

InfraShore Consortium

Proposed Redevelopment Royal North Shore Hospital

Stormwater Management Report



October 2008

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Stormwater Management Report

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1 Introduction

Hyder Consulting have been commissioned by InfraShore Consortium to prepare this stormwater management report in support of a Project Application submission for the proposed Royal North Shore Hospital (RNSH) redevelopment.

This report covers the stormwater management works required to address the Director General (DG) requirements including drainage infrastructure, on-site detention (OSD) and water sensitive urban design philosophy.

The proposed development is for the construction of a new Acute Hospital, Community Health Facility, multi-level car park and associated works on land known as the 'Royal North Shore Hospital Redevelopment', (RNSH), and is to be administered as a Project Application under Part 3A of the Environmental Planning and Assessment Act 1979, (the Act). The Project is referred to as MP 08_0172.

In summary, the proposed scope of works includes:

- Acute Hospital building.
- Community Health Facility.
- Multi-level car park for 576 vehicles.
- Refurbishment/alterations to the Douglas Building.
- Pedestrian bridge linking new Hospital and Douglas Building.
- New roads associated with the development of the Acute Hospital building, Community Health Facility and car park.
- At grade parking and the temporary use of land for parking purposes during construction.
- Public Domain works including footpaths, lighting and street tree planting.
- Demolition of Buildings 1, 2, 10 and part 19 (demolition of all other buildings requiring demolition has already been approved)
- Landscaping.
- Civil works including storm water and drainage infrastructure, new roads and utilities.

This Report has been prepared to address those matters related to Stormwater Engineering and the assessment of MP 08_0172. Refer to 'Background' discussion below.

1.1 Background

1.1.1 Concept Plan

A Concept Plan Approval was issued by the Minister for Planning on 9 February 2007, (Major Project Application No. 06_0051), which gave concept approval for the following hospital related components:

- Subdivision of the site into a hospital precinct and other development precincts.
- A maximum floor area of 178,370m² across the development precincts (maximum FSR are prescribed for each precinct)
- Minimum and maximum FSR for the various components of the proposal including residential, employment generating uses, nurses accommodation etc.
- The conceptual road design.
- Urban design, landscaping, open space and heritage concepts.
- Maximum heights.
- Car parking provision to be in accordance with Willoughby Council DCP.
- Improved servicing of the site.
- Staged re-opening of Westbourne Street to through traffic.

Project Application Approval was given for demolition works and site preparatory works to ground level.

On 31 January 2008, the Concept Plan and Project Application Approval was modified in so far as amendments being to conditions related to agreements with public transport providers and with respect to the scheduling of a Traffic Management and Accessibility Plan (TMAP) (Conditions M9.1 and M10.1).

The Concept Plan and Project Application was further modified on 7 April 2008. The modification allowed for the erection of temporary buildings and imposed relevant conditions.

1.1.2 Project Application

Further to the Concept Approval for the whole RNSH site, and along with it the identification of development precincts within the site, on 19 August 2008 a request was made to the Minister to declare the core medical precinct as a "Critical Infrastructure Project", under Clause 6 of SEPP Major Projects 2005 (the SEPP), to permit the lodgement of a Project Application, under Part 3A of the Act.

The application was accompanied by a Preliminary Environmental Assessment, (PEA), for development within the core medical precinct and a request for any relevant Director-General's environmental assessment requirements (DGR's).

On 30 September 2008, the DGR's were issued by the NSW Department of Planning, under s.75F of the Act. The project has been declared a Major Project Application, (MP 08-0172).

2 Site Description

The site for the proposed works is indicated in Figure 1 below and is bound by Westbourne Street to the north, Herbert Street to the east, the Pacific Highway to the south and Gore Hill Park to the west.

The site of the proposed Hospital extension covers an area of approximately 5.2ha and sits within a 28.4ha drainage catchment that grades generally from north-west to south-east.

