Infrastructure Management Plan

Cranbrook Senior School Redevelopment

5 Victoria Road, Bellevue Hill NSW 2023

REPORT

PREPARED FOR
Cranbrook School
5 Victoria Road
Bellevue Hill NSW 2023

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INFRASTRUCTURE MANAGEMENT PLAN

Activity Schedule

Date	Revision	Issue	Prepared By	Approved By
28.02.2018	1	Draft Issue	M. Peatman	T. Sailing
05.03.2018	2	SSDA Issue	T. Sailing	Y. Maharaj

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EXECUTIVE SUMMARY

This Infrastructure Management Plan (IMP) report for Electrical, Telecommunications, Stormwater and Hydraulic services has been prepared by Northrop Consulting Engineers Pty Ltd (Northrop)[1] on behalf of Buildcorp Construction Pty Ltd (Buildcorp) for the Cranbrook School Senior School Redevelopment project (the Project).

This IMP outlines the existing infrastructure, detailing information on the existing capacity and any augmentation to the aforementioned services required for the proposed development. The report also details records of consultation with relevant agencies. The details within this report are preliminary and based on currently available information and correspondence undertaken at the time of writing.

This report is provided in response to the Secretary's Environmental Assessment Requirements (SEARs) issued for the project and has been prepared for lodgement to the State Significant Development (SSD) application for Cranbrook School Senior School Redevelopment. This IMP addresses the Infrastructure Management Plan requirements held within Item 14 of the SEARs.

[1] The Consulting Engineer responsible for Electrical and Telecommunications services is Northrop. The Consulting Engineer responsible for Stormwater services is AECOM. The Consulting Engineer responsible for Sewer, Water and Gas services is Warren Smith + Partners. Northrop has compiled third party information into this singular report and shall not be held responsible for the correctness or accuracy of third party information prepared by others.

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1. DEVELOPMENT DESCRIPTION

Client: **Cranbrook School**

Client Acronym: **CS**

State Significant Development Number: **SSD 8812**

Project Name: **Senior School Redevelopment**

Project Address: **5 Victoria Road, Bellevue Hill NSW 2023**

The Cranbrook School Senior School Redevelopment project proposes a significant expansion of the current facilities on site (Refer to Site Concept in Figure 1). The proposed works are as follows:

1.1.1 Construction of New Buildings & Facilities

- New Integrated learning building – Centenary Building
- New Aquatic Fitness Centre (AFC) beneath the Hordern Oval
- New underground carpark accessible from Rose Bay Avenue for students and staff
- New pickup and drop-off along main driveway ('Heritage Driveway')

1.1.2 Site & Infrastructure Preparation Works

- Tree Removal
- Excavation and Earthworks
- Remediation Works
- Demolition of existing road surfaces, kerbs, footpaths, retaining walls and other related civil works

1.1.3 Landscaping and Outdoor Facilities Improvement

- Construction of new outdoor sporting facilities including a sporting pitch and surrounding seating

1.1.4 Infrastructure

- Augmentation, extension and diversion of physical infrastructure and utilities as required

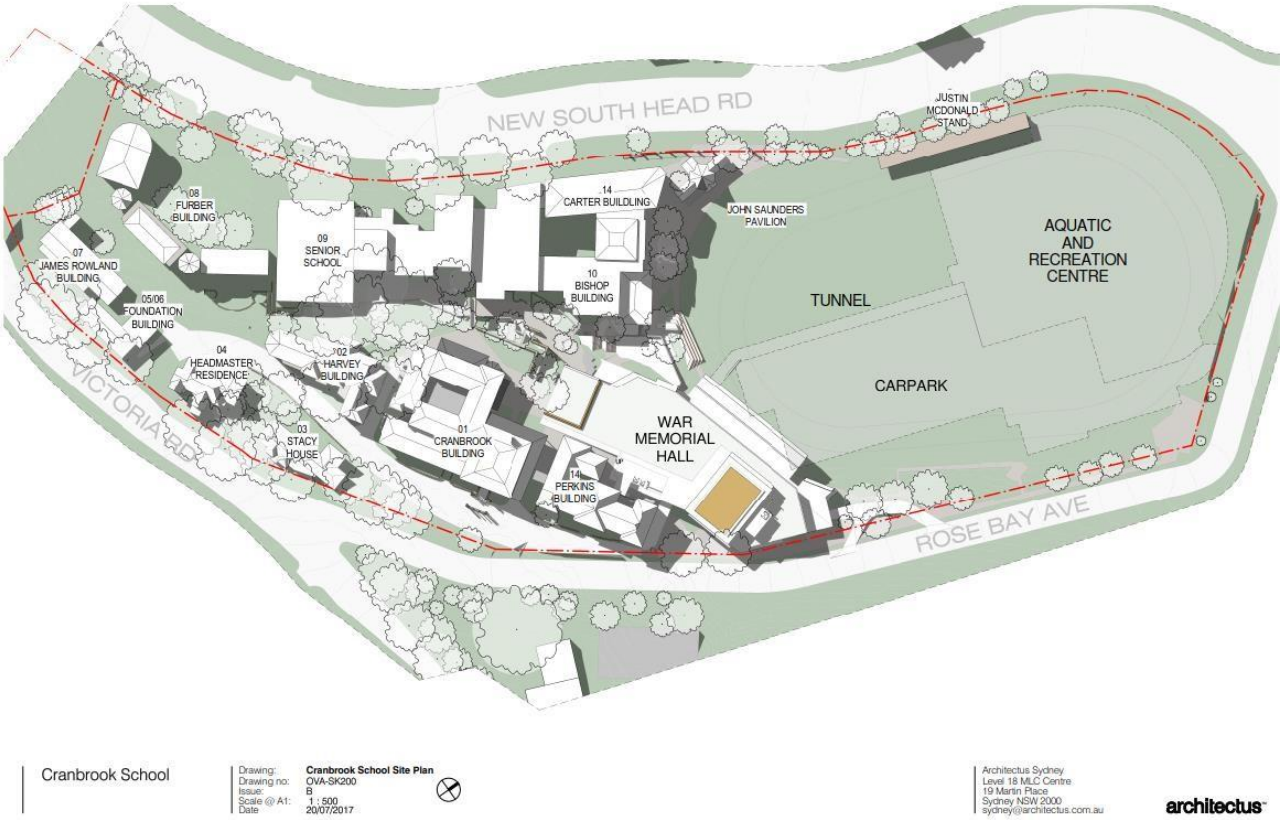


Figure 1: Site Concept Plan

2. SEARS ISSUES ADDRESSED

This report addresses how the proposed project addresses Item 14 of the SEARs and outlines strategies relating to Utilities. These requirements are outlined below alongside where the response to each can be found within this report;

Item	Action to Address the Requirement	Report Location
Prepare an Infrastructure Management Plan in consultation with relevant agencies, detailing information on the existing capacity and any augmentation requirements of the development for the provision of utilities including staging of infrastructure.	This IMP report details the existing hydraulic and electrical services infrastructure available to service the proposed Cranbrook School Senior School Redevelopment. This report also includes details regarding any augmentation / amplifications required to service the proposed high school development	Section 4 & 5.
Prepare an Integrated Water Management Plan detailing any proposed alternative water supplies, proposed end uses of potable and non-potable water, and water sensitive urban design.	Section 6 of this report describes the water sensitive urban design strategy proposed to be used within the proposed school to offset the use of potable water services. Sections 4 & 5 of this report describe proposed alternative water supplies and potable/non-potable end use.	Section 4, 5 & 6

3. SITE DESCRIPTION

3.1 The Site

The proposed site of works is located on the northern half of the current school site bounded by New South Head Road and Rose Bay Avenue (Refer to hatched area in Figure 2 below).

Figure 2: Proposed Site of Works

The site is approximately 4.2ha in size and is situated on a hill that slopes in a northerly direction. The Surface levels vary between RL 40m AHD along the southern periphery to 15m AHD on the northern side with an average slope of approximately 7%.

The current site consists of significant impervious areas including paved roads, bitumen driveways, paved footpaths and buildings. Pervious areas include the grassed oval and garden beds.

4. EXISTING SERVICES

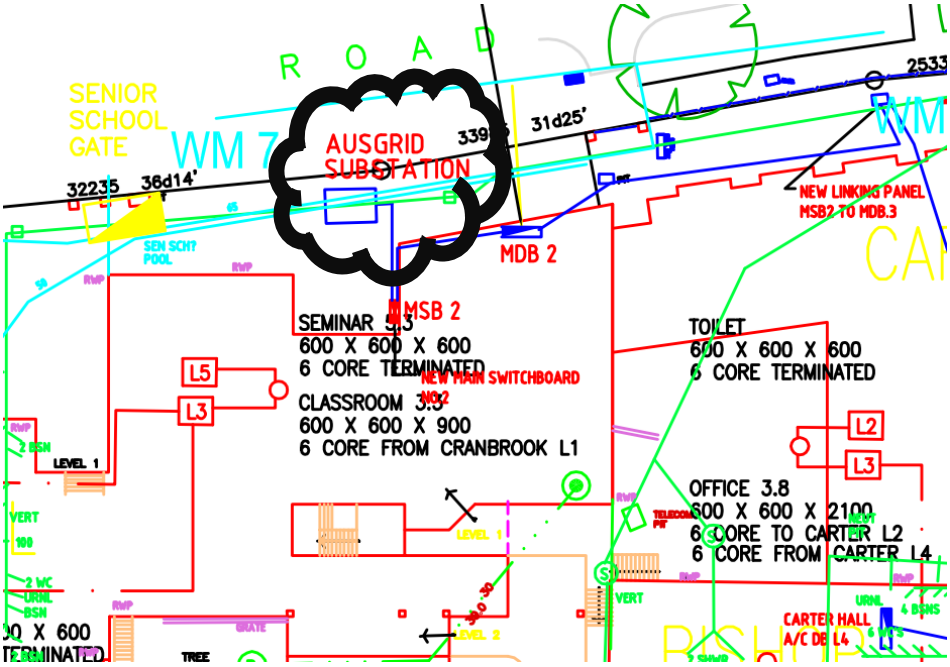
4.1 Power

This section of the report has been prepared by Northrop (28th February 2018)

The existing site is bounded by Ausgrid high-voltage infrastructure (11 kV cabling) on the northern and southern boundary roads, New South Head Road and Rose Bay Avenue, downstream of the zone substation. Ausgrid public lighting services also exist on the four boundary streets.

