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EGC CUSTODIAN SERVICES PTY LTD

Whiteside Street, North Ryde - Stormwater Management and Flood Assessment

Revised Part 3A Concept Plan Application

301015-02422 – 01-CI-REP-0002

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SYNOPSIS

This report has been produced for EGC Custodian Services Pty Ltd in support of the proposed residential development located at Whiteside Street, North Ryde. This report has been revised to incorporate changes to the concept masterplan and addresses stormwater management and flooding issues raised by the former New South Wales Department of Planning (now the New South Wales Department of Planning and Infrastructure), as part of a Part 3A Concept Plan application.

Any advice given in this report supersedes any advice provided previously.

Disclaimer

PROJECT 301015-02422 - WHITESIDE STREET, NORTH RYDE - STORMWATER MANAGEMENT AND FLOOD ASSESSMENT

REV	DESCRIPTION	ORIG	REVIEW	WORLEY-PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
B	Issued for Client Review	JNH	PT		12-01-11	N/A	
0	Final	JNH	PT	PT	31-01-11		
1	Reference Updates	JNH	PT	PT	08-03-11		
2	Incorporating revised Masterplan	JNH	FC	PT	31-05-11		

CONTENTS

1. EXECUTIVE SUMMARY

This report has been amended to incorporate changes to the masterplan, which has been amended since the submission of the original Stormwater Management and Flood Assessment report in March 2011. Any advice in this report supersedes any advice provided previously.

This report has been prepared for EGC Custodian Services Pty Ltd, who propose to develop an existing site, located on Whiteside Street, located off Epping Road, North Ryde.

Originally, the masterplan proposed four multi-storey residential apartments to provide a total of 256 apartments and 380 basement car parks. Based on the proposed landscaping plan of the original masterplan, it was believed that the impervious percentage of the site would have been approximately 65-70%.

The amended masterplan consists of demolition of all existing buildings and the construction of two multi-storey residential apartment buildings (3 and 8 floors), two semi-detached dwellings and an underground basement car park with integrated communal open spaces. The development would provide a total of 213 apartments, spread across the four buildings, and approximately 311 basement car parking spaces.

The amended masterplan is believed to have an impervious percentage of approximately 70-75%. While there are fewer apartment and car park numbers, it has been noted that the footprint of the buildings under the revised masterplan is much larger, contributing to a larger impervious area. The arrangement of the buildings has also been modified, allowing for stormwater management of a larger area of the site.

A layout of the proposed masterplan is illustrated in **Appendix 1**.

The existing site consists of three (3) residential lots with a free standing dwelling on each of the two smaller lots, and cottages and sheds on the larger lot. Two of the residential lots are used for residential purposes, while the third semi rural lot is used for training horses. The site covers an area of approximately 1.4 ha.

The site is located within City of Ryde's Local Government Area (LGA) and is surrounded by low density housing towards the south, east and west and industrial/commercial space to the north.

The site is predominately surrounded by low density residential housing from David Avenue to the south east, Parklands Road to the south west and Whiteside Street to the north west. The site is also bound by Epping Road to the north east which is buffered by a vacant portion of land that belongs to the Roads and Traffic Authority (RTA). The site currently can be accessed either through Whiteside Street or Epping Road.

A Sydney Water Corporation (SWC) easement has been identified across a low point of the site to the west. The easement has been provided to convey two 1200 mm ductile steel water mains which service the Pymble/Killara catchment. The water mains run parallel with Whiteside Street,

approximately 15 m from the Whiteside Street road reserve. A plan illustrating the locations of the SWC water mains are shown in **Appendix 1**.

The proposed development has been identified by the Director General of the former New South Wales Department of Planning (now the Department of Planning and Infrastructure - DoPI) as a significant project. The Director General's Requirements (DGR) were issued by the former DoP on 1st December 2010. The issues to be addressed in this report for Concept Approval are as follows:

*"**12. Drainage, Stormwater Management and Flooding Potential***

- *The EA shall address drainage/groundwater/flooding issues associated with the development and indicate how integrated Water Management, Water Sensitive Urban Design (WSUD) measures and Council's requirements can be implemented."*

The DGRs will be addressed by adopting standard best practice for managing stormwater quantity, quality and flooding. The City of Ryde Development Control Plan 2010 has been referenced during the assessment as a guideline.

This report will explore, in concept, how stormwater and flooding issues are to be addressed on-site to mitigate impacts to the local and downstream environments.

The site is not believed to be affected by flooding. There are no defined overland flow paths across or through the site, and the site is also located some distance and elevation away from any major water ways. Additional details are discussed further in **Section 5**. Adequate drainage and appropriately designed overland flow paths would be constructed across the development to ensure stormwater flows are conveyed safely from the site into Council's existing stormwater infrastructure network.

As noted earlier, a SWC easement has been identified across a low section of the site. In order for the development to connect into Council's stormwater infrastructure, a design solution has been prepared to cross over the major water mains with shallow high class concrete pipes. A detail for the stormwater outlet crossing is shown in **Appendix 4**, and has been generally designed to Sydney Water's specifications.

While no formal application have been submitted to SWC, informal discussion with Sydney Water's operations officers have indicated that Sydney Water would in general support the proposed stormwater crossing, provided that the crossing details are designed appropriately to SWC requirements. A formal application would be submitted to SWC at a later stage of the development.

Stormwater runoff generated across the site would be controlled and reduced with the implementation of on-site detention (OSD). An OSD tank, with a designed discharge control outlet, would be used to control peak flows, such that flows generated across the proposed development do not exceed peak flows generated under pre-developed conditions. The discharge controls would be designed to cater for all storm events up to the 100 year average recurrence interval (ARI) storm event. This would ensure no impact to receiving water bodies or impacts to any of Council's existing stormwater infrastructure. The hydrologic modelling undertaken as part of this assessment is discussed in **Section 6**.

Water quality is to be managed on site with the implementation of Water Sensitive Urban Design (WSUD) best practices principles. Adopting these principles, a stormwater treatment train approach has been developed which incorporates the use of rainwater tanks, OSD tanks and bio-retention swales. Details of each of the stormwater treatment facilities are discussed in **Section 8.5.2**. Modelling of the treatment effectiveness of the proposed treatment train and the adopted WSUD principles are discussed in **Section 8**. The water quality modelling discussed in **Section 8** demonstrates that the proposed treatment train is effective at achieving the Department of Environment, Climate Change and Water (DECCW – formerly DECC) pollutant reduction targets for urban stormwater management.

The flooding and stormwater management assessments undertaken as part of the revised concept plan submission to the DoPI generally complies with the DGRs and clearly demonstrate that the proposed development and stormwater management strategies sufficiently mitigate any stormwater/drainage and flooding impacts to downstream properties and receiving environments.

2. INTRODUCTION

WorleyParsons was engaged by EGC Custodian Services Pty Ltd to address stormwater and flooding issues as part of a concept plan application for the proposed development at Whiteside Street, North Ryde.

This report has been revised to incorporate changes to the masterplan which has been revised since our original submission in March 2011.

The application seeks approval for a concept plan which includes demolition of existing dwellings and sheds located within the site, and the construction of two multi-story residential apartment buildings, two semi-detached dwellings and an underground basement car park with integrated communal open space. The proposed development is to provide a total of approximately 213 apartments across the four buildings and approximately 311 basement car parking spaces.

In addition, the apartment buildings have been re-arranged in a matter that allows for runoff from a larger catchment area to be captured, detained and treated.

The original masterplan proposed four multi-storey residential apartment buildings and provided approximately 256 apartments and 380 underground basement car parks.

The Director General of the former NSW Department of Planning provided the issues to be addressed in the application in the Director General's Requirements (refer to **Appendix 2**).

This report discusses the proposed stormwater management and flooding requirements to address all the issues raised in the DGRs.

3. EXISTING SITE CONDITIONS

The proposed developed is located on Whiteside Street, off Epping Road, in North Ryde. The site currently consists of three (3) residential lots, each with a free standing residential dwelling, which includes 5 Whiteside Street and 14 and 16 David Avenue (otherwise known as Lot 6 DP 260000 and Lot 3 and 4 DP 25688 respectively). The site covers an area of approximately 1.4 ha.

The two lots fronting David Avenue are currently occupied by two residential properties while the Whiteside semi-rural lot is currently occupied by residential and commercial properties as well as orchard, grassed area and horse paddocks.

The site is predominately surrounded by low density residential housing on David Avenue to the south east, Parklands Road to the south west and Whiteside Street to the north west. The site is also bound by Epping Road to the north east which is buffered by a vacant portion of land that belongs to the Roads and Traffic Authority (RTA). The site can be accessed either through Whiteside Street or Epping Road. The site is located approximately one (1) km south of Macquarie University Railway Station and one km west of Macquarie Park Railway Station.

A Sydney Water Corporation (SWC) easement has been identified across a low section of the site to the west. The easement has been provided to convey two 1200 mm ductile steel water mains which service the Pymble/Killara catchment. The water mains run parallel with Whiteside Street, approximately 15 m from the Whiteside Street road reserve.

The site is located within a low density suburban region within the City of Ryde Local Government Area (LGA).

The location of the site is illustrated in **Figure 1**.

Figure 1 – Site Location

3.1 Topography

The site is located partially on the crest of a local high point, which slopes to the north west of the site towards the intersection of Epping Road and Whiteside Street. The site slopes uniformly to the north west with a grade of approximately 5% from a high point of RL 66.0 m AHD to a local low point of RL 56.8 m AHD.

The majority of the site drains diffusely to the north west towards the intersection of Epping Road and Whiteside Street. The site catchment contributes to the Macquarie Park catchment, where stormwater is conveyed via Council's stormwater pit and pipe network within Whiteside Street, and ultimately discharged into Lane Cove River to the north.

There are no defined overland flow paths that traverse across the site or immediately surrounding it.

A survey plan of the existing site illustrating the sites topography is shown in **Appendix 3**.

3.2 Land Use

The site is currently zoned as R2 Low Density Residential under the Draft Ryde Local Environmental Plan (2011). The site consists of three residential lots, each with a free standing single dwelling and complies with Council's current zoning description.

Based on visual site inspections and review of areal maps and survey, the site is estimated to be approximately 13% impervious.

3.3 Geotechnical Conditions

A Phase 1 Preliminary Environment Site Assessment has been undertaken by Environmental Investigation Services (EIS) in April 2008. This assessment includes an investigation into the geology, hydrogeology and subsurface conditions of the site.

