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CITY TO CAPE
2100 SEA-LEVEL RISE
SEMINAR REPORT

CURTIN UNIVERSITY OF TECHNOLOGY, PERTH
22 JULY 2010

Curtin University

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CITY TO CAPE: 2100 SEA-LEVEL RISE
Seminar Report

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Contents

Introduction

THEME: COPING WITH THE LIKELY IMPACTS OF SEA-LEVEL RISE ON AUSTRALIA'S SOUTH-WEST COAST – FROM PERTH TO CAPE NATURALISTE – BY 2100.

A one-day seminar titled *City to Cape: 2100 sea-level rise* was held on the 22nd July 2010, at Curtin University, in Perth. The purpose of the seminar was to raise the level of understanding of projected sea-level rise and its impacts over Western Australia's coastal region from Perth to Cape Naturaliste through presentations by experts and informed debate and analysis.

It was not the purpose of the Seminar to debate the causes of climate change but rather to focus on the extent of sea-level rise and initiate the development of strategies for the mitigation of, and adaptation to, the effects of the likely rise in sea level for the region.

The seminar was sponsored by the Australian Academy of Technological Sciences and Engineering (ATSE), Engineers Australia (EA) and Curtin University's Australian Sustainable Development Institute (ASDI). It was attended by some 150 people, including a State parliamentarian, and representatives of many of the local government municipalities along the coast, several WA Government departments, Perth universities, consulting engineers, contractors, port authorities, environmental groups, property developers, the insurance industry, emergency services, general public and the three sponsoring organisations.

The seminar program was chosen to be broad, deliberately reflecting the complexity and cross-disciplinary character of a challenge affecting all sectors of Society. Thus, presentation topics spanned the geological setting, the science of sea-level rise, engineering principles and applications, planning principles, social science and public values, and legal perspectives.

In addition to making their presentations, the speakers participated in panel discussions, developing on questions and comments from the audience. The program, biographies of speakers and abstracts of their papers from the Seminar are included in this report as addenda. All of the lectures (presentation slides and sound) recorded during the day of the seminar are web-mounted at:
http://www.asdi.curtin.org.au/knowledge_hub/lectures.cfm

Seminar recommendations have been prepared for consideration by the various levels of Government, the professions and all stakeholders.

Background

The coastal region from Perth (and adjacent areas) to Cape Naturaliste is somewhat unusual in the world in having a micro-tidal environment (average tidal range being about 0.6 metres) coupled with relatively low-relief, coastal plains. While some of the coasts have rocky shores or protecting off-shore reefs, many consist extensively of unconsolidated sediments and are therefore prone to erosion, sediment transport and re-deposition. Moreover, the off-shore reefs may lose their protective ability in overtopping situations.

Accordingly, relatively small, systematic increases in local sea level are likely to have important impacts on coastal shores – even though the impacts may be slow and/or sporadic. Furthermore, the micro-tidal environment limits the effectiveness and application of some well-known protective structures, such as barrages that open and close, which are used in other parts of the world where there is a wide tidal range.

Fundamentally, should local sea-level rise exceed the current tidal range on a permanent basis, tidal drainage – for example, behind protective barrages designed to prevent present water levels being exceeded – would not be effective.

Key Issues

A number of key issues emerged at the seminar and are summarised as follows.

1. WORKING IN AN ENVIRONMENT OF UNCERTAINTY

A recurring theme in presentations and panel sessions was the importance of being able to plan, prepare, work, and/or cope with a degree of uncertainty in terms of the extent of likely sea-level rise at a time-scale of several decades. It is equally important that the public understand the scientific concept of uncertainly so that it is able to engage effectively with planners and decision-makers.

2. LEVEL OF RISE FOR PLANNING

Two speakers showed that it would be wise planning to take into account a possible/probable rise of local sea-level of the order of 0.8 to 1.0 metres by 2100, resulting from expansion of the oceans due to global warming. This aligns with Western Australian Planning Commission's revision (September 2010) from a figure of 0.38 metres up to 0.9 metres as being the likely rise by 2110, While the frequency of extreme storm events will not change significantly, their intensity will and their effects will be compounded by underlying sea-level rise. The contribution resulting from any substantial melting of landmass ice, dominated by the icecaps of Greenland and Antarctica, would cause an additional component of a potentially far greater magnitude.

