Hyder

SIMTA Intermodal Terminal Facility- Stage 1

Stormwater and Flooding Environmental Impact Assessment

SIMTA

SYDNEY INTERMODAL TERMINAL ALLIANCE

Part 4, Division 4.1, State Significant Development

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Hyder Consulting Pty Ltd
ABN 76 104 485 289
Level 5, 141 Walker Street
Locked Bag 6503
North Sydney NSW 2060
Australia
Tel: +61 2 8907 9000
Fax: +61 2 8907 9001
www.hyderconsulting.com

SIMTA

MOOREBANK INTERMODAL TERMINAL FACILITY - STAGE 1

Stormwater and Flooding Environmental Assessment

SIMTA

Author	Bruce Caldwell (Water Quantity) David Stone (Water Quality)	Bruce Caldwell David Stone
Checker	Greg Ives	Greg Ives
Approver	Greg Huzij	Greg Ives
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1 INTRODUCTION

1.1 BACKGROUND

The SIMTA Project involves the development of an intermodal facility, including warehouse and distribution facilities, freight village (ancillary site and operational services), stormwater, landscaping, servicing and associated works on the eastern side of Moorebank Avenue, Moorebank (the SIMTA site). The SIMTA Project also includes a Rail link, within an identified rail corridor (the Rail Corridor), which connects from the southern part of the SIMTA site to the Southern Sydney Freight Line (SSFL) (the entire area, SIMTA site and Rail Corridor referred to as the Project site). The SIMTA Project is to be developed in three key stages:

- Stage 1- Construction of the Intermodal Terminal Facility and Rail link
- Stage 2- Construction of warehouse and Distribution Facilities
- Stage 3- Extension of the Intermodal Terminal Facility and completion of Warehouse and Distribution Facilities.

A summary of the approvals undertaken to date for the SIMTA site, relating to the SIMTA Project, include:

- **EPBC Approval** (No. 2011/6229) granted in March 2014 for the impact of the SIMTA Project on listed threatened species and communities (sections 18 and 18A of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)) and Commonwealth land (sections 26 and 27A of the EPBC Act).
- **Concept Approval** (No. 10_0193) granted by the Planning Assessment Commission (PAC) on the 29 September 2014 for the 'Concept Approval' of the SIMTA Project under Part 3A of the EP&A Act.

Both of these approvals involved the preparation of design and environmental assessment documentation.

1.2 REPORT PURPOSE AND STRUCTURE

This report has been prepared for approval of the initial stage of the SIMTA Project, known as the Proposal. A summary of the works included in the Proposal is provided below. This report has been prepared to support a State Significant Development (SSD) Application for which approval is sought under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

This report has been prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs) (ref: SSD 14-6766 and dated December 2014). Table 1 provides a summary of the SEARs and the section where they have been addressed in this report.

Table 1: SEARS (SSD 14-6766) Compliance for Flooding and Stormwater

SEARs Key Assessment Requirement	Report Section Reference
9. Soil and Water – including but not limited to: An assessment of soil and water impacts for the entire site including rail link. The assessment shall:	Only flooding and stormwater are addressed in this document. Soil items and groundwater risks or impacts are included within the geotechnical and Environmental Site Investigation (ESA) reports.
a) assess impacts on surface and groundwater flows, quality and quantity, with particular reference to any likely impacts on Georges River and Anzac Creek;	Sections 3 and 4 – surface water quantity. Section 6 and 7 – surface water quality (Groundwater is not addressed as part of this report and is discussed in the geotechnical and ESA reports).
b) assess flooding impacts and characteristics, to and from the project (including rail link), with an assessment of the potential changes to flooding behaviour (levels, velocities and direction) and impacts on bed and bank stability, through flood modelling, including: i. hydraulic modelling for a range of flood events; ii. description, justification and assessment of design objectives (including bridge, culvert and embankment design); iii. an assessment of afflux and flood duration (inundation period) on property; and iv. consideration of the effects of climate change, including changes to rainfall frequency and/or intensity, including an assessment of the capacity of stormwater drainage structures.	Sections 3 and 4.
c) include a detailed and consolidated site water balance;	Section 7 – site water balance
d) include details of the water supply source(s) for the proposal including any proposed surface water and groundwater extraction;	Section 7 – site water balance
e) assess potential cumulative impacts on water resources, and any proposed options to manage the cumulative impacts;	Section 7 – site water balance
f) address drainage issues associated with the development / site, including stormwater, drainage infrastructure and incorporation of Water Sensitive Urban Design measures;	Sections 2 and 5 – surface water quantity. Section 6 – surface water quality. (Groundwater is not addressed as part of this report and is discussed in the geotechnical and ESA reports).
g) undertake an assessment of surface water quality during construction (including reference to water quality objectives for the relevant catchment where objectives have been determined), including an identification of works that may impact water quality, and a summary of proposed mitigation measures in accordance with Managing Urban Stormwater – Soils & Construction Volume 1 2004 (Landcom) and Volume 2 (DECC 2008);	Section 6
h) consideration of stormwater management during operation of the site with the objective of maintaining or improving existing water quality.	Sections 6 and 7

1.3 KEY TERMS

Table 2 provides a summary of the key terms which are included within this report. Figure 1 also provides an indication of the site areas discussed in this table.

Table 2- Key terms

Term	Description
Concept Plan Approval	Concept Plan Approval (MP 10_0193) granted on 29 September 2014 for the development of the SIMTA Moorebank Intermodal Terminal Facility at Moorebank. This reference includes the associated Conditions of Approval (CoA) and Statement of Commitments (SoC) which form the approval documentation for the Concept Plan Approval.
EPBC Approval	Approval (No. 2011/6229) granted under the EPBC Act on March 2014 by the Commonwealth Department of Environment for the development of the SIMTA Moorebank Intermodal Terminal Facility at Moorebank.
SIMTA Project	The SIMTA Moorebank Intermodal Terminal Facility at Moorebank as approved by the Concept Plan (MP_10_0913).
SIMTA site	Includes the former Defence National Storage and Distribution Centre (DNSDC) site, the land owned by SIMTA which is subject to the Concept Plan Approval (refer to Figure 1).
Rail Corridor	Area defined as the ‘Rail Corridor’ within the Concept Plan Approval. The Rail link is also included within this area (refer to Figure 1).
Project site	Includes the SIMTA site and the Rail Corridor, i.e. the entire site area which was approved under the Concept Plan Approval (refer to Figure 1).
Stage 1 site	The subject of this EIS, the western part of the SIMTA site which includes all areas to be disturbed by the Stage 1 Proposal (including the Operational area and Indicative Construction area) (refer to Figure 1). This area does <u>not</u> include the Rail Corridor.
Construction area	Extent of construction works, namely areas to be disturbed during construction of the Stage 1 Proposal (refer to Figure 1).
Operational area	Extent of operational activities for the operation of the Proposal (refer to Figure 1).
Proposal site	Includes the Stage 1 site and the Rail Corridor, i.e. the area for which approval (construction and operation) is sought within this EIS.
Rail link	The Rail link including the area on either side to be impacted by the construction works included in the Stage 1 Proposal.
Former DNSDC South	The land to the south of the operational footprint of the Intermodal Terminal, to the boundary fence of the former DNSDC.
Southern Boot Land	Commonwealth owned land to the south of Former DNSDC South, and to the north of the RailCorp Land (part of the Boot Land in the MIC proposal).
RailCorp Land	Lot 1 DP 825352 (part of the Rail Corridor) and owned by RailCorp.
The Proposal	Stage 1 of the SIMTA Moorebank Intermodal Terminal Facility including construction and operation of the intermodal terminal facility and Rail link, i.e. all works and built form for which approval is sought in this EIS/Technical Report.
MIC Proposal	The development of an intermodal facility, associated commercial infrastructure (warehousing) and a Rail link (3 options have been provided) to be located on the MIC site, for which an approval, under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979.* This proposal is currently under assessment by the Department of Planning and Environment.
MIC site	The former School of Military Engineering site to the immediate west of the SIMTA site, across Moorebank Avenue.

Figure 1 – SIMTA Stage 1 Location Plan and Key Areas

1.4 PROPOSAL OVERVIEW

The Proposal involves the construction and operation of the necessary infrastructure to support a maximum container freight volume of 250,000 TEU (twenty-foot equivalent units) throughput per annum. Specifically, Stage 1 includes the following key components, which together comprise the intermodal terminal facility (IMT):

- Truck processing, holding and loading areas- entrance and exit from Moorebank Avenue.
- Rail loading and container storage areas – installation of four rail sidings with adjacent container storage area serviced by manual handling equipment initially and overhead gantry cranes progressively. .
- Administration facility and associated car parking- light vehicle access from Moorebank Avenue.
- The Rail link – located within the Rail Corridor, including a connection to the intermodal terminal facility, traversing of Moorebank Avenue, Anzac Creek and Georges River and connection to the SSFL.
- Ancillary works- vegetation clearing, remediation, earth works, utilities installation/connection, signage and landscaping.

1.5 SITE DESCRIPTION

The SIMTA site, including the Stage 1 site, is located approximately 27 kilometres south-west of the Sydney Central Business District (CBD) and approximately 26 kilometres west of Port Botany. The SIMTA site is situated within the Liverpool Local Government Area (LGA), in Sydney's South West Sub-Region, approximately 2.5 kilometres from the Liverpool City Centre.

The SIMTA site is located approximately 800 metres south of the intersection of Moorebank Avenue and the M5 Motorway. The M5 Motorway provides the main road link between the SIMTA site and the key employment and industrial areas within the West and South Western Sydney Sub-Regions. The M5 Motorway connects with the M7 Motorway to the west, providing access to the Greater Sydney Metropolitan Region and NSW road network. Similarly the M5 Motorway is the principal connection to Sydney's north and north-east via the Hume Highway.

The Southern Sydney Freight Line (SSFL) is located one kilometre to the west of the proposed SIMTA site. The SSFL is a 36 kilometre dedicated freight line between Macarthur and Chullora.

The SIMTA site was recently operating as the Defence National Storage and Distribution Centre (DNSDC) however Defence has recently relocated this operation and vacated the SIMTA site. The majority of land immediately surrounding the SIMTA site is owned and operated by the Commonwealth and comprises:

- School of Military Engineering (SME), on the western side of Moorebank Avenue directly adjacent to the SIMTA site.
- Holsworthy Military Reserve, to the south of the site on the southern side of the East Hills Passenger Railway Line.
- Commonwealth Residual Land, to the east between the SIMTA site and the Wattle Grove residential area.
- Defence National Storage and Distribution Centre (DNSDC), to the north and north east of the SIMTA site.

The site to immediate west of the SIMTA site which currently includes the SME is the subject of a Development Application (DA) (SSD-5066), under Part 4, Division 4.1 of the EP&A Act, for the development of an intermodal facility known as the Moorebank Intermodal Terminal Project (MIC Proposal). The EIS for the MIC Proposal has recently been prepared and publically exhibited on 8 October 2014 to 8 December 2014. A Preferred Project Report (PPR) is currently under preparation to respond to submissions received during public exhibition. The MIC Proposal has yet to be determined by the Department of Planning and Environment (DP&E).

A number of residential suburbs are located in proximity to the Stage 1 site, including:

- Wattle Grove, located approximately 600 metres from the Stage 1 site and 750 metres from the Rail link to the east.
- Moorebank, located approximately 1,700 metres from the Stage 1 site and more than 2,700 metres from the Rail link to the north.
- Casula, located approximately 1,100 metres from the Stage 1 site and 250 metres from the Rail link to the west.
- Glenfield, located over 1,700 metres from the Stage 1 site and 750 metres from the Rail link to the south-west.

2 PREVIOUS FLOODING AND STORMWATER PLAN

Previously, Hyder completed the *SIMTA Sydney Intermodal Terminal Alliance: Flood Study and Stormwater Management Part 3A Concept Plan Application* (12/08/2011) (Concept Plan report). The Concept Plan report was completed to support a Concept Plan application for the development of the SIMTA Project.

The Concept Plan report detailed existing catchments, hydrology and hydraulics relevant to the SIMTA Project. The report presented flooding and stormwater management and mitigation measures for the post-development site condition including concept designs for on-site detention (OSD) and options for managing external (neighbouring area) catchment flows.

The main components of that August 2011 report have been summarised in the sections below. However, the 2011 report did not include analysis of the Rail link joining the SIMTA site to the SSFL or an assessment of the first construction stage, which has now been identified as Stage 1 (the Project)

The full Concept Plan report is available online at his location: *http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=4400 Documents 31 – 36 'Flood Study and Stormwater Management'*, and should be read in conjunction with this current report.

This current report summarises the major findings of the Concept Plan report (report Section 2) before addressing the specific flooding and stormwater management items which have now been completed in addition to the Concept Plan report. These include:

(i) Assessment of the Rail link at the crossing of Anzac Creek (report Section 3).

(ii) Assessment of the Rail link at the crossing of Georges River (report Section 4).

(iii) Assessment of the Project in isolation of the overall SIMTA Project (Section 5 Water Quantity, Section Water Quality, and Section 7 Water Balance).

The location of each of these elements is presented in Figure 2.

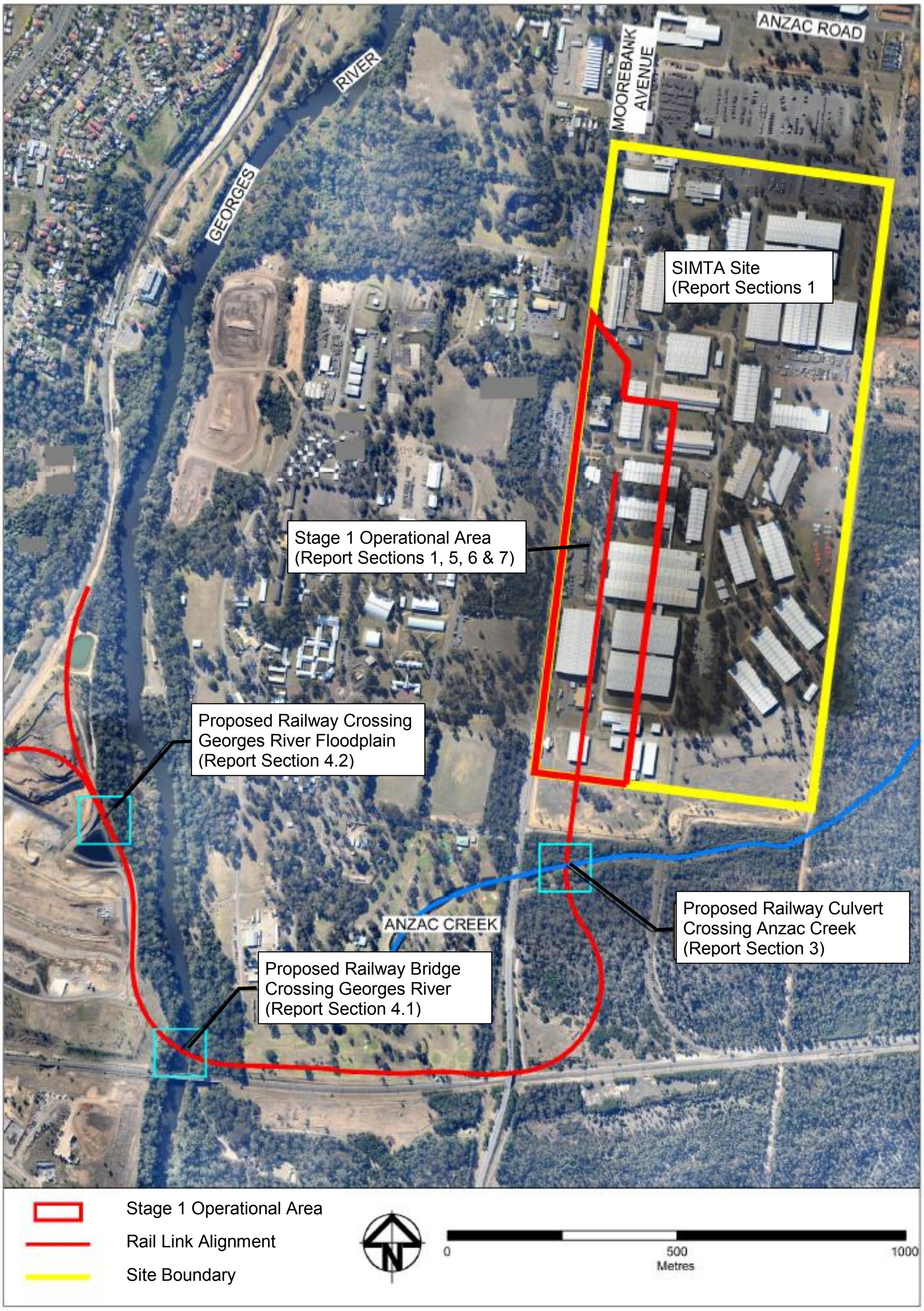


Figure 2 – Flooding & Stormwater Stage 1 Areas

2.1 EXISTING CONDITIONS

The topography of the SIMTA site is relatively flat, with reduced levels (RLs) ranging between 14 and 16 metres Australian Height Datum (mAHD). Along the eastern site boundary, the land rises from about RL14 mAHD at each end to a localised peak of RL22 mAHD about midway along the length. There are three internal catchments within the SIMTA site and a number of small external catchments that discharge into the site. The site catchments are shown in Figure 3.