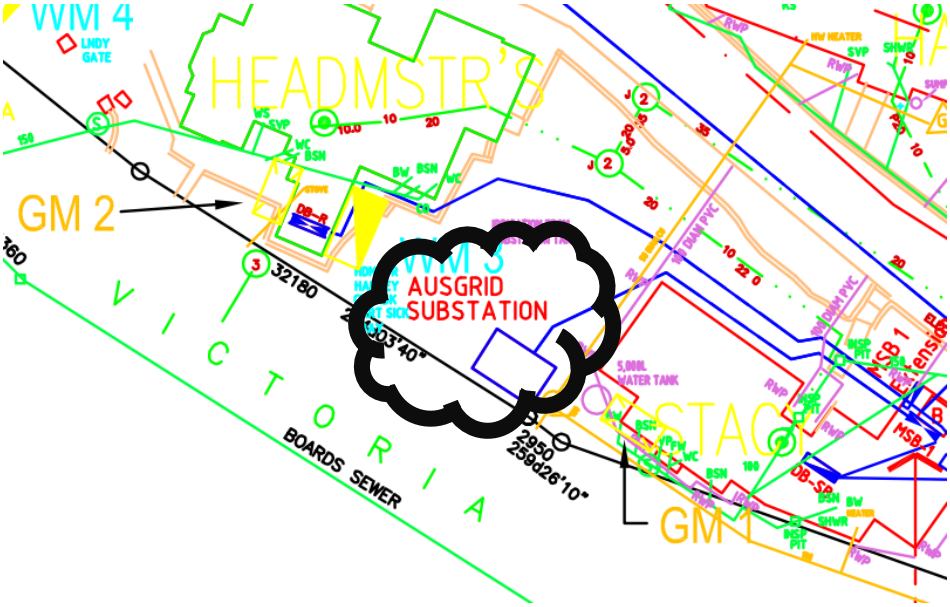
The existing site is supplied by three separate instances of electrical utility infrastructure (substations) from Ausgrid, as per the following:

4.1.1 Substation S63099

Asset Number	S63099
Type of Asset	Pad-mount Kiosk Substation/Transformer
HV Operating Voltage	11 kV
Location on Site	New South Head Road, to the immediate north of MSB2 at the east of the Senior School Building, west of the Carter Building.  (Image extracted from January 2014 electrical site plan)
Impacts on Infrastructure	S63099 is rated at 1000 kVA. Based on the power profile data provided by Cranbrook School, approximately 280 kVA spare capacity exists in this substation. Discussions were held during the concept design phase for potentially leveraging some of this remaining capacity for portions of the Senior School Redevelopment. Northrop submitted a preliminary enquiry to Ausgrid on 10th January 2018 through the standard form NECF-01 to determine the true remaining load capacity. Ausgrid responded via telephone on 29th January 2017 that they were unable to disclose the remaining capacity of S63099, due to the substation not being dedicated to Cranbrook School, and located in public land.

	Due to its long distance from the Senior School Redevelopment, it is unlikely that this asset will otherwise be impacted by the works.

4.1.2 Substation S6230

Asset Number	S6230
Type of Asset	Pad-mount Kiosk Substation/Transformer
HV Operating Voltage	11 kV
Location on Site	Victoria Road, to the east of the Headmaster's Residence.  (Image extracted from January 2014 electrical site plan)
Capacity	S6320 is rated at 1000 kVA. The electrical site services drawings issued by Cranbrook School nominate the location of the substation inside Cranbrook School's boundary, with the majority of its supply dedicated to the School. The substation's recorded data reveals that it is at capacity with no spare capacity available. This substation will not be impacted by the new redevelopment works.

4.1.3 Substation S35442

Asset Number	S35442
Type of Asset	Pad-mount Kiosk Substation/Transformer
HV Operating Voltage	11 kV
Location on Site	New South Head Road, to the immediate west of the school oval, north of the intersection of New South Head Road and Wolseley Road.

	 (Image extracted from current Ausgrid GIS plan)
Impacts on Infrastructure	S35442 is rated at 1000 kVA, Based on Ausgrid GIS plans, data shows the substation's capacity is currently shared by multiple customers external to the School. Discussions were held during the concept design phase for determining and potentially leveraging any remaining capacity for portions of the Senior School Redevelopment. Northrop submitted a preliminary enquiry to Ausgrid on 10th January 2018 through the standard form NECF-01 to determine the true remaining load capacity. Ausgrid responded via telephone on 29th January 2017 that they were unable to disclose the remaining capacity of S35442, due to the substation not being dedicated to Cranbrook School, and located in public land. This substation is nearby the proposed site of works. While the current documentation has determined that Ausgrid assets do not encroach the site, care must be taken by all relevant parties that existing functional Ausgrid assets are not impacted by construction works.

4.2 Telecommunications

This section of the report has been prepared by Northrop (28th February 2018)

Following the review of the Dial Before You Dig (DBYD) plans and our site inspection conducted on 26th July 2017, we have identified existing utility telecommunications services in the immediate vicinity of the Cranbrook School Senior School Redevelopment. Utility telecommunications cabling is installed in underground conduits on street verges, with regular access points through pits along New South Head Road and Victoria Avenue/Rose Bay Avenue.

According to the information given on DBYD, no other communications services (private fibre, dark fibre or otherwise) are known to traverse the vicinity of the School site. This does not resolve the Contractor of their responsibility to conduct a thorough survey of all areas of excavation and ensure that no existing services shall be disrupted.

4.2.1 NBN

Existing NBN ducts reticulate on all the boundary roads New South Head Road, Victoria Road and Rose Bay Avenue. NBN trenches/ducts and cables are shared with Telstra services due to NBN taking ownership of the existing Telstra copper and hybrid-fibre-coaxial (HFC) network in Bellevue Hill. The ducts contain NBN backbone fibre optic cable and NBN customer copper/HFC cabling (shared with Telstra for premises not yet converted to NBN). The site is not currently converted to NBN, and still uses Telstra's copper infrastructure, through three lead-in pits on Victoria Road.

NBN ducts exist on the opposite side of the road to the school site and thus do not encroach on the existing school site nor the proposed development site. The main exception to this is on New South Head Road until a road crossing at Wunulla Road. From there, the network traverses the southern side of New South Head Road and conduit encroaches on the development site at the northern end of the oval (refer to Figure 3). This follows the same route as the Optus pit and conduit network (refer to Section 4.2.4).

Figure 3: NBN Pit and Conduit Routes

Refer to Section 4.2.3 for further details of shared NBN/Telstra assets that may be impacted by the proposed development.

4.2.2 PIPENetworks

Existing PIPENetworks (TPG) assets are present in the vicinity. PIPENetworks' fibre network runs along New South Head Road on the northern side. The PIPENetworks network crosses New South Head Road, entering a dual pit on the southern side of New South Head Road, to enter the school's existing Carter Building via lead-in conduit.

The PIPENetworks carrier cabling terminates in the Carter Building main server room. Return cabling through another core of fibre links the Senior School with the Junior School, roughly two kilometres east of the site on Kent Road, Rose Bay.

The PIPENetworks assets exist in only a limited capacity on the side of New South Head Road that the School site lies on. Furthermore, the PIPENetworks assets are located a substantial distance from the Senior School Redevelopment, thus it is unlikely that this asset will otherwise be impacted by the works. (Refer Figure 4).

Figure 4: PIPENetworks duct shown in blue

4.2.3 Telstra

As per the above point regarding existing NBN services, Telstra services coexist with NBN services servicing the Bellevue Hill area.

To the site's north east along Rose Bay Ave, a roadside cabinet denoted 'ECMB' surrounded by pits and powered by an adjacent pillar was sighted. (Refer Figure 5) This cabinet is used to distribute copper services to the vicinity and is owned by Telstra.

Figure 5: Roadside Cabinet (Left) and location on Satellite of Roadside Cabinet (Right)

The cabinet was noted during the Concept Design phase due to its proximity to the proposed driveway entry point. Northrop commenced an investigation, first liaising with Telstra Network Integrity (reference number: SR202584-1) on 17th August 2017 to determine if the cabinet could be relocated outside of the development site.

On 28th September 2017, Northrop received verbal confirmation from Telstra Network Integrity that the cabinet was a Remote Integrated Multiplexer (RIM). Telstra Network Integrity further confirmed that the cabinet may be

relocated from its current location for a fee, however this option is not considered to be workable due to the significant costs involved.

The design team's strategy for reducing the impact of construction on this asset is to locate the driveway away from the cabinet, and minimise excavation around the immediate area, to avoid disrupting the cabinet or any cables leading to/from it. A full services survey is planned to be conducted around the area to further mitigate any potential risk.

4.2.4 Optus

Optus fibre services currently run along New South Head Road, and not any other boundary road surrounding the School site. Optus fibre pit and conduit network traverses the northern (opposite side of the road from the School) side of New South Head Road until a road crossing at Wunulla Road. From there, the network traverses the southern side of New South Head Road and conduit encroaches on the development site at the northern end of the oval (refer Figure 6). This follows a similar route to the NBN pit and conduit network (refer to Section 4.2.1).

Figure 6: Optus fibre pit and conduit network

4.3 Water

This section of the report is based on the Utility Services Report prepared by Warren Smith & Partners (16th October 2017)

Existing Sydney Water utility services are present around the existing Cranbrook School site.

An existing Modified Polyvinyl Chloride (mPVC) DN 200mm water main is available, running on the western side of the site, on New South Head Road.

An existing Ductile Iron Cement Lined (DICL) DN 300mm water main is available, running on the northern side of the site, on New South Head Road.

4.4 Sewer

This section of the report is based on the Utility Services Report prepared by Warren Smith & Partners (16th October 2017)

Existing Sydney Water utility services are present around the existing Cranbrook School site.

An existing Salt Glazed Ware (SGW) DN 255mm sewer main is available, running on the northern and eastern sides of the site, on Rose Bay Avenue.

An existing Vitrified Clay (VC) DN 150mm sewer main is available, running on the western side of the site, on New South Head Road.

4.5 Stormwater

This section of the report has been prepared by AECOM (17th November 2017)

4.5.1 Flooding Context

The current site conditions and topology show that the broader Rose Bay catchment drains towards a low point along New South Head Road bordering the northern side of Cranbrook School site. The Council adopted flood study for the site (prepared by WMAwater dated 2010) shows the site lying outside of the 100yr ARI and PMF flood extents, as well as any 'flood risk precincts'.

While the development site is outside of the flood risk precincts, it is noted that New South Head Road immediately to the north acts as a major overland flow route for the broader catchment. As such, part of the stormwater management approach adopted includes ensuring this overland flow path is not impacted by the development, and the new development has been adequately designed to ensure elimination or adequate mitigation of the risks associated with the known overland flow path.

