J. WYNDHAM PRINCE CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

ABN 67 002 318 621

Our Ref: 9600_PL_Rural_WQ_RevC.docx
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18 December 2013

Penrith Lakes Development Corporation Pty Ltd
PO Box 457
Cranebrook NSW 2749

Attn: **Mr Chad Jackson**

Subject: **Penrith Lakes Proposed Rural Subdivision – Water Quality Assessment**

Dear Chad,

As requested, J. Wyndham Prince have investigated the water quality requirements in support of a proposed Development Application for the rural subdivision with the Penrith Lakes land. The proposed development is shown on Figure 1 (attached) and includes the creation of approximately 138 rural lots with an approximate minimum area of two (2) hectares each, along with the roads for access.

The roads are generally to be located on ridge lines within the site so that stormwater sheds off through the lots before discharging to the lakes scheme and ultimately to the Nepean River. A typical lot within the proposed rural subdivision has a 100 metre wide frontage and is 200 metres deep. Therefore, the lots will effectively act as a buffer or swale to treat stormwater runoff from the road.

There are three areas within the development where runoff from the road does not shed across the rural lots before entering the lakes, or where the road is not located on the ridge and flows from the lots sheds toward the road and will be intercepted by a table drain. In these cases, swales and/or bioretention systems are proposed to treat the stormwater runoff to the appropriate pollutant removal targets. The three areas are marked as “A”, “B” and “C” on the attached Figure 1.

The pollutant reduction loads have been assessed in accordance with the Department of Environment, Climate Change and Water’s “*Managing Urban Stormwater – Environmental Targets / Treatment Techniques”* – October 2007. The pollutant reduction targets are shown in Table 1 below. The stormwater runoff pollutant concentrations have also been assessed in accordance with Penrith Lakes Development Corporation’s water quality targets, which are shown in Table 2 below.

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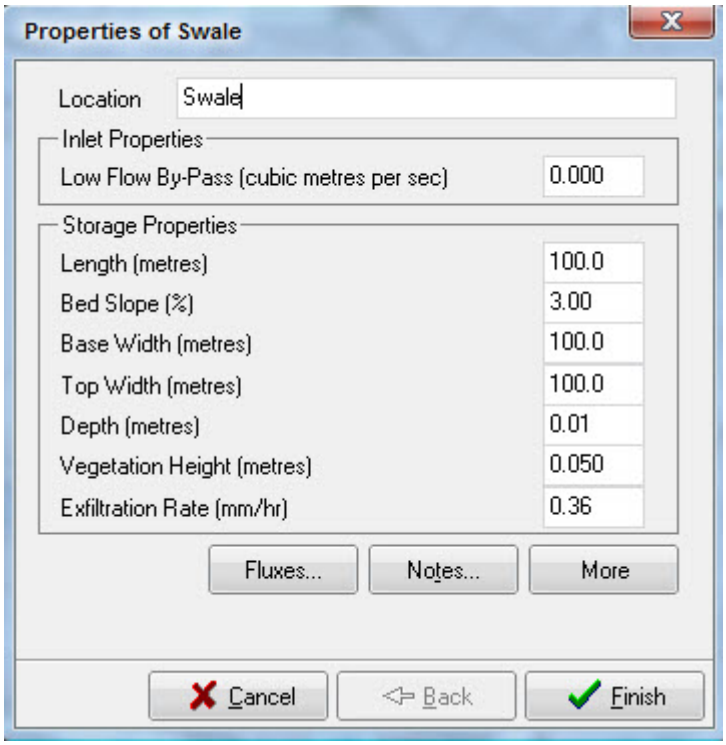
Table 1 – Stormwater Quality Objectives

ENVIRONMENTAL STORMWATER OBJECTIVES[1,2]					
	WATER QUALITY % reduction in pollutant loads[3]				ENVIRONMENTAL FLOWS – Stream erosion index [4]
	Gross Pollutants (> 5mm)	Total suspended solids	Total phosphorus	Total nitrogen	
Stormwater management objective	90	85	65	45	3.5 – 5.0 [5]
'Ideal' stormwater outcome[6]	100	95	95	85	1

Table 2 – PLDC Water Quality Targets

	PLDC Target Water Quality
Suspended Solids	<25mg/L
Total Nitrogen	<0.7mg/L
Total Phosphorus	<0.025mg/L

To estimate the pollutant loads and reductions where the roads are located on the crests, a typical rural lot and half road have been modelled in MUSIC Version 5. The road has been conservatively modelled as 100% impervious, while the lot has been conservatively modelled as 10% impervious (2000m^2 of impervious area). The rear 100 metres has been modelled as a swale treatment node with the following conservative properties:



For the areas where stormwater is intercepted by catch drains, the swale / bioretention properties are summarised in Table 3 below.

