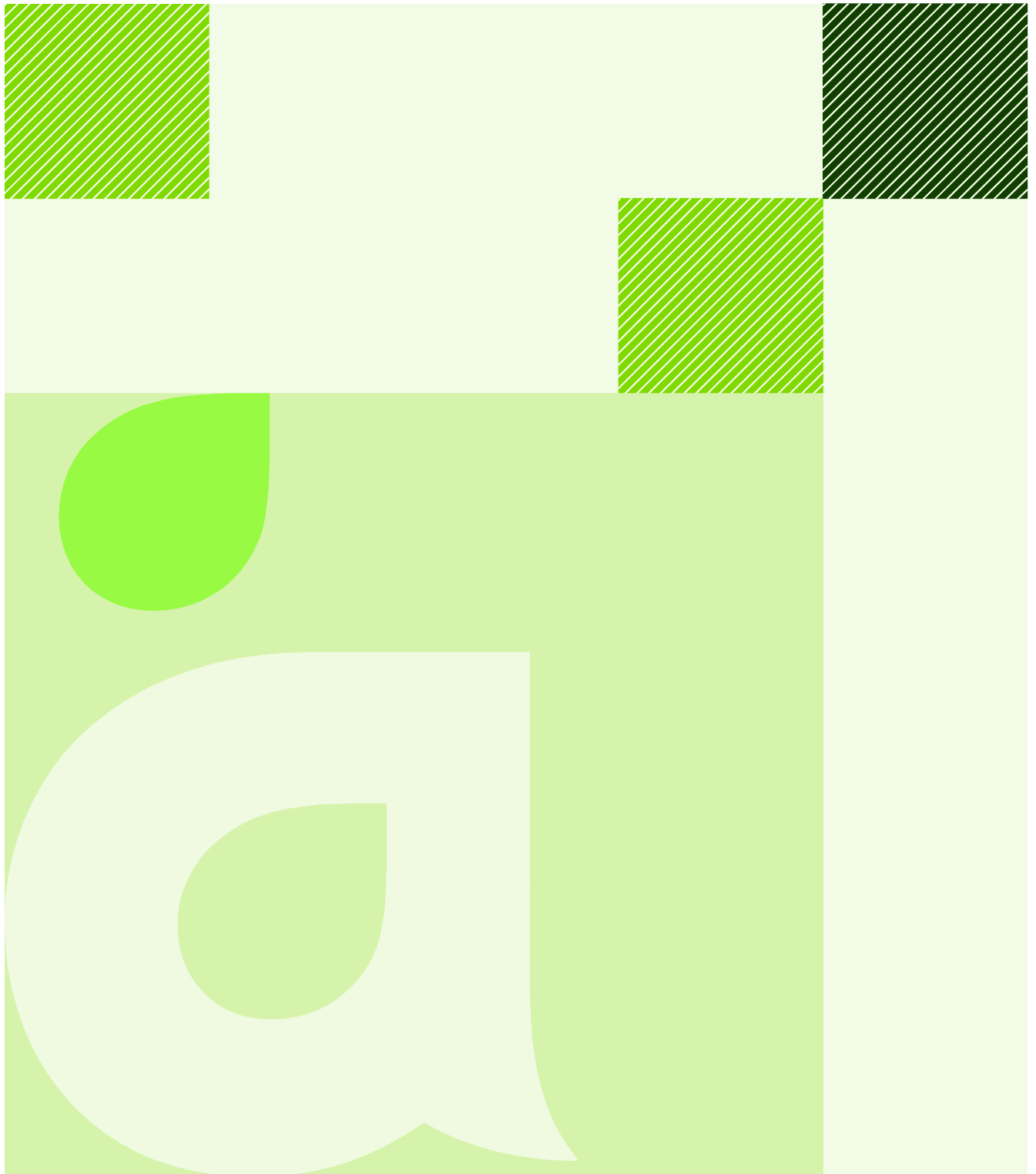


# Stormwater Management Plan

*Aurecon*



**aurecon**

**WESTERN SYDNEY STADIUM**  
**Stormwater Management Plan (SMP)**  
**Lendlease**

**3 March 2017**  
**Revision: F**  
**Reference: 253451**

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# WESTERN SYDNEY STADIUM

Date 3 March 2017  
Reference 253451  
Revision F

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# Executive Summary

This report addresses the requirements placed upon the stadium team by The Department of Planning & Environment and details the flooding, water quality, water source and drainage considerations for the site and proposes a design intent that shall be carried through to construction. The design is to adhere to the following three-tier stormwater management system:

- a. Flows for the 100 yr ARI (1% AEP) event and above must be conveyed via overland flow paths modelled with 100% pipe blockage. This is to be demonstrated using 2D modelling.
- b. 20 yr ARI (5% AEP) event stormwater flows must be carried within the roads and road pipe drainage network.
- c. 3 month storm (4 EY) 'first flush' low flow must be separated and treated using water sensitive urban design measures.

The overland flow strategy directs run-off away from the superstructure and directs in two directions, towards Parramatta River and O'Connell Street.

The stadium superstructure and habitable substructures have been placed above the 1% AEP flood line throughout the site boundary. A minimum free-board of 500mm above the 1% AEP has been adopted throughout. Surface run-off is directed away from habitable structures should in-ground stormwater infrastructure become blocked, or in the case of more intense rainfall due to climate change occur during the lifetime of the Stadium.

Water sensitive urban design (WSUD) principles where appropriate have been incorporated into the design intent with more conventional means adopted elsewhere. The introduction of WSUD has greatly increased the quality of water leaving the site when compared to the existing conditions where no WSUD principles exist.

The design and the reshaping of the site through bulk earthworks will not impact the artesian groundwater or negatively affect the riparian corridor.

The proposed remediation for the site with respect to stormwater will enhance the quality of run-off and will not contribute or adversely impact flooding within the surrounding environment. It is suitable for the conditions set by the Secretary's Environment Assessment Requirements application number SSD 8175.

This report is largely concurrent to the Stage 1 DA submission with the exception of the removal of on-site detention. This matter is discussed in detail in section 4.2 of this report.

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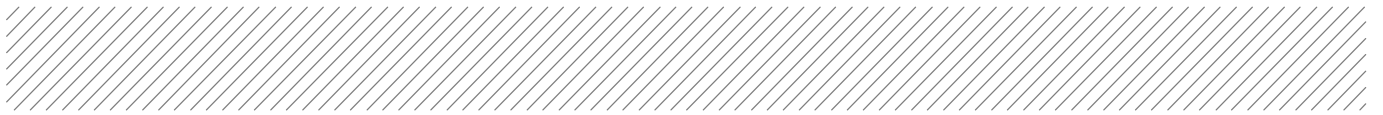
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# 1 Project Overview

## 1.1 Introduction

This report supports a State Significant Development (SSD) Development Application (DA) submitted to the Minister for Planning pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The Application (referred to as SSDA16\_8175) follows the approval of a Stage 1 SSD DA (SSDA16\_7534) in December 2016. The Stage 1 SSDA sets out a Concept Proposal for the redevelopment of the Western Sydney Stadium and future supporting uses. In summary, the Stage 1 Consent includes the following components:

- **Concept Proposal** for the Western Sydney Stadium, including building envelopes, a new 30,000 seat stadium, 500 surface car parking spaces, access, ancillary infrastructure and landscaping; and
- **Detailed works** for staged demolition and removal of the existing stadium and associated infrastructure and the Parramatta Swimming Centre.

### 1.1.1 Overview of Proposed Development

The proposal relates to a detailed ('Stage 2') DA for the detailed design and construction of the stadium. This SSD DA seeks approval for the following components of the development:

- Detailed design of the stadium, public domain and car parking spaces;
- Construction and use of the 30,000 seat stadium including:
  - General Admission Facilities including bars, food and drink stalls, amenities and viewing areas;
  - A function centre and kitchen facility;
  - Associated Stadium facilities including player and coaching facilities, media and press conference rooms, security and stadium managers facilities;
  - Waste storage and loading dock;
- Construction and embellishment of the public domain including:
  - Outdoor sporting and recreation facilities;
  - Public plazas and entertainment areas;
  - General landscaping works;
- Provision of up to 500 car parking spaces with vehicle access to the development from O'Connell Street and internal roads for vehicular circulation;
- Provision of signage zones, lighting and other ancillary stadium elements;
- Pedestrian access and footpath upgrades along O'Connell Street; and
- Extension and augmentation of physical infrastructure / utilities as required.
- The existing substation (AusGrid Ref EE SUB 840) along O'Connell Street will remain in place. This substation powers the O'Connell Street roadside lighting.