4.5.2 Existing Sub-Catchments

The Cranbrook School site itself consists of four main sub-catchments, differentiated by their existing points of discharge across surrounding roads. The sub-catchments have been delineated through review of survey contours, existing drainage plans provided by council and through analysis of GIS and LIDAR data. The site comprises the following main sub-catchments:

1. South-western sub-catchment draining to New South Head Road along existing Council stormwater drainage pipes within an easement through the site;
2. Western sub-catchment draining to New South Head Road along existing stormwater drainage system to the west of the site;
3. Eastern sub-catchment draining towards Rose Bay Avenue to the east of the site along an existing pit and pipe system; and
4. Northern sub-catchment draining to New South Head Road to the north of the site. It is noted that discharge of the catchment is likely to be at several locations due to the flat geometry and lack of formalised drainage structures.

The overall internal sub-catchments as outlined above are presented in Figure 7. It is noted that sub- catchments 2,3 and 4 discharge to Rose Bay Avenue or New South Head Road and ultimately outlet to Rose Bay, while sub-catchment 1 discharges through St Mervyns Avenue and outlets to Double Bay.

Figure 7: Site Sub-Catchment Layout

4.5.3 Pre-Development Stormwater Management Approach

A review of site infrastructure audit reports, topographical survey information, Dial-Before-You-Dig information and data collected during visual site inspections has been undertaken to determine the existing on-site stormwater management system. This has been assessed to consist of multiple pit and pipe drainage network and informal overland flow paths.

The south-western sub-catchment (1) is drained by a Council drainage line within an easement running through the southern portion of the site, traversing from Victoria Road to St Mervyns Avenue.

The western sub-catchment (2) is collected by an existing pit and pipe system discharging to the existing Council drainage pit in New South Head Road.

The eastern sub-catchment (3) is partially collected by an existing pit and pipe system within the existing main driveway, ultimately discharging to Rose Bay Avenue as overland flow via a pipe connected directly to the existing Council kerb and gutter.

The northern sub-catchment (4) collects within the existing sporting oval which is likely to pond to a nominal level before spilling at multiple locations to New South Head road and the northern segment of Rose Bay Avenue. Three main locations have been assumed for the purposes of this report:

- 4(a) – western spill point – at the existing driveway, behind existing ‘Justin McDonald Stand’
- 4(b) – northern spill point – at the localised low point near northern-most point of site, spilling near existing stairway
- 4(c) – eastern spill point at Rose Bay Avenue – collects at existing grated pit adjacent the existing maintenance sheds

This layout is presented schematically in Figure 8.

Figure 8: Pre-Development Stormwater Conditions

4.5.4 Pre-Development Hydrologic and Hydraulic Performance

The pre-development hydrological and hydraulic performance has been assessed using the DRAINS software. The DRAINS model has been used to assess the existing stormwater flows for the 20 and 100 year ARI design storm events. This has been used to form the baseline conditions against which the proposed development will be assessed.

Estimated flow rates at key discharge points on the site are presented in the below table for the relevant catchments displayed in Figure 7. These have been selected to provide baseline conditions against which the proposed development will be assessed.

ARI	Catchment	Piped Flow (l/s)	Overland Flow (l/s)	Total (l/s)
20 year	1	200	525	725
	2	202	282	484
	3	-	203	203
	4(a)	-	333	333
	4(b)	-	328	328
	4(c)	14	376	390
	Combined	**416**	**2,047**	**2,463**
100 year	1	200	660	860
	2	202	372	574
	3	-	242	242
	4(a)	-	339	339
	4(b)	-	336	336
	4(c)	14	381	395
	Combined	**416**	**2,330**	**2,746**

4.6 Natural Gas

This section of the report is based on the Utility Services Report prepared by Warren Smith & Partners (16th October 2017)

Existing Jemena utility services are present around the existing Cranbrook School site.

The Cranbrook School currently has five (5) existing gas meter and mains connections. The existing gas meters and connections do not have the capacity to serve the new AFC and Centenary buildings.

Refer to Figure 9 and Figure 10 which show the location of the 1,050 kPa secondary main directly adjacent the proposed development.

We assume this will be the main to connect to which would require a secondary mains meter set.

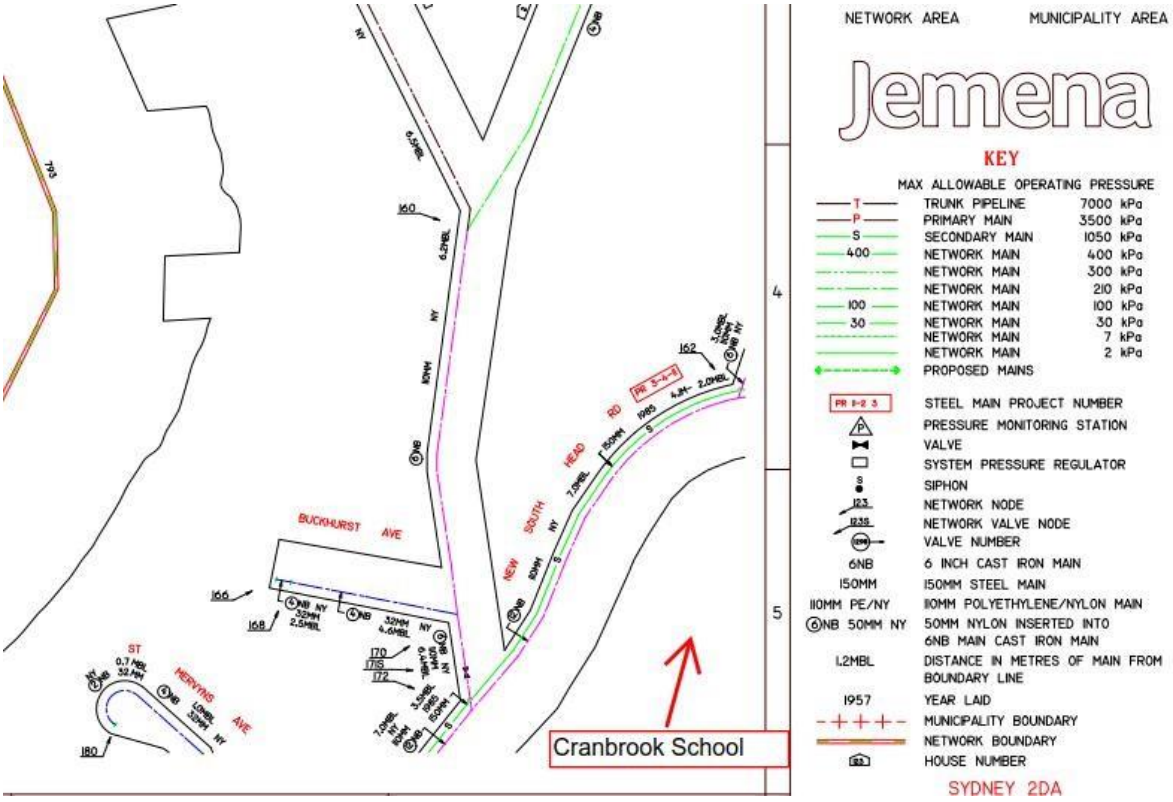


Figure 9: Existing Surrounding Gas Mains

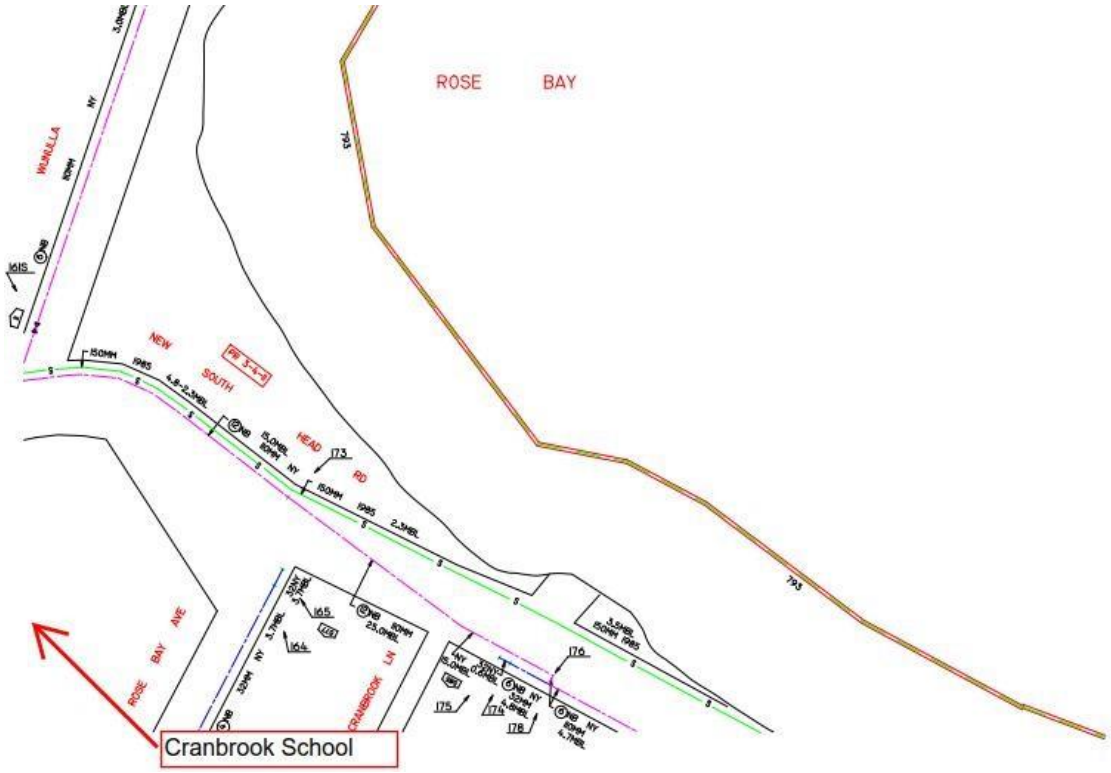


Figure 10: Existing Surrounding Gas Mains

5. PROPOSED INFRASTRUCTURE & AUGMENTATION

5.1 Power

This section of the report has been prepared by Northrop (28th February 2018)

During the Concept Design phases of the project, Northrop completed ongoing maximum demand calculations based on the Architectural plans to determine the required augmentation to utility power services to service the Senior School Redevelopment.

Northrop's latest maximum demand calculation (based on the current working architectural plan) is 1,540 amps/phase (983 kVA). Refer to Appendix C for maximum demand calculations. The existing School site contains three existing padmount kiosk type substations accessible around the site's perimeter (refer to Section 4.1 for details). Collectively, these substations have insufficient capacity to support the Senior School Redevelopment's proposed loads; therefore there is a requirement for new power infrastructure from the local supply authority, Ausgrid.

