Discovery Point, Wolli Creek
Concept Plan

SOIL AND WATER MANAGEMENT PLAN

Ref: C0100170-R1

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APPENDIX B: INCLUDED REPORTS

Coffey Geotechnics Pty Ltd (2010) – *Assessment of Groundwater Impacts – Discovery point Development Wolli Creek* – Report GEOTLCOV24013AA-AB to Australand issued 11 June 2010

Parsons Brinckerhoff Pty Ltd (2010) – *Discovery Point Flood Assessment* – Report 2114734A to Australand issued 11 June 2010

REFERENCES

Coffey Geosciences Pty Ltd (2003) – *Interciti Development (Discovery point), Arncliffe – Geotechnical Investigation* – Report S20325/5-AP to Robert Bird + Partners Pty Ltd 15 August 2003

Douglas Partners Pty Ltd (2000) – *Report on preliminary acid sulphate soil and supplementary contamination testing, proposed commercial and residential development, Interciti @ Arncliffe* – October 2000 – Report to Taylor Thomson Whitting Pty Ltd

Environmental & Earth Sciences Pty Ltd (2005) – *Detailed ASS mapping of site 2, contained within the diaphragm wall at the Discovery Point development, Magdalene Terrace, Wolli Creek NSW* – Report No 105034 to Australand Holdings 6 April 2005

MWH+PB (2009) – *Cooks River Flood Study* – Report 24203-040 to Sydney Water Corporation dated 26 February 2009

NSW Department of Environment and Climate Change (2007) – *Practical Consideration of Climate Change* – Issued 25 October 2007

NSW Department of Environment, Climate Change and Water (2009) – *NSW Sea Level Rise Policy Statement* – Issued October 2009

NSW Department of Planning (2008) – *Development near rail corridors and busy roads: Interim Guidelines*

Robert Bird Group Pty Ltd (2007) – *Acid Sulphate Soils Management Plan – Discovery point, Wolli Creek Sites 3 and 4* – Report 03197-15 for Australand issued 2 October 2007.

1. Introduction

A Concept Plan has been prepared for the undeveloped portion of the Discovery Point development. An application for approval of this Concept Plan is to be made under Part 3A of the Environmental Planning and Assessment Act 1979. The NSW Department of Planning has confirmed that the proposed Concept Plan may be assessed under Part 3A and has issued the Director-General's Requirements (DGRs) under Section 75F.

This report has been prepared in response to DGR 13 Drainage and Groundwater, which states:

- *The EA shall address drainage/flooding issues associated with the development/site, including: stormwater, drainage infrastructure and incorporation of Water Sensitive Urban Design measures.*
- *The EA shall provide an assessment of any flood risk on site in consideration of any relevant provisions of the NSW Floodplain Development Manual (2005) including the potential effects of climate change, sea level rise and an increase in rainfall intensity.*
- *The EA shall address any impacts upon groundwater resources, and when impacts are identified, provide contingency measures to remediate, reduce of manage potential impacts.*

In addition, the following requirement is also addressed:

- *The EA must address planning provisions applying to the site, including permissibility and the provisions of all plans and policies contained in "Development Near Rail Corridors and Busy Roads – Interim Guidelines".*

This report also incorporates the following documents required to be submitted with the EA:

- **Stormwater Concept Plan** – illustrating the concept for management;
- **Erosion and Sediment Control Plan** – plan or drawing that shows the nature and location of all erosion and sedimentation control measures to be utilised on the site.

2. Site Description

The Discovery Point site is bounded by the Cooks River to the north, Princes Highway to the east, the Illawarra Railway Line to the west, and Magdalene Terrace and Brodie Spark Drive to the south. The site contains the Wolli Creek railway station and sits over part of the underground railway line (the New Southern Railway Line) running north-east from that station. The site also contains an area of land adjacent to Princes Highway which is listed on the State Heritage Register (SHR). The SHR boundary encompasses a building known as Tempe House, St Magdalene's Chapel, part of Discovery Point Park and a hill known as Mount Olympus. This land is referred to as the Tempe House Precinct.

The original master plan identified nine sites within the overall development. Site 1 (Greenbank) is at the south-eastern corner of the Discovery Point site, and Site 2 (Verge) is located adjacent to and north of Site 1. Site 4 (Vine) is located adjacent to and north of Site 2. All of these sites have frontage to Brodie Spark Drive, which has been extended northwards from the intersection with Magdalene Terrace and Arncliffe Street. Sites 1 and 2 have been completed, and Site 4 is under construction. These 3 sites are therefore excluded from the proposed Concept Plan. However, the proposed drainage system incorporates a significant portion that has already been completed as part of the development of Sites 1, 2, 4 and Tempe House Precinct.

The proposed Concept Plan is shown on the architectural drawing DA3-001 and the indicative Landscape Concept Plan L-MP-02 included in Appendix A to this report. A total of 14 separate buildings are proposed in the balance area of the Discovery Point site, numbered 1 to 14. Buildings 1 to 5 and 14 are located south of the Wolli Creek station, and buildings 6 to 13 are located to the north of the station.

