Responding to Sea Level Rise

ENGINEERING PRACTICAL CLIMATE CHANGE SOLUTIONS

Institute of Public Works Engineering Australia

Balancing the Risks of Climate Change

Is Sea Level Rise Your Greatest Risk ?

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GHD Asset Management Group

Content of Talk

- Introduction – the Premis
- What is the real coastal risk ?
- Is it our greatest risk ?
- Understanding the whole of Infrastructure Business Risks
- Valuing and comparing risks
- Adopting viable economically justified mitigation strategies

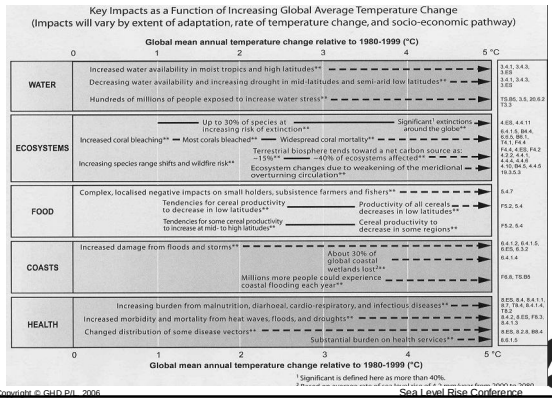
Key Take Home Messages

- Sea levels will rise – gradually over the next 50 years.
- Cyclonic troughs (low pressures) already lift water (storm surges) far higher than climate change will
- Strong wind events (cyclonic) are here already and will occur with greater strength and more frequency over the next 50 years
- The wave heights & their impacts from these wind events outweigh all the above issues

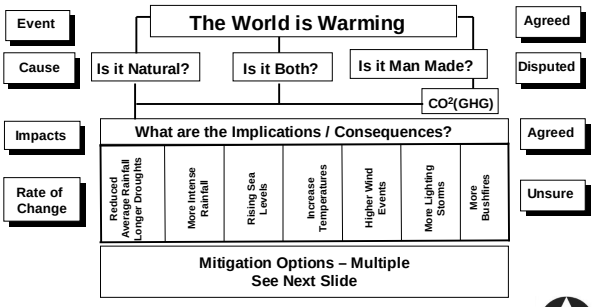
Key Take Home Messages

- But is this our greatest business risk ?
- We need to act holistically on this issue and take a whole of Municipality approach

The Total Climate Change Risks



Logic Diagram – Climate Change



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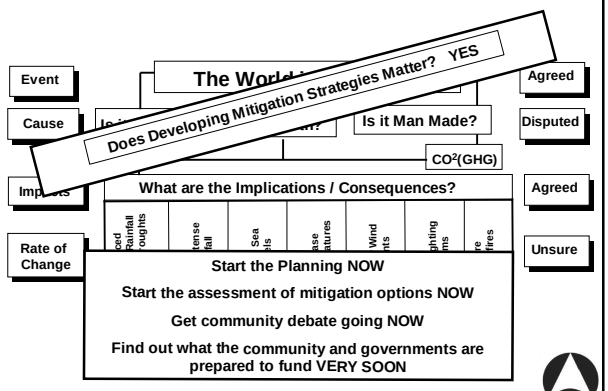


Climate Change – Key Impacts

- Rise in average temperatures
- Reduced total long term rainfall
- Increased high wind events
- Increased rainfall intensity (storm events)
- Increased sea level and foreshore erosion
- Increased lightning activity and strikes
- Less clouds more direct sunlight

Risk Management

RISK = CONSEQUENCE X PROBABILITY

HAZARD = IMPACTS X LIKELYHOOD

NO - NOT ALWAYS

REAL RISK = RISK + OUTRAGE

Climate change is an event that can easily cause total outrage…global bird flu is another

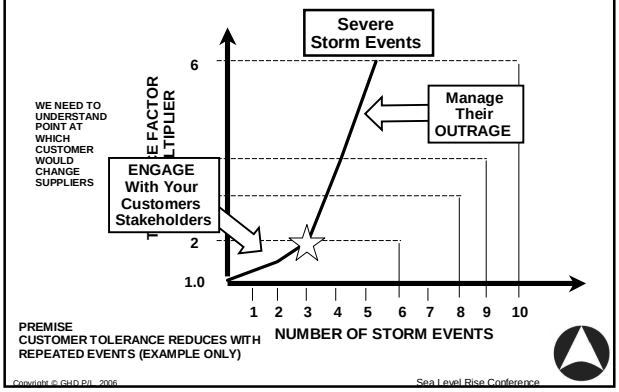
What is Outrage ?