Based on the information it is apparent that the site lies within an area underlain by Ashfield Shale as per the 1:100,000 geological map of Sydney (Map 9130, 1:100,000 Department of Mineral Resources [now the Department of Primary Industries and Investments] – 1983). According to the Soil Landscapes of Sydney 1:100,000 Sheet (Chapman & Murphy, 1989), the site sits in area of the Glenore Soil Landscape group, which is generally classified as having high erosion hazard, moderate reactivity and localised impermeable high plastic subsoil.

The subsurface conditions of the site generally consist of topsoil comprising of silty clayey sand. The topsoil is underlain by natural silty clay followed by layer of shale, in some areas of the site, followed by weathered sandstone rock bed.

For further details please refer to EIS's Phase 1 Preliminary Environmental Site Assessment report (April 2008).

4. PROPOSED DEVELOPMENT

As mentioned previously, this report has been revised to accommodate changes to the original masterplan which has been amended since submission of WorleyParsons original Stormwater Management and Flood Assessment Report (March 2011).

Originally, the masterplan proposed four multi-storey residential apartments and provided a total of approximately 256 apartments and 380 underground basement car parks. The impervious percentage of the original masterplan was approximately 65-70%.

The revised proposed development would consist of the demolition of all existing structures located within the site to make way for the construction of two multi storey residential apartment buildings, two semi-detached dwellings, linked together via an underground basement car park.

The applicant seeks approval for a concept plan for the proposed development which includes construction of 213 apartments spread across the four buildings and 311 basement car parking spaces. The development would provide communal open space, playgrounds and communal vegetable gardens. The impervious percentage of the revised masterplan is believed to be approximately 70-75%. In addition to these changes, the masterplan has also been arranged to allow a larger catchment area to be captured, detained and treated to further assist with the proposed stormwater management strategy.

While there are fewer apartment and car park numbers under the revised masterplan, it has been noted that the footprints of the buildings under the revised masterplan are much larger, contributing to a larger impervious area.

Three locations for communal pedestrian access would be provided on Epping Road, David Avenue and Whiteside Street, while vehicular access would be provided via an ingress/egress point located along Whiteside Street.

For more details please refer to the architectural plans.

4.1 Legal Requirements and Objectives

The proposed development has been identified by the Director General of the former New South Wales Department of Planning (DoP) as a significant project. The Director General's Requirements (DGR) were issued by the DoP on the 27th of January 2011. The issues to be addressed in this report for Concept Approval are as follows:

*"**12. Drainage, Stormwater Management and Flooding Potential***

- *The EA shall address drainage/groundwater/flooding issues associated with the development and indicate how integrated Water Management, Water Sensitive Urban Design (WSUD) measures and Council's requirements can be implemented."*

Council has published a flood study for the Macquarie Park catchment (Macquarie Park Floodplain Risk Management Study Plan – Feb 2011). Based on the study and the flood maps, it is believed that the site is not affected by flooding (refer to **Section 5**).

To address issues regarding stormwater quantity, standard practices would be adopted that require peak flows generated across the development to match or improve on existing, or preferably pre-development conditions, as discussed in **Section 6**.

For a development of this nature, where stormwater generated across the site will eventually discharge into a major water way (The Lane Cove River), it is important that the proposed development maintains proposed peak runoff rates at existing levels to ensure no significant adverse impacts on existing infrastructure or downstream flood levels.

Water Sensitive Urban Design (WSUD) best practices would be adopted to address pollutant discharge from the proposed development and water quantity. It is proposed to adopt DECCW's pollutant reduction targets for urban stormwater to ensure no net impact, which subsequently is similar to Council's reduction targets. Details of the adopted treatment targets are discussed in **Section 8.2.1**.

This report has also referred to the City of Ryde Development Control Plan (2010) as a guideline to address all issues raised by the Director General.

5. FLOODING

It is noted that the revised masterplan has no impact on the original flood assessment. The site sits on the crest of a local high point where no defined overland flow paths have been identified.

As mentioned earlier, the site drains towards the north west and contributes to the Macquarie Park catchment which discharges into the Lane Cove River. Flooding from the Lane Cove River is unlikely as the river is located approximately 2 kilometres to the north east and 40 m below the lowest point of the site.

The closest water body to the site would be Shrimpton Creek, which is located approximate 250 m to the west of the site. According to the Macquarie Park Floodplain Risk Management Study Plan (Feb 2011), Shrimpton Creek has been known to flood and affect nearby residential homes in the past.

The flood maps shown in the Macquarie Park Floodplain Risk Management Study Plan (Feb 2011) demonstrate that the simulated flood events, up to the 100 year ARI flood event, do not affect or impact the site.

As the site is not affected by flooding the Director General's requirements for flooding on site are considered to have been addressed.

6. HYDROLOGY

A RAFTS rainfall/runoff model was formulated for the hydrological analysis of the revised Whiteside Street development. The impervious area of the revised masterplan has increased from 65-70% to 70-75%. This is largely due to the larger footprint of the proposed apartment buildings and an increased in paved areas across the site.

The change in impervious area is likely to increase peak flows across the site and hence the OSD requirements for the site need to be reassessed to address to ensure the proposed development does not have an adverse affect on peak flows across the site.

A hydrologic model was used to estimate catchment runoff under existing and developed catchment conditions for the 5, 20 and 100 year average recurrence interval (ARI) storm events. Storm durations ranging from 15 minutes to 1080 minutes have been assessed for each of the modelled storms.

A preliminary estimate of on-site detention requirements was undertaken as part of this assessment.

6.1 RAFTS

RAFTs is a program consisting of five discrete modules that simulate the rainfall/runoff routing process, namely:

- A library module
- A hydrograph generation module
- A loss module
- A reservoir routing module
- A river/channel routing module

Intensity Frequency Duration (*IFD*) data for the site was obtained from *Bureau of Meteorology* and is shown in **Table 6-1** below.

Table 6-1 – Adopted IFD values

Storm Event	Duration	Rainfall Intensity
2 year ARI	1 hour storm	37.30 mm/hr
2 year ARI	12 hour storm	8.09 mm/hr
2 year ARI	72 hour storm	2.57 mm/hr
50 year ARI	1 hour storm	72.4 mm/hr
50 year ARI	12 hour storm	17.6 mm/hr
50 year ARI	72 hour storm	5.75 mm/hr

- Location skew (G) 0.00

- Geographical factor (F2) 4.3
- Geographical factor (F50) 15.85

Other input parameters adopted in the formation of the RAFTS model were as follows:

- Manning's 'n' was taken to be 0.02 for impervious areas and 0.03 for pervious areas for existing conditions
- Manning's 'n' was taken to be 0.02 for impervious areas and 0.025 for pervious areas for proposed conditions
- Initial and continuing losses for pervious areas were modelled as 5 mm and 1 mm/hr respectively
- Initial and continuing losses for impervious areas were modelled as 1 mm and 0 mm/hr respectively

Three scenarios, as outlined below, were analysed to ascertain the hydrological impact of the proposed development to the nearby environment.

- Pre-developed conditions
- Proposed developed conditions
- Proposed developed conditions with detention

This analysis ensures the proposed development meets the stormwater quantity requirements discussed in **Section 4.1**.

6.1.1 Pre-developed Conditions

A single catchment has been identified for the site under pre-developed conditions. The catchment falls to the north west of the site towards Epping Road. The extents of the catchments were determined from supplied survey data and defined by the property boundary.

The areas included in each of the existing sub-catchments are shown in **Figure 2** and detailed in **Table 6-2**.

Figure 2 – Catchment Plan of Pre-developed Site

Table 6-2 – Pre-developed Catchment Details

Catchment	Area (ha)	Impervious (%)
Pre-developed Catchment	1.4	10%
Total	1.4	10%

The estimated peak 5, 20 and 100 year ARI outflows from the site are summarised in **Table 6-3**. The results in **Table 6-3** would be used as benchmark or target to ensure peak flows under developed conditions do not exceed pre-developed flows.

The results below are reported to two decimal places for comparative purposes. Furthermore, the results below have only been provided illustrate the peak storm events.

Table 6-3 Estimated Peak Outflows under Pre-developed Conditions

Pre-developed Catchment	Storm event		
	5 year ARI	**20 year ARI**	**100 year ARI**

60 min	0.38 m^3/s	0.53 m^3/s	0.66 m^3/s
90 min	**0.40 m^3/s**	**0.55 m^3/s**	**0.69 m^3/s**
120 min	0.38 m^3/s	0.51 m^3/s	0.64 m^3/s

6.1.2 Proposed Conditions (without Detention)

Two sub-catchments were identified within the site under proposed conditions. The extents of the proposed catchments were determined from the proposed development layout, sections and elevations. These sub-catchments are differentiated into areas which can and cannot be collected via on-site stormwater drainage and detention (Catchment A and B respectively).

The catchment plan of the revised masterplan has allowed for a larger sub-catchment (Catchment A) to be captured by on-site stormwater drainage and detention in comparison to the original masterplan

The proposed catchments are defined in **Figure 3** and the data in **Table 6-4** was used to create a RAFTS model for the site.

