Appendix B

Surface water design calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	Maximum Rainfall (mm/hr)	40.0
Additional Flow (%)	20	Minimum Velocity (m/s)	0.70
FSR Region	Scotland and Ireland	Connection Type	Level Inverts
M5-60 (mm)	16.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.300	Preferred Cover Depth (m)	0.800
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	15.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SWMH Con			73.750	1200	303817.958	230626.095	1.930
SWMH 1.1			73.750	1200	303815.504	230625.668	1.920
SWMH 1.2			74.110	1200	303799.696	230598.832	2.155
SWMH 1.3			74.950	1200	303782.426	230580.233	2.894
SWMH 1.4			74.000	1200	303758.271	230566.848	1.834
SWMH 1.5			73.400	1200	303757.069	230569.573	1.200
SWMH 2.1			73.400	1200	303711.904	230562.661	1.200
SWMH 2.2			74.070	1200	303687.569	230556.650	1.589
SWMH 2.3			74.470	1200	303670.643	230547.154	1.773
SWMH 2.4			74.750	1200	303642.697	230541.928	1.740
SWMH 2.5			74.400	1200	303635.113	230535.287	1.100
SWMH 3.1			73.400	1200	303713.345	230563.983	1.200
SWMH 3.2			73.440	1200	303712.194	230567.644	1.224
SWMH 3.3			73.350	1200	303708.217	230566.882	1.118
SWMH 3.4			73.350	1200	303704.599	230566.252	1.118
SWMH 3.5			73.950	1200	303686.012	230558.931	1.377
SWMH 3.6	0.100	15.00	73.980	1200	303661.138	230552.006	1.000
SWMH 4.1			74.400	1200	303631.352	230537.088	1.100
SWMH 4.2			74.430	1200	303631.148	230539.756	1.100
SWMH 4.3			74.420	1200	303634.232	230540.511	1.055
SWMH 4.4	0.095	15.00	74.410	1200	303637.844	230541.476	1.010
SWMH 5.1			73.580	1200	303685.833	230580.559	1.238
SWMH 5.2	0.304	15.00	73.590	1200	303672.259	230648.324	0.990
SWMH 6.1			73.200	1200	303847.702	230663.364	1.340
SWMH 6.2			73.210	1200	303844.808	230663.133	1.270
SWMH 6.3			73.230	1200	303842.379	230664.158	1.210
SWMH 6.4			73.260	1200	303839.319	230665.554	1.160
SWMH 6.5	0.919	15.00	73.200	1200	303833.673	230655.847	0.990
SWMH 7.1			74.090	1200	303773.734	230579.515	1.940
SWMH 7.2	0.176	15.00	73.330	1200	303768.761	230579.061	1.130
SWMH 8.1	0.578	15.00	73.240	1200	303839.708	230679.632	0.990
SWMH 9.1			73.200	1200	303847.525	230671.902	1.500
SWMH 9.2			73.780	1200	303792.728	230685.834	1.852

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SWMH 9.3			73.850	1200	303704.302	230668.965	1.562
SWMH 9.4			73.630	1200	303671.938	230669.031	1.214
SWMH 9.5	0.147	15.00	73.830	1200	303667.664	230668.294	1.330
SWMH 10.1	0.107	15.00	73.840	1200	303667.035	230606.315	1.140
SWMH 11.1			73.400	1200	303649.445	230812.584	1.400
SWMH 11.2			73.480	1200	303650.077	230810.421	1.470
SWMH 11.3			73.510	1200	303646.938	230809.503	1.484
SWMH 11.4			73.450	1200	303640.412	230807.832	1.400
SWMH 11.5			73.650	1200	303642.244	230781.958	1.496
SWMH 11.6			73.600	1200	303656.748	230746.601	1.294
SWMH 11.7			73.580	1200	303671.252	230711.244	1.122
SWMH 11.8	0.620	15.00	73.580	1200	303676.967	230683.964	1.000
SWMH 12.1			73.400	1200	303738.067	230855.865	1.400
SWMH 12.2			73.480	1200	303734.936	230849.613	1.440
SWMH 12.3			73.590	1200	303702.648	230834.615	1.360
SWMH 12.4			73.710	1200	303669.274	230819.112	1.250
SWMH 12.5	0.545	15.00	73.810	1200	303667.251	230811.410	1.310
SWMH 13.1			73.400	1200	303711.263	230852.399	1.250
SWMH 13.2			73.380	1200	303712.947	230849.060	1.170
SWMH 13.3			73.390	1200	303717.240	230850.696	1.110
SWMH 13.4			73.390	1200	303721.614	230852.503	1.040
SWMH 13.5	0.228	15.00	73.390	1200	303722.638	230850.369	1.000
SWMH 14.1			72.500	1200	303694.193	230852.700	0.550
SWMH 14.2			73.180	1200	303696.055	230852.502	1.205
SWMH 14.3			73.400	1200	303698.321	230852.272	1.400
SWMH 15.1			72.500	1200	303817.102	230737.720	1.200
SWMH 15.2			72.710	1200	303816.412	230732.304	1.370
SWMH 15.3			73.200	1200	303850.692	230702.747	1.606
SWMH 15.4			73.200	1200	303857.797	230686.534	1.500
SWMH 16.1			73.400	1200	303800.963	230758.451	1.170
SWMH 16.2			73.380	1200	303799.149	230762.228	1.100
SWMH 16.3			73.400	1200	303797.672	230765.466	1.070
SWMH 16.4	0.537	15.00	73.380	1200	303795.212	230764.430	1.000
SWMH 17.1			72.500	1200	303793.390	230792.952	0.550
SWMH 17.2			73.300	1200	303793.004	230791.640	1.325
SWMH 17.3			73.400	1200	303792.566	230790.278	1.400
SWMH 18.1	0.622	15.00	73.940	1200	303621.405	230776.978	1.586