Based on the above assessment, one (1) off 1000 kVA padmount kiosk type substation is required to supply the new building. This substation is proposed to be located on the corner of the property where Rose Bay Avenue meets New South Head Road (refer to Figure 11).

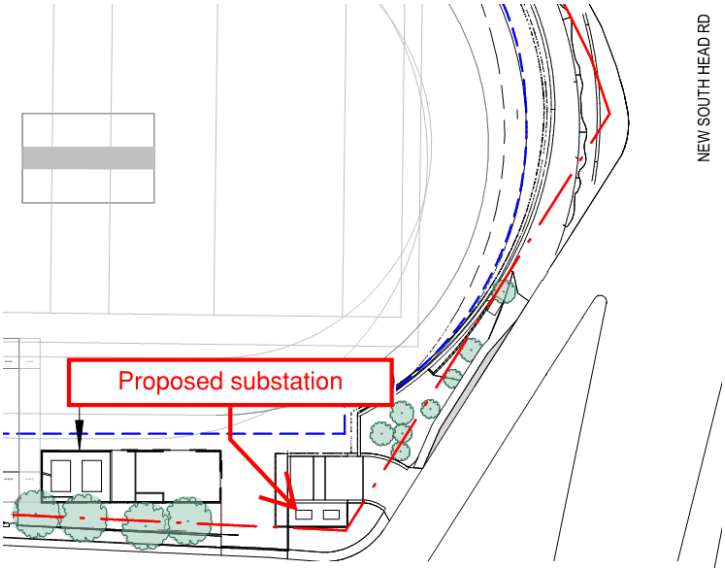


Figure 11: Location of proposed new substation

The new substation is proposed to be an Ausgrid 'L' type kiosk. The kiosk carries an easement size of 5.3 metres by 3.3 metres. For all Ausgrid high-voltage cables, an additional two-metre easement is required around the path the cable is laid.

The project has been registered with Ausgrid by way of application for connection; detailed design of the infrastructure will be directed by a Design Information Package, expected to be issued by Ausgrid in the coming weeks. For further information, please refer to Appendix C for the application for connection of load.

The existing three substations surrounding the School (including the two substations servicing the School's existing buildings) are located outside the redevelopment site and will be unaffected by the proposed construction works. The existing substations shall continue to operate as normal during and after project completion.

5.2 Telecommunications

This section of the report has been prepared by Northrop (28th February 2018)

The existing School site is presently serviced by a single PIPENetworks fibre link for wide-area network/data services, and a number of Telstra copper services for telephone access. With respect to data services, it is recommended that the School considers a secondary connection from a separate location to allow for a redundant internet connection.

Preliminary assessment indicates that the street verge of Rose Bay Avenue could be utilised to install a redundant fibre optic connection serving the new Aquatic Fitness Centre or Centenary Building (the latter of which is intended to house a dedicated server room).

The secondary fibre optic connection could be provided by PIPENetworks to provide a dual-redundancy single-network solution; for increased backup functionality it is suggested the secondary connection is provided by a separate carrier. It is proposed that an inexpensive NBN fibre to the premises lead-in be provided to the Secondary School Redevelopment to allow for business-grade traffic class services to be provided from the School's preferred provider. This connection should be from the Rose Bay Avenue section of the site.

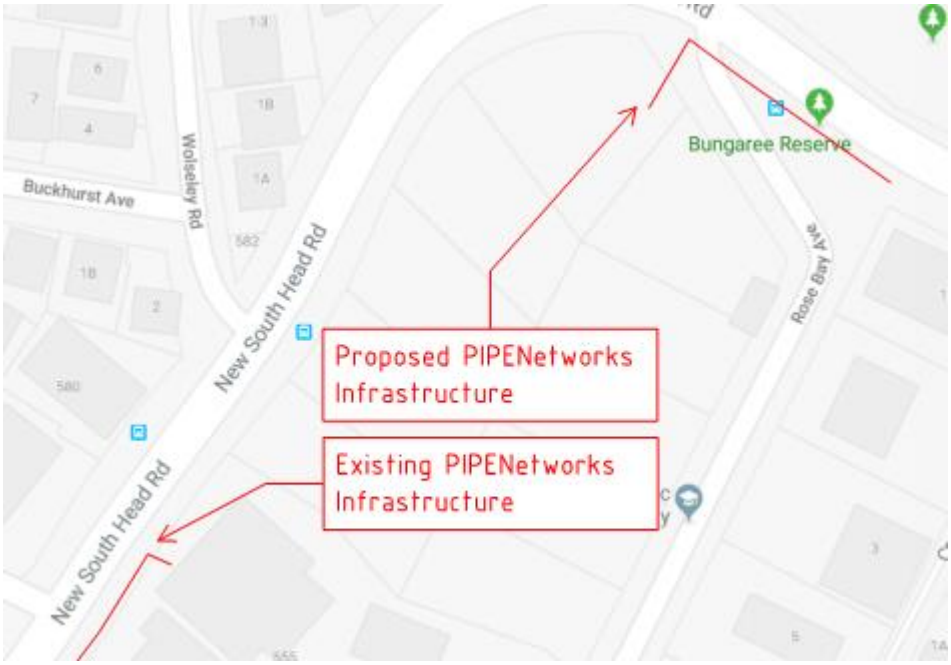


Figure 12: Proposed PIPENetworks Infrastructure

5.3 Water

In order to assess the capabilities of the surrounding hydraulic services infrastructure, Warren Smith and Partners has undertaken a preliminary load assessment for the precinct. Warren Smith and Partners' estimates of the demands imposed on Sydney Water for the Cranbrook School redevelopment are as follows:

5.3.1 Water Supply Demand Calculations

This section of the report has been prepared by Warren Smith & Partners (16th October 2017)

Given that the Centenary Building is multi-purpose it is difficult to define the total number of students undertaking in regular usage of the facility. Classroom and teaching space has been defined to cater to a total of 375 students. There are no additional students as a result of the Centenary Building development.

The Aquatic Fitness Centre (AFC) is focused on recreation for students of the Cranbrook High School and consists of things such as a fitness gym, a multi-function court, pools, and some office space. The AFC has not resulted in an increase in population in students.

The assumption taken in determining the average daily potable water demands for the current 1150 student population were taken from the Sydney Water table, "Average Daily Water Use by Property Type" and is presented in Table 1 below. Please refer to *Appendix A* for the Sydney Water table.

Table 1: Average Daily Water Demand

Classification	Metric Unit	Average Demand (L/Metric Unit/Day)
School	Students	20

Please refer to Table 2 below for the average daily water demand calculation for the site.

Table 2: Average Daily Water Demand Calculation

Total students	Average Demand (L/Metric Unit/Day)	Total Average Daily Water Demand (kL)
1150	20	23

As there is no increase in students it could be said that there is no increase in simultaneous flow, however, the new buildings have the opportunity for simultaneous shower usage in changerooms and the like where previously the population did not have this opportunity. The shower count for the AFC and the Centenary Building is approximately 39 and 10 respectively. The buildings also have the potential to sustain populations that are outside of the typical student/teacher/administration that might be expected.

Due to the difficult nature of assessing the probable simultaneous demand for such a dynamic venue refer to attached *Appendix B* - the design population, to help Sydney Water to assess the developments as they see fit.

The following flows have also been calculated for the entire site:

- Cooling towers flow – 1.87 L/sec
- Pool evaporation flow – 0.093 L/sec – based on 2930m^3 per year
- Fire flow for hydrants – 20 L/sec
- Fire flow for sprinklers – 20 L/sec

5.3.2 Proposed Water Connection Points

Subject to other design outcomes and Building Code regulations there are currently two options being considered to service both the Aquatic Fitness Centre (AFC) and the Centenary Building.

- **Option 1 (Preferred)** – Utilise what appears to be an existing hydrant and mains connection of the mPVC DN 200mm water main on New South Head Road. This option is preferred as it is central to both buildings and may not require a new connection to the water main. The connection may require upgrading. If this is not an existing connection this location shall still be assessed for feasibility as a new connection may be proposed.
- **Option 2** – A new connection to the DICL DN 300mm water main on New South Head Road is proposed to service the development.

Refer to Figure 13 below for a diagrammatical detail for water utility connection points (also shows sewer utility connection points).

