Submission 006
Date received: 21/07/2011

GOULBURN BROKEN
CATCHMENT MANAGEMENT AUTHORITY

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20th July 2011

Mr. Tony Zappia
Chair, House Standing Committee on
Climate Change, Environment and the Arts
PO Box 6021
Parliament House
Canberra ACT 2600

Dear Tony,

Re: Terms of reference response for the committee to inquire into Australia's biodiversity in a changing climate in relation to nationally important ecosystems.

On behalf of the Goulburn Broken Catchment Management Authority (CMA) I would like to thank you for the opportunity to respond to the terms of reference in your enquiry.

The Goulburn Broken CMA has taken significant steps to acknowledge the impacts of climate change throughout its operations including the development of a climate change integration strategy and through support to key climate change research and organisations such as the Goulburn Broken Greenhouse Alliance.

Attached is our response to the terms of reference key areas. I trust they provide a solid base to understanding our concerns and current climate change mitigation strategies to date. Should you require any further information regarding our submission please don't hesitate to contact Steve Wilson, Goulburn Broken CMA Land and Biodiversity Manager on ph.

Yours sincerely

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Parliament of Australia, House of Representatives
House Standing Committee on Climate Change, Environment and the Arts
Inquiry into Australia's Biodiversity in a Changing Climate

Submission response to Terms of Reference from the Goulburn Broken Catchment Management Authority of northern Victoria

Connectivity between ecosystems and across landscapes that may contribute to biodiversity conservation

Loss of flora species, increased isolation and reduction in functional size of remnants

Clearing and fragmentation of native vegetation over time across farming landscapes has contributed to a loss in ecosystem function in Australia. This not only affects the natural balance of ecosystems, but affects the primary resources required to support farming industries. This includes: water quality, soil stabilisation, soil fertility, soil microbes, organic matter, weed species abundance, insect and predator balance, pollination mechanisms and flora and fauna gene flow through the landscape. A breakdown of these parts of a system limits the potential for resilient ecosystems and adaptation in a changing climate. By reconnecting native vegetation in the landscape, building species diversity, and building plant numbers of those species, and re-connecting populations, we are improving genetic health, through gene connectivity of plant and animal species, recreating a time when flora and fauna genes were more easily dispersed throughout the landscape and therefore more adaptable, viable populations created.

Adaptive response

Increasing genetic diversity and numbers of plants

A practical example of this in our NRM programs is through the Goulburn Broken Catchment's 'Indigenous Seed Production Program'. Target flora species are selected, and seed is collected from existing fragmented remnant populations throughout a targeted provenance area. This seed is then germinated and propagated at the nursery and planted together in a 'seed production area', reconnecting existing populations, encouraging cross pollination when the plants mature, and ultimately using that 2nd generation seed stock to provide a healthier resource base for revegetation purposes and ecosystem resilience.

Strong evidence now exists that fragmented plant populations are negatively affected by small population size and; increased isolation:

1. These effects are often mediated by the reproductive biology of a species and can include reductions in seed output and the production of poor quality seed that fails to thrive following germination;
2. These negative responses are often underpinned by low genetic diversity limiting the number of compatible mates within a population (i.e. inbreeding);
3. Genetic variation is also the basis of evolutionary adaptation to changing environments;
4. Small remnant populations are more likely to be affected by non-adaptive evolution through random genetic drift at the expense of adaptive change by natural selection;
5. For highly fragmented vegetation communities, the use of this seed for restoration projects is unlikely to produce positive long term outcomes for biodiversity;
6. Necessitating a shift to seed production under controlled conditions using seed of known genetic quality.

References

1Aguilar et al. (2008) Mol. Ecol. 17; 2Broadhurst & Young Biol. Cons. 133; 2Buza & Young (2000) Biol. Cons.93;

4Gordon & Rice (1998) Rest. Ecol. 6; 5Ellstrand & Elam (1993) Ann. Rev Ecol. Syst. 24; 6Broadhurst et al. (2008) Evol. Appl.

Fragmentation and isolation of remnants

The GB CMA has addressed threats associated with Climate Change including:

- Planning for landscape restoration and protection at the catchment and regional scale to include priorities for connectivity and functional linkages.
- At the regional scale, zones were developed based on intact, fragmented and relictual, identifying biolink areas where restoration and connectivity is the priority, as well as flagship areas (intact areas) for protection of existing assets.