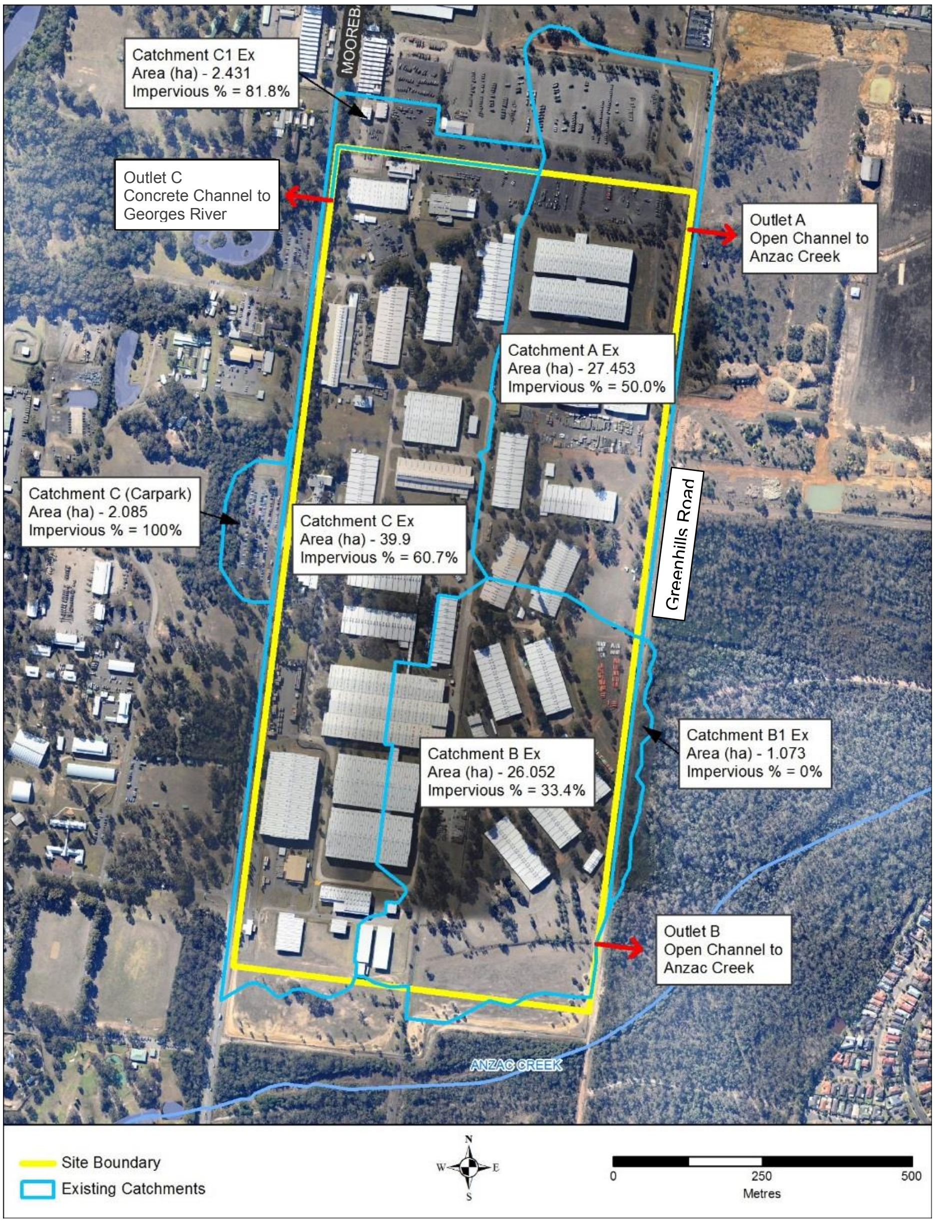


Figure 3 - Existing Catchments of the SITMA Site (Concept Plan 12/08/2011)

There are three existing stormwater culvert outlets from the site. Two outlets discharge eastward to Anzac Creek and cross under the Greenhills Road formation via pipes and headwalls (Outlets A and B). Stormwater to these two culvert outlets is conveyed through the site via formal open grass lined channels. From Greenhills Road to Anzac Creek the channels appear less formalised.

On the western portion of the site water from both the site and the eastern side of Moorebank Avenue is collected in a formal concrete lined channel which runs within the site parallel to

Moorebank Avenue. These channel flows discharge via a culvert under Moorebank Avenue (Outlet C) into a channel which leads to Georges River.

DRAINS software was used to develop a rainfall runoff model to assess the performance of the existing site drainage. The modelled flows at each of the three site discharge points for the 2 year, 20 year, 100 year average recurrence interval (ARI) flood levels and the probable maximum flood (PMF) are summarised in Table 3.

Table 3: Existing Site Condition Peak Flows (Concept Plan 12/08/2011)

Discharge Location	Site Condition	Catchment Area (ha)	Flow (m^3/s)			
			2year	20year	100year	PMF
Outlet A (Greenhills Rd Nth)	Existing	27.45	2.4	6.2	8.3	50
Outlet B (Greenhills Rd Sth)	Existing	27.13	0.4	1.1	2.6	31
Outlet C (Moorebank Avenue)	Existing	42.33	5.7	10.2	12.7	62

2.2 POST-DEVELOPMENT CONDITIONS

The existing conditions within the DRAINS model were adjusted to represent the post-development site conditions. In particular the adjustments included:

- Changes to sub-catchment boundaries to represent the sub-catchments of the SIMTA Project. The amended catchments are shown in Figure 4.
- Adopting a 100 per cent impervious surface percentage within the SIMTA site.
- Reduced flow travel times representative of the SIMTA Project.
- Proposed waterways and detention storages to mitigate potential flow increases (see Figure 5).

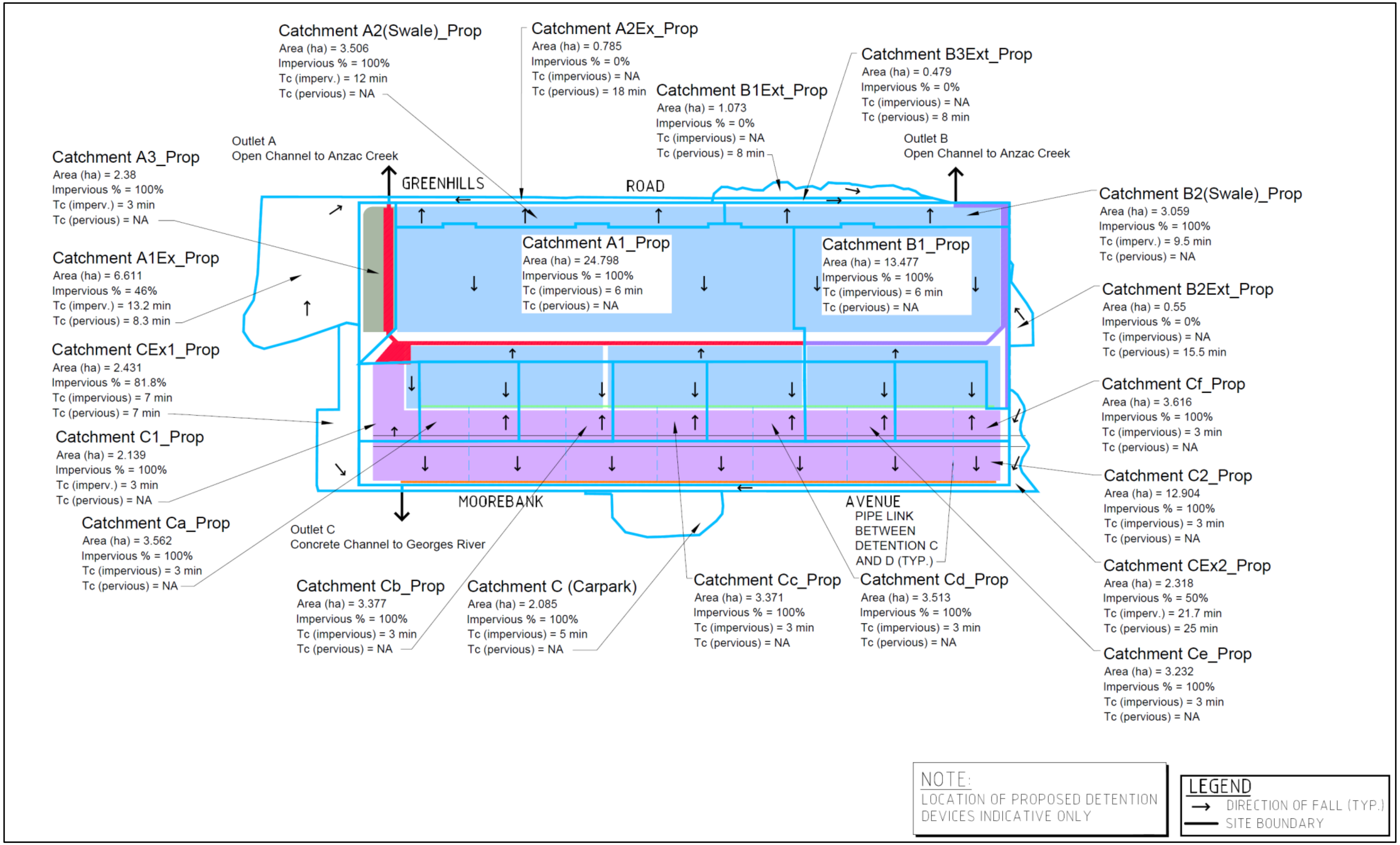


Figure 4 - Post development Catchments (Concept Plan 12/08/2011)

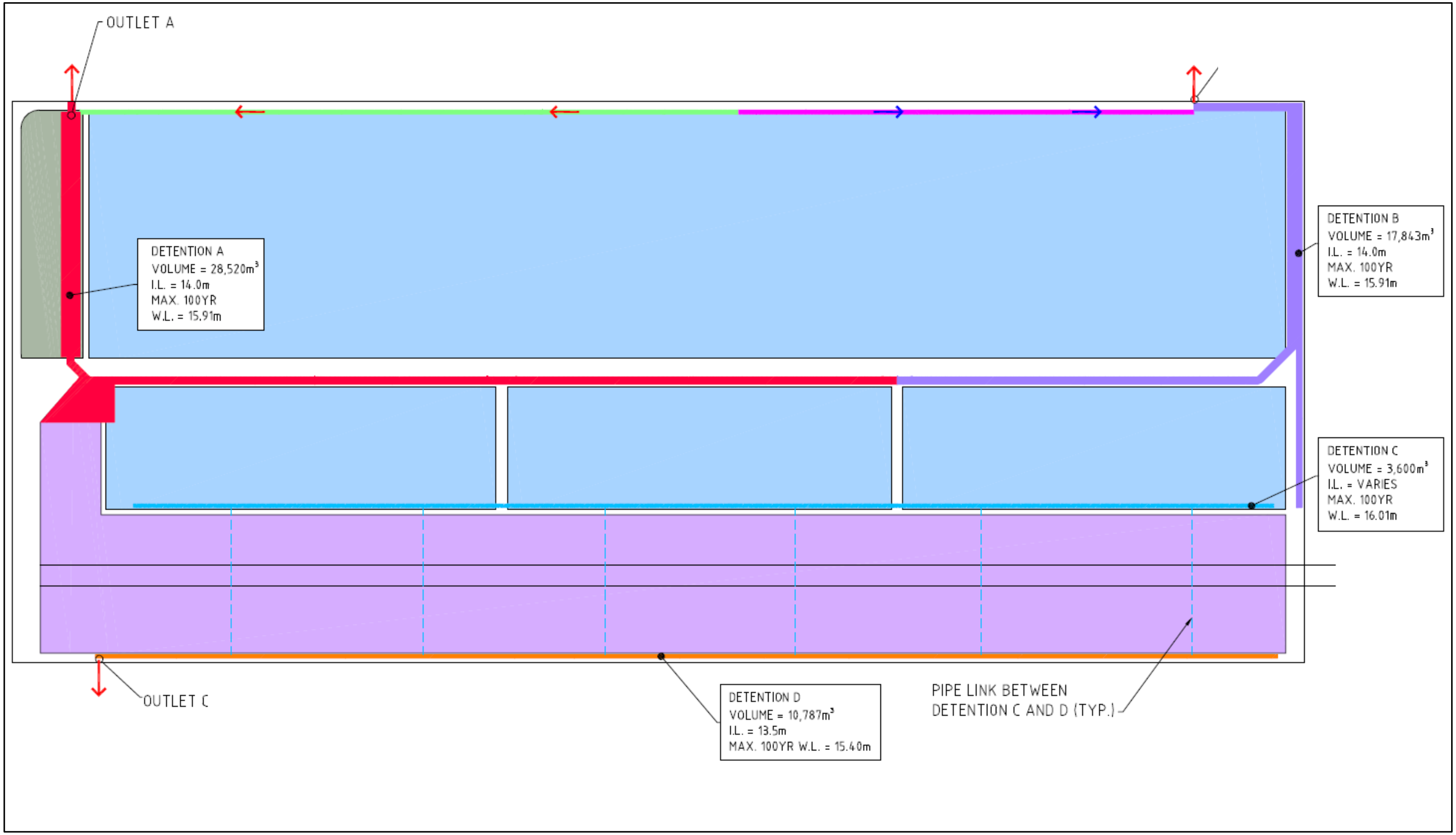


Figure 5 - Post development Site Flow Management (Concept Plan 12/08/2011)

Peak site flows generated from the DRAINS modelling for the post-development site condition are compared with the existing conditions flows in Table 4. Flow results for a fuller range of assessed storm durations are provided in the Concept Plan report. This initial DRAINS modelling indicated that the provision of on-site stormwater detention storages should adequately mitigate potential site runoff flow increases. However, in addition to the DRAINS modelling, a regional catchment wide analysis (using TUFLOW software) was carried out to assess potential impacts on flow regimes on the broader Anzac Creek waterway.