Table 3 – Swale and Bioretention Properties

	Road A	Road B	Road C
Swale Properties			
Length (m)	230	370	-
Bed Slope (%)	0.5	0.5	-
Base Width (m)	1	1	-
Top Width (m)	5	5	-
Depth (m)	0.5	0.5	-
Bioretention Properties			
Extended Detention Depth (m)	0.3	0.3	0.3
Storage Surface Area (m2)	30	10	70
Filter Area (m2)	30	10	70
Saturated Hydraulic Conductivity (mm/hr)	100	100	100
Filter Depth (m)	0.5	0.5	0.5

The rainfall-runoff parameters and pollutant concentrations adopted in the modelling are consistent with the Draft NSW MUSIC Modelling Guidelines[1].

The MUSIC model layout for the typical case where the road is located on the crest is shown in Plate 1 below.

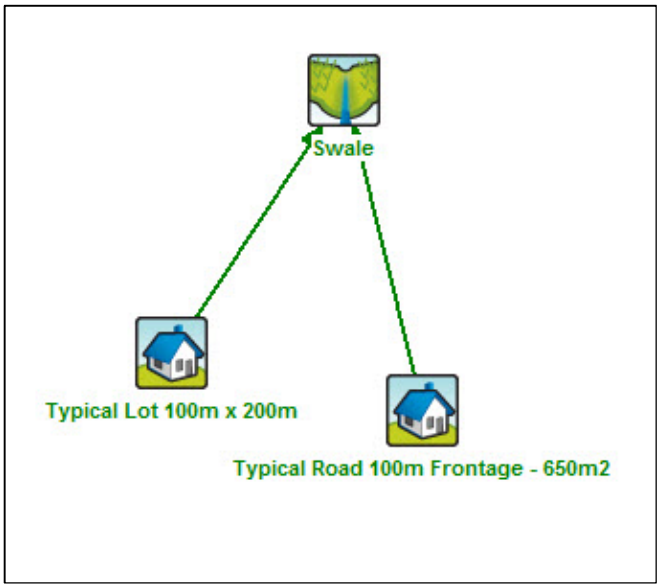


Plate 1 – MUSIC Model Layout for Typical 2ha Lot and Road Frontage

The MUSIC model layout for areas where stormwater runoff from the roads is intercepted by catch drains is shown in Plate 2 below.

[1] Sydney Metropolitan Catchment Management Authority / BMT WBM – Draft NSW MUSIC Modelling Guidelines (2010)