3. ABILITY TO MEASURE CHANGES TO ICE CAP MASS

Scientific and technological developments are now making it possible to measure directly the extent of change to the icecaps. For example, the GRACE pair of satellites (Gravity Recovery and Climate Experiment, a joint NASA and German Aerospace Centre mission, launched in 2002) allows the measurement of small variations in the Earth's gravity field which can then show changes in the mass (and thus volume) of ice. By interpretation of such data, science will soon be able to predict quantitatively the contributions of melting icecaps to sea-level rise. Such studies will also be able to provide "early warning" of accelerated melting should this take place.

4. THE 18.6-YEAR LUNAR NODAL CYCLE

Local sea-level rise is modulated by an 18.6-year lunar nodal cycle of some 20 centimetres amplitude, comparable with the increase in mean sea level over the past 20 years. The nodal cycle is currently heading down, which could ease community concerns, but the next nodal maximum will be approximately 2025, adding to the accumulating sea-level rise. Notable coastal flooding impacts occur when more than one of the contributing factors – storm surge, nodal lunar cycle and heavy rain – coincide. Such impacts are being exacerbated by slow but continuous sea-level rise.

5. ACTION PLANS

It seems that insufficient has been done in the area of long-term planning (over time scales of several decades) for the projected impacts of climate change on coastal areas. At this relatively early stage appropriate thought and effort could be put into making sensible recommendations, using risk-management techniques. A planning body could make integrated recommendations on such issues as:

- set-backs from the coastline;
- defend or retreat strategies;
- levels above mean sea level at which developments should be set;
- foundation type, sea walling and protection types for different shorelines;

- responsibilities (between developers and approving bodies);
- tenure of developments;
- maintenance;
- types of developments (temporary or permanent); and
- usage of the facility (recreation, commercial or residential).

Such a planning body could pull together and integrate all current information, fill gaps in the information and produce materials (maps, sketches and broad specifications) that could direct or inform long-term governmental decisions.

6. INAPPROPRIATE ENGINEERING SOLUTIONS

If local sea-level rise turns out to be of the order of 1.0 metre by 2100, the "creeping tidal range" would result in a relatively short life span for the concept of protection against rising sea level by opening and closing barrages (for example across the mouth of the Swan River at Fremantle) because of the characteristic micro-tides in the region. It was also reported that 'maladaptation', whereby an engineering intervention such as coastal armouring solves a local problem but creates a problem elsewhere, needs to be avoided. Engineering strategies must therefore be assessed within a holistic context.

7. APPROVALS PROCESS

WA currently has at least nine approving bodies and three levels of Government involved in the approvals process for projects and developments which involve climate-change effects. Added to this are stakeholders from the oil and gas, shipping, fishing, tourism and recreation industries, plus the general community and conservationists. It is reported to be very difficult to work with the complexity of present planning processes. This can lead to outcomes that are probably not what is best for the future, but instead are protracted, with delays adding unnecessary expense.

8. LEGISLATION

It is inevitable that as increasing losses occur as a result of flooding, inundation and severe storm damage, stakeholders will look for ways to recover their losses. Insurance companies are already reviewing their cover. Approving bodies will likely become the target of claims and thus adopt much tighter conditions to project approvals. There needs to be a close look at the issues and legislation established which removes as many of the "grey areas" as possible from potential disputes.

9. EDUCATION

The seminar emphasised the importance of climate-change education for both the general public and school students. This would enable present and future generations to engage constructively in planning, endorsing and promoting through the political process the strategies that can ameliorate the effects of sea-level rise. School curricula would benefit from inclusion of the scientific and engineering components of the seminar presentations couched at a technical level matched to the level of ability to understand and form opinions on the material presented. As generations moved through the educational system with enhanced levels of understanding and conviction, it would be easier for decision makers to make the "right decision" rather than being forced by present expedients to make a "popular decision". Good television programs, or other forms of popular media, could achieve similar results for members of the general public who had progressed beyond the formal education period of their lives.

