REDESIGN OF A REGIONAL CITY TO ADDRESS FLOODING ISSUES - INCLUDING OVERLAND FLOODING, ESTUARY FLOODING & SEA LEVEL RISE

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ABSTRACT

Gosford City Council (GCC), in partnership with the NSW Government's Land & Property Management Authority (NSW Lands), is currently undertaking a comprehensive masterplanning process for the Gosford City Centre. The masterplanning process aims to regenerate Gosford into a world class waterfront city as befits the regional capital of the New South Wales Central Coast. This project is a rare opportunity to redesign and renew a whole city centre.

Flooding was identified as one of the main environmental constraints that would affect the development potential of the city. Part of the Gosford City Centre was developed on low lying reclaimed marshland that is bounded by steep slopes to the east and Brisbane Water estuary to the south and has a history of flooding.

Gosford is affected by various flooding issues. Overland flooding is the dominate form of flooding in terms of potential impact to the City Centre area, whilst estuary flooding and Sea Level Rise (SLR) impact the lower areas of the catchment.

To identify the overland flooding extents, the Gosford Overland Flood Study [1] was commissioned during the masterplanning process. As GCC had not undertaken an Overland Flood Study before and due to time constraints, Council was seeking an innovative, cost effective and technically sound approach to achieve the desired outcomes at nominated deadlines.

The estuary flooding and potential SLR extents had been defined in the Brisbane Water Foreshore Flood Study [2]. The subject study was completed before the detailed masterplanning process began.

This paper examines the following:

- Strategic Plan for the Gosford City Centre
- Gosford City Centre revitalisation masterplanning process,
• A summary of the estuary flooding and potential SLR extents defined in the Brisbane Water Foreshore Flood Study [2],
• The methodology used to undertake the Gosford Overland Flood Study [1],
• The outcome of the masterplanning process in terms of managing the flooding impacts.

STRATEGIC PLANS FOR THE GOSFORD CITY CENTRE

Gosford City Centre has been in decline for the past twenty years mainly due to the development of major retail centres in Erina and Tuggerah. Gosford also shares with many similar-sized towns and communities, a range of modern social ills including underemployment, homelessness, and behavioural problems linked to alcohol and drugs.

Regardless the GCC Gosford Vision 2025 [3] & NSW Department of Planning Central Coaast Regional Strategy [4] both nominate Gosford City Centre as a vital component of the strategic economic and social planning for the Local Government Area (LGA) and the NSW Central Coast.

GCC Vision 2025 [3] is a strategic planning initiative developed in conjunction with the community that is used to guide the future direction of the LGA. One of the main visions identified is to develop the City of Gosford into the regional city of the NSW Central Coast by revitalising the CBD to serve as the economic, social and cultural hub of the region, providing new opportunities for entertainment, arts, culture, recreation and employment. Another vision outlined in the subject document is to redevelop Gosford waterfront into a cultural and economic asset that is linked to the CBD.

The Central Coast Regional Strategy [4] represents an agreed NSW Government position on the future of the Central Coast and has been prepared to complement and inform other relevant State planning instruments. The strategy's primary purpose is to ensure that adequate land is available and appropriately located to sustainably accommodate the projected housing needs and promote local employment opportunities over the next 25 years. It identifies Gosford as the regional city of the NSW Central Coast and has set the following targets for the City Centre by the year 2031:
• 6,000 new jobs,
• 6,000 new dwellings,
• 10,000 new residents.

GOSFORD REVITALISATION MASTERPLANNING PROCESS

In recognition of the strategic plans and the issues described in the section above, GCC in partnership with the NSW Lands is currently undertaking a comprehensive masterplanning process for the Gosford City Centre, aptly named "The Gosford Challenge". The Gosford Challenge, initiated in 2008, aims to develop and grow Gosford as a world class waterfront regional city and is a rare opportunity to redesign and renew a whole city centre.
A project steering group with representatives from the NSW Department of Premiers and Cabinet and the NSW Department of Planning joining GCC and NSW Lands is guiding the process. All state government landholders in the city centre have demonstrated their support by putting their land up for consideration in the masterplanning process. After a rigorous tender process, the joint partners of The Gosford Challenge appointed The Cox Group as the strategic design partner.

During the planning stages of The Gosford Challenge community engagement / consultation was recognised as a vital component of the project in facilitating a successful outcome of the masterplanning process in terms of meeting the community wants / needs and gaining public acceptance.

In the lead up to the masterplanning design 'Charrette' process, extensive community engagement was undertaken with the aim to enable the community to communicate their wants and to empower the public with information so that they can make informed decisions throughout the process.

As described in The Gosford Challenge - Charrette Design Brief [6], 'Charrette' is the word used by designers to describe an intensive and collaborative design process where well briefed individuals with non design-related expertise, from business people to parents and other community members, work with professional designers to come up with design solutions to complex urban circumstances.

