics is about the wise use of resources taking into account all social values and utility. We may sometimes have to look in strange places but in our travels we are unlikely to find true Wilderness.

Importance of focus and scope:

Project scoping takes time and significant engagement with the stakeholders to get a detailed understanding of potential issues relating to climate change. A critical part of scoping is the identification and testing of assumptions, which, if not dealt with, can derail clear thinking about the issues and potential options.

This part of the process is critical because once it is in place it is rarely revisited and can lead to ongoing difficulties and failed outcomes.

Good scoping:

- Takes time
- Needs the right people involved
- Includes spatial and temporal frames
- Avoids “Frame blindness” (i.e. thinking you understand the “problem”, and hence the “solution” before analysing the full dimensions of the situation)
- Incorporates systems thinking (can you draw a diagram?)
- Recognition of, and respect for, different values (use difference as creative tension).

Assumptions

A colleague used to say “assume: making an **ass** of **u** and **me**. If we are blind to anything it is likely to be the assumptions (not always bad!) on which our work is based. Without articulating these assumptions we invalidate communication and expose ourselves to errors:

- Untested and unacknowledged assumptions can lead to irreconcilable conflict and dumb outcomes
- Look for differences in opinion or paradigm conflicts and ask how much they might be based on different assumptions. Can they be reconciled? Can we be

positive and learn from these differences? An “opportunity” rather than a “constraint” – difference as creative tension!

- Cannot solve a “wicked problem” by appeal to the facts (ppi Policy Update, 2011) but may be able to challenge underlying assumptions?

Data

Having got rid of opinion as a basis for a decision we need to provide evidence to support what we need to do. Data will never be (nor need be) perfect. Proper statistical analysis will tell you about power and confidence, and inform good designs (SCCG web site: <http://www.monitor2manage.com.au/>):

- How “good” is the data? “Good enough” is good enough; don’t waste resources but don’t use bad data.
- Interpretation/meaning/importance [correlation is not the same as causality]
- Measure the right things; “a difference, to be a difference, must make a difference”]
- Test your assumptions and the implementation as well as the outcome
- Keep on tracking (monitoring and reporting)

Data can be used in an exploratory way. For the CBD study a simple linear model of the Tank Stream drainage system was developed to test assumptions about the importance of tidal locking on the system. The model was insufficient for design but adequate as a preliminary test of the assumption, and showed it to be wrong.

Value of risk assessment:

The risk assessment process is an important step in understanding the extent of the problem. Simple assessment or modelling can be effective as a screening tool in excluding potential issues, but do more detailed modelling where issues are identified.

Systems thinking is important here so that both the assets of highest risk are identified (for each kind of threat) and options for managing risk are fully explored. A system might be more resilient by allowing failed components to be bypassed rather than making every component safe to every risk.

Changing a system may change not only the level of risk, it may change the kind of risk (Wynne, 1992): a resilient system, e.g., while controlling the external threat may require greater intervention, bringing in other levels of risk due to operator error.

Risk assessment needs to be as flexible and responsive as any part of the process of developing flexible adaptation pathways. Communicating risk is critical for community awareness and acceptance. In a broader sense the resilience of the community, and their abilities to respond to, and to manage, extreme events is as important as the physical infrastructure.

Iteration leading to greater understanding:

At all points in a project the partners will not have access to perfect knowledge; and it is important to begin the process of adaptation being mindful of the need to revisit earlier decisions and evaluations in the light of new knowledge.

Uncertainty occurs at many levels, and in many forms in a project. Friend and Hickling (1987) broadly describe uncertainties about:

- Guiding values (clearer objectives)
- The working environment (more information)
- Related decisions (more co-ordination/governance).

Because many uncertainties co-exist (see Figure 3) it is necessary to progress (cautiously) on the basis of the best available information while monitoring the external environmental for improved/changing data and knowledge. This iterative progress is an ongoing dynamic between the possible and the (hoped for) ideal.