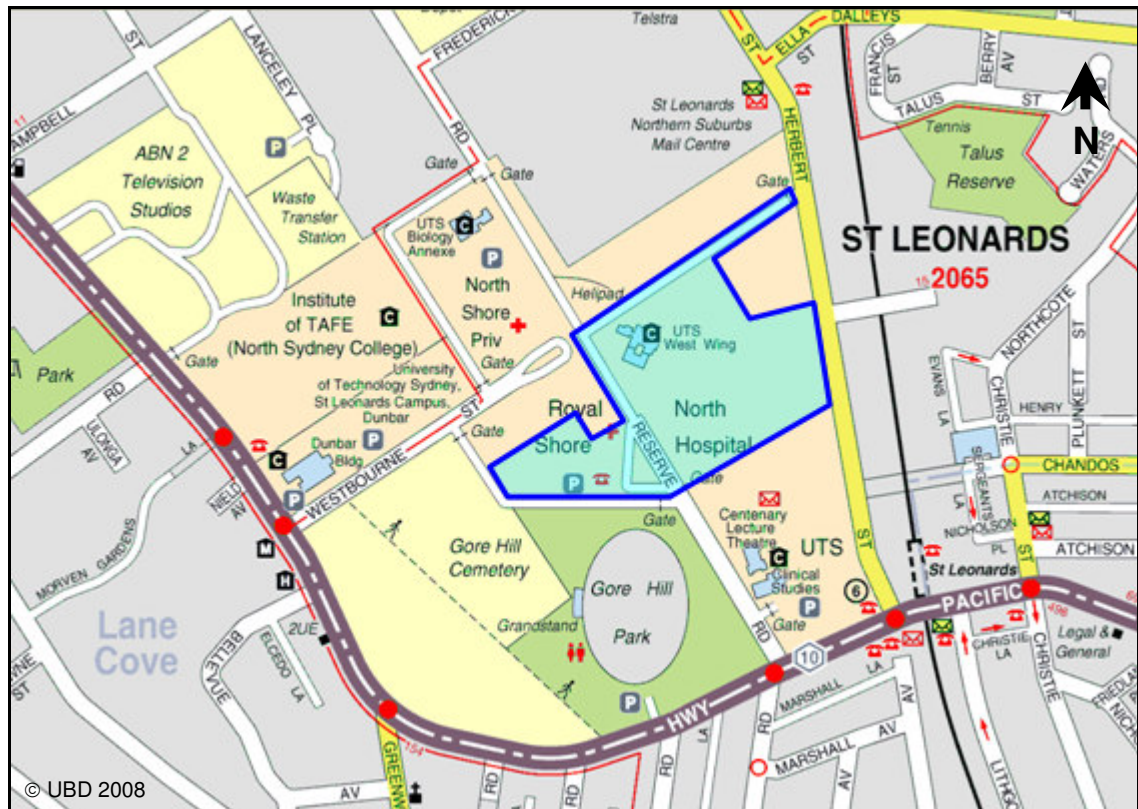


Figure 1 - Site Locality

3 Stormwater Management Overview

As part of the investigation to support the submission of the Project Application, the existing minor stormwater system has initially been assessed. Then based on architectural plans (prepared by Bligh Voller Nield dated Nov 2007) a proposed stormwater system (as shown on the accompanying civil drawings) including a pit and pipe network and detention storages, has been developed.

For the purposes of this assessment rainwater tanks were assumed to be full when the design storm event occurs and therefore do not contribute to detention capacity. It should be noted that Willoughby City Council (WCC) has indicated that there is an opportunity to offset the detention storage through the implementation of stormwater harvesting. This will be further investigated in coordination with the building hydraulic consultant at subsequent design stages.

3.1 Stormwater Drainage Standards

The stormwater drainage has been designed to comply with the following guidelines:

- Australian Rainfall and Runoff 2000 (ARR);
- NSW Floodplain Management Manual 2001;
- Willoughby City Council Development Control Plans, August 2006;
- Willoughby City Council Engineering Guidelines D5 – Stormwater Drainage Design, April 1999;
- Willoughby City Council Technical Standards:
 - No. 1. On-Site Detention, September 2005;
 - No. 2. Rainwater Tanks, September 2005;
 - No. 4. Sediment and Erosion Control, November 2004;
 - No. 5. Water Quality, November 2004;
- Soils and Construction, Volume 1, 4th Edition, March 2004.

3.2 Philosophy & Methodology

It is the intent of this development to limit flows to no greater than existing leaving the development and at key locations where connections into the existing network are proposed. The assessment process has involved firstly performing a catchment analysis on the existing stormwater system using DRAINS software; then secondly, modelling the proposed system with OSD to mitigate potential adverse flood impacts on neighbouring property as a consequence of the development introducing local catchment diversions and changes in impervious fractions.

4 Existing Stormwater Drainage System

4.1 Site Catchment and Drainage

The existing site has been divided into four sub-catchments (a, b, c and d) as indicated on Figure 2. Each of these existing sub-catchments has been modelled using DRAINS software to determine the stormwater system flows at these key locations where site discharges enter the neighbouring trunk drainage systems:

- a. The north-western catchment which is made up of the existing hospital site ultimately drains south towards an existing 900mm diameter pipe. This will serve as a future point of comparison for the proposed redevelopment stormwater flows. WCC GIS data indicates there are two existing connections currently servicing the hospital. Where possible these connections are intended to be utilised for the future redevelopment or reproduced to provide similar pit losses.
- b. The south-western catchment which is made up of a Gore Hill Cemetery and the Gore Hill Oval drains towards an existing 1500mm diameter pipe. WCC GIS data indicates that the 1500mm pipe reduces to a 900mm pipe at the down stream sag point crossing Reserve Road. This will serve as a future point of comparison for the proposed redevelopment stormwater flows. Site inspections have indicated that surface flows from the oval are contained via a batter mound along the south-eastern boundary. Additionally, there is no formalised drainage system evident (specifically around the low point) to capture the surface flows. The catchment west of Reserve Road has not been assessed in the model. This assumption does not impact on the assessment criteria as existing and proposed conditions are to remain unchanged.
- c. The south-eastern catchment which is made up of Precincts 3, 4 and 5 ultimately drains towards an existing 1800mm diameter pipe. This is intended to serve as a future connection for the proposed redevelopment and is the major outlet for stormwater flows leaving the site. Currently the stormwater flows outlet from the site via a 1050mm diameter pipe at the sag point in Herbert Street which then runs north against grade into a 1500mm diameter pipe and then east outletting into a 1800mm diameter pipe. Existing local catchments downstream of the site (roof and half road areas east of Herbert Street) have been excluded from the model. This assumption does not impact on the assessment criteria as existing and proposed conditions are to remain unchanged.
- d. The north-eastern catchment which is made up of Precinct 7 drains towards an existing 450mm diameter pipe. This is intended to serve as a future connection for the proposed redevelopment and is the minor outlet for stormwater flows leaving the site. Existing local catchments downstream of the site (roof and half road areas east of Herbert Street) have been excluded from the model. This assumption does not impact

on the assessment criteria as existing and proposed conditions are to remain unchanged.