Mechanisms to enhance community engagement and to promote the sustainable use of natural resources and ecosystem services in a changing climate

- Conservation Management Networks (CMNs) and Landcare can play a key role in engaging, involving and informing community of a changing climate and its impact on biodiversity.
- Resilience of communities and their ability to adapt to the effects of a changing climate relies in part in their connectedness to their local and broader community. This connectedness can be provided via a CMN/Landcare group. CMNs and Landcare Groups have the capacity to practically demonstrate actions to manage biodiversity in a changing climate through on-ground works. For example, a CMN or Landcare group can source funds to undertake a gully-protection program, which will serve as crucial drought refuges for wildlife in a changing climate. Landholders can then see for themselves the first hand effects, and proceed with the knowledge that their actions are of demonstrated purpose, backed by funding and are in keeping with the actions of their neighbours.
- CMNs and Landcare are not generally perceived by the community to be 'Government Agencies', and are therefore often responded to in a more willing manner
- Landcare and CMNs provide a forum for landholders and community members to meet and exchange and receive information. These forums are well resourced and can deliver up-to-date information which it is assumed the community can rely on. This is important in creating confidence and willingness within the community to receive and act upon information.
- Market Based Instruments, environmental grants, workshops, research projects and information forums are all mechanisms that can be used within the structure of Landcare and CMNs to enhance community engagement. It is important that these mechanisms link in to State and Federal programs, again creating confidence that their actions are part of a scientifically sound 'bigger picture' based on policy.

The Conservation Management Networks Victoria Strategic Plan (2008) states six Biodiversity Objectives and five Social Objectives as its cornerstone of operation. Relevant as a mechanism to enhance community engagement are the following points (page 4 and 5):

- 7. To enhance community ownership and encourage ownership of the local environment;
- 8. To provide a network for all land managers and bring together other managers and stakeholders;
- 9. To integrate conservation into management by empowerment with knowledge and resources;
- 10. To share knowledge between landholders, scientists and conservation planners and managers.

In addition to these, each CMN develops a set of unique objectives based on local environment and community conditions that are broadly consistent with state and federal biodiversity objectives including:

- Recognising CMNs as a mechanism to enhance community engagement, the Biodiversity Strategy for the Goulburn Broken Catchment, Victoria 2010-2015 cites the following comments on CMNs (p.36)

"*Conservation Management Networks within the catchment provide a good model for making timely judgements and getting on with the job, while the science and prioritisation processes area refined*".

- A key principle of the Biodiversity Strategy for the Goulburn Broken Catchment, Victoria 2010-2015 (p.3) states: "*The environment must not be separated from people when decisions are made. Community capacity, engagement and recognition are crucial elements to achieving on-ground change; the achievement of biodiversity outcomes relies on strong partnerships with other programs and agencies, and with private and public land managers*".

How climate change impacts on biodiversity may flow on to affect human communities and the economy

Victoria's biodiversity is declining at an alarming rate. In Victoria key threats to biodiversity include pollution, invasive species, land clearance, clearance of remnant native vegetation, and subsequent fragmentation of flora and habitat for native fauna species. Some key threats to Victoria's biodiversity that climate change is likely to further impact on include:

- habitat fragmentation from development
- predation and competition for food, shelter and resources from introduced flora and fauna, which are likely to change in distribution and extent.
- introduced diseases, potential biosecurity risk through increase in pathogens impacting on community and biodiversity http://www.crcplantbiosecurity.com.au/project/crc10071-c
- altered fire regimes, likely to be more frequent and intense in Victoria, noting at the 2006 10th Biennial Australian Bushfire Conference, Australia's south-east is recognised as one of the most fire prone areas in the world, and fire management agencies have identified climate change as one of the most important strategic issues confronting fire managers, community, industry and biodiversity in Australia http://www.griffith.edu.au/conference/bushfire2006/
- inappropriate grazing/overgrazing which could occur over larger areas during drought
- inappropriate management activities including the destruction of riparian habitat for flood management or water extraction
- water pollution, which may increase with increased water temperatures and less frequent flood events

To address and reverse current biodiversity trends our society must recognise, understand and value biodiversity. Land managers, indigenous communities, local industries, government and the broader community value biodiversity in different ways. However, we must work together in a coordinated approach to conservation and management of biodiversity for outcomes to be effective and to ensure the continuation of these values for the wellbeing of future generations.
Climate change impacts on biodiversity values vary across many interest areas and may also include:

