



**LEES
ROXBURGH**
Consulting Engineers

LEES ROXBURGH LIMITED
The Genesis Centre, Science Park South
Birchwood, Warrington WA3 7BH
Tel: 01925 812898 Fax: 01925 838864
Email: office@leesroxburgh.co.uk
Website: www.leesroxburgh.co.uk

5538

Hayhurst Rd, Whalley

Drainage Calculations

For Bellway Homes

November 2014

Network 1 - Surface Water Design

Lees Roxburgh Limited		Page 0
The Genesis Centre Science Park South Birchwood WA3 7BH	5538 Whalley Appraisal	
Date November 2014 File appsws 04.08.14...	Designed by Chris Be... Checked by	
Elstree Computing Ltd	Network W.12.6	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for APPSWS 04.08.14.SWS

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	Add Flow / Climate Change (%)	10
M5-60 (mm)	19.000	Minimum Backdrop Height (m)	0.200
Ratio R	0.300	Maximum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	5	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	0.75
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500
PIMP (%)	100		

Designed with Level Soffits

Network Design Table for APPSWS 04.08.14.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	32.083	0.802	40.0	0.064	5.00	0.0	0.600	o	225
1.001	25.307	0.633	40.0	0.056	0.00	0.0	0.600	o	225
2.000	30.205	0.076	397.4	0.156	5.00	0.0	0.600	o	900
2.001	20.552	0.051	400.0	0.074	0.00	0.0	0.600	o	900
1.002	22.754	0.057	399.2	0.058	0.00	0.0	0.600	o	900
1.003	18.491	0.046	400.0	0.000	0.00	0.0	0.600	o	900
1.004	21.060	0.053	400.0	0.087	0.00	0.0	0.600	o	900
3.000	10.517	0.026	404.5	0.058	5.00	0.0	0.600	o	900
3.001	14.392	0.036	400.0	0.063	0.00	0.0	0.600	o	900

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	5.00	5.26	52.699	0.064	0.0	0.0	0.1	2.07	82.5	1.0
1.001	5.00	5.46	51.897	0.120	0.0	0.0	0.2	2.08	82.5	1.8
2.000	5.00	5.32	49.113	0.156	0.0	0.0	0.2	1.57	995.9	2.3
2.001	5.00	5.54	49.037	0.230	0.0	0.0	0.3	1.56	992.7	3.4
1.002	5.00	5.78	48.986	0.408	0.0	0.0	0.6	1.56	993.7	6.1
1.003	5.00	5.98	48.929	0.408	0.0	0.0	0.6	1.56	992.7	6.1
1.004	5.00	6.21	48.882	0.495	0.0	0.0	0.7	1.56	992.7	7.4
3.000	5.00	5.11	48.939	0.058	0.0	0.0	0.1	1.55	987.1	0.9
3.001	5.00	5.27	48.913	0.121	0.0	0.0	0.2	1.56	992.7	1.8

Lees Roxburgh Limited		Page 1
The Genesis Centre Science Park South Birchwood WA3 7BH	5538 Whalley Appraisal	
Date November 2014 File appsws 04.08.14...	Designed by Chris Be... Checked by	
Elstree Computing Ltd	Network W.12.6	

Network Design Table for APPSWs 04.08.14.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)
3.002	18.782	0.047	400.0	0.006	0.00	0.0	0.600	o	900
1.005	37.568	0.094	399.7	0.023	0.00	0.0	0.600	o	900
1.006	17.853	0.045	400.0	0.124	0.00	0.0	0.600	o	1200
1.007	18.968	0.047	400.0	0.083	0.00	0.0	0.600	o	1200
1.008	21.344	0.053	400.0	0.063	0.00	0.0	0.600	o	1200
1.009	13.639	0.082	166.3	0.050	0.00	0.0	0.600	o	225

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
3.002	5.00	5.47	48.877	0.127	0.0	0.0	0.2	1.56	992.7	1.9
1.005	5.00	6.61	48.830	0.645	0.0	0.0	0.9	1.56	993.1	9.6
1.006	5.00	6.77	48.436	0.769	0.0	0.0	1.0	1.86	2108.6	11.5
1.007	5.00	6.94	48.391	0.852	0.0	0.0	1.2	1.86	2108.6	12.7
1.008	5.00	7.13	48.344	0.915	0.0	0.0	1.2	1.86	2108.6	13.6
1.009	5.00	7.35	48.290	0.965	0.0	0.0	1.3	1.01	40.2	14.4