## 1.1.2 Background

### Stadia Strategy

The stadium is the first project to be delivered under the NSW Government's \$1.6 billion Stadia Strategy, the largest investment in sporting infrastructure since the 2000 Olympics. The new Western Sydney Stadium will:

- Be able to cater for bigger crowds, provide an improved game day experience and bring major benefits to the Western Sydney economy
- Generate approximately 1,200 jobs during construction and between 600 and 900 jobs once operational for sporting event days and major events
- Cater for a range of sporting and community uses within the precinct.

### Concept Proposal (SSDA 16\_7534)

Infrastructure NSW (iNSW) on behalf of Venues NSW submitted a State Significant Development Application (SSDA) for the Stage 1 concept proposal and demolition of the existing stadium in July 2016. Consent for the Stage 1 SSDA was granted by the Minister for Planning on 7 December 2016 and includes:

- a maximum total GFA of approximately 60,000 m<sup>2</sup> (excluding the playing pitch) for the stadium development, including:
  - additional seating for approximately 10,000 spectators in a seating bowl with 30,000 seats, including 27,000 general admission seats and 3,000 corporate seats;
  - playing pitch;
  - five levels of premium box/terrace, function/lounge offerings and a number of suite offerings;
  - flood lighting, stadium video screens and other ancillary fittings;
  - additional facilities for team, media, administration and amenity, including:
    - police facility and security office;
    - players changing rooms;
    - ticket gates and ticket boxes;
    - media interview rooms;
    - green room;
    - production suite and joint operation control room;
    - event briefing rooms;
    - hirers office and patron services offices;
    - first aid facilities;
    - loading docks for deliveries; and
    - food, beverage and retail facilities.
- a maximum GFA of approximately 20,000 m<sup>2</sup> for future development of ancillary uses within the northern corner of the Site;
- transport, parking and accessibility;
- public domain elements; and landscaping elements throughout the Site.



### **1.1.3 Design Excellence and Project Tender Phase**

Since receiving the development consent for Stage 1, Venues NSW have appointed Lendlease as the contractor for the Stage 2 detailed design and the demolition and construction of the stadium. The tender process also served as a competitive design process in accordance with the Director General's Design Excellence Guidelines and Clause 7.10 of the *Parramatta Local Environmental Plan 2011*.

### **1.1.4 Site Establishment Works Modification**

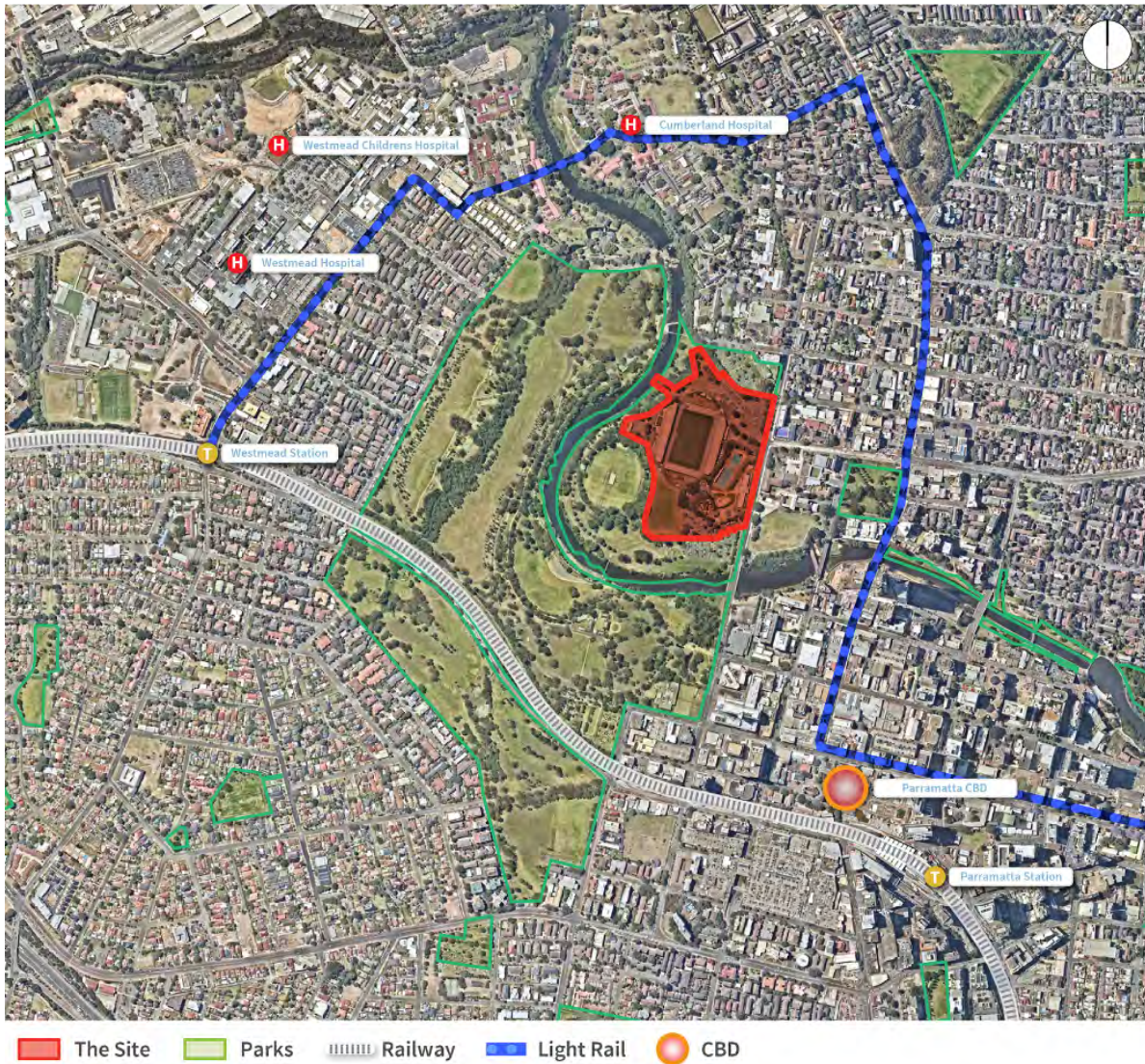
A modification application (MOD 1) was made to the Stage 1 DA pursuant to Section 96(2) of the EP&A Act in February 2017. The modification seeks to expand the approved range of site preparation works to include piling and remediation/earthworks, as outlined below:

- Remediation works comprising the excavation and storage of contaminated materials and bulk excavation. Contaminated materials will be stored on site and capped below ground in accordance with the recommendations outlined in the Remedial Action Plan,
- Piling works which will comprise the driving and drilling of concrete piles to establish foundations for the construction of a stadium located within the Stage 1 building envelope,

The modification application is currently under assessment by the Department of Planning and Environment (DPE) and is awaiting determination.

## 1.2 Site Description

The Western Sydney Stadium is located at 11-13 O'Connell Street, within the Parramatta Park on the north-eastern edge of the Parramatta CBD. It is bound to the south and west by the Parramatta Park and the Parramatta River, the Parramatta Leagues Club to the north and O'Connell Street to the east. The Site is located within the City of Parramatta local government area (LGA). A locational context plan is provided at **Figure 1** below.



**Figure 1 – Site Context Plan**

The site has an area of approximately 95,000m<sup>2</sup> and owned by Venues NSW and The Parramatta Park Trust.

The site is irregular in shape and is illustrated in Figure 2 below.



 The Site

Figure 2 – Site Aerial Plan

### 1.3 Purpose of this Stormwater Management Plan

Aurecon Australia Pty Ltd has been commissioned by Lendlease to prepare a Stormwater Management Plan (SMP) in support of the Development Application. This report will present the stormwater strategy developed during the early concept design stage following project award for stormwater drainage. The report will discuss the impact of potential flooding from pluvial<sup>1</sup> and fluvial<sup>2</sup> whilst at the same time mitigates the flood risk.


The report responds to the States Secretary's Environmental Assessment Requirements (SEARS) *Section 78A(8A) of the Environmental Planning and Assessment Act Schedule 2 of the Environmental Planning and Assessment Regulation 2000.*

The following conditions set out in the SEAR are discussed within the report;

- SEAR's 17 – Water Sensitive Urban Design (WSUD)
- SEAR's 20 – Water Sources

<sup>1</sup> Rain related flooding from extremely heavy rainfall that saturates the urban drainage system in which excess water cannot be absorbed and is instead converted into run-off or overland flow.

<sup>2</sup> Fluvial or River Flood, occurs when excessive rainfall over an extended period of time causes a river (Parramatta River Catchment) to exceed its capacity.