Figure 3 – Catchment Plan of the Site under Proposed Conditions

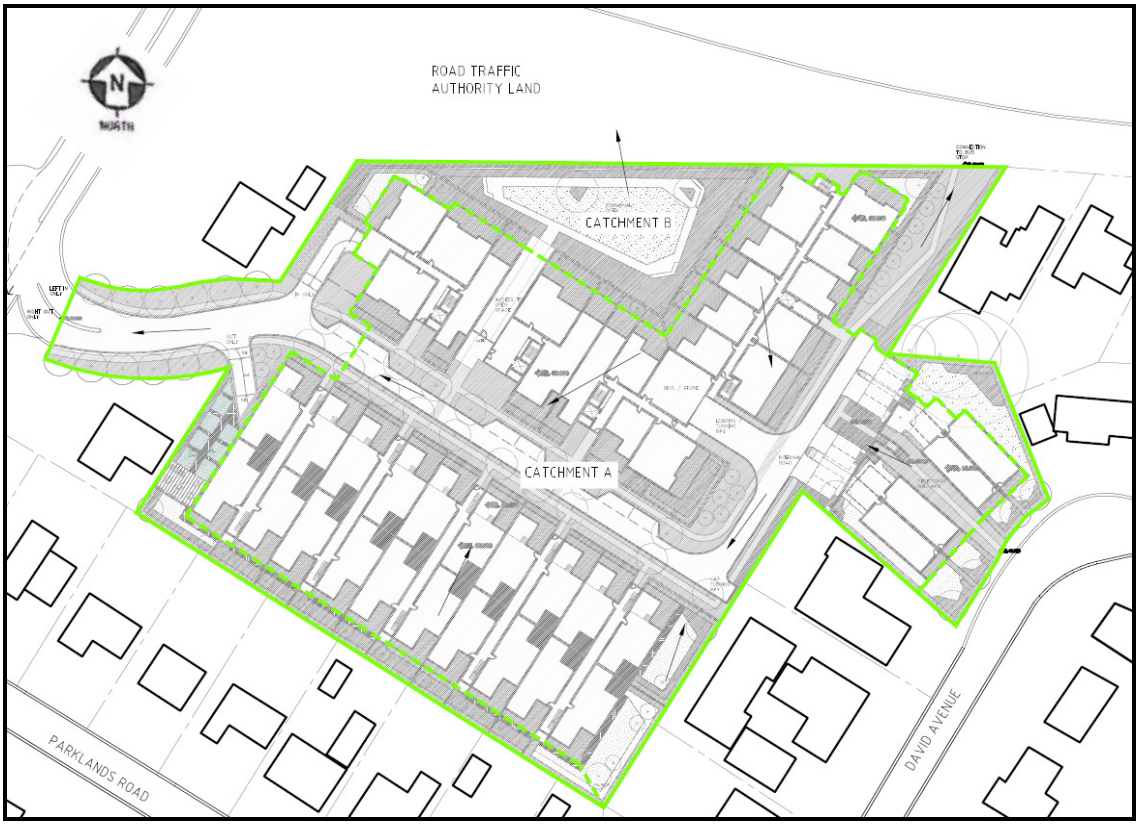


Table 6-4 -Proposed Catchment Details

Catchment	Area (ha)	Impervious (%)
Catchment A	1.08	80%
Catchment B	0.32	39%
Total	1.40	68%

The estimated peak 5, 20 and 100-year ARI outflows from the site are summarised in **Table 6-5**. The results below are reported to two decimal places for comparative purposes. Furthermore, the results below have only been provided to illustrate the peak storm events.

Table 6-5 Estimated Peak Outflows under Proposed Conditions without Detention

Pre-developed Catchment	**Storm event**		
	5 year ARI	**20 year ARI**	**100 year ARI**
60 min	0.45 m^3/s	0.63 m^3/s	0.77 m^3/s
90 min	**0.49 m^3/s**	**0.68 m^3/s**	**0.83 m^3/s**
120 min	0.45 m^3/s	0.63 m^3/s	0.78 m^3/s

The results of the proposed development above have been modelled without the implementation of OSD. The results show a significant increase in peak flows generated within the catchment in comparison to pre-developed conditions. This is a result of changes to the impervious areas within the site.

6.1.3 Proposed Conditions (with On-Site Detention)

A final scenario has been developed to model the proposed development with OSD. The two same sub-catchments that were described in **Section 6.1.2** were adopted for this iteration. Effective detention volumes provided by the bio-retention swales have not been included in this assessment.

To optimise the effectiveness of the OSD tank, considerations needs to be taken to ensure sufficient drainage can be provided while capturing as much stormwater from upstream as possible. As a result, an OSD tank has been proposed within Catchment A, the largest of the two sub catchments.

The estimated peak 5, 20 and 100-year ARI outflows from the site are summarised in **Table 6-6**. The results below are reported to two decimal places for comparative purposes. Furthermore, the results below have only been provided to illustrate the peak storm events.

Table 6-6 Estimated Peak Outflows under Proposed Conditions with Detention

Proposed Conditions	**Storm event**		
	5 year ARI	**20 year ARI**	**100 year ARI**

Proposed Conditions	**Storm event**		
60 min	0.37 m^3/s	0.51 m^3/s	0.65 m^3/s
90 min	**0.39 m^3/s**	**0.54 m^3/s**	**0.69 m^3/s**
120 min	0.38 m^3/s	0.53 m^3/s	0.68 m^3/s

6.2 Results

The results of the hydrologic assessment illustrate that the implementation of OSD within the proposed development is capable of reducing peak flows to pre-development levels. Further detailed analysis is required at the project plan and construction certificate stages to ensure the final design achieves the objectives.

Based on preliminary modelling it is apparent that the water quantity objectives can be achieved with a smaller OSD tank than that originally proposed for the site. Under the revised masterplan a detention tank of 180 kL is required to meet out adopted water quantity objectives.

The smaller OSD is largely due to the revised masterplan and the re-arrangement of the buildings on the site, where runoff from a larger area of the site can be captured and detained, while minimising the total catchment area that discharges directly into Council's stormwater infrastructure without treatment. As a result of the revised masterplan, a more efficient OSD system can be designed to achieve the requirements.

It is noted that the RAFTS modelling has not taken into account the effective detention volumes of the proposed rainwater tanks. It is believed that an analysis into the detention capacities of the rainwater tanks in the hydrologic model would further assist in reducing peak flows from the site.

Further details of the proposed stormwater strategy and the OSD requirement are discussed in **Section 7**.

With improvements in peak flows from the proposed development, compared to those generated under pre-developed conditions, there would be little to no impact on existing surrounding stormwater infrastructure and little to no impact on properties downstream.

7. STORMWATER DRAINAGE STRATEGY

With the revised masterplan, the only component of the drainage strategy which have changed are the sizes of the proposed OSD tank and the bio-retention swales across the site. Otherwise, the stormwater drainage strategy for the site remains generally unchanged.

A Stormwater Management Concept Plan is illustrated in **Appendix 5**.

Under proposed conditions the development would be split into 2 main catchments, Catchment A and B (as discussed in **Section 6.1.3**). A stormwater drainage network and stormwater treatment train is proposed for Catchment A as it is the larger catchment and contributes the bulk of volumetric runoff from the site.

The stormwater treatment train in Catchment A would begin with rain water collected from the roofs of Buildings A and B of the development into rainwater tanks. Collected rainwater will be reused for internal and external non-potable water reuse (ie toilet flushing and irrigation). Overflows from the rainwater tanks as well as runoff from the open space of the site, within Catchment A, would be directed into the closest bio-retention swale.

The captured stormwater would be treated with bio-retention swales through filtration in the swale. Sub-soil drainage will be incorporated in the swales to discharge treated stormwater into Council's stormwater network. Stormwater flows in minor storm events would be allowed to infiltrate through the filter medium and be collected into the drainage network via sub-soil drainage.

During larger storm events, stormwater will be allowed to pond to an extended detention depth of 0.3 m, before flows are collected via a high flow stormwater pit within the swale. The high flow pit will be connected to Councils stormwater network. An overflow weir would be incorporated into the swales with appropriate energy dissipation devices to ensure safe conveyance of stormwater overflow. For more details regarding the bio-retention swales, and changes since the original masterplan, please refer to **Section 8.5.2**.

Stormwater runoff generated from the site and the swales will be collected and piped via an underground stormwater drainage network, as illustrated in the Stormwater Concept Plan. The drainage lines will be designed to convey storms up to the 20 year ARI storm events. Detailed hydraulic modelling will be undertaken at future stages of this development to design the drainage work in more detail.

All stormwater events above the 20 year ARI and up to the 100 year ARI will be conveyed safely via overland flow paths and into Council's stormwater infrastructure. At this stage it is envisaged that the community road that traverse through the middle of the site would act as the overland flow path during a significant storm event.

Piped stormwater flows would be directed into an OSD tank located towards the downslope end of the site. Peak flows would be controlled within the detention tank. Based on preliminary modelling, the OSD tank would require a detention volume of approximately 180 m^3. Peak flows will be controlled via

orifice plates and weir outlets within the tanks. Details of the proposed tanks are discussed in more detail in **Section 7.1**.

Gross pollutants would be controlled via grated inlet pits, a GPT and a trash screen inside the OSD tank.

The captured stormwater, from Catchment A, would discharge into Council's existing stormwater network along Whiteside Street. To Council's existing stormwater network, the stormwater outlet pipe from the site would need to cross the SydneyWater main located towards the west of the site. A pier and pipe solution has been proposed to cross SydneyWaters's infrastructure and is discussed in more detail in **Section 7.2**.

Catchment B is predominately pervious and minor in comparison with Catchment A. Hence no treatment train would be provided for the Catchment B, however stormwater drainage would be provided to allow runoff generated within the catchment to discharge safely towards Epping Road.

Runoff from the Catchment B would diffusely discharge over into the RTA portion of land to the north, similarly under existing conditions.

The proposed Stormwater Management Concept Plan discusses how stormwater and drainage would best be managed on site, complying with standard practice for management urban stormwater. Preliminary modelling has demonstrated that proposed peak flows can be managed with OSD to match existing peak flows and clearly addresses stormwater management issues raised by the Director General.

7.1 On Site Detention

An on site detention (OSD) tank is proposed as part of the stormwater treatment train. The OSD tank would be sized and designed to control peak flow rates discharged from the proposed development to match those generated under pre-developed conditions.

The size of the OSD tank to achieve our stormwater management objectives for the revised masterplan would be approximately 180 kL.

As noted earlier, the smaller OSD is largely due to the revised masterplan and the re-arrangement of the buildings on the site. Under the revised masterplan a larger area of the site can be captured and detained, and hence minimising the total area of runoff that discharges directly into Council's stormwater infrastructure without treatment/detention. As a result of the revised masterplan, a more efficient OSD tank design can be designed to achieve our stormwater requirements.

A discharge control outlet pit would be designed to control peak flows and would include an orifice plate and overflow weir outlet. It is envisaged that the proposed OSD tanks would be located towards the western portion of the site, near the access ramp to the underground car park.

Access to the OSD tanks, for maintenance purposes, would be provided from the surface via access chambers from the top of the OSD tanks. Maintenance for the OSD tank would be required every 6 months (twice a year).

The OSD tanks will have to be set at an invert level that provides sufficient cover and drainage. The minimum invert level of the OSD Tank would remain unchanged at RL 58.5 m AHD. The OSD tank could employ a proprietary product such as the Humes StormTrap.

A sump pit and trash screen would be included in the design of the OSD tank and discharge outlet to prevent blockage of the tank system.

It is understood that the existing lots do not currently have any form of on-site detention facilities.

7.2 Sydney Water Mains

A SWC easement has been identified across a low section of the site to the west. In order for stormwater from the development to connect into Council's stormwater infrastructure, a design solution has been prepared to cross over the major water mains identified within the easement.

A concept design solution for the stormwater outlet crossing is illustrated in **Appendix 4**.