3. Site Access for Construction

Construction access to the site will be from Magdalene Terrace. An existing driveway off Magdalene Terrace has been used for construction of Site 2 (Verge) and can be used for access to the site south of the Wolli Creek railway station. In addition, a roadway is located at the western end of Magdalene Terrace. This roadway and its adjacent footpath currently provide vehicular and pedestrian access to Wolli Creek railway station. This roadway will also be used for site construction access. When construction of the western edge of the southern part of the site needs to proceed, this roadway will need to be closed. However, at all times vehicular access and pedestrian access to Wolli Creek railway station must be maintained. Therefore alternative access routes will be provided, as outlined below.

The Staging Strategy issued by Bates Smart (included in Appendix A) shows the anticipated sequence of construction. The stages below relate to this plan and are indicative only.

In Stage 0, Vine will be completed. Brodie Spark Drive will then have been completed up to the existing bridge crossing the railway tunnel. This will provide an alternative route for construction access to the northern part of the site. However, until the building is constructed up to podium level, a temporary ramp will need to be provided down to existing ground levels.

For Stages 1 to 3, the existing station access road will be maintained. In Stage 3, a temporary turning circle will be built at the end of Brodie Spark Drive. This will provide vehicular access to the station.

In Stage 4, the existing station access will be closed and access for construction will be from the western end of Magdalene Terrace and the culdesac end of Brodie Spark Drive, via the northern end of the existing access roadway which will ultimately become Spark Lane. This will permit construction of building 4. When building 4 is completed to podium level, the roadway along the western edge (Spark Lane) will be graded down to match existing levels at the roadway to the west of the Wolli Creek railway station. This will restore vehicular access to the railway station from that direction. It will also provide construction access for the building works north of the railway station.

The temporary turning circle at the end of Brodie Spark Drive must be maintained until such time as building 5 has been completed, at which time there will be a loop road from Brodie Spark Drive to Spark Lane and back to Magdalene Terrace. However the turning circle may be retained for construction vehicles until Brodie Spark Drive has been extended all the way to Spark Lane and graded down to existing levels adjacent to the railway electrical substation. This provides a loop road for construction vehicles. The temporary turning circle must then be removed for construction of buildings 11 and 13.

Hoardings will be placed around the construction zone for each stage along the interface with Brodie Spark Drive, Magdalene Terrace and Spark Lane as applicable to limit site access and to provide protection to pedestrians.

Specific site access requirements will be provided in future subsequent project applications.

4. Bulk Excavation

The extents of bulk excavation are shown on drawings C0100170-CP-04 and C0100170-CP-05. Typical sections have been taken through the site and are shown on drawing C0100170-CP-06. These drawings are provided in Appendix A to this report. All drawings are conceptual only and subject to detailed design.

The bulk excavation may be divided into three distinct sections.

The proposed basement for the buildings north of the Wolli Creek railway station will have a floor level of RL 2.0m AHD, and an estimated bulk excavation level of RL 1.8m AHD. In this area, there is an earth bund which protects the northern part of Wolli Creek station against floods up to RL 4.3m AHD. Part of this bund will need to be removed for the basement excavation. It is essential that alternative means be provided to maintain the level of flood protection to the Railway Precinct before any section of the existing bund is removed. This may include construction of a temporary wall linking sections of the earth bund. The temporary wall would then be removed after the permanent walls of the basement have been completed.

To the south of the Wolli Creek railway station, an area has been enclosed by a diaphragm wall. This wall was excavated down to rock level and acts to prevent the ingress of groundwater to the basements constructed within the enclosed area. Basement excavation within this area has extended down to RL -7.05m AHD for the lowermost basement of Site 2 (Verge) and Site 4 (Vine), which includes the area beneath Brodie Spark Drive. A 1 in 3 batter extends from natural surface down to this level.

It is proposed to further excavate within this area for basements at two levels. At the northern section, the proposed basement level is RL -1.0m AHD, and excavation would extend down to RL -1.2m AHD. At the southern section, the proposed basement level is RL -3.7m AHD, and the excavation level would be approximately RL -3.9m AHD. The proposed floor level in this section would match the B2 level under Site 2 (Verge).

For the balance area to the south of the Wolli Creek railway station, the proposed basement level is RL 1.8m AHD, and the excavation level is estimated at RL 1.6m AHD, with the exception of the neighbourhood parkland proposed between buildings 2, 3, 5 and 18. In this area, finished surface levels would match podium levels, and fill up to 2.2 metres thick will be required.

All surplus excavated materials will be removed from the site. No filling may be placed in the zone between the northern perimeter of the northern buildings and Cooks River, as this would have an impact on flood levels in the region.