10. EXPERT INPUT

Expert bodies such as ATSE, Engineers Australia and universities, together with the other three Australian Academies (the Academy of Science, Academy of Social Sciences, and the Academy of Humanities) can play an effective role interfacing with government to promote understanding and action in the important areas of climate change. Furthermore, they can drive the adoption of a long-term

non-partisan agenda and continuity of planning. In parallel, the support available from these bodies can assist in informing the general public, thereby easing the political challenge of parliamentarians to represent their constituents when making decisions that address the long-term demands of coping with climate change and sea-level rise.

Recommendations

The key recommendations arising from the seminar are that:

1. EDUCATION

More focused programs of education for students and the general public be undertaken to provide objective information and impart understanding of climate change and sea-level rise as it directly impacts upon their region. Such education needs to utilise a language and conceptual framework that can be readily understood by the audience addressed.
[Addressing key issues: 1, 2, 3, 4, 6, 9, 10]

2. GREATER INVOLVEMENT OF EXPERTISE

Key expert bodies work to forge increased non-partisan links with the State and local governments to serve as a conduit for the provision of expert and objective advice on issues of climate change and sea-level rise that will enable properly informed policy to the developed.
[Addressing key issues: 1, 2, 3, 4, 5, 6, 7, 8, 10]

3. ASSESSMENT AND APPROVALS PROCESS

The three levels of Government develop streamlined and unified assessment procedures, together with a practicable approvals process, for projects deemed to have, or be subjected to, sea-level rise impacts.
[Addressing key issues: 1, 2, 4, 5, 6, 7, 8]

4. ACTION PLAN FOR COASTAL DEVELOPMENT

A committee comprising scientists (including social scientists), engineers, planners, lawyers and insurance (risk-management) organisations, be formed to bring together the full range of current information on the projected impacts of climate change on coastal regions and, through critical analysis, identify risks and options in an action plan for coastal development.
[Addressing key issues: 1, 2, 4, 5, 6, 8, 10]

5. FEASIBILITY OF ENGINEERING UNDERTAKINGS

A body of engineering knowledge be developed for the region that can be accessed to inform and determine the likely efficacy, impacts and characteristics of coastal engineering developments and /or projects designed to ameliorate the effects of future sea-level rise, storm surge and flooding rains.
[Addressing key issues: 1, 2, 4, 5, 6, 7, 10]

6. LEGISLATION

The legal profession be mobilised to report to government and engage with the action-plan committee on developments and precedents set in the management of sea-level rise issues as well as proposing workable legislation that can accommodate the special situations that may arise in Western Australia.
[Addressing key issues: 1, 2, 5, 7, 8]

Addendum 1: Seminar Program

Title	Speaker
Seminar Opening: Welcome to Country, Welcome to Curtin University	Professor Jeanette Hacket, Vice-Chancellor of Curtin University
Purpose of Seminar	Professor Ray Smith, ATSE, CSIRO & Curtin University
Morning Session I Chaired by Dr Ian Duncan, ATSE & Engineers Australia	
Geology of our living coastline, Perth to Cape Naturaliste	Mr Bob Gozzard, WA geological Survey
Understanding sea-level rise and its implications for the future [The science of sea-level rise: national and international principles, best estimates, drivers, and what sea-level rise is likely to mean]	Dr John Church, CSIRO, Hobart
Morning Session II Chaired by Mr Charlie Thorn, Curtin University's Australian Sustainable Development Institute (ASDI)	
The Science of Sea Level Rise: implications for Perth and surroundings	Professor Chari Pattiaratchi, University of Western Australia
Engineering a Response to Sea Level Rise: An International Perspective [Engineering principles with regards to protection, adaptation and costs: international perspectives]	Professor Paul Hardisty, WorleyParsons
Panel Discussion (morning speakers) chaired by Dr Ian Duncan and Mr Charlie Thorn	
Afternoon Session : Chaired by Prof Tony Lucey, Engineers Australia & Curtin University	
Southwest WA: Coastal engineering principles for response to climate change [Engineering principles with regards to protection, adaptation and costs: Perth to Cape Naturaliste region]	Mr Matt Eliot, Damara WA
Planning perspectives and implications: issues and uncertainties	Professor David Wood, WA Planning Commission & Curtin University
Social and Sustainability Impacts of a 1m Sea Level Rise [Our lives – the social reality of sea level rise: loss of beaches, impact of sea walls, coastal retreat, attitudes and actions]	Mr Darren Bilsborough, Parsons Brinckerhoff (for Prof Peter Newman) and Associate Professor Laura Stocker, Curtin University
Legal Perspectives	Mr Glen McLeod, Partner, MinterEllison
Panel Discussion (all speakers) chaired by Prof Tony Lucey and Mr Charlie Thorn	
Closing remarks	Professor Ray Smith, ATSE, CSIRO & Curtin University