- maintenance of the life cycles of all species
- production value for the provision of food, medicines, clothing and building materials consumed by society
- the maintenance of ecosystem services which affect the natural storing and cycling of nutrients, stabilising soil formation, protection of water resources and breakdown of pollution, and maintenance of biodiversity and environmental flows

- socio-economic value for recreation, research, education and monitoring, and cultural values
- future value to maintain the capacity to identify future direct or indirect utilitarian value
- economic value and ongoing productive capacity of existing systems.

Fundamental to any effort on climate change mitigation is adequate biodiversity protection in state and national legislation; education and awareness, and routine modelling of current biodiversity assets and introduced species to determine potential rates of increase in changing climate regimes. A recent comment by the Intergovernmental Panel for Climate Change (IPCC) Working Group noted "Unmitigated climate change would, in the long term, be likely to exceed the capacity of natural, managed and human systems to adapt". The GBCMA has its own regional biodiversity strategy which highlights the potential impacts on biodiversity from climate change. The GBCMA as an organisation is also developing a Climate Change Integration Strategy to build in targets and efforts for mitigation across the CMA's business.

http://www.ipcc.ch/SPM6avr07.pdf

http://www.conservationsa.org.au/biodiversity-in-a-changing-climate.html

The GB CMA will be a leader in the development of strategies to mitigate and adapt to climate change. Climate Change is recognised in the strategy and is given special attention.

The strategy highlights:

- finer scale assessments will be needed to help understand the full impact of climate change on biodiversity
- the emphasis of future assessments needs to be on the INTERACTION of climate change on existing threats to biodiversity
- GB CMA has realised large-scale water efficiency projects
- Future thinking about impacts of climate change needs to consider possibly unforseen social and political effects. For example, the response to the Victorian Bushfires which lead to widespread clearing and changes to vegetation removal laws to allow clearing without permits, increase exemptions and general fear of fire and 'blame' of trees and bush for the fires.
- Climate change will have significant impacts on changing land use, especially if there are more fires, floods and long dry periods. For example, intensity changes in agriculture could result in opportunities for biodiversity.
- Carbon prices provide opportunities for biodiverse plantings in strategic locations. These plantings should be carried out under permit and with consultation with regional NRM organisations. CMAs are, in particular, in the best position to identify strategic planting areas, communicate with the local communities and carry out on-ground works.
- Opportunities for on-ground works provided by 'good' or 'average' years need to be better planned. A greater influx of funds for revegetation, pest plant and animal control, etc. needs to occur in good years.
- Economic trends are likely to be the major driver of land use change (as has occurred in the past). NRM agencies need to be better prepared to respond positively to these changes.
- Biodiversity conservation needs to be a primary consideration in mitigation and adaptation to climate change.
- Policy and research needs to be translated into actions on the ground through better and ongoing communication between researchers, policy developers and CMAs.

- Identification, definition and response to socio-economic and policy drivers needs to be timely. This can occur through identifying likely changes in land use and how biodiversity conservation can be optimised rather than reduced needs to occur. This may require tailored support to a changing social-political landscape.
- Concentrated works need to occur across strategic biolink areas, with funding opportunities developed to achieve long-term visions. For example, prioritising areas to be purchased, revegetated and protected. The best mechanisms (eg grants, MBI) need to be developed and provided as appropriate.
- Priorities are based on increasing ecosystem function and diversity under a changing climate.
- Land managers need to be stewards of the environment through education, incentives and regulation.
- Better promotion of the fundamental reliance on biodiversity for the quality of human life needs to occur.

Strategies to enhance climate change adaptation, including promoting resilience in ecosystems and human communities

Resilience is

- The capacity of the system to experience shocks or disturbances while retaining the same basic identify...while it is important that ecosystems are able to adapt to major shocks they must also be able to cope with gradual change
- Need to be explicit that it is also about transitioning from one system to another in a way to maximise outcomes
- Just as importantly we must embrace the change, how we respond will determine whether the impacts of climate change is a massive species extinction event or a rapid speciation event
- We need to focus on the resilience of the system in order to build diversity and facilitate adaptation

Climate Change is a major threat - both acute and gradual

- This means that we will be adapting on two fronts
    - to obvious threats and change and
    - to the slow variables, slower more gradual change
- We need to distinguish between the two so as to not become overly focussed on either one
- Slow threats are difficult to monitor but can have profound effects. Even our experience to date with groundwater rising is that thresholds are passed without warning. It is only when subsequent events result in unexpected outcomes that we are able to recognise this-all too late.