4.1. Acid Sulphate Soil

Potential Acid Sulphate Soil (PASS) has been found at various locations and depths across the Discovery Point site. A summary of the extents of PASS as determined by all testing carried out to date is summarised in the Acid Sulphate Soil Management Plan (ASSMP) prepared for Sites 3 and 4 (as identified on the old master plan) by Robert Bird + Partners (2007).

Drawing 03197-SKC103 from that report is included in Appendix A to this report. It shows the location of all boreholes taken on site, together with the bulk excavation plan proposed under the old master plan. Further boreholes were also drilled by Environmental & Earth Sciences Pty Ltd (2005) within the area enclosed by the diaphragm wall described in the previous section.

All boreholes indicate that no PASS should be encountered during bulk excavation to the levels proposed. All PASS that has been encountered to date is located at much greater depths. However, during construction any material which appears by visual inspection or smell to be possible PASS should be tested on site by a suitably qualified person to determine whether it is PASS before it is carted away.

Management of any PASS that might be encountered during excavation will be dealt with in a separate Acid Sulphate Soils Management Plan, to be prepared before starting excavation on site. This will include advice on the identification and testing of PASS as described above.

4.2. Detailed Excavation

Detailed excavation will occur for building footings, piles, retaining walls and the like.

All detailed excavation will be subject to the same controls regarding erosion control and dust control as for the bulk excavation works.

It is expected that PASS will be encountered during drilling for piers, as the piers will extend to rock through layers of PASS which are known to exist at depths below basement excavation levels. The volumes of PASS which would be removed would be small. Management of the PASS will be addressed in the Acid Sulphate Soils Management Plan discussed above, for each construction stage.

4.3. Excavation near Rail Corridor

The NSW Department of Planning (2008) produced an Interim Guideline for development near rail corridors and busy roads. The guideline requires that excavation of more than 2m below ground within 25m of a rail corridor requires consultation with the rail authority before consent can be granted. Some parts of the proposed basement will be within 25m of the Wolli Creek railway station and the New Southern Railway line, as well as the Illawarra Railway line.

Coffey Geotechnics (2010) were commissioned (inter alia) to investigate the potential effects of excavation for the site development in the vicinity of the rail corridor. Their report is included in Appendix B to this report. They conclude that, with good practice excavation techniques, there would be no impact on the geotechnical performance of railway structures. They also recommend a future geotechnical review of proposed future excavation and shoring details and observation of excavation within 25m of the rail corridor.

All excavation in the vicinity of the rail corridor will be subject to procedures set out in the Rail Development Deed issued by Railcorp.

5. Sedimentation and Erosion Control

Preliminary Erosion and Sedimentation Control Plans C0100170-CP-11 and C0100170-CP-12 have been prepared and are included in Appendix A to this report. Erosion of soil, and the deposition of sediment outside the site, will be controlled by (but not limited to) the measures described below. Details of these measures are shown on drawing C0100170-CP-13 in Appendix A to this report. A detailed methodology will be outlined in subsequent Project Applications.

5.1. Soil Batters

Soil batters in cut and fill will be sloped at 1 vertical to 2 horizontal, in accordance with the recommendations in Coffey Geosciences (2003) report.

Soil batters that will remain for extended periods due to staging considerations will be stabilised against erosion by wind and rain. Methods of stabilisation would include topsoiling and grassing, with or without the use of a biodegradable erosion blanket such as Enviromat. This type of blanket would provide protection against erosion until vegetation becomes established, thereby minimising maintenance costs.

5.2. Soil Adhering to Truck Wheels

Soil adhering to truck wheels will be prevented from leaving the site by the use of a truck shaker grid and a truck wheel wash. These will be located at the exit roadway so that all trucks leaving the site may be inspected and treated before leaving the site.

Water used in the truck wheel wash will be recycled by directing it to a sedimentation basin to allow the settlement of sediments. Sediment will be collected from the sediment basin and scraped off the shaker grid and the truck wheel wash itself. The frequency of sediment removal will depend on the rate at which it collects. Typically, the shaker grid would be scraped off daily, and the sedimentation basin cleaned out weekly.

5.3. Interim Protection

Until all disturbed surfaces are stabilised, the transport of sediment will be minimised by the construction of sediment fences. These will be constructed at the toe of all soil batters and soil stockpiles. Sediment collected behind the fences will be removed periodically so that the weight of collected sediment will not cause distortion and eventual tearing or collapse of the sediment fence fabric.

5.4. Sediment in Site Runoff

Stormwater that falls on the site will be directed to sumps for collection and pumpout. This water will contain silt and suspended soil particles, which must be removed before discharge from the site.

Stormwater will initially be pumped to a sedimentation chamber where sediments will be allowed to settle. Settlement of finer particles will be accelerated by the addition of a flocculating agent such as alum. The water will then pass through a filter medium into a pump chamber. This pump will direct the water to the existing trunk drainage system, or in the case of that part of the site north of the Wolli Creek railway station, direct to Cooks River.