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.1	SWMH 1.1	SWMH Con	2.491	0.600	71.830	71.820	0.010	249.1	300	16.49	40.0
1.2	SWMH 1.2	SWMH 1.1	31.146	0.600	71.955	71.830	0.125	249.2	300	16.45	40.0
1.3	SWMH 1.3	SWMH 1.2	25.381	0.600	72.056	71.955	0.101	251.3	300	15.92	40.0
1.4	SWMH 1.4	SWMH 1.3	27.616	0.600	72.166	72.056	0.110	251.1	300	15.50	40.0
1.5	SWMH 1.5	SWMH 1.4	2.978	0.600	72.200	72.166	0.034	87.6	300	15.03	40.0
2.2	SWMH 2.2	SWMH 2.1	25.066	0.600	72.481	72.200	0.281	89.2	150	16.24	40.0
2.3	SWMH 2.3	SWMH 2.2	19.408	0.600	72.697	72.481	0.216	89.9	150	15.85	40.0
2.4	SWMH 2.4	SWMH 2.3	28.430	0.600	73.010	72.697	0.313	90.8	150	15.55	40.0
2.5	SWMH 2.5	SWMH 2.4	10.081	0.600	73.300	73.010	0.290	34.8	150	15.10	40.0
3.2	SWMH 3.2	SWMH 3.1	3.838	0.600	72.216	72.200	0.016	239.9	300	16.76	40.0
3.3	SWMH 3.3	SWMH 3.2	4.049	0.600	72.232	72.216	0.016	253.1	300	16.70	40.0
3.4	SWMH 3.4	SWMH 3.3	3.672	0.600	72.248	72.232	0.016	229.5	300	16.63	40.0
3.5	SWMH 3.5	SWMH 3.4	19.977	0.600	72.573	72.248	0.325	61.5	225	15.46	40.0
3.6	SWMH 3.6	SWMH 3.5	25.820	0.600	72.980	72.573	0.407	63.4	225	15.26	40.0
4.2	SWMH 4.2	SWMH 4.1	2.676	0.600	73.330	73.300	0.030	89.2	225	15.12	40.0
4.3	SWMH 4.3	SWMH 4.2	3.175	0.600	73.365	73.330	0.035	90.7	225	15.09	40.0
4.4	SWMH 4.4	SWMH 4.3	3.739	0.600	73.400	73.365	0.035	106.8	225	15.05	40.0
5.1	SWMH 5.1	SWMH 3.4	23.598	0.600	72.342	72.232	0.110	214.5	300	16.57	40.0
5.2	SWMH 5.2	SWMH 5.1	69.111	0.600	72.600	72.342	0.258	267.9	300	16.21	40.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.1	0.991	70.1	101.7	1.620	1.630	0.782	0.0	300	1.004
1.2	0.991	70.1	101.7	1.855	1.620	0.782	0.0	300	1.004
1.3	0.987	69.8	101.7	2.594	1.855	0.782	0.0	300	1.000
1.4	0.987	69.8	78.8	1.534	2.594	0.606	0.0	300	1.000
1.5	1.681	118.8	78.8	0.900	1.534	0.606	0.0	179	1.793
2.2	1.064	18.8	12.4	1.439	1.050	0.095	0.0	89	1.135
2.3	1.060	18.7	12.4	1.623	1.439	0.095	0.0	89	1.130
2.4	1.055	18.6	12.4	1.590	1.623	0.095	0.0	89	1.127
2.5	1.713	30.3	12.4	0.950	1.590	0.095	0.0	67	1.625
3.2	1.011	71.4	66.5	0.924	0.900	0.511	0.0	230	1.142
3.3	0.984	69.5	66.5	0.818	0.924	0.511	0.0	236	1.114
3.4	1.033	73.0	66.5	0.802	0.818	0.511	0.0	226	1.166
3.5	1.671	66.4	13.0	1.152	0.877	0.100	0.0	67	1.303
3.6	1.644	65.4	13.0	0.775	1.152	0.100	0.0	68	1.292
4.2	1.385	55.1	12.4	0.875	0.875	0.095	0.0	73	1.124
4.3	1.373	54.6	12.4	0.830	0.875	0.095	0.0	73	1.115
4.4	1.264	50.3	12.4	0.785	0.830	0.095	0.0	76	1.052
5.1	1.069	75.6	53.5	0.938	0.818	0.411	0.0	187	1.156
5.2	0.956	67.5	39.6	0.690	0.938	0.304	0.0	165	0.992

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
6.2	SWMH 6.2	SWMH 6.1	2.903	0.600	71.940	71.860	0.080	36.3	225	15.24	40.0
6.3	SWMH 6.3	SWMH 6.2	2.636	0.600	72.020	71.940	0.080	33.0	225	15.22	40.0
6.4	SWMH 6.4	SWMH 6.3	3.363	0.600	72.100	72.020	0.080	42.0	225	15.20	40.0
6.5	SWMH 6.5	SWMH 6.4	11.230	0.600	72.210	72.100	0.110	102.1	225	15.14	40.0
7.1	SWMH 7.1	SWMH 1.3	8.722	0.600	72.150	72.056	0.094	92.8	150	15.22	40.0
7.2	SWMH 7.2	SWMH 7.1	4.994	0.600	72.200	72.150	0.050	99.9	150	15.08	40.0
8.1	SWMH 8.1	SWMH 6.4	14.083	0.600	72.250	72.100	0.150	93.9	225	15.17	40.0
9.2	SWMH 9.2	SWMH 9.1	56.540	0.600	71.928	71.700	0.228	248.0	300	19.03	40.0
9.3	SWMH 9.3	SWMH 9.2	90.021	0.600	72.288	71.928	0.360	250.1	300	18.08	40.0
9.4	SWMH 9.4	SWMH 9.3	32.364	0.600	72.416	72.288	0.128	252.8	300	16.57	40.0
9.5	SWMH 9.5	SWMH 9.4	4.337	0.600	72.500	72.416	0.084	51.6	300	15.03	40.0
10.1	SWMH 10.1	SWMH 5.1	26.113	0.600	72.700	72.342	0.358	72.9	225	15.38	40.0
11.2	SWMH 11.2	SWMH 11.1	2.253	0.600	72.010	72.000	0.010	225.3	300	17.38	40.0
11.3	SWMH 11.3	SWMH 11.2	3.270	0.600	72.026	72.010	0.016	204.4	300	17.35	40.0
11.4	SWMH 11.4	SWMH 11.3	6.737	0.600	72.050	72.026	0.024	280.7	300	17.30	40.0
11.5	SWMH 11.5	SWMH 11.4	25.939	0.600	72.154	72.050	0.104	249.4	300	17.18	40.0
11.6	SWMH 11.6	SWMH 11.5	38.216	0.600	72.306	72.154	0.152	251.4	300	16.74	40.0
11.7	SWMH 11.7	SWMH 11.6	38.216	0.600	72.458	72.306	0.152	251.4	300	16.09	40.0
11.8	SWMH 11.8	SWMH 11.7	27.872	0.600	72.580	72.458	0.122	228.5	300	15.45	40.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
6.2	2.178	86.6	194.8	1.045	1.115	1.497	0.0	225	2.218
6.3	2.287	90.9	194.8	0.985	1.045	1.497	0.0	225	2.329
6.4	2.023	80.4	194.8	0.935	0.985	1.497	0.0	225	2.060
6.5	1.294	51.4	119.6	0.765	0.935	0.919	0.0	225	1.317
7.1	1.043	18.4	22.9	1.790	2.744	0.176	0.0	150	1.063
7.2	1.005	17.8	22.9	0.980	1.790	0.176	0.0	150	1.024
8.1	1.349	53.7	75.2	0.765	0.935	0.578	0.0	225	1.374
9.2	0.994	70.2	19.1	1.552	1.200	0.147	0.0	107	0.850
9.3	0.989	69.9	19.1	1.262	1.552	0.147	0.0	107	0.847
9.4	0.984	69.6	19.1	0.914	1.262	0.147	0.0	107	0.842
9.5	2.193	155.0	19.1	1.030	0.914	0.147	0.0	71	1.505
10.1	1.533	60.9	13.9	0.915	1.013	0.107	0.0	73	1.244
11.2	1.043	73.7	161.6	1.170	1.100	1.242	0.0	300	1.057
11.3	1.096	77.5	161.6	1.184	1.170	1.242	0.0	300	1.110
11.4	0.933	66.0	161.6	1.100	1.184	1.242	0.0	300	0.945
11.5	0.991	70.0	161.6	1.196	1.100	1.242	0.0	300	1.004
11.6	0.987	69.8	80.7	0.994	1.196	0.620	0.0	300	1.000
11.7	0.987	69.8	80.7	0.822	0.994	0.620	0.0	300	1.000
11.8	1.036	73.2	80.7	0.700	0.822	0.620	0.0	300	1.049