Addendum 2: Abstracts and Speaker Biographies

Geology of our living coastline, Perth to Cape Naturaliste

Mr Bob Gozzard, WA Geological Survey
bob.gozzard@dmp.wa.gov.au

Abstract

Both the position and shape of the shoreline are ephemeral. They change in response to variations in sea level, sediment supply and transport, and wave and swell patterns. Changes in sea level are related to changes in climate on a geological timescale, on historical timescales, and to short-term storm events. These changes are interrelated and their effects can be seen in the landforms that develop in the coastal environment. Shorelines in southwest WA are wave-dominated and can be broadly categorised into two types – rocky and sandy coasts. Gneissic rocks are found between Cape Naturaliste and Dunsborough where they form smooth slopes with boulders at the base of the cliffs. In contrast, limestone, which occurs between Perth and Bunbury, is eroded into vertical cliffs that can be undercut and become liable to collapse. Sandy coasts are more dynamic and display a wide range of landforms. Large-scale landforms, such as cuspate forelands, parabolic and transgressive dunes, have formed gradually during periods of higher and lower sea levels in response to the waxing and waning of polar ice caps. Sediment was pushed ashore and deposited as a foreshore wedge as the sea level rose. Sometimes this sediment enclosed embayments and formed coastal lakes like Lakes Preston and Clifton south of Mandurah. Three types of beaches are found along the coast – wave-dominated sandy beaches on high energy coasts like those between Fremantle and Trigg; low-wave, sheltered coasts like those north of Sorrento and south of Fremantle; and perched beaches like those at Cottesloe and North Beach.

Biography

Bob Gozzard has worked at the Geological Survey of Western Australia since 1981. He has been involved in a number of regolith and geomorphological mapping projects throughout WA, from the coastal belt to the arid interior. Bob is currently producing a guide and atlas of applied geological information for the southern Swan Coastal Plain that can be easily understood by non-geologists and that can be incorporated into local and regional planning policies and frameworks. He is also developing a geological framework for coastal characterisation as an input to marine and coastal management activities.

Understanding sea-level rise and its implications for the future

Dr John Church FTSE, CSIRO, Hobart
John.Church@csiro.au

Abstract

Sea-level rise is a high profile and controversial aspect of climate change. Over the last two decades, there has been significant progress in understanding sea-level rise. The rate of sea level has increased from the 19th to the 20th century and since 1993 has been rising at over 3 mm/yr. The main contributions are ocean thermal expansion, the melting of glaciers, with smaller contributions from the ice sheets of Greenland and Antarctica and changes in terrestrial storage. It now appears that the ice sheets are making an increasingly important contribution. Perhaps surprisingly, volcanic eruptions have a link to the rate of sea-level rise, particularly through changes in ocean heat content. Since the early 1990s, sea level has been rising at close to the upper end of the IPCC Third and Fourth Assessment Report projections. Despite the importance of sea-level rise, the last two IPCC reports have not been able to satisfactorily close the sea-level budget. Updated estimates of the observed rate of rise from both satellite altimeter and in situ observations together with estimates from all of the major contributions to sea-level change now satisfactorily explain the observed rise. An important component is the contribution of the Greenland and Antarctic Ice Sheets. Sea-level rise will continue during the 21st century and beyond. Changes in sea level will be felt most acutely through extreme events, particularly coastal flooding and erosion. Increases in the frequency and intensity of coastal flooding events has already been observed on the Australian east and west coasts during the 20th century, and will continue during the 21st century. Sea levels will continue to rise and there is the possibility that during the 21st century greenhouse gas concentrations will cross critical thresholds leading to sea-level rise of metres over coming centuries.