The stormwater crossing illustrated in **Appendix 4** consist of a shallow high class 300mm reinforced concrete pipe crossing over the SWC water mains. The stormwater pipe would be placed on a 150 mm layer of stabilised sand for a stable bed and for added protection for the water mains. The invert levels of the stormwater outlet will be located such that 300 mm of cover can be provided between the pipe and the water main.

The stormwater outlet is located within the verge adjacent to the proposed footpath and would not be exposed to significant loads.

Finished levels above the stormwater outlet would be raised and landscaped to minimise visual impact, limit access to the general public and to ensure the stormwater infrastructure is kept below ground. It is believed that the increase in grounds levels over the stormwater pipe would be no more than 300 mm.

It is believed that this solution adequately provides stormwater drainage to the site, without damaging the water mains or impeding access for maintenance.

At this stage, no formal application has been submitted to SWC regarding the construction of the stormwater outlet over the water mains. An application would be submitted to Sydney Water upon receipt of consent conditions. Informal discussions with Sydney Water's operations officers however have indicated that Sydney Water would, in principle, support the proposed water main crossing provided that:

- Sufficient cover is provided between the stormwater pipe and the water main
- The stormwater pipe crosses the water main in a perpendicular angle
- The stormwater pipe is not laid over any of the joints of the water main
- No significant loading over the water main

8. WATER SENSITIVE URBAN DESIGN

The water sensitive urban design (WSUD) strategy for the Whiteside development has been formulated to negate any significant adverse impacts the proposed development may have on the Lane Cove River (the site contributes to the Lane Cove River catchment, refer to **Section 5**). The Lane Cove River passes through the Lane Cove National Park and ultimately discharges into Sydney Harbour, hence, a WSUD approach has been adopted to minimise any adverse impact on stormwater quality discharge from the site.

The new WSUD strategy for the site remains largely unchanged from the original strategy, with exception of the bio-retention basin, which has changed in area and location across the site. The new WSUD strategy has been revised to accommodate for the redistribution of landuse areas and increase in imperviousness across the site.

The proposed development includes a range of best practice measures to meet the following WSUD objectives:

- Reduction in potable water consumption through the use of water saving devices (ie. dual flush toilets etc)
- Reduction in wastewater production
- Utilisation of available rainwater
- Minimisation of impacts on downstream receiving waters
- Safe conveyance of stormwater
- Integration of water management measures with landscape design into the proposed development

It is proposed to sustainably reduce reliance on mains water through the introduction of rainwater tanks for water reuse.

Further details of the adopted WSUD strategy integrating with the site's stormwater drainage strategy is discussed in detail in **Section 7**. WorleyParsons believes the adopted WSUD measures address the WSUD considerations in the DGR.

8.1 Water Resources

It is understood that potable water needs within the existing dwellings of the site are currently provided by local Sydney Water Corporation (SWC) water mains.

8.2 Water Quality

8.2.1 Water Quality Treatment Targets

The NSW Department of Environment, Climate Change and Water (*DECCW formally DECC*) recommend reduction targets in annual runoff pollutant loads for developments of:

- 85% for total suspended solids (TSS);
- 60% for total phosphorous (TP); and
- 45% for total nitrogen (TN).

This guiding principle is generally adopted for new developments (Greenfield developments) where significant changes to the land use and impervious fraction are proposed. Since the proposed development involves changing the land use from low to medium/high residential, a stormwater treatment train would be developed to ensure no net impact on total pollutant discharge from the site and ensure no adverse affect on local and downstream environments.

These proposed treatment targets are consistent with the requirements in Part: 8.2 of the City of Ryde Development Control Plan 2010 for Stormwater Management.

8.2.2 MUSIC Water Quality Model

MUSIC is a continual-run conceptual water quality assessment model developed by the Cooperative Research Centre for Catchment Hydrology (*CRCCH*). MUSIC can be used to estimate the long-term annual average stormwater volume generated by a catchment as well as the expected pollutant loads. MUSIC is able to conceptually simulate the performance of a group of stormwater treatment measures (*treatment train*) to assess whether a proposed water quality strategy is able to meet specified water quality objectives.

To undertake the water quality assessment component of the Stormwater Management Plan, a long-term MUSIC model was established for the proposed development. The model was used to estimate the annual pollutant load generated under existing state and developed conditions over a period of historical average rainfall.

MUSIC was chosen for this investigation because it has the following attributes:

- It can account for the temporal variation in storm rainfall throughout the year;
- Modelling steps can be as low as 6 minutes to allow accurate modelling of treatment devices;
- It can model a range of treatment devices;
- It can be used to estimate pollutant loads at any location within the catchment; and
- It is based on logical and accepted algorithms.

8.2.3 Input Data

RAINFALL

The nearest rainfall station to the site is located at Macquarie Park (Willandra Village – Station Number 66156), just over 1 kilometres north west of the site. Daily rainfall data only was available for the Macquarie Park station and monthly average rainfalls were obtained from the Bureau of Meteorology for all available years. The mean annual rainfall at Macquarie Park was found to be of the order of 1,150 mm (Data dating back from 1971 to 2011).

In order to develop a model that could comprehensively assess the performance of water quality treatment, the use of pluviograph rainfall data (captured at six minute intervals) was considered necessary. The nearest station to the site with similar elevation for which pluvial data was available was from the Sydney Observatory Hill.

Six-minute pluviograph data was used for the 5 year period of rainfall data from 5/01/1962 to 31/12/1966 from the Sydney Observatory Hill, as per the Draft NSW MUSIC Modelling Guidelines (2010) by BMT WBM for the Sydney Metropolitan Catchment Management Authority. The average rainfall for this period is 1,279 mm/yr. As such, this is the best available dataset to represent a 5 year period at North Ryde.

EVAPORATION

Monthly areal potential evapotranspiration values were obtained for North Ryde from the Bureau of Meteorology data and are shown in **Table 8-1**.

Table 8-1 – Monthly Areal Potential Evapotranspiration

Month	Areal Potential Evapotranspiration (*mm*)
January	180
February	135
March	128
April	88
May	58
June	43
July	43
August	58
September	88
October	127
November	152

Month	Areal Potential Evapotranspiration (*mm*)
December	163
Total	**1,265**

SOIL PROPERTIES

Calibration of the runoff-rainfall parameters within the MUSIC model was completed in accordance with the Draft NSW MUSIC Modelling Guidelines (2010) to achieve an appropriate runoff co-efficient for the site. The MUSIC default and adopted rainfall run-off parameters along with the resulting run-off co-efficient are presented in **Table 8-2**. The Soil Storage Capacity and Field Capacity were changed to achieve a suitable volumetric runoff co-efficient of approximately 0.30 for the site under natural undeveloped conditions. This is in the range of expected values based on available data for gauged catchments.

Table 8-2 – Adopted MUSIC Soil Parameters

	Default Parameters	Adopted Parameters
Impervious Area Properties		
Rainfall Threshold (mm/day)	1	1
Pervious Area Properties		
Soil Storage Capacity (mm)	120	108
Initial Storage (% of capacity)	30	30
Field Capacity (mm)	80	96
Infiltration Capacity Coefficient (a)	200	180
Infiltration Capacity Exponent (b)	1	3
Groundwater Properties		
Initial Depth (mm)	10	10
Daily Recharge Rate (%)	25	25
Daily Baseflow Rate (%)	5	25
Daily Deep Seepage Rate (%)	0	0
Runoff Co-efficient		

	Default Parameters	Adopted Parameters
100% Pervious	0.37	0.35
87% Pervious (as per existing conditions)	0.44	0.43

The adopted MUSIC soil parameters yielded a volumetric runoff coefficient (C_v) of 0.35 for the site under pre-developed conditions. This C_v value is believed to be acceptable considering the grade of the site and the silty clay layer found across the site (refer to geotechnical report).

POLLUTANT CONCENTRATIONS

The stormwater pollutant input parameters that were used in the modelling were derived from the Draft NSW MUSIC Modelling Guidelines (August 2010). The adopted pollutant concentrations are shown **Table 8-3**.

Table 8-3 – Adopted Pollutant Concentrations

Land Use	Pollutant Concentration (mg/L)					
	Wet Weather Concentration (mg/L)			Dry Weather Concentration (mg/L)		
	Suspended Solids	Total Phosphorous	Total Nitrogen	Suspended Solids	Total Phosphorous	Total Nitrogen
Urban	140	0.25	2	16	0.14	1.3
Roofs	20	0.13	2	-	-	-
Roads	270	0.50	2.2	-	-	-
Rural	90	0.22	2	1.4	0.06	0.9

8.3 Existing Conditions

The primary objective is to achieve no adverse impact on pollutant discharge as discussed in **Section 8.2.1**. Therefore, MUSIC modelling of the site will be undertaken for comparative purposes.

8.3.1 Model Inputs

The existing catchment is defined in **Figure 3** and the data in **Table 8-4** was used to create a MUSIC model for the site. The extents of the catchments were determined from supplied survey data.

Table 8-4 – Existing Catchment Data

Site Catchment	Land Use	Area (*ha*)	Impervious (%)
Roof area	Roofs	0.040	100
Open space	Urban	1.000	10
Paddocks	Rural	0.360	10
Total		**1.40**	**13%**

8.3.2 Model Results

The calibrated MUSIC model was used to simulate pollutant export generated during the 5 year rainfall period using the typical pollutant concentrations contained in **Table 8-3**.

For the purposes of comparing the proposed case with the existing case, the estimated annual exports of pollutants generated by the site are shown in **Table 8-5**.

Table 8-5 – Total Annual Pollutant Export Loads from Site – Existing State

Scenario	Pollutant Load (*kg/yr*)			
	Suspended Solids	Total Phosphorous	Total Nitrogen	Gross Pollutants
Existing Site	1,110	1.96	16.1	90.8

Results from the MUSIC modelling show average volumetric flows from the existing site to be 5.46 ML/year, yielding a volumetric runoff coefficient (C_v) of 0.43. The C_v value is a result of the slope of the site and the high percentage of cleared land within the site.

8.4 Proposed (*No Treatment*)

8.4.1 Model Inputs

The existing state model was modified to reflect the proposed conditions. No treatment techniques were implemented in the proposed (*no treatment*) model. The model was modified to reflect the impervious proportions of the catchment as defined in **Table 8-6** and illustrated in **Figure 4**.

The revised masterplan has resulted in a redistribution of roof, roads/car parking and open space areas across the site in comparison to the original masterplan. This amendement has an impact on the corresponding pollutant concentrations associated with these land use areas and the total volumetric pollutant discharge from the proposed site.