- Public outrage is when logic is put aside.
- It is when our customers & communities of interest feel that:
- The consequences of an event are considered far greater than they really are
- It is when mathematical probabilities make no sense

It is when logic is discarded ..

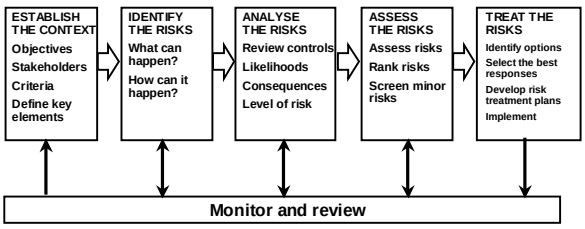
Storm events can have this effect ….

What Event Point Causes Outrage?



Risk Management Standard

A&NZS 4360

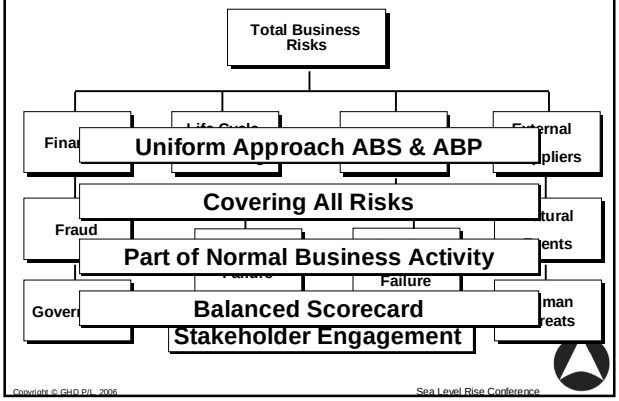


Categories of Infrastructure Risk

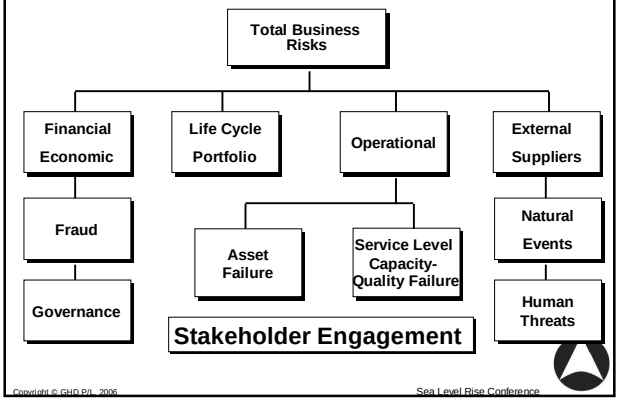
- Strategic Planning ..
- Design
- Construction
- Commissioning
- Operation & Maintenance Phase
- Extreme Weather Events
- Renewal
- Disposal