Biography

John Church is an oceanographer with the Centre for Australian Weather and Climate Research and the Antarctic Climate and Ecosystems Cooperative Research Centre. He was co-convening lead author for the Chapter on Sea Level in the IPCC Third Assessment Report. He was awarded the 2006 Roger Revelle Medal by Intergovernmental Oceanographic Commission, a CSIRO Medal for Research Achievement in 2006 and the 2007 Eureka Prize for Scientific Research.

The Science of Sea Level Rise: implications for Perth and surroundings

Winthrop Professor Charitha Pattiaratchi, University of Western Australia
Chari.pattiaratchi@uwa.edu.au

Abstract

In south-western Australia experiences a micro-tidal range (~0.5m) and therefore small changes in mean sea level have a large influence on the coastal response and stability. The Fremantle tidal record has shown that the mean sea level has increased almost 20 cm at a rate of 1.54 mm per annum since 1897, representing more than 20 per cent of the tidal range. From 1990, rate of increase in the mean sea level has increased. The increase in the mean sea level means that extreme storm surges reach higher levels resulting in coastal flooding and enhanced erosion of beaches with the erosive effects of wave action able to reach higher on the beachface. Climate change can also influence the global wind field thus changing the frequency and magnitude of storm surges and the wave climate. Hindcast sea levels along the south-west of Australia have identified marked changes to the number and the tracks of storms over the past

60 years. The changes to the mean sea level and storm surge climate are superimposed on the natural changes to the mean sea level due to tidal effects particularly due to long-term changes arising from the lunar nodal tide which as 18.6 year cycle and an amplitude of 20 cm which is comparable with the increase in mean sea level over the past 20 years. Thus similar to coastal regions around the world, south-west Australia is vulnerable to climate change impacts at the shoreline arising from changes to the wind climate, frequency and magnitude of storm surges and mean sea level rise. The combined effects of an altered wind wave climate and the magnitude and frequency of storm surges together with relative sea level rise would have important implications for coastal stability, flooding and vulnerability.

Biography

Professor Charitha Pattiaratchi holds Bachelors, Masters and PhD degrees from the University of Wales, UK. He has been at the University of Western Australia for over 20 years and currently holds the positions of Winthrop Professor of Coastal Oceanography and Head of the School of Environmental Systems Engineering. Professor Pattiaratchi has supervised over 30 PhD students and 100 honours students and has published over 300 articles/reports on coastal oceanography, which include over 100 in peer-reviewed international journals. Professor Pattiaratchi's research interests are in coastal physical oceanography and coastal sediment transport, with emphasis on field experiments and numerical modelling.

Engineering a Response to Sea Level Rise: An International Perspective

Professor Paul Hardisty, Worley Parsons
paul.hardisty@worleyparsons.com

Abstract

Under a mandate from Congress, 55 of America's leading scientists determined that man-made climate change is real. Its effects are already being felt and immediate action is necessary to limit damage.

Sea-level rise is accelerating and momentum in the system could mean a rise in sea level of a metre by the year 2100. It is time to engineer an adaptation response. Globally 40 per cent of the world's major cities lie on low coastal elevations. Engineering responses being considered include coastal defences, landform changes and dykes. Relocation may be the only option for some cities. Engineering and construction services will come under huge pressure as the effort will be required everywhere at the same time. This massive effort in itself could add to the problem by producing significant carbon emissions unless there is a shift away from fossil fuel produced energy. The world's poorest nations will be the most affected and have the least ability to cope. Rich nations may be overwhelmed and unable to assist. The irony is that the efforts to protect ourselves from disasters of our own making could be seen as a positive contribution to GDP. Modern Engineering is capable of protecting us from sea-level rise.