- SEAR's 21 – Drainage and Flooding,

In response to the above criteria, this report largely reflects the strategies adopted by the previously issued AECOM Engineers Working Paper which addresses the majority of issues characteristically associated with a Stormwater Management plan.

This report incorporates the best practice policies and standards of local councils such as Blacktown City Council Engineering Guidelines for Development and City of Parramatta Development Guidelines.

#### **On-Site Detention Requirement**

This report discusses the merit of On-Site Detention (OSD) and it's unsuitability as a flood mitigation system for the greater Parramatta and downstream regions.



## 2 Existing Environment

### 2.1 Site Topography

The Site is located on the Eastern side of a bend in the Parramatta River. The Site has a ground surface which ranges from 9 mAHD to 16 mAHD. Historically, the land would have been graded from the North-eastern corner of the site down to the Parramatta River along the North-western and Southern boundaries.

The pre-urban terrain would appear to have been considerably modified to incorporate the existing stadium facilities, playing surface and surrounding ovals. The existing stadium pitch has an elevation of approximately 9 mAHD and is the lowest elevation within the Site.

### 2.2 Local Drainage Network

The runoff generated outside of the Site is conveyed by the Parramatta City Council stormwater network to the Parramatta River.

Surface runoff on O'Connell Street is collected by road side pits and conveyed by pipes Southward to the Parramatta River. During larger runoff events, it is likely some runoff which exceeds the capacity of the pipe network would flow into the Site via the road entrance at Victoria Road (Hyder, 2014). This water would likely flow South through the Parramatta Swimming Centre and into the Parramatta River for internal and external drainage flow paths. This is the only location where external runoff may flow into the Site. In all other locations, the existing site is elevated above the surrounding land and this prevents runoff entering the site from external catchments.

### 2.3 Parramatta River

The Parramatta River conveys runoff from the upstream 103 km<sup>2</sup> catchment past the Eastern and Southern side of the Site. The catchment includes Blacktown City, Baulkham Hills, Holroyd City and Parramatta City Councils (Bewsher, 2003).

Since the 1970s, the catchment has undergone flood mitigation works to reduce the flood risk to many parts of the catchment. In 1989 the Upper Parramatta River Catchment Trust was established to provide a cohesive flood mitigation strategy for the four councils, which included a flood inundation model (Bewsher, 2003). The original 2003 flood study had calculated that during a 100yr ARI event, the North-western area of the Site would be inundated. During a Probable Maximum Flood (PMF), the majority of the Site would be inundated. The new stadium development would not be fully protected against the PMF.

# 3 Basis of Design

## 3.1 Design Objectives

The Parramatta Council specifies stormwater design objectives for new developments in Section 3 of the Parramatta Development Control Plan (DCP) 2011. However, under the State Environmental Planning Policy 2011, the Site is excluded from development control plans. Nonetheless, these objectives have been adopted and expanded for this Project and assessment to aim for maximum sustainable triple bottom line (3BL) benefits to the Site which may not be as prevalent otherwise.

A summary of these design objectives are presented below:

### Stormwater Quantity Objectives:

- Minimise the post-development volume and rate of stormwater runoff to equal or less than the pre-development,
- No increase in flood risk to adjoining or downstream properties,
- Minimise flooding,
- Minimise disturbance to existing drainage system,
- Utilise distributed stormwater control and treatment measures,
- Utilise Water Sensitive Urban Design (WSUD) measures,
- Stormwater infrastructure to visually integrate with the landscape,
- The site is not flood affected by the 100 yr ARI flood envelope but can be affected by the PMF flood envelope,
- Stormwater system designed for a minimum of 100 yr ARI where there is no overland flow path or 20yr ARI where an overland flow path is provided,
- Provision of flood evacuation routes from the Stadium and Stadium Precinct,
- Assess the Bureau of Meteorology (BoM) release of the 2013 Intensity Frequency Duration (IFD) design rainfall to the design,
- The effects of Climate Change due to the possible increase of rainfall,

### 3.1.1 Stormwater Quality Objectives

- Treatment and control measures implemented and used during construction and operation of the stadium,
- Minimise contamination of stormwater,
- Minimise erosion and sedimentation, nutrient and seed dispersal due to stormwater discharge,
- Ensure no adverse environmental impacts on the Parramatta River system,
- The stormwater treatment system MUSIC is used to model the required pollution reduction loads presented here in Table 1,

**Table 1 - Stormwater Treatment Targets for Development**

Pollutant	Performance Target Reduction Loads <sup>1</sup>
Gross Pollutants (GP)	90% reduction in the post development mean annual load of total gross pollutant load (greater than 5mm)
Total Suspended Solids (TSS)	85% reduction in the post development mean annual load of Total Suspended Solids (TSS)
Total Phosphorus (TP)	60% reduction in the post development mean annual load of Total Phosphorus (TP)
Total Nitrogen (TN)	45% reduction in the post development mean annual load of Total Nitrogen (TN)
Hydrocarbons, motor oils, oil and grease	No visible oils for flows up to 50% of the one-year ARI peak flow specific for service stations, depots, vehicle body repair workshops, vehicle repair stations, vehicle sales or hire premises, car parks associated with retail premises, places of public worship, tourist and visitor accommodation, registered clubs and pubs

### 3.1.2 Water Sources Objectives

- Ensure no adverse environmental impacts on the Parramatta River, aquatic environment and riparian corridors,
- Highlight mitigation measure to manage any possible impacts,
- Assess whether or not construction or operations impact on groundwater dependant ecosystems

### 3.2 Stormwater Strategy Objectives

- The site stormwater drainage system (minor system) has been designed for the 20 Year Average Recurrence Interval (ARI) in accordance with AS/NZS 3500.3.2015 - Stormwater drainage,
- The overland flow routes throughout the precinct have been design to cater for the 20 to 100yr ARI event with safe passage for emergency vehicles and patrons during high rainfall events with safe flow depth/velocities. The route nominated is the existing O'Connell – Victoria Road junction (post-development following regarding of the site) that is not inundated during the 100yr ARI storm event,
- Collection of the roof drainage for the 100yr ARI storm event,
- The design Intensity-Frequency-Duration (IFD) has been derived from the Bureau of Meteorology in accordance with the Australian Rainfall & Runoff 2013,
- Site discharge from the proposed development is limited to a pre-development flow as established by the AECOM Engineers Drainage and Flooding Working Paper 2016 presented as part of the RFT.

# 4 Current Flood Assessment Results

## 4.1 Quantitative Assessment of Flooding Related Risks

The following presents the modelling calculations that were completed by AECOM Engineers and Others to enable an assessment of the water related risks for the development and to enable mitigation strategies to be established.

### 4.1.1 Regional flood inundation modelling

The flood inundation modelling of the Parramatta River by Bewsher Consulting Pty Ltd in 2003, determined that portions of the existing site may be at risk of flood inundation during a 100yr ARI event. To assess this risk, a flood model was developed which included the surface elevation and new stadium location.

A two dimensional rain-on-grid TUFLOW model was developed for the Parramatta River Catchment. A 10m gridded model of the entire regional catchment was run for all storm durations for the 100yr ARI event. The critical storm was determined to be the 9 hr event. This produced a peak flow rate at Charles Street Weir of 916 m<sup>3</sup>/s at a peak flood elevation of 5.5 mAHD. This is comparable to the modelling investigation by SKM Engineers who calculated a critical storm of 9 hours with a peak flow rate of 847m<sup>3</sup>/s at a peak flood elevation of 5.4 mAHD. Since there is close correlation with the SKM investigation, which has been calibrated to historical events, the model produced previously is deemed suitable for use in this site assessment. A presentation of the flood inundation for the catchment is provided by AECOM in Figure 3.

