Pluvial Urbanism

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ABSTRACT
Waterfronts are a critical site for urban redevelopment in the early 21st century. However many waterfront sites have serious environmental problems, especially the management of contaminated stormwater, which contemporary models of waterfront development do little to remedy. Why? While there is a good understanding of techniques that are viable for the remediation of urban stormwater, they are often ignored or treated as a design novelty. The author suggests that the cause is to be found in the way market forces dominate waterfront development models. Contemporary urban theory such as new urbanism is complicit with these forces, advocating an urban planning model with a high FAR (Floor Area Ratio) and large areas of impervious surface. The author proposes the development of an alternative waterfront development strategy using GIS-based mapping. Focusing on how the remediation of urban stormwater could drive the development of a new model of urban development on the waterfront, the author uses GIS mapping to explore the effect of pervious and impervious surfaces on the production of stormwater in an urban catchment. In a similar way GIS mapping is used to simulate different urban densities. A case study project on the Wynyard Quarter, Auckland, New Zealand is used to explore these techniques. The result is the development of a GIS model that models the consequences of increased density on urban stormwater remediation within a catchment. The model helps planners and developers to conceive an environmental sustainable urban waterfront while ensuring an economically viable return.

KEYWORDS
Waterfront, Stormwater, GIS.

INTRODUCTION

The waterfront as a development site has become an enduring urban trope through out the world. The accepted development model, transforming 19th century abandoned low value industrial sites into highly valued and successful real estate ventures, was established by building of the Baltimore Inner Harbour development starting with the development of the Charles Center master plan in 1958. This project established a generic urban pattern; urban space is designed and built by a private/ public partnership along the waters edge of the water. A promenade is established that connects a series of public spaces, parks, square and public building such as, aquarium and art galleries and museums. Within this matrix, private development, like malls, and office towers are inserted. This model, while undergoing a number of architectural modifications over thirty years has morphologically and ideologically remained surprising resilient. The water edge is treated as a passive consumer spectacle that links entertainment zones, while the accompanying building agenda is a dense programme of retail, entertainment, commercial, and residential uses.

While the urban programme of waterfront development is highly visible, the contaminated nature of many waterfront sites is almost always elided. Waterfronts as the site of many years of industrial activities are often highly contaminated from heavy metals to petroleum products. Another series environmental problem is the discharge of contaminated stormwater from highly urbanised