The draft design brief for the masterplanning 'Charrette' process was prepared from a review of the Gosford Vision 2025 [3], Central Coast Regional Strategy [4] and other urban frame work documents as well as community consultation including:

- A dedicated website - [www.thegosfordchallenge.com.au](http://www.thegosfordchallenge.com.au) that was developed as a resource to 'spread the word' of the project and provide project updates / information to the community,
- Establishment of a number of 'Discovery Teams' - Groups of community members with a depth of knowledge and understanding of various areas of interest. Ten teams were established by the time of the Charrette including the Women's Perspective, Arts & Creativity, Aboriginal, Entertainment, Business, Residential and Environmental Sustainability 'Discovery' Teams.
- Community Forums named 'Have your Say Day' were conducted at three different shopping centres at different times and days, including a Saturday, in an attempt to take the consultation to 'the masses' and avoid the perceived apathy of the majority of residents in replying to an article in the local paper.

The attendees were invited to provide input on a range of topics, with this information being considered during the preparation of the Gosford City Centre Masterplan. Members of The Gosford Challenge Team representing a range of disciplines involved in the wider planning process were also present to provide assistance / advice to any interested
shopper. Approximately 1000 residents contributed their ideas on various topics of The Gosford Challenge

The draft design brief was reviewed and reworked within two one-day workshops that were attended by 130 community stakeholders comprising community, business and government. The resulting feedback was used to finalise The Gosford Challenge Charrette design brief [6] that outlines the principles, goals and objectives as well as measures that will be used to frame the emerging design of the Masterplan.

The Charrette design brief [6] has eleven principles that provide a generalised framework that is used as the basis for design. With regard to flooding, one of the principles states that buildings and infrastructure should capitalise on the natural opportunities of the site and work with rather than against natural systems.

The design brief’s [6] principles were then broken down into 5 topic-related key areas with specific goals and objectives. Flooding and Water Sensitive Urban Design (WSUD) were grouped in the 'Natural Environment' key area with the following goals / objectives defined:

- Goal 3.2 Maximise the integration and minimise the conflict between urban and natural functions,
- Goal 3.5 - Integrate natural functions with infrastructure systems whilst activating the public realm,
- Goal 3.7 - incorporate water efficiency, integrated water cycle management and WSUD initiatives to achieve positive outcomes.

To achieve the principles and goals /objectives described, the natural constraints including flooding need to be defined and then seen as an opportunity that could enhance the Masterplan instead of just an issue to be dealt with. The following sections of this paper will discuss the means by which the various forms of flooding, that could potential affect the City Centre, were defined.

ESTUARY FLOODING AND SEA LEVEL RISE IMPACTS

Most of the urban development on land directly fronting Brisbane Water, including the Gosford City Centre waterfrontage, occurred during the middle part of the last century. Many such developments were placed in low lying marshlands and swamps were filled just enough to build the developments. Almost all of the subject developments face numerous flooding and drainage issues due to the flatness of the sites and being very close to the high tide level in Brisbane Water and as such are potentially affected by climate change induced SLR.

The GCC LGA was identified as the 3rd most vulnerable area in NSW to the impacts of climate change induced SLR, as reported recently in the findings of the inquiry "Managing Our Coastal Zone in a Changing Climate: The Time to Act is Now" by the House of Representatives Standing Committee on Climate Change, Water, Environment and the Arts [7]. It should be noted that in
December 2009, GCC adopted 0.9m as its sea level rise planning level for the year 2100 with an assumed linear increase from 1990 levels as the basis for Council staff to proceed with risk assessment, policy development, and strategic planning decisions.

In recognition of the estuarine flooding and tidal inundation including SLR, GCC commissioned the Brisbane Water Foreshore Flood Study [2] (BWFFS) that was undertaken by Cardno Lawson Treloar. Up until the subject study was completed and adopted, Brisbane Water tributaries flood studies and development controls for property adjacent to the estuary assumed 1.95m AHD as the 1% AEP flood level in Brisbane Water. The level was based on the observed levels in Brisbane Water during the 1974 ocean storm events outlined by the Department of Public Works in 1976 [8].

The BWFFS that was completed and adopted before the masterplanning process began, defined the flood behaviour in Brisbane Water for various design events taking into account rainfall runoff from the whole catchment, elevated ocean levels and local winds (wave and wind set-up). The study also considered various SLR scenarios with a maximum increase of 0.9m being assessed. The flood levels reported in the BWFFS and relevant to The Gosford Challenge in developing the Masterplan are described below:

- 1.75m AHD - 100 year ARI design water level
- 2.65m AHD - 100 year ARI design water level including the 0.9m SLR.