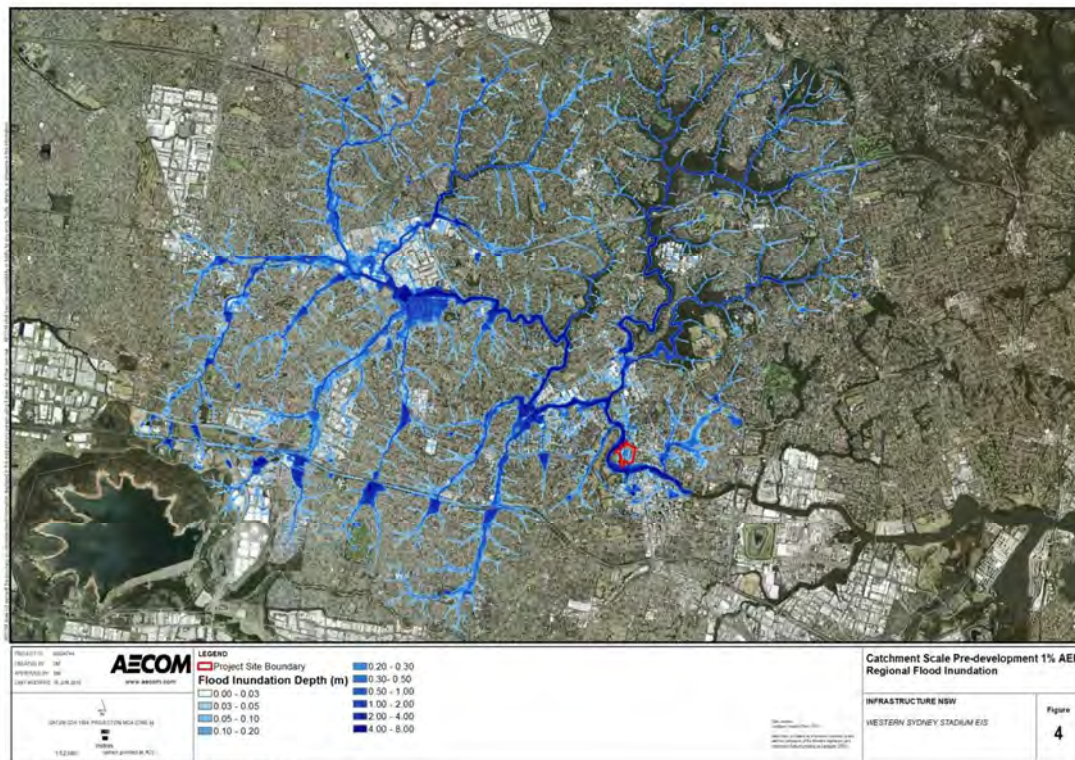


Figure 3 - Catchment Scale Pre-development 1% AEP Regional Flood Inundation

## 4.1.2 Existing Local flood inundation modelling

### 4.1.2.1 Pre-developed (existing) Site Conditions

The local flood inundation model (prepared by others) was prepared for the immediate site using the regional model for inflows within the Parramatta River. The local flood inundation model had a reduced model domain and an increased model grid resolution to 1.5 m. This enabled increased accuracy and definition in the flood extent. The local flood inundation for the existing Site conditions model is presented in Figure 4.

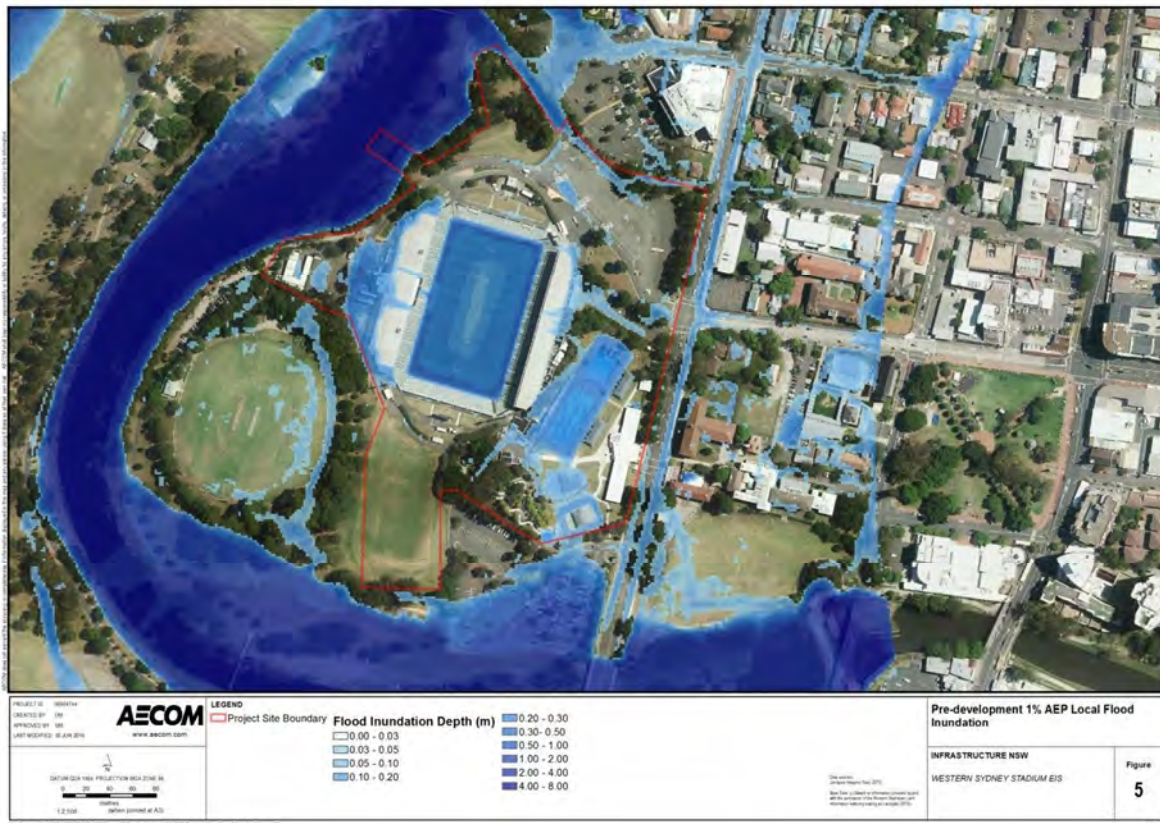


Figure 4 - Pre-development 1% AEP Local Flood Inundation

The results indicate that the flood extent of the Parramatta River does not overlap the existing Site. The minor inundation of the existing Site presented in Figure 4 is due to excess runoff generated from the Site's impervious surfaces and detained within low points in the topography. The historical maximum height of the 1% AEP affecting the Site is learnt to be 8.5m AHD.

### 4.1.2.2 Post-developed Site Conditions

The design surface levels for the playing field is 9m AHD with the surrounding concourse of 14m AHD. Outside the stadium superstructure, reduced levels will vary across the site to match existing topographical levels around the site boundary and in particular O'Connell Street. The new stadium precinct will have large car parks to the west and north of the superstructure with a paved/landscaped patron entertainment area parallel to O'Connell Street as shown in Figure 5.