6. Dust Control

Dust may be generated on site as a result of excavation activity, the passage of vehicles, or the passage of wind across unstabilised earth surfaces or constructed surfaces coated with dirt from construction activity. Dust will ultimately be controlled by the stabilisation of earth surfaces with vegetation, by the cessation of construction activity, and by street sweeping as part of regular maintenance following completion. During construction, at the very least, dust will be controlled by the following measures. As for sedimentation and erosion plans, a detailed methodology will be outlined in subsequent Project Applications.

6.1. Bare Earth Surfaces

Bare earth surfaces will be kept damp during construction activity. This will be achieved by the use of water trucks on access roadways and hand-held hoses elsewhere. Water for this purpose will be obtained under licence from street hydrants or by the recycling of water from dewatering operations.

Nominated site personnel will be assigned the task of monitoring the environmental conditions to determine the frequency of water application. The amount of water to be applied must be sufficient to prevent dust being generated and transported by wind, but not enough to make the site slushy or to hamper free movement of vehicles.

At the end of each working day in dry conditions, a final application of water will be sprayed over bare earth surfaces to prevent dust transmission during the night.

6.2. Constructed Surfaces

Workplace Health and Safety regulations stipulate the regular collection of rubbish from site into skips for disposal to approved waste depots. As part of this operation, construction surfaces will be swept regularly (typically weekly, but as site conditions dictate).

Skips for the collection of rubbish will be located in areas with suitable truck access. If these areas are exposed to the wind, they will be kept covered to prevent dust (and other rubbish) from being picked up and conveyed by wind.

6.3. Transported Materials

Materials likely to generate dust will be transported to or from site under cover, or dampened to prevent dust from being picked up and transported by wind.

7. Flooding

7.1. Annual Exceedance Probability

Rainfall intensities have been measured and collated by the Bureau of Meteorology over many years in order to determine the statistical relationship between rainfall of a particular intensity and the frequency of its occurrence. The probability that a particular intensity might be exceeded in a storm in any one year is denoted as its *Annual Exceedance Probability* (AEP). Thus an intensity which has an AEP of 1% has a probability of 0.01 of being exceeded in any one year. This may also be considered as the intensity that might be exceeded on average once every 100 years (the inverse of 0.01). This intensity can thus also be termed as the 100-year *Average Recurrence Interval* (ARI) intensity, and the greatest rate of runoff generated from this rainfall would be termed the *Q100 peak runoff*.

7.2. Previous Flood Advice

In 1999, Rockdale City Council nominated flood levels for the Discovery Point site based on a flood study carried out by Webb McKeown and Associates Pty Ltd (1994) and additional advice which extended the original study for higher ARI and PMF. Council adopted the 200-year ARI flood event as the design standard for the Wolli Creek area. The flood advice and associated planning controls are summarised in the following Table 1.

Condition	Level on AHD
100 year ARI	2.55m
200 year ARI	2.75m
500 year ARI	2.95m
Minimum habitable floor level	3.25m (200-year ARI flood level + 0.3m)
Minimum garage level when unprotected by entry threshold	2.75m (200-year ARI flood level)
Flood proofing level for Railway Precinct (DCP No 45)	4.30m
Probable Maximum Flood (PMF)	5.4m

Table 1. Previous flood advice and controls

7.3. Current Flood Investigation

In 2009 Sydney Water commissioned a new investigation to model Cooks River flooding using more up-to-date techniques involving a combination of two-dimensional (grid) and one-dimensional (linear) modelling. The investigation included a sensitivity analysis to determine the range of possible effects of climate change on flood levels. The report (MWH+PB 2009) analysed flooding for the 2-year, 20-year and 100-year ARI flood events as well as the Probable Maximum Flood (PMF) based on current rainfall and sea level conditions, and modelled the effects of sea level rise of 0.55m and rainfall intensity increases of 10%, 20% and 30% on the 100-year ARI flood.

Since the issue of that report, the NSW Government has issued the *NSW Sea Level Rise Policy Statement* (DECCW 2009) which recommended sea level rise scenarios to be adopted in flood planning investigations. Parsons Brinckerhoff were commissioned to repeat the Cooks River analysis taking into account this policy, include the peak 200-year ARI flood event, and pay particular attention to the Discovery Point site. Their report (Parsons Brinckerhoff 2010) is included in Appendix B to this report.

Flood levels were determined at four points along the Cooks River bank, as shown on Figure 1 (copied in Appendix A to this report). The results of the updated flood study are summarised in Table 2 below.