Some Key Stakeholders

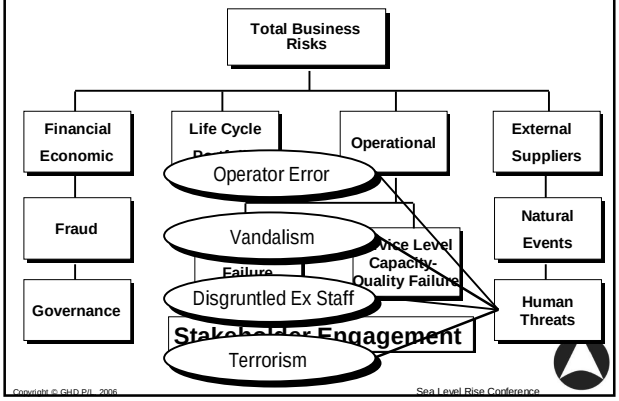
The Different Forms of Business Risk



The Different Forms of Business Risk



The Different Forms of Business Risk



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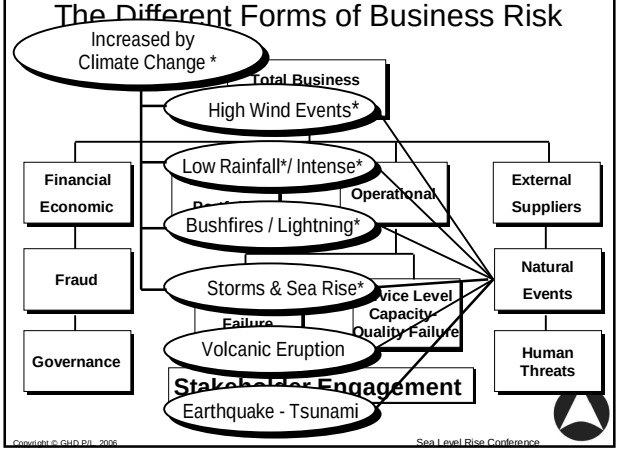
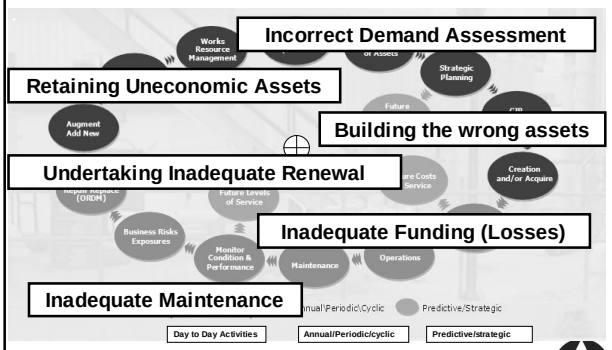


There Are Other Costly Risks



Sea Level Variables & Probabilities

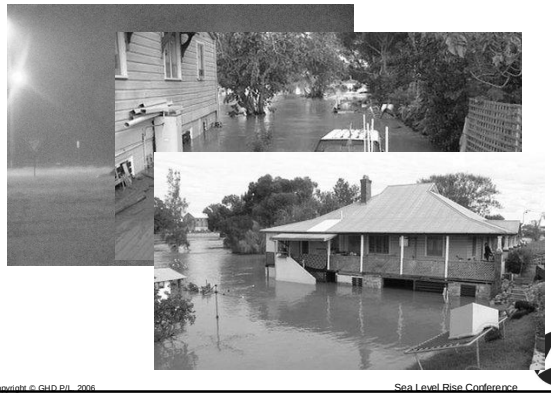
» Tides*	0.75 –8.00	Twice Daily
» Storm surge +	0 – 3.00	1:10 -1:15
» Waves	0 – 6.00	1:10 -1:15
» Sea level rise	0 – 1.00	In 25 to 50
» Max likely (Ave)	7.00M	1: 12

- * Depends on location
- + I cm for every millibar drop in pressure

Brighton – 120 kph (Parallel to shore?)

Newcastle 2007 – Cyclonic Storm

Newcastle 2007 – Cyclonic Storm



Impacts on Councils Coasts

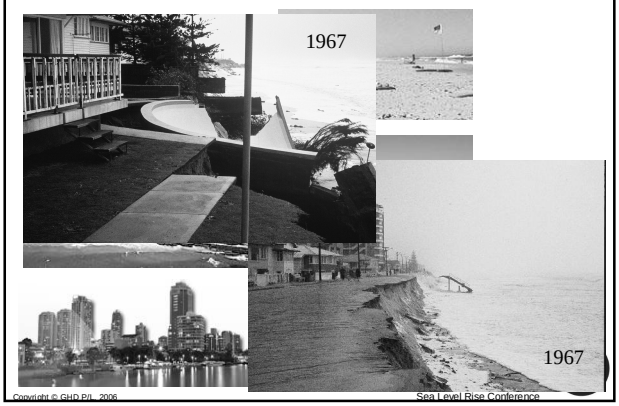
- Higher risk of river & estuarine entrance closures;
- Increased risk of beach erosion;
- Increased risk of inundation by seas;;
- Higher costs of maintaining coastal infrastructure;
- Probable loss of coastal land;
- significant impacts on tourism;
- Breaching of dunes and changes in ecosystems;
- Increased use of coastal areas for wind farms;
- Increased use of coastal areas for desalination.