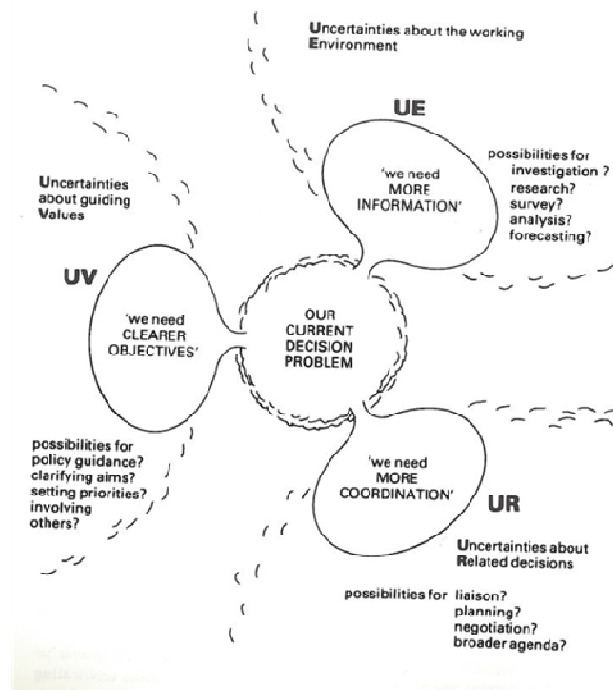


Figure 3 Planning under Uncertainty

Uncertainty can be particularly important for economic planning where key factors (such as the timing of events, external responses to decisions) are outside our control, and it is difficult to evaluate fully all aspects of the proposed adaptation pathway.

For example, all the case studies for the Integrated Water Infrastructure project evolved through a number of iterations. Even the Wollongong case study, where a lot of information was available, evolved as the issues were scoped and the problem reframed. Berry Creek, a seemingly simple case study, moved from a stormwater management frame to a more holistic environmental values issue, requiring different data sets and expertise to be brought into the discussion.

Governance as a critical barrier to resolve:

Governance is one of the most critical, and common, barriers to implementation of a Flexible Adaptation Pathway identified by the case studies. Who can make the decisions? Who is accountable? Who owns the problem?

Who has responsibility for the managing a system, and its components, is often critical. Not talking to the right people can hinder framing and analysis, and can prevent the development of effective options. Systems can be as complicated as the Cooks River with multiple Local Government authorities and major infrastructure providers (including road, rail, and air), or as is “simple” as Berry Creek with two Local Government agencies and one major infrastructure provider, but without input from the right people the project can go nowhere. Having said that, even a good decision might not be implemented for organisational reasons, which is where the Monitoring and Evaluation Framework from the Multicriteria analysis can assist.

The participants need to bring the right:

- Knowledge
- Skills
- Different thinking
- Values
- Priorities
- Experience, and
- The authority to make decisions

The issue of “silos” within agencies can be very alive and emphasises the need for involving all relevant parts of an organisation and to ensure effective collaboration and organisation commitment.

Existing climate threats require action as well as future threats:

Almost all of the case studies identified that current climate, combined with urban development and an ageing asset base, already impact the performance of existing assets. Current extreme events will place demands on existing systems and assets, as demonstrated by the disruption in Sydney caused by the rainfall on the 8 March 2012.. Statistically this event (109.4mm of rain in less than 12 hours) was estimated to be less than a 5 year ARI event. The most intense rainfall occurred between 8am and 10am as the majority of Sydney workers were commuting to work and significant disruption occurred as buses were diverted or delayed and train stations inundated.

The Wollongong study showed that for some critical assets action is required now as the existing situation, within the range of expected events, can lead to failure of the system.

Financial analysis is complex and may be iterative.

Different approaches can be used to progress the Flexible Adaptation Pathway (FAP), and in many cases Cost Benefit Analysis (CBA) will not be relevant and may only delay or confuse decision-making. Valuation of all inputs to CBA is difficult and alternative methods may be easier to communicate and more effective at engaging stakeholders in conversations.