The TUFLOW modelling indicated potential water level increases in Anzac Creek of up to approximately 0.05 metres in the 100 year ARI event. As such the initial DRAINS model estimates of on-site storage were increased from 28,500 m^3 to 35,000 m^3 in the north-eastern portion of the SIMTA site. The post-development TUFLOW model was subsequently re-run and the potential flood level increases were demonstrated to be reduced to match existing.

The TUFLOW model was also run for the PMF one hour event. The modelling results for these assessments are included in the Concept Plan report.

With respect to potential post-development flood impacts on the Anzac Creek floodplain, results indicated:

- Flood level increases would be limited to less than five millimetres in the 100 year ARI nine hour event. Management of local catchment flows from areas immediately neighbouring the site are discussed in the 'Civil Design Options', Section 7, of Concept Plan report.
- For the PMF one hour event, the proposed site raising would result in flood level increases of up to 0.25 metres immediately south of the SIMTA site. Since this area to the south is largely undeveloped there is little current implications for this neighbouring area. Further downstream flood level increases are limited to no more than five millimetres (mm).

Table 4: Comparison of Existing and Post-Development Peak Flows

Discharge Location	Site Condition	Catchment Area (ha)	Flow (m^3/s)			
			2 year	20 year	100 year	PMF
Outlet A (Greenhills Rd Nth)	Existing	27.45	2.4	6.2	8.3	50
	Developed *	38.08	1.7	2.9	3.5	56
Outlet B (Greenhills Rd Sth)	Existing	27.13	0.4	1.1	2.6	31
	Developed *	18.64	0.4	0.9	2.0	27
Outlet C	Existing	42.33	5.7	10.2	12.7	62
	Developed *	40.46	3.4	8.4	9.2	104

* With OSD storage provided (Concept Plan 12/08/2011)

It is anticipated that the mitigating OSD storage would be achieved by adopting the following strategies:

1. Configuring the OSD channels with vertical walls, and horizontal inverts (with rain garden inverts) as outlined in Figure 6.
2. Raising site ground levels.
3. Where necessary, providing above ground storages within or adjacent to proposed buildings.

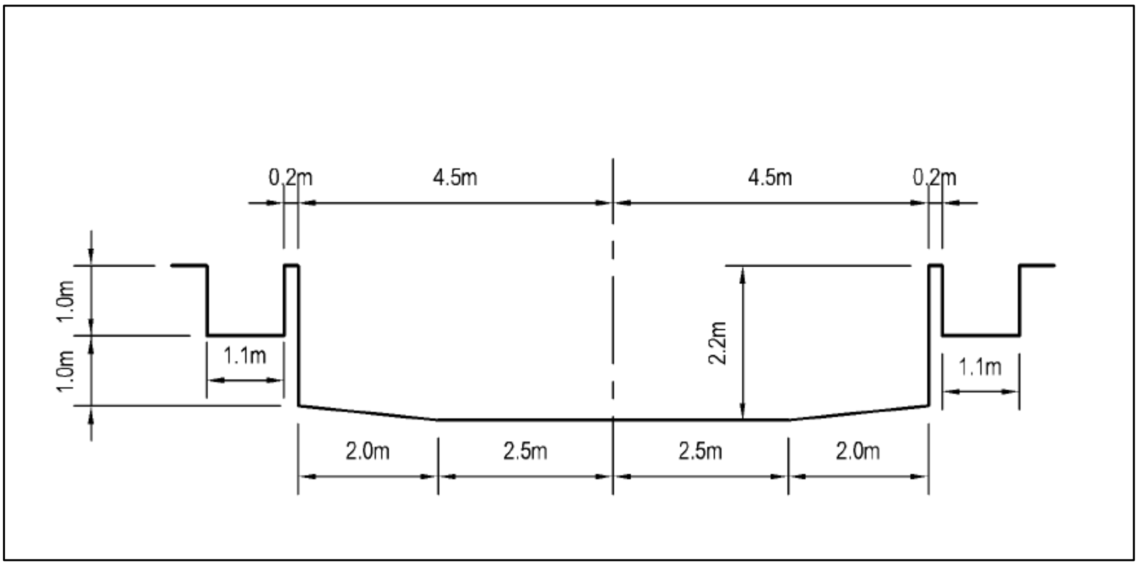


Figure 6 - Indicative OSD Channel Section for Onsite Detention (Concept Plan 12/08/2011)

2.2.1 SUMMARY OF DESIGN INPUTS

Design parameters adopted to mitigate stormwater impacts associated with the SIMTA Project include:

- Design of OSD structures to mitigate potential increases in peak flows discharging from the site up to and including the 100 year ARI.
- Incorporating swales and culverts to adequately convey neighbouring property flows through the SIMTA site in order to prevent adverse flood impacts on adjacent lands as a result of the site development.
- A number of stormwater treatment devices including rainwater tanks, gross-pollutant traps, buffer strips, bio-retention and bio-swales.

3 ANZAC CREEK

Anzac Creek is within the larger Georges River catchment and a sub-catchment of the Liverpool District catchment. The creek is 4 kilometres long, forming in the (former) Royal Australian Engineers Golf Course, owned by the Department of Defence, and flowing northward past the suburb of Wattle Grove and underneath the M5 at the intersection with Heathcote Road. From there the creek continues northwards through Ernie Smith Recreation Reserve, flanked by the Moorebank Industrial Area to the west and the suburb of Moorebank to the east, under Newbridge Road, through McMillan Park, and into Lake Moore at Chipping Norton.

3.1 RAILWAY CULVERT OVER ANZAC CREEK

Existing condition flow regimes along Anzac Creek have been previously determined by Liverpool City Council (Council) in the process of conducting their Anzac Creek Floodplain Risk Management Study and Plan (by BMT WBM Pty Ltd, 30 May 2008), and the Georges River Floodplain Risk Management Study and Plan (by Bewsher Consulting, May 2004).

The Council's RAFTS catchment rainfall runoff model files developed for these studies were reviewed by Hyder. The provided files were re-run by Hyder and the hydrographs for both the 100 year ARI nine-hour event and PMF one-hour used in the Council studies were replicated.

Council also provided Hyder with the 100 year ARI nine-hour event and PMF one-hour event TUFLOW model files. The provided files were re-run by Hyder and the Council's 100 year nine-hour results were reproduced. The PMF TUFLOW modelling results were not provided by Council, nonetheless the provided files were used in developing an adjusted 'existing conditions' Anzac Creek model (see Section 3.1.1).

Council provided a number of TUFLOW run files incorporating various degrees of blockage for the structural elements across the stormwater infrastructure system. For the purposes of this railway culvert assessment, the 25 percent blockage scenario was adopted and was amended to create a base model suitable for the purposes of this assessment.

3.1.1 ASSESSMENT METHODOLOGY

DRAINS modelling of flows

Council's RAFTS model catchments were adjusted to:

- Exclude the subject site area which has been more accurately defined in the site drainage DRAINS software.
- Provide additional sub-catchment areas upstream of Greenhills Road to facilitate assessment of the upstream flow regimes.

Catchment plans are provided in Appendix A. The adjusted RAFTS model was used to generate 100 year ARI hydrographs which served as inputs in the TUFLOW modelling of Anzac Creek for existing and post-development conditions.

TUFLOW Modelling of Flow Regimes

Council's Anzac Creek TUFLOW model was adjusted to include ground information sourced from Aerial Laser Survey data collected in August 2010 by AAMHatch. In the vicinity of the SIMTA site, levels were updated to include the detailed survey data of Hard and Forester Pty Ltd (July 2012), in particular, the Hard and Forester survey covers part of the Anzac Creek floodplain to the south of SIMTA site area across which the Rail link is currently proposed.

The model adopts a 5 m grid using TUFLOW Build: 2006-06-DB. The Council inflow boundary setup was modified to define local catchments to the south of the SIMTA site, taking into account the proposed railway embankment and associated culvert intersecting the floodplain. In addition, outflows from the SIMTA site area were incorporated into the TUFLOW model, and the lag times for RAFTS and DRAINS in relation to the Georges River inflow were adjusted to be consistent with the original setup of the Council model.

To assess the post-development conditions of the area, the railway alignment was included in the TUFLOW digital elevation model along with the proposed Anzac Creek culvert crossing (6, 2.1m x1.8m reinforced concrete box culverts, with two additional fauna crossings assumed fully blocked). A concept design figure of railway alignment and culvert sizing is provided in design drawing 'Anzac Creek Culvert Bridge General Arrangement' Sheets 1 and 2 Dwg Nos.SKR913 and14 (included in Appendix B).

3.1.2 RESULTS AND COMMENTS

RAFTS model output summaries are included in Appendix A.

Existing and post-development condition TUFLOW figures of flood extents and levels are included in Appendix B and indicate the following for Anzac Creek:

- Under existing conditions the 100 year ARI flood level to the south of the SIMTA site is 14.9m Australian height datum (AHD). When modelled with the proposed Rail link culverts and allowing for 50 per cent blockage of those culverts the flood levels to the south of the SIMTA site increase by up to 10mm, upstream of the proposed railway. The post-development condition model was also run with the proposed railway culvert fully unblocked, with the result that the 100 year flood level increase (as a result of the proposed railway crossing) reduced to less than 5mm.
- Under existing conditions the PMF level to the south of the site is approximately 15.6 mAHD. Downstream of the proposed railway culvert crossing there is no anticipated increase to PMF flood levels, however upstream of the proposed Rail link culvert crossing flood levels would increase by approximately 0.15m upstream and across Moorebank Avenue under a 50 per cent blockage scenario.

A sensitivity assessment was also carried out with 100 year rainfall intensities increased by 20%. This resulted in an increase of approximately 0.01m upstream of the proposed railway (compared to 100 year water levels with 50 per cent blockage of the proposed Rail link culverts). This sensitivity assessment is considered representative of potential climate change impacts, being consistent with projected rainfall increases in accordance with the New South Wales Department of Environment and Climate Change (DECC) 'Floodplain Risk Management Guideline Practical Consideration of Climate Change' (October 2007) for Hawkesbury-Nepean catchment.

3.1.3 CONCLUSION

The TUFLOW model results indicate that the impact of the proposed railway and associated culvert would result in negligible flood impacts within the Anzac Creek catchment area.

4 GEORGES RIVER

The SIMTA site is located entirely within the catchment area of the Georges River, which lies approximately 750 m to the west of the site. The Rail Corridor is located within the mid-Georges River catchment and is a Liverpool District sub-catchment. The Georges River enters the Liverpool LGA from the south on the western side of the Defence Lands at Holsworthy and flows to the north, meeting with Glenfield Creek at Casula. The river then continues to flow north past the Liverpool City Centre, under Newbridge Road, past Lighthorse Park and over the Liverpool Weir. Downstream of the Liverpool Weir, the Georges River becomes brackish and is subject to tidal influences. Figure 7 shows the proposed Rail link alignment.

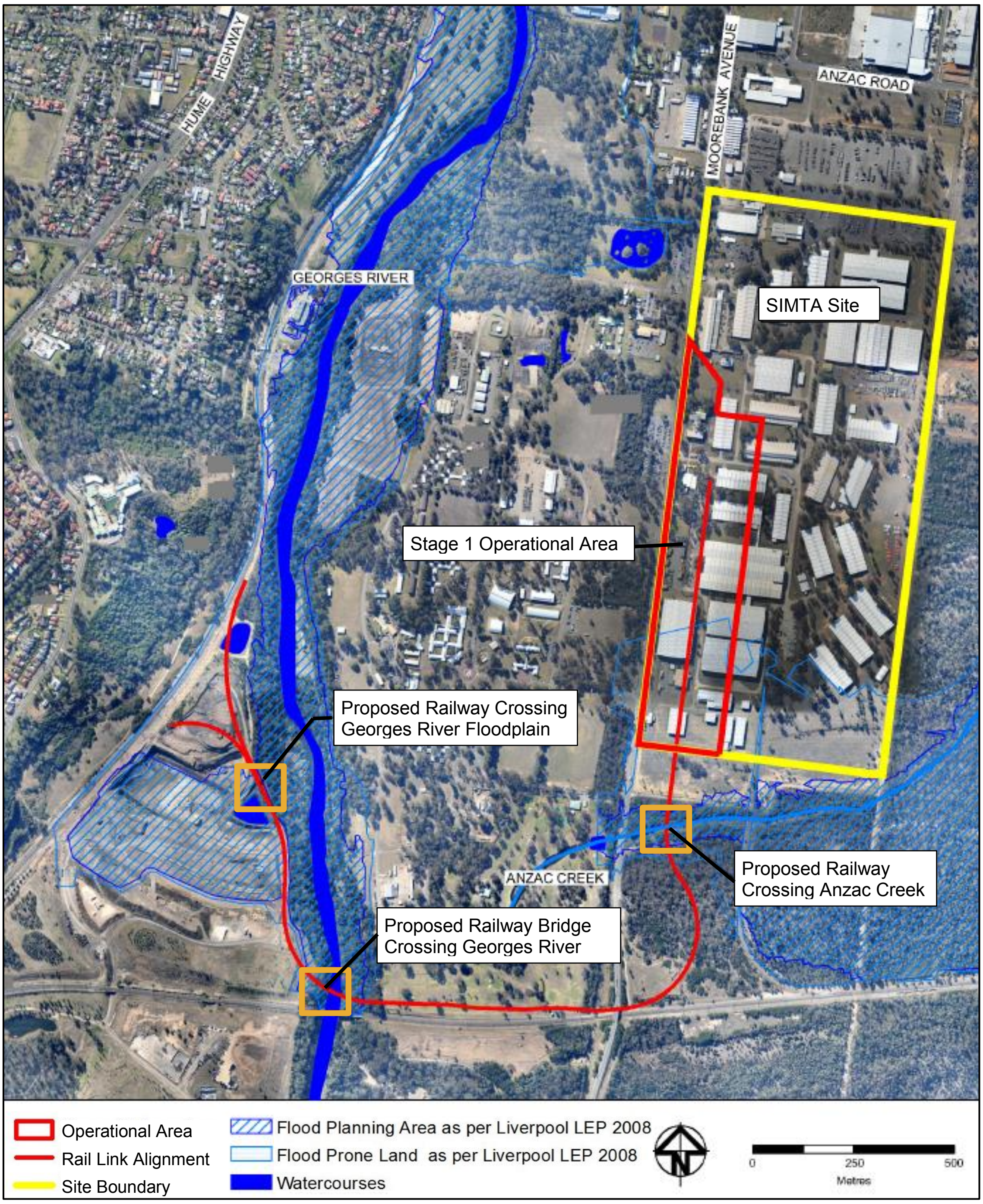


Figure 7 - Proposed Rail Link Alignment (overlaying Liverpool City Council Regional Flood Planning Areas)

The proposed Rail link has the potential to directly impact the Georges River and its immediate floodplain at two locations:

1. Georges River railway bridge.
2. Rail link crossing of the Georges River floodplain (i.e. within GWS facility).

Potential for flooding impacts at these two locations are discussed in the following sections of this report.

4.1 GEORGES RIVER RAILWAY BRIDGE

A flood assessment has been undertaken to analyse potential flooding impacts of the proposed railway bridge crossing of the Georges River for the 100 year ARI and PMF events.

4.1.1 ASSESSMENT METHODOLOGY

The potential flood impact assessment of the proposed Georges River railway bridge was assessed through development of a HEC-RAS model of the Georges River. As an industry standard software for open waterway analysis, HEC-RAS was determined to be appropriate to assess flooding impacts associated with the proposed Georges River railway bridge.

The HEC-RAS model was built using information provided in the ‘Upper Georges River Flood Study’ prepared by Department of Land and Water Conservation in conjunction with Liverpool City Council (December 2000). Information from the December 2000 study was provided by FloodMit Pty Ltd, and included:

- River section geometry, location and roughness.
- Flow hydrographs.
- Hydraulic boundary conditions.
- Flood levels (generated by MIKE-11 software).