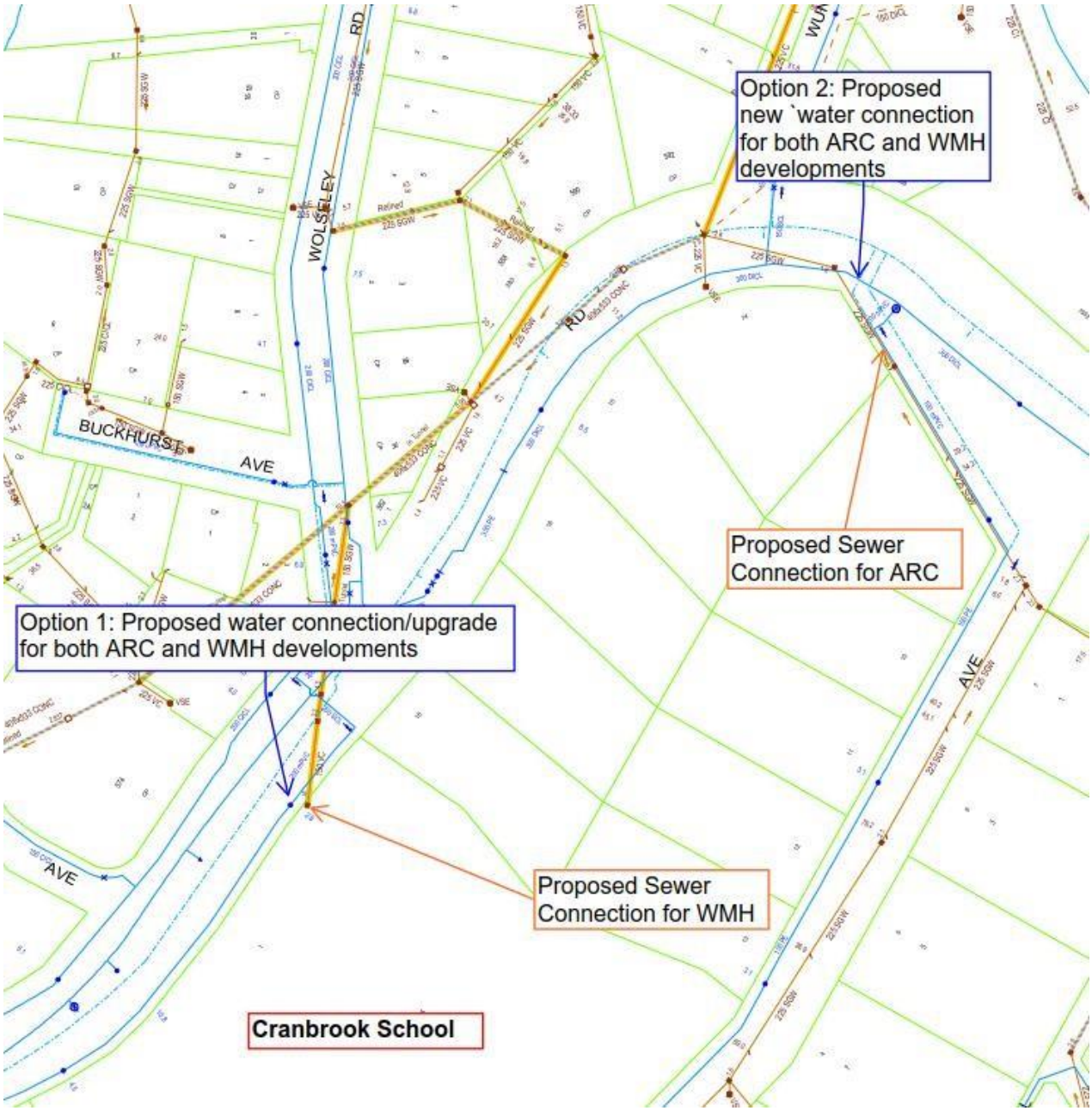


Figure 13: Proposed Water & Sewer Connection Points

5.4 Sewer

In order to assess the capabilities of the surrounding sewerage services infrastructure, Warren Smith and Partners has undertaken a preliminary discharge assessment for the precinct. Warren Smith and Partners' estimates of the sewerage demands imposed on Sydney Water for the Cranbrook School redevelopment are as follows:

5.4.1 Sewer Discharge Calculations

This section of the report has been prepared by Warren Smith & Partners (16th October 2017)

In order to determine the average daily sewer discharge for the proposed development, the estimated equivalent population (EP) for the proposed development is required. Please refer to Table 3 below for the EP data adopted, sourced from the Water Service Association of Australia, Sewerage Code of Australia WSA 02-2002-2.2.

Table 3: EP Data

Classification	Unit	EP per Bed
Educational institution	Student	0.2

Please refer to Table 4 below for the EP calculation for the site.

Table 4: EP Calculation

Total students	EP per Unit	Equivalent Population
1150	0.2	230

5.4.2 Proposed Sewer Connection Points

There are two proposed connection points; one for the Aquatic Recreation Centre (ARC) and another for the War Memorial Hall (WMH) due to their proposed locations.

- **AFC:** All sewer waste will be pumped to a new connection to the SGW DN 225mm sewer main located on Rose Bay Avenue.
- **Centenary Building:** Sewer waste discharge is to be gravity fed to a new connection to the VC DN 150mm sewer main located on New South Head Road.

Refer to Figure 13 above for a diagrammatical detail for sewer utility connection points (also shows water connection points).

5.5 Stormwater

This section of the report has been prepared by AECOM (17th November 2017)

5.5.1 Proposed Stormwater Management Approach

The main design considerations have formed the basis for the Cranbrook School Development stormwater management approach:

- Provision of a pit and pipe drainage network with capacity to convey the 20 year ARI (minor) design storm event;
- Provision of overland flow routes to safely convey runoff from the 100 year ARI (major) design storm event;
- Where the above requirements are not feasible due to downstream conditions, the stormwater system is designed to allow the maximum flow, ensuring no adverse impacts to adjacent properties and downstream conditions, whilst allowing a safe conveyance of stormwater from the developed site to the existing Council system
- Management of water quality through the incorporation of Water Sensitive Urban Design (WSUD) techniques; and
- Management of water quantity to ensure no increase in peak stormwater discharge from the site for the 20- and 100-year ARI storms.

Figure 14 presents a schematic of the proposed stormwater management strategy detailed in the following sections.

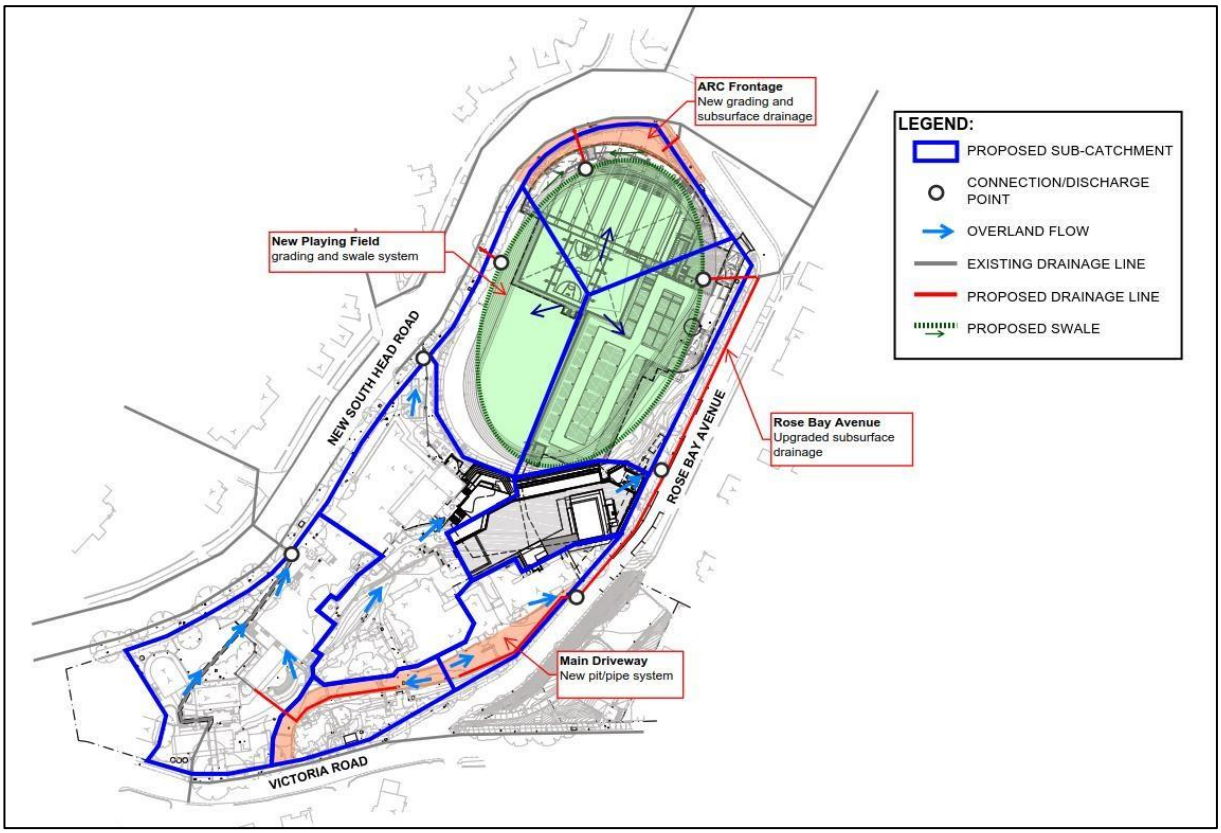


Figure 14: Proposed Stormwater Management Approach

5.5.2 On-Site Detention

While the development site lies outside of the OSD exclusion zone for Woollahra Council, consultation with Council has indicated that an alternative OSD strategy may be adopted for the purposes of this development. Council is in principle supportive of removing the requirement for a formalised OSD tank, provided a sufficient green roof area and retention tank or irrigation tank volume is provided.

5.5.3 Proposed Infrastructure

New stormwater infrastructure is proposed for the development comprising:

- A new pit and pipe system in Rose Bay Avenue to convey stormwater to the existing Council stormwater network (to be dedicated to Council)
- New pit and pipe system within the new 'pick-up/drop-off road' to collect localised stormwater flows from the road and adjacent existing building to the upgraded system in Rose Bay Avenue
- New grassed swale and surcharge pits within connections to existing Council drainage infrastructure to collect stormwater flows from playing field run-off (where discharge is in excess of the proposed playing field subsurface drainage system); and
- Adjustment of existing on-site stormwater infrastructure to direct to new network (where required).

Details of the proposed stormwater infrastructure as required by the stormwater management approach are provided in the following sections.

5.5.3.1 Main Driveway Drainage

The upgraded pick-up/drop-off road is proposed to incorporate a new pit and pipe network to convey the local catchment to the new proposed system in Rose Bay Avenue. It is noted that an existing pit/pipe system is available and may pending further investigation of size and connection points.

Drainage is proposed to maintain the existing catchment discharge.

5.5.3.2 Rose Bay Avenue Drainage

The roof drainage for the new Centenary Building is proposed to discharge to Rose Bay Avenue. This effectively increases the catchment discharging at this location. To ensure no adverse impacts to the existing street stormwater system, a new pit and pipe system is proposed on the western side. This also provides a piped connection point for the proposed main driveway drainage (which currently discharges as overland flow to Rose Bay Avenue). The additional discharge is conveyed as pipe flow, effectively reducing the overall overland flow under post-development conditions.

5.5.3.3 Building Connections

2 no. connection pits have been provided for potential connection to building downpipes. Discharge allowances for each connections point are provided in the below table.

No.	Building connection	Pit reference	Peak discharge flow rate	
			Minor (m^3/s)	Major (m^3/s)
1	Perkins Building (existing drainage to be intercepted)	4\01	**0.049**	**0.055**
2	War Memorial Hall	3\01	**0.189**	**0.214**

5.5.3.4 Aquatic Fitness Centre Frontage Drainage

Significant level changes are proposed at the Aquatic Fitness Centre (AFC) frontage to allow access to the new foyer floor level. Levels are proposed to fall away from the new building entrance to a low point as shown in Figure 16. A grated drain has been provided falling to the low point with a sag pit and pipe discharging to the existing Council drainage pit in Rose Bay Avenue. In addition, multiple outlets are proposed at a higher level to connect at the Council kerb and gutter in Rose Bay Avenue to provide an emergency overflow route in the case of blockage, or in storm events beyond the existing pipe capacity. The level of the overflow outlets is proposed to be set at a level such that the overflow will to spill to Rose Bay Avenue prior to spilling to the new AFC.