Biography

Paul is originator of the Environmental and Economic Sustainability Assessment (EESA) method, quantifying environmental, social and economic issues supporting more sustainable decisions. He is a recognised expert in investigation and remediation of contaminated sites and groundwater, visiting Professor in environmental engineering at Imperial College London, UK, and Adjunct Professor at the University of Western Australia, teaching sustainability. He is author of books on groundwater remediation and protection economics and, recently, on sustainability. Paul is Director of Green Cross Australia, an international environmental NGO contributing to President Gorbachev's Climate Change Task Force, and Member of the Waste Authority of Western Australia. He lives in Perth, Western Australia.

Southwest WA: Coastal engineering principles for response to climate change

Mr Matt Eliot, Damara WA
matt.eliot@damarawa.com

Abstract

Climate change, including sea level rise, is expected to cause erosion and increased mobility of coastal landforms, placing pressure on our foreshore reserves and existing coastal defences. We expect increased public pressure for coastal protection structures to defend our assets and amenity. Climate change should be recognised in the way we manage our coast and design coastal protection structures.

There is a need to prioritise and target defensive efforts, clearly identifying likely, future and possible impacts to the adjacent and downdrift coast. Along the Southwest coast, impacts should be considered within coastal compartments, defined by the underpinning geological structure. The nature of the site will commonly determine the immediacy of any defence, with existing accretion zones expected to be under less pressure than areas already experiencing erosion.

For new or existing coastal defences, change, including structural degradation, will affect the performance criteria of the structure. However, in many cases, it is not feasible or practical to construct a present day structure for future changes. It is necessary to design for adaptation, where the structure may be readily modified to improve its capacity. The simple concept of 'build for the expected, but plan for the worst' provides a prudent approach.

Adaptive design requires regular monitoring of coastal structures, and the conditions affecting their performance. These should be reviewed with an understanding of the parameters to which structural performance is sensitive. Design criteria should include allowance for uncertainty associated with climate change or coastal evolution over the defined monitoring-repair-modification period.

Biography

Matt Eliot has 16 years of experience as a civil engineer, with specialist project experience as a coastal and maritime engineer, being involved with projects covering shore protection works, dredging, water quality evaluation, mooring systems, boat ramps and piled structures. He has particular knowledge of Western Australian coastal processes, including detailed research into sea level phenomena. Matt has undertaken a range of studies in the southwest involving historic and projected climate change assessments to identify suitable strategies for foreshore management and protection.

Planning perspectives and implications: issues and uncertainties

Professor David Wood, WA Planning Commission &
Curtin University of Technology

Abstract

The impacts of climate change are likely to erode the beaches we love, make our farm lands less productive, reduce biodiversity, make our cities hotter and more susceptible to extreme events, render useless important infrastructure and more. However, while many acknowledge the likely impacts of climate change we appear, on one hand, reluctant to alleviate the causes of climate change and on the other, to develop policies to adapt to climate change impacts.

Western Australians have size 13 carbon footprints; amongst the largest if not the largest of all human beings in the world but we insist on living in larger and larger houses in sprawling urban environments. Because our urban environments are so dispersed, we suffer from inadequate public transport systems and are car dependent and nationally, Australia lacks bipartisan support for measures to reduce carbon emissions lagging behind many other nations.

Whilst we appear to lack the will to reduce harmful pollutants and the foresight to remediate past actions that have formed a society of profligate carbon emitters, we seem blind to the likely impacts of climate change. CSIRO scientists have demonstrated that the severity and frequency of severe storms in Fremantle has increased and these storms threaten coastal infrastructure throughout the south-west. These storms, CSIRO scientists argue, are stark reminders of the threat posed by climate change, reminders that have arrived in advance of ambient sea level rises.

This presentation will discuss public policy measures to reduce carbon emissions and question our apparent reluctance to prepare to adapt to the impacts that climate change.

Biography

Professor David Wood is Deputy Vice-Chancellor, International (DVCI), at Curtin University of Technology and is a member of Curtin University's executive management team. Before being appointed DVC I, Professor Wood was Pro Vice-Chancellor (PVC) of Curtin University's Faculty of Humanities.