Location Figure 2	Estimated Flood Levels for the following flood cases (in m on AHD)								
	Current sea level and rainfall intensities			100-year ARI with climate change scenarios					
				0.4m Sea Level Rise			0.9m Sea Level Rise		
	100-year ARI	200-year ARI	PMF	Intensity +10%	Intensity +20%	Intensity +30%	Intensity +10%	Intensity +20%	Intensity +30%
1	2.2	2.4	3.6	2.5	2.6	2.6	2.7	2.8	2.8
2	2.2	2.4	3.5	2.5	2.6	2.6	2.7	2.7	2.8
3	N/A	2.4	3.5	2.5	2.5	2.6	2.7	2.7	2.8
4	2.2	2.4	3.5	2.4	2.5	2.5	2.7	2.7	2.8

Table 2. Predicted Flood Levels

Flood levels calculated to current sea level and rainfall intensities are lower than the earlier studies had estimated. In fact, the earlier 100-year ARI flood levels appear equivalent to the new flood levels for the 100-year ARI climate change scenario which included 0.4m sea level rise and 20% increase in rainfall intensity.

The flood modelling showed that the proposed development will encroach slightly on the floodplain in the 100-year ARI flood event. This can be seen on Figure 2 in the Parsons Brinckerhoff report (copied in Appendix A to this report). The volume of flood storage which has been lost has been estimated at roughly 500 cubic metres. The effect of this loss of storage would be to raise flood levels locally (between the Princes Highway and the Illawarra Railway bridge) by less than 10mm, and is thus considered negligible. However, to minimise further loss of flood plain storage, buildings should not move closer to the Cooks River bank than currently indicated. No filling will be placed in the area between the buildings and the river bank.

The loss of flood storage would increase with higher ARI, and as a result of climate change as modelled in the flood report. The extent of encroachment in the 200-year ARI flood event is shown in Figure 5 of the Parsons Brinckerhoff report (also copied in Appendix A) and this is typical of the encroachment in climate change scenarios. However, for all ARI events modelled in the report, the effects of loss of flood storage are expected to be minor and localised.

Mapping of flood velocities in the flood report shows that velocities are typically less than 0.25 m/sec adjacent to the development. Effectively, the site is outside the main flow channel and not affected by velocities that could cause scour even when sea level rise of 0.9 metres coincides with 30% increase in rainfall intensity.

For the PMF flood case, flood levels are dramatically lower than what had previously been estimated (RL 3.5m compared to RL 5.4m). However, the quoted PMF flood level is measured at the river bank, rather than within the Discovery Point site. Reference to Figure 26 in the Parsons Brinckerhoff report (copied in Appendix A to this report) shows that in the PMF flood event, flood water would overtop the Illawarra Railway Line and enter the Discovery Point site at approximately RL 5.0m. The proposed levels along Spark Lane, adjacent to the railway line, would be generally higher than RL 5.0m, and fall to the north or to the south. This would tend to prevent flood waters entering the site by diverting the flows to the north and south.

However, in the vicinity of the Wolli Creek railway station, Spark Lane drops down to match existing driveway levels (approximately RL 4.5m). This is below RL 5.0m and would act to funnel the PMF flood waters into the Railway Precinct. This would overwhelm the railway station pumpout system and result in catastrophic flooding of the railway tunnel. To prevent this from happening, the levels along the boundary of the Illawarra Railway line will be raised for the full extent of the lower section of Spark Lane. This would take the form of garden beds or a concrete wall. The flood water would back up against this barrier rather than overflow the railway embankment as a weir, so the flood level at the barrier would be approximately the same as on the western side of the railway line, at RL 5.2m. Accordingly the flood “barrier” garden / wall would have a minimum height of RL 5.2m AHD.

Provision of this barrier to overland flow would increase the level of protection of the Wolli Creek railway station to flooding. The currently quoted level of protection is 1 in 10,000 years. The level of protection would increase to the Probable Maximum Flood.

8. <u>Stormwater Drainage</u>

8.1. General Design Principles

The design of the stormwater system for this site has and will be based on relevant national design guidelines, Australian Standard Codes of Practice, the standards of Rockdale City Council, and accepted engineering practice.

Runoff from buildings will generally be designed in accordance with AS 3500.3 National Plumbing and Drainage Code Part 3 – Stormwater Drainage.

Overall site runoff and stormwater management will generally be designed in accordance with the Institution of Engineers, Australia publication “Australian Rainfall and Runoff” (1987 Edition), Volumes 1 and 2 (AR&R 1987).

8.2. Trunk Stormwater Drainage

The proposed stormwater drainage network is shown on drawings C0100170-CP-02 and C0100170-CP-03 in Appendix A to this report.

The overall network is divided into two separate systems as described on the next page:

- System 1: The catchment north of the Wolli Creek station and railway line, which drains to two outlets to the Cooks River (the existing one at the north-east corner of the site as described below, and a new outlet at the north-west corner of the site); and

- System 2: The balance of the site, which drains through the Tempe House Precinct and discharges via an existing stormwater outlet to the Cooks River.

System 1 has been sized to collect and convey the runoff from the peak 20-year Average Recurrence Interval (ARI) storm event. Flows in excess of the pipe system capacity would travel by overland flow to Cooks River. The gutters and drainpipes for all buildings which drain to this system will be designed in accordance with AS 3500.

