The Institution of Engineers, Australia

THE COASTAL IMPACTS OF THE GREENHOUSE EFFECT

A Position Paper prepared by the National Committee on Coastal and Ocean Engineering

INTRODUCTION

The Greenhouse Effect is a global climatic change which is expected to occur as a result of increasing levels of certain gases in the earth's atmosphere. The gases, which include carbon dioxide, nitrous oxide, methane, and chlorofluorocarbons, are partially opaque to heat radiation emitted from the earth's surface. There is evidence to suggest that these gases are building up in the atmosphere mainly as a by-product of industrialization. The build-up will cause heat to be trapped in the lower layers of the atmosphere, thus producing an increase in the temperature of the earth.

Over the last 100 years the earth's temperature has risen by about 0.5° C. Over the next 30 to 50 years the temperature is expected to increase by 1.5 to 4.5° C. Such an increase will result in changes to the general circulation of the atmosphere — and hence redistribution of climatic zones — and a consequent rise in sea level.

The southern limit of tropical cyclones might shift some 200 to 400km further south and the maximum intensity might increase by 30 to 60 per cent. The frequency of occurrence might change. The warming effect would be non-uniformly distributed and there might not be a significant change in the Antarctic weather systems. Consequently, south of approximately 36° S, wind speeds and hence wave climate would be expected to increase due to the change in north-south temperature gradients.

At present the atmospheric physicists are still unclear as to the full extent of the Greenhouse Effect. Whilst a world wide meeting of scientists in Villach, Austria (1986) confirmed that a general warming trend of the earth is occurring, there is still considerable debate about both the timing and impact of this temperature increase.

SEA LEVEL

The sea level would be influenced by both the thermal expansion of the upper layers of the world's oceans and the melting of the ice sheet induced by the Greenhouse Effect. However, the latter would be unlikely to contribute signficantly to the effect within the next 100 years. Scientists are presently predicting a sea level rise of some 0.20 to 1.40 metres in the next 50 years as a result of the thermal expansion of oceanic waters.

THE IMPACT OF THE GREENHOUSE EFFECT ON THE COASTAL ZONE

This paper presents a preliminary engineering assessment of the impact which the Greenhouse Effect predicted by scientists would have on the coastal zones of Australia.

Coastal Recession

An increase in sea level would be likely to produce an increased rate of coastline recession. The actual rate would vary along the coast depending on factors such as offshore bed slope, availability of erodable material, and the combined effects of sea level rise and changes in wave climate due to weather pattern alterations.

Coastal Plains

The salinity of rivers and estuaries would alter and low-lying areas, including some coastal farm land, would be salt affected and/or inundated. Water tables in coastal areas would rise. Canal estates and similar low-lying developments might experience stormwater drainage problems and the probability of flooding would increase.

Coastal Processes

The predicted rise in sea level and climatic changes would alter factors such as:

- gross sediment transport
- net sediment transport
- storm water level recurrence
- wave climate (including wave direction)
- coastal alignment
- movement of sediment into estuaries
- operation of offshore sediment sink mechanisms
- overtopping of dune systems.

Consequences for Engineering Structures

Increased coastal recession rates would bring hitherto 'safe' developments into the reach of the active coastal zone.

Toe scour at the base of seawalls and other beach and surf zone structures might increase.

Many structures would be subject to higher wave attack due to both climatic change and the sea level rise. The latter would also increase the height of the depth-limited wave which would occur at the structure.

In areas where a 'dune' policy has in the past been implemented and development set-back lines established, further protection works and/or beach nourishment would be necessary. Where a back beach revetment already exists the sea level rise would reduce the beach width if not totally remove the beach.

Coastal structures might be overtopped during extreme events. Coastal developments including, for example, fixed marina berths, wharfs, and their associated infrastructure would require reconstruction to accommodate the higher sea levels.

WHAT CAN BE DONE?

- Sea level trends must be carefully monitored to establish a reliable data base. To this end an Australia-wide network of reliable long-term tide gauging stations needs to be established immediately.
- Research effort is required to develop a better knowledge of the link between sea level rise and shoreline recession.
- Close liaison needs to be established between coastal engineers and relevant disciplines such as atmospheric physics and meteorology.

The questions to be addessed include:

- At what point in time should Greenhouse Effects be considered in coastal engineering practice?
- To what extent should they be considered?
- What values should be used?

WHO IS RESPONSIBLE?

Coastal engineers have a duty of care with respect to the provision of advice, the design of coastal structures, and construction of such works in the coastal zone. Without adequate data the total impact of the Greenhouse Effect cannot be quantified. However, there is sufficient evidence and weight of opinion available today to suggest that the Greehouse Effect in the coastal zone should be taken into account by the engineering profession.

ACTION REQUIRED

1. A concerted effort to improve the current 'best estimates' for sea level and climatic change effects.
2. An evaluation of the impact of these effects on the social, environmental, and economic fabric of the coastal zone and its implications for coastal management strategies and engineering practice.
3. Establishment of an expert committee to develop rational and consistent guidelines for engineering practice in the coastal zone.
4. Establishment of a review process so that management strategies and engineering practice can be varied as further information comes to hand.
5. Make political and economic decision makers aware of the potential seriousness of the problem so that adequate funds are made available to implement the above actions.

FOR FURTHER INFORMATION PLEASE CONTACT:

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