Free Flowing Outfall Details for APPSWs 04.08.14.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.009	11	51.174	48.208	0.000	0	0

Network 1 - Surface Water Simulations

(1 in 30 yr storm)

Lees Roxburgh Limited		Page 0
The Genesis Centre Science Park South Birchwood WA3 7BH	5538 Whalley Appraisal	
Date November 2014 File appsws 04.08.14...	Designed by Chris Be... Checked by	
Elstree Computing Ltd	Network W.12.6	

Summary of Results for 60 minute 30 year Winter (APPSWS 04.08.14.SWS)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

PN	US/MH Name	Water	Surcharged	Flooded	Flow / Overflow Cap. (l/s)		Pipe	Status
		Level (m)	Depth (m)	Volume (m³)			Flow (l/s)	
1.000	1	52.757	-0.167	0.000	0.15	0.0	11.6	OK
1.001	2	51.979	-0.143	0.000	0.29	0.0	21.9	OK
2.000	12	49.647	-0.366	0.000	0.04	0.0	26.9	OK
2.001	13	49.647	-0.290	0.000	0.05	0.0	34.6	OK
1.002	3	49.646	-0.239	0.000	0.09	0.0	59.9	OK
1.003	4	49.646	-0.183	0.000	0.08	0.0	51.8	OK
1.004	5	49.645	-0.138	0.000	0.09	0.0	58.4	OK
3.000	14	49.644	-0.195	0.000	0.02	0.0	7.9	OK
3.001	15	49.644	-0.169	0.000	0.03	0.0	13.7	OK
3.002	16	49.644	-0.133	0.000	0.02	0.0	11.6	OK
1.005	6	49.644	-0.086	0.000	0.07	0.0	56.7	OK
1.006	7	49.641	0.006	0.000	0.05	0.0	52.3	SURCHARGED
1.007	8	49.641	0.050	0.000	0.04	0.0	45.4	SURCHARGED
1.008	9	49.640	0.096	0.000	0.03	0.0	35.0	SURCHARGED
1.009	10	49.639	1.124	0.000	0.68	0.0	23.7	SURCHARGED

Lees Roxburgh Limited		Page 0
The Genesis Centre Science Park South Birchwood WA3 7BH	5538 Whalley Appraisal	
Date November 2014 File appsws 04.08.14...	Designed by Chris Be... Checked by	
Elstree Computing Ltd	Network W.12.6	

Summary of Results for 120 minute 30 year Winter (APPSWS 04.08.14.SWS)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

PN	US/MH Name	Water	Surcharged	Flooded	Flow / Overflow Cap. (l/s)		Pipe	Status
		Level (m)	Depth (m)	Volume (m³)			Flow (l/s)	
1.000	1	52.746	-0.178	0.000	0.10	0.0	7.6	OK
1.001	2	51.962	-0.160	0.000	0.19	0.0	14.2	OK
2.000	12	49.690	-0.323	0.000	0.02	0.0	16.9	OK
2.001	13	49.690	-0.247	0.000	0.03	0.0	21.3	OK
1.002	3	49.690	-0.196	0.000	0.05	0.0	37.1	OK
1.003	4	49.689	-0.140	0.000	0.05	0.0	32.3	OK
1.004	5	49.688	-0.094	0.000	0.06	0.0	37.1	OK
3.000	14	49.687	-0.152	0.000	0.01	0.0	5.4	OK
3.001	15	49.687	-0.126	0.000	0.02	0.0	8.7	OK
3.002	16	49.687	-0.090	0.000	0.01	0.0	7.7	OK
1.005	6	49.687	-0.042	0.000	0.05	0.0	37.9	OK
1.006	7	49.682	0.047	0.000	0.03	0.0	37.6	SURCHARGED
1.007	8	49.682	0.091	0.000	0.03	0.0	33.8	SURCHARGED
1.008	9	49.681	0.137	0.000	0.02	0.0	27.7	SURCHARGED
1.009	10	49.680	1.165	0.000	0.69	0.0	24.0	SURCHARGED

Lees Roxburgh Limited		Page 0
The Genesis Centre Science Park South Birchwood WA3 7BH	5538 Whalley Appraisal	
Date November 2014 File appsws 04.08.14...	Designed by Chris Be... Checked by	
Elstree Computing Ltd	Network W.12.6	