Professor Wood is a prominent urban and regional planner in Western Australia and, in addition to his responsibilities at Curtin University, he is Chair of Western Australia's Coastal Planning and Coordination Council, and is a Commissioner of the Western Australian Planning Commission. Until recently, he was Chair of the Ningaloo Sustainable Development Committee and a Councillor of the Western Australian Heritage Council.

Social and Sustainability Impacts of a 1m Sea Level Rise

Professor Peter Newman FTSE and
Associate Professor Laura Stocker,
Curtin University of Technology.
l.stocker@curtin.edu.au
Note that Peter Newman's contribution was presented by Adjunct Professor Darren Bilsborough,
Parsons Brinckerhoff, Australia Pacific
dbilsborough@pb.com.au

Abstract

The impact of sea level rise can be overstated as though there is nothing that can be done about it. On the contrary when whole suburbs are threatened with being abandoned then engineering action will be demanded and political action will be taken to ensure it will occur. The costs of this will be high and rising but will have to be done cleverly and the sooner the better. In cities the need to build sea walls and barrages will become very obvious and will be illustrated in Fremantle and Mandurah in ways that can be easily adopted. However there will be beach-based suburbs where the costs will be too great and 'retreat' will be the only option. The social implications of this are severe. They are the same also when we build in vulnerable areas on flood plains. The 'rights' of people, developers and companies to build in such locations are going to be the subject of much litigation and pain so we must try to ensure that the planning system does not allow building in these long term problem areas. The planning principles of

focusing development and retreating from unfocussed scatter have been well known for 100 years and the planning powers are there to enforce it. It just needs to be done.

Biographies

Peter Newman is the Professor of Sustainability at Curtin University and was recently appointed as a Lead Author on the next IPCC Report on Transport. He is on the Board of Infrastructure Australia that is funding infrastructure for the long term sustainability of Australian cities. His two new books in 2009 'Resilient Cities: Responding to Peak Oil and Climate Change' and 'Green Urbanism Down Under', were both written with Tim Beatley. In 2001-3 Peter directed the production of Western Australia's Sustainability Strategy in the Department of the Premier and Cabinet.

Associate Professor Laura Stocker is a Marine Ecologist and coordinates the Master in Sustainability Studies at the Curtin University Sustainability Policy (CUSP) Institute. She researches and teaches in the areas of coastal sustainability, climate change policy, sustainability education, sustainability mapping, and cultural models of the coast and conceptual aspects of sustainability. She is currently deputy leader of the new CSIRO Coastal Collaboration Cluster, a nationwide research project that focuses on enabling science uptake by decision-makers in Australia's coastal zone.

Darren Bilsborough is an engineer whose career has taken him throughout Asia-Pacific. He has been at the forefront of sustainable development issues in the built environment in a number of roles, including inaugural Chair of the Sustainable Development Committee for the South Australian Division of the Property Council of Australia, serving on the SA Premier's Round Table on Sustainability in 2003, and as Chair of both the Sustainable Settlements Subcommittee of the Round Table and the building sector working group for the SA Greenhouse Strategy 'Tackling Climate Change' released in May 2007. Darren serves on the National Council of Directors of Environment Business Australia and on the SA Development Assessment Commission.

Since joining Parsons Brinkerhoff as Director of Sustainability in July 2007, Darren has been responsible for development of policy and strategy in the delivery of sustainable infrastructure solutions in the Australasia region. Darren is also an Adjunct Professor of Sustainability at Curtin University.