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
12.2	SWMH 12.2	SWMH 12.1	6.992	0.600	72.040	72.000	0.040	174.8	300	16.23	40.0
12.3	SWMH 12.3	SWMH 12.2	35.601	0.600	72.230	72.040	0.190	187.4	300	16.13	40.0
12.4	SWMH 12.4	SWMH 12.3	36.799	0.600	72.460	72.230	0.230	160.0	300	15.61	40.0
12.5	SWMH 12.5	SWMH 12.4	7.963	0.600	72.500	72.460	0.040	199.1	300	15.12	40.0
13.2	SWMH 13.2	SWMH 13.1	3.740	0.600	72.210	72.150	0.060	62.3	225	15.16	40.0
13.3	SWMH 13.3	SWMH 13.2	4.594	0.600	72.280	72.210	0.070	65.6	225	15.12	40.0
13.4	SWMH 13.4	SWMH 13.3	4.733	0.600	72.350	72.280	0.070	67.6	225	15.07	40.0
13.5	SWMH 13.5	SWMH 13.4	2.367	0.600	72.390	72.350	0.040	59.2	225	15.02	40.0
14.2	SWMH 14.2	SWMH 14.1	1.872	0.600	71.975	71.950	0.025	74.9	225	15.05	40.0
14.3	SWMH 14.3	SWMH 14.2	2.278	0.600	72.000	71.975	0.025	91.1	225	15.03	40.0
15.2	SWMH 15.2	SWMH 15.1	5.460	0.600	71.340	71.300	0.040	136.5	225	16.15	40.0
15.3	SWMH 15.3	SWMH 15.2	45.263	0.600	71.594	71.340	0.254	178.2	225	16.07	40.0
15.4	SWMH 15.4	SWMH 15.3	17.701	0.600	71.700	71.597	0.103	171.9	225	15.30	40.0
16.2	SWMH 16.2	SWMH 16.1	4.190	0.600	72.280	72.230	0.050	83.8	225	15.11	40.0
16.3	SWMH 16.3	SWMH 16.2	3.559	0.600	72.330	72.280	0.050	71.2	225	15.06	40.0
16.4	SWMH 16.4	SWMH 16.3	2.669	0.600	72.380	72.330	0.050	53.4	225	15.02	40.0
17.2	SWMH 17.2	SWMH 17.1	1.368	0.600	71.975	71.950	0.025	54.7	225	15.03	40.0
17.3	SWMH 17.3	SWMH 17.2	1.431	0.600	72.000	71.975	0.025	57.2	225	15.01	40.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
12.2	1.186	83.8	70.9	1.140	1.100	0.545	0.0	212	1.324
12.3	1.145	80.9	70.9	1.060	1.140	0.545	0.0	218	1.285
12.4	1.240	87.7	70.9	0.950	1.060	0.545	0.0	205	1.375
12.5	1.110	78.5	70.9	1.010	0.950	0.545	0.0	224	1.251
13.2	1.659	66.0	29.7	0.945	1.025	0.228	0.0	106	1.617
13.3	1.617	64.3	29.7	0.885	0.945	0.228	0.0	108	1.587
13.4	1.592	63.3	29.7	0.815	0.885	0.228	0.0	109	1.569
13.5	1.703	67.7	29.7	0.775	0.815	0.228	0.0	104	1.648
14.2	1.513	60.1	191.3	0.980	0.325	1.470	0.0	225	1.540
14.3	1.370	54.5	191.3	1.175	0.980	1.470	0.0	225	1.395
15.2	1.117	44.4	213.9	1.145	0.975	1.644	0.0	225	1.138
15.3	0.976	38.8	213.9	1.381	1.145	1.644	0.0	225	0.994
15.4	0.994	39.5	213.9	1.275	1.378	1.644	0.0	225	1.013
16.2	1.429	56.8	69.9	0.875	0.945	0.537	0.0	225	1.455
16.3	1.552	61.7	69.9	0.845	0.875	0.537	0.0	225	1.580
16.4	1.794	71.3	69.9	0.775	0.845	0.537	0.0	181	2.034
17.2	1.772	70.4	140.8	1.100	0.325	1.082	0.0	225	1.804
17.3	1.732	68.9	140.8	1.175	1.100	1.082	0.0	225	1.764

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
Pond 1.1	SWMH 11.1	SWMH 14.3	62.960	0.600	72.000	72.000	0.000	0.0	300	18.88	40.0
Pond 1.2	SWMH 13.1	SWMH 14.3	12.943	0.600	72.150	72.000	0.150	86.3	225	15.31	40.0
Pond 2.1	SWMH 12.1	SWMH 17.3	85.275	0.600	72.000	72.000	0.000	0.0	300	18.26	40.0
Pond 2.2	SWMH 16.1	SWMH 17.3	32.916	0.600	72.230	72.000	0.230	143.1	225	15.61	40.0
Pond 3.1	SWMH 9.1	SWMH 15.4	17.878	0.600	71.700	71.700	0.000	0.0	300	19.46	40.0
Pond 3.2	SWMH 6.1	SWMH 15.4	25.274	0.600	71.860	71.700	0.160	158.0	300	15.58	40.0
Pond 4.1	SWMH 3.1	SWMH 1.5	44.080	0.600	72.200	72.200	0.000	0.0	300	17.81	40.0
Pond 4.2	SWMH 2.1	SWMH 1.5	45.691	0.600	72.200	72.200	0.000	0.0	150	17.33	40.0
Pond 5	SWMH 4.1	SWMH 2.5	4.170	0.600	73.300	73.300	0.000	0.0	225	15.22	40.0
18.1	SWMH 18.1	SWMH 11.5	21.426	0.600	72.354	72.154	0.200	107.1	300	15.24	40.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
Pond 1.1	0.700	49.5	161.6	1.100	1.100	1.242	0.0	0	∞
Pond 1.2	1.408	56.0	29.7	1.025	1.175	0.228	0.0	116	1.428
Pond 2.1	0.700	49.5	70.9	1.100	1.100	0.545	0.0	0	∞
Pond 2.2	1.091	43.4	69.9	0.945	1.175	0.537	0.0	225	1.111
Pond 3.1	0.700	49.5	19.1	1.200	1.200	0.147	0.0	0	∞
Pond 3.2	1.248	88.2	194.8	1.040	1.200	1.497	0.0	300	1.264
Pond 4.1	0.700	49.5	66.5	0.900	0.900	0.511	0.0	0	∞
Pond 4.2	0.700	12.4	12.4	1.050	1.050	0.095	0.0	0	∞
Pond 5	0.700	27.8	12.4	0.875	0.875	0.095	0.0	0	∞
18.1	1.518	107.3	80.9	1.286	1.196	0.622	0.0	195	1.663

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.1	2.491	249.1	300	Circular	73.750	71.830	1.620	73.750	71.820	1.630
1.2	31.146	249.2	300	Circular	74.110	71.955	1.855	73.750	71.830	1.620
1.3	25.381	251.3	300	Circular	74.950	72.056	2.594	74.110	71.955	1.855
1.4	27.616	251.1	300	Circular	74.000	72.166	1.534	74.950	72.056	2.594
1.5	2.978	87.6	300	Circular	73.400	72.200	0.900	74.000	72.166	1.534
2.2	25.066	89.2	150	Circular	74.070	72.481	1.439	73.400	72.200	1.050
2.3	19.408	89.9	150	Circular	74.470	72.697	1.623	74.070	72.481	1.439
2.4	28.430	90.8	150	Circular	74.750	73.010	1.590	74.470	72.697	1.623

