

# MANAGING FLOOD RISK IN URBAN RENEWAL AREAS - A CASE STUDY OF CONSTRAINTS AND OPPORTUNITIES IN GREEN SQUARE

**E Kefalianos<sup>1</sup>, S Alam<sup>1</sup>**

<sup>1</sup>City of Sydney, Sydney, NSW

## **Abstract**

Urban renewal provides a unique opportunity to address the legacy of flood risk within the existing urban environment. However changes in land use, such as industrial to residential, often necessitate the adoption of a higher flood standard than presently exists. This represents a significant challenge in existing highly developed urban environments.

The broader Green Square development precinct covers an area of 278 Hectares located 3.5km southeast of the Sydney central business district. The Green Square urban renewal project will transform an existing industrial area into a new residential precinct with a predicted population of 33,000 residents by 2030.

Drainage in the precinct is characterised by piped or channelised watercourses with limited conveyance capacity and constrained by large adjoining industrial developments. Private land as well as major road and rail transport links to the city are frequently inundated causing property damage and disruption. Above floor level inundation and disruption to transport occur in storms as frequent as the 2 year Average Recurrence Interval (ARI) storm.

The existing flood risk significantly impacts the redevelopment potential of the land requiring significant mitigation to facilitate redevelopment. The City has embarked on several large flood mitigation projects to facilitate redevelopment.

This paper will focus on the experience of the City of Sydney in implementing flood risk management during the planning and implementation of major urban renewal projects. The broader Green Square development precinct will be used as a case study illustrating constraints and opportunities.

## **Historical Development and Flooding**

Prior to development the natural environment was dominated by a series of interconnected dams and natural swamplands. Development occurred in the early 1900's with the swamplands filled and industrial development constructed by the 1940's. The trunk drainage through the area was largely constructed by the 1930's and is owned by the Sydney Water Corporation.

Significant floods have been recorded within the catchment. The most notable historical floods occurred on:

- 15 June 1949;
- 20 November 1961;
- 11 March 1975;

- 5 November 1984;
- 8-9 November 1984;
- 26 January 1991; and
- 28 February 2001.

In addition to the major historical floods, frequent flooding of a major trapped low point in Joynton Avenue has been recorded as well as significant flooding of Botany Road (a major access road to the Sydney CBD).

Hydrologic and hydraulic analysis of catchment flooding has revealed that the capacity of the existing stormwater network is typically at the 2yr Average Recurrence Interval (ARI). Significant flooding including high hazard conditions have been identified at key locations within the catchment posing a significant risk to people and property and disrupting traffic on significant roads through the area.

## **Future Development**

The broader Green Square development precinct consists of three main development precincts within the suburbs of Zetland, Beaconsfield, Roseberry Alexandria and Waterloo. The Green Square Town Centre Precinct adjoins the eastern side of the Green Square Railway Station and is bound by Botany Road, Joynton Avenue, Portman Street and Hansard Street. The precinct is dominated by high rise buildings and a retail precinct adjoining the Railway Station.

The Lachlan precinct is approximately 1km to the northeast of the town centre and is generally bound by Lachlan Street, O'dea Avenue, South Dowling Street and Bourke Street. The precinct is predominantly 6-8 storey residential development.

The Epsom Park precinct is located to the east of the Green Square Town Centre and is generally bound by Joynton Avenue, South Dowling Street, Epsom Road and Kirby Walk. The Epsom Park precinct is predominately residential development with significant recreational facilities including the Green Square Aquatic Centre and Gynyama Park.

Other residential development precincts include the largely completed Victoria Park precinct and a smaller precinct called North Rosebery.

In order to support the future development, the construction of significant infrastructure projects is also required including the following:

- Upgrading and raising of Joynton Avenue
- East-West road link
- Child care, community and cultural facilities at the former South Sydney Hospital Site.
- New Town Centre Library and Plaza.

## **Opportunities and Constraints**

Redevelopment of the precinct was seen as an opportunity to address the legacy of past land use planning as it provides an opportunity to remove existing development with

significant flooding exposure, provide opportunity to reinstate overland flow paths and implement improved flood standards. Redevelopment of the area would provide both funding and justification for flood mitigation works to support the proposed development.