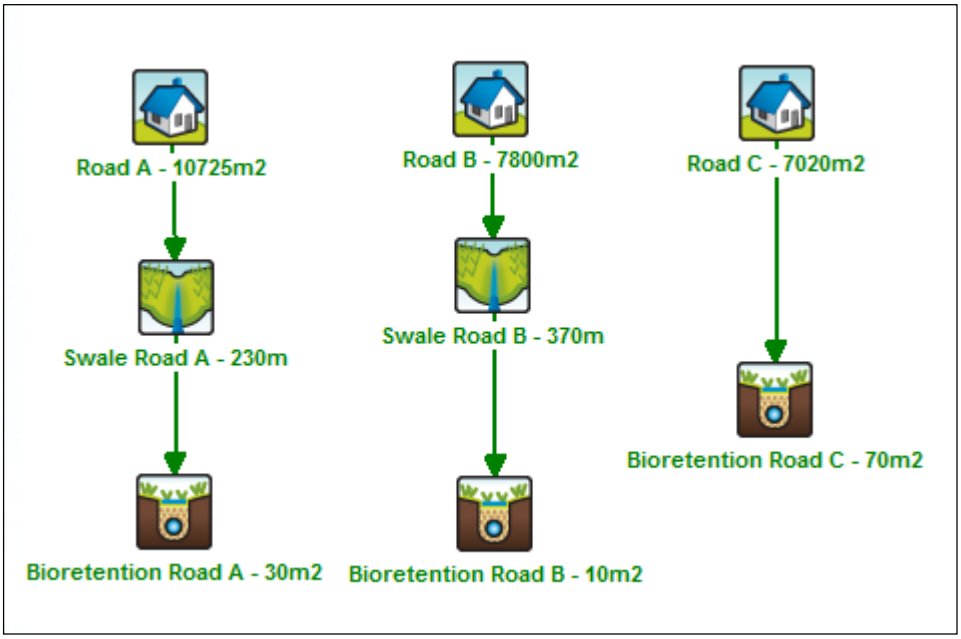


Plate 2 – MUSIC Model Layout Where Stormwater Runoff from the Road is Intercepted By Catch Drains

The MUSIC modelling utilises 6 minute rainfall data obtained from the Bureau of Meteorology for the Richmond area. Rainfall data for Penrith is available, however it is a short data set that is not representative of the long term statistical data due to a large number of dry years from the drought period. The Richmond data set from 1980 – 1990 provides a good representation of the long term statistical data for the Penrith area and was therefore adopted in the assessment.

Total annual pollutant load estimates and concentrations were derived using MUSIC for the typical rural lot and half road, incorporating the rear of the lot as a swale. The estimated annual pollutant loads, reductions and concentrations delivered by the proposed management system for the typical case are presented in Table 4.

Table 4 – Summary of Mean Annual Pollutant Loads and Reductions Typical Rural Lot and Half Road

	Mean Annual Loads (kg/yr)			
	GP	**TSS**	**TP**	**TN**
Typical 2ha Lot & Half Road				
Total Development Source Loads	85.5	679	1.37	9.7
Minimum Reduction Reqd. (%)	**90%**	**85%**	**65%**	**45%**
Minimum Reduction Required (kg/yr)	77.0	577	0.89	4.35
Total Residual Load to Penrith Lakes	0	72	0.32	3.17
Total Reduction Achieved (kg/yr)	85.5	607	1.05	6.50
Total Reduction Achieved (%)	**100.0%**	**89.4%**	**76.7%**	**67.2%**
	Mean Concentrations (mg/L)			
	GP	**TSS**	**TP**	**TN**
PLDC Target Water Quality Concentrations	N/A	<25mg/L	<0.025mg/L	<0.7mg/L
Concentrations Achieved	N/A	0.421	0.004	0.041

Total annual pollutant load estimates and concentrations were also derived using MUSIC for the three areas ("A-C" on Figure 1) where the stormwater runoff is intercepted by catch drains, rather than shed through the lots. The estimated annual pollutant loads, reductions and concentrations delivered by the proposed management system for these three areas are presented in Tables 5 - 7.

Table 5 – Summary of Mean Annual Pollutant Loads and Reductions Area A

	Mean Annual Loads (kg/yr)			
	GP	**TSS**	**TP**	**TN**
Road A				
Total Development Source Loads	217	2,830	4.63	19.0
Minimum Reduction Reqd. (%)	**90%**	**85%**	**65%**	**45%**
Minimum Reduction Required (kg/yr)	195.3	2,406	3.01	8.55
Total Residual Load to Penrith Lakes	0	99.6	0.888	10.4
Total Reduction Achieved (kg/yr)	217.0	2,730	3.74	8.60
Total Reduction Achieved (%)	**100.0%**	**96.5%**	**80.8%**	**45.3%**
	Mean Concentrations (mg/L)			
	GP	**TSS**	**TP**	**TN**
PLDC Target Water Quality Concentrations	N/A	< 25	< 0.025	< 0.7
Concentrations Achieved	N/A	1.66	0.023	0.361