The location of the MIKE 11 and corresponding HEC-RAS sections modelled as part of this assessment are shown in Figure 8 and Appendix C.

Furthermore, since the proposed bridge has a curved alignment (in plan), to represent the bridge in HEC-RAS, section chainages and associated ground levels were projected to represent the bridge section orientation perpendicular to Georges River flows. Sketches of this process are included in Appendix C.

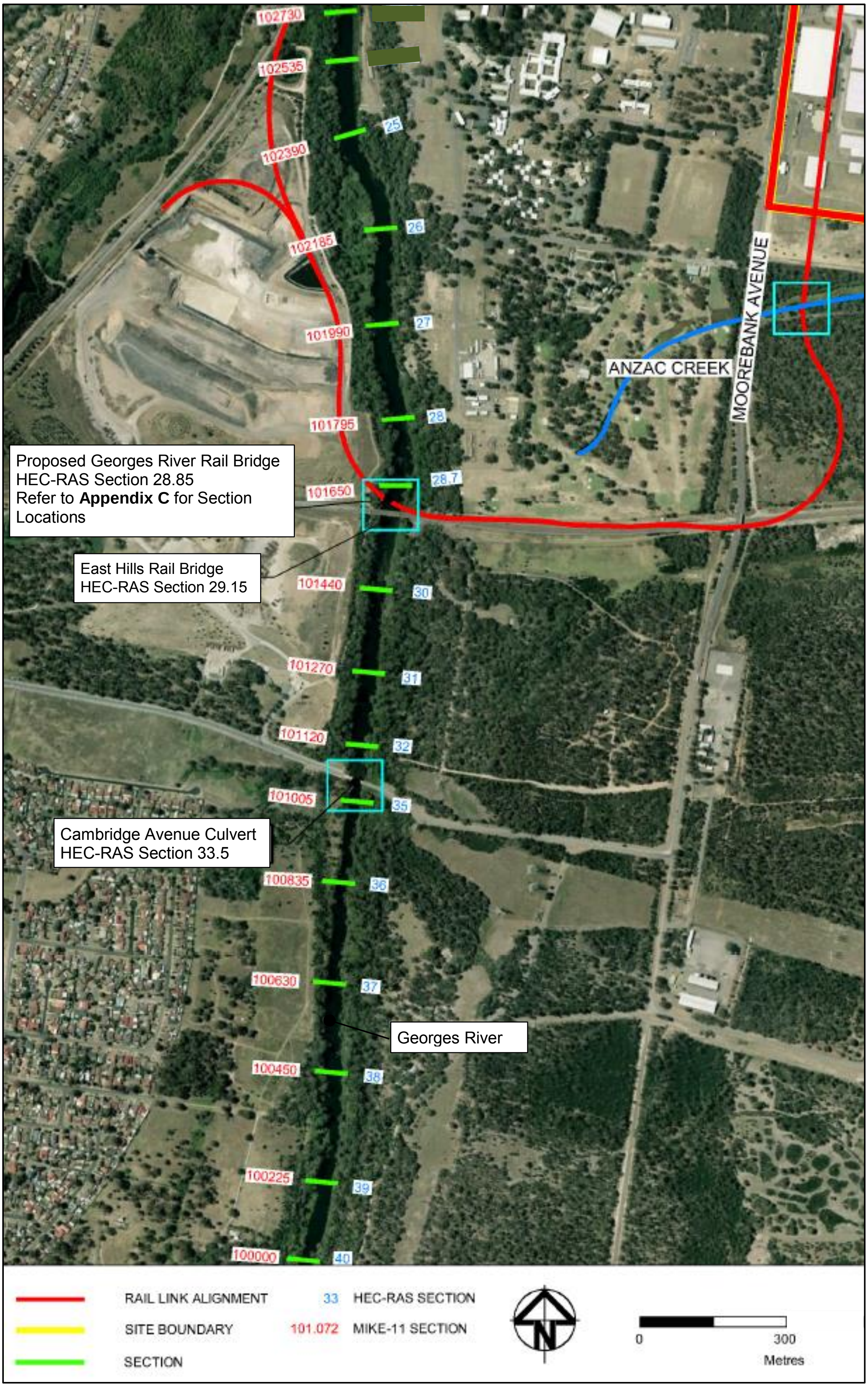


Figure 8 - Location of HEC-RAS Sections

4.1.2 EXISTING CONDITIONS

An initial HEC-RAS model was built to reproduce the MIKE-11 flood levels, generated by the December 2000 model. Modelling undertaken in December 2000 excluded the existing East Hills Railway line bridge as it had not been constructed at that time. The 100 year ARI peak flow adopted from the December 2000 study was 1877 m^3/s and the water levels generated by the initial HEC-RAS model were compared to the December 2000 reported MIKE-11 levels, as shown in Table 5.

Table 5: Comparison of HEC-RAS and Mike 11 Results; Year 2000 Scenario

Mike-11 Section Label	HEC-RAS Section Label	Year 2000 Scenario [No Railway Bridges]	
		MIKE-11	HEC-RAS
100.000 (P1)	40	13.2	13.2
100.225 (P2)	39	13.0	12.9
100.450 (P3)	38	12.9	12.9
100.630 (P4)	37	12.7	12.8
100.835 (P5)	36	12.6	12.6
101.005 (P6)	35	12.5	12.6
101.057 (P6.4)	34	12.5	12.2
Cambridge Ave culvert	33.5 **Cambridge Ave culvert**	-	-
101.072 (P6.6)	33	12.1	12.1
101.120 (P7)	32	12.0	12.0
101.270 (P8)	31	12.0	12.0
101.440 (P9)	30	11.7	11.8
New Section	29.3	-	11.8
New Section	29.2	-	11.7
Existing. Rail Bridge	29.15 **Existing. Rail Bridge**	-	-
New Section	29.1	-	11.7
101.650 (P10)	29	11.6	11.7
New Section	28.9	-	11.7
Proposed Rail Bridge	28.85 **Proposed Rail Bridge**	-	-
New Section	28.8	-	11.7
New section	28.7	-	11.5
101.795 (P11)	28	11.5	11.4
101.990 (P12)	27	11.4	11.4
102.185 (P13)	26	11.3	11.4
102.390 (P14)	25	11.2	11.2

As seen in Table 5, there is a high level of correlation between the two results and it was determined that the HEC-RAS model developed adequately reflected the flooding regime of the George's River.

Subsequently, the HEC-RAS model was adjusted to include the existing East Hills Railway bridge crossing. The existing railway bridge details have been based upon 'WAE' drawing information included in Appendix C. The results of this modelling are presented in Table 6.

Table 6: HEC-RAS Results; Year 2000 scenario and East Hills Railway Bridge Comparison

HEC-RAS Section Label	Year 2000 Scenario [No Railway Bridges]	East Hills Railway Existing Bridge flood level	Flood Level Change* (m)
40	13.21	13.22	0.01
39	12.92	12.94	0.02
38	12.93	12.95	0.02
37	12.77	12.79	0.02
36	12.64	12.66	0.02
35	12.64	12.66	0.02
34	12.23	12.25	0.02
33.5 **Cambridge Ave culvert**	-	-	-
33	12.12	12.14	0.02
32	12.03	12.04	0.01
31	11.95	11.97	0.02
30	11.84	11.85	0.01
29.3	11.78	11.79	0.01
29.2	11.72	11.73	0.01
29.15 **Existing. Rail Bridge**	-	-	-
29.1	11.71	11.71	0.00
29	11.67	11.67	0.00
28.9	11.70	11.70	0.00
28.85 **Proposed Rail Bridge**	-	-	-
28.8	11.69	11.69	0.00
28.7	11.49	11.49	0.00
28	11.35	11.35	0.00
27	11.35	11.35	0.00
26	11.41	11.41	0.00
25	11.20	11.20	0.00

* Due to existing railway bridge

4.1.3 POST-DEVELOPMENT CONDITIONS

The HEC-RAS model was further adjusted to include a proposed Georges River railway bridge, to be located on the downstream side of the existing bridge, as proposed for the Proposal.

Three bridge configurations were modelled, all with triple 1.8m diameter pier sets:

- **Option 1**: a six span bridge with pier sets poorly aligned hydraulically (to simplify design and construction);
- **Option 2**: a six span bridge with pier sets well hydraulically aligned (to limit flood impacts);
- **Option 3**: a five span bridge with pier sets well hydraulically aligned (to limit flood impacts).

The recommended (**Option 2** bridge) is shown in Figure 9 (refer also to design drawings ‘Georges River Railway Bridge General Arrangement’ Sheets 1 and 2’ Dwg No.SKR910/911).

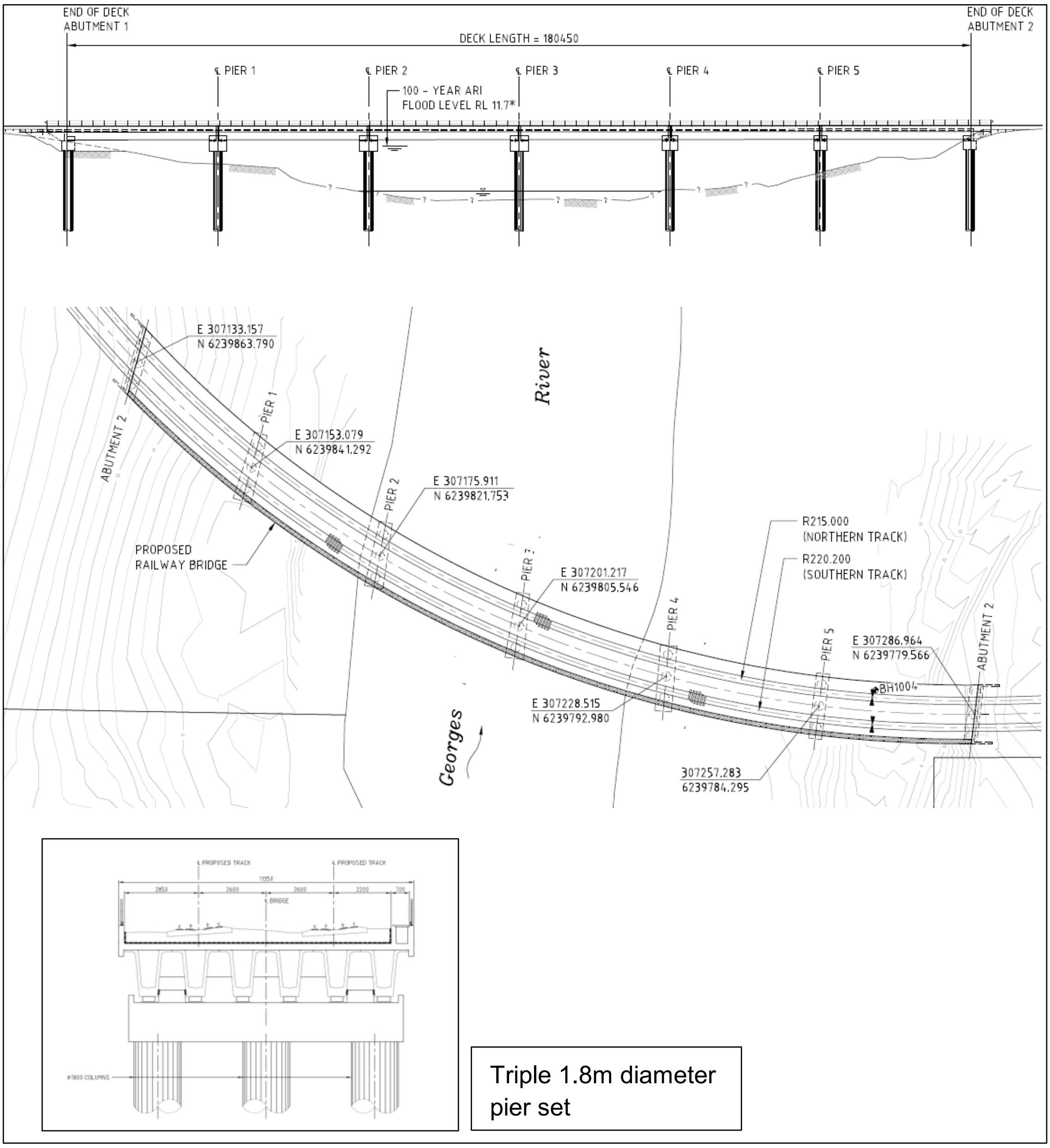


Figure 9 - Six Span Bridge Layout

4.1.4 RESULTS

Table 7 provides a summary of the HEC-RAS results for 100 year ARI water levels along the Georges River for the three bridge options assessed for flood impacts. These results indicate that for 100 year ARI flood events:

- **Option 1**, would introduce an increase in water levels of approximately 70mm upstream of the proposed Georges River railway bridge, reducing to a 40mm increase some 600m upstream, just upstream of the Cambridge Avenue culvert.
- **Option 2**, would introduce an increase in water levels of approximately 30mm upstream of the proposed Georges River railway bridge, reducing to a 10mm increase some 600m upstream, just upstream of the Cambridge Avenue culvert.
- **Option 3**, would result in water level increases of the same order of **Option 2**.

HEC-RAS model details and results are included in Appendix C.

Significantly, a key to minimising hydraulic impacts of the proposed rail bridge upon the Georges River is the design of streamlined bridge piers, discussed in Section 4.1.5). In fact, with well streamlined piers, there would be limited difference in flood impacts whether a six span bridge (as proposed), or a five span bridge were built.

Table 7: Georges River 100 year ARI Flood Levels for Existing & Post Railway Bridge Development

HEC-RAS Section Label	East Hills Railway Existing Bridge only	Inclusive of Proposed Railway Bridge					
		Option 1 - 6 Spans #		Option 2 - 6 Spans #		Option 3 - 5 Spans	
		Flood Level (mAHD)	Flood Level Change* (m)	Flood Level (mAHD)	Flood Level Change* (m)	Flood Level (mAHD)	Flood Level Change* (m)
40	13.22	13.25	**0.03**	13.23	**0.01**	13.23	**0.01**
39	12.94	12.98	**0.04**	12.95	**0.01**	12.95	**0.01**
38	12.95	12.98	**0.03**	12.96	**0.01**	12.96	**0.01**
37	12.79	12.82	**0.03**	12.80	**0.01**	12.80	**0.01**
36	12.66	12.70	**0.04**	12.67	**0.01**	12.67	**0.01**
35	12.66	12.70	**0.04**	12.67	**0.01**	12.67	**0.01**
34	12.25	12.29	**0.04**	12.26	**0.01**	12.26	**0.01**
33.5 **Cambridge Ave culvert**			**-**		**-**		**-**
33	12.14	12.19	**0.05**	12.16	**0.02**	12.16	**0.02**
32	12.04	12.10	**0.06**	12.06	**0.02**	12.06	**0.02**
31	11.97	12.03	**0.06**	11.99	**0.02**	11.99	**0.02**
30	11.85	11.92	**0.07**	11.88	**0.03**	11.88	**0.03**
29.3	11.79	11.86	**0.07**	11.82	**0.03**	11.82	**0.03**
29.2	11.73	11.80	**0.07**	11.76	**0.03**	11.76	**0.03**
29.15 **Existing. Rail Bridge**	-		**-**	-	**-**	-	**-**
29.1	11.71	11.77	**0.06**	11.73	**0.02**	11.73	**0.02**
29	11.67	11.74	**0.07**	11.70	**0.03**	11.70	**0.03**
28.9	11.70	11.76	**0.06**	11.72	**0.02**	11.72	**0.02**
28.85 **Proposed Rail Bridge**	-		**-**	-	**-**	-	**-**
28.8	11.69	11.69	**0.00**	11.69	**0.00**	11.69	**0.00**
28.7	11.49	11.49	**0.00**	11.49	**0.00**	11.49	**0.00**
28	11.35	11.35	**0.00**	11.35	**0.00**	11.35	**0.00**
27	11.35	11.35	**0.00**	11.35	**0.00**	11.35	**0.00**
26	11.41	11.41	**0.00**	11.41	**0.00**	11.41	**0.00**
25	11.20	11.20	**0.00**	11.20	**0.00**	11.20	**0.00**

* Due to proposed railway bridge.