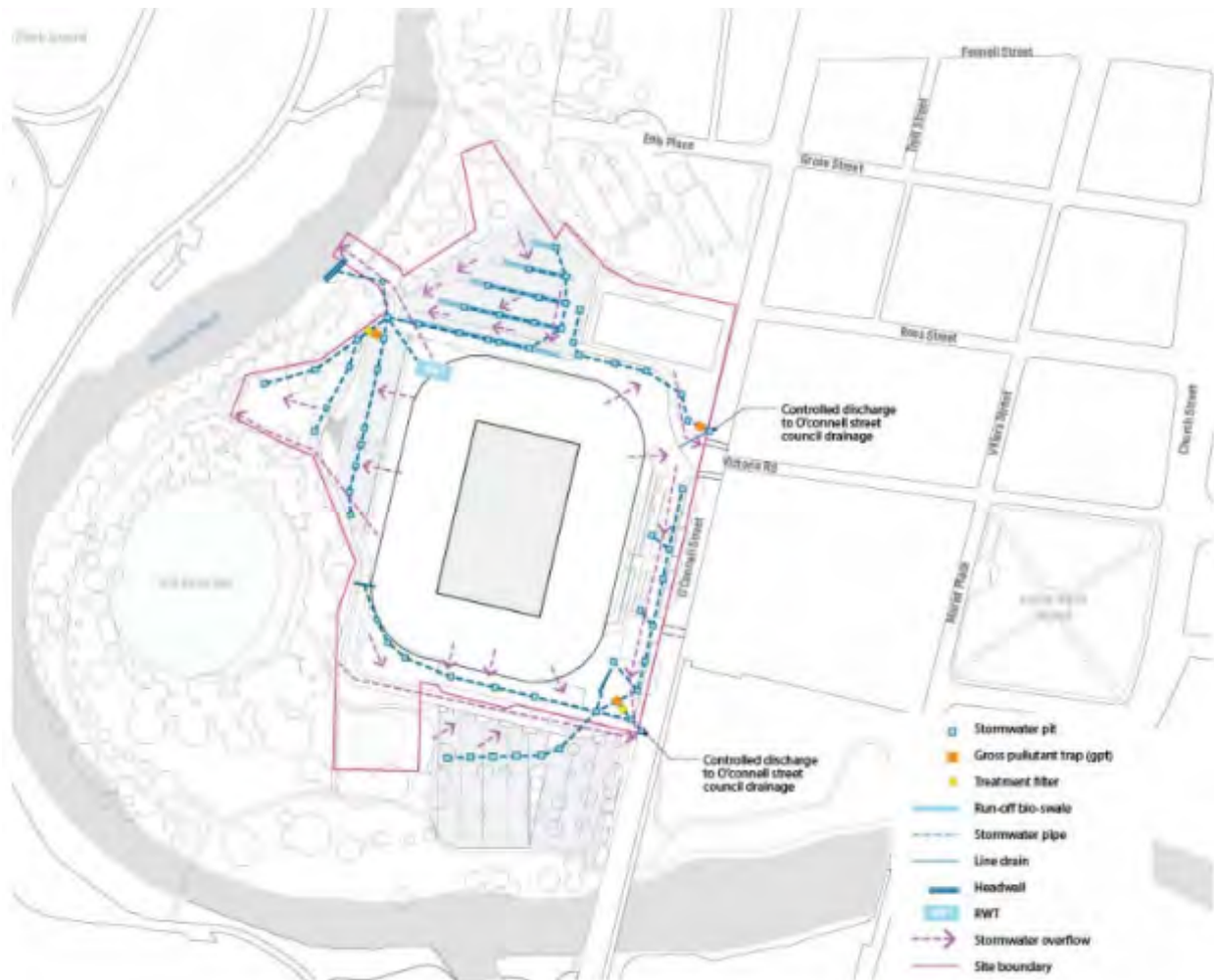


Figure 5 - Proposed Site Drainage Flow Paths during rainfall exceedance events

The Parramatta River flood levels do not overlap the post-development Site for the 100yr ARI flood event. The playing surface reduced level remains at 9 mAHD with the surrounding concourse at 14 mAHD. Therefore, the 100 year ARI Parramatta River flood levels will not impact the new stadium and the development is subsequently unlikely to have any impact on the flood risk of adjoining properties. The playing field has an overland flow path through the lower stadium bowl which couples as the entry for large Pantech vehicles during concert events.

A minimum free-board of 500mm will be provided above the 100 yr ARI or 1% AEP storm event. Landscaping and the proposed stadium concourse will slope away from the building envelop as demonstrated by Figure 4 above. The repositioning of the new stadium further aids in maintaining freeboard as it moves further away from the river banks lower slopes.

The reshaping of the site in the form of bulk earthwork will further help protect the site in the event of the PMF by directing run-off away and around the new stadium bowl. Emergency access during the 100 yr ARI (1% AEP) and the PMF will be provided at the Victory Street Junction following project completion.

The reshaping of the stadium bowl to direct run-off away from the superstructure further protects the precinct in such times when climate change will most likely mean that future rainfalls will exceed current rainfall intensities.

### 4.1.3 Local stadium precinct drainage network modelling

The local drainage reticulation has been simulated in DRAINS. The model was applied to calculate stormwater runoff flows through and off the Site for the pre- and post-development scenarios. The pre-development flow was established independently by AECOM Engineers.

The AECOM Engineers assessment of the as-built information for the Site did not identify all drainage line configurations. The assessment did reveal a single point of discharge, for the main stadium facilities, into Parramatta River. Therefore, where drainage line configurations could not be identified, the sub-catchments were assumed to connect into the nearest identified drainage pit or junction and subsequently into the outfall pipe.

The DRAINS model configuration of the pre-developed (existing conditions) drainage system for the stadium facilities is shown in Figure 6.

Lesser catchments have not been modelled such as does on the existing Parramatta Public Pool site which presently discharges into the local Council drainage system within O'Connell Street.

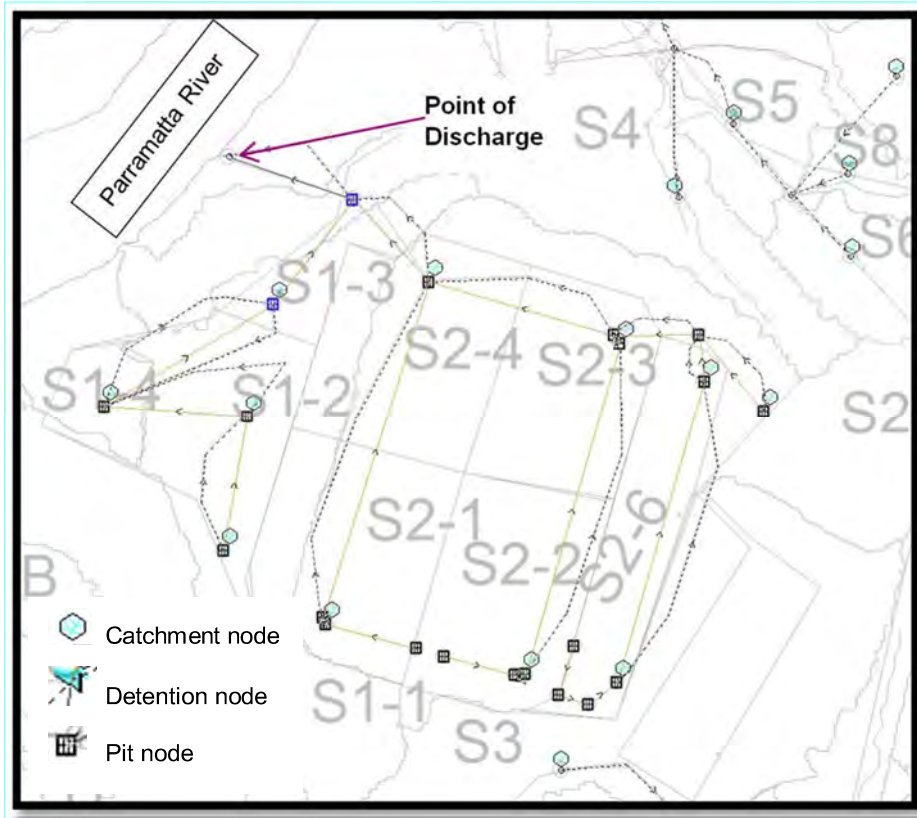



Figure 6 - Pre-Development DRAINS model (source AECOM Engineers)

The DRAINS model configuration of the post-development (design conditions) drainage system for the stadium facilities is shown in Figure 7.

 Catchment node

 Pit node

Discharge to Parramatta River

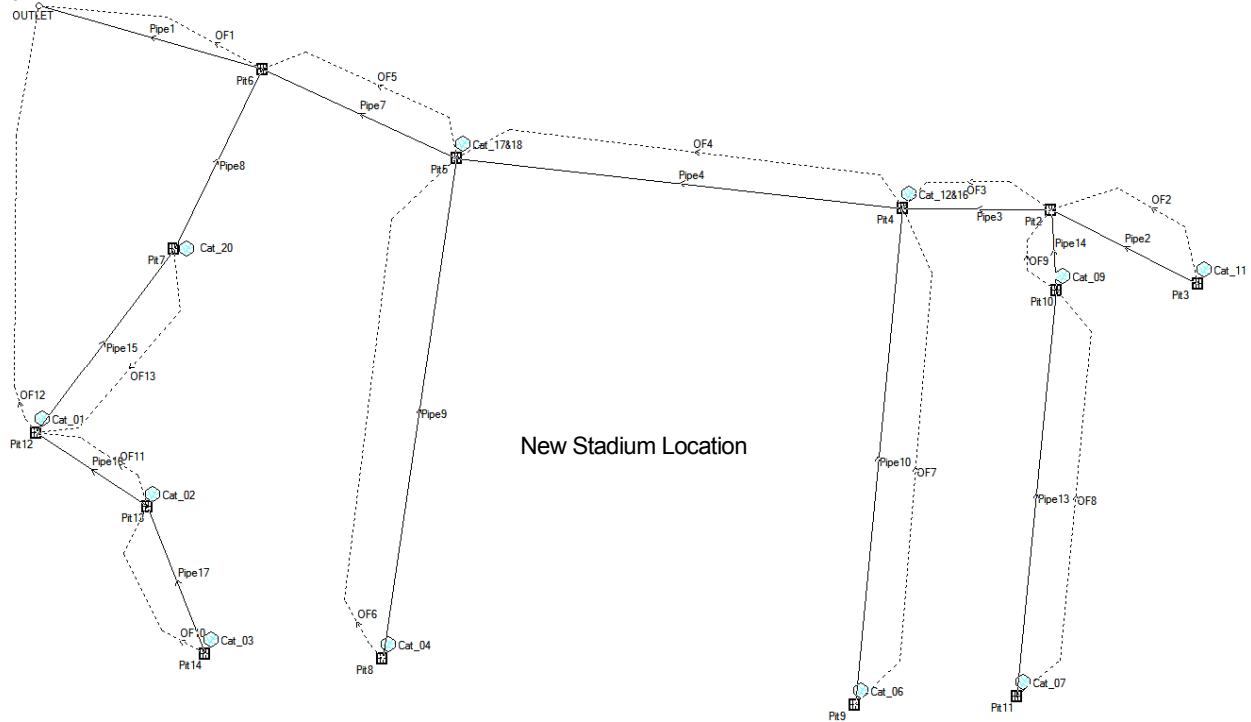


Figure 7 - Post-Development DRAINS model line diagram

The DRAINS model was used to simulate storm durations from five minutes to three hours for the 10, 20 year and 100 year ARI storm events, respectively. Analysis of the DRAINS model results indicate that for the pre-development system, the 25 minute and 20 minute rainfall duration is the critical duration for the 10, 20 year and 100 year storm events. For the post-development system, the 25 minute duration is the critical duration for all storm events. The resulting discharge flow rates into Parramatta River are listed in Table 2 and Table 3 for the 10 year ARI and 100 year ARI storm events, respectively.