The threat of being lost in the noise

- Need to acknowledge that there is a significant risk that biodiversity will be missed or lost in the broader community response, particularly to acute events
    - unless it is linked to the answer to adaptation and mitigation
    - and unless it is seen as encompassing the social and human systems

There are high levels of uncertainty

- And there is no reason to think that we are well placed to manage this uncertainty
- Climate change is yet another challenge to managing biodiversity in a highly modified landscapes and yet we have not come to grips with that from a community perspective

- Size of change and impact on the ecosystem must put into question reliance on existing paradigms
    - The focus on species, particularly threatened species will be difficult to sustain unless the evidence e shows them to have high evolutionary adaptability
    - This means deciding what to let go of
        - And this will require better intelligence gathering, monitoring and risk assessment processes

We need to identify key principles[1]

To build resilience means we need to embrace change, and in order to do that we need to:

1. Maintain genetic diversity and do not select for particular species and systems on the basis of their current status
2. Build or maintain the structural complexity using natural systems as models and benchmarks.
3. Reduce fragmentation of the landscape by maintaining connectivity, building remnant structure and complexity
4. Build functional diversity and redundancy in the landscape and within existing remnants
5. Building our understanding of the consequences of likely edaphic changes to better assess new transition states and elements and to appropriately identify the threats of invasive species[2]
6. Be proactive in facilitating change by assisting regeneration and revegetation with plants from regions that approximate expected conditions in the future.
7. Recognise that isolated populations may represent pre adapted gene pools that could form core populations in a changed environment
8. Ensure that there are national and regional networks of scientifically designed, comprehensive, adequate, and representative protected areas
9. Build these networks into national and regional planning for large-scale landscape connectivity.

Goulburn Broken experience

- Focuses on strategic objectives and local action
- Build's community capacity and awareness
    - Enrol the community through provision of information
    - Allow the community the flexibility and licence to find innovative responses
- Build's adaptive management systems that
    - Constantly review objectives in the light of emerging knowledge and information
    - focus on risk assessment
    - build the evidence base
    - monitor evaluate and respond

References

DCC (2008) Submission to the Productivity Commission Inquiry into government drought support arrangements in Australia

NRMMC (2009) Australia's' biodiversity and climate change -Summary for policy makers. A report for the

Natural Resource Management Ministerial Council

NRMMC () 2004-2007 National Biodiversity and climate change action plan. A report for the Natural Resource Management Ministerial Council

Sgro, C.M., Lowe, A.J. and Hoffman, A.A. (2010) Building evolutionary resilience for conserving

Thompson, I., Mackey, B., McNulty, S., Mosseler, A. (2009). Forest Resilience, Biodiversity, and Climate Change. A synthesis of the biodiversity/resilience/stability relationship in forest ecosystems. Secretariat of the Convention on Biological Diversity, Montreal. Technical Series no. 43, 67 pages.

[1]Adapted from Thomson at al 2009

2 Need to know which plants and animals are threats and which are the new community members, and which are part of the transition process biodiversity under climate change, *Evolutionary Applications 4 326-337*

Note: The Goulburn Broken Catchment Management Authorities River & Wetland Health and Floodplain Management Program has done considerable investigation into climate change impacts on the region's aquatic ecosystems, the following information and data may be valuable:

Water quality thresholds

- We have reasonable information on salinity and nutrient thresholds for a range of species especially macroinvertebrates and macrophytes. Some data is available for fish. Much of the information is available for single species and parameters.

Risks of crossing thresholds

- There are substantial risks associated with crossing thresholds
- Maintaining water quality within threshold levels requires management of both chronic and acute water quality events. Chronic water quality conditions have the potential for management but acute events are extremely difficult, if not impossible, to manage
- Managing or maintaining the resilience of the whole system is likely to be a more robust approach to managing the likelihood of crossing thresholds.

Can thresholds be managed?