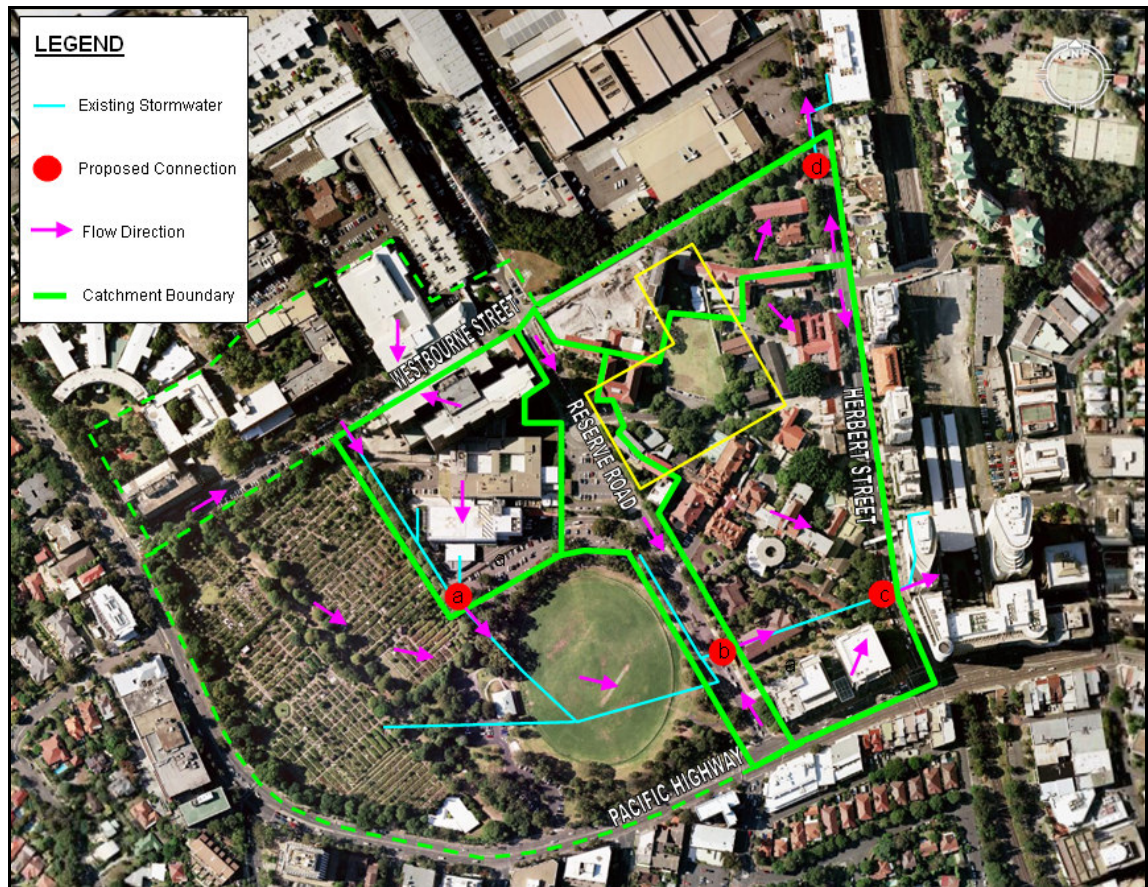


Figure 2 – Site Analysis Areas for Existing Conditions

4.2 Stormwater Modelling

DRAINS software was used to develop a rainfall runoff model for the site and neighbouring catchments which impact on the development. The model has been used to facilitate the modelling of existing detention storages and pit and pipe system capacity and includes the following:

- Design rainfall IFD data provided by Willoughby City Council
- Paved area depression storage = 1mm
- Supplementary area depression storage = 1mm
- Pervious area depression storage = 5mm
- Soil Type = 3
- Antecedent Moisture Content (AMC) = 3

The catchment areas, including the site, were determined based survey information provided by Hard and Forester (dated 30-05-2007). The percentage impervious area was estimated based on aerial photography and are shown in Civil Drawing SWR01 (see Appendix D).

The catchments have been lumped at four key locations as indicated on Figure 2. Times of concentration have been estimated based on ARR, design charts and site inspection.

The stormwater network is represented in accordance with site survey provide by Hard and Forester (dated 30-05-2007), Geographical Information System (GIS) data provided by WCC (dated 11-07-2007) and site inspections. Where invert levels or pipe diameter could not be obtained from the survey, levels and diameters were assumed based on minimum cover and available upstream and downstream information or site inspections.

4.3 Results

DRAINS modelling data and results are shown in Appendix A. A summary of flows at the four key locations are shown in Appendix C.

5 Proposed Stormwater Drainage System

5.1 Site Catchment and Drainage

The proposed redevelopment does not increase the overall catchment area, however internal roads and building footprints have implications in terms of minor catchment diversions and changes in impervious fractions. The percentage impervious area was estimated based on proposed architectural layout and are shown in Civil Drawing SWR02 (see Appendix D).

Table 1 summarises the change in impervious area as a result of the proposed development.

Table 1 - Catchment Area Comparison

Catchment Condition	Sub Catchment							
	a		b		c		d	
	Area (ha)	Imperv. (%)	Area (ha)	Imperv. (%)	Area (ha)	Imperv. (%)	Area (ha)	Imperv. (%)
Existing	2.06	89	1.51	70	6.11	79	2.38	86
Proposed Development	2.02	88	0.58	70	7.58	81	1.94	79