catchment at the waters edge and the more localised problem of contaminated stormwater from the immediate highly impervious urban pattern.
A good example of this phenomenon is the development of the Wynyard Quarter on the Auckland waterfront. The Wynyard Quarter is situated on the western side of the Auckland CBD, between the Westhaven marina and Viaduct harbour. This western area has been undergoing a slow redevelopment from industrial wharfs to a new consumerist waterfront for the last 20 years.
The Wynyard Quarter is a reclamation begun in the 1930s; the site was used for warehousing, the fishing industry and most importantly as an industrial fuel store, a tank farm. Starting in the early 2000's development plans were begun to transform the site. Peter Walker, an American landscape architect, was commissioned in 2003 to develop a master plan. The basis of this plan was the establishment of two axis that connect the site to the city, a north/south axis from the existing Victoria Park to the northern tip of the reclamation and an west/east axis from the WQ to the CBD via Quay street.
This plan was modified by a local Auckland architectural practice, Architectus in a report prepared in 2007. The proposed building programme is contained in the indicative framework section of the report. The Wynyard Quarter is approx. 38.8 ha. of this area 5.8 ha. is to remain as existing marine related industries, mainly on the Westhaven marina side. The main body of the site is a development zone, approx. 21 ha. The rest of the site is put aside as public space.
The development site is broken into three zones; the first is called the Point Precinct, at the northern end of the site. 4 large blocks occupy the south/east part of this site with three smaller ones on Wynyard Wharf. The ground floor of these blocks is devoted to entertainment/retail, commercial on the first floor, then residential above for the larger blocks with commercial above for the smaller blocks. The resulting build out is; entertainment and retail, 17010 sqm. commercial, 22230sqm., and residential 186400 sqm.
The middle zone, the Jellicoe Precinct is has a more complex social and building programme, which relates to its role as part of a structural urban axis linking the WQ to the CBD. Jellicoe Street is lined with two rows of buildings, the northern block is 25 to 15 m high, and the southern block is up to 52 m high. The GFA of this zone is 22566sqm. devoted to entertainment and retail, 49105sqm for commercial, and 138386 for residential.
The Central Precinct is the largest from Jellicoe Street to Fanshawe Street, a third of this site is owned by another party, Viaduct Holding Group. This zone is devoted to mostly residential and commercial use with small percentage of retail. The build out is 37125sqm for entertainment/ retail, 515250sqm. for commercial and 138386 for residential. The total GFA is residential/retail, 76701 sqm. , commercial 586585 sqm. and residential, 453661sqm. giving a total build out of 1115947 sqm.
The first part of the project, the public space on Jellicoe Street axis has just been completed in time for the 2011 Rugby World Cup. Two important differences from the 2007 scheme are evident. The first is the proposed new building programme between the North Wharf and Jellicoe Street has been rejected in favour of retaining the existing cargo sheds, which have been renovated into entertainment zone of bars and restaurants. The other major change was the removal of the proposed stormwater remediation pond, at the junction of the Jellicoe Precinct and the Point Precinct. The proposed pond, a large triangular shaped body, was designed to treat the stormwater generated from the proposed urban development. The pond was mentioned in the 2007 report, however while 26 pages was devoted to the indicative frame work plan detailing the commercial configuration of the new urban layout, the issue of stormwater was confined to a paragraph that indicated where onsite stormwater remediation would be carried out and where the main Freemans Bay stormwater discharge pipe and point is located. This 'minor point' is actually a critical environmental issue. The size of the Freemans bay catchment, a highly urbanised site, the concentration of the catchment stormwater in a 4m. by 4m. pipe with a single discharge point under the North Wharf, leads to a highly visible harbour contamination.

Aims and Objectives

The aim of this investigation is to explore the ways in which the production of contaminated stormwater can be reduced in an urban catchment through the reconfiguration of urban morphology.

The objectives of this investigation are;

To demonstrate that a new kind of urban development model can be developed from a study of hydrological systems

To show how generation of on site contaminated stormwater can be reduced by lessening the impervious surface of a sub catchment.

To show how the increase in pervious surface at the littoral can contribute to the design of stormwater remediation measures, such as day lighting wetlands for contaminated water from other parts of the catchment.

To show how the associate real estate programme associate with urban waterfront development can be realised in a new architectural and urban configuration.

METHODS

Conceptual Background.

The aim of this project is to explore ways in which two seemly disparate and irreconcilable realms, the study of ways in which to treat contaminated stormwater within the city and the ways in which real estate return in waterfront development are extended can be connected.

Developing an understanding of the real estate requirements of waterfront development it is necessary to translate the typical waterfront building programme from an architectural /urban design realm to a simplified real estate programme. This can be expressed as GFA (gross floor area) a ratios divided between different real estate functions, retail/entertainment/commercial and residential. These requirements can be expressed in different combination in simple block models or combination within blocks. Another way of measuring real estate is through a floor area ratio (FAR) There are number of tools in ArcGIS that can measure/visualise FAR in urban situations. Dirk Donath and Danny Lobos discuss ways in which the shapes of individual building can be prefigured from modelling different planning regime such as FAR (• Donath D and Lobos D. 2008 Journal issue 4(5), 2008). Anandan Karunakaran and Kamal Raj Gopal Raamakrishnan discuss a more pragmatic exploration of modelling urban density using GIS (Karunakaran & Raamakrishnan, 2010). There is also a number of modelling software programmes that help visualise FAR such as City Engine. Existing city plans can be imported or new city plans can be generated, a number of operational rules can applied to generate both existing city mode and speculative development possibilities ("City Engine,")

The commonality of all this work is the acceptance of a grid street network, from which building are extruded to various heights and shapes according to the various planning/real estate criteria.