Table 8-6 – Proposed Catchment Data

Sub Catchment	Land use	Area (ha)	Impervious (%)

Sub Catchment	Land use	Area (ha)	Impervious (%)
Car park/Roads	Roads	0.14	100
Open Space	Urban	0.63	34
Roof Area	Roof	0.63	100
Total		**1.40**	**70**

8.4.2 Model Results

The estimated annual export of pollutants from the proposed (*no treatment*) site are compared with existing conditions in **Table 8-7**.

Table 8-7 – Annual Pollutant Export Loads – Proposed (No Treatment)

Scenario	Pollutant Load (*kg/yr*)			
	Suspended Solids	Total Phosphorous	Total Nitrogen	Gross Pollutants
Existing Site	1,110	1.96	16.1	90.8
Proposed (no treatment)	1,490	3.27	28.8	304

By comparing the pollutants discharged from the proposed site without treatment measures, it is clear that the proposed development is generating an elevated volume of pollutants. This increase is a result of an increase in impervious area across the development (no treatment) and changes to the redistribution of roof, roads/car parking and open space areas and corresponding pollutant concentrations associated with these land use areas.

Results from the MUSIC modelling show average volumetric runoff under proposed conditions (no treatment) to be 13.1 ML/year, yielding a C_v of 0.74.

8.5 Proposed (*With Treatment*)

8.5.1 Model Inputs

The MUSIC model of the proposed site (with treatment) takes into consideration of the use of the proposed GPT, rainwater tank and bio-retention swales on site. Details of the proposed stormwater treatment train facilities are discussed below.

8.5.2 Stormwater Management Facilities

An illustration of the Stormwater Management Concept Plan can be found in **Appendix 5**.

Details for each of the treatment facilities are discussed below and should be read in conjunction with the stormwater management strategy discussed in **Section 7**.

RAINWATER TANKS

A rainwater tank is proposed as part of the concept stormwater treatment train. A total volume of approximately 150 kL would be incorporated into the stormwater treatment train and would assist in reducing runoff volume, maximising non-potable supply/reuse and minimising peak flows for frequent storm events. The implementation of the rainwater tank has also been incorporated as part of an Ecological Sustainable Development (ESD) assessment by Built Ecology. Based on ESD assessment, it is understood that the amended masterplan would not have a significant effect on the proposed rainwater tanks.

The following assumptions for the rainwater tank reuse and demands are as follows:

- Equivalent tenement for one, two and three bedroom apartments of 1.25, 1.74 and 2.5, respectively (based on Australian Bureau of Statistics, ABS – 1301.0 Year book Australia 2007)
- Use of water saving devices, including dual flush toilets and water saving taps etc
- Daily water consumption for toilets of 27 L/pp/day
- Daily water consumption for car washing of 0.2 L/pp/day
- Daily water consumption for irrigation of 8.3 L/pp/day

Possible locations for the rainwater tank include placing the structure next to Building A, or within the proposed underground basement car park underneath Building A. Overflows from the rainwater tanks would be directed corresponding bio-retention swales.

In order to achieve our water quality treatment targets, it is recommended that all of the apartments be connected to the rainwater tanks.

GROSS POLLUTANT TRAP

A Gross Pollutant Trap (GPT) has been proposed as part of the treatment train. A GPT is a mechanical treatment device which captures litter, coarse sediment, some nutrients, oils and greases. While the pollutant capture efficiency of various traps may vary, the paper “Removal of Suspended Solids and Associated Pollutants by a Gross Pollutant Trap” (Cooperative Research Centre for Catchment Hydrology, 1999) suggests the following efficiencies for a GPT unit, or similar:

- gross pollutants up to 95%
- sediments up to 70%
- total phosphorous up to 30%
- total nitrogen up to 13%

The GPT would be designed to treat flows up to and including the 3 month average recurrence interval (ARI). Maintenance for the GPT would be required every 3 months. The GPT would be located upstream of the OSD tank.

ON SITE DETENTION

One on site detention (OSD) tank has been proposed as part of the stormwater treatment train. The OSD tanks would be sized and designed to control peak flow rates discharged from the proposed development to match those generated under pre-developed conditions.

As discussed previously, the proposed OSD tank would be approximately 180 kL. The OSD tank would have a trash grate and a sump pit to assist with the removal of suspended solids and gross pollutants from the captured stormwater discharge.

For additional details, refer to **Section 7.1**.

BIO-RETENTION SWALES

Bio-retention swales are also proposed as part of the stormwater treatment train. The purpose of bio-retention is to remove pollutants typically found in urban runoff (i.e. TN, TP and TSS) by sedimentation, filtering and biological action. Low flows are maintained as much as possible on the surface (i.e. not piped) which would be exposed to sunlight, with turbulence introducing oxygen to the flows.

The role of the bio-retention systems is not to promote infiltration into the surrounding subsoils but to maintain it below the surface in the drainage media incorporated at the base of the swale.

Bio-retention systems promote the detention and passage of stormwater through a prescribed subsurface filter medium. Runoff is forced to pond on the surface of the bio-retention system, and then percolate through the filter media.

The bio-retention system for the revised masterplan would comprise of four swales which would be located along the north side of the proposed road. The filter medium would be 1.0 m deep and cover a combined surface area of approximately 75 m^2. The bio-retention swales would have an anoxic zone in the filter medium, to a depth of 0.45 m, to additional treatment efficiency.

Small rainfall events will pond and filter through the media, while during larger rainfall events water will initially infiltrate the trenches before also spilling into a collection pit or along a designated overland flowpath.

The bio-retention swales will have a maximum extended detention depth of 300 mm and would be set at a minimum invert level of RL 61.1 m AHD. This is required such that adequate drainage into Council's existing stormwater infrastructure is achievable. The bio-retention swales will cover surface areas of approximately 200 m^2 depending on final landscape levels.

This bio-retention system differs from the arrangement proposed for the original masterplan where stormwater runoff was primarily treated by a large bio-retention basin located within the middle of the site. However, as a result of the revised masterplan, the bio-retention system had to be revised to accommodate for the constraints and the amount open space available across the site.

8.5.3 Model Results

The estimated annual exports of pollutants from the proposed (with treatment) site are compared with the existing and proposed (no treatment) conditions in **Table 8-8**.

Table 8-8 – Annual Pollutant Export Loads – Proposed (With Treatment)

Scenario	Pollutant Load (*kg/yr*)			
	Suspended Solids	Total Phosphorous	Total Nitrogen	Gross Pollutants
Existing Site	1,110	1.96	16.1	90.8
Proposed (no treatment)	1,490	3.27	28.8	304
Proposed (with treatment)	702	1.88	16.1	69.3

By comparing the volumes of pollutants discharged from the proposed site with treatment measures, it is clear that the proposed development, with treatment, can effectively reduces the volume of pollutants discharged from the site.

Results from the MUSIC modelling show average volumetric runoff from the re-developed site (with treatment) of 10.1ML/year, yielding a C_v of 0.57. The modelling demonstrates that the proposed treatment measures have decreased the average volumetric flow from the site.

The volumes of pollutants discharged from the site under developed conditions (with treatment) are lower than those generated under existing conditions. The MUSIC model predicts that the proposed development would ensure no adverse impacts if not show any improvement in water quality runoff.

Further to this, the results from the MUSIC modelling have also demonstrated that the proposed treatment train would be effective in meeting the water quality treatment targets discussed in **Section 8.2.1**. Treatment performances in comparison to the DECCW guidelines are summarised in **Table 8-9**.

Table 8-9 – Reduction performances of the Proposed Treatment Train

Pollutants	Reduction Performance of Treatment Train (%)	DECCW Reduction Targets (%)
Total Suspended Solids	96	80
Total Phosphorus	64	60
Total Nitrogen	58	45

It is noted that the proposed stormwater treatment train has been designed based on preliminary modelling and that further detailed modelling would be need to optimise the efficiency and design of the treatment facilities. These additional investigations would be undertaken at later stages of the development.

9. SERVICES AND SURROUNDING INFRASTRUCTURE

A Dial Before you Dig (DBYD) investigation has been conducted and has identified several major service trunk lines along Epping Road, and minor distribution service trunk lines along David Avenue, Whiteside Street and Parkland Roads.

These include services from Sydney Water Corporation (SWC), Energy Australia, AGL and Telstra.

It is noted that the recent amendments to the masterplan is unlikely to have a significant impact on serviceability for the proposed development.

9.1 Water and Sewer

The two lots fronting David Avenue are currently serviced by 100 mm SWC water mains along David Avenue. While there are 100 mm water mains located along Parklands and Whiteside Street, there appears to be no existing infrastructure within the majority of the Whiteside site.

To sufficiently supply potable water to the proposed development, a 250 mm pipe connection to SWC water mains would be required. Supply may be sourced from the 250 mm water main on the north side of Epping Road. It is possible that the current potable network has the capacity for the proposed development, however a detailed assessment would need to be undertaken at a later stage to assess what upgrades would be required, if needed.

The sewer catchment of North Ryde is serviced by the North Head Sewage Treatment Plant. The site is currently not serviced by any sewer services with the exception of the lots on David Avenue, which are serviced by a sewer gravity line located along Epping Road. There is a 150 mm sewer mains located to the west of the site which could be utilised for discharge, however it is unlikely that the line would have sufficient capacity to service the proposed development. This 150 mm line would likely need to be upgraded to cater and service the proposed development.

9.2 Power

Energy Australia currently services the area of North Ryde. A minor power trunk line is currently located along David Avenue, Parklands Road and Whiteside Street. Plots from Energy Australia show no servicing of the existing site with the exception of the lots fronting David Avenue. As a result, additional infrastructure or upgrades to the existing distribution line may be required to service the proposed development.

Additional loads due to the higher density of the proposed development may require an upgrade or construction of a new substation. Discussions with Energy Australia have identified that power is likely to be available for the proposed development, however may come at a cost to the developer if augmentation is required before Energy Australia's scheduled upgrades.

An investigation at future stages of the development would be required to assess what upgrades, if any, are required.

9.3 Gas

AGL currently provides gas to the area surrounding the site. A 32 mm cast iron gas main has been identified along David Avenue, Parkland Road and Whiteside Street. It is believed that the majority of the site is not serviced for gas with the exception of the lots fronting David Avenue.

An investigation at future stages of the development would be required to assess what upgrades, if any, are required.

9.4 Telecommunications

Telstra currently services the existing area surrounding the site. Major telecommunication trunks lines have been identified along David Avenue, Parkland Road and Whiteside Street. The proposed development could be serviced via these trunk lines that currently service the existing dwellings on Parkland Road and David Avenue.