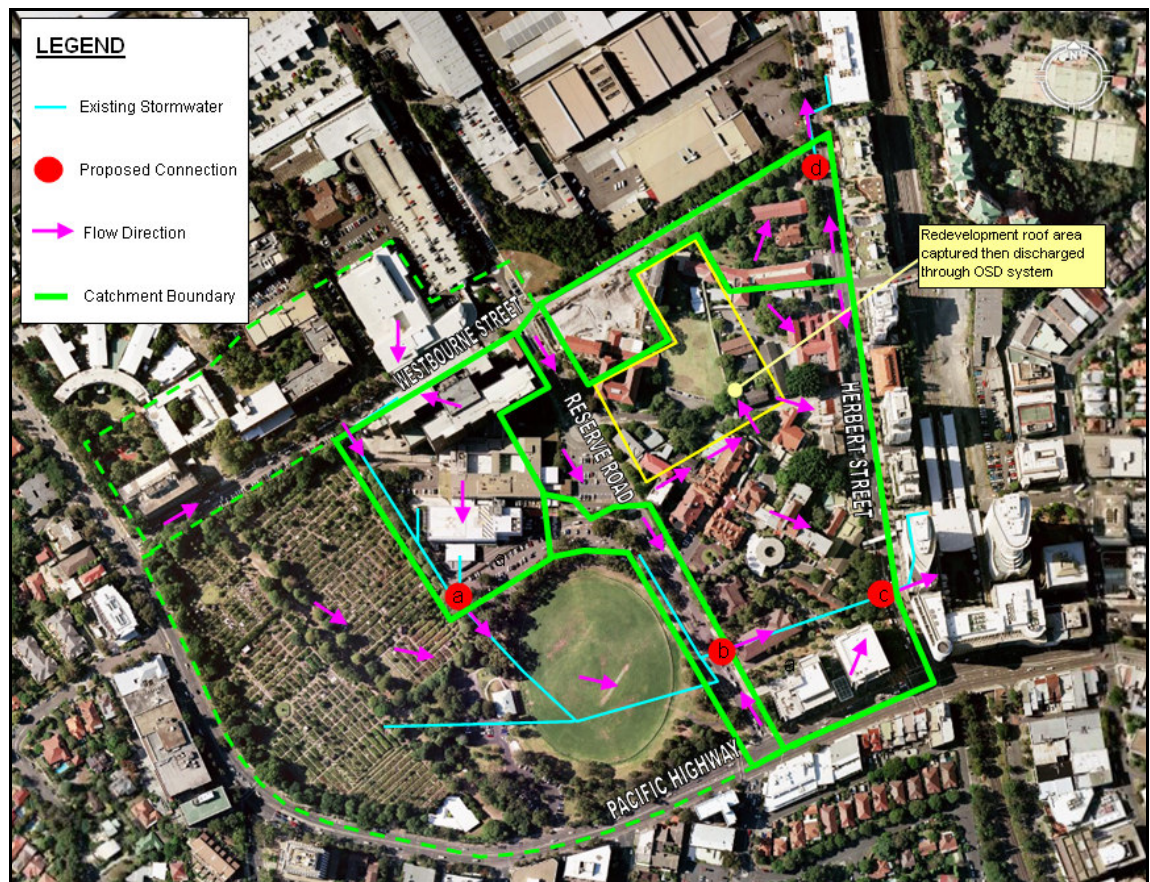


Figure 3 – Site Analysis Areas for Proposed Conditions

5.2 Stormwater Modelling

This proposed catchment has been divided into four sub-catchments (a, b, c and d) as indicated on Figure 3. Each of these sub-catchments has been modelled using DRAINS software to determine the stormwater system performance and flow at key locations where site discharges enter neighbouring trunk drainage systems for comparison with existing conditions.

Preliminary pipe sizing and pit spacing has been modelled in accordance with the WCC Engineering Guidelines D5 – Stormwater Drainage Design for street flow widths and velocity versus depth ratios. Minimum pipe diameters of 375mm have been adopted in road reserves.

The proposed in ground drainage system has been designed for with 20 year ARI capacity with runoff in excess of the 20 year ARI event and up to the 100 year ARI event safely directed via overland flow paths, in accordance with the WCC Engineering Guidelines D5 – Stormwater Drainage Design.

Blockage factors for inlet pits have been adopted in accordance with the WCC Engineering Guidelines – D5, Stormwater Drainage Design-Table D5.2. For on-grade kerb inlet pits a blockage of 20% is applied. For kerb inlet pits in a low point (sag) a blockage of 50% is applied.

On Site Detention (OSD)

OSD is to proposed to be provided on sub-catchment c to meet the DG requirement that the proposed RNSH redevelopment will not increase flooding on neighbouring property. Flows off the other sub-catchment areas a, b, and d (which are reduced in area) do not have increased discharges (compared to existing conditions) and do not require OSD.

The OSD volume and discharge requirements have been determined by modelling the 5 year, 20 year and 100 year ARI storms for all durations ranging from the 5 minute to 3 hours (as specified in Australian Rainfall and Runoff).

5.3 Results

The results from the modelling indicate that the proposed stormwater drainage network achieves the outcomes set out in the WCC Engineering Guidelines D5 – Stormwater Drainage Design and the DG requirements for 20 year ARI capacity pipe network and mitigation of flows for all storm events at outlets and key locations where proposed connects to existing.

Sub-catchment c requires 870m³ of underground OSD storage within the hospital footprint, OSD design parameters are included in Appendix B. DRAINS modelling data and results are also included in Appendix B. A summary of flows at the four key sub-catchment locations are included in

Appendix C, and indicate that discharges into the existing neighbouring catchment areas are no greater than for existing conditions.

5.4 Management and Design Comments

The ultimate development in the subcatchment areas of West (Blue), Precinct 7 (Purple) and Main Entrance (Orange) catchments (refer to SWR02 – Appendix D) is unknown at this stage. For the purpose of this report a conservative assumption has been made with respect to the percentage impervious over each of these subcatchment areas.

It is likely that the usage will change with potential increases in pervious areas as a result.

These assumptions will be reviewed at the next stage of design and if additional information is available.

It will be the responsibility of any future developer of these areas to limit the discharge to no greater than that of the modelled outflows from these areas which potentially may require provision of on-site detention.

The following comments are made with respect to the proposed stormwater systems within the sub-catchment areas a, b, c and d.

- a. Ultimately the flows from the Main Entrance catchment will be diverted to the OSD tank within the proposed hospital. This catchment diversion will ultimately reduce the flows exiting catchment a via the 900mm diameter pipe in Reserve Road. In the interim stages prior to the construction within the demolished lots (which are not part of this contract) there are no proposed increases in catchment areas or fraction impervious, hence, proposed flows will not increase.
- b. There are no proposed adjustments to the external catchments from Gorehill Oval, Cemetery and TAFE. Ultimately there will be a reduction to the existing catchment in Reserve Road due to stormwater network diversions north of the round-a-bout. In the interim stages prior to the construction within the demolished lots (which are not part of this contract) there are no proposed increases in catchment areas or fraction impervious, hence, proposed flows will not increase. It is noted that the DG requires 350m³ of OSD to be provided within the Gore Hill Oval reserve. Based our assessment this additional (off-site) storage is not required to limit the proposed development flows to that of existing conditions. As such detention storage works within this public area are not proposed. Should this DG requirement be considered further, then it would need to be prepared in conjunction with WCC.