- It may be possible to manage one or two parameter thresholds, but it seems unlikely that all parameters can be managed all the time. We need to come up with a way of managing most parameters, most of the time while accepting there will be some changes (a resilience or adaptive systems approach?).

Ecosystem impacts of loss of species?

- Given the high likelihood of state change (i.e. thresholds crossed or not maintained) and the numerous examples of state changes we need to accept that there will be thresholds crossed and that there will consequences for some biota.

Risks associated with decline in water quality?

- Impacts of changes in water quality on the health of the system are well documented, especially for single parameters. The effects of changes in multiple parameters are not at all well documented. Given that climate change is expected to change many water quality parameters this is a major gap;
- The magnitude of potential water quality changes associated with climate change is unknown;

- For a first pass ERA we can say that the consequences water quality changes associated with climate change will be major or catastrophic. The likelihood of these changes is almost certain and the risks can be rated as very high.

Resilience in drier conditions

- Managing resilience in drier conditions will be the same as managing resilience now how to apply the principles at a range of temporal and spatial scales.
- (Unfortunately we initially focused on the assumption that climate change will result in drying (drought) conditions. As recent events have shown it is probably both extremes (dry and wet) that we have to worry about).

Managing water quality implications of reduced flows

- What other aspects will be impacted by low flows e.g. flow variability, pulse events
- Is flow the overriding parameter to manage? That is, if we can't manage flow, is it worth worrying too much about other water quality parameters? Or is just part of the overall package?

Stage 2 – Detailed investigation and assessment and mitigation method

As part of the planning for this stage we have come across of number of relevant projects working in the same space. A water quality/climate impact change project at ANU/Canberra University and Murray Darling Basin Commission (MDBA) has been undertaking a series of projects reviewing risks to water resources. Two MDBA projects of most relevance to the climate change water quality ERA are:

SKM – impacts on water quality

- Part 1 looked at water quality in P10 and P90 years; came up with general traits of WQ in wet and dry years
- Part 2 focussed on extreme events ie events with rare occurrence but with extreme consequence
- How will CC affect WQ?
    - Increased T
    - Variable rainfall and run off
    - events

Griffith University – impacts on aquatic ecosystems

- Looked at general drivers exposure, sensitivity and adaptability
- CC drivers
    - Major drivers are T and precipitation
    - Air temp up leads to increased water temp and evaporation
    - Changes in precipitation
    - Increased frequency, magnitude and duration of extreme T events (but also think about other parameters e.g. rainfall) (think about the trifecta rather than singly)
- Hard to summarise ecological outcomes over large areas (scale issue)
- Modelled hydrological scenarios can be used to predict habitat changes (e.g. to floodplain inundation frequency, magnitude and duration)
- Need to think about alien species invasion versus invading species (native species changing range)
- High DOC (from high levels of organic matter) a risk to potable water supplies.

Full reports have been obtained and are briefly reviewed below:

Impacts on water quality (SKM, 2010).

- The report focuses totally on extreme events.
- There is no reporting of the part 1 work on review of wq monitoring data.
- Includes simple conceptual models for impacts of the various extreme events considered:
  - Drought
  - Heat waves
  - Bushfires
  - Flooding (extreme precipitation events)
  - Dust storms
- The conceptual models will be useful.
- Risk assessment approach is worth considering should help focus attention on relevant issues, although vulnerability will also need consideration.

Impacts on aquatic ecosystems (Sheldon *et al.*, 2010)

- Includes a useful literature review of climate change impacts on aquatic ecosystems
- Highlight sensitivity of aquatic ecosystems to climate change due to high heat capacity of water
- Has many very useful (relatively simple) conceptual diagrams for a number of ecosystem components (see example over).