Summary of Results for 180 minute 30 year Winter (APPSWS 04.08.14.SWS)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	52.740	-0.184	0.000	0.08	0.0	5.8	OK
1.001	2	51.953	-0.169	0.000	0.14	0.0	10.9	OK
2.000	12	49.664	-0.349	0.000	0.02	0.0	13.0	OK
2.001	13	49.664	-0.273	0.000	0.02	0.0	16.6	OK
1.002	3	49.663	-0.222	0.000	0.04	0.0	29.1	OK
1.003	4	49.663	-0.166	0.000	0.04	0.0	26.3	OK
1.004	5	49.662	-0.121	0.000	0.05	0.0	30.2	OK
3.000	14	49.661	-0.178	0.000	0.01	0.0	4.2	OK
3.001	15	49.661	-0.152	0.000	0.01	0.0	7.1	OK
3.002	16	49.661	-0.116	0.000	0.01	0.0	6.5	OK
1.005	6	49.661	-0.069	0.000	0.04	0.0	32.8	OK
1.006	7	49.658	0.022	0.000	0.03	0.0	33.9	SURCHARGED
1.007	8	49.657	0.066	0.000	0.03	0.0	30.7	SURCHARGED
1.008	9	49.657	0.113	0.000	0.02	0.0	25.8	SURCHARGED
1.009	10	49.656	1.140	0.000	0.68	0.0	23.8	SURCHARGED

Network 1 - Surface Water Simulations

(1 in 100 yr storm + Climate Change)

Lees Roxburgh Limited		Page 0
The Genesis Centre Science Park South Birchwood WA3 7BH	5538 Whalley Appraisal	
Date November 2014 File appsws 04.08.14...	Designed by Chris Be... Checked by	
Elstree Computing Ltd	Network W.12.6	

Summary of Results for 60 minute 100 year Winter (APPSWS 04.08.14.SWS)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	52.770	-0.154	0.000	0.22	0.0	16.7	OK
1.001	2	51.998	-0.124	0.000	0.41	0.0	31.4	OK
2.000	12	50.918	0.905	0.000	0.05	0.0	36.2	SURCHARGED
2.001	13	50.918	0.981	0.000	0.06	0.0	37.3	SURCHARGED
1.002	3	50.917	1.031	0.000	0.10	0.0	66.1	SURCHARGED
1.003	4	50.916	1.087	0.000	0.09	0.0	53.7	SURCHARGED
1.004	5	50.915	1.132	0.000	0.09	0.0	60.7	SURCHARGED
3.000	14	50.913	1.074	0.000	0.02	0.0	11.4	SURCHARGED
3.001	15	50.913	1.100	0.000	0.03	0.0	17.3	SURCHARGED
3.002	16	50.913	1.136	0.000	0.02	0.0	11.0	SURCHARGED
1.005	6	50.913	1.184	0.000	0.07	0.0	54.6	SURCHARGED
1.006	7	50.911	1.276	0.000	0.04	0.0	49.9	SURCHARGED
1.007	8	50.910	1.319	0.000	0.04	0.0	44.3	SURCHARGED
1.008	9	50.909	1.366	0.000	0.03	0.0	35.1	SURCHARGED
1.009	10	50.908	2.393	0.000	0.94	0.0	32.9	SURCHARGED

Lees Roxburgh Limited		Page 0
The Genesis Centre Science Park South Birchwood WA3 7BH	5538 Whalley Appraisal	
Date November 2014 File appsws 04.08.14...	Designed by Chris Be... Checked by	
Elstree Computing Ltd	Network W.12.6	

Summary of Results for 120 minute 100 year Winter (APPSWS 04.08.14.SWS)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