Table 2 - 10 year ARI

Storm Duration	AECOM Engineers Pre Development Discharge (m <sup>3</sup> /s)	Developer Post Development Discharge (m <sup>3</sup> /s)- Unmitigated
5 minutes	0.743	0.248
10 minutes	0.837	0.248
15 minutes	0.907	0.485
20 minutes	0.930	0.847
25 minutes	0.961	0.893
30 minutes	0.915	0.858
1 hour	0.804	0.953
3 hours	0.612	1.029

Table 3 - 20 year ARI (Shown for information only)

Storm Duration	Developer Post Development Discharge (m <sup>3</sup> /s)- Unmitigated
5 minutes	0.301
10 minutes	0.651
20 minutes	1.040
30 minutes	1.048
1 hour	1.134
2 hours	1.204
6 hours	0.776

Table 4 - 100 year ARI

Storm Duration	AECOM Engineers Pre Development Discharge (m <sup>3</sup> /s)	Developer Post Development Discharge (m <sup>3</sup> /s)- Unmitigated
5 minutes	1.10	0.494
10 minutes	1.35	0.981
15 minutes	1.38	0.494
20 minutes	1.42	0.981
25 minutes	1.40	1.305
30 minutes	1.37	1.303
1 hour	1.27	1.368
3 hour	0.98	1.411

The results indicate that there is a good correlation between the AECOM Engineers and Developers DRAINS models. Peak discharge figures are similar with respect to storm durations.

There will be two minor connections to the municipal council system along O'Connell Street – the North entrance and South entrance.

## 4.2 On-site dentition (OSD)

This section of the report discusses the merit of providing no OSD for the project due to the Sites proximity to Parramatta River and the probable impact that the controlled discharge from an OSD will have on fluvial flood waters within the Parramatta River.

### Current authority guidelines

Retention and discharge from the site will be at the discretion of local authorities including Parramatta City Council and the Upper Parramatta River Catchment Trust. Presently, the policy of these authorities is to detain run-off from upper catchment sites and allow discharge in a controlled manner with the quality of the discharge not having an adverse impact on the surrounding waterway environment or drainage infrastructure systems.

### Existing OSD conditions

The existing Parramatta Stadium does not provide attenuation on-site. Nor is there any indication that run-off from the site is treated. Existing overland flow paths are also directed towards the Parramatta River. Run-off from the lower end of the precinct and the existing Parramatta Swimming Centre discharges into the local council drainage network running along O'Connell Street which in turn discharges directly downstream of the Parramatta River and the existing stadium site.

### Fluvial flood mitigation

The Upper Parramatta River Catchment has a total area of circa 103km<sup>2</sup>, the run-off from which has in the past contributed significantly to flooding along the Parramatta River. The peak flow from this catchment as discussed in section 4.1.1 of this report occurs during the 9hr event when surface run-off from the upper reaches of the catchment reach the river and contribute to the swelling of the river when in flood.

To mitigate against this swelling of the river, discharge from the Western Sydney Stadium (WSS) site should enter the river many hours before the 9 hour peak reaches the lower boundary of the catchment where the future stadium is to be built. Should run-off from WSS be detained within an OSD, the controlled discharge will contribute to the swelling of the river whilst in flood.

As WSS is in such close proximity to the Parramatta River, discharge from site run-off (post treatment) should enter directly into the river and local drainage network prior to the peak flow reaching the lower end of the catchment. In this way, instantaneous discharge will prevent the WSS site from contributing to the peak river flood flow and help reduce the impact of river flood further down the Parramatta River as it reaches the mouth of the harbour.

Preliminary discussions with local authorities (Parramatta River Trust and Parramatta City Council) indicate that such a design philosophy is agreeable as direct discharge does not affect neighbouring land users or sub-catchments.

## 4.3 Water Quality

Presently the existing stadium precinct does not provide any notable water quality initiatives such as, gross pollutant control, filtration or the use of bio-swales to treat site wide run-off from environmental rainfall events.

### 4.3.1 Water quality modelling

The water quality modelling is concurrent with the water quality modelling undertaken by AECOM Engineers who used the MUSIC 6.2 software program. Input parameters for source and treatment nodes have been obtained from Sydney Catchment Authority MUSIC modelling manual (NSW Govt, 2012) as well as the NSW MUSIC modelling guidelines (BMT WBM, 2010).

The source nodes in the MUSIC model have been configured based on the DRAINS catchment nodes for both the pre- and post-development scenarios.

- Average potential evapo-transpiration (PET) data for the Parramatta North station has been adopted,
- Music version 6.1.0 has been used.

The pre-development (existing conditions) site MUSIC model configuration is shown in Figure 8.

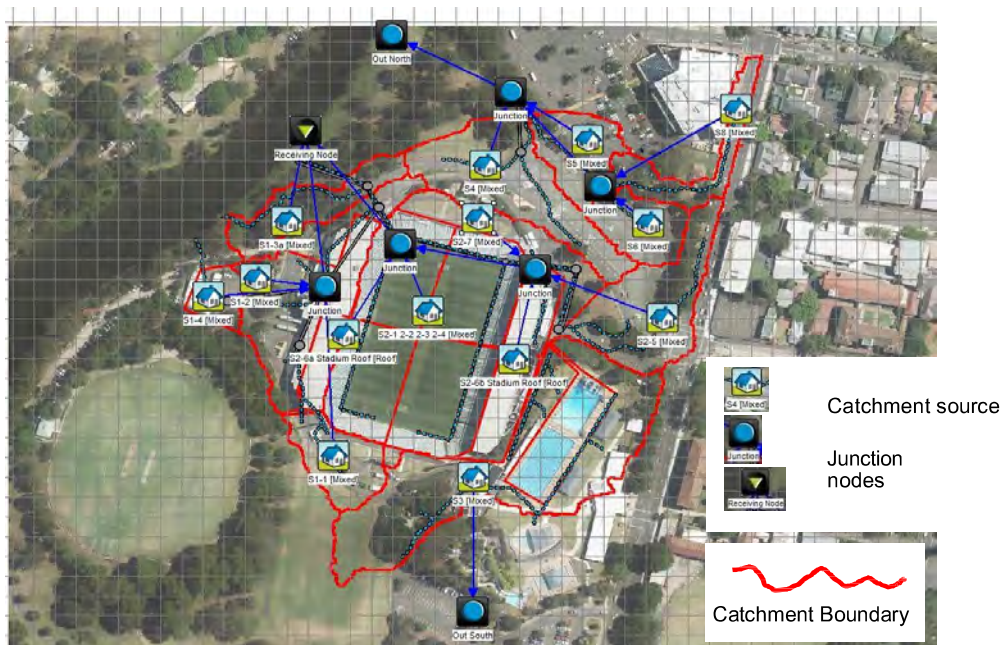


Figure 8 - Pre-Development (Existing Conditions) MUSIC Model Configuration

The pre-development stormwater pollutant constituents calculated for the existing main stadium facilities and discharging into Parramatta River are shown in Table 5.

Table 5 - Pre-Development Stormwater Quality Statistics

Pollutant	Estimated annual pollutant reduction efficiencies (%)	Pollutant Reduction Targets (%)
Total Suspended Solids (TSS)	84.3	85
Total Phosphorus (TP)	55.8	65
Total Nitrogen (TN)	33.6	45
Gross Pollutants (GP)	55.8	90

The post-development (design conditions) site MUSIC model configuration is shown in Figure 9.