Developing an understanding of the way in which the treatment of contaminated stormwater can connect to urban outcomes has been written about extensivly. Professor Wong has described the trajectory of how stormwater quality management has developed into a larger discipline that makes critical linkages with urban design at a wide number of levels. (Wong, 2006) Of particular interest is the debate on stormwater quality, between the aims of lowering pollutant level or lowering annual load reductions. This opens up the field of the effect of impervious surfaces on receiving ecosystems. Roon, et al describes the connection between the design of stormwater systems and the relationship to ecological efficacy. The idea of hydrological neutrality is explored, ‘Conviction of the need for and methods to achieve less than 15% ‘effective’ imperviousness, to ensure hydrological neutrality within a catchment, is a major challenge for all stakeholders but particularly those involved in redevelopment’. (Roon, 27 June, 2005). The authors write, " The challenge is to… design (ing) and build(ing) urban areas that simultaneously recreate forest eco systems.”

Experiment

The concept of hydrological neutrality offers a metric toward the goal of stormwater remediation in an urban area.

Proposition

If we want to ensure that a brown field waterfront site does not contribute to intensifying stormwater contamination then the impervious surface of the catchment must be 15 % or less of the gross area.

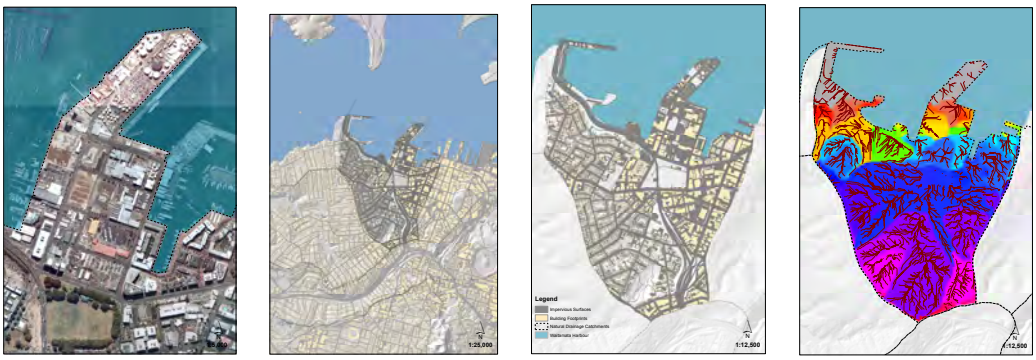
The first step towards this goal is to measure the imperviousness of the site. Many GIS data sets map types of impervious surfaces There are also a number of studies that explore ways to understand and calculate degrees of imperviousness.(Murphy, 2010)

However to reach a goal of 85 % permeable surface in an urban situation is extremely difficult, sooner or later we are bought to up short by the prevailing existing urban layout in most cities, an infrastructure grid with a intensive building programme.

A radical rethink of urban form is required if we are to attain the goal of 15 percent impervious surface. If we look at retrofitting the existing city to achieve this solution we are confronted by a number of substantive obstacle. Established business / real estate interests inevitably preclude any of the necessary radical rebuilding. However the typical waterfront site does give us the opportunity to pursue this idea/ notion/concept. Many waterfront development sites are abandoned, brown fields, and often in large area parcels so a more radical consideration of urban form is possible than under the normal constrains of the contemporary city.

Case Study

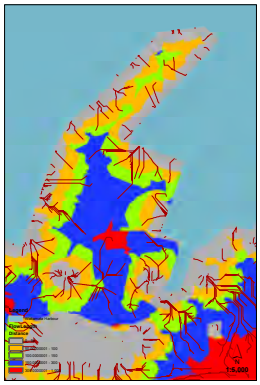
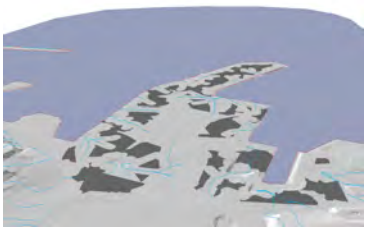
The Wynyard Quarter, Auckland, New Zealand, is a 35.3 ha. inner city site. The site is early 20th century reclamation, oriented to the north, and surrounded on three sides with water.