- c. Catchment c currently outlets into a 1050mm diameter pipe under Herbert Street. This arrangement is proposed to be improved by directing flows from the proposed street network further downstream into the existing 1800mm diameter pipe with more favourable alignment. The proposed pipe network within Herbert Street has been designed for 20 year ARI capacity which will improve overland flows in Herbert Street (which currently does not have a formal piped drainage system). Due to the increase in fraction impervious and catchment area within catchment c OSD is proposed to mitigate flows to no greater than existing conditions at the down stream outlet.
- d. Catchment d currently outlets into a 450mm diameter pipe at the corner of Herbert and Westbourne Street. Three surcharge pits are proposed in Westbourne Street to approximate existing condition sheet flows within Westbourne Street so as not to concentrate downstream flows in Herbert Street. To achieve surcharge at these three pits it is proposed to constrict flows with 450mm diameter orifice plates prior to connecting into the existing WCC network (these constrictions can be removed should the downstream Council system capacity be upgraded in the future).

5.5 Recommendations

The treatment of stormwater drainage prior to discharge is an integral part of the stormwater management process for the site. Given the site constraints, a best fit approach for WSUD will be adopted.

OnSite Detention will be provided within the building footprint to limit flows to no greater than existing leaving the development in accordance with Councils requirements. Stormwater harvesting will be implemented to minimise adverse environmental impacts caused by increased stormwater runoff by reducing the total volume of runoff being discharged.

The WSUD measures will be further developed at the detailed design stage in accordance with Council guidelines and relevant Authorities.