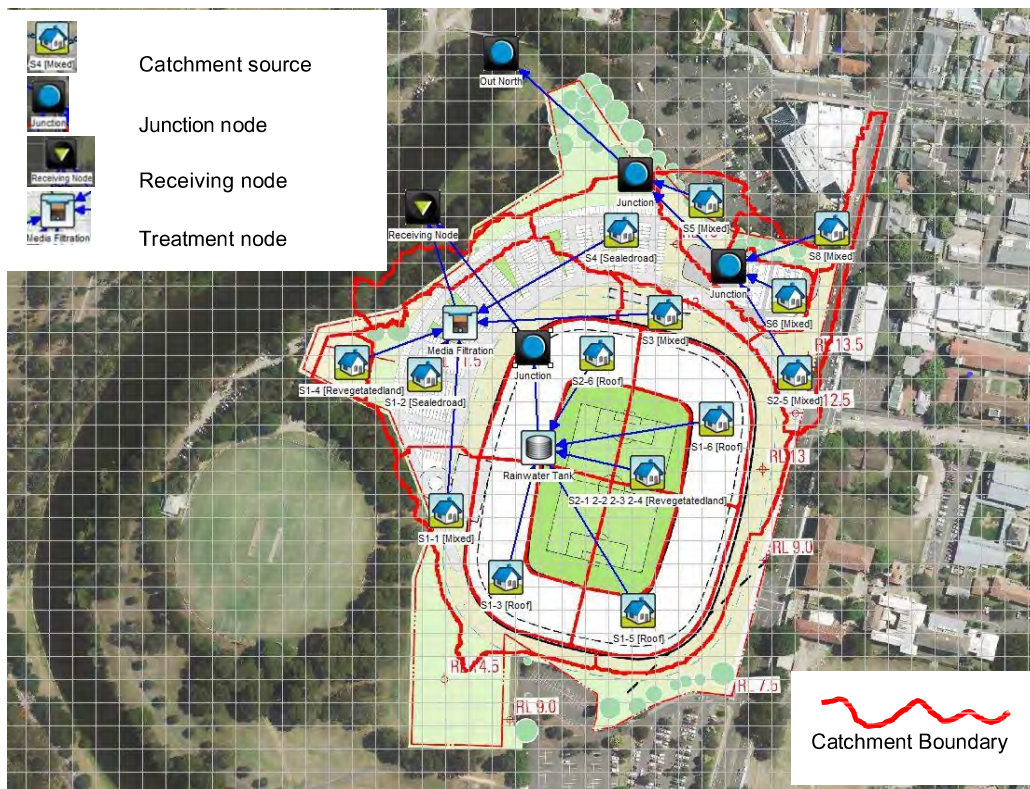


Figure 9 - Post-Development (Design Conditions) MUSIC Model Configuration

The treatment nodes incorporated into this model include a rainwater tank for stormwater harvesting of both the proposed stadium roof and playing field, and a bio-swale filtration system for the car park facilities. The post-development stormwater pollutant constituents calculated for the main stadium facilities for total water demand reuse, discharging from the point of discharge are shown in Table 6.

Table 6 - Post-Development Stormwater Quality Statistics – Total Water Demand Reuse

Pollutant	Estimated annual pollutant reduction efficiencies (%)	Pollutant Reduction Targets (%)
Total Suspended Solids (TSS)	85.9	85
Total Phosphorus (TP)	64.2	65
Total Nitrogen (TN)	48.6	45
Gross Pollutants (GP)	94.9	90

As shown in Table 6 the stormwater quality management objectives can be achieved through a combined WSUD and integrated water cycle management (IWCM) philosophy utilising the maximum volume of non-potable water supplies for reuse.

### 4.3.2 Water quality treatment train

The stormwater environment flow (6 month ARI rainfall event) will be treated through two primary means. Run-off from car parks will predominantly flow into bio-swales that will capture, detain and filter/treat the environmental flow. For rainfall events greater than the environmental flow, pits located within the swales will convey the greater run-off flows into a conventional pit and pipe system. The figure below is a typical example of a bio-swale integrated into a car park.



Figure 10 - Integrated Car Park Bio-Swale

All other catchments that do not enter the bio-swale system will be treated by a Humes JellyFish filtration unit (or equivalent). Humes JellyFish membrane filter system is an underground, precast concrete stormwater tertiary treatment device. It incorporates an efficient up-flow design that facilitates influent flow over the entire surface area of the filters. It provides pollutant removal, with a smaller treatment flow footprint. Hydraulic pressure forces water through the filter media — causing a constant velocity throughout the filter area realising a consistent media contact time and therefore treatment.

Upon completion of a treatment cycle, the filter backwashes and effectively dislodges particulates from the filtration layers. This re-establishes filter media interstitial porosity. The dislodged particles then accumulate away from the filter media allowing easy removal during maintenance.

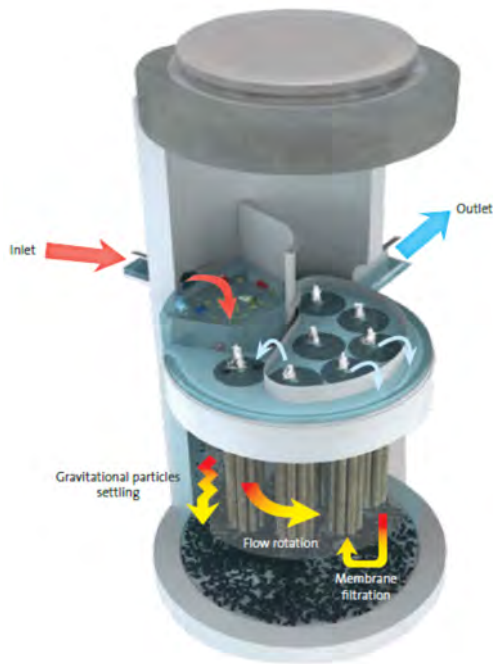


Figure 11 - Typical Humes JellyFish Filter

Typical pollutant removal efficiencies are:

Table 7 - JellyFish filter performance summary (Humes, 2014)

Pollutant	Median reduction
TSS	89%
TP	65%
TN	55%
Cu	61%
Zn	91%
Total oil and grease	62%

Reference: University of Florida (2011) and West Ipswich (2014).

## 4.4 Water Sources

A geotechnical investigation of the stadium was conducted 11 July 1984 (Douglas and Partners, 1984), which included 20 test bores. The bore data indicates that the site generally has a top layer of "Filling" material which consists of brown fine sand and silt. The depth varies across the site due to past historical earthwork activities. Below this is a layer of brown Sandy Clay material to a depth of approximately 5 m R.L. Below this level the material consists of silt stone and sand stone.

The bore logs indicate that during the works there was no general presence of groundwater. However, after three weeks, many of the bores along the western side of the existing stadium did exhibit a presence of groundwater at the level equal to the interface of the filling material and the sandy-clay material. This indicates that there is a localised perched groundwater system which likely formed due to the 123 mm rainfall event which occurred two weeks after (26/7/1984) the bore construction (BoM, 2/6/2016).

### 4.4.1 Construction impact on groundwater dependant ecosystems

The site's lowermost reduced level is the existing playing field at RL 9.0m AHD. It is proposed to move the stadium footprint parallel to O'Connell Street and increase the playing surface to 9.55m AHD.

Cut to fill during bulk earthworks will not exceed a reduced level of circa 8.8m AHD (western stand underside of basement slab). Groundwater as interrelated from borehole log data indicated that the artesian level is far below this level (with an allowance for perched groundwater following intense rainfall) and hence such construction works is unlikely to interfere with groundwater dependant ecosystems.

Construction works that will enter into the groundwater is restricted to the new stadium piled footings. However, any impact this might have on the groundwater dependant ecosystem is thought to be negligible due to the dispersed nature of the piling solution. No continuous piling is used on this project. The majority of piles used comprise of driven piles with a section of bored piled to be used on the Western Stadium Stand only.

Groundwater boreholes will not be used on this project to extract groundwater for the use in dust suppression or irrigation.

### 4.4.2 Operational impact on groundwater dependant ecosystems

Groundwater boreholes will not be used on this project to extract groundwater for the use of landscape irrigation or otherwise. Water re-use tank(s) will capture roof run-off for the use of flushing and short term landscape irrigation. The new playing field will utilise potable water to irrigate the field under OHS considerations for players and ground staff.

Recharge of artesian groundwater will occur through the capture, treatment and infiltration of rainwater run-off via bio-swales within the larger Northern car park and through the natural landscaping of the surrounding sports precinct.