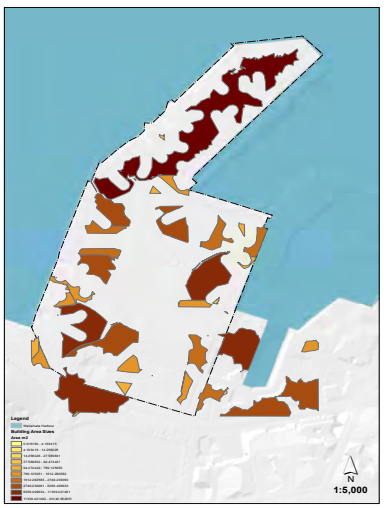
The first move is to reframe the Wynyard Quarter as part of a larger catchment system, the Freemans Bay catchment. This site is defined by four ridge roads, on the western boundary, Shelly Beach Road Jervois Road, Ponsonby Road, K Road along the southern boundary and returning on the eastern side on Hobson Street. The Freeman bay catchment is 303.4 ha. The impervious surface is made up of road and pavement coverage 240.4 ha. (46.3 percent) and building coverage75 ha. (24.9 percent)) Making 71.2 percent impervious surface off the total site.

Breaking the site into sub catchments with overland flow paths enables us to refocus on the Wynyard Quarter as an array of smaller basins that follow a topographical logic rather than the urban grid.