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.1	SWMH 1.1	1200	Manhole	Adoptable	SWMH Con	1200	Manhole	Adoptable
1.2	SWMH 1.2	1200	Manhole	Adoptable	SWMH 1.1	1200	Manhole	Adoptable
1.3	SWMH 1.3	1200	Manhole	Adoptable	SWMH 1.2	1200	Manhole	Adoptable
1.4	SWMH 1.4	1200	Manhole	Adoptable	SWMH 1.3	1200	Manhole	Adoptable
1.5	SWMH 1.5	1200	Manhole	Adoptable	SWMH 1.4	1200	Manhole	Adoptable
2.2	SWMH 2.2	1200	Manhole	Adoptable	SWMH 2.1	1200	Manhole	Adoptable
2.3	SWMH 2.3	1200	Manhole	Adoptable	SWMH 2.2	1200	Manhole	Adoptable
2.4	SWMH 2.4	1200	Manhole	Adoptable	SWMH 2.3	1200	Manhole	Adoptable

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
2.5	10.081	34.8	150	Circular	74.400	73.300	0.950	74.750	73.010	1.590
3.2	3.838	239.9	300	Circular	73.440	72.216	0.924	73.400	72.200	0.900
3.3	4.049	253.1	300	Circular	73.350	72.232	0.818	73.440	72.216	0.924
3.4	3.672	229.5	300	Circular	73.350	72.248	0.802	73.350	72.232	0.818
3.5	19.977	61.5	225	Circular	73.950	72.573	1.152	73.350	72.248	0.877
3.6	25.820	63.4	225	Circular	73.980	72.980	0.775	73.950	72.573	1.152
4.2	2.676	89.2	225	Circular	74.430	73.330	0.875	74.400	73.300	0.875
4.3	3.175	90.7	225	Circular	74.420	73.365	0.830	74.430	73.330	0.875
4.4	3.739	106.8	225	Circular	74.410	73.400	0.785	74.420	73.365	0.830
5.1	23.598	214.5	300	Circular	73.580	72.342	0.938	73.350	72.232	0.818
5.2	69.111	267.9	300	Circular	73.590	72.600	0.690	73.580	72.342	0.938
6.2	2.903	36.3	225	Circular	73.210	71.940	1.045	73.200	71.860	1.115
6.3	2.636	33.0	225	Circular	73.230	72.020	0.985	73.210	71.940	1.045
6.4	3.363	42.0	225	Circular	73.260	72.100	0.935	73.230	72.020	0.985
6.5	11.230	102.1	225	Circular	73.200	72.210	0.765	73.260	72.100	0.935
7.1	8.722	92.8	150	Circular	74.090	72.150	1.790	74.950	72.056	2.744
7.2	4.994	99.9	150	Circular	73.330	72.200	0.980	74.090	72.150	1.790
8.1	14.083	93.9	225	Circular	73.240	72.250	0.765	73.260	72.100	0.935

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
2.5	SWMH 2.5	1200	Manhole	Adoptable	SWMH 2.4	1200	Manhole	Adoptable
3.2	SWMH 3.2	1200	Manhole	Adoptable	SWMH 3.1	1200	Manhole	Adoptable
3.3	SWMH 3.3	1200	Manhole	Adoptable	SWMH 3.2	1200	Manhole	Adoptable
3.4	SWMH 3.4	1200	Manhole	Adoptable	SWMH 3.3	1200	Manhole	Adoptable
3.5	SWMH 3.5	1200	Manhole	Adoptable	SWMH 3.4	1200	Manhole	Adoptable
3.6	SWMH 3.6	1200	Manhole	Adoptable	SWMH 3.5	1200	Manhole	Adoptable
4.2	SWMH 4.2	1200	Manhole	Adoptable	SWMH 4.1	1200	Manhole	Adoptable
4.3	SWMH 4.3	1200	Manhole	Adoptable	SWMH 4.2	1200	Manhole	Adoptable
4.4	SWMH 4.4	1200	Manhole	Adoptable	SWMH 4.3	1200	Manhole	Adoptable
5.1	SWMH 5.1	1200	Manhole	Adoptable	SWMH 3.4	1200	Manhole	Adoptable
5.2	SWMH 5.2	1200	Manhole	Adoptable	SWMH 5.1	1200	Manhole	Adoptable
6.2	SWMH 6.2	1200	Manhole	Adoptable	SWMH 6.1	1200	Manhole	Adoptable
6.3	SWMH 6.3	1200	Manhole	Adoptable	SWMH 6.2	1200	Manhole	Adoptable
6.4	SWMH 6.4	1200	Manhole	Adoptable	SWMH 6.3	1200	Manhole	Adoptable
6.5	SWMH 6.5	1200	Manhole	Adoptable	SWMH 6.4	1200	Manhole	Adoptable
7.1	SWMH 7.1	1200	Manhole	Adoptable	SWMH 1.3	1200	Manhole	Adoptable
7.2	SWMH 7.2	1200	Manhole	Adoptable	SWMH 7.1	1200	Manhole	Adoptable
8.1	SWMH 8.1	1200	Manhole	Adoptable	SWMH 6.4	1200	Manhole	Adoptable

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
9.2	56.540	248.0	300	Circular	73.780	71.928	1.552	73.200	71.700	1.200
9.3	90.021	250.1	300	Circular	73.850	72.288	1.262	73.780	71.928	1.552
9.4	32.364	252.8	300	Circular	73.630	72.416	0.914	73.850	72.288	1.262
9.5	4.337	51.6	300	Circular	73.830	72.500	1.030	73.630	72.416	0.914
10.1	26.113	72.9	225	Circular	73.840	72.700	0.915	73.580	72.342	1.013
11.2	2.253	225.3	300	Circular	73.480	72.010	1.170	73.400	72.000	1.100
11.3	3.270	204.4	300	Circular	73.510	72.026	1.184	73.480	72.010	1.170
11.4	6.737	280.7	300	Circular	73.450	72.050	1.100	73.510	72.026	1.184
11.5	25.939	249.4	300	Circular	73.650	72.154	1.196	73.450	72.050	1.100
11.6	38.216	251.4	300	Circular	73.600	72.306	0.994	73.650	72.154	1.196
11.7	38.216	251.4	300	Circular	73.580	72.458	0.822	73.600	72.306	0.994
11.8	27.872	228.5	300	Circular	73.580	72.580	0.700	73.580	72.458	0.822
12.2	6.992	174.8	300	Circular	73.480	72.040	1.140	73.400	72.000	1.100
12.3	35.601	187.4	300	Circular	73.590	72.230	1.060	73.480	72.040	1.140
12.4	36.799	160.0	300	Circular	73.710	72.460	0.950	73.590	72.230	1.060
12.5	7.963	199.1	300	Circular	73.810	72.500	1.010	73.710	72.460	0.950
13.2	3.740	62.3	225	Circular	73.380	72.210	0.945	73.400	72.150	1.025
13.3	4.594	65.6	225	Circular	73.390	72.280	0.885	73.380	72.210	0.945
13.4	4.733	67.6	225	Circular	73.390	72.350	0.815	73.390	72.280	0.885
13.5	2.367	59.2	225	Circular	73.390	72.390	0.775	73.390	72.350	0.815