### 4.4.3 Construction impact on surface water run-off dependant ecosystems

During construction, erosion and sediment control measures will capture run-off and direct it sedimentation ponds. The run-off captured will either infiltrate or be re-used for dust control. During high rainfall events, controlled overflow is to discharge into the existing O'Connell Street Council drainage system. Refer to drawing 253451-CC048 EROSION & SEDIMENT CONTROL PLAN issued as part of the Stage 2 DA SEAR's conditions.

### 4.4.4 Operational impact on surface water run-off dependant ecosystems

The environmental or 6 month ARI flow will be captured and treated for pollutants prior to discharge into external drainage networks inclusive of the Parramatta River. This is discussed in detail within section 4.3 of this report.

#### **4.4.5 Construction impact along the riparian corridor**

At the time this report was written, on-site investigation into the existing stormwater discharge pipe into Parramatta River is to be conducted as to ascertain the pipes capacity and current condition. If the pipe is found to be in good condition the pipe will be re-used without the need to disturb the riparian corridor. No other works is to occur within the riparian corridor. Should the discharge pipe be unsuitable for re-use, minor excavation along the existing pipe route and the use of non-toxic materials such as rocks/boulders will be used to secure the new discharge pipe and prevent fluvial erosion. At no time will concrete or any such substance be specified within the riparian corridor.

# Appendix A – Council Correspondence

Hi Michael

What you have written below is in good accord with Council's views on the implementation of WSUD at this site.

Council would emphasise maximising rainwater harvesting, not just for toilet flushing but for other uses, notably irrigation.

We had looked before at the possibility of providing water to Parramatta Park via a submerged pipe across the river - although this may be difficult to implement legally.

Also Council would seek to maximise integration of stormwater management into the landscape for a long term water quality benefit.

Kind regards

Paul Clark

**Paul Clark** | A/Team Leader Technical Specialists & Senior Development Engineer  
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PO Box 32, Parramatta NSW 2124  
(02) 9806 5050



**From:** Michael O'Rourke [mailto:Michael.O'Rourke@aurecongroup.com]  
**Sent:** Wednesday, 7 September 2016 4:35 PM  
**To:** Paul Clark  
**Subject:** Western Sydney Stadium - Stormwater Treatment and Disposal

Paul,

I hope this finds you well?

Apart from the Public Domain, I'm helping out Lendlease on their bid for the new Western Sydney Stadium.

I was advised by one of the stormwater asset engineers that my questions regarding stormwater within the precinct should be directed to the Development Section in the first instance and your name popped up. The Engineer I spoke to Aziz, I didn't get a second name I'm afraid.

I've been charged with looking into, flooding protection, run-off treatment and stormwater discharge.

### **Flooding**

From a flood protection aspect, I've advised Lendlease that we should be above the RL of 8.50m AHD as a minimum, this level is 500mm above the 100 yr ARI. The lowest point of the new stadium is 9.00m AHD.

### **Run-Off Treatment**

At present, there is no water treatment undertaken on the stadium site, the State has advised that we should meet the following treatment levels as a minimum.

Water Quality Parameters	Greenfield developments
	Large developments (% reduction)
Gross Pollutants	90
Total Suspended Solids (TSS)	85
Total Phosphorus (TP)	60
Total Nitrogen (TN)	45

### **Water Re-Use**

Roof run-off will be captured and re-used for toilet flushing.

### **Stormwater Discharge**

The State have advised that they do not require OSD on the site but this will be subject to Local Council Approval. The position taken so far is that OSD is redundant considering the proximity of the Stadium to Parramatta River. The existing stadium currently discharges to the river with no treatment or OSD. Flood studies of the Upper Parramatta River Catchment indicate that the critical storm event is the 100 yr 9hr event. Our philosophy is to discharge to the river (post treatment) prior to the peak flow thus not to contribute to the flood.

We consider this to be a realistic and practical solution but in-put from Parramatta Council would be most welcome. Do you consider our approach to be a measured one?

On the opposite end of the site (low end), some run-off is expected to flow into the existing O'Connell Street drainage system. This is in line with the existing Parramatta Swimming Complex (which unfortunately will be demo'd) which discharges into the street, again, no OSD or treatment. As-Built information indicates a 300mm diameter pipe. Preliminary design indicates a similar pipe size discharging into O'Connell Street (with treatment).

Please find attached two sketches that document our philosophy to date, again, we welcome any feedback.

Should you wish to discuss further, or require additional information, please do not hesitate to contact me.

Kind regards,

**Michael O'Rourke** BEng CEng MIEAust  
Senior Civil Engineer, Aurecon  
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# Appendix B – Development Consent Requirements

The following is the minimum basis of for development (Stormwater & Flooding)

## Development consent

Section 89E of the *Environmental Planning and Assessment Act 1979*

### Stormwater Management

- B8. Prior to the commencement of works, a Stormwater Management Plan (SMP) is to be prepared and submitted to the Certifying Authority. The SMP is to detail the proposed stormwater disposal and drainage from the development, designed in accordance with, but not limited to the Australian and Council's Stormwater Management Code as follows:
- Australian Rainfall and Runoff – A Guide to Flood Estimation, Volumes 1 and 2 (1987);
  - SA/NZS 3500.3.2 National Plumbing and Drainage Part 3.2: Stormwater Drainage – Acceptable Solutions;
  - On-Site Stormwater Detention Handbook (Fourth Edition, December 2005) – Upper Parramatta River Catchment Trust;
  - Managing Urban Stormwater – Soils and Construction Volume 1 (4th Edition March 2004) – NSW Department of Housing;
  - Blacktown City Council Engineering Guidelines for Development – 2015;
  - Blacktown City Council Development Control Plan 2015 Part J Water Sensitive Urban Design and Integrated Water Cycle Management;
  - loading and unloading, including construction zones;
  - predicted traffic volumes, types and routes; and
  - pedestrian and traffic management methods.

All approved details for the disposal of stormwater and drainage are to be implemented in the development.

### Erosion and Sedimentation Control

- B11. Soil erosion and sediment control measures shall be designed in accordance with the document *Managing Urban Stormwater-Soils & Construction Volume 1 (2004)* by Landcom. Details are to be submitted to the satisfaction of the Certifying Authority prior to commencement of above ground works involving vegetation removal or soil disturbance.

# Appendix C – Secretary’s Environmental Assessment Requirements - SEARS

## 20. Water Sources

- Assess the construction and operational impacts on the Parramatta River, aquatic environment and riparian corridors potentially affected by the proposal and mitigation measures to manage any impacts.
- Assess the construction and operational impacts on groundwater, including groundwater quality, quantity and connectivity and groundwater dependent ecosystems .

→ *Relevant Policies and Guidelines:*

- *NSW Aquifer Interference Policy (NOW, 2012)*
- *NSW State Rivers and Estuary Policy (1993)*
- *NSW Guidelines for Controlled Activities on Waterfront Land (DPI, 2012)*
- *Policy and Guidelines for Fish Habitat Conservation and Management (2013)*

## 21. Drainage and Flooding

- Detail the drainage system for the proposal and demonstrate that the design adheres to a three-tier stormwater management system in accordance with the City of Parramatta’s guidelines and recommendations.
- Assess any potential flood risks on-site associated with the proposal and consideration of any relevant provisions of the NSW Floodplain Development Manual (2005), including:
  - the potential effects of climate change, sea level rise and increase in rainfall intensity;
  - details of flood prone land, the flood planning area, and hydraulic categorisation (floodway and flood storage areas);
  - any impacts the proposal may have on the social and economic cost to the community as a consequence of flooding;
  - compatibility of the flood hazard of the land;
  - compatibility with the hydraulic functions of flow conveyance in floodways and storage in flood storage areas of the land;
  - appropriate mitigation measures required to offset potential flood risk arising from the proposal; and
  - details of measures to manage risk to life from flood and emergency management/evacuation measures for all flood events including the 1% AEP event up to the PMF, and any impacts the proposal may have on exiting community emergency management arrangements for flooding.
- Describe the flood assessment and modelling undertaken in determining the design flood levels for events, including the minimum of the 1 in 10 year, 1 in 100 year flood levels and the probable maximum flood (PMF).
- Model the effect of the proposal (including any bulk earthworks) on the flood behaviour, including:
  - the current flood behaviour for a range of design events as identified above, including and up to the probable maximum flood;
  - the 1 in 200 and 1 in 500 year flood events as proxies for assessing sensitivity to an increase in rainfall intensity of flood producing rainfall events due to climate change;
  - any detrimental changes in potential flood affection of other developments or land, including the redirection of flow, flow velocities, hazards and hydraulic categories; and
  - impacts of earthworks and stockpiles within the flood prone land up to the PMF level.



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