At the same time it was also recognised that there were significant constraints. One of the major constraints was that in a high density area there would be no physical space to go back at a later date to retrofit additional mitigation measures. It was critical to ensure that appropriate measures were in place prior to development.

Other key constraint was to recognise that local drainage was owned by the City, however trunk drainage was owned by Sydney Water. This required close collaboration between the City and Sydney Water in the consideration of standards and mitigation options as well as joint funding from both organisations.

## **Flood Risk Management**

An important first step in managing the flooding risk is to consider potential management options through the Floodplain Risk Management process and to determine an appropriate mix of flood modification, property modification and response modification measures. This was done jointly by the City and Sydney Water through the Green Square – West Kensington Floodplain Risk Management Study and the Green Square Floodplain Risk Management Plan. This study considered a number of potential floodplain management options for the Green Square Town Centre.

At the same time a Floodplain Risk Management Study for the broader Alexandra Canal, in which Green Square is located, was undertaken. This study looked more broadly at the current, future and continuing risk across the broader catchment thus was able to consider the cumulative impacts of multiple development precincts across the entire catchment.

It was recognised that the existing trunk drainage capacity was not adequate to service the proposed development precinct. The low capacity of the existing trunk drainage would result in frequent flooding of the local roads disrupting traffic, local businesses and residents as well as impeding emergency response. This was considered a significant risk to the community. Property modification and response modification measures were considered however it was determined that these alone were not sufficient to manage the flooding risk.

In addition to the local impacts it was identified that there were several major road corridors between the airport, proposed residential precincts and the Sydney CBD which are currently disrupted by flooding. This was considered to pose a significant disruption to the broader region.

A third area of concern was the impact of minimum flood planning levels on urban design aspects such as appearance and accessibility. This was particularly of concern for the commercial and retail areas where floor levels needed to be as close to street level as possible to retain accessibility and activation of the public domain.

A fourth area of concern was that of personal safety within basements. The 'flash flooding' nature of the catchment combined with the population size and prevalence of basements was seen as posing a high risk to human life. This was particularly highlighted with the Green Square Town Centre where population projections anticipate approximately 6,000

residents and 7,000 workers within a 150m radius and on land that was historically Waterloo Dam.

## **Appropriate Flood Standards**

Based on the consideration of the flood risks as part of the Floodplain Risk Management Studies, the following flood objectives were considered appropriate:

- Underground drainage network to cater for the 20yr ARI.
- Overland flow paths through commercial/ retail area to be less than 0.15m deep. (i.e. within the kerb and gutter)
- Flooding of existing trapped low points such as Joynton Avenue and Botany Road to be reduced to a low flood hazard.
- Residential Flood Planning Level set at the 100yr ARI plus freeboard.
- Commercial/retail floor levels to be 0.3m above surrounding ground level (i.e. gutter invert).
- Basement entry points to have a PMF flood standard.

## **Consideration of Mitigation Options**

Initial investigations into flood modification measures initially focused on providing flood retarding basis to attenuate flows and retain the existing trunk drainage. Significant constraints were encountered in the consideration of flood retarding.

An important constraint was the limited availability of land to provide the requisite storage and the high cost of acquiring land. Due to the limited land availability and high projected population, there was significant recreational and community amenity demands placed on any available public land. Therefore, the dual use of public land for flood storage was not considered feasible.

Subsequent investigations focused on below ground trunk drainage upgrades to increase the conveyance of flood waters. It was determined that a 2.4km trunk drainage upgrade between Link Road, Zetland and Alexandra Canal would provide the required flood mitigation. Several alignment options were considered and the presence of existing underground services was a major consideration in selection of the preferred route. The majority of the current route is located within proposed new roads or private land in order to avoid existing utility services.

## **Option Development**

The original concept was initially developed jointly by the City and Sydney Water as part of the floodplain risk management process for the catchment. The preferred trunk drainage option was initially identified as a box section varying from 4.2m wide by 1.8m high at the upstream end to twin culverts 3.0m wide by 1.8m high discharging into Alexandra Canal.