PN	US/MH Name	Water	Surcharged	Flooded	Flow / Cap.	Overflow (l/s)	Pipe	Status
		Level (m)	Depth (m)	Volume (m³)			Flow (l/s)	
1.000	1	52.755	-0.169	0.000	0.14	0.0	10.8	OK
1.001	2	51.976	-0.146	0.000	0.27	0.0	20.3	OK
2.000	12	51.254	1.241	0.000	0.03	0.0	23.2	SURCHARGED
2.001	13	51.257	1.320	0.000	0.06	0.0	39.8	SURCHARGED
1.002	3	51.260	1.374	0.000	0.10	0.0	68.1	SURCHARGED
1.003	4	51.262	1.433	0.000	0.14	0.0	87.7	SURCHARGED
1.004	5	51.260	1.478	0.000	0.13	0.0	88.7	SURCHARGED
3.000	14	51.253	1.414	0.000	0.02	0.0	7.5	SURCHARGED
3.001	15	51.257	1.444	0.000	0.04	0.0	20.1	SURCHARGED
3.002	16	51.259	1.482	0.000	0.06	0.0	39.2	SURCHARGED
1.005	6	51.258	1.528	0.000	0.14	0.0	110.5	SURCHARGED
1.006	7	51.252	1.617	0.000	0.07	0.0	83.7	SURCHARGED
1.007	8	51.249	1.658	0.000	0.06	0.0	70.0	FLOOD RISK
1.008	9	51.247	1.703	6.307	0.04	0.0	49.9	FLOOD
1.009	10	51.348	2.833	0.615	0.99	0.0	34.6	FLOOD

Lees Roxburgh Limited		Page 0
The Genesis Centre Science Park South Birchwood WA3 7BH	5538 Whalley Appraisal	
Date November 2014 File appsws 04.08.14...	Designed by Chris Be... Checked by	
Elstree Computing Ltd	Network W.12.6	

Summary of Results for 180 minute 100 year Winter (APPSWS 04.08.14.SWS)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	52.748	-0.176	0.000	0.11	0.0	8.3	OK
1.001	2	51.966	-0.156	0.000	0.20	0.0	15.5	OK
2.000	12	51.239	1.226	0.000	0.02	0.0	18.1	SURCHARGED
2.001	13	51.239	1.302	0.000	0.03	0.0	18.1	SURCHARGED
1.002	3	51.238	1.353	0.000	0.05	0.0	31.2	SURCHARGED
1.003	4	51.237	1.408	0.000	0.04	0.0	27.2	SURCHARGED
1.004	5	51.236	1.454	0.000	0.05	0.0	30.7	SURCHARGED
3.000	14	51.235	1.396	0.000	0.01	0.0	5.7	SURCHARGED
3.001	15	51.235	1.422	0.000	0.02	0.0	9.0	SURCHARGED
3.002	16	51.235	1.458	0.000	0.01	0.0	6.1	SURCHARGED
1.005	6	51.235	1.505	0.000	0.04	0.0	31.6	SURCHARGED
1.006	7	51.233	1.597	0.000	0.03	0.0	31.3	SURCHARGED
1.007	8	51.232	1.641	0.000	0.03	0.0	31.6	FLOOD RISK
1.008	9	51.231	1.687	0.000	0.03	0.0	33.8	FLOOD RISK
1.009	10	51.230	2.714	0.000	1.00	0.0	34.9	FLOOD RISK

Lees Roxburgh Limited		Page 0
The Genesis Centre Science Park South Birchwood WA3 7BH	5538 Whalley Appraisal	
Date November 2014 File appsws 04.08.14...	Designed by Chris Be... Checked by	
Elstree Computing Ltd	Network W.12.6	

Summary of Results for 240 minute 100 year Winter (APPSWS 04.08.14.SWS)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	52.744	-0.180	0.000	0.09	0.0	6.7	OK
1.001	2	51.958	-0.164	0.000	0.17	0.0	12.6	OK
2.000	12	51.119	1.106	0.000	0.02	0.0	14.8	SURCHARGED
2.001	13	51.120	1.183	0.000	0.07	0.0	47.8	SURCHARGED
1.002	3	51.123	1.237	0.000	0.11	0.0	72.4	SURCHARGED
1.003	4	51.126	1.298	0.000	0.14	0.0	89.4	SURCHARGED
1.004	5	51.131	1.349	0.000	0.14	0.0	91.5	SURCHARGED
3.000	14	51.128	1.289	0.000	0.02	0.0	8.7	SURCHARGED
3.001	15	51.129	1.316	0.000	0.05	0.0	27.8	SURCHARGED
3.002	16	51.131	1.354	0.000	0.07	0.0	43.6	SURCHARGED
1.005	6	51.137	1.407	0.000	0.14	0.0	104.3	SURCHARGED
1.006	7	51.151	1.515	0.000	0.07	0.0	75.3	SURCHARGED
1.007	8	51.153	1.562	0.000	0.05	0.0	62.8	FLOOD RISK
1.008	9	51.153	1.610	0.000	0.04	0.0	46.5	FLOOD RISK
1.009	10	51.152	2.637	0.000	0.97	0.0	33.9	FLOOD RISK