Fibre Optic cables are also present within the surrounding the development from David Avenue, servicing the private lots on the south east corner of the development.

10. CONSTRUCTION PHASE EROSION AND SEDIMENT CONTROL

In accordance with the best practice state government guideline "Managing Urban Stormwater – Soils and Construction" (*Landcom, 2004*), Erosion and Sediment Control Plans are required for sites of area less than 2,500 m^2 while Soil and Water Management Plans (SWMPs) are required for sites greater than 2,500m^2. The proposed development covers a total area of over 14,000 m^2, therefore a Soil and Water Management Plan would be required.

A detailed SWMP would be completed to accompany further applications for construction and other works.

The soil and water management plans would provide a control strategy for each sub catchment to ensure appropriate runoff quality. These controls would consist of filter fences, run off diversion mounds, a sediment basin and stabilised site access.

11. CONCLUSION

This report has been produced for EGC Custodian Services Pty Ltd in support of the redevelopment of their site located on Whiteside Street, off Epping Road, in North Ryde. EGC Custodian Services are seeking approval for a concept plan including demolition of existing single dwellings located within the site, and the construction of two multi-storey residential apartment buildings, two semi-detached dwellings with underground basement car parking and integrated communal open space. The proposed development is to provide a total of approximately 213 apartments across the four buildings and approximately 311 basement car parking spaces.

This report has been revised to incorporate changes to the masterplan which have been recently amended since the submission of WorleyParsons original stormwater management report (March 2011). Originally, the masterplan proposed four multi-storey residential apartments and provided a total of 256 apartments and 380 underground basement car parks.

This report addressed the drainage, stormwater and flooding concerns raised by the former Department of Planning in Section 12 of the Director General's Requirements (DGR) (Refer to **Appendix 2**). The DGRs have been addressed by adopting standard practices for management of stormwater quantity, quality and flooding. The City of Ryde Council's Development Control Plans 2010 was also consulted.

The site is located some distance and elevation away from any major water ways. There are no defined overland flow paths across or through the site and is not affected by flooding. Adequate drainage and appropriately designed overland flow paths would be constructed across the development to ensure stormwater flows are conveyed safely from the site into Council's existing stormwater infrastructure network.

Stormwater runoff generated across the site would be controlled and reduced with the implementation of on-site detention (OSD). An OSD tank, with a designed discharge control outlet, would be used to control peak flows such that flows generated across the proposed development do not exceed peak flows generated under pre-developed conditions. The discharge controls would be designed to cater for all storm events up to the 100 year average recurrence interval (ARI) storm event. This would result in no significant adverse impact to receiving water bodies or Council's existing stormwater infrastructure.

Water quality is to be managed on site with the implementation of Water Sensitive Urban Design (WSUD) best practice principles. Adopting these principles, a stormwater treatment train has been developed, which incorporates the use of rainwater tanks, GPT's, OSD tanks and bio-retention swales. Modelling of the treatment effectiveness of the proposed treatment train demonstrates that the proposed treatment train is effective at achieving the Department of Environment, Climate Change and Water pollutant reduction targets for urban stormwater management.

As noted earlier, a SWC easement has been identified across a low section of the site. In order for stormwater from the development to connect into Council's stormwater infrastructure, a design

solution has been prepared to cross over the major water mains identified within the easement. While no formal application have been submitted to SWC, informal discussions with Sydney Water's operations officers have indicated that Sydney Water would generally support the proposed stormwater crossing provided the stormwater outlet is designed to SWC specifications.

The flooding and stormwater management assessments undertaken as part of this concept plan submission to the DoP clearly demonstrate that the proposed development and stormwater management strategies sufficiently mitigate any stormwater/drainage and flooding impacts to downstream properties and receiving environments.

Infrastructure and services from Sydney Water Corporation (SWC), Energy Australia, AGL and Telstra have been identified within the area, and currently service the site. Additional loads due to the higher density of the proposed development may require augmentation and adjustments to local water and sewer mains, power lines, as well as gas and telecommunications, to appropriately service the development. A detailed investigation would need to be undertaken at the next stage of the development to appropriate assess what upgrades, if any, are required.

12. REFERENCES

- Australian Bureau of Statistics, 2007, ABS – 1301.0 Year book Australia 2007;
- Bureau of Meteorology, 1937-1952, Daily Rainfall Data from the Sydney Observatory Hill Rainfall Station;
- City of Ryde Council, 2010, City of Ryde Development Control Plan;
- Bewsher, February 2011, Macquarie Park Floodplain Risk Management Study & Plan;
- BMT WBM, August 2010, Draft NSW MUSIC Modelling Guidelines;
- Jeffery and Katauskas Pty Ltd, April 2008, Report to EG Funds Management on Stage 1 Environmental Site Assessment for Proposed Medium Density Residential Development at 166A Epping Road, 14 and 16 David Avenue, North Ryde;
- Landcom, March 2004, Managing Urban Stormwater: Soils and Construction;
- Hard and Forester, 2010, Pot Hole Survey – Whiteside Street North Ryde; and
- Watson Buchan Pty Ltd, 2008, Plan Showing levels and details over Lots 4, 5 & 6 in DP 260000 and Lots 4 & 5 in DP 25688 at No.s 4, 5 & 6 Whiteside Street and No. 14 and 16 David Avenue North Ryde.

APPENDIX 1 – REVISED MASTERPLAN

EPPING ROAD

ROAD TRAFFIC
AUTHORITY LAND

WHITESIDE STREET

PARKLANDS ROAD

DAVID AVENUE

ONE-WAY

LEFT IN ONLY

RIGHT OUT ONLY

IN ONLY

OUT ONLY

ACCESS TO OPEN SPACE

COMMUNAL OPEN SPACE

BINS / STORE

LOADING / TURNING BAY

INTERNAL ROAD

PEDESTRIAN WALKWAY

CONNECTION TO BUS STOP

CAR TURNING BAY

2 X 1200 mm
SYDNEYWATER MAINS

LEGEND

SITE BOUNDARY

NOTE: FOR ADDITIONAL DE
PLEASE REFER TO DRAWI
PROVIDED BY SJB

8 0 8 16

1:400 (A1) 1:800 (A

WorleyParsons
resources & energy

OneWay
to zero harm

ISSUE	DATE	ISSUE DESCRIPTION
A	02-05-11	FINAL ISSUE

NORTH

WHITESIDE STREE
PROPOSE

APPENDIX 2 – DIRECTOR GENERALS REQUIREMENTS

NSW GOVERNMENT | Planning

Contact: Andrew Smith
Phone: 02 9228 6369
Fax: 02 9228 6540
Email: andrew.smith@planning.nsw.gov.au

Our ref: MP 10_0165
File: 10/19087

Mr Ian Cady
Associate Director
Urbis Pty Ltd
Level 21, 321 Kent Street
SYDNEY NSW 2000

Dear Mr Cady,

CONCEPT PLAN FOR A RESIDENTIAL DEVELOPMENT - MP 10_0165
5 WHITESIDE STREET AND 14-16 DAVID AVENUE, NORTH RYDE

Thank you for your request for Director-General's environmental assessment requirements (DGRs) for the above project. The DGRs were prepared from the information provided within your application and in consultation with relevant Government agencies.

Under section 75F(3) of the Act, the Director-General may alter or supplement these requirements if necessary and in light of any additional information that may be provided prior to the Proponent seeking approval for the project.

Prior to exhibiting the Environmental Assessment, the Department will review the document to determine if it adequately addresses the DGRs. If the Director-General considers that the Environmental Assessment does not adequately address the DGRs, the Director-General may require the Proponent to revise the Environmental Assessment to address the matters notified to the Proponent.

Following this review period the Environmental Assessment will be made publicly available for a minimum period of 30 days. Please contact the Department at least two weeks before you propose to submit the Environmental Assessment to determine the fees applicable to the application.

I understand that copies of submissions from other agencies addressing their key issues for the proposal have already been forwarded to you. Please note that these responses have been provided to you for information only and do not form part of the DGRs for the Environmental Assessment, except where specifically referred to in the DGRs.

Should you have any questions regarding any of the above, please contact Andrew Smith on the contact details above.

Yours sincerely

Michael Woodland
Director
Metropolitan Projects
As delegate for the Director-General

27/1/2011

NSW GOVERNMENT | Planning

Director-General's Requirements
Section 75F of the *Environmental Planning and Assessment Act 1979*

Application number	MP 10_0165
Proposal	**Concept Plan** application for a residential development with basement parking.
Location	5 Whiteside Street, 14 David Avenue and 16 David Avenue, North Ryde
Proponent	Urbis on behalf of EGC Custodian Services Pty Ltd
Date issued	27 JANUARY 2011
Expiry date	If the Environmental Assessment (EA) is not exhibited within 2 years after the date of issue, the applicant must consult further with the Director-General in relation to the preparation of the environmental assessment.

Key issues	The Environmental Assessment (EA) must address the following key issues:
	1. Relevant EPI's policies and Guidelines to be Addressed
	Planning provisions applying to the site, including permissibility and the provisions of all plans and policies are contained in **Appendix A**.
	2. Built Form and Urban Design
	• The EA shall address the height, bulk and scale of the proposed development within the context of the locality. In particular, detailed envelope/ height and contextual studies should be undertaken to ensure the proposal integrates with the local environment. The EA shall also provide the following:
	  • Visual and view analysis to and from the site from key vantage points;
	  • Comparable height study to demonstrate how the proposed height relates to the height of the existing/approved developments surrounding the subject site and in the locality; and
	  • Investigation of alternative options for the siting and layout of the building envelopes, massing and articulation, with particular consideration given to the impact upon residential amenity arising from different options.
	• The EA shall address the design quality with specific consideration of the massing, setbacks, building articulation, landscape setting, and public domain, including an assessment against the CPTED Principles.
	• The EA shall address the urban design interface of the site to:
	  • Epping Road, with an appropriate design response to safeguarding the amenity of future residents of the site; and
	  • The surrounding low-density residential dwellings, in particular in terms of fringe impacts and identification of mitigation measures such including façade treatment, setbacks, deep soil planting etc.
	3. Site Amalgamation
	• The proposal should seek to amalgamate with adjacent properties, particularly adjoining properties on Whiteside Street which would be isolated as a result of the development. Details shall be included in the EA outlining any negotiations with the owners of affected properties. If amalgamation is not possible, the EA shall detail possible development options for the adjacent land.
	4. Public Domain
	• The EA must explain the type, function and landscape character of the various private, communal and public areas on site. Pedestrian circulation and linkages should be demonstrated in schematic form.