Just One Storm – 120 KPH

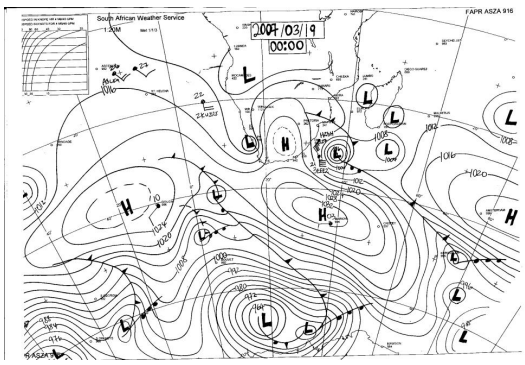
Mornington 120 kph On Shore 2008

Just One Storm Katrina – 240 KPH

Vulnerable Foreshores – Gold Coast

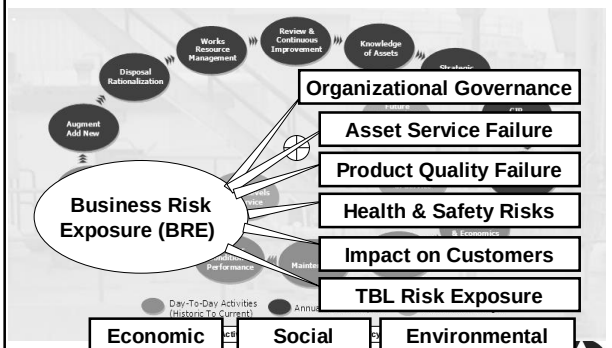


Vulnerable Foreshores – Durban 2007



Vulnerable Foreshores – Durban 2007

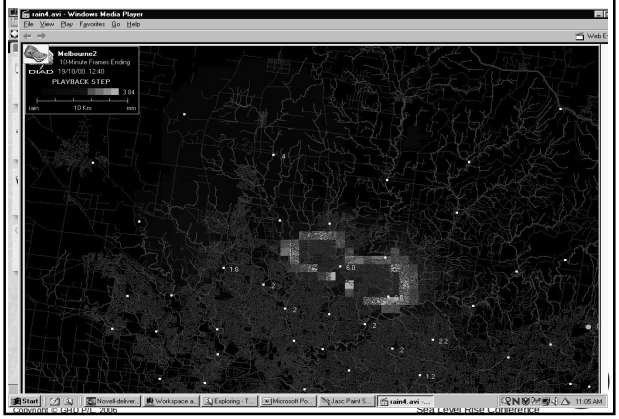
Accommodating all the AM Business Risks



Part of Infrastructure Portfolio Management

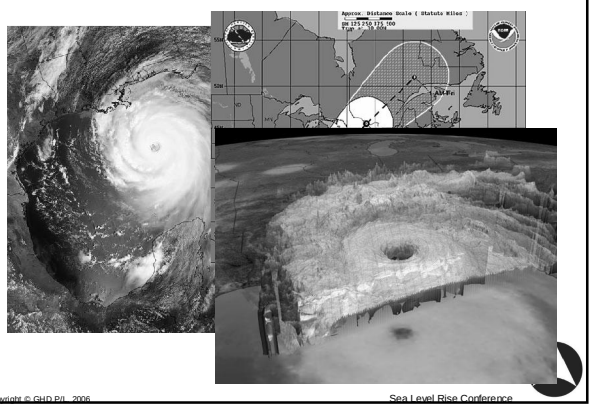
Understanding Storm Intensities .

Dopler Radar Advantages



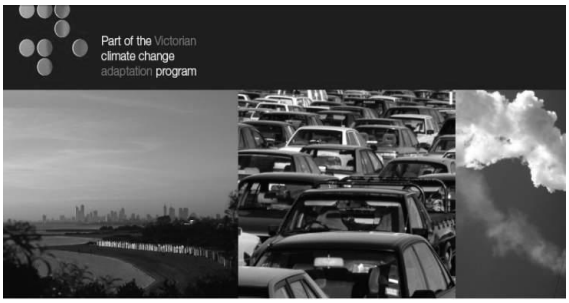
Drainage Risks – More Probable

Satellites & Science – Predictive Models



Katrina – Response ??