Table 6 – Summary of Mean Annual Pollutant Loads and Reductions Area B

	Mean Annual Loads (kg/yr)			
	GP	**TSS**	**TP**	**TN**
Road B				
Total Development Source Loads	158	2,070	3.40	14.0
Minimum Reduction Reqd. (%)	**90%**	**85%**	**65%**	**45%**
Minimum Reduction Required (kg/yr)	142.2	1,760	2.21	6.30
Total Residual Load to Penrith Lakes	0	73.9	0.662	7.51
Total Reduction Achieved (kg/yr)	158.0	1,996	2.74	6.49
Total Reduction Achieved (%)	**100.0%**	**96.4%**	**80.5%**	**46.4%**
	Mean Concentrations (mg/L)			
	GP	**TSS**	**TP**	**TN**
PLDC Target Water Quality Concentrations	N/A	< 25	< 0.025	< 0.7
Concentrations Achieved	N/A	1.83	0.023	0.356

Table 7 – Summary of Mean Annual Pollutant Loads and Reductions
Area C

	Mean Annual Loads (kg/yr)			
	GP	**TSS**	**TP**	**TN**
Road C				
Total Development Source Loads	142	1,830	3.05	12.5
Minimum Reduction Reqd. (%)	**90%**	**85%**	**65%**	**45%**
Minimum Reduction Required (kg/yr)	127.8	1,556	1.98	5.63
Total Residual Load to Penrith Lakes	0	253.0	0.845	6.29
Total Reduction Achieved (kg/yr)	142.0	1,577	2.21	6.21
Total Reduction Achieved (%)	**100.0%**	**86.2%**	**72.3%**	**49.7%**
	Mean Concentrations (mg/L)			
	GP	**TSS**	**TP**	**TN**
PLDC Target Water Quality Concentrations	N/A	< 25	< 0.025	< 0.7
Concentrations Achieved	N/A	1.79	0.023	0.346

The performance of the proposed water quality management strategy for the typical two (2) hectare lot and half road obtained from the MUSIC model, as summarised in Table 4, shows that the proposed sheet flows across grassed areas that will occur within the development will be sufficient to ensure that the target reductions identified in the *Department of Environment, Climate Change & Water's 'Managing Urban Stormwater - Environmental Targets/ Treatment Techniques - October 2007'* publication are achieved. It is also noted that the resulting pollutant load reductions meet the requirements of Penrith City Council's Draft Water Sensitive Urban Design Policy (2013). The pollutant concentrations for this arrangement also achieve compliance with PLDC's water quality targets.

The performance of the proposed water quality management strategy for the three areas where stormwater flows are intercepted by catch drains, as summarised in Tables 5 – 7, show that the proposed swales and/or bioretention treatment systems are sufficient to ensure that the target reductions identified in the *Department of Environment, Climate Change & Water's 'Managing Urban Stormwater - Environmental Targets/ Treatment Techniques - October 2007'* publication are achieved. The pollutant concentrations for this arrangement also achieve compliance with PLDC's water quality targets. A bioretention media bed with low orthophosphate content (< 35 mg/kg) is required to achieve the TP concentrations.

Should you have any queries regarding this matter please do not hesitate to contact me.