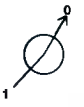
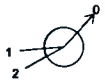
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
9.2	SWMH 9.2	1200	Manhole	Adoptable	SWMH 9.1	1200	Manhole	Adoptable
9.3	SWMH 9.3	1200	Manhole	Adoptable	SWMH 9.2	1200	Manhole	Adoptable
9.4	SWMH 9.4	1200	Manhole	Adoptable	SWMH 9.3	1200	Manhole	Adoptable
9.5	SWMH 9.5	1200	Manhole	Adoptable	SWMH 9.4	1200	Manhole	Adoptable
10.1	SWMH 10.1	1200	Manhole	Adoptable	SWMH 5.1	1200	Manhole	Adoptable
11.2	SWMH 11.2	1200	Manhole	Adoptable	SWMH 11.1	1200	Manhole	Adoptable
11.3	SWMH 11.3	1200	Manhole	Adoptable	SWMH 11.2	1200	Manhole	Adoptable
11.4	SWMH 11.4	1200	Manhole	Adoptable	SWMH 11.3	1200	Manhole	Adoptable
11.5	SWMH 11.5	1200	Manhole	Adoptable	SWMH 11.4	1200	Manhole	Adoptable
11.6	SWMH 11.6	1200	Manhole	Adoptable	SWMH 11.5	1200	Manhole	Adoptable
11.7	SWMH 11.7	1200	Manhole	Adoptable	SWMH 11.6	1200	Manhole	Adoptable
11.8	SWMH 11.8	1200	Manhole	Adoptable	SWMH 11.7	1200	Manhole	Adoptable
12.2	SWMH 12.2	1200	Manhole	Adoptable	SWMH 12.1	1200	Manhole	Adoptable
12.3	SWMH 12.3	1200	Manhole	Adoptable	SWMH 12.2	1200	Manhole	Adoptable
12.4	SWMH 12.4	1200	Manhole	Adoptable	SWMH 12.3	1200	Manhole	Adoptable
12.5	SWMH 12.5	1200	Manhole	Adoptable	SWMH 12.4	1200	Manhole	Adoptable
13.2	SWMH 13.2	1200	Manhole	Adoptable	SWMH 13.1	1200	Manhole	Adoptable
13.3	SWMH 13.3	1200	Manhole	Adoptable	SWMH 13.2	1200	Manhole	Adoptable
13.4	SWMH 13.4	1200	Manhole	Adoptable	SWMH 13.3	1200	Manhole	Adoptable
13.5	SWMH 13.5	1200	Manhole	Adoptable	SWMH 13.4	1200	Manhole	Adoptable

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
14.2	1.872	74.9	225	Circular	73.180	71.975	0.980	72.500	71.950	0.325
14.3	2.278	91.1	225	Circular	73.400	72.000	1.175	73.180	71.975	0.980
15.2	5.460	136.5	225	Circular	72.710	71.340	1.145	72.500	71.300	0.975
15.3	45.263	178.2	225	Circular	73.200	71.594	1.381	72.710	71.340	1.145
15.4	17.701	171.9	225	Circular	73.200	71.700	1.275	73.200	71.597	1.378
16.2	4.190	83.8	225	Circular	73.380	72.280	0.875	73.400	72.230	0.945
16.3	3.559	71.2	225	Circular	73.400	72.330	0.845	73.380	72.280	0.875
16.4	2.669	53.4	225	Circular	73.380	72.380	0.775	73.400	72.330	0.845
17.2	1.368	54.7	225	Circular	73.300	71.975	1.100	72.500	71.950	0.325
17.3	1.431	57.2	225	Circular	73.400	72.000	1.175	73.300	71.975	1.100
Pond 1.1	62.960	0.0	300	Circular	73.400	72.000	1.100	73.400	72.000	1.100
Pond 1.2	12.943	86.3	225	Circular	73.400	72.150	1.025	73.400	72.000	1.175
Pond 2.1	85.275	0.0	300	Circular	73.400	72.000	1.100	73.400	72.000	1.100
Pond 2.2	32.916	143.1	225	Circular	73.400	72.230	0.945	73.400	72.000	1.175
Pond 3.1	17.878	0.0	300	Circular	73.200	71.700	1.200	73.200	71.700	1.200
Pond 3.2	25.274	158.0	300	Circular	73.200	71.860	1.040	73.200	71.700	1.200
Pond 4.1	44.080	0.0	300	Circular	73.400	72.200	0.900	73.400	72.200	0.900
Pond 4.2	45.691	0.0	150	Circular	73.400	72.200	1.050	73.400	72.200	1.050
Pond 5	4.170	0.0	225	Circular	74.400	73.300	0.875	74.400	73.300	0.875
18.1	21.426	107.1	300	Circular	73.940	72.354	1.286	73.650	72.154	1.196

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
14.2	SWMH 14.2	1200	Manhole	Adoptable	SWMH 14.1	1200	Manhole	Adoptable
14.3	SWMH 14.3	1200	Manhole	Adoptable	SWMH 14.2	1200	Manhole	Adoptable
15.2	SWMH 15.2	1200	Manhole	Adoptable	SWMH 15.1	1200	Manhole	Adoptable
15.3	SWMH 15.3	1200	Manhole	Adoptable	SWMH 15.2	1200	Manhole	Adoptable
15.4	SWMH 15.4	1200	Manhole	Adoptable	SWMH 15.3	1200	Manhole	Adoptable
16.2	SWMH 16.2	1200	Manhole	Adoptable	SWMH 16.1	1200	Manhole	Adoptable
16.3	SWMH 16.3	1200	Manhole	Adoptable	SWMH 16.2	1200	Manhole	Adoptable
16.4	SWMH 16.4	1200	Manhole	Adoptable	SWMH 16.3	1200	Manhole	Adoptable
17.2	SWMH 17.2	1200	Manhole	Adoptable	SWMH 17.1	1200	Manhole	Adoptable
17.3	SWMH 17.3	1200	Manhole	Adoptable	SWMH 17.2	1200	Manhole	Adoptable
Pond 1.1	SWMH 11.1	1200	Manhole	Adoptable	SWMH 14.3	1200	Manhole	Adoptable
Pond 1.2	SWMH 13.1	1200	Manhole	Adoptable	SWMH 14.3	1200	Manhole	Adoptable
Pond 2.1	SWMH 12.1	1200	Manhole	Adoptable	SWMH 17.3	1200	Manhole	Adoptable
Pond 2.2	SWMH 16.1	1200	Manhole	Adoptable	SWMH 17.3	1200	Manhole	Adoptable
Pond 3.1	SWMH 9.1	1200	Manhole	Adoptable	SWMH 15.4	1200	Manhole	Adoptable
Pond 3.2	SWMH 6.1	1200	Manhole	Adoptable	SWMH 15.4	1200	Manhole	Adoptable
Pond 4.1	SWMH 3.1	1200	Manhole	Adoptable	SWMH 1.5	1200	Manhole	Adoptable
Pond 4.2	SWMH 2.1	1200	Manhole	Adoptable	SWMH 1.5	1200	Manhole	Adoptable
Pond 5	SWMH 4.1	1200	Manhole	Adoptable	SWMH 2.5	1200	Manhole	Adoptable
18.1	SWMH 18.1	1200	Manhole	Adoptable	SWMH 11.5	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SWMH Con	303817.958	230626.095	73.750	1.930	1200	1	1.1	71.820	300
									