**GOSFORD CITY CENTRE OVERLAND FLOOD STUDY**

The NSW Floodplain Development Manual [9] now requires that both mainstream and overland flooding be assessed. Whilst previous drainage studies had been undertaken within The Challenge area, namely the Gosford CBD Drainage Investigation [10] and East Gosford Catchment Study [11], overland flood paths / extents and in turn the properties affected had not been previously identified or mapped. This flood information was also required for The Gosford Challenge masterplanning process.

To provide the required information, the Gosford CBD Overland Flood Study was commissioned during the masterplanning process, funded through the National Disaster Mitigation Programme with the contract awarded to Cardno Lawson Treloar. The objective of the study was to define local flood behaviour in the study area by producing information on flows, flood levels & extents, depth of flows, velocities and provisional flood hazard for the 10 year, 100 year ARI events and the PMF under existing catchment conditions.

As GCC had not undertaken an Overland Flood Study before and due to time constraints with regard to the masterplanning process, Council was seeking an innovative, cost effective and technically sound approach to achieve the desired objectives at the nominated deadlines. It was decided to use the study as a pilot for future overland flow studies, with three scenarios modelled:
1. The existing stormwater infrastructure (pit/pipe networks) is assumed to be ineffective and no buildings to be incorporated in the model i.e. all flow passes overland.
2. The incorporation of pipes (greater than and equal to 600mm) in the model with no buildings.
3. The incorporation of pipes (greater than and equal to 600mm) and buildings in the model.

The three scenarios were assessed for two main reasons. Firstly to assess and compare the results from each of the scenarios and to provide justification of the scope of works used for future overland studies. Secondly to provide results progressively to The Gosford Challenge in an attempt to meet the required deadlines.

The scenarios were modelled using full 2D hydraulic and 'direct rainfall on grid' hydrological approaches. Due to the 4.9km$^2$ study area combined with the 2m grid modelled, the catchment was split into two models delineated by the natural topography of the area.

The results of the scenarios were compared and the following is a summary of the key findings:

- Significant reductions, up to 0.6m, in peak water levels occur with the addition of the pipe system in the model.
- The addition of buildings redirects flow paths and results in constrictions and blockages to flow. This increases / decreases the water level at different locations
- Scenario 3 is probably the best outcome but also most expensive. The choice of this option may be dependent on the significance of buildings within the flowpaths and the resources available to undertake the study.

REDESIGN OF A CITY TO ADDRESS FLOODING ISSUES.

In The Gosford Challenge Charrette process the stakeholders, that included community, business and government representatives, were split into four topic related groups based on the Environment, Social, Economic and Infrastructure issues. The environment group, aptly named the green group, were charged with the responsibility of reviewing the natural environmental constraints that included flooding. As the stakeholders were well prepared with the relevant information, such as the overland / estuarine flood extents and potential SLR impact, they were able to make an informed suggestion/decision with regard to design solutions that satisfied the design brief goals/objectives and in turn the design principles.

During the six day intensive design process, the four topic related groups would collaborate to discuss the specific design solutions with respect to impact on other groups design objectives. The second section of day two had the key stakeholders bring people from the larger workshops up to speed on where they are heading. The stakeholders asked the larger group these questions: What did you like/agree with? What did you not like/not agree with? What is missing? Do you support the general directions of the groups? More than 160 people attended. This ensured that groups were on the right track. During the Charette, the design solutions from the various groups were debated and required 'give and take' by the community members with differing views. The strength of the procedure is that the necessary compromises were reached...
within the design process. The design solutions formulated underpinned the key design strategies for the Draft Masterplan

At the time of composing this paper the draft Masterplan had been endorsed by GCC and NSW Lands and was put on Public Exhibition for a period of 2 months.

With respect to flooding, the draft Masterplan included opening up a major trunk culvert system to create an open channel, where the original creek line ran before the site was filled. The existing culverts were designed to convey the 100 year ARI event and are located in the low part of the catchment. Potential SLR would have increased the tailwater level to above the obvert of a lengthy section of the culverts making the culverts ineffective. The open channel will be designed to convey the stormwater as well as the tidal inundation including the potential SLR. In addition to the hydraulic function the open channel will incorporate an inviting landscaped pedestrian boulevard that will connect the city to the water. This outcome has achieved the design brief goals described in the masterplanning process section of this paper

After the public exhibition is finished and the Masterplan is adopted, the challenge that lies ahead is the implementation of the Masterplan, i.e. the redevelopment of the city. The final design of the proposed developments will need to adhere to the minimum floor heights outlined in floodplain management plans and incorporate the defined overflow routes in the building/infrastructure design.

TAKE HOME MESSAGES

- Community engagement / consultation is vital to the 'deemed' success of local government projects, including floodplain management, in terms of meeting the community wants / needs and gaining public acceptance.
- Overland flooding needs to be assessed. Modelling which includes the pipe system and incorporates the buildings is the most accurate modelling scenario in terms of defining the flood behaviour in an urban environment.

REFERENCES