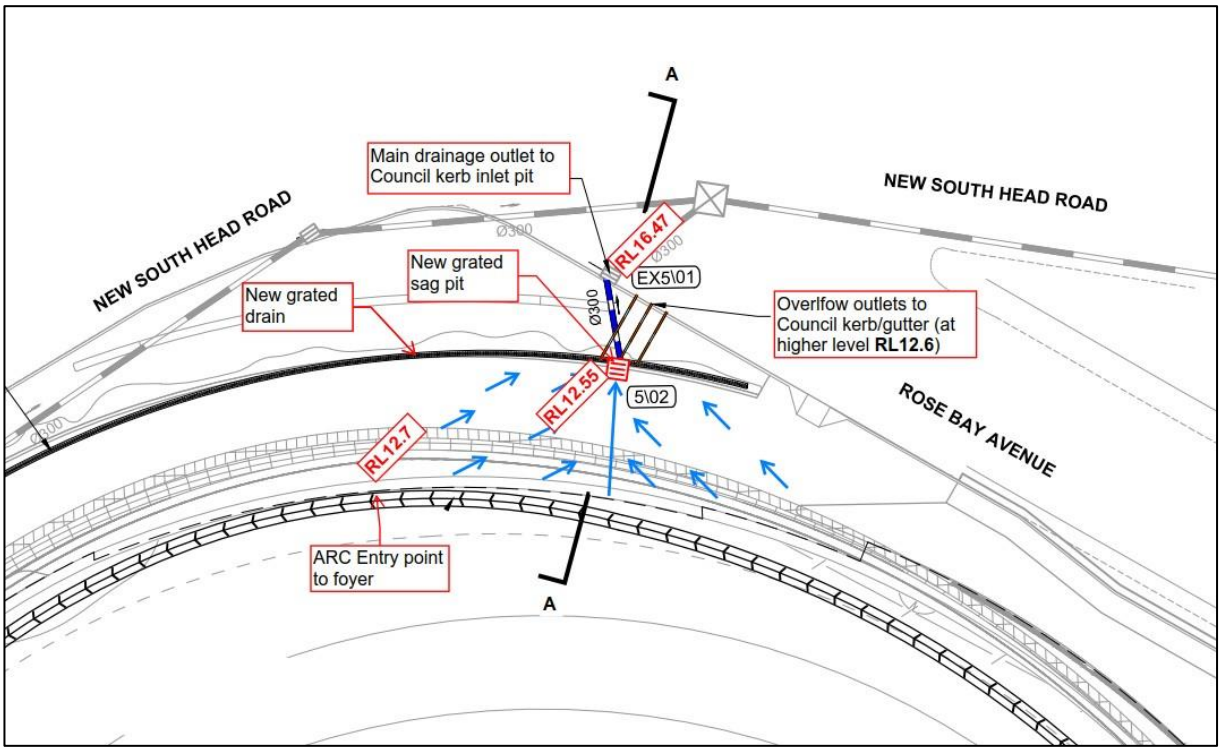


Figure 15: AFC Frontage Stormwater Management Approach

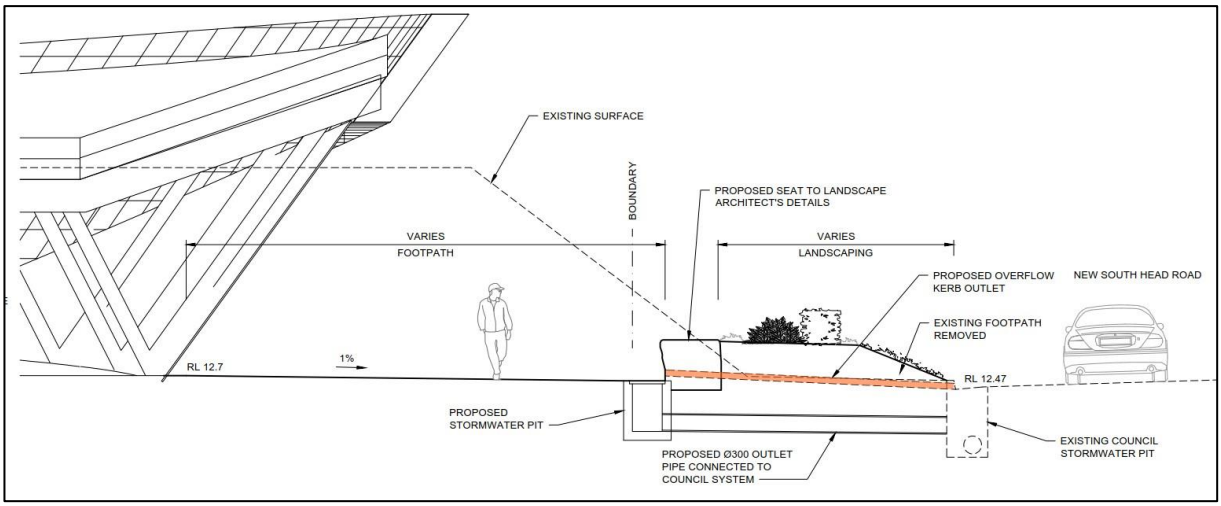


Figure 16: Typical section through AFC frontage to New South Head Road (Section A-A)

5.5.3.5 Playing Field Drainage

At this stage it has been assumed that the playing field will incorporate a specialist drainage design with either a network of subsoil pipes or drainage cells. It is assumed that this system will not be adequately sized for the design storm event. As such, an overland flow and swale system has been proposed to direct to any overland flow beyond the capacity of the subsoil system to the Council drainage system.

The playing field is proposed to outlet to the Council stormwater system at three points. These generally correspond to existing oval discharge points described in section 4.5.3 (currently overflowing from playing field as uncontrolled overland flow) and are as follows:

- New South Head Road west
- New South Head Road north
- Rose Bay Avenue

The general stormwater approach for the playing field comprises:

- Provision of a main high point near the centre of playing field
- Provision for field grading at 1% outwards toward proposed field perimeter
- Provision for a grassed swale to convey playing field surface runoff to the discharge points as outlined above
- Provision of sag pits allowing nominal ponding to allow some attenuation of the flow generated from the oval runoff.

At each discharge point, a grated sag pit is proposed to collect main playing field surface runoff. Sag pits are assumed to allow 0.2m ponding, corresponding to approximately $10m^3$ of storage volume. This volume is considered achievable at each of the discharge locations within the available space at the playing field boundary, assuming the ponding extent is limited to outside the playing field area, or contained wholly within the proposed swale.

The provision of sag pits and grassed swale presents an opportunity to attenuate flows generated by the before discharging to the Council system. This reduction has been quantified as part of DRAINS modelling and presented in Section 5.5.4.1.

Refer to Figure 17 for details of the proposed playing field drainage strategy.

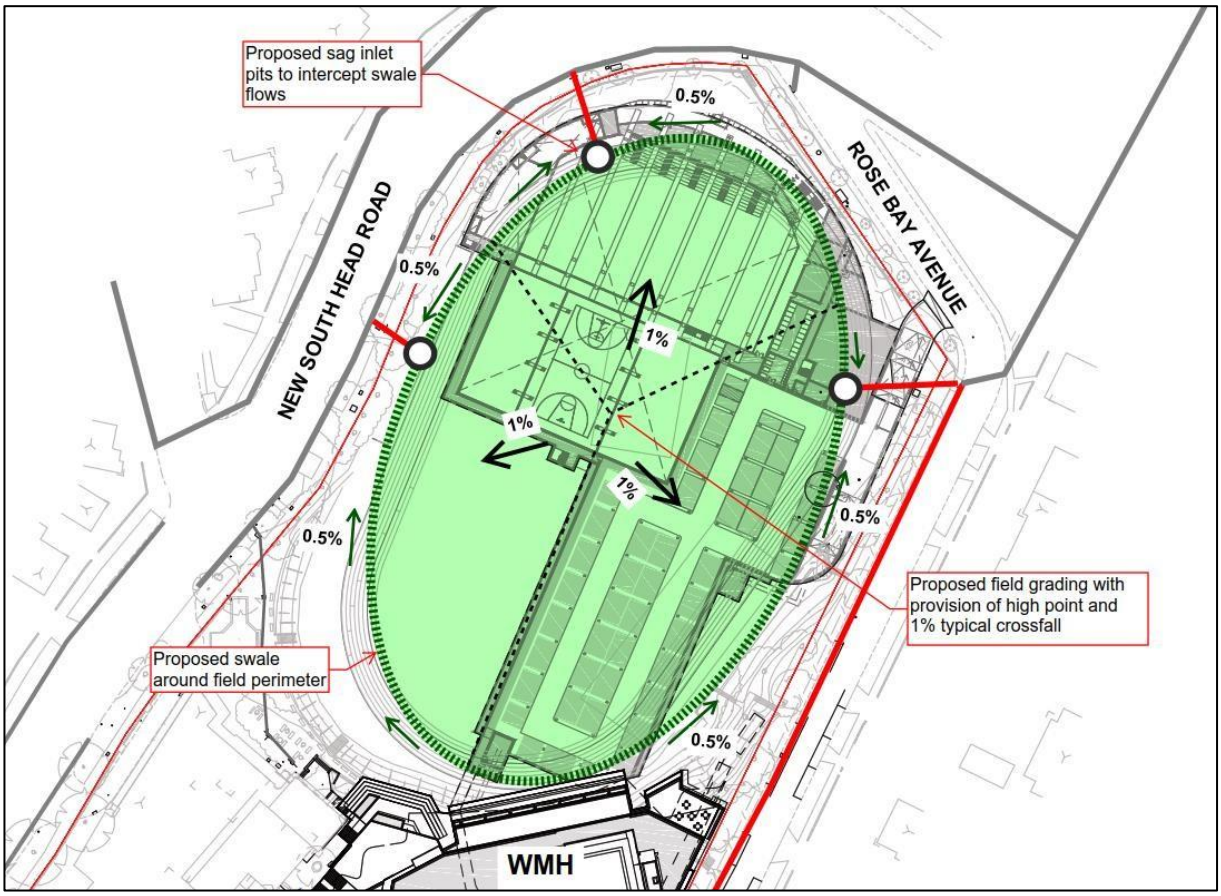


Figure 17: Playing Field Stormwater Management Approach

5.5.4 DRAINS Modelling

Hydraulic modelling using the DRAINS software has been undertaken to support the stormwater management approach detailed in the sections above. A model has been developed for the existing and proposed conditions and used identify peak discharge rates pre-development and post- development.

The peak discharge is compared for each of the catchment discharge points described in Section 4.5.2, compared with the corresponding discharge under developed conditions for both the 20- and 100yr ARI storm events. The results are presented in Section 5.5.4.1 below.