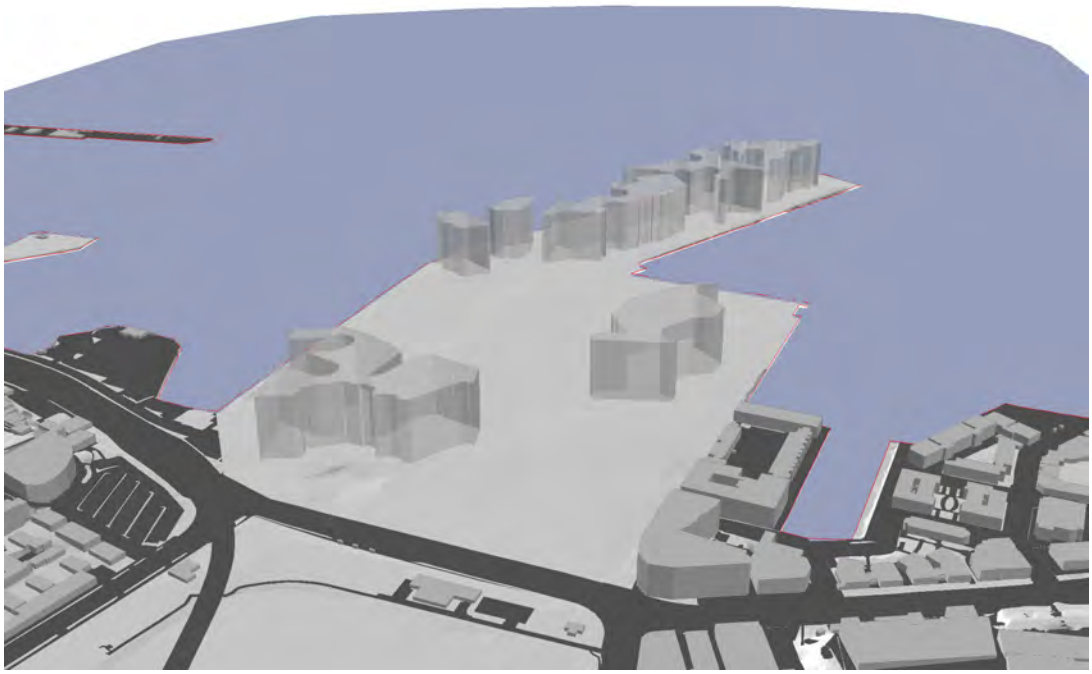


Running a hydrological programme generates overland flow paths which are then buffered 15m on both sides. Ten sub catchments are revealed with unique flow paths.
Taking the maximum allowable are of imperviousness is 15 percent of the 35.5 ha site gives 5. 325 ha of impervious surface to ensure hydrological neutrality. Applying the ratio of building to roading found in the larger catchment, (approx. 47 percent building and 53 percent road/paving) gives an approx. 2.2 ha for building, and 3.095 ha for roading/paving.
Into this reconfigured hydrological landscape, the building programme from the 2007 Wynyard Quarter plan can be inserted. The total GFA is residential/retail, 76701 sqm. , Commercial 586585 sqm. and residential, 453661sqm. giving a total build out of 1115947 sqm.
The next question is how this building programme will be distributed in the site. Some criteria that could be adopted might be, not building on the overland flow paths and not building on the coastal edge. Building the overland flow path and buffering and establishing a series of buffers from the coastal edge based on flow accumulation maps helps to delineate possible building footprints. Isolating the 50 -150 m margins and privileging the size of the possible building footprints gives an idea of the size of the possible building platforms. The total footprint is approx 11.8 ha. a considerable increase on the allowable impervious building footprint of 2.2 ha.


Mapping the footprints over an existing map of the site helps to remove some of the blocks, such as ones that overlap Fanshawe Street. By reclassifying the blocks according to area, larger blocks can be identified as possible building footprints.
A spinal block along the Point Precinct and two large blocks within the body of the Central Precinct are identified as building sites. The total are of these blocks is 5.2 ha.
Taking the GFA building programme of the WQ at 1115947 sqm. and dividing it 5.3ha. gives an average height of 23 stories. The footprints are extruded to a height of 63m. The next stage, (with a little help from Rhino) is for the outline of the blocks to be smoothed, giving a gross footprint of 4.3 ha. or 25 stories.



RESULTS AND DISCUSSION

The results of this experiment are:

By remodelling a highly urban impervious surface, both in its existing condition and under the proposed redevelopment, an important step towards hydrological neutrality is advanced.

A number of speculations can be advanced for the use of the resulting area of pervious land. The area could be used as a site for large scale storm water remediation techniques to treat contaminated storm water from the remaining catchment. Techniques such as wetlands and day lighting stormwater pipes that are extremely difficult to use in conventional urban waterfronts because of the limitations on land availability, are freed up in this new urban configuration. Similarly, goals for urban sustainability through the development of specific urban eco systems can be developed. Restoration of native habitats, both terrestrial and aquatic, positioning of urban habitats patches, a rich series of possibilities are opened up by this radical new urban configuration.

The real estate requirements of contemporary urban waterfronts can (at least conceptually) be remodelled to allow for a more hydrologically equitable world. The production of over 1 million sqm of saleable space has given rise to a new urban configuration that gives the business and residential occupants a new connection to the city, both as on the ground plan as and as inhabitants of a tower, connection to the larger Auckland landscape.

CONCLUSIONS

This experiment is obviously speculative and selective. It relies on a highly simplistic reading of the concept of hydrological neutrality, and by limiting the site analysis to two parametrics, overland flow paths and proximity of the coastal edge, has generated a simplistic building footprint. Similarly the building programme is equally naïve, the extrusion of the selected footprints to fill the programmatic volume disregards a number of critical architectural issues, such as how to determine the mix of occupational types. Similarly the quality and materiality of the surrounded urban space is left unexplored, the relationship of building to the intermediate urban surrounding, the place of the building within the larger landscape are, frankly, elided. What has been produced is almost a caricature of the modernist tabula rasa.

While acknowledging these obvious lacuna, this outline, however diagrammatic does contain some points or rather gestures towards a future direction/strategy that Water Sustainable Urban Design could take. The way is which water is privileged so that the site is restored toward a hydrologically

neural field is a concept that is at olds with our traditional understanding of the city as an impervious network. This project provide at once a provocation to accepted ideological models of urban development based on the grid and the block and gestures toward a huge range of urban possibility that an understanding of hydrologically systems can lead us.

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