SWMH 1.1	303815.504	230625.668	73.750	1.920	1200	1	1.2	71.830	300
									
						0	1.1	71.830	300
SWMH 1.2	303799.696	230598.832	74.110	2.155	1200	1	1.3	71.955	300
									
						0	1.2	71.955	300
SWMH 1.3	303782.426	230580.233	74.950	2.894	1200	1	7.1	72.056	150
						2	1.4	72.056	300
									
						0	1.3	72.056	300
SWMH 1.4	303758.271	230566.848	74.000	1.834	1200	1	1.5	72.166	300
									
						0	1.4	72.166	300
SWMH 1.5	303757.069	230569.573	73.400	1.200	1200	1	Pond 4.2	72.200	150
						2	Pond 4.1	72.200	300
									
						0	1.5	72.200	300
SWMH 2.1	303711.904	230562.661	73.400	1.200	1200	1	2.2	72.200	150
									
						0	Pond 4.2	72.200	150
SWMH 2.2	303687.569	230556.650	74.070	1.589	1200	1	2.3	72.481	150
									
						0	2.2	72.481	150
SWMH 2.3	303670.643	230547.154	74.470	1.773	1200	1	2.4	72.697	150
									
						0	2.3	72.697	150
SWMH 2.4	303642.697	230541.928	74.750	1.740	1200	1	2.5	73.010	150
									
						0	2.4	73.010	150
SWMH 2.5	303635.113	230535.287	74.400	1.100	1200	1	Pond 5	73.300	225
									
						0	2.5	73.300	150
SWMH 3.1	303713.345	230563.983	73.400	1.200	1200	1	3.2	72.200	300
									
						0	Pond 4.1	72.200	300
SWMH 3.2	303712.194	230567.644	73.440	1.224	1200	1	3.3	72.216	300
									
						0	3.2	72.216	300

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SWMH 3.3	303708.217	230566.882	73.350	1.118	1200	1	3.4	72.232	300
						0	3.3	72.232	300
SWMH 3.4	303704.599	230566.252	73.350	1.118	1200	1	3.5	72.248	225
						2	5.1	72.232	300
						0	3.4	72.248	300
SWMH 3.5	303686.012	230558.931	73.950	1.377	1200	1	3.6	72.573	225
						0	3.5	72.573	225
SWMH 3.6	303661.138	230552.006	73.980	1.000	1200	0	3.6	72.980	225
SWMH 4.1	303631.352	230537.088	74.400	1.100	1200	1	4.2	73.300	225
						0	Pond 5	73.300	225
SWMH 4.2	303631.148	230539.756	74.430	1.100	1200	1	4.3	73.330	225
						0	4.2	73.330	225
SWMH 4.3	303634.232	230540.511	74.420	1.055	1200	1	4.4	73.365	225
						0	4.3	73.365	225
SWMH 4.4	303637.844	230541.476	74.410	1.010	1200	0	4.4	73.400	225
SWMH 5.1	303685.833	230580.559	73.580	1.238	1200	1	10.1	72.342	225
						2	5.2	72.342	300
						0	5.1	72.342	300
SWMH 5.2	303672.259	230648.324	73.590	0.990	1200	0	5.2	72.600	300
SWMH 6.1	303847.702	230663.364	73.200	1.340	1200	1	6.2	71.860	225
						0	Pond 3.2	71.860	300
SWMH 6.2	303844.808	230663.133	73.210	1.270	1200	1	6.3	71.940	225
						0	6.2	71.940	225
SWMH 6.3	303842.379	230664.158	73.230	1.210	1200	1	6.4	72.020	225
						0	6.3	72.020	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SWMH 6.4	303839.319	230665.554	73.260	1.160	1200		1 6.5	72.100	225
							2 8.1	72.100	225
							0 6.4	72.100	225
SWMH 6.5	303833.673	230655.847	73.200	0.990	1200		0 6.5	72.210	225
SWMH 7.1	303773.734	230579.515	74.090	1.940	1200		1 7.2	72.150	150
							0 7.1	72.150	150
SWMH 7.2	303768.761	230579.061	73.330	1.130	1200		0 7.2	72.200	150
SWMH 8.1	303839.708	230679.632	73.240	0.990	1200		0 8.1	72.250	225
SWMH 9.1	303847.525	230671.902	73.200	1.500	1200		1 9.2	71.700	300
							0 Pond 3.1	71.700	300
SWMH 9.2	303792.728	230685.834	73.780	1.852	1200		1 9.3	71.928	300
							0 9.2	71.928	300
SWMH 9.3	303704.302	230668.965	73.850	1.562	1200		1 9.4	72.288	300
							0 9.3	72.288	300
SWMH 9.4	303671.938	230669.031	73.630	1.214	1200		1 9.5	72.416	300
							0 9.4	72.416	300
SWMH 9.5	303667.664	230668.294	73.830	1.330	1200		0 9.5	72.500	300
SWMH 10.1	303667.035	230606.315	73.840	1.140	1200		0 10.1	72.700	225
SWMH 11.1	303649.445	230812.584	73.400	1.400	1200		1 11.2	72.000	300
							0 Pond 1.1	72.000	300
SWMH 11.2	303650.077	230810.421	73.480	1.470	1200		1 11.3	72.010	300
							0 11.2	72.010	300

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SWMH 11.3	303646.938	230809.503	73.510	1.484	1200		1	11.4	72.026	300
							0	11.3	72.026	300
SWMH 11.4	303640.412	230807.832	73.450	1.400	1200		1	11.5	72.050	300
							0	11.4	72.050	300
SWMH 11.5	303642.244	230781.958	73.650	1.496	1200		1	18.1	72.154	300
							2	11.6	72.154	300
							0	11.5	72.154	300
SWMH 11.6	303656.748	230746.601	73.600	1.294	1200		1	11.7	72.306	300
							0	11.6	72.306	300
SWMH 11.7	303671.252	230711.244	73.580	1.122	1200		1	11.8	72.458	300
							0	11.7	72.458	300
SWMH 11.8	303676.967	230683.964	73.580	1.000	1200		0	11.8	72.580	300
SWMH 12.1	303738.067	230855.865	73.400	1.400	1200		1	12.2	72.000	300
							0	Pond 2.1	72.000	300
SWMH 12.2	303734.936	230849.613	73.480	1.440	1200		1	12.3	72.040	300
							0	12.2	72.040	300
SWMH 12.3	303702.648	230834.615	73.590	1.360	1200		1	12.4	72.230	300
							0	12.3	72.230	300
SWMH 12.4	303669.274	230819.112	73.710	1.250	1200		1	12.5	72.460	300
							0	12.4	72.460	300
SWMH 12.5	303667.251	230811.410	73.810	1.310	1200		0	12.5	72.500	300
SWMH 13.1	303711.263	230852.399	73.400	1.250	1200		1	13.2	72.150	225
							0	Pond 1.2	72.150	225
SWMH 13.2	303712.947	230849.060	73.380	1.170	1200		1	13.3	72.210	225
							0	13.2	72.210	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SWMH 13.3	303717.240	230850.696	73.390	1.110	1200	1	13.4	72.280	225
						0	13.3	72.280	225
SWMH 13.4	303721.614	230852.503	73.390	1.040	1200	1	13.5	72.350	225
						0	13.4	72.350	225
SWMH 13.5	303722.638	230850.369	73.390	1.000	1200	0	13.5	72.390	225
SWMH 14.1	303694.193	230852.700	72.500	0.550	1200	1	14.2	71.950	225
SWMH 14.2	303696.055	230852.502	73.180	1.205	1200	1	14.3	71.975	225
						0	14.2	71.975	225
SWMH 14.3	303698.321	230852.272	73.400	1.400	1200	1	Pond 1.2	72.000	225
						2	Pond 1.1	72.000	300
						0	14.3	72.000	225
SWMH 15.1	303817.102	230737.720	72.500	1.200	1200	1	15.2	71.300	225
SWMH 15.2	303816.412	230732.304	72.710	1.370	1200	1	15.3	71.340	225
						0	15.2	71.340	225
SWMH 15.3	303850.692	230702.747	73.200	1.606	1200	1	15.4	71.597	225
						0	15.3	71.594	225
SWMH 15.4	303857.797	230686.534	73.200	1.500	1200	1	Pond 3.2	71.700	300
						2	Pond 3.1	71.700	300
						0	15.4	71.700	225
SWMH 16.1	303800.963	230758.451	73.400	1.170	1200	1	16.2	72.230	225
						0	Pond 2.2	72.230	225
SWMH 16.2	303799.149	230762.228	73.380	1.100	1200	1	16.3	72.280	225
						0	16.2	72.280	225
SWMH 16.3	303797.672	230765.466	73.400	1.070	1200	1	16.4	72.330	225
						0	16.3	72.330	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SWMH 16.4	303795.212	230764.430	73.380	1.000	1200				
						0	16.4	72.380	225
SWMH 17.1	303793.390	230792.952	72.500	0.550	1200	1	17.2	71.950	225
									