System 2 has been designed to collect and convey the runoff from the peak 100-year ARI storm event. Most of this system has already been built and is operational. This includes most of the drainage system in Brodie Spark Drive and all the drainage system in Magdalene Terrace and downstream through Tempe House Precinct. Flows in excess of the system capacity in Magdalene Terrace would travel by overland flow south along Mount Olympus Boulevard and Arncliffe Street. The gutters and downpipes for all buildings which drain to this system will be designed to the 100 year ARI design standard.

The north-eastern discharge point from System 1 connects to the outlet from System 2. This minimises the number of stormwater outlets to Cooks River. The capacity of System 2 has been checked and is unaffected by this additional flow.

8.3. Climate Change

According to research described by the Intergovernmental Panel on Climate Change (IPCC) and accepted by the New South Wales Government, the effects of Climate Change will be manifested in Sea Level Rise and Increased Rainfall Intensities.

The extents of predicted Sea Level Rise to be taken into account in the assessment of new developments have been set out in the NSW Sea Level Rise Policy Statement (DECCW 2009). This states that consideration must be made for the following Sea Level Rise scenario:

- By the year 2050, a rise in sea level of 0.4 metres relative to 1990 mean sea level; and

- By the year 2100, a rise in sea level of 0.9 metres relative to 1990 mean sea level.

The extents of Increased Rainfall Intensities have been modelled by IPCC on a world-wide basis, and further study is being undertaken by CSIRO to apply this data to the Sydney region. Current advice is that the overall precipitation along the eastern seaboard of Australia would reduce slightly, but rainfall intensities would tend to increase. At present, no definitive policy has been issued by the NSW government. However DECC (2007) has recommended that a sensitivity analysis should be undertaken for a range of increased rainfall intensities to determine the effects on proposed developments and their drainage systems.

Accordingly, System 2 (as defined in the previous section) has been analysed for rainfall intensity increases of 10%, 20% and 30% relative to the current design rainfall intensities published by the Bureau of Meteorology. This has been repeated for each tailwater condition: current Mean High Water Springs (MHWS), MHWS plus sea level rise of 0.4m, and MHWS plus sea level rise of 0.9m.

When the capacity of pits or pipelines is exceeded, overland flow occurs. The resulting system bypass flows (in cubic metres per second) for each scenario are summarised in Table 3 below.

Design Rainfall Intensities	Outlet Tailwater Level : Mean High Water Springs		
	Current MHWS RL 0.675m AHD	2050 scenario (+0.4m) RL 1.075m AHD	2100 scenario (+0.9m) RL 1.575m AHD
100-year ARI (unfactored)	0.006	0.006	0.006
100-year ARI + 10%	0.008	0.008	0.008
100-year ARI + 20%	0.010	0.010	0.010
100-year ARI + 30%	0.135	0.135	0.135

Table 3. System Bypass Flows

The results indicate that:

a. The existing system has sufficient capacity for a 20 percent increase in current rainfall intensities without increased surcharge.

b. The system is essentially unaffected by sea level rise. This is because there are two steps totalling nearly 0.9m in the existing trunk drainline, where the drainline crosses over a bank of telecommunications cables and where the drainline steps up to Site 1 (podium) level. As a result, the Hydraulic Grade level with higher tailwater level will rise to match pipe obvert levels. This can be seen on the longitudinal section (drawing C0100170-CP-07 in Appendix A to this report). There would be increased depths of ponding at two low points within the Tempe House precinct. These occur in areas which have been kept at a relatively low ground level to preserve heritage structures. The increased depth of ponding will have no harmful impact, as these areas are not normally accessible to the public.

c. The peak overflow of the system (135 litres per second) occurs in Magdalene Terrace at the intersection with Arncliffe Street. The overflow will potentially increase the extent of flooding which already occurs in this area. However, the peak overflow is relatively small, representing approximately 9% of the catchment runoff, and only occurs when rainfall intensities increase by more than 20%. In terms of the overall catchment to Arncliffe Street, the overflow is estimated to increase the catchment runoff by less than 2%. The effects on flood levels would be minimal.

8.4. Railway Precinct Discharge

The area immediately surrounding the Wolli Creek Railway Station will not drain into the stormwater drainage system proposed for the Discovery Point development. This is because the proposed stormwater drainage will be located within or suspended just beneath the podium level of the new development, which will be constructed at higher levels than existing levels in the vicinity of the railway station.

The catchment which will be excluded from the proposed drainage system may be referred to as the Railway Precinct catchment. It is divided functionally into two parts.

Stormwater runoff from the sub-catchment to the south of the railway station is currently collected and pumped directly to Cooks River via a pumping station fitted with dual pumps and a 300mm diameter discharge pipeline.