Victorian Government Report



Infrastructure and climate change risk assessment for Victoria

Report to the Victorian Government

Valuing (?) and Comparing Risks

Table 6: Climate Change Exposure and Infrastructure Sensitivity Matrix

Infrastructure Type	Increased Solar Radiation	Decrease in Available Moisture	Increased Variation in Wet/Dry Spells	Increased Temperature & Heatwaves	Decrease in Rainfall	Increase in Extreme Daily Rainfall	Increase in Frequency and Intensity of Storms	Increase in Intensity of Extreme Wind	Increased Electrical Storm Activity	Increase in Bush Fires	Sea-Level Rise	Humidity
Water												
Sewer												
Stormwater												
Electricity												
Gas and Oil												
Fixed Line Telecom Network												
Mobile Network												
Roads												
Rail												
Bridges												
Tunnels												
Airports												
Ports												
Buildings and Structures												
Urban Facilities												

Climate Change Impacts

Table Legend

	Negligible Risk – Presents "negligible" risk within the probability of natural variation
	Definite Risk – Presents "definite" risk within the probability of natural variation

Water Infrastructure Risks

Table 15: Water Infrastructure Risk Summary

Water Sector	Risk Scenario	Climate Variable	Risk Rating 2030 Low	2030 High	2070 Low	2070 High
Water storage and supply	Water shortage	• Decrease in Available Moisture • Decrease in Rainfall • Increased Temperature and Heatwaves	High	High	High	Extreme
	Degradation and failure of water supply piping	• Increased Variation in Wet/ Dry Spells • Decrease in Available Moisture	Moderate	Moderate	Moderate	High
	Bushfire impacts on catchment and storage	• Increase in Bushfires • Decrease in Available Moisture	Moderate	High	High	Extreme
Sewer	Degradation and failure of sewer pipes	• Increased Variation in Wet/ Dry Spells • Decrease in Available Moisture	Moderate	Moderate	Moderate	High
	Sewer spills to rivers and bays	• Increase in Extreme Daily Rainfall • Increase in Sea Level	Low	Moderate	Moderate	High
Storm water Drainage	Storm water drainage and flooding damage	• Increase in Extreme daily rainfall • Decrease in available moisture • Sea level rise	High	High	Extreme	Extreme
	Degradation and failure of drainage infrastructure	• Increase in extreme daily rainfall • Increase in frequency and intensity of storms	Moderate	Moderate	Moderate	High

Water Infrastructure Risks 2070 Low

Water Risk Assessment 2070 Low

Water	Risk Scenario	Climate Variable (Cause)	Climate Change Impact	Risk Descripdos for Multiple Causes	Risk Rating	Infrastructure Service	Social	Governance	Finance
3.1 Water Storage and Supply	3.1.1 Water Shortage	Decrease in Available Moisture	The frequency of drought increases by up to 20% for the majority of Victoria, with a 1/4 of the state experiencing up to a 40% increase. The annual reduction in the moisture balance for majority of Vic is between -100 and -200mm with a 1/4 between -200 and -400mm. Reduced capacity of the dams and reservoirs to capture and store water due to higher evaporation and water losses rates.	• Moderately likely to have seasonal loss of supply to localised regions. • Water supply shortage to sections of cities (regional and Melbourne). • Increase in water treatment costs due to lower water quality of catchment supply and potential health risks • Financial impact to water dependent industries and water supply agencies. • Expensive transport of water and extraction from other water constrained areas. • Increase in water demand due to temperature increases and heat stress on humans, animals and vegetation potentially leading to fatalities. • Dry ground causing increased run-off and less filtration into ground water, therefore less water storage and reduced quality of water. More water storage facilities required and increases to water treatment costs. • Less regionally stored water in reservoirs leading to under utilisation of irrigation and water storage infrastructure. • Increased regional costs due to greater need for establishing water collection, storage and reuse systems for communities, developers, investors, local government and water authorities.	High	H (C4)	H (C4)	H (C4)	H (C4)
		Decrease in Rainfall	The majority of the state will have a 5-10% reduction in rainfall. Decrease in rainfall to refill storage. Increase in drought occurrence						
		Increased Temperature and Heatwaves	1-1.5°C increase in temp over majority of the state and increase of 3 (Melbourne) to 6.5 (Rutherglen) days over 35 and an increase in the number of heatwaves evates over 30 C° by 1 (Melbourne) to 4.5 (Rutherglen) p.a. Increased losses from storage facilities and increased demand for water due to heat stresses, greater water irrigation demand.						
	3.1.2 Degradation and Failure of Water Supply Piping	Increased Variation in Wet/Dry Spells	An increase in variation of short Inensitve wet spells and prolonged dry spells. Increased in fluctuation in groundwater levels, changes to soil composition and foundation structures	• Degradation, failure and replacement of pipe and waterway structures due to increases in ground and foundation movement and shrinkage, flooding events and changes in groundwater.	Moderate	M (B3)	M (B3)	M (C3)	M (B3)