\# **Option 1** hydraulically has poorly aligned piers. **Option 2** has hydraulically well aligned piers

4.1.5 FLOOD MITIGATION MEASURES

Option 2, a six span bridge with pier sets well hydraulically aligned (to limit flood impacts) is the bridge configuration proposed for the Proposal.

In doing so, the following design principles are to be incorporated (shown indicatively in the proposed concept bridge design drawing 'Georges River Railway Bridge General Arrangement Sheet' Dwg No.SKR910 included in Appendix C) during future design stages so as to minimise flooding impacts, and avoid the formation of large-scale turbulence or the erosion of the bed and banks of the waterway.

- The bridge abutments are not to encroach on the existing Georges River waterway area.
- The piers of the Georges River bridge structure are to be hydraulically efficient, i.e. causing minimum disruption to the River flows. This includes piers that are:
  - circular or semi-circular nosed, and
  - oriented parallel to the River flows (which vary in direction across the width of the River). To this end it is recommended that, for future design stages, local two dimensional hydraulic modelling (using say TUFLOW) is carried out to more accurately assess the optimal pier alignments so as to minimise afflux and turbulence.
- The bridge deck structure, including noise/guard rails, is to be no lower than that of the existing railway bridge (immediately south of the Proposal site).

4.1.6 SENSITIVITY ASSESSMENT

A sensitivity assessment was also carried out with 100 year flows increased by 20%. This resulted an increase in 100 year water levels along the modelled length of Georges River varying from approximately 0.3m at the existing rail bridge (immediately south of the Proposal) to 0.6m at Cambridge Avenue under existing conditions.

With the proposed 6 span rail bridge included (with well aligned piers) the incremental flood level increase immediately upstream of the proposed bridge increased by up to 0.01m (compared to 100 year no climate change conditions). This sensitivity assessment is considered representative of potential climate change impacts, being consistent with projected rainfall increases in accordance with the New South Wales Department of Environment and Climate Change (DECC) 'Floodplain Risk Management Guideline Practical Consideration of Climate Change' (October 2007) for Hawkesbury-Nepean catchment.

4.1.7 COMMENTS AND CONCLUSION

With the implementation of the above noted design principles hydraulic impacts, of the proposed rail bridge, upon the Georges River would be minimised.

That said, more accurately determination of optimum pier alignments and potential flood impacts, and quantify bed scour protection requirements, should be carried out in future design stages. Such modelling should incorporate updated survey of the Georges River bathymetry in the vicinity of the proposed bridge, and two dimensional hydraulic modelling of proposed pier impacts.

4.2 PROPOSED RAILWAY FLOODPLAIN CROSSING

Figure 10 indicates a section of the proposed Rail link alignment to be located within the western floodplain of the Georges River.

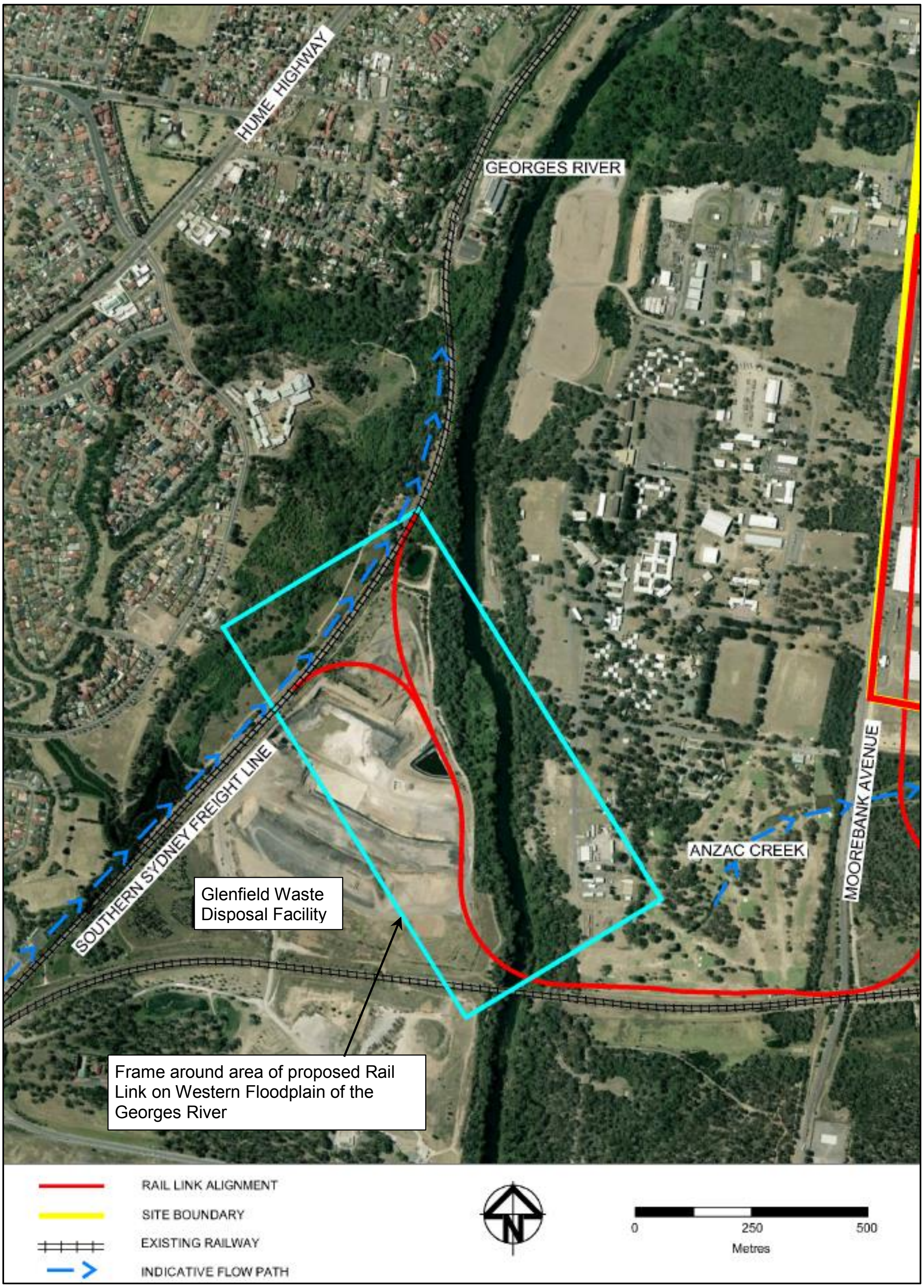


Figure 10 - Proposed Rail Link Alignment on Western Floodplain of the Georges River

Figure 11 shows the George's River floodplain 'flood planning' and flood prone' areas as defined by Liverpool City Council. The flood planning and flood prone areas extend westward, across the overbank of the Georges River and through the existing Glenfield Waste Disposal Facility and quarry.

Ground surveys undertaken by Hard and Forester Pty Ltd in August 2010 and July 2012 have confirmed that the Georges River western top of bank levels are no lower than 11.8 mAHD. This is at least 0.4 m above the Georges River 100 year ARI flood levels in this vicinity, which range from 11.4 mAHD at Mike-11 Section 101.795 (HEC-RAS section 28) to 11.2 mAHD at Mike 11 Section 102.390 (HEC-RAS section 25)(see Figure 8 and Appendix C). As such the Georges River 100 year ARI mainstream flood flows would not extend overbank to the Glenfield Waste Disposal Facility, nor as far west as the proposed Rail link alignment.

In terms of the Georges River PMF, the Mike-11 flood level is 13.9 mAHD at Section 101.795 to 13.3 mAHD at Mike 11 section 102.390. It is noted that the proposed top of rail level in this area would be at approximately 16.0 mAHD. Therefore to avoid adverse flood impacts along the Georges River floodplain (in extreme events larger than the 100 year ARI) as a result of the proposed Rail link, sections of the rail embankment would require a water conveying structure(s) to allow for extreme event flood flows to spread westward across the floodplain, as is currently the case. The necessity for, and sizing of, these structures will be investigated during detailed design.

Also, it appears that under existing conditions, there is little if any catchment runoff impacting on the western side of the proposed railway alignment due to the operations within the Glenfield Waste Disposal Facility. Larger catchment areas to the west of the quarry are cut-off and directed northward to Georges River as indicated in Figure 10.

4.2.1 COMMENTS AND CONCLUSION

The Rail link alignment along the western floodplain of the Georges River would not impact on the 100 year ARI Georges River flooding levels.

To avoid adverse flood impacts along the Georges River floodplain (in extreme events larger than the 100 year ARI), sections of the rail embankment would require a waterway structure(s) to allow for extreme event flood flows to spread westward across the floodplain.

Management of local stormwater runoff from the Rail link itself is discussed in Section 5.2.

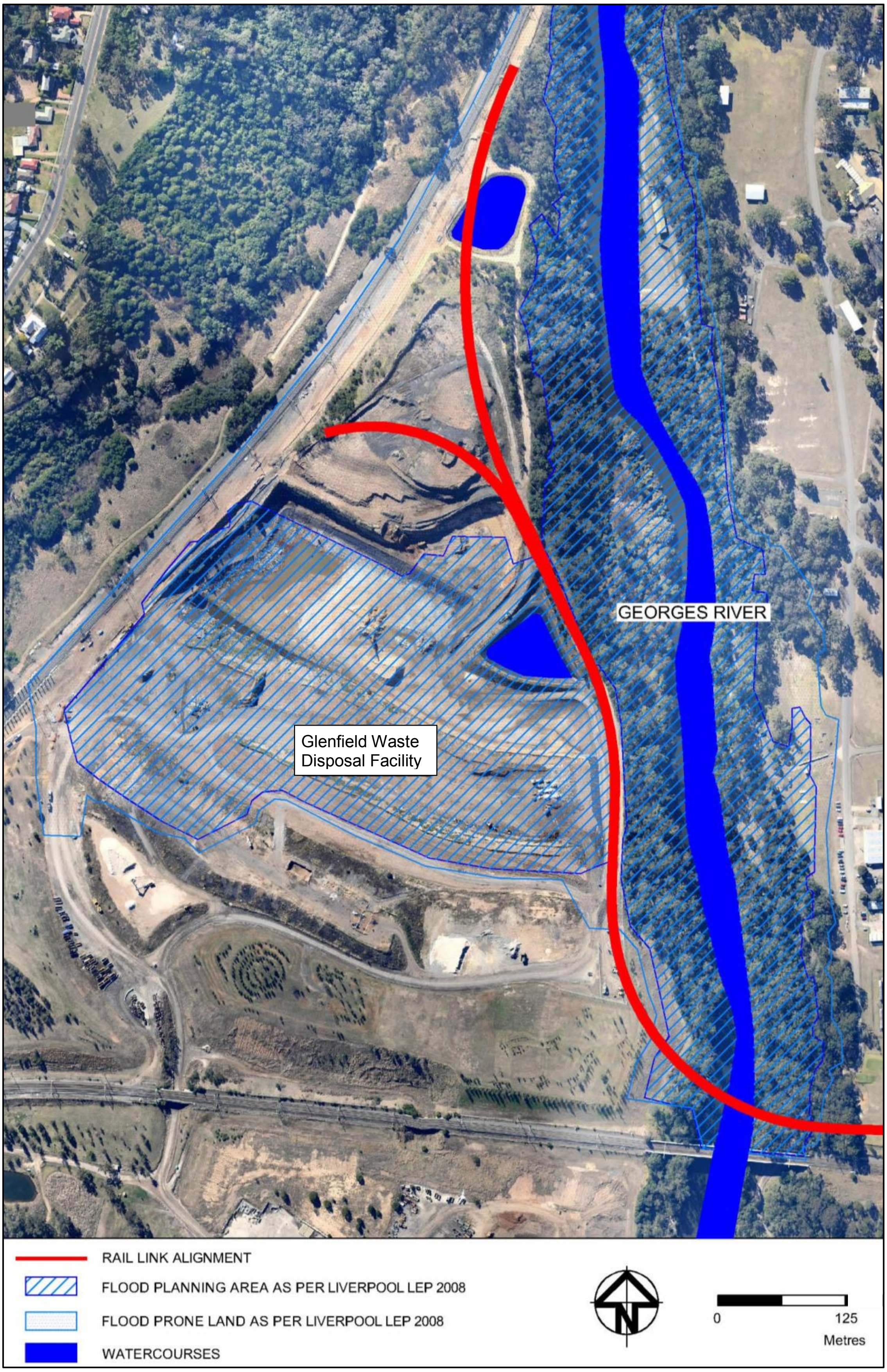


Figure 11 - Liverpool City Council Flood Planning Areas for Existing Catchment Conditions

5 WATER QUANTITY

As shown in Figure 12, the Stage 1 Operational Area is located in the south western corner of the SIMTA site. The proposed Operational Area of the development has the potential to impact upon the existing local area hydrology, Anzac Creek and the Georges River. The potential flood impacts resulting from the Proposal's Stage 1 Operational Area works have been investigated and proposed flooding and stormwater mitigation measures identified in Section 5.1 to minimise adverse impacts. Similarly, commentary on stormwater management and mitigation works for the Rail Link's local embankment drainage is provided in Section 5.2, and for the Construction Phase in Section 5.3. Section 5.4 then turns to the issue of flood emergency response planning.

5.1 OPERATIONAL AREA ANALYSIS AND DESIGN

The methodology used for representing the flow regimes for the Proposal's Stage 1 Operational Area includes use of:

- DRAINS software to develop rainfall runoff models to represent existing and post-development site conditions.
- HEC-RAS software to assess proposed open channel waterways including:
  - along the southern site boundary;
  - along the eastern (and northern) site boundary; and
  - the proposed on-site detention, to be located along the western side of the site.

In demonstrating compliance with the SEARs itemised in Table 1 of this report, the analysis and design includes:

- provision of 10 year ARI minor drainage system capacity for the site in accordance Liverpool City Council's *New south Wales Development Design Specification D5 Stormwater Drainage Design,* January 2003;
- 100 year ARI drainage system depths limited to no greater than 0.2m within the site (excluding open waterways);
- 10 year ARI minor system capacity for the proposed Moorebank Avenue drainage system; and
- mitigation of potential adverse flood impacts that may otherwise result from the Operational Area development by the provision of on-site detention (OSD).