Legal Perspectives

Mr Glen McLeod, Partner, Minter Ellison

Abstract

As the risks faced by coastal property owners become more pronounced, the availability of insurance for these vulnerable property owners will likely be restricted, with rising premiums and reduced coverage. Given the lack of protection offered by insurance, property owners are more likely to pursue compensation from other sources. One such avenue for compensation may be to pursue the decision makers who gave planning approval for development on coastal property and exposed these property owners to the risk of damage caused by rising sea-levels and storms, or the local authority who failed to implement protective measures along the coastline to reduce the risk of erosion, flooding and storm damage. This paper will explore some of the legal issues surrounding the liability of local government and coastal developers, particularly in relation to claims of negligence. The liability of local councils in

this context has yet to be tested and there remains a lot of uncertainty about the extent to which the actions of local authorities can be said to have caused damage sustained by property owners and the policy implications of such liability. However, it is arguable that we have reached a point where there is enough knowledge about the risks associated with climate change and rising sea-levels to place an onus on local governments, developers and decision-makers at all levels to inform themselves of these risks and implement mitigation and avoidance measures to reduce these risks. A failure to do so may well result in their liability for the damage sustained as a result.

Biography

Minter Ellison Partner, Glen McLeod has more than 30 years experience in environmental, planning, government and climate change law. His blend of local and international experience includes the establishment of major new projects including redevelopment schemes, complicated infrastructure projects and the enhancement or protection of significant long-term industrial operations and real estate assets. His skills include project management, litigation and strategic planning in approval processes.

Minter Ellison has been acknowledged for its commitment to addressing climate change, and continues to invest in improvement strategies for environmental performance, to reduce its greenhouse footprint and to work with its clients to address the challenge of global warming and associated environmental phenomenon.

Addendum 3: Organising Committee

Name	Role	Affiliation
Professor Ray Smith FTSE	Chairperson	ATSE, CSIRO and Curtin University
Dr Ian Duncan FTSE	Treasurer	ATSE and Engineers Australia
Mr Ray Purdy FTSE	Committee Member	ATSE and Engineers Australia
Mr Charlie Thorn	Committee Member	Australian Sustainable Development Institute (ASDI), Curtin University
Professor Tony Lucey	Committee Member	Engineers Australia and Curtin University
Ms Kelly Pilgrim-Byrne	Committee Secretary	Curtin University

Addendum 4: Sponsor Organisations

AUSTRALIAN SUSTAINABLE DEVELOPMENT INSTITUTE

www.asdi.org.ua

Curtin University of Technology has established the Australian Sustainable Development Institute (ASDI) for the purpose of advancing the economic and social welfare of the state, the nation and the world without compromising the quality of the environment for current and future generations. ASDI has a unique mix of themes and priorities not found in other Australian environment and sustainable development institutes. ASDI combines the capacities of diverse research and teaching groups and disciplines in the four Faculties ranging across energy policy, efficiency and technology; climate change adaptation and coastal development, water management, sustainable resources, regional development, Indigenous futures and community engagement, Asia partnerships, urban development and sustainable cities, information and infrastructure security and sustainable food.

Curtin University

ENGINEERS AUSTRALIA

www.engineersaustralia.org.au

Engineers Australia (EA) is the national organisation for the advancement of engineering and the professional development of its members. EA has 90,000 members embracing all disciplines of the engineering team, making it the largest and most diverse professional body for engineers in Australia. Divisions of Engineers Australia exist in each state territory; the Western Australia Division has in excess of 12,000 members. EA assesses and accords the status of Chartered Engineer – the recognition of a qualified and experienced professional – trusted not only in Australia, but also worldwide. EA conducts a broad range of activities for its members, the profession and the broader community. These include professional development, advocacy, engineering-program accreditation, migration-skills assessment, and schools and community programs to increase awareness and understanding of engineering.

ENGINEERS AUSTRALIA

THE ACADEMY OF TECHNOLOGICAL SCIENCES & ENGINEERING

www.atse.org.au

The Academy of Technological Sciences & Engineering (ASTE) is an independent, non-government organisation, promoting development and adoption of new and existing technologies to improve and sustain our society and economy. Objectives of the Academy are to promote, in Australia, the application of scientific and engineering knowledge to practical purposes. ATSE is one of four Academies in Australia, the others being the Academy of Science, the Academy of Social Sciences and the Academy of Humanities. ATSE's purpose includes:

- providing a forum for informed debate;
- Eencouraging research, education and the pursuit of excellence; and
- providing analyses and advice to governments

ATSE

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ATSE

City to Cape: 2100 Sea-Level Rise – Seminar Report

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