SWMH 17.2	303793.004	230791.640	73.300	1.325	1200	 1	17.3	71.975	225
						0	17.2	71.975	225
SWMH 17.3	303792.566	230790.278	73.400	1.400	1200	 1	Pond 2.2	72.000	225
						2	Pond 2.1	72.000	300
						0	17.3	72.000	225
SWMH 18.1	303621.405	230776.978	73.940	1.586	1200				
						0	18.1	72.354	300

Simulation Settings

Rainfall Methodology	FSR	Drain Down Time (mins)	1440
FSR Region	Scotland and Ireland	Additional Storage (m³/ha)	20.0
M5-60 (mm)	16.800	Check Discharge Rate(s)	✓
Ratio-R	0.300	1 year (l/s)	8.5
Summer CV	0.750	30 year (l/s)	19.4
Winter CV	0.840	100 year (l/s)	24.7
Analysis Speed	Normal	Check Discharge Volume	✓
Skip Steady State	x	100 year +20% 1440 minute (m³)	1876

Storm Durations

1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	20	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)	5.005	Betterment (%)	0
SAAR (mm)	755	QBar	10.0
Soil Index	3	Q 1 year (l/s)	8.5
SPR	0.30	Q 30 year (l/s)	19.4
Region	11	Q 100 year (l/s)	24.7
Growth Factor 1 year	0.85		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	20
Positively Drained Area (ha)	5.005	Storm Duration (mins)	1440
Soil Index	3	Betterment (%)	0
SPR	0.30	PR	0.378
CWI	124.865	Runoff Volume (m^3)	1876

Node SWMH 1.4 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	72.166	Product Number	CTL-SHE-0079-3000-1200-3000
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	3.0	Min Node Diameter (mm)	1200

Node SWMH 2.4 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	73.010	Product Number	CTL-SHE-0013-1000-1000-1000
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	0.1	Min Node Diameter (mm)	1200

Node SWMH 7.2 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	72.200	Product Number	CTL-SHE-0023-2000-0500-2000
Design Depth (m)	0.500	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	0.2	Min Node Diameter (mm)	1200

Node SWMH 8.1 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	72.250	Product Number	CTL-SHE-0023-2000-0500-2000
Design Depth (m)	0.500	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	0.2	Min Node Diameter (mm)	1200

Node SWMH 13.5 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	72.390	Product Number	CTL-SHE-0023-2000-0500-2000
Design Depth (m)	0.500	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	0.2	Min Node Diameter (mm)	1200

Node SWMH 14.2 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	71.975	Product Number	CTL-SHE-0064-1800-1000-1800
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	1.8	Min Node Diameter (mm)	1200

Node SWMH 15.3 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	71.594	Product Number	CTL-SHE-0071-2500-1300-2500
Design Depth (m)	1.300	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.5	Min Node Diameter (mm)	1200

Node SWMH 16.4 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	72.380	Product Number	CTL-SHE-0045-7000-0500-7000
Design Depth (m)	0.500	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	0.7	Min Node Diameter (mm)	1200

Node SWMH 17.2 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	71.975	Product Number	CTL-SHE-0064-1800-1000-1800
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	1.8	Min Node Diameter (mm)	1200

Node SWMH 18.1 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	72.354	Product Number	CTL-SHE-0029-3000-0500-3000
Design Depth (m)	0.500	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	0.3	Min Node Diameter (mm)	1200

Node SWMH 13.5 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.02500	Invert Level (m)	72.390	Slope (1:X)	100.0
Side Inf Coefficient (m/hr)	0.02500	Time to half empty (mins)	360	Depth (m)	0.350
Safety Factor	2.0	Width (m)	43.000	Inf Depth (m)	0.350
Porosity	0.33	Length (m)	17.000		

Node SWMH 16.4 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.05000	Invert Level (m)	72.380	Slope (1:X)	100.0
Side Inf Coefficient (m/hr)	0.05000	Time to half empty (mins)	330	Depth (m)	0.350
Safety Factor	2.0	Width (m)	57.000	Inf Depth (m)	0.350
Porosity	0.36	Length (m)	17.000		

Node SWMH 8.1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.02000	Invert Level (m)	72.250	Slope (1:X)	100.0
Side Inf Coefficient (m/hr)	0.02000	Time to half empty (mins)	420	Depth (m)	0.350
Safety Factor	2.0	Width (m)	46.000	Inf Depth (m)	0.350
Porosity	0.33	Length (m)	44.000		

Node SWMH 7.2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.01000	Invert Level (m)	72.200	Slope (1:X)	100.0
Side Inf Coefficient (m/hr)	0.01000	Time to half empty (mins)	450	Depth (m)	0.350
Safety Factor	2.0	Width (m)	58.000	Inf Depth (m)	0.350
Porosity	0.33	Length (m)	17.000		

Node SWMH 1.5 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	72.200
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	900

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	211.0	0.0	1.100	422.0	0.0

Node SWMH 2.5 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	73.300
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	138.0	0.0	1.100	60.0	0.0

Node SWMH 15.4 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	71.700
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	500.0	0.0	1.500	800.0	0.0

Node SWMH 17.3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	72.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	600

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	300.0	0.0	1.300	750.0	0.0

Node SWMH 14.3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	72.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	750

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	300.0	0.0	1.300	850.0	0.0

Node SWMH 18.1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.02000	Invert Level (m)	72.354	Slope (1:X)	1000.0
Side Inf Coefficient (m/hr)	0.02000	Time to half empty (mins)	0	Depth (m)	0.350
Safety Factor	2.0	Width (m)	20.000	Inf Depth (m)	0.350
Porosity	0.33	Length (m)	160.000		

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +20% CC 1440 minute summer	15.421	4.133	100 year +20% CC 1440 minute winter	10.364	4.133