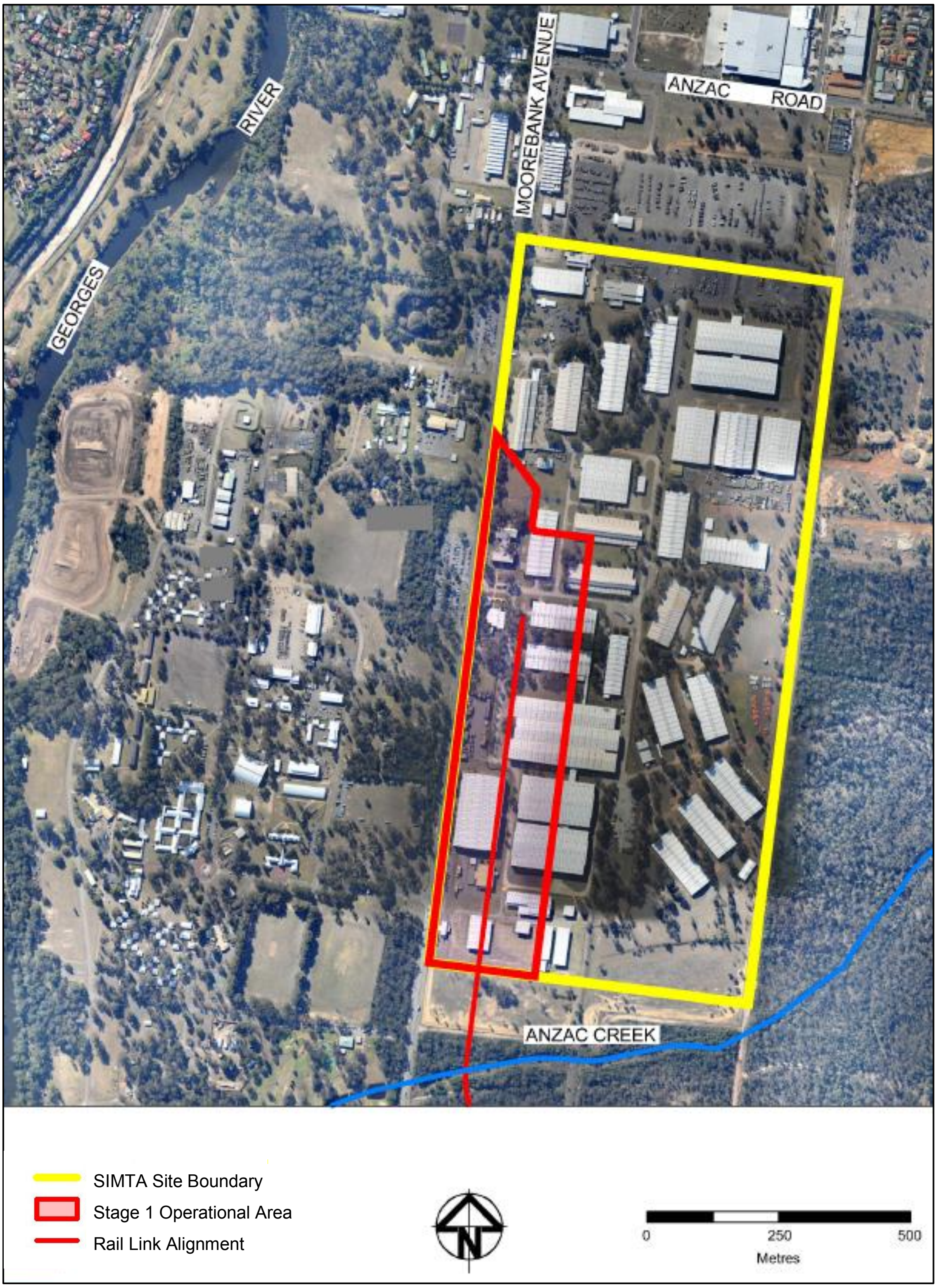


Figure 12 - Stage 1 Operational Area (located within the SIMTA Site)

5.1.1 FLOWS AND STORMWATER

Existing Conditions

DRAINS software has been used to develop rainfall runoff models to represent site flows for existing site and post-development site conditions. The model extents cover the Stage 1 Operational Area portion of the site and neighbouring catchment areas.

The existing conditions catchments and impervious areas have been based on:

- Aerial photography.
- Aerial laser survey for areas external to the site boundary (to the north and west).
- Ground survey for the site, areas to the south, and for specific areas such as details downstream of the site discharge points.
- Site inspection to verify certain surveyed features.

The catchments to Outlet C (see earlier Section 1.1, Figure 3) have been split into further sub-catchments to better represent the distribution of flows over the site, and in particular the Stage 1 Operational Area. A sub-catchment plan that represents the layout adopted for the existing conditions DRAINS model is included in the accompanying design drawings.

The model parameters include:

- Paved area and supplementary area depression storage = 1 mm, and pervious area depression storage = 5mm.
- Soil type = 3.0.
- A fraction impervious (average) for the Stage 1 Operational Area of approximately 60%.

The DRAINS model has been run for storm durations of 5 minute to 24 hours for the 2 year, 10 year, 20 year and 100 year ARIs, and 15 minute to 6 hours for probable maximum precipitation (PMP) events.

A summary of the model input data and outputs for existing conditions is included in Appendix D.

Post-development

The existing conditions DRAINS model was adjusted to represent the post-development site conditions for the Stage 1 Operational Area in accordance with the design drawings attached to this report. The modelling also includes future conceptual development (to the north of the Stage 1 Operational; Area). Model adjustments have included:

- Changes to sub-catchment boundaries. A sub-catchment plan that represents the layout adopted for the proposed conditions DRAINS model is included in the design drawings.
- Adopting a 100% impervious percentage within the Stage 1 Operational Area.
- Reduced flow travel times representative of the proposed development.
- Introduction of stormwater systems to facilitate drainage of the development.
- Detention storage to mitigate potential flow increases.

The DRAINS modelling has involved interfacing with a HEC-RAS model (discussed in the following report Section 5.1.2) to represent the water surface gradient in the proposed on-site detention. Subsequent sizing of site drainage systems that discharge into the on-site detention has allowed for 100 year ARI water levels in the OSD as estimated from the HEC-RAS modelling.

A summary of DRAINS model input data and outputs for post-development conditions is included in Appendix D. The drainage system and detention storage concept layout is included in the accompanying design drawings.

A comparison of DRAINS model existing condition and post-development condition flows at the downstream location of Stage 1 Operational Area is included in Appendix D for a range of durations. This comparison indicates that the proposed detention storage should adequately mitigate potential flow increases (up to the 100 year ARI) leaving the Stage 1 Operational Area.

A summary of the performance of the OSD storage is provided Table 8. A comparison of the peak Operational Area site discharges is included in Table 9.

Table 8: Detention Storage Performance Summary

Average Recurrence Interval (year)	Storage		
	Inflow (m^3/s)	Outflow (m^3/s)	Water Level (mAHD)
10	4.8	1.8	15.1
100	6.4	2.3	15.3
PMF	-	-	16.1*

Storage parameters and outlet configuration are included in Appendix D.
* Assumes OSD spills at 16.0mAHD along wall length of approx. 850m.

Table 9: Summary of Peak Discharges at Stage 1 Operational Area Downstream Boundary

Average Recurrence Interval (year)	Discharge (m^3/s)	
	Existing Conditions (Existing Channel)	Post Development Conditions (FChannel 1)
10	6.4	4.1
100	9.4	5.8
PMF	46	27

( ) Indicated DRAINS model reference

Future SIMTA Staging

The post development model of Stage 1 Operational Area has been extended to the northern boundary of the SIMTA site assuming:

- the Georges River total sub-catchment area within the SIMTA site remains as for existing conditions;
- 100% impervious development; and
- OSD storage, represented in concept, to facilitate OSD water level representation in the Stage 1 Operational Area under future SIMTA site development. The OSD configuration north of the Stage 1 Operational Area has been assumed to be similar in shape to that outlined in the accompanying design drawings for the Stage 1 Operational Area.

This future conditions ('All Stages Scenario') DRAINS modelling has been used to generate 100 year ARI flow inputs for HEC-RAS modelling of water surface levels in the OSD, discussed in Section 5.1.2).

5.1.2 OPEN WATERWAYS

Open waterway modelling has incorporated culvert and terrain survey information carried out within the Stage 1 Operational Area and its immediate surrounds by Hard and Forester Pty Ltd (August 2010 and July 2012). For areas beyond the extent of ground survey, aerial laser survey by AAM Hatch (May 2008) has been adopted where necessary.

To facilitate assessment and design of the Stage 1 Operational Area stormwater management, the following within site open waterways (indicated in the accompanying design drawings) have been formally modelled, the:

- existing channel along the western SIMTA site boundary;
- proposed OSD adjacent to the western Stage 1 boundary, to determine the water surface gradient along its length;
- proposed waterway along the southern Stage 1 Operational Area boundary; and
- proposed waterway along the eastern (and northern) Stage 1 Operational Area boundaries.

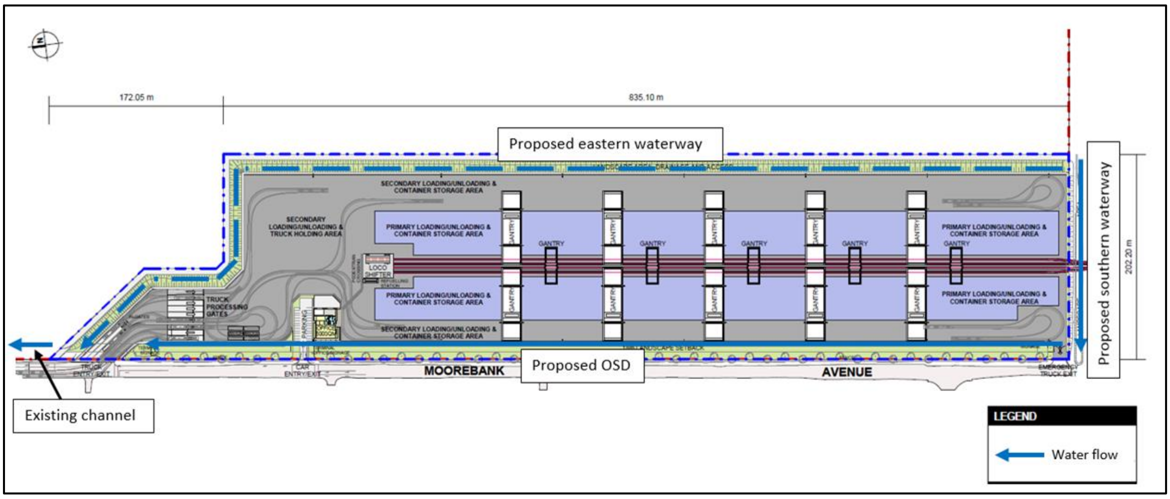


Figure 13: Location of Stage 1 Operational Area Waterways

Flows quantified in the DRAINS modelling have been incorporated into each of the waterways to determine their configurations, flow regimes and water levels. Channel assessments details are discussed as follows.

Existing Conditions

The TUFLOW model developed for the Concept Plan report provided 100 year ARI water levels along the main north western waterway within the SIMTA site (in Appendix G of that August 2011 report). This water level information has been used to facilitate the on-site detention analysis and design for the Stage 1 Operational Area, and in considering ultimate final development of the SIMTA site.

Post-development

OSD Waterway

HEC-RAS modelling of the proposed OSD waterway has been carried out to estimate the water surface gradient along the OSD for a concept All Stages Scenario (which, if configured similar to the Operational Area OSD, may have higher water levels than under the Stage 1 development due to its greater length and inflows).

This All Stages Scenario development assessment assumes:

- flows to the existing northern outlet under Moorebank Avenue would be limited to no greater than for existing conditions;
- the catchment area managed by the OSD would be as for existing conditions (limited to the Georges River catchment area of approximately 35.7ha within the SIMTA site).
- the OSD configuration would be similar to that currently proposed for the Stage 1 Operational Area, subject to adequate flow mitigation performance.

HEC-RAS model input and output details are included in Appendix E.

The model results indicate that water surface gradient along the OSD waterway may have a water surface gradient of the order of 0.3m along its length (approximately 1.3km) in a 100 year ARI event.

This water surface gradient has been taken into account for the initial sizing of the Stage 1 Operational Area drainage systems (discharging into the OSD) to have tailwater levels of 15.7mAHD (to achieve 10 year minor, and 100 year major capacities, as discussed in Section 5.1 above). The potential water surface gradient has also be taken into consideration with respect to achieving a minimum freeboard of 0.3m along the channel walls.

It is however acknowledged that the future OSD to the north of the Stage 1 Operational Area could be provided with alternative configurations of the current stage 1 OSD channel (although potentially requiring more land-take) that may reduce the estimated water surface gradient.

Southern Waterway

Catchment runoff from neighbouring areas along the southern Stage 1 Operational Area boundary are proposed to be managed by an open waterway adjacent to the Stage 1 Operational Area site as indicated in the accompanying design drawings. This waterway extends westward to discharge into the proposed Moorebank Avenue drainage system, and includes a culvert (3, 1.5m(w) x 0.6m(h) reinforced concrete box culverts (RCBCs), assessed with 50% blockage) under the proposed Rail link, immediately south of the Stage 1 site.

Model input and output details for this waterway is included in Appendix E.

Because of the flat gradients along this proposed channel it will be necessary to prevent nuisance ponding by providing an effective soak away/subsoil conveyance system as outlined in the accompanying design drawings.

Eastern Waterway

HEC-RAS modelling of the waterway along the eastern boundary and northern boundaries of the Stage 1 Operational Area demonstrates its adequacy to convey flows (up to a 100 year ARI) from the neighbouring existing conditions sub-catchment areas of the Georges River located to the east of the Stage 1 Operational Area works, (including the proposed 12m wide corridor of landscaping, drainage and fire access road along the eastern and northern extents of the Stage 1 Operational Area).

Concept channel details are provided in the accompanying design drawings and HEC-RAS model input and output details for this waterway is included in Appendix E.

5.1.3 SENSITIVITY ASSESSMENTS

A sensitivity assessment was also carried out with 100 year rainfall intensities increased by 20%. This resulted in an increase in 100 year water levels of approximately 0.1m in the OSD (compared to a 100 year event). This sensitivity assessment is considered representative of potential climate change impacts, being consistent with projected rainfall increases in accordance with the New South Wales Department of Environment and Climate Change (DECC) ‘Floodplain Risk Management Guideline Practical Consideration of Climate Change’ (October 2007) for Hawkesbury-Nepean catchment.

A sensitivity assessment of increasing the OSD channel roughness from n=0.04 to n=0.05, within the 2m deep width of channel increased 100 year ARI flood levels by up to 0.01m along its length.

5.1.4 COMMENTS AND CONCLUSION

The DRAINS and HEC-RAS modelling results indicate that the proposed drainage systems and OSD can provide adequate system capacities and mitigate potential adverse flood impacts that may otherwise result from the Stage 1 Operational Area works. However it should be noted that there are several design issues and potential refinements (itemised below) that should be taken into consideration for future design detailing so as to be consistent with the stormwater management proposed in this report and the accompanying design drawings.

Pavement Grades

There are varying and alternative pavements and associated drainage configurations, however a key consideration is the surface grading. To minimise local ponding and breakdown of pavement areas minimum grades are necessary across the Stage 1 Operational Area. For concrete pavements 1% minimum grading is recommended. For pavers and bitumen surfaces, 2% minimum grading, and if gravel surfacing (sometimes suitable in say container areas) horizontal grading has proven adequate.

While steeper than the minimum grades may further limit potential water damage to pavements, the above noted minimum grades limit the potential damage to container units in the handling and operation processes (*UNCTAD Monographs on Port Management 5 Container Terminal Pavement Management,* United Nations, 1996, p53).

On-site detention (OSD) Configuration

Design of the OSD also allows for alternative configurations with respect to landscaping and OSD form (than simply the vertical sided walls indicated on the accompanying design drawings). That said, it should be noted that:

1. Batter slopes of landscape storage systems that would comply with Liverpool City Council (LCC) requirements are 1(V):4(H) (*OSD Stormwater Detention Technical Specification*, LCC, January 2003), noting that basin side slopes should be ‘preferably no steeper than 1 in 6 to allow easy egress’ (*Development Design Specification D5 Stormwater Drainage Design*, LCC, January 2003)
2. Trees are not to be planted on basin embankments (*Development Design Specification D5 Stormwater Drainage Design*, LCC, January 2003), with trees to located away from the toe of batters.
3. A minimum freeboard of 0.3m above the 100 year water level is necessary.
4. Spillway to manage greater than 100 year ARI events should be located at the northern extent of the OSD to minimise impacts on Moorebank Avenue.