Results of the DRAINS modelling are also presented schematically in the figures below:

Figure 18: Pre-Development 20-year ARI

Figure 19: Pre-Development 100-Year ARI

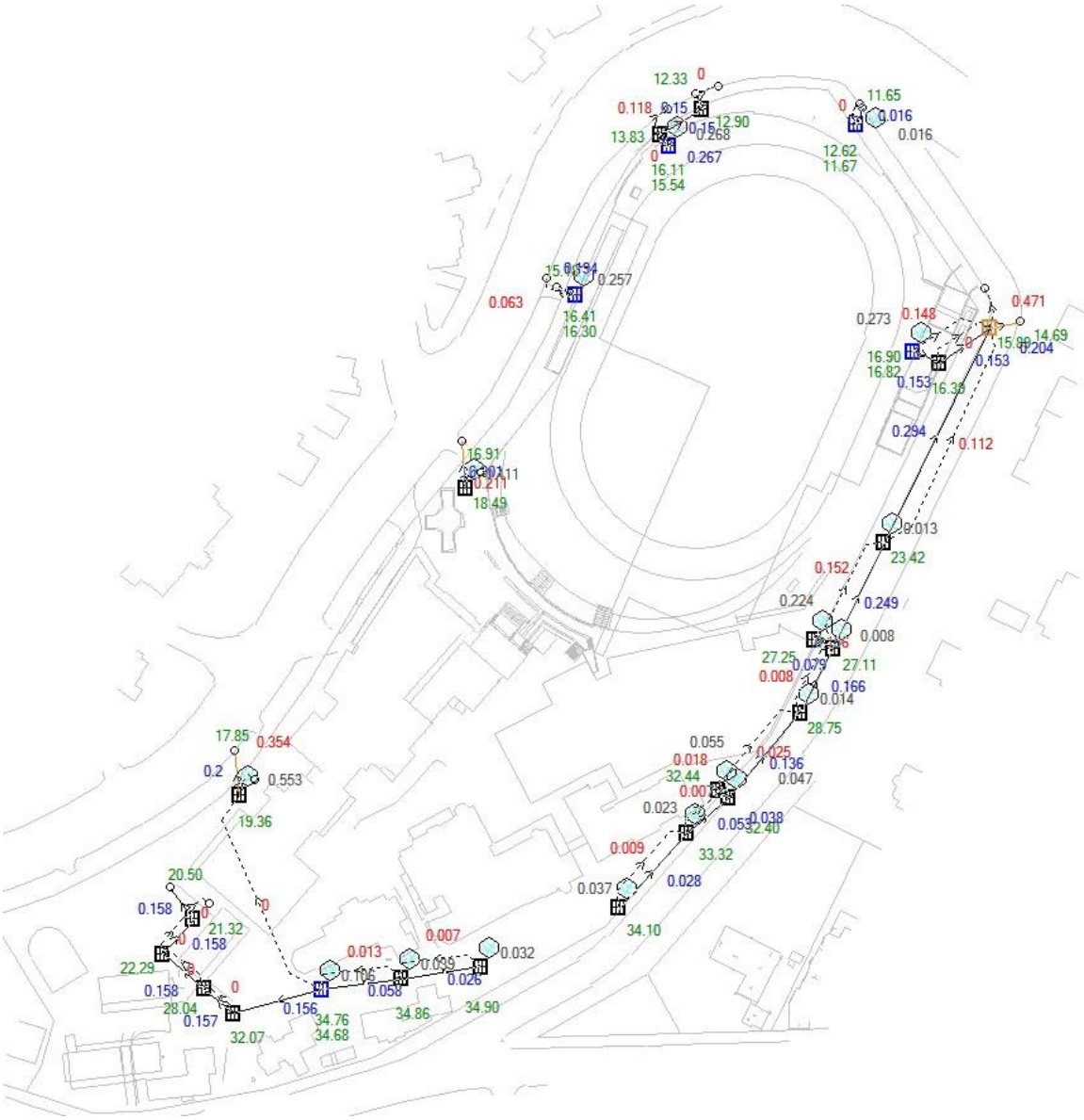


Figure 20: Post-Development 20-Year ARI

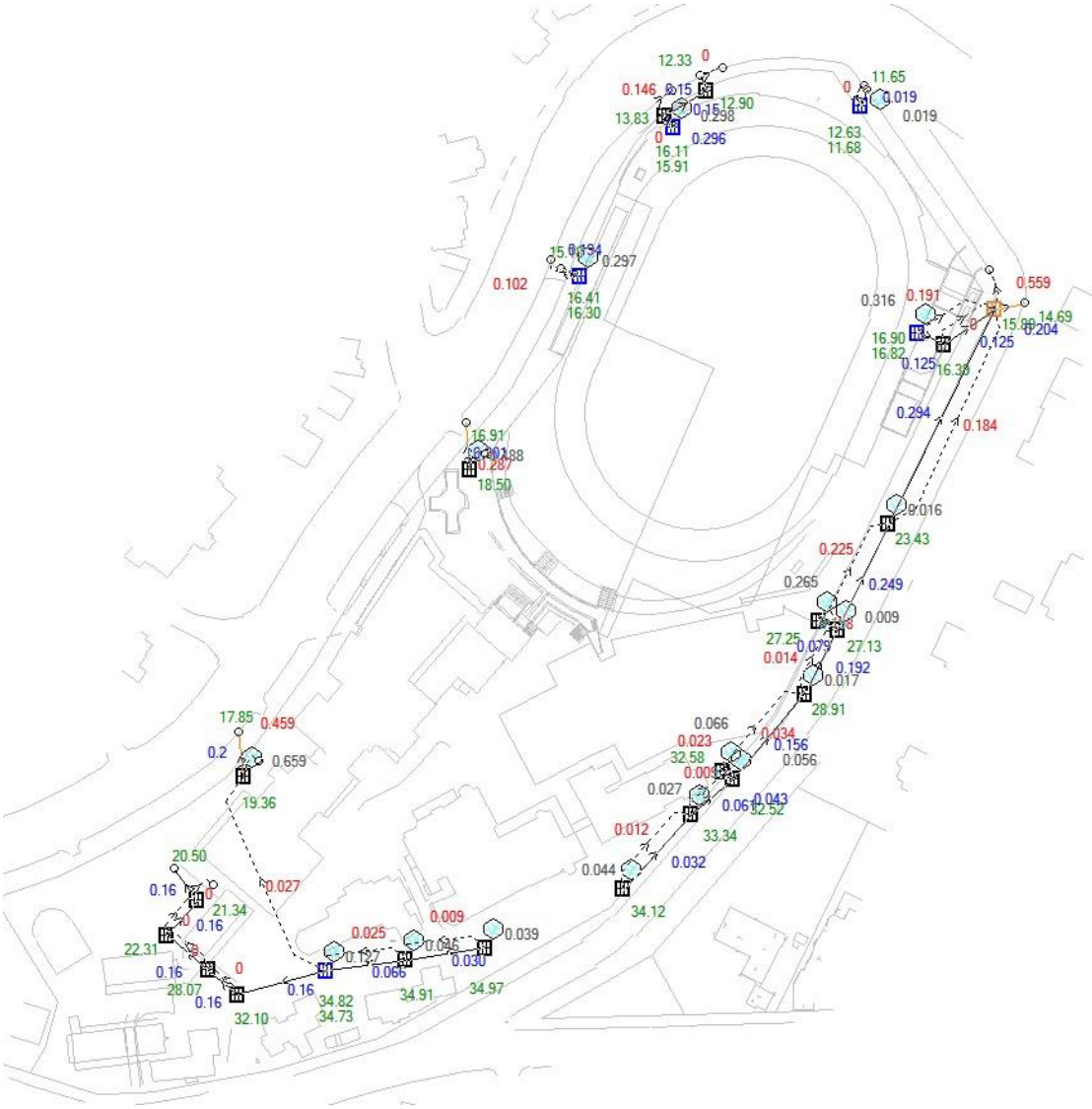


Figure 21: Post-Development 100-Year ARI

5.5.4.1 Post-Development Stormwater Performance

The DRAINS results for site discharge under post-development conditions are presented in the table below. The total peak discharge from site is reduced by 5% in the minor storm and 2% in the major storm event. By providing new pipe drainage within the site and connections to Council subsurface system, the total overland flow has been dramatically reduced from baseline conditions.

Post-development Peak Site Discharge and Comparison to Baseline Results

ARI	Catchment	Piped Flow (l/s)	Overland Flow (l/s)	Total (l/s)	Reduction from baseline	Overland flow reduction from baseline	Comments
20 year	1	358	354	712	2%	33%	Additional pipe drainage included in main driveway
	2	201	211	412	15%	25%	Portion of catchment redistributed to (3)

	3	249	152	401	-98%	25%	Total flow increased, overland decreased
	4(a)	193	64	257	23%	81%	New pipe drainage and attenuation of flows from proposed grassed swale and ponding storage
	4(b)	149	118	267	19%	64%	
	4(c)	138	149	287	26%	60%	
	Combined	**1288**	**1048**	**2336**	**5%**	**49%**	
100 year	1	360	459	819	5%	30%	Additional pipe drainage included in main driveway
	2	201	287	488	15%	23%	Portion of catchment redistributed to (3)
	3	249	225	474	-96%	7%	Total flow increased, overland decreased
	4(a)	193	105	298	12%	69%	New pipe drainage and attenuation of flows from proposed grassed swale and ponding storage
	4(b)	149	147	296	12%	56%	
	4(c)	125	191	316	20%	50%	
	Combined	**1277**	**1414**	**2691**	**2%**	**39%**	

5.6 Natural Gas

In order to assess the capabilities of the surrounding gas services infrastructure, Warren Smith and Partners has undertaken a preliminary load assessment for the precinct. Warren Smith and Partners' estimates of the demands imposed on Jemena for the Cranbrook School redevelopment are as follows:

5.6.1 Gas Load Calculations

This section of the report has been prepared by Warren Smith & Partners (16th October 2017)

Please refer to the table below for the gas loads associated with the ARC and WMH buildings:

Appliances	**Total (Mj/hr)**
Domestic Hot Water Burners	2,300 Mj/hr
Mechanical HVAC	4,000 Mj/hr
Pool Plant	2,500 Mj/hr
TOTAL	8,800 Mj/hr

5.6.2 New Gas Connections

This section of the report is based on the Utility Services Report prepared by Warren Smith & Partners (16th October 2017)

New gas main connections and meters will need to be provided to the AFC and Centenary buildings. The size will need to cater for:

- Domestic hot water load
- Pool heating load
- Air conditioning heat load

- Total new load: 8,800 mj/hr

As part of the application process, Jemena is to confirm if any amplification of the natural gas main is required and which main will be available for connection. Refer to Figure 9 and Figure 10 in Section 4.6 which show the location of the 1,050 kPa secondary main directly adjacent the proposed development.