Appendix A

DRAINS Model Existing Conditions Input Data & Output Data

EXISTING

Input Data

20 year ARI Results

100 year ARI Results

Appendix B

DRAINS Model Proposed Conditions Input Data & Output Data

PROPOSED

Input Data

20 year ARI Results

100 year ARI Results

Appendix C

Comparison of Site Flows

Catchment a
Catchment b
Catchment c
Catchment d

Catchment a

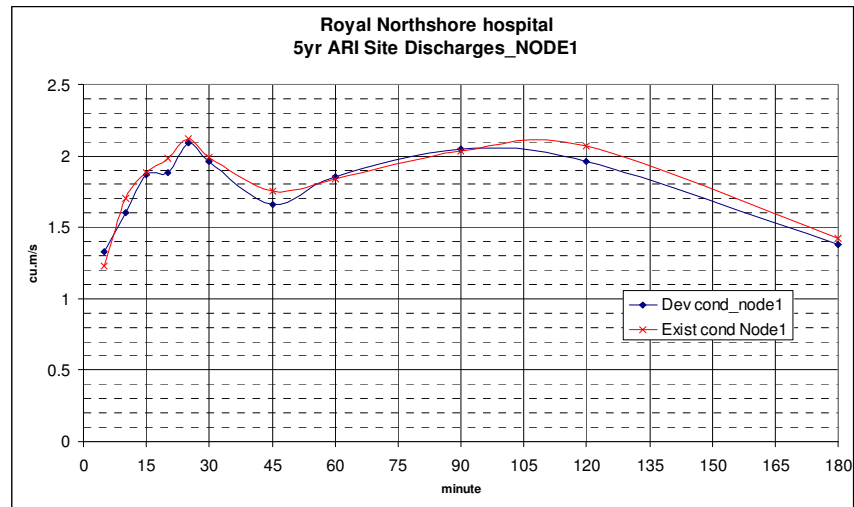


Figure B.1a - Catchment a - 5 year hydrograph

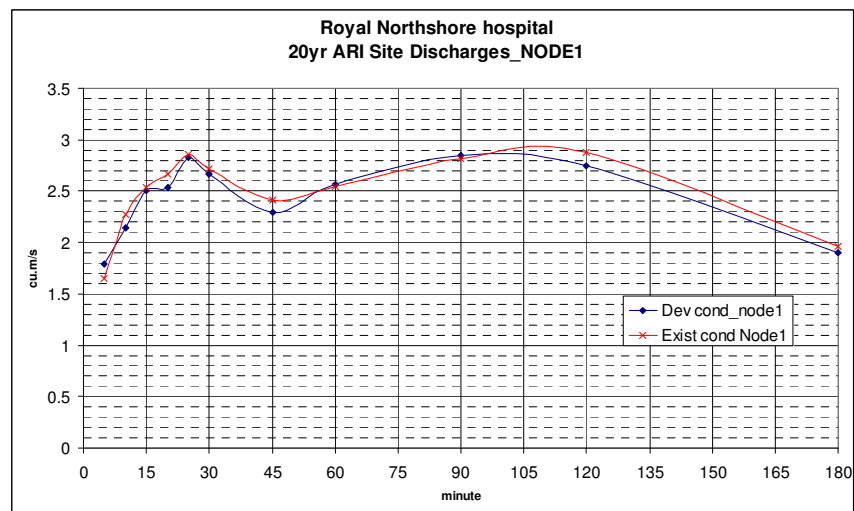


Figure B.2a - Catchment a - 20 year hydrograph

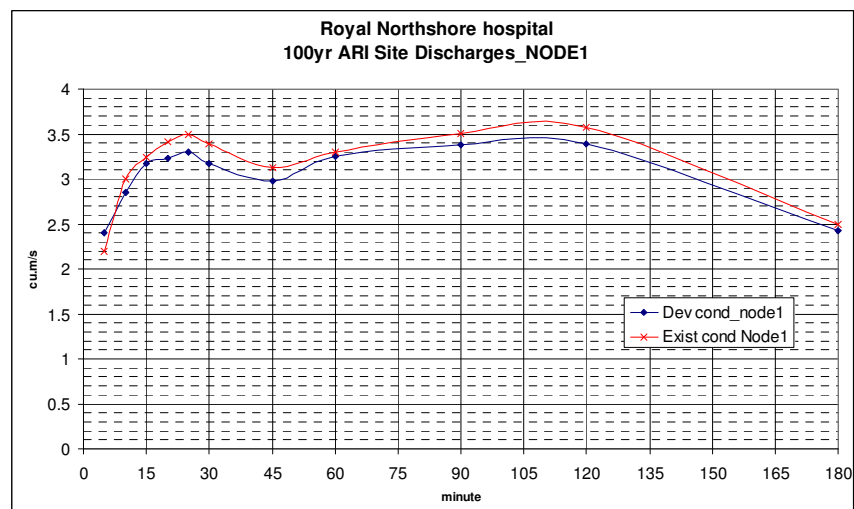


Figure B.3a - Catchment a - 100 year hydrograph

Catchment b

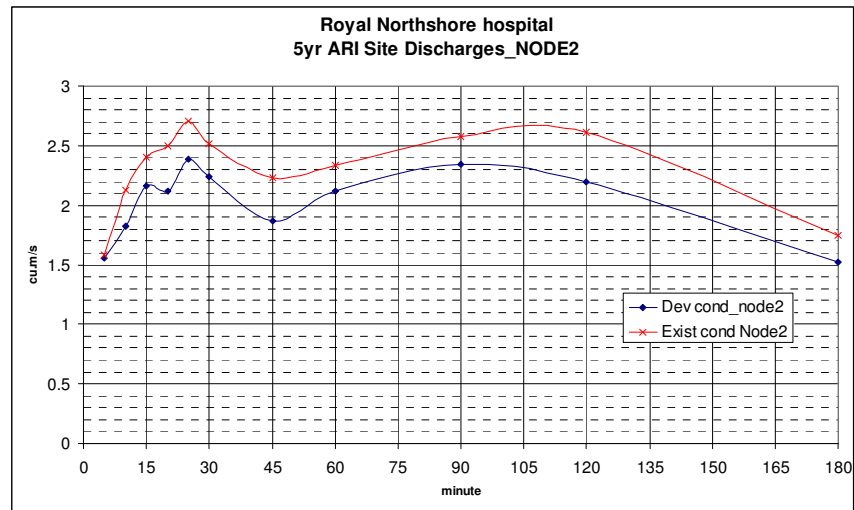


Figure B.1b - Catchment b - 5 year hydrograph

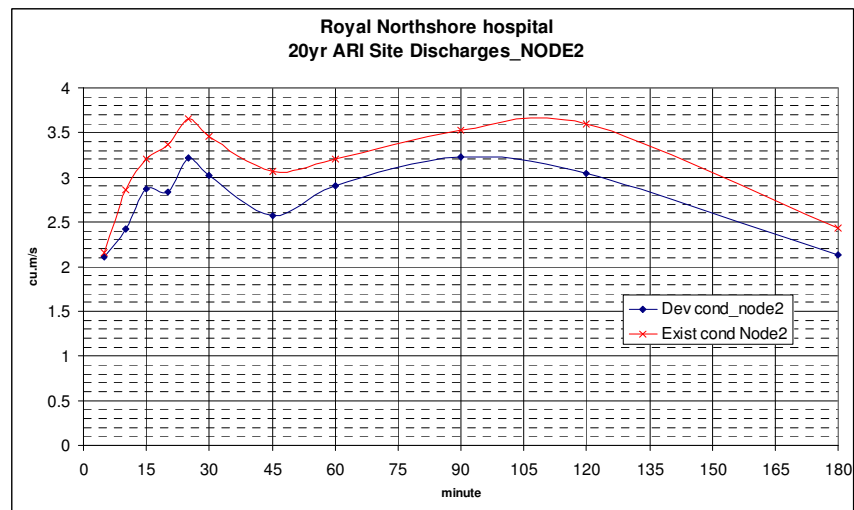


Figure B.2b - Catchment b - 20 year hydrograph

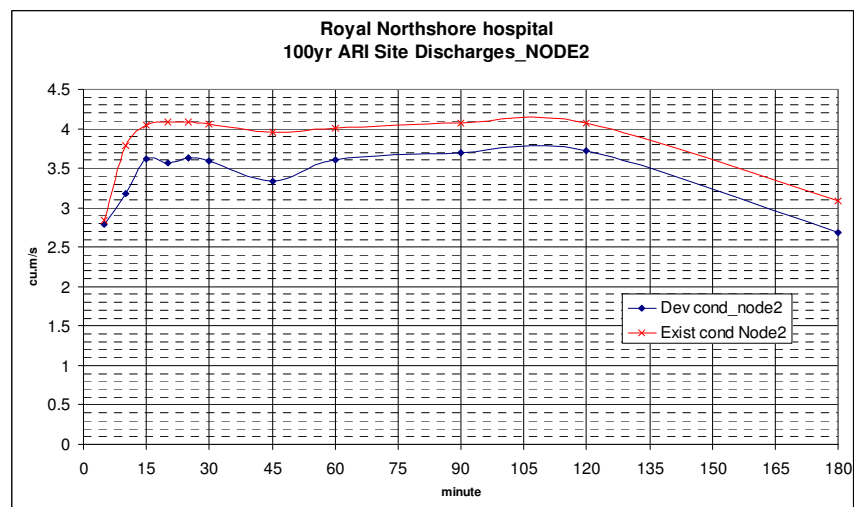


Figure B.3b - Catchment b - 100 year hydrograph

Catchment c

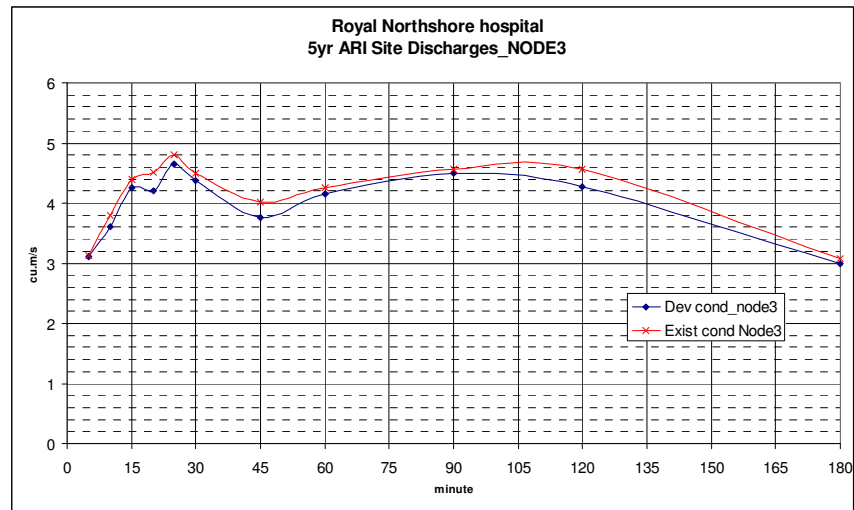