Moorebank Avenue Drainage

Under existing conditions Moorebank Avenue rainfall runoff is served by an open channel system that extends from the southern end of the SIMTA site northward for approximately 1.3km to twin box culverts which convey flows westward under Moorebank Avenue (as outlined in the accompanying design drawings). This 1.3km length of channel has a very flat grade of 0.2%. From the Moorebank Avenue culverts, flows continue westward in an open channel system for approximately another 1.2km before discharging into the Georges River.

The proposed Moorebank Avenue drainage system is a series of surface runoff capture swales. These swales are to be typically graded at 0.5%, and discharge into a proposed underground conduit system approximately 0.8km in length (extending northward from the southern Stage 1 Operational Area (SIMTA) site boundary before discharging into the existing open channel system. This existing system continues northward to an existing culvert under Moorebank Avenue). The proposed underground conduit system retains a 0.2% grade (similar to the existing drainage system). Minimum velocities in the proposed conduit system are likely to be somewhat less than the desirable minimum velocity of 0.6m/s for self-cleansing, particularly at its downstream where backwater effects from the existing system may slow velocities. That said, silting and sedimentation build-up impacts will be limited by the relatively large culvert sizing, which will also assist maintenance and flushing when necessary.

Works Outside of Site

Landholder consent and approval is currently being sought to carryout out works for the Proposal in the Moorebank Avenue corridor and in the neighbouring areas to the south of the Stage 1 Operational Area, as indicated in the accompany design drawings.

Alternative design options may be to carry out works within the Stage 1 Operational Area. With respect to drainage, which are the primary works within the two neighbouring areas, similar system capacities and waterway areas would be required to adequately manage projected runoff and flows.

5.2 RAIL LINK

The stormwater management of Rail link cross drainage (under the proposed rail embankments) and longitudinal drainage (located along the toe of proposed embankments) is outlined in the accompanying design drawings which indicate proposed scour protection measures and water systems to mitigate potential adverse drainage impacts on existing systems and areas. A description of the proposed drainage is as follows.

East of Moorebank Avenue

This length of Rail link is proposed to be a raised rail embankment except for a short length through an existing fill area (immediately west of Moorebank Avenue) where the rail will be in cut.

Along the embankment length it is proposed to mitigate potential adverse environment impacts, with respect to drainage, by providing scour protection along the toe of the rail embankments to retain existing flow path conditions on the Anzac Creek floodplain.

In the existing fill area (where the rail will be in cut), cut-off embankments are proposed along the top of the cut. Within the cut corridor, the maintenance access zone will facilitate drainage.

Immediately south of the existing fill is a low point (between the fill area and Moorebank Avenue) where local runoff is proposed to be collected by a cross drainage system to convey flow under the proposed rail embankment and discharge into the open channel which serves the local runoff area and existing East Hills Rail Line.

Moorebank Avenue to Georges River

Immediately west of Moorebank Avenue there is an existing culvert which captures and conveys local catchment runoff under the existing East Hills Rail Line embankment in a southerly direction. To maintain this flow conveyance, it is proposed to provide a new culvert under the proposed Rail link as indicated in the accompanying design drawings.

Further to the west, the Rail link is proposed to transition from being a raised embankment formation to being in cut, so as to grade down to the proposed Georges River bridge crossing. The cut formation diverts a catchment area of about 0.6ha for the upper reaches of Anzac Creek more directly to the Georges River near the proposed rail bridge rather than via Anzac Creek (which itself discharges to the Georges River about 6km downstream of the proposed rail bridge). The runoff generated from the 0.6ha area would be approximately 0.3m^3/s in a 100 year event, and hence negligible compared with the 100 year Georges River flow of some 1880m^3/s.

With respect to the local stormwater management of the Rail Link flows in this area, it is proposed to provide scour protection/energy dissipation and flow distribution to protect the steep areas that grade down to the bridge abutment area and Georges River, and if necessary (to accommodate the minor flow increases) local stormwater system upgrading as indicated in the accompanying design drawings.

Georges River Bridge

Stormwater runoff from the bridge deck is proposed to be collected and conveyed via a suspended pipe system between the bridge girders to each abutment, then discharged into the river

West of Georges River

Immediately west of Georges River it is proposed to provide scour protection and energy dissipation either side of the rail embankment along the steep areas that are to convey flows to the Georges River.

Further west, the Rail link, as shown in the rail drawings by AECOM (2015c) between approximately ch40340 and ch39340, is located within the existing Glenfield Waste Disposal Facility. As such, the stormwater management strategy for this section of the Rail link area is to maintain the discharging of runoff into the Waste Disposal Facility, enabling flows to be managed in accordance with the Waste Disposal Facility’s Environmental Protection License. However, a northern portion of the Waste Disposal Facility (as indicated in the accompanying design drawings) currently discharges to the Georges River. As such a culvert cross drainage system is proposed to convey runoff, from this northern area of the Waste Disposal Facility, under the Rail link then via an energy dissipater and scour protection system to the Georges River.

5.3 CONSTRUCTION PHASE

Care will be required on all areas of the Stage 1 Operational Area and associated Proposal areas during the construction phase to avoid potential adverse flood impacts on neighbouring property. Flood mitigation measures necessary to maintain existing condition flow regimes and distributions leaving the Construction Areas (so as to maintain runoff to no greater than for existing conditions) should include such alternatives as:

- maintaining existing site catchment/sub-catchment boundaries;
- limiting site imperviousness and grades to no greater than under existing development conditions;
- provision of OSD.

Furthermore, flood emergency response plans (FERPs) will be necessary for each of the Proposal areas as discussed in Section 5.4.

5.4 FLOOD EMERGENCY RESPONSE PLANS

Part of the approach to the overall stormwater management for the Proposal is the consideration of evacuation and refuge. For this reason site conditions during a probable maximum flood (PMF) is to be considered.

It will be necessary for the operator to develop FERPs for each stage of the Proposal taking into consideration, site flooding and broader flood emergency response plans for the Georges River and Anzac Creek floodplains, and Moorebank area.

For areas impacted by Georges River flooding, flood warning may be available, and FERPs could be quite different in terms of flood readiness, evacuation and recovery, than for say the Stage 1 Operational Area.

5.4.1 STAGE 1 OPERATIONAL AREA

The TUFLOW site model results for Anzac Creek (see Appendix B) indicates that the southern portion of the SIMTA site is impacted by regional flooding under existing conditions, and that proposed filling will raise the Stage 1 Operational Area above the regional PMF levels. However, areas not impacted by regional flooding can still be affected by local PMF flow regimes.

The Stage 1 Operational Area is located within upper catchment areas and, as recognised in the NSW Floodplain Management Manual (April 2005, Section L6.2), there would be little if any available warning time for people to undertake action. As such, in developing an evacuation and refuge plan, it should include safe refuge within the site (above PMF flood levels) until hazardous flows have subsided and safe evacuation is possible.

5.4.2 RAIL LINK

While the Rail Link beyond the Stage 1 Operational Area has top of rail levels above the PMF levels, consideration of evacuation, refuge and recovery, and hence FERP(s) will need to be formalised.

6 WATER QUALITY

6.1 OBJECTIVES AND PERFORMANCE TARGETS

The stormwater quality objectives and performance targets for the Proposal have been derived from the following key documents.

- ***Liverpool Development Control Plan 2008*** (Liverpool City Council, 12 November 2014) – provides general objectives and controls that apply to development within Liverpool LGA.
- ***Georges River Estuary Coastal Zone Management Plan*** (Georges River Combined Council's Committee, July 2013) – provides objectives and targets specifically for the Georges River Estuary and its catchment.
- ***SEARs for SIMTA Intermodal Terminal Facility – Stage 1 SSD*** (NSW Planning & Environment, December 2014) – provides specific environmental assessment requirements and objectives for the Proposal.

6.1.1 OBJECTIVES

The key objectives for stormwater quality management for the Proposal include:

- Maintain or improve existing water quality.
- To protect the aquatic environment of the downstream waterways including the Georges River.
- Prevent bed and bank erosion and instability of waterways.
- Provide sufficient flows to support aquatic environments and ecological processes.
- Incorporate a Water Sensitive Urban Design (WSUD) approach.

6.1.2 PERFORMANCE TARGETS

Water quality performance targets for the Proposal have been derived from the key documents identified previously and are summarised in Table 10.

Table 10: Water Quality Performance Targets

	Liverpool DCP 2008	Georges River Estuary CZMP 2013	SEARs December 2014, (Item 9. h)
Total Suspended Solids (TSS)	80%	**85%**	**NorBE**
Total Phosphorus (TP)	45%	**60%**	**NorBE**
Total Nitrogen (TN)	45%	**45%**	**NorBE**
Gross Pollutants (GP)	90%	**90%**	**NorBE**

Table Key:

- *Percentage (%) values are the pollutant reduction targets relative to post development pollutant loads without any treatment*
- *NorBE = Neutral or Beneficial Effect (ie. 'maintain or improve existing water quality' as required by the SEARs)*
- **Bold** values are the adopted targets

While the percentage reduction targets contained in Georges River Estuary CZMP are more stringent that the targets contained in Liverpool DCP 2008, given that they have been developed specifically for the Georges River catchment it is considered appropriate to adopt these for the SIMTA Stage 1 Operational Area. In addition to these percentage reduction targets, the SEARs require existing water quality to be maintained or improved (ie. 'NorBE' / Neutral or Beneficial Effect). Whether NorBE is more stringent than the percentage reduction targets depends on the existing water quality conditions and it is considered appropriate to check the performance of the proposed WSUD strategy against both targets. Therefore, both the Georges River Estuary CZMP percentage reduction and NorBE targets have been adopted for the site.

For the Rail link, where pollutant loads in stormwater runoff are expected to be low and therefore have no measurable impact on water quality, hence no quantitative treatment targets have been adopted. Pollutant generation is likely to be limited to small sediment loads and therefore treatment measures which target sediment removal, such as vegetated swales, are proposed to be implemented where feasible.

It should also be noted that the percentage reduction targets are considered applicable to the Stage 1 Operational Area of the SIMTA site, but should not necessarily be applied to the remainder of the SIMTA site. Where significant roof areas are proposed (only small roof areas are proposed in Stage 1), it is considered inappropriate to apply percentage reduction targets due to the significant difficulties (and appropriateness of treating relatively clean water to achieve these targets. In these cases the adoption of the NorBE target on its own is considered appropriate.

6.2 PROPOSED STORMWATER QUALITY MEASURES

To address potential impacts on stormwater quality, WSUD principles and a treatment train approach have been applied. Two key treatment measures are proposed for the Stage 1 Operational Area to meet the performance targets:

1. Gross Pollutant Traps (GPTs)
2. Rain gardens (Bioretention systems).

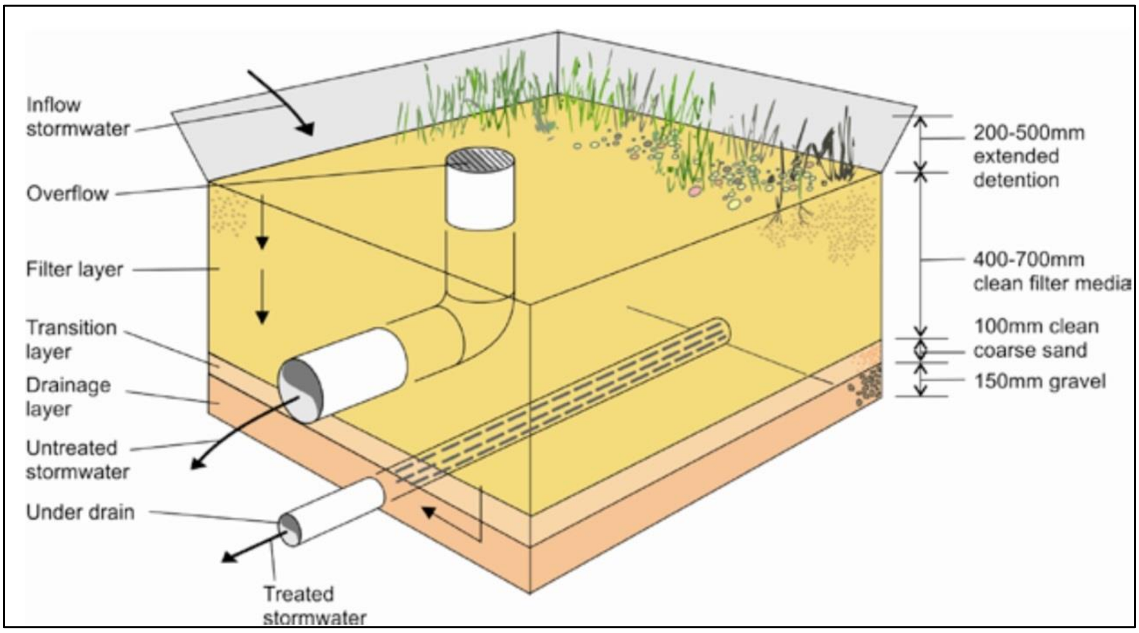
Gross Pollutant Traps

Gross pollutant traps (GPTs) are primary stormwater treatment measures, typically applied as the first measure in a stormwater treatment train. GPTs come in varying forms from simple trash racks through to more complex devices with continuous deflection screens and hydrodynamic separation.

The performance of GPTs varies according to the type of device selected. In this case, a device has been selected with continuous deflection screens and hydrodynamic separation to target the removal of a significant proportion of the Total Suspended Solid (TSS) load. Removal of TSS is important for protecting and minimising maintenance of downstream treatment devices such as rain gardens which are sensitive to high TSS loads.

Rain Gardens

Rain gardens are bioretention systems that comprise a combination of vegetation and filter substrate (refer Figure 14). They provide treatment of stormwater through the processes of settling, filtration and biological uptake and are very effective in the removal of fine sediments and nutrients. Rain gardens are proposed in the base of the OSD basin/channel (refer Section 5).



Source: Using MUSIC in Sydney's Drinking Water Catchment (Sydney Catchment Authority, December 2012)

Figure 14: Typical Rain Garden Concept

In general, rain gardens are lined to protect adjacent structures or if there are known salinity hazards. The SIMTA site is located in an area of 'moderate salinity potential' as defined by the 'Salinity Potential in Western Sydney 2002' map distributed by the NSW Office of Environment and Heritage (OEH). This salinity classification in itself does not mean the proposed rain gardens need to be lined, however the site's soils are predominantly clays and sandy clays which are associated with shrinkage and differential settlement. Lining of the rain gardens will therefore be required when located adjacent to footings of structures such as retaining walls and buildings.

6.3 ASSESSMENT METHODOLOGY

Assessment of the performance of the proposed stormwater quality measures has been undertaken using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC V6.1).

A MUSIC model for the Stage 1 Operational Area has been developed by applying the land uses and imperviousness values for existing and proposed conditions included in Table 11. The MUSIC model layout and other key modelling parameters are included in Appendix F.

Table 11: Stage 1 Operational Area Land Use Areas and Imperviousness

Land use	Existing		Proposed	
	Area (ha)	Imperviousness (%)	Area (ha)	Imperviousness (%)
Roof	5.5	100	0.1	100
Road	2.8	100	8.1	100
Stacking Area	-	-	5.8	100
Other	6.1	5	0.4	0

6.4 RESULTS AND COMMENTS

Based on the proposed stormwater quality measures the performance of the treatment measures included in the Stage 1 Operational Area are presented in Table 12 and Table 13 relative to percentage reduction and NorBE targets respectively.