Stormwater runoff from the sub-catchment to the north of the railway station is collected within a bund and discharges directly to Cooks River by a gravity pipeline. This gravity pipeline grades from an invert level of RL 0.92m AHD within the bunded area, to its outlet at approximately RL 0.17m AHD.

It is proposed that both existing systems will be maintained. However, the gravity pipeline from the northern sub-catchment may clash with the proposed basement or building structures that may be located along the pipeline alignment. This would require protection and/or relocation of the pipeline. Its existing capacity must not be reduced, and must be at least the 100-year ARI runoff from that portion of the Railway Precinct catchment. Details of any proposed relocation and/or augmentation will be outlined in future Project Application stages.

8.5. Rainwater Harvesting

A number of initiatives are being considered in relation to ESD measures for reduction in water demand by the development. The most important of these is the proposal to establish a black water treatment plant within the site for sewage treatment and sewer mining. This would generate a quantity of water for non-potable uses within the development.

In the event that the black water treatment plant option might not be pursued, or if the volume of non-potable water demand exceeds the output of the plant, rainwater harvesting tanks would be provided for each proposed building.

The water stored in the rainwater harvesting tanks would typically be used for toilet flushing and irrigation of landscaping. The size of each tank will be determined by the Hydraulic Consultants based on historical records of the average rainfall per fortnight. The volume of each tank will be proportional to the roof catchment area. The tanks would be topped up from the potable water main system when the volume stored reduces to 10% of full capacity.

It has been suggested that some buildings may have green roofs – that is, rooftop garden planting. This is a significant ESD initiative, as it reduces runoff from the building and provides insulation to the top floor of the building. Where green roofs are provided, the demand for non-potable water would increase.

The need for non-potable water storage tanks, and the sizes of those tanks, would be determined at detailed project application stage, having regard to the volume available from sewer mining, and the demand based on the final mix of unit sizes, numbers of fixtures, and areas of landscaping.

8.6. Water Sensitive Urban Design (WSUD)

Water Sensitive Urban Design aims to reduce the effect of development on the water balance of the site. It does so by filtration of runoff to remove pollutants and divert stormwater to vegetation rather than simply collect all runoff to the piped system. This tends to reduce peak discharges and reduces the level of fine particulate and dissolved pollutants in site stormwater discharge.

The opportunities for WSUD on this development are constrained, because of the extent of suspended podium structures over the site. However, it is proposed that they be incorporated wherever possible. These initiatives are in addition to other ESD initiatives that are being explored as part of the Concept Plan.

WSUD initiatives being investigated include:

- Bioretention swales at the perimeter of the parkland south of Wolli Creek railway station, to treat stormwater runoff from adjacent roads;
- Grading of surfaces towards soft landscaping elements to provide direct watering and thereby minimise the need for irrigation; and
- Provision of sand filter strips to treat site runoff at tree pits.

It should be noted that the sand filters provided at tree pits will not be true bioretention treatment devices as defined in standard WSUD design guidelines. Bioretention treatment devices incorporate specific vegetation that treats the stormwater, which is subsequently diverted to the stormwater system and not to groundwater. These filters would remove pollutants without biological treatment, and the filtered water would be available for the tree planting.

8.7. Water Quality Controls

The current stormwater master planning provides for three points of stormwater discharge from the Discovery Point site to the Cooks River.

An existing stormwater outlet discharges the stormwater conveyed through the Tempe House Precinct. A Gross Pollutant Trap (GPT) of the Ecosol in-line type has been provided to trap gross pollutants, oils and sediments. This GPT has been located so that the invert of the pipe on the downstream side of the GPT is above the Highest Astronomical Tide (HAT) level. This ensures that the operation of the GPT is not affected by tidal fluctuation. A trash basket was located further downstream, just before the outlet, to collect litter from the catchments downstream of the GPT.

Two similar GPTs can be provided just upstream of the outlet from each of the two future sections of the stormwater drainage system servicing the catchment north of the Wolli Creek railway station. In each case, the invert level of the pipe discharging from the GPT will be above HAT. The GPTs will be sized in future project applications to treat the runoff from all storms up to the storm event that occurs on average twice per year (sometimes referred to less precisely as the 6-month ARI storm event). The level of pollutant removal would typically be as follows (Table 4):

Type of Pollutant	**Level of removal**
Gross Pollutants exceeding 1.5mm in size (ie cigarette butts, vegetation)	95%
Surface oil	95%
Sediment greater than 0.2mm size	95%
Total Suspended Solids	90%
Total Phosphorus	30%
Total Nitrogen	10%

Table 4. GPT Efficiency

It is essential that all trapped pollutants be retained to prevent remobilisation by following storm events. The Ecosol units specified have large storage volumes for litter, sediment and surface oils.

GPTs would be cleaned by suction truck, rather than by basket removal, to avoid spillage. This also means that trucks do not need to drive right up to the GPT for waste removal. Typically suction trucks can clean GPTs with hoses up to 30 metres long. The locations of GPTs are indicatively shown on drawing C0100170-CP-03 and are within this distance from the street network.