Figure B.1c - Catchment c - 5 year hydrograph

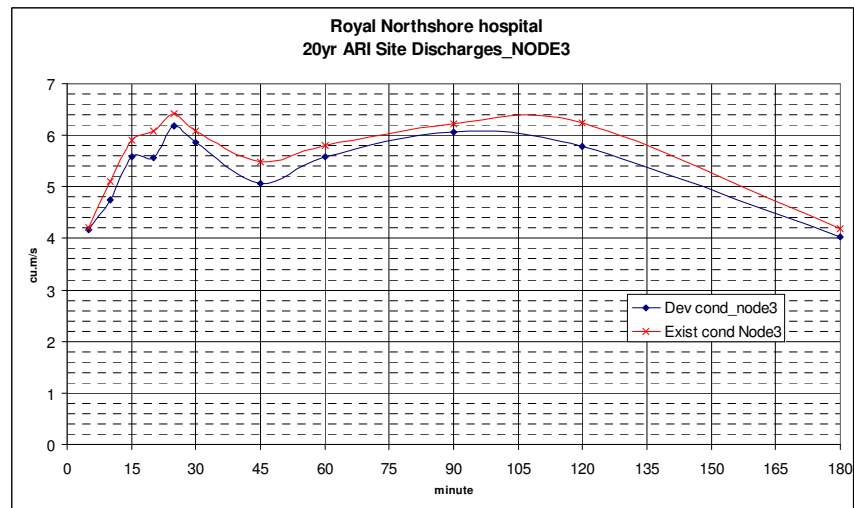


Figure B.2c - Catchment c - 20 year hydrograph

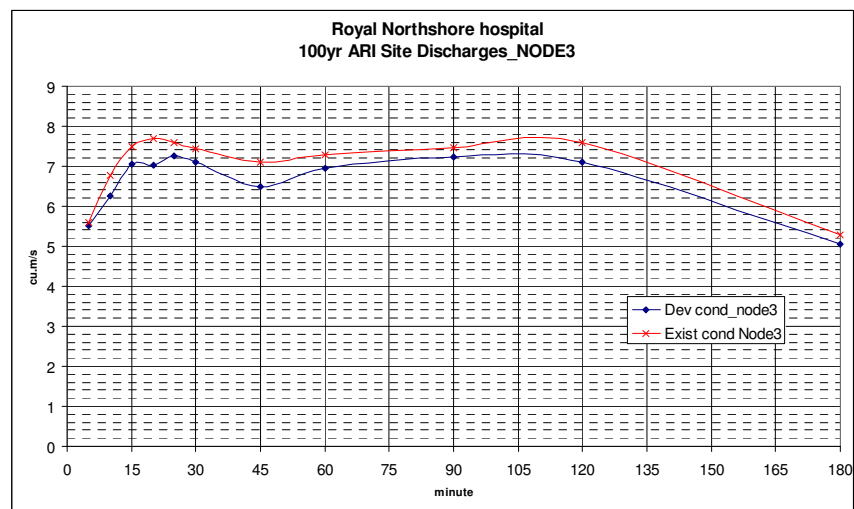


Figure B.3c - Catchment c - 100 year hydrograph

Catchment d

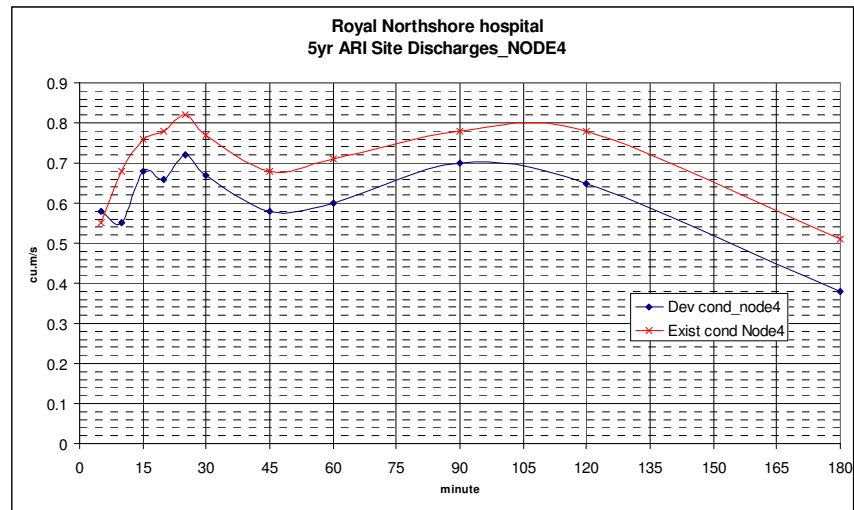


Figure B.1d - Catchment d - 5 year hydrograph

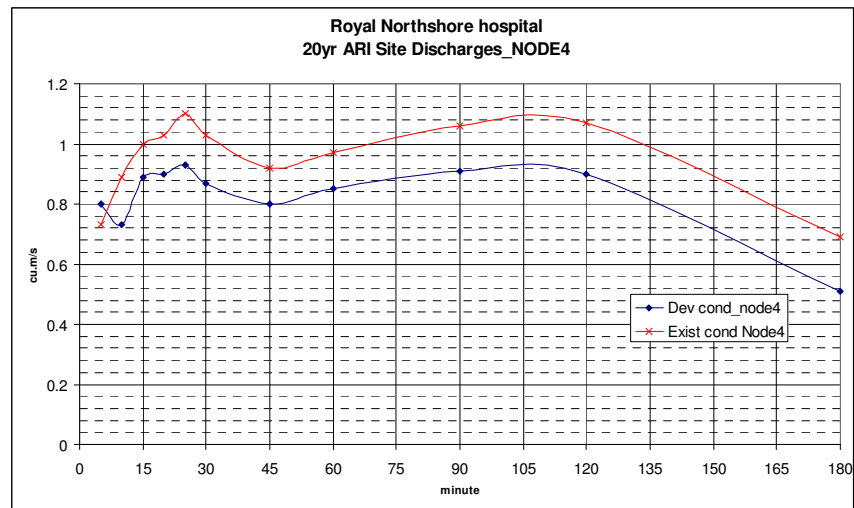


Figure B.2d - Catchment d - 20 year hydrograph

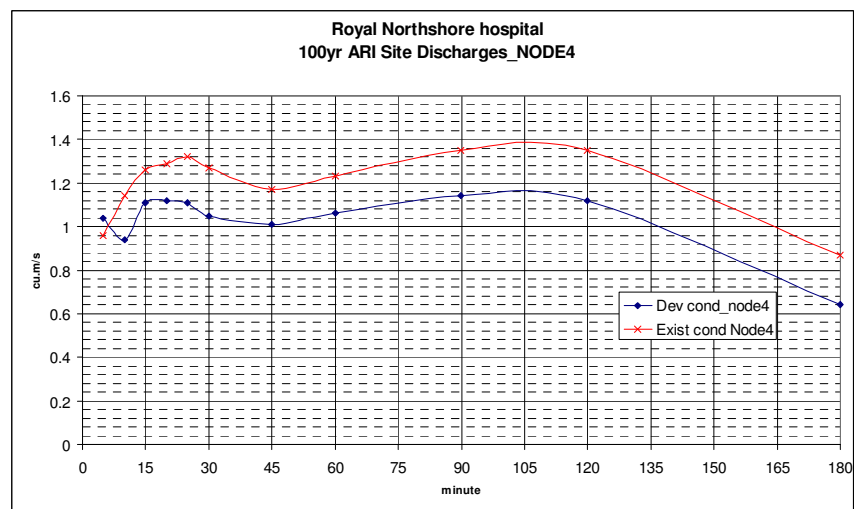


Figure B.3d - Catchment d - 100 year hydrograph

Appendix D

Concept Catchment Gross Assumptions

SWR01 - Existing Stormwater Catchment Plan

SWR02 - Proposed Stormwater Catchment Plan

Appendix E

Project Application (PA) Drawing List

CIVIL PA DRAWING LIST

GENERAL

DWG.IC.C.1500 TITLE SHEET NOTES AND LEGENDS
DWG.IC.C.1501 TYPICAL ROAD CROSS SECTIONS

EROSION AND SEDIMENTATION

DWG.IC.C.1505 EROSION AND SEDIMENT CONTROL PLAN

BULK EARTHWORKS

DWG.IC.C.1510 BULK EARTHWORKS PLAN

SITEWORKS AND STORMWATER DRAINAGE

DWG.IC.C.1515 SITEWORKS PLAN - SHEET 1