Funding may require a more detailed economic analysis but effective decision making and progress on the FAP need not be delayed if it cannot be done. Of the case studies only one project (Wollongong coastal hazards) was in a position to undertake a more detailed economic analysis but all made progress in scoping and progressing along the pathway to a FAP.

Optimism bias

Overall we had a very ambitious program within the time frame of the grants. Despite having good partnerships and effective contributions from our consultants we did not explore Flexible Adaptation Pathways to the extent we would have liked.

In particular some of the case studies were limited in the climate change variables and the critical events that were explored.

The projects still allowed important learnings and we hope to provide ongoing support for the outputs to be taken up by our members (and others) to keep developing and refining the tools.

Ways forward

Business as usual

Local Government has clear roles and responsibilities that need to be ongoing. Incorporating relevant aspects of adaptation into those core businesses, as modified practices and/or as prevention and preparedness planning allowS business as usual while preparing for change.

Building social capital (democracy is messy)

Effective requires community support. Except perhaps in a crisis, this can be time consuming, multidimensional and messy.

- Engaging
- Exchanging/learning

- (Very) long time frames
- Iterative (as required in Integrated Reporting Framework)

It is not all about adaptation

Lance Armstrong said “its not about the bike”; drawing attention to the training, infrastructure, and support services that are required for any successful project.

There is much to do that fits into Local Government responsibilities and adaptation is part of a broader discussion about Council priorities and management. Getting adaptation to the table is often about normalising those concerns and our Monitoring and Evaluation Framework will assist in understanding how adaptation fits into existing business and the gaps in Council’s resources and planning.

Getting adaptation planning into the broader program of works and asset management, which is a key aim of the Seawalls project, can ensure proper discussion and assessment of assets with the community, and recognition in funding programs.

Climate change is not different

There is long history of government, and the private sector, planning in the face of uncertainty. This history provides ways forward based on deliberative and powerful engagement with all stakeholders. This practice is often about making a commitment to action rather than a simplistic move to a “solution”. Even the term “wicked problem” has been around longer than climate change.

The focus on the detail of Sea Level Rise, or other particular aspects of Climate Change, is misplaced as it places demands on one aspect of a complex situation, without making similar demands of the social, financial, and other dimensions. The response of some people to Climate Change is emotional, and likely therefore to take extreme positions, but this can be case for many issues in public policy.

A spurious seeking for certainty

- The future is unknowable, by definition
- Will never have enough information to eliminate uncertainty/Too many variables
- We move towards a commitment, not a definitive solution in a broader operational and political context (Friend and Hickling 1987), see Figure 4.

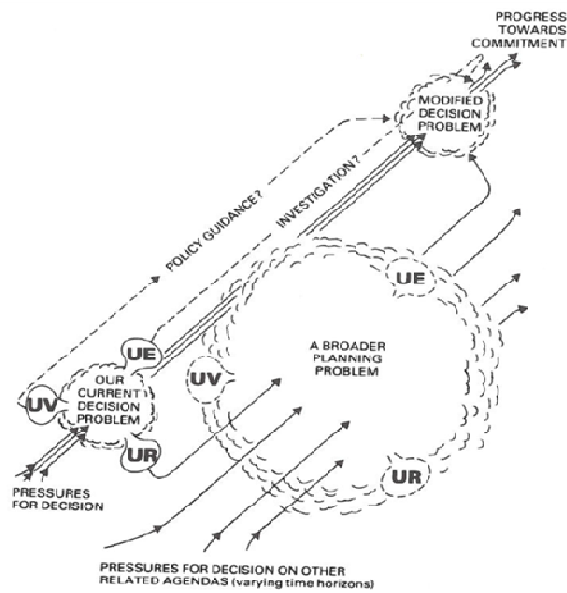
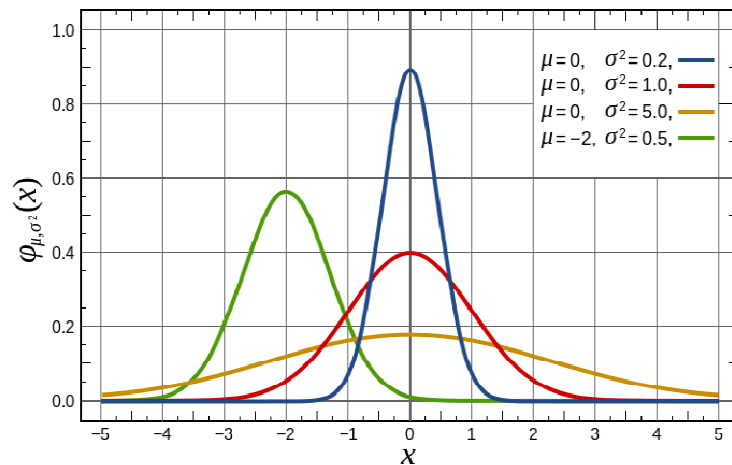