9. <u>Groundwater</u>

Previous geotechnical investigations by Coffey Geosciences (2003) and Douglas Partners (2000) recorded water table levels in boreholes taken below water table level across the Discovery Point site. The highest water table levels measured within the site were RL 1.5m AHD south of the Wolli Creek railway station and RL 1.15m north of the railway station.

Coffey Geotechnics (2010) were commissioned (inter alia) to investigate the effects of site development, climate change and flooding on water table levels and groundwater resources. Their report is included in Appendix B to this report. The report recommends monitoring of water table levels prior to construction to confirm the long-term water table levels for design purposes. The report also concludes that:

- The proposed development would have negligible impact on water table levels and no impact on existing bores.
- Long-term water table levels would rise by approximately the same height as sea level rise, but the gradient of the water table surface would reduce slightly with increased distance from Cooks River in response to predicted reduced annual rainfall.
- Groundwater levels will rise for a short time in response to rainfall events and river flooding.

Detailed design of the building basements must take into account both these long-term and short term variations in water table levels.

Subfloor drainage systems will generally be provided under basement floors in the proposed development. In addition, drainage will be used behind basement walls that are earth retaining. Both subsoil drainage systems will connect to basement sumps, where water will be collected and pumped to the trunk drainage system.

The purpose of these drainage systems will be to collect seepage under and behind the building elements which would otherwise result in unacceptable damp conditions within the buildings. They will also relieve excessive hydrostatic pressures which, if not relieved, could result in structural damage.

The adopted standard for climate change for this development is the year 2050 scenario (sea level rise of +0.4m relative to 1990 levels). Based on current data, the basements will be constructed above long-term water table levels, even allowing for the water table rise in response to the adopted climate change scenario. However, short-term rises in the water table would occur in response to rainfall events and flooding, particularly at or near the river edge. The subsoil drainage system including the basement pumpout system will be designed to reduce the water table levels in the area immediately adjacent to the building to reduce hydrostatic pressures within the design parameters of the structure. Measures can be implemented to minimise groundwater flows into the subfloor and retaining wall drainage systems. However, if detailed analysis indicates that the required drainage system and pumpout rate would be excessive, the basement floors and walls may need to be designed for additional hydrostatic pressures. These matters will be investigated and resolved with detailed design.

10. Dewatering

10.1. Dewatering During Construction

Borehole records indicate that all bulk excavation will be above existing water table levels. Accordingly, lowering of the water table by pumping out groundwater will not be required during construction. The only dewatering required will be removal of the minor seepage flows into drilled piers. Water that is pumped out from piers will be treated in a similar fashion to site stormwater runoff, as described in Section 5.4, before discharge from site.

10.2. Dewatering after Completion

As described in section 9 on the previous page, subfloor drainage and retaining wall backfill drainage will be provided to relieve hydrostatic pressures that would otherwise be generated on walls and basement floors in response to raised water table levels following rainfall or river flood events. The water collected by these drainage systems would be pumped from the basements to the stormwater drainage system. This dewatering will have no impact on long-term water table levels.

11. Conclusions

This report, with the subconsultant reports attached, has addressed the Director-General's Requirements as detailed in the introduction. The results may be summarised as follows.

a. A concept design of the proposed stormwater drainage system has been presented. The system will comply with previous design constraints and will place no additional burden on existing infrastructure.

b. The stormwater drainage system will not be affected by sea level rise up to 0.9m (NSW year 2100 scenario). In the worst case rainfall intensity increase of more than 20%, a small amount of stormwater will bypass the system into the Arncliffe Street drainage system, but the volume would be so small as to have minimal impact.

c. The proposed development will be essentially unaffected by river flooding in the 200-year ARI design event, even allowing for climate change. Habitable floor levels will be above the PMF. Wolli Creek railway station will be protected to the PMF.

d. The development footprint will encroach slightly into the Cooks River flood plain for floods in excess of the 100-year ARI event. However the associated loss of flood storage will result in negligible flood level increase in the 100-year ARI flood event and only small, localised flood level increases in the 200-year ARI and 100-year plus climate change flood events. These will not impact on existing development.

e. The proposed development will have negligible impact on long-term water table levels and no impact on groundwater resources.

f. Sea level rise will result in higher water table levels. Based on current water table data, for the adopted design scenario (NSW year 2050 scenario with sea level rise of 0.4m) long-term water table levels would stay below proposed basement levels.

g. Flooding and rainfall can have a short-term impact on water table levels. The impact of these short-term increases on building basements in specific areas (for example, those basements closest to river banks) will be controlled by appropriate detail design in future project application stages.

h. No adverse impacts on road and rail infrastructure are expected provided construction is in accordance with good engineering practice.

i. Standard erosion, sedimentation and dust controls will be implemented during construction.

APPENDIX A – DRAWINGS

APPENDIX B – INCLUDED REPORTS