Understanding The Rising Climate Risk

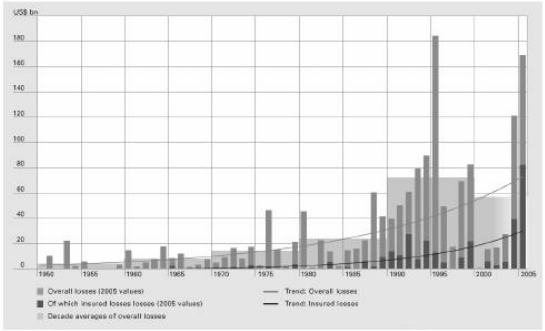
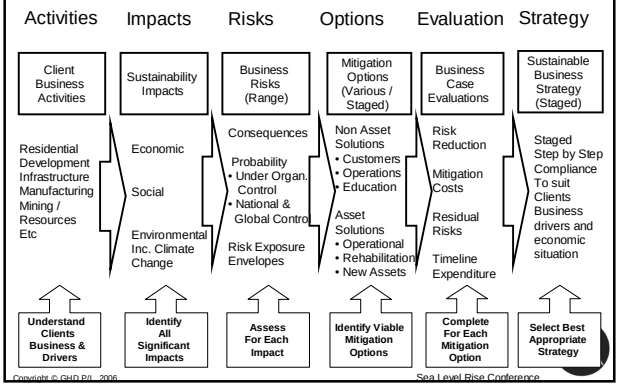


Figure 5. Overall losses and insured losses, adjusted to present values (Munich Re, 2006).

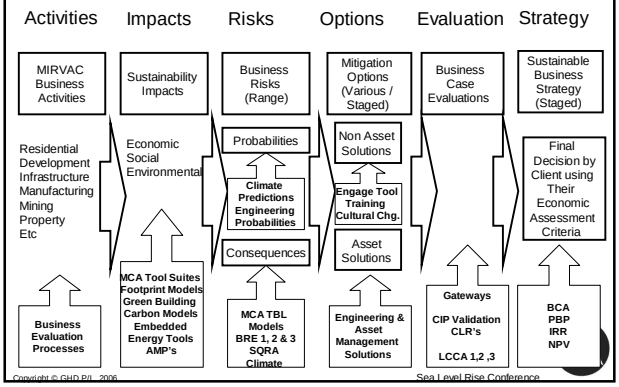
Sustainability – Different Perspectives

Sustainable Financial Business	**Basic Finances Only** Only worried about whether they won't go broke, meeting finance & basic O&M only
Sustainable Infrastructure Service Delivery	**Full Economic Cost** Want to make a small profit and ensure that intergenerational equity is balanced, with renewal annuity
Sustainable Environmentally Including climate change	**Environmental Impacts** Allows for all environmental impacts including water, waste, energy and GHG - Climate Change
Sustainable Socially	**Social Impacts** Assesses all social costs to their customers, community, suppliers and staff (OH&S)
Fully Sustainable Business	**Total TBL Compliance** Assesses and reports all issues fully transparently , with agreed funding models