Figure 4 An expanded operational focus

- Accuracy v precision



We assume, if unaware, that in moving from the lowest curve, which has the lowest precision, to a curve of higher precision that we will increase accuracy at the same time. This is not necessarily the case! All the curves in the diagram lie within the range of values of the least precise curve so without the benefit of hindsight we cannot know always that a more precise result is more accurate.

Planning for a broader range of impacts may provide a more robust solution in the short term and allow a more refined approach as climate change impacts are understood better in later years. If we can never be certain about the future; a better question might be “can we handle the worst scenario?” rather than “can we predict the most likely?” A sensible path will include:

- Developing scenarios as part of consultation (but which criteria do we use to evaluate?)
- Balancing security and overinvestment (emergency management as a backup?)

- Monitoring & Evaluation – track what is actually happening
- Avoid solutioneering (“To a man with a hammer everything looks like a nail”)
- Recognise that what stakeholders bring to the table is more important than any tool
- Always keep in mind both structural and non-structural solutions
- Don’t rely on one approach (they all have the potential to provide insights)

Moving to commitment vs making a decision

The discussion above proposed a practical approach of moving to commitment rather than expecting to develop an ideal solution. This is about keeping on moving rather than being paralysed by doubt. This can include:





- Using the “medical model” => eliminate the “sick” decisions first [remember that a bad decision is not the same as a bad outcome!] – which is why we need Monitoring & Evaluation
- Robust decisions/Satisficing (Simon, 1986) vs Optimum decisions
- Keeping Operational decisions central. This is the core of our business (just keep them heading in the right direction)
- Strive for equity and not just a concern for efficiency.

Managing Change

A widely used descriptor of the mechanisms of managing change is:

Change occurs when: $D \times V \times P > E$

Where
 D = Level of discontent with the current situation
 V = Vision of what improvement is possible
 P = Plan of how to bring it about
 E = Emotional cost of making change
 (Kathleen Dannemiller, 1992)

Action requires	D		Acknowledge and encourage dissatisfaction with the status quo
	V		Communicate commitment, leadership and direction, and other opportunities for change
	P		Provide knowledge, tools, resources, organisation and reporting/communicating systems
	E		Recognise/reward achievement, adopt recommendations, delegate ownership

Every model has its flaws but (nearly) every model can be useful in assisting us find a way forward. This model gives us some structure and guidance to how we can prepare for change, while maintaining our core business.

If any of the factors on the left hand side of the equation are zero then change is highly unlikely, and this is a reminder that no one approach to adaptation will be successful.

A Flexible Adaptation Pathway, to be usable and flexible, needs to take into account all three, although the reality is that they are unlikely all to be exactly in sync or having all parts at the same stage of development.

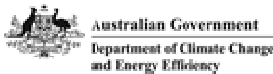
We may need to start with Dissatisfaction (and reducing the emotional cost of change) before we can put the necessary resources into the Vision and Plan. "Plan" in some formulations is described as F (= First Steps) and the beginning of a Plan may be enough to create the movement needed.

Adaptation requires a multidisciplinary approach to address the wide range of issues and barriers, and development the confidence and support of the community.

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