The City undertook detailed hydraulic modelling using a 1D/2D model to confirm the suitability of the proposed works to achieve the required flood mitigation performance. This

modelling work produced an 'Ultimate Development Scenario' model incorporating the following development proposals:

- Construction of the Green Square Trunk Drain
- Development of the Green Square Town Centre precinct
- Development of the Epsom Park precinct
- Development of the Lachlan precinct
- Trunk drainage upgrade on Joynton Avenue
- Reconstruction and raising of Joynton Avenue
- Construction of an East-West traffic route

The outcome of the 'Ultimate Development Scenario' was confirmation that the proposed works achieve the objectives sought as well as considering the cumulative impacts of development within the catchment.

Subsequently, the City and Sydney Water signed a Memorandum of Understanding for delivery of the project.

A risk assessment of delivery was undertaken which determined that the preferred method of delivery was through an Alliance contact between Sydney Water, City of Sydney and a third party selected for delivery of the works.

A consultant was commissioned to undertake further investigations into the hydraulic performance of the culvert through a second modelling exercise which produced a numerical model, called the 'Reference Design' of the proposed works. This numerical model has refined the concept design to improve the hydraulic efficiency and sets the hydraulic performance requirements for delivery by the Alliance.

A constructability review was also commissioned to consider various physical constraints and a Review of Environmental Factors was also produced to assess the impacts of the works.

The City and Sydney Water signed an alliance contract with a third party for the delivery of the trunk drainage works. The works are currently in the detailed design phase and the concept has been further refined. The works will consist of circular pipes constructed through a combination of micro tunnelling and cut and cover.

## **Timing and Coordination**

One of the greatest challenges is delivery of the project within the time frame required for delivery of the various development precincts and projects.

In order to meet development pressures and construction targets for development precincts, construction timing for the Green Square Trunk Drain has been divided into four portions to be delivered in three key stages as outlined in Table 1 below.

**Table 1: Green Square Trunk Drain Completion Schedule**

<b>Portion</b>	<b>Description</b>	<b>Completion Date</b>
1	Link Road to Rose Valley Way	December 2017
2	Rose Valley Way to Portman Street	December 2016
3	Portman Street to Botany Road	December 2015
4	Botany Road to Alexandra Canal	December 2016

Portion 3 is the first portion to be constructed and is located within the Green Square Town Centre. This has been done to permit construction of other infrastructure, such as roads, within the town centre while the downstream connection is under construction.

Major community facilities to be delivered by the City within the precincts include the following:

- Green Square Library and Plaza
- Aquatic Centre
- Gynyama Park
- Drying Green (park)
- Former South Sydney Hospital site
  - Child care centre
  - Stormwater reuse plant
  - Five Community facilities

Due to the lengthy time period required to design community facilities and the short time frame for delivery of the development precincts, the City commenced detailed design of community facilities prior to finalisation of the trunk drainage design. The community facilities have been designed in accordance with the information available from the 'Ultimate Development Scenario' and 'Reference Design'. The design risk to these projects has been managed to ensure that projects can be delivered within the required time frame. Furthermore, as the trunk drainage design has developed, confidence in the performance standard and the acceptability of the community facility designs has increased.

To date private development within the precincts has been generally limited to land on the fringes of the floodplain and away from the proposed trunk drain alignment. Where development has been approved, the proposals have been required to consider both the ultimate development of the catchment as well as the intermediate flooding risk.

## **Conclusion**

Urban renewal in the broader Green Square development precinct has provided the City with an opportunity to address historical land use patterns and current flood risk.

Consideration of flood risk within Green Square has led to the conclusion that property and response modification measures alone were not enough to manage the future and continuing flood risk within the redevelopment precinct. A modern development precinct would require a modern flood standard and this would extend to flood modification measures such as trunk drainage.

The pressures of higher density also created pressures for higher quality urban design and limited the scope for property modification measures.

The limited availability of public land in older development areas combined with the pressures for higher density and greater urban design standards makes dual use recreational and flood mitigation facilities difficult to implement.

If existing urban areas are to be redeveloped, careful consideration needs to be given to the land capability and the need for additional infrastructure to manage flooding.

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