DWG.IC.C.1516 SITEWORKS PLAN - SHEET 2
DWG.IC.C.1517 SITEWORKS PLAN - SHEET 3
DWG.IC.C.1520 PROPOSED STORMWATER CATCHMENT PLAN
DWG.IC.C.1525 STORMWATER LONGITUDINAL SECTIONS - SHEET 1
DWG.IC.C.1526 STORMWATER LONGITUDINAL SECTIONS - SHEET 2
DWG.IC.C.1527 STORMWATER LONGITUDINAL SECTIONS - SHEET 3
DWG.IC.C.1528 STORMWATER LONGITUDINAL SECTIONS - SHEET 4
DWG.IC.C.1529 STORMWATER LONGITUDINAL SECTIONS - SHEET 5

ROAD LONGITUDINAL AND CROSS SECTIONS

DWG.IC.C.1535 RESERVE ROAD SOUTH LONGITUDINAL AND CROSS SECTIONS
DWG.IC.C.1536 WESTSIDE ROAD LONGITUDINAL AND CROSS SECTIONS
DWG.IC.C.1537 RESERVE ROAD ENTRANCE LOOP LONGITUDINAL AND CROSS SECTIONS
DWG.IC.C.1538 RESERVE ROAD NORTH & AMBULANCE LONGITUDINAL AND CROSS SECTIONS
DWG.IC.C.1539 WESTBOURNE STREET LONGITUDINAL AND CROSS SECTIONS
DWG.IC.C.1540 RED ROAD LONGITUDINAL AND CROSS SECTIONS
DWG.IC.C.1541 CAR PARK & EILEEN STREET LONGITUDINAL AND CROSS SECTIONS
DWG.IC.C.1542 BLUE ROAD LONGITUDINAL AND CROSS SECTIONS

PAVEMENT

DWG.IC.C.1550 PAVEMENT PLAN