Yours faithfully
J. WYNDHAM PRINCE

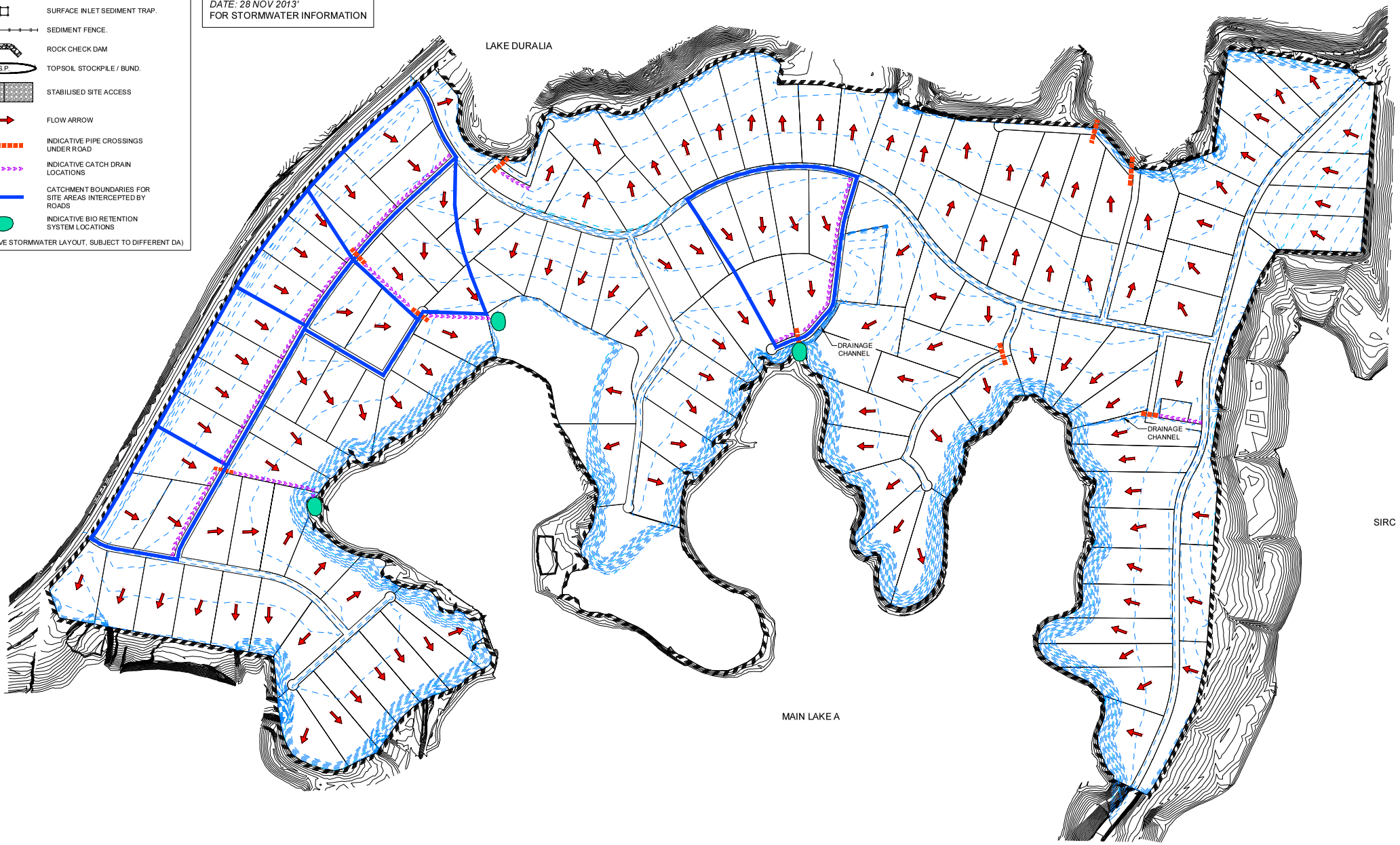
DANIEL GARDINER
Senior Water Resources Engineer

LEGEND

- FILTER ROLLS (AT KERB INLET PIT)
- SURFACE INLET SEDIMENT TRAP.
- SEDIMENT FENCE.
- ROCK CHECK DAM
- S.P. — TOPSOIL STOCKPILE / BUND.
- STABILISED SITE ACCESS
- FLOW ARROW
- INDICATIVE PIPE CROSSINGS UNDER ROAD
- INDICATIVE CATCH DRAIN LOCATIONS
- CATCHMENT BOUNDARIES FOR SITE AREAS INTERCEPTED BY ROADS
- INDICATIVE BIO RETENTION SYSTEM LOCATIONS

(INDICATIVE STORMWATER LAYOUT, SUBJECT TO DIFFERENT DA)

NOTE:
REFER TO REPORT:
'WATER QUALITY ASSESSMENT
9600_PL_RURAL_WQ_B
DATE: 28 NOV 2013'
FOR STORMWATER INFORMATION



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CLIENT: PENRITH LAKES

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ISSUED FOR DA APPROVAL
NOT FOR CONSTRUCTION

PENRITH LAKES
PROPOSED RURAL SUBDIVISION
STORMWATER MANAGEMENT PLAN

PLAN No: 9600/DA11 C
FILE No: 9600DA11
SHEET SIZE: A1 ORIGINAL

AMENDMENT	DES	DRN	CKD	APR	DATE
C LEGEND AMENDED	DJH	LVD	AM	MS	28/02/14
B ISSUE FOR DA APPROVAL	AM	NW			26/1 1/13
A ISSUED FOR CLIENT REVIEW	AM	NW			25/10/13

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