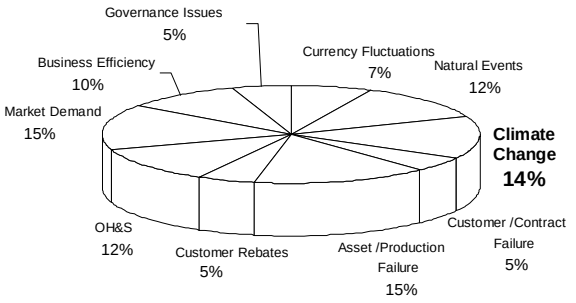
Total Sustainability Assessments



Sustainability Assessment Tools

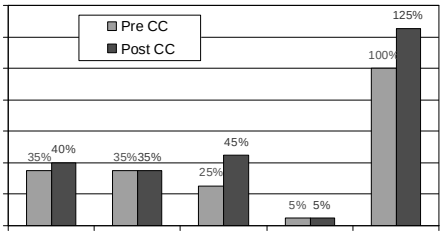


Total Picture - Cause of Risk Exposure



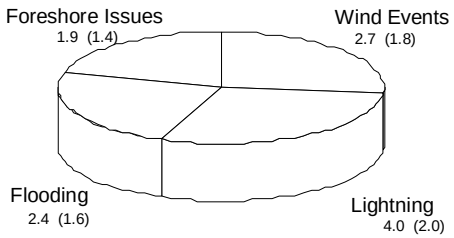
Example Only

The Changing Risk Picture



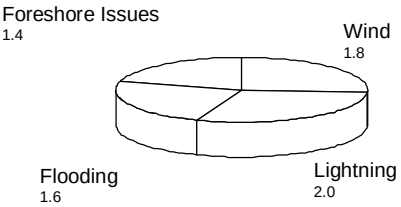
Example Only

Climate Change Impacts – Pessimistic



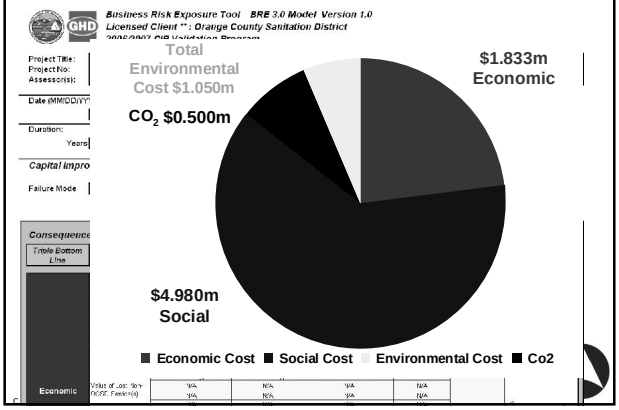
Figures intended to represent the probable increase in events over our experience of the last 30 years

Climate Change Impacts – Optimistic

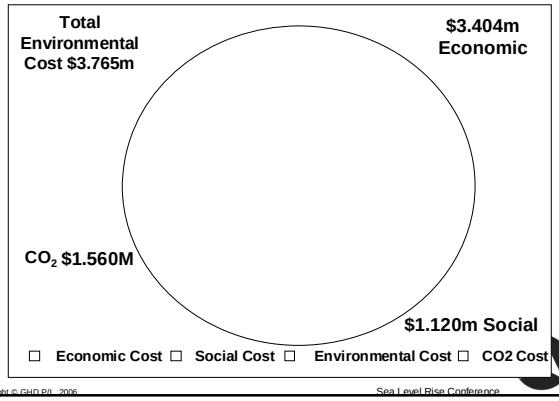


Figures represent the probable increase in events over the average experience of the last 30 years

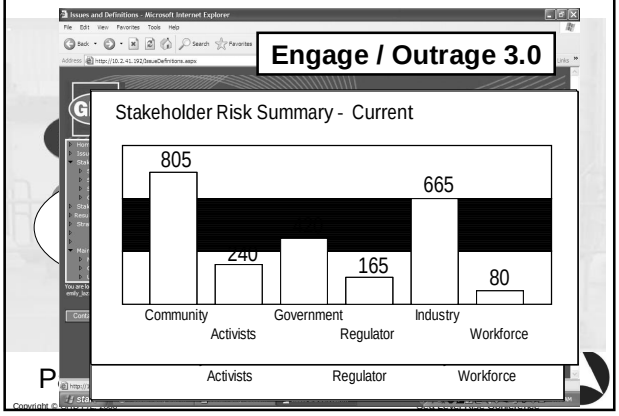
Easy To Understand Results



Consequence of Failure by TBL Costs



Understanding & Managing Outrage



Take Away Messages

- Risk Management is critical to any infrastructure rich business
- Understanding all key business risks is essential to
  - Sustainable asset management
  - Mitigating unacceptable risks
- Climate change is a critical risk for many infrastructure businesses
- Foreshores represent a critical risk for any seaside municipality, not so much from sea level rise but hign wind events..

Institute of Public Works Engineering Australia

IPWEA Conference
Coffs Harbour august 2008

Balancing the Risks of Climate Change

Is Sea Level Rise Your Greatest Risk ?

Any Questions ?