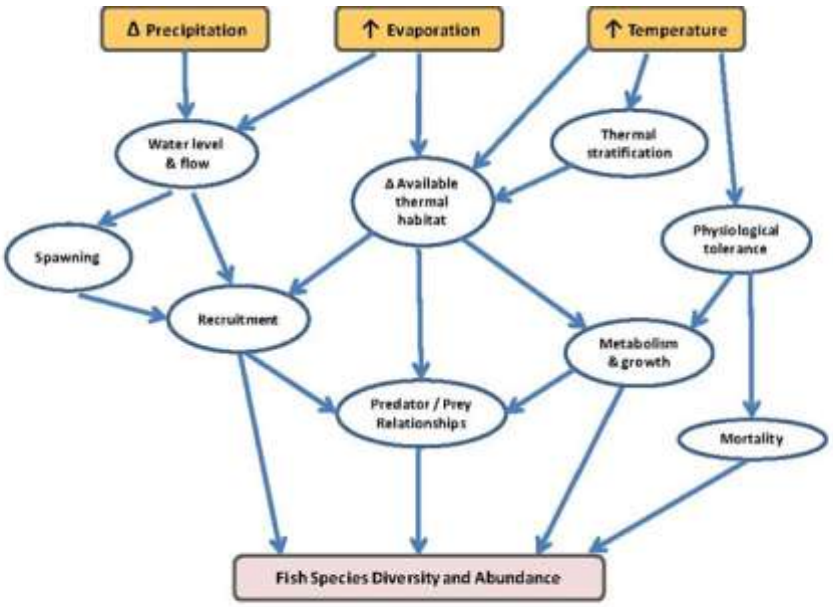

Figure 3-1. Conceptual model of the predicted impact of climate change (mediated through changes in precipitation, increased temperature and increased evaporation) on fish species diversity and abundance.

- The conceptual diagrams all follow a similar template and include consideration of changes in T, Et and T a useful idea.
- Refer to a modelling approach adopted for quantifying changes in aquatic habitat under different climate scenarios by Marsh et al 2010 but little detail is provided. It seems the

approach is to identify key species and quantify the watering needs of those species in the form of habitat models. These models of water needs are then run at key locations for alternative climate scenarios and the results provide a relative comparison of the likely changes in habitat availability under the different climate scenarios. (I suspect the approach is similar to that used by (Bond *et al.*, 2010).

- Outline an approach for describing potential impacts at a regional, rather than a basin scale.

Conclusions

- The approaches in both reports point to some useful approaches (a recipe book) to thinking about potential climate change impacts.
- The conceptual models are very useful and they aren't too detailed.
- Risk assessment approaches should also be in the recipe book.
- Are modelling approaches too quantitative (detailed and difficult) for this project at this stage? But, the idea of considering frequency, magnitude and duration of extreme events is useful.

References

Bond, Reich, Thomson, Giling and Stein (2010). Modelling the impacts of climate variability and change on fish to inform NRM investment strategies (DSE Refugia Project) Final Report. June, 2010, Monash University for Department of Sustainability and Environment.

Sheldon, Balcombe, Capon, Hadwen, Kennard, Bond and Marsh (2010). Modelling the impacts of Climate Change on aquatic ecosystems of the Murray-Darling Basin, Murray-Darling Basin Authority, Canberra.

SKM (2010). Impacts to Water Quality in the Murray-Darling Basin arising from Climate Change. Water quality risks from extreme events. Draft A, Murray Darling Basin Authority.

An assessment of whether current governance arrangements are well placed to deal with the challenges of conserving biodiversity in a changing climate

The Goulburn Broken Catchment Management Authority and its partners have been working towards improving the resilience of the catchments natural assets, through the development of a number of strategies for example the Goulburn Broken Biodiversity Strategy and the implementation of a number of on-ground activities.

A regional approach to prioritising natural assets (along with a state and national view) and activities is vital in ensuring that challenges of conserving biodiversity in a changing climate is achieved. A regional approach allows for innovation and those closest to the issues to address the challenges. This should be supported through both the State and Federal governments.

Current arrangements allow for the implementation of revegetation activities, protection of remnant vegetation and protection of waterways to name a few. This has been achieved through a number of approaches such as grants (Environmental Management Incentives), market based instruments (such as Bush Returns, Greengraze and Wetland Tender) and education (through CMN's and Landcare). Systems based approaches have also been used in the case of Pasture Cropping and Grazing Management activities.

However, a workshop held in 2008 to highlight the need for the Goulburn Broken CMA programs to consider and respond to climate change concluded that although we have some of the tools at the CMA's disposal, the scale and timeframes in which the activities need to take place where not appropriate. In general it is

clear that the governance arrangements need to allow for more of the activities that are currently invested in within a quicker timeframe.

The governance arrangements also need to allow for long-term projects, funding cycles need to be drawn out as long as possible but always allowing for flexibility and changes as a result of new information.

References:

SKM (2008). Information and communication on vulnerability of NRM regions to climate change Goulburn Broken CMA Workshop.