6. WATER SENSITIVE URBAN DESIGN

This section of the report has been prepared by AECOM (17th November 2017)

The stormwater quality management approach will involve incorporation of Water Sensitive Urban Design (WSUD) techniques in the proposed stormwater drainage system.

The WSUD measures described below ensure water quality targets are met, considering stormwater runoff from roads, parks, vegetated areas and the remaining site.

6.1.1 WSUD Implementation

WSUD measures including Gross Pollutant Traps, Grassed Swales, Passive Irrigation and Rainwater Harvesting have been considered for the development. General layouts have been adopted for the current design, and further details including subsoil drainage and exact infrastructure layouts will be further developed in detailed design.

6.1.1.1 Passive Irrigation

The drainage design for the site ensures that the majority of site runoff on to will be directed into vegetated areas or green roofs prior to discharging to outlet locations. These areas will provide passive irrigation to stormwater before being collected by inlet pits throughout the site, or running off to. Given the extent of landscaped areas, it is expected that passive irrigation will provide the majority of treatment to stormwater flows for the site.

If run-off exceeds the infiltration or temporary storage capacity of the planted areas, run-off will be directed as overflow toward the existing on-site pit and pipe network. Run-off exceeding the on-site stormwater network capacity will discharge to Hordern Oval ultimately being directed to the outlet point at New South Head Road.

6.1.1.2 Grassed Swales

Grassed swales are proposed along the perimeter of the Horden Oval to control runoff from the oval, towards the main outlets. The intent of these grassed swales is to provide a formalised overland flow path, where runoff exceeds the playing field infiltration rate. The swales also provide a location for water to pond away from the playing field, providing an opportunity for water quality control.

6.1.1.3 Rainwater Harvesting

A number of existing rainwater and retention tanks are located within the Cranbrook School development site. These are used to supply rainwater for irrigation of Hordern Oval and surrounding lawns and landscaped areas.

The total proposed rainwater harvesting volume is currently under design development and will be incorporated into the water quality model as part of detailed design.

6.1.1.4 Gross Pollutant Trap

It is likely that a minor catchment will likely bypass the above treatment measures which will inevitably have an impact on the overall WSUD performance of the development. This is anticipated from the new 'Drop-off road' into Rose Bay Avenue, and may be unavoidable due to existing site and road grading.

As a final water treatment measure, a gross pollutant trap (GPT) may be required to meet the WSUD treatment requirements. Provision of a GPT will be investigated as part of detailed design if warranted by the resulting treatment performance of the above measures.

7. CONCLUSION

This Infrastructure Management Report (IMP) outlining the proposed Utility Infrastructure servicing the proposed development addresses the Secretary's Environmental Assessment Requirements (SEARs) issues identified in this report.

The project, located on the northern portion of the Cranbrook School Site (5 Victoria Road Bellevue Hill NSW 2023), including the construction of the Aquatic Fitness Centre, Centenary Building, carpark and sports field, can be sufficiently serviced by power, telecommunications, water, sewer, gas and stormwater services.

It has been identified that there will be insufficient electrical infrastructure to support the proposed buildings, requiring an additional kiosk substation (subject to Ausgrid requirements), requiring further investigation of the current capacity of the local HV network identified in Section 5.1 to support the proposed utility works.

The stormwater management approach for the Senior School Redevelopment confirms that stormwater can be managed in accordance with SSD and Woollahra Council requirements.

This IMP has addressed all aspects of the SEARs items identified in Section 2 of this report.

APPENDIX A: SYDNEY WATER TABLE

Average Daily Water Use by Property Type

Development Type	Development Sub-Type	Key Metric	Metric Unit	Average Demand (L/Metric Unit / Day)
Residential	Single Lot Torrens	Dwelling	Each dwelling	623.00
	Flats Torrens	Net Floor Area	Square Meter	2.36
	High Rise Units	Net Floor Area	Square Meter	3.34
	Single Lot Community	Dwelling	Each dwelling	623.00
Mixed	Residential / Commercial	Combined Floor Area	Each dwelling / Square Meter	Use separate rates for each component
	Commercial / Industrial	Combined Floor Area	Square Meter	Use separate rates for each component
Commercial	Aged Accom - Self Care	Net Floor Area	Square Meter	2.50
	Aged Accom - Hostel	Bed	Each bed	271.00
	Aged Accom - Full Care	Bed	Each bed	271.00
	Childcare	Net Floor Area	Square Meter	3.60
	Hotel / motel / serviced apartments	Room	Each room	359.94
	Office	Net Floor Area	Square Meter	2.27
	Shopping Centre	Net Floor Area	Square Meter	3.00
	Laundry / Dry Cleaner	Net Floor Area	Square Meter	10.50
	Café / Fast Food / Butcher / Deli	Net Floor Area	Square Meter	2.48
	Retail Units	Net Floor Area	Square Meter	2.48
	Medical / Veterinary	Net Floor Area	Square Meter	2.48
	Mechanical Repair	Net Floor Area	Square Meter	2.48
	Car / Boat Sales	Net Floor Area	Square Meter	2.48
	Car Wash	Net Floor Area	Square Meter	9.40
	Club	Net Floor Area	Square Meter	3.77
Industrial	Heavy Process		As required	
	Chemical Manufacturing		As required	
	Printing Manufacturing		As required	
	Beverage Manufacturing		As required	
	Light Factory Unit	Developed floor area	Square Meter	2.82
	Warehousing	Developed floor area	Square Meter	2.82
	Transport / Bus Depot	Site area	Square Meter	0.91
Special Uses	University	Student	Each student	20.00
	School	Student	Each student	20.00
	Hospital	Bed	Each bed	271.00
	Religious Assembles	Developed floor area	Square Meter	1.30
	Government Depot	Site area	Square Meter	0.91

	Community Centre / Library	Floor area	Square Meter	1.84
	Sport Fields with Amenities		As required	
	Park & Reserves		As required	
	Services - Police / Ambulance etc.	Floor area	Square Meter	1.40

APPENDIX B: CRANBROOK SCHOOL POPULATION TABLE

WMH ESTIMATED POPULATION

Project name	Cranbrook School - Horden Precinct	Date	15.08.2017
Project no.	170013	Revision	1

Occupancy Numbers	Use	Area (approximate)	Est. Population	Comment	TOTAL
L00	Meeting room	45	5		700
	Multi purpose hall	1155	60		
	Multi purpose hall seating	175	300	300 seats	
	Sports change (2 no.)	75	NA	Counted elsewhere	
	Theatre	340	250	250 seats	
	Theatre - Stage	115	80	Small symphony orchestra	
	Theatre change (2 no.)	75	NA	Counted elsewhere	
	Workshop	85	5		
L01	Meeting room (2 no.)	35	5		11
	Office	50	6		
L02	Classroom / teaching space (6 no.)	395	156	25 pupils + 1 staff per room	163
	Dining / commons + prefunction space	400	NA	Counted elsewhere	
	Kitchen	130	5	Kitchen staff, users counted elsewhere	
	Office (catering)	15	2		
L03	Classroom (7 no.)	470	182	25 pupils + 1 staff per room	324
	Office (department, house master)	55	5		
	Classroom (2 no. performance)	360	52	25 pupils + 1 staff per room	
	Classroom (orchestral rehersal)	180	80	Small symphony orchestra	
	Meeting room	25	5		
L04	Chapel	280	300	300 seats	342
	Chapel stage	25	40		
	Office / vestry	10	2		
TOTAL			**1540**		**1540**

Note - Infrequent events in the multipurpose hall to cater for up to 1600 people. It is assumed the rest of the building will be mostly empty during these events.

APPENDIX C: ELECTRICAL DEMAND CALCULATIONS

Calculation in accordance with AS/NZS 3000:2007 Table C3

Dist. Group	Load Description	Area (m^2)	Load per m^2 (VA)	Load for whole area (kVA)	Load (A/Phase)
WMH - B1	Plant Room	21.6	15	0.324	0.5
WMH - B1	B1 Coridoors - no AC	228.7	40	9.148	13.2
WMH - L00	Multi Function Hall	1350	100	135	194.9
WMH - L00	Plant Area/ Store Room/Toilets	333	15	4.995	7.2
WMH - L00	Theatre	310	100	31	44.7
WMH - L00	Workshop/Back of House	200	40	8	11.5
WMH - L00	Change Rooms + Green Room + First Aid	258	15	3.87	5.6
WMH - L00	Circulation	380	40	15.2	21.9
WMH - L01	Seating	206	40	8.24	11.9
WMH - L01	Plant/Store Rooms	137	15	2.055	3.0
WMH - L01	Offices/Control Room	88	80	7.04	10.2
WMH - L01	Circulation	389	40	15.56	22.5
WMH - L02	Flat Floor Performance	175	100	17.5	25.3
WMH - L02	OR	168	100	16.8	24.2
WMH - L02	Plant Areas	405	15	6.075	8.8
WMH - L02	Kitchen	274	200	54.8	79.1
WMH - L02	Dining	332	40	13.28	19.2
WMH - L02	Informal Learning/Teaching Spaces/Prefunction Area	621.5	80	49.72	71.8
WMH - L03	Informal Learning/Teaching Spaces	1043	80	83.44	120.4
WMH - L03	Plant Areas	230	15	3.45	5.0
WMH - L04	Chapel	320	100	32	46.2
WMH - L04	Vestry/Office Areas	30	80	2.4	3.5
WMH - L04	Store rooms	19	15	0.285	0.4
ARC - LG	Car Park	3673	10	36.73	53.0
ARC - LG	Plant Areas	184	15	2.76	4.0
ARC - LG	Reception/Circulation	257	40	10.28	14.8
ARC - LG	Meeting Room	36	80	2.88	4.2
ARC - LG	MSB/Comms Rooms	67	200	13.4	19.3
ARC - LG	Gym	650	100	65	93.8
ARC - G	Plant Areas+ Store Rooms	670	15	10.05	14.5
ARC - G	Learn to Swim + Main Pool	2171	100	217.1	313.4
ARC - G	Multipurpose Court	731	100	73.1	105.5
ARC - G	Offices incl. Lifeguards Office & First Aid	77	80	6.16	8.9
ARC - G	Seating	336	40	13.44	19.4

ARC - G	Change Rooms (Public and Pupils)	323	15	4.845	7.0
ARC - G	Circulation	183	40	7.32	10.6
	4 x Lifts				120.0
	Totals	**16876.8**		**983.2**	**1539.2**
				Spare Capacity	0%
	AS3000 Maximum Demand (Non-Domestic, Design Spare Capacity)				**1539.2 Amps/ Phase**

APPENDIX D: ELECTRICAL SUPPLY AUTHORITY CORRESPONDENCE