- The EA is to demonstrate how the design of proposed structures and the treatment of public domain and open spaces will:
  - Maximise safety and security within the site and the public domain.
  - Maximise surveillance and activity within the site and the public domain.
  - Comply with Crime Prevention through Environmental Design principles.
  - Ensure access for people with disabilities.
  - Minimise potential for vehicle and pedestrian conflicts.
- The EA shall consider the interface of the proposed development and public domain and public domain improvements needed to provide a high level of residential and pedestrian amenity.

5. Staging

- The EA must include staging details for the proposal, if applicable, including the provision and timing of all required infrastructure works, and methodology for protecting the amenity of occupants of completed stages whilst subsequent stages are under construction.

6. Transport & Accessibility Impacts

- The EA shall provide a Transport Management and Accessibility Plan (TMAP) prepared with reference to prepared with reference to the *Metropolitan Transport Plan – Connecting the City of Cities*, the *NSW State Plan 2010, NSW Planning Guidelines for Walking and Cycling*, the *Integrating Land Use and Transport* policy package and the RTA's Guide to Traffic Generating Developments, including consideration of:
  - The potential impacts on the local road network and, in particular, the intersections identified in the RTA response dated 9 December 2010. Consideration should also be given to the use of Ryde Council's '*Macquarie Park 2007 Base Paramics Model*', where appropriate;
  - An assessment of the access restrictions detailed in the RTA response dated 15 December 2010 in relation to adjacent road reservations and their impact on the proposed development;
  - An estimate of the trips generated by the proposed development, including an assessment of existing and proposed public transport, pedestrian and cycle movements within the vicinity of the subject site and any measures to address increased demand on existing public transport, walking or cycling infrastructure;
  - Identification of measures to manage travel demand and increase the use of public and non-car transport modes and the potential for improving accessibility to local services and facilities and regional connections; and
  - Appropriate on-site parking provision having regard to Council and RTA guidelines and the availability of public transport (Note: the Department supports reduced car parking in areas well-served by public transport).
- The EA shall include a conceptual sustainable travel plan, with reference to the matters above and other measures such as a car sharing scheme.

7. Environmental and Residential Amenity

- The EA must address solar access, visual and acoustic privacy, and view impacts and demonstrate that the Concept Plan can achieve a high level of environmental and residential amenity – both for the proposed development and the surrounding properties;
- The EA must provide a detailed solar access/ overshadowing assessment for the proposal in relation to nearby residential properties; and,
- The EA must demonstrate how the Concept Plan addresses the requirements of SEPP 65 and the associated Residential Flat Design Code (RFDC).

8. Noise Assessment

- The EA should address noise impacts and detail how these will be managed

	and ameliorated through siting and design of the buildings with reference to Australian Standards and the Department's *Interim Guidelines for Development near Rail Corridors and Busy Roads.* **9. Ecologically Sustainable Development (ESD)** • The EA shall detail how the development will incorporate ESD principles in the design, construction and ongoing operation phases, and demonstrate that the development has been assessed against a suitably accredited rating scheme to meet industry best practice and relevant Council controls. **10. Contributions** • The EA shall detail the provision of public benefits, services and infrastructure having regard to Council's Section 94 Plan and any Planning Agreement. • The EA shall provide a summary of proposed public benefits. **11. Consultation** • Undertake an appropriate and justified level of consultation in accordance with the Department's *Major Project Community Consultation Guidelines October 2007.* **12. Drainage and Stormwater Management** • The EA shall address drainage/ groundwater/ flooding issues associated with the development and indicate how Integrated Water Management, Water Sensitive Urban Design (WSUD) measures and Council's requirements can be implemented. **13. Groundwater Management** • The EA is to identify groundwater issues and address any impacts upon groundwater resources and, when potential impacts are identified, provide an indicative scheme for remediation, reduction or management of impacts. **14. Utilities** • In consultation with relevant agencies, address the existing capacity and requirements of the development for the provision of utilities, including staging of infrastructure works. **15. Statement of Commitments** • The EA must include a draft Statement of Commitments detailing measures for environmental management, impact mitigation and ongoing monitoring.
Deemed refusal period	60 days

Appendix A

Relevant matters, Planning Instruments and Policies to be addressed:

- Objects of the NSW *Environmental Planning & Assessment Act* 1979.
- NSW State Plan 2010;
- Sydney Metropolitan Plan 2010;
- Draft Inner North Subregional Strategy;
- Metropolitan Transport Plan 2010;
- NSW Bike Plan 2010;
- NSW Planning Guidelines for Walking & Cycling;
- Interim Guideline for Development Near Rail Corridors and Busy Roads;
- NSW Office of Water Groundwater Policies (as identified in the submission from the NSW Office of Water dated 16 December 2010);
- NSW Health Healthy Urban Development Checklist 2010;
- Ryde LEP 2010, Ryde DCP 2010, and other relevant Development Control Plans;
- SEPP (Building Sustainability Index: BASIX) 2004;
- SEPP 55 - Remediation of Land;
- SEPP 65 - Design Quality of Residential Flat Development and the Residential Flat Design Code (RFDC);
- SEPP (Infrastructure) 2007; and,
- Nature and extent of any non-compliance with relevant environmental planning instruments, plans and guidelines and justification for any non-compliance.

Appendix B

Plans and Documents to accompany the Application

General	The Environmental Assessment (EA) must include: **1.** An executive summary; **2.** A thorough site analysis including site plans, areal photographs and a description of the existing and surrounding environment; **3.** A thorough description of the proposed development: **4.** An assessment of the key issues specified above and a table outlining how these key issues have been addressed; **5.** An assessment of the potential impacts of the project and a draft Statement of Commitments, outlining environmental management, mitigation and monitoring measures to be implemented to minimise any potential impacts of the project; **6.** The plans and documents outlined below; **7.** A signed statement from the author of the Environmental Assessment certifying that the information contained in the report is neither false nor misleading; **8.** A Quantity Surveyor's Certificate of Cost to verify the capital investment value of the project (in accordance with the definition contained in the Major Projects SEPP and Planning Circular PS10-008); and **9.** A conclusion justifying the project, taking into consideration the environmental impacts of the proposal, the suitability of the site, and whether or not the project is in the public interest.
Plans and Documents	The following plans, architectural drawings, diagrams and relevant documentation shall be submitted; **1.** **An existing site survey plan** drawn at an appropriate scale illustrating; • the location of the land, boundary measurements, area (sq.m) and north point; • the existing levels of the land in relation to buildings and roads; • location and height of existing structures on the site; • location of existing trees; • location and height of adjacent buildings and private open space; and • all levels to be to in Australian Height Datum (AHD). **2.** **A Site Analysis Plan** must be provided which identifies existing natural elements of the site (including all hazards and constraints), existing vegetation, footpath crossing levels and alignments, existing pedestrian and vehicular access points and other facilities, slope and topography, utility services, boundaries, orientation, view corridors and all structures on neighbouring properties where relevant to the application (including windows, driveways, private open space etc). **3.** **A locality/context plan** drawn at an appropriate scale should be submitted indicating: • significant local features such as parks, community facilities and open space and heritage items; • the location and uses of existing buildings, shopping and employment areas; • traffic and road patterns, pedestrian routes and public transport nodes. **4.** **Architectural drawings** at an appropriate scale illustrating: • the location of any existing building envelopes or structures on the land in relation to the boundaries of the land and any development on

	adjoining land; • building envelopes and heights/ levels; • extent of basement parking and deep soil zones; • envelope/ land use staging plans and diagrams; • the height (AHD) of the proposed development in relation to the land; • the level of the lowest floor, the level of any unbuilt area and the level of the ground; • changes to the level of the land by excavation, filling or otherwise; and • indicative section drawings. 5. **Shadow diagrams** showing solar access to the site and adjacent properties at summer solstice (Dec 21), winter solstice (June 21) and the equinox (March 21 and September 21) at 9.00 am, 12.00 midday and 3.00 pm, with shadow diagrams at more regular intervals and/or in elevation where required to detail specific impacts. 6. **Visual and View Analysis -** Visual aids such as a photomontage and 3D models must be used to demonstrate visual impacts of the proposed building envelopes in particular having regard to the siting, bulk and scale relationships from key areas; 7. **Public Domain/Landscape Concept Plan** - illustrating accessibility to, location, area and treatment of private and public open space areas on the site, screen planting along common boundaries and tree protection measures both on and off the site, and an arborists assessment of any trees to be removed and retained. 8. An appropriate level of **Contamination Assessment**; 9. **Stormwater Concept Plan** – illustrating the concept for stormwater management in accordance with Council's policy; 10. **Geotechnical/ Groundwater Assessment** – identifying any groundwater issues and potential degradation to groundwater that may be encountered during excavation and/or piling. The assessment should identify contingency measures to manage any potential impacts.
Documents to be submitted	• 1 copy of the EA, plans and documentation for the **Test of Adequacy**; • **Once the EA has been determined adequate** and all outstanding issues adequately addressed, 6 copies of the EA for exhibition; • 8 sets of architectural and landscape plans to scale, including two (2) sets at A1 size (to scale); and • 12 copies of the Environmental Assessment and plans on CD-ROM (PDF format), each file not exceeding 5Mb in size. **NOTE: All files must be titled and saved in such a way that it is clearly recognisable without the file being opened. If multiple PDF's make up one document/report each must be titled in sequential order.**

APPENDIX 3 – SITE SURVEY/TOPOGRAPHY

(A) RESTRICTION AS TO USER 3.0 WIDE & EASEMENT FOR BATTER 3.0 WIDE
(B) EASEMENT FOR ELECTRICTY TRANSMISSION VIDE F 71687 3.66 WIDE
(C) EASMENT FOR WATER MAIN PIPES VIDE B 979441 6.095 WIDE
(D) EASEMENTS FOR WATER SUPPLY WORKS VIDE G 403543 6.095 WIDE

NOTES

1. COPYRIGHT OF THIS DRAWING AND/OR DESIGN IS THE PROPERTY OF WATSON BUCHAN PTY LTD, AND SHOULD NOT BE REPRODUCED IN PART OR WHOLE WITHOUT WRITTEN PERMISSION OF THE COMPANY.

2. RELATIONSHIP OF IMPROVEMENTS TO BOUNDARIES IS DIAGRAMMATIC ONLY. DO NOT SCALE OFF THIS PLAN WHERE OFFSETS ARE CRITICAL. THEY SHOULD BE CONFIRMED BY A FURTHER SURVEY.
Contours shown depict the topography at 0.5m intervals, except at spot levels shown they do not represent the exact level at any particular point.