Table 12: Treatment Performance Relative to Percentage Reduction Targets

Scenario	Pollutant Loads (kg/year)			
	Gross pollutants	TSS	TP	TN
Proposed (no treatment)*	3170	32,000	54	279
Proposed (with treatment)*	28	2,440	9	117
% Reduction Achieved	99	92	83	58
% Reduction Targets	*90*	*85*	*60*	*45*

** Node: "Receiving Node", Model: AA003760_Moorebank_MUSIC6_Stage1EIS_Dev_20150217.sqz*

Table 13: Treatment Performance Relative to NorBE Targets

Scenario	Pollutant Loads (kg/year)			
	Gross pollutants	TSS	TP	TN
Existing#	2,010	11,300	25	187
Proposed (with treatment)+	28	2,440	9	117
Reduction Achieved	1,982	8,860	16	70

 # Node: "Receiving Node", Model: AA003760_Moorebank_MUSIC6_Stage1EIS_Exg_20150217.sqz

+ Node: "Receiving Node", Model: AA003760_Moorebank_MUSIC6_Stage1EIS_Dev_20150217.sqz

In summary, the water quality assessment has demonstrated that the performance of the proposed treatment measures (i.e. GPTs and rain gardens) complies with the catchment specific targets of the Georges River Estuary CZMP and also the site specific targets contained in the SEARs.

6.5 CONSTRUCTION

The SEARs for the Proposal include a requirement to undertake an assessment of surface water quality during construction, identify works that may impact water quality and provide a summary of proposed mitigation measures.

This section should be read in conjunction with accompanying design drawings.

6.5.1 PROPOSED WORKS

Section 1.4 provides a summary of the construction works for the Stage 1 Proposal. While all construction activities have the potential to impact on water quality, the key activities are:

- vegetation clearing and demolition works;
- bulk earthworks;
- Georges River Bridge construction;
- stormwater and drainage works.

6.5.2 EROSION AND SEDIMENT CONTROLS

Without any mitigation measures and during typical construction activities, site runoff would be expected to convey a significant sediment load. A Soil and Water Management Plan (SWMP) and Erosion and Sediment Control Plan (ESCP), or equivalent, would be implemented for the construction of the Proposal. The SWMP and ESCPs would be developed in accordance with the principles and requirements of *Managing Urban Stormwater – Soils & Construction Volume 1 ('Blue Book')*(Landcom, 2004) and *Volume 2* (DECC 2008).

In accordance with the principles included in the Blue Book, a number of controls have been incorporated into a preliminary ESCP (refer to accompanying Drawings).

The proposed controls include:

Sediment Basins

Sediment basins have been sized and located to ensure sediment concentrations in site runoff are within acceptable limits. Preliminary basin sizes have been calculated in accordance with the *Blue Book* and are based on Berkshire Park Group soils ('Type F'). These soils are fine grained and require a relatively long residence time to allow settling.

As the majority of the Stage 1 Operational Area site drains to the west, the sediment basins have been located generally along the western boundary of the site in the proposed drainage channel. An additional basin is proposed at the northern end of the Eastern Swale to treat any flows that may discharge to the east.

Within the Rail link area, sediment basins are proposed at key discharge points from the site.

Sediment basins for 'Type F' soils are typically wet basins which are pumped out following a rainfall event when suspended solids concentrations of less than 50 mg/L have been achieved.

Sediment Fences

Sediment fences are located around the perimeter of the site to ensure no untreated runoff leaves the site. They have also been located around the existing and proposed drainage channels to minimise sediment migration into waterways and sediment basins.

Stabilised Site Access and Truck Washdown

For the Stage 1 Operational Area, a stabilised site access and truck washdown area is proposed at a single access point on Moorebank Avenue, at the northern end of the site. This will limit the risk of sediment being transported onto Moorebank Avenue and other public roads.

For the Rail link area, access will be required at a number of locations where stabilised site access and truck washdown areas will be provided.

Georges River Bridge Controls

During construction of the Georges River Bridge the Principal Contractor would develop a Project Specific Procedure (PSP), or equivalent, that would specify how works within and adjacent to the river would be managed to minimise environmental impacts. The PSP would specify the following measures:

- Works across the bed of the Georges River would be staged to minimise the total disturbance at any given time and to allow the full bypassing of stream flows around the works to maintain fish passage.
- Scour protection works around piers, along creek banks and on bridge abutments should be installed as early as possible.
- Measures to contain potential pollutants should be installed in-stream, such as silt curtains to contain sediment.
- Material for the formation of piling platforms must be clean material with minimal fines.
- Measures to manage runoff from the bridge approaches / abutments must be established as early as possible.
- Management measures identified in the PSP would be developed to address the requirements for high erosion hazard sites, in accordance with the requirements of the Blue Book.

Anzac Creek Controls

The following management measures would be implemented during works in and adjacent to Anzac Creek to mitigate potential impacts on water quality during construction:

- All reasonable efforts would be taken to program construction activities during those periods when flood flows and fish passage is not likely to occur.
- Temporary side-track crossings would be constructed from clean fill (free of fines) using pipe or box culvert cells to carry flows, or a temporary bridge structure.
- All temporary works, flow diversion barriers and in-stream sediment control barriers would be removed as soon as practicable and in a manner that does not promote future channel erosion.
- The construction site would be left in a condition that promotes native revegetation.
- The management principles outlined in the Blue Book for sites with high erosion potential would be implemented.

Other Management Measures

Other management measures that will be employed are expected to include:

- minimising the extent of disturbed areas across the site at any one time;
- progressive stabilisation of disturbed areas once earthworks are complete;
- regular monitoring and implementation of remedial works to maintain the efficiency of all controls.

It is noted that the controls included in the preliminary ESCP are expected to be reviewed and updated in accordance with the Preliminary Construction Environmental Management Plan (CEMP)(Hyder Consulting, 2015) as the design, staging and construction methodology is further developed for the Proposal.

7 SITE WATER BALANCE

7.1 OBJECTIVES

The objective of the site water balance is to identify any potential impacts on surface water and groundwater resources and assess management options where appropriate. This is in accordance with the SEARs items 9. c, d and e (refer Table 1).

The site water balance focuses on the Stage 1 Operational Area. With respect to the Rail link, under existing conditions the area is essentially 100% pervious. Under proposed development conditions, the Rail link area will effectively remain 100% pervious, noting that the proposed rail bridge over the Georges River will runoff into the River, and the proposed rail structure located within the existing Glenfield Waste Disposal Facility is an area that will continue to discharge into the Waste Disposal Facility, enabling flows to be managed in accordance with the Waste Disposal Facility's Environmental Protection License.

7.2 METHODOLOGY

Given that rainfall-runoff processes dominate the water balance for the site, a site water balance model was established using MUSIC (the same model used to assess water quality impacts, refer Section 6) for both existing and proposed conditions. MUSIC enables a continuous simulation of rainfall-runoff processes to be undertaken for a long time period. In this case, a 10 year period of rainfall was selected which includes a range of rainfall depths across both wet and dry years.

Other components of the site water balance include potable water supply from Sydney Water and wastewater discharge to sewer, although the volumes associated with these are relatively minor and have not been assessed in detail.

7.3 WATER DEMAND & WASTEWATER GENERATION

The water demands for the Stage 1 Operational Area are small relative to the size of the development and are largely associated with the terminal management office. The demands have been estimated by AECOM, the services infrastructure consultant for this project, to be approximately 410 kL / year . This is proposed to be supplied from Sydney Water's potable water supply network. No extraction from any potential surface water or groundwater resources is proposed.

Wastewater generation, allowing for an 80% sewer discharge factor relative to the water demands, is estimated by AECOM to be approximately 330 kL / year. This is proposed to be discharged to sewer.

The water demands and wastewater generation associated with the previous land use for the site (i.e. as the DNSDC) are unknown. However, given that the previous and proposed land uses are relatively similar, it is assumed that previous water demands and wastewater generation would have been of a similar magnitude to those estimated for the proposed conditions.

7.4 RAINFALL RUNOFF PROCESSES

The existing conditions for the site include significant impervious surface areas in the form of roads and roofs. From aerial photos it has been estimated that the existing Stage 1 Operational

Area is approximately 60% impervious. While the remainder of the site is pervious (grassed or treed), it is underlain by predominantly clay soils (refer Appendix G for Geotechnical Interpretative Report extracts) which limit the potential for infiltration.

The proposed conditions for the Proposal are predominantly paved surfaces. It is assumed to be approximately 95% impervious, allowing for some pervious landscaped areas.

The average annual rainfall-runoff volumes for the site are shown in Figure 15.

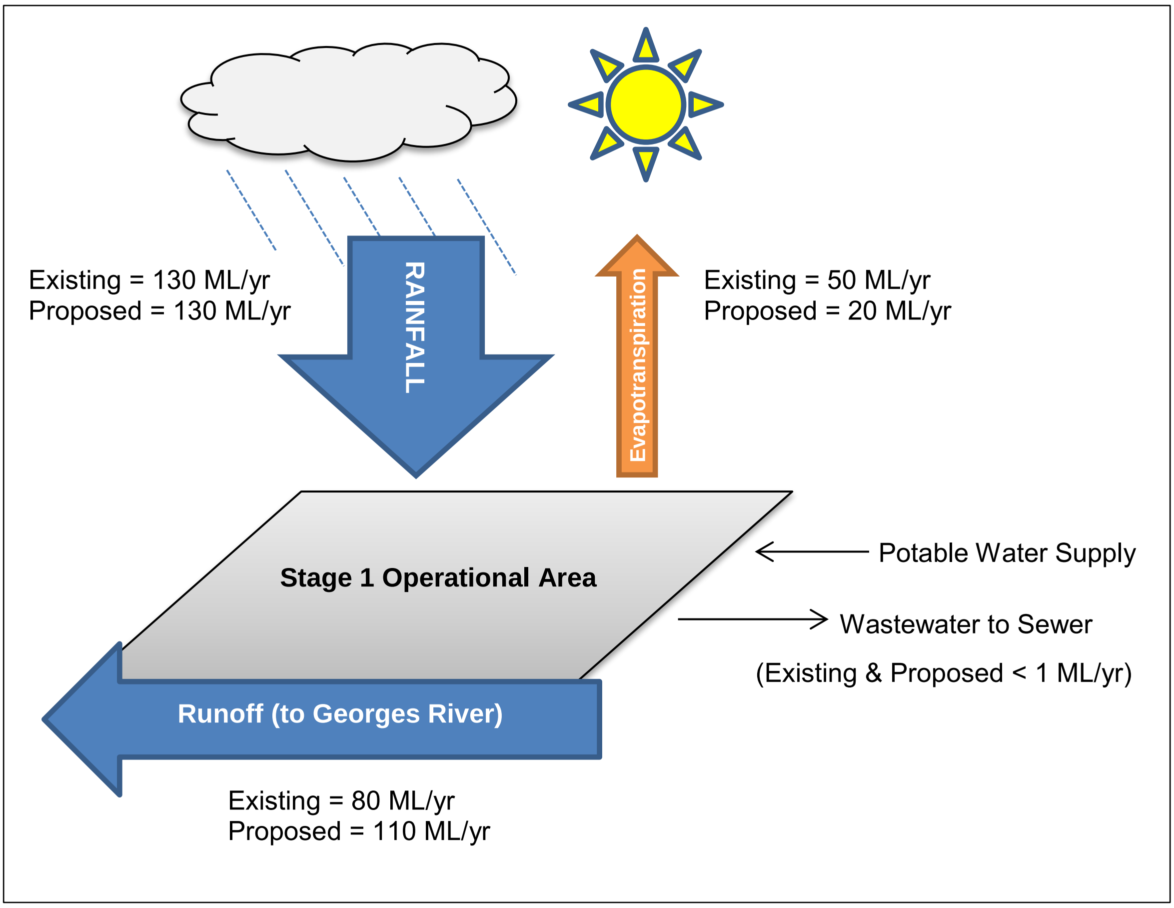


Figure 15: Stage 1 Operational Area Site Water Balance for Existing and Proposed Conditions

7.5 COMMENTS

The key changes to the Stage 1 Operational Area site water balance from existing to proposed conditions are a reduction in evapotranspiration of 30 ML/yr and an increase of the same magnitude to runoff. This is largely a result of the increase in impervious areas from existing conditions (60%) to proposed conditions (95%).

Options considered to reduce the runoff volume from the site included collecting runoff for reuse purposes and/or infiltration. Potential for reuse is limited by the small water demand (< 1 ML/yr) on the Proposal and hence only a very small portion of the runoff volume could be reused. In relation to infiltration, the clay soils would limit infiltration rates and the groundwater is also noted in the *Geotechnical Interpretative Report* (Golder Associates, 2015) as having high levels of salinity. Infiltration is therefore not considered to be practical or desirable.

The potential increase in runoff volume from the site should also be considered in the context of flow volumes conveyed in the Georges River. The total Georges River catchment area is approximately 960 km^2 and would generate annual flow volumes many orders of magnitude greater than from the SIMTA Stage 1 operational area (which represents less than 0.02% of the total catchment area).

Furthermore, the total pollutant loads contained in the runoff from the site would be less than or equal to loads under existing conditions (refer **Section 6**) and the pollutant concentrations would be significantly less than existing (the total pollutant load is less than or equal to existing conditions and the runoff volume has increased, hence the concentration of pollutants will decrease).

The site water balance has demonstrated that while there would be an increase in runoff from the site following the development, the impacts associated with the increase are expected to be negligible in the context of the Georges River catchment as a whole.

8 CONCLUSION

This Stormwater and Flooding Assessment has been prepared for approval of the initial stage of the SIMTA Project, known as the Proposal. This report has been prepared to support a State Significant Development (SSD) Application for which approval is sought under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and in accordance with the Secretary's Environmental Assessment Requirements (SEARs) (ref: SSD 14-6766 and dated December 2014).

The following conclusions and recommendations have been made within this report:

- TUFLOW model results indicated that the impact of the proposed Rail link and associated culvert would result in negligible flood impacts within the Anzac Creek catchment area.
- Design principles were identified to minimise the hydraulic impacts, of the proposed rail bridge, upon the Georges River. Additional modelling would be undertaken to more accurately determine optimum pier alignments and potential flood impacts, and quantify bed scour protection requirements during future design stages. Such modelling should incorporate updated survey of the Georges River bathymetry in the vicinity of the proposed bridge, and two dimensional hydraulic modelling of proposed pier impacts.
- The Rail link alignment along the western floodplain of the Georges River would not impact on the 100 year ARI Georges River flooding levels. To avoid adverse flood impacts along the Georges River floodplain (in extreme events, larger than the 100 year ARI), sections of the rail embankment would require a waterway structure(s) to allow for extreme event flood flows to spread westward across the floodplain.
- The DRAINS and HEC-RAS modelling results indicate that the proposed drainage systems and OSD can provide adequate system capacities and mitigate potential adverse flood impacts that may otherwise result from the Stage 1 Operational Area works. Design considerations to optimise stormwater management on the Stage 1 Operational area were identified.
- Stormwater management structures for the Rail link have been identified to predominantly maintain existing surface water conditions.
- Stormwater quality modelling was undertaken for the Proposal, which demonstrated that implementation of the WSUD measures identified, including the use of gross pollutant traps and rain gardens, would result in a 'net or better effect' on water quality as a result of the Proposal during operation.
- A site water balance was prepared for the Proposal that concluded that the Proposal would result in an increase in surface water runoff of 30 ML. Opportunities for reuse within the Proposal site are limited; however, the impacts associated with the increase are expected to be negligible in the context of the Georges River catchment as a whole.