3. SERVICES SHOWN HEREON HAVE BEEN DETERMINED FROM VISUAL EVIDENCE ONLY. PRIOR TO ANY DEMOLITION, EXCAVATION OR CONSTRUCTION ON THE SITE, THE RELEVANT AUTHORITY SHOULD BE CONTACTED TO ESTABLISH DETAILED LOCATION AND DEPTH.

4. THE BEARINGS ON THESE PLAN BOUNDARIES, ARE FROM PLANS OF THE DEPARTMENT OF LANDS. THEY ARE ON MAGNETIC MEDIAN. IF ACCURATE TRUE NORTH IS REQUIRED, A FURTHER SURVEY WOULD BE NECESSARY.

TK DNOTES TOP KERB
SP DENOTES SIGNPOST
USE DENOTES UNDERSIDE EAVE
USG DENOTES UNDERSIDE GUTTER

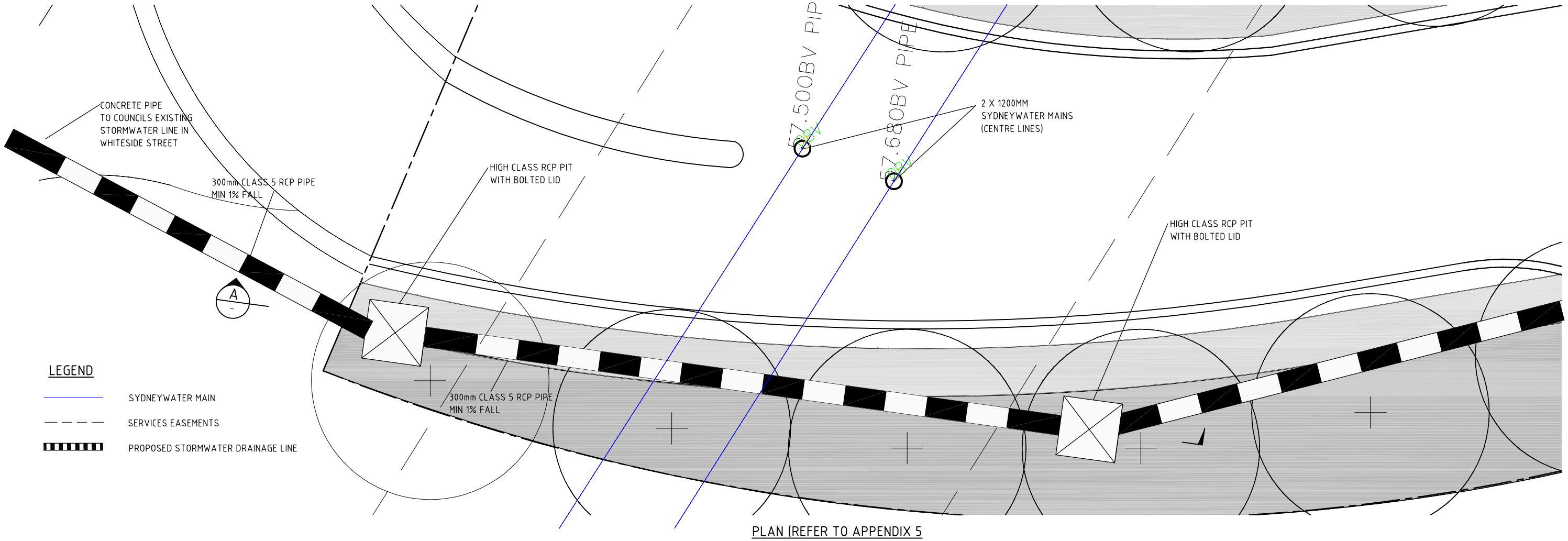
PLAN SHOWING LEVELS AND DETAILS OVER LOTS 4, 5 & 6 IN DP 260000 AND LOTS 4 & 5 IN DP 25688 AT No.s 4, 5 & 6 WHITESIDE STREET AND No. 14 & 16 DAVID AVENUE NORTH RYDE FOR E G PROPERTY GROUP

DWN: A.M | CHD: J.W. | DATE: 14/2/2008

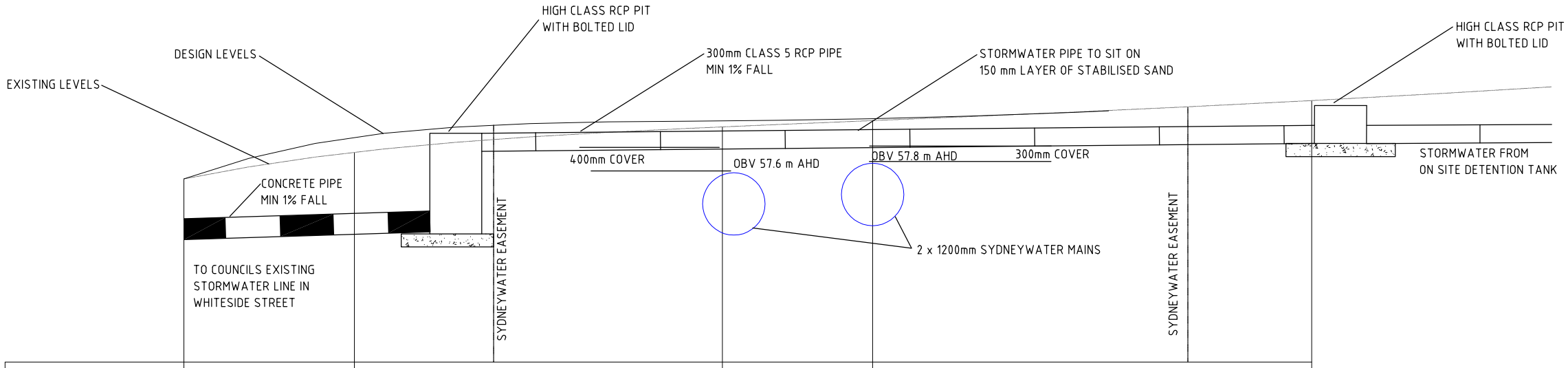
DATE: 14/2/2008
SCALE: 1:400
DATUM: AUST HEIGHT DATUM
ORIGIN: SSM 108457 RL 63.524 (AHD)
SOURCE: S.C.I.M.S.
OUR REF: 08 / 0015

CONSULTING SURVEYORS
WATSON BUCHAN PTY.LTD.
P.O. BOX 176 CARINGBAH
PHONE: 9524 4073
FAX: 9540 1387
EMAIL : surveyor@watsonbuchan.com.au

APPENDIX 4 – STORMWATER OUTLET CROSSING DETAIL



PLAN (REFER TO APPENDIX 5



DESIGN LEVELS		58.29		58.62	58.65	59.00
STORMWATER INVERT				57.90	58.10	58.15
EXISTING LEVELS	57.59	58.00		58.50	58.62	59.00

LONG SECTION A - A

1 0 1 2 3 4 5
SCALE OF METRES 1:50

WorleyParsons
resources & energy

OneWay™ to zero harm

ISSUE	DATE	ISSUE DESCRIPTION
E	1/06/2011	INCORPORATING CHANGES TO MASTERPLAN
D	08/03/11	REVISED REPORT
C	27/01/11	REVISED DESIGN
B	20/01/11	FINAL ISSUE
A	14/01/11	DRAFT

N
NORTH

WHITESIDE STREET, NORTH RYDE
SYDNEYWATER MAIN CROSSING DETAIL

APPENDIX 4

PLOT DATE & TIME: 2/6/2011 11:26:58 AM
SAVE DATE & TIME: 1/6/2011 7:05:56 PM
USER NAME: james.hoang
CTB FILE: __00-WP-Syd-std.ctb
LOCATION: W:_INFRASTRUCTURE\PROJECTS\301015\02422 - WHITESIDE STREET\110 DRAWINGS\SKETCHES\APPENDIX 1 - CONCEPT MASTERPLAN.DWG
Plotter:\\ausyd4vppri01v\L105YDRI(OH3500RPCS

APPENDIX 5 – STORMWATER MANAGEMENT CONCEPT PLAN

GROSS POLLUTANT TRAP

ON SITE DETENTION TANK
DETENTION VOLUME – 180 kL

BREAK INTO AND CONNECT TO COUNCILS EXISTING STORMWATER INFRASTRUCTURE

WHITESIDE STREET

CONNECTION TO BUS STOP

COMMUNAL OPEN SPACE

ACCESS TO OPEN SPACE

ROOF AREA COLLECTED IN RAINWATER TANKS

LEFT IN ONLY

RIGHT OUT ONLY

IN ONLY

OUT ONLY

BINS / STORE

LOADING / TURNING BAY

INTERNAL ROAD

PEDESTRIAN WALKWAY

BRIDGING DETAIL
REFER TO APPENDX 4

COMMERCIAL GARDEN

2 X 1200 mm
SYDNEYWATER MAINS

ROOF AREA COLLECTED IN RAINWATER TANKS

CAR TURNING BAY

BIO RETENTION SWALES
TOTAL FILTER AREA – 75 M2
TOTAL SURFACE AREA – 150 M2
FILTER DEPTH – 1.00 M
ANOXIC ZONE DEPTH – 0.45 M
EXTENDED DETENTION DEPTH – 0.30 M

PARKLANDS ROAD

DAVID AVENUE

LEGEND

- SITE BOUNDARY
- OSD TANK
- BIO-RETENTION SWALES
- ROOF AREA TO RAINWATER TANKS
- STORMWATER DRAINAGE

NOTE: FOR ADDITIONAL DETAIL, PLEASE REFER TO DRAWINGS PROVIDED BY SJB

8 0 8 16 24 32 40m
1:400 (A1) 1:800 (A3)

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ISSUE	DATE	ISSUE DESCRIPTION
B	26-05-11	REVISED STRATEGY FOR AMENDED MASTERPLAN
A	02-05-11	FINAL ISSUE

NORTH

WHITESIDE STREET, NORTH RYDE
STORMWATER MANAGEMENT CONCEPT PLAN

APPENDIX 5

LOCATION W:_INFRASTRUCTURE\PROJECTS\301015\024-22 - WHITESIDE STREET\11 0 DRAWINGS\SKETCHES\APPENDIX 1 - CONCEPT MASTERPLAN.DWG
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PLOT DATE & TIME: 2/6/2011 2:44:23 PM
SAVE DATE & TIME: 1/6/2011 7:05:56 PM