Results for 100 year +20% CC 1440 minute summer. 2880 minute analysis at 30 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	SWMH Con	720	71.861	0.041	3.1	0.0000	0.0000	OK
1440 minute summer	SWMH 1.1	720	71.876	0.046	3.1	0.0518	0.0000	OK
1440 minute summer	SWMH 1.2	720	71.997	0.042	3.1	0.0480	0.0000	OK
1440 minute summer	SWMH 1.3	720	72.099	0.043	3.1	0.0490	0.0000	OK
1440 minute summer	SWMH 1.4	1080	72.889	0.723	3.6	0.8176	0.0000	SURCHARGED
1440 minute summer	SWMH 1.5	1080	72.889	0.689	15.6	191.6685	0.0000	SURCHARGED
1440 minute summer	SWMH 2.1	1080	72.889	0.689	0.3	0.7791	0.0000	SURCHARGED
1440 minute summer	SWMH 2.2	1080	72.889	0.408	0.3	0.4612	0.0000	SURCHARGED
1440 minute summer	SWMH 2.3	1080	72.889	0.192	0.1	0.2169	0.0000	SURCHARGED
1440 minute summer	SWMH 2.4	1470	73.788	0.778	0.2	0.8803	0.0000	SURCHARGED
1440 minute summer	SWMH 2.5	1470	73.788	0.488	2.9	59.4913	0.0000	SURCHARGED
1440 minute summer	SWMH 3.1	1110	72.890	0.690	15.6	0.7805	0.0000	SURCHARGED
1440 minute summer	SWMH 3.2	1500	72.934	0.718	15.7	0.8125	0.0000	SURCHARGED
1440 minute summer	SWMH 3.3	1110	72.892	0.660	15.7	0.7467	0.0000	SURCHARGED
1440 minute summer	SWMH 3.4	1230	72.900	0.668	15.8	0.7551	0.0000	SURCHARGED
1440 minute summer	SWMH 3.5	1230	72.895	0.322	3.2	0.3636	0.0000	SURCHARGED
1440 minute summer	SWMH 3.6	720	73.014	0.034	3.2	0.1071	0.0000	OK
1440 minute summer	SWMH 4.1	1470	73.790	0.490	3.0	0.5538	0.0000	SURCHARGED
1440 minute summer	SWMH 4.2	1440	73.790	0.460	3.0	0.5203	0.0000	SURCHARGED
1440 minute summer	SWMH 4.3	1470	73.790	0.425	3.0	0.4804	0.0000	SURCHARGED
1440 minute summer	SWMH 4.4	1440	73.790	0.390	3.1	1.1742	0.0000	SURCHARGED

Link Event	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute summer	SWMH 1.1	1.1	SWMH Con	3.1	0.490	0.044	0.0157	406.0
1440 minute summer	SWMH 1.2	1.2	SWMH 1.1	3.1	0.480	0.044	0.1999	
1440 minute summer	SWMH 1.3	1.3	SWMH 1.2	3.1	0.500	0.044	0.1564	
1440 minute summer	SWMH 1.4	1.4	SWMH 1.3	2.9	0.487	0.042	0.1683	
1440 minute summer	SWMH 1.5	1.5	SWMH 1.4	3.6	0.262	0.030	0.2097	
1440 minute summer	SWMH 2.1	Pond 4.2	SWMH 1.5	0.3	0.062	0.027	0.8044	
1440 minute summer	SWMH 2.2	2.2	SWMH 2.1	0.3	0.089	0.016	0.4413	
1440 minute summer	SWMH 2.3	2.3	SWMH 2.2	0.3	0.271	0.013	0.3417	
1440 minute summer	SWMH 2.4	2.4	SWMH 2.3	0.1	0.271	0.005	0.2550	
1440 minute summer	SWMH 2.5	2.5	SWMH 2.4	0.2	0.165	0.006	0.1775	
1440 minute summer	SWMH 3.1	Pond 4.1	SWMH 1.5	15.6	0.256	0.315	3.1041	
1440 minute summer	SWMH 3.2	3.2	SWMH 3.1	15.6	0.222	0.219	0.2703	
1440 minute summer	SWMH 3.3	3.3	SWMH 3.2	15.7	0.268	0.226	0.2851	
1440 minute summer	SWMH 3.4	3.4	SWMH 3.3	15.7	0.363	0.216	0.2586	
1440 minute summer	SWMH 3.5	3.5	SWMH 3.4	3.2	0.174	0.048	0.7945	
1440 minute summer	SWMH 3.6	3.6	SWMH 3.5	3.2	0.857	0.049	0.5457	
1440 minute summer	SWMH 4.1	Pond 5	SWMH 2.5	2.9	0.383	0.105	0.1658	
1440 minute summer	SWMH 4.2	4.2	SWMH 4.1	3.0	0.247	0.054	0.1064	
1440 minute summer	SWMH 4.3	4.3	SWMH 4.2	3.0	0.421	0.055	0.1263	
1440 minute summer	SWMH 4.4	4.4	SWMH 4.3	3.0	0.515	0.060	0.1487	

Results for 100 year +20% CC 1440 minute summer. 2880 minute analysis at 30 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	SWMH 5.1	1110	72.895	0.553	13.2	0.6254	0.0000	SURCHARGED
1440 minute summer	SWMH 5.2	1110	72.895	0.295	9.8	2.1438	0.0000	OK
1440 minute summer	SWMH 6.1	1440	72.684	0.824	28.8	0.9321	0.0000	SURCHARGED
1440 minute summer	SWMH 6.2	1440	72.687	0.747	28.8	0.8453	0.0000	SURCHARGED
1440 minute summer	SWMH 6.3	1440	72.683	0.663	28.9	0.7502	0.0000	SURCHARGED
1440 minute summer	SWMH 6.4	1440	72.687	0.587	29.3	0.6635	0.0000	SURCHARGED
1440 minute summer	SWMH 6.5	1440	72.686	0.476	29.5	9.3722	0.0000	SURCHARGED
1440 minute summer	SWMH 7.1	600	72.160	0.010	0.2	0.0113	0.0000	OK
1440 minute summer	SWMH 7.2	930	72.460	0.260	5.7	58.1699	0.0000	SURCHARGED
1440 minute summer	SWMH 8.1	930	72.800	0.550	18.6	182.5781	0.0000	SURCHARGED
1440 minute summer	SWMH 9.1	1440	72.685	0.985	4.3	1.1139	0.0000	SURCHARGED
1440 minute summer	SWMH 9.2	1440	72.685	0.757	4.7	0.8561	0.0000	SURCHARGED
1440 minute summer	SWMH 9.3	1440	72.685	0.397	4.7	0.4489	0.0000	SURCHARGED
1440 minute summer	SWMH 9.4	1440	72.685	0.269	4.7	0.3042	0.0000	OK
1440 minute summer	SWMH 9.5	1440	72.685	0.185	4.7	0.6179	0.0000	OK
1440 minute summer	SWMH 10.1	1230	72.895	0.195	3.4	0.5876	0.0000	OK
1440 minute summer	SWMH 11.1	1290	72.707	0.707	266.9	0.7999	0.0000	SURCHARGED

Link Event	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute summer	SWMH 5.1	5.1	SWMH 3.4	12.9	0.303	0.170	1.6618	
1440 minute summer	SWMH 5.2	5.2	SWMH 5.1	9.8	0.516	0.145	4.8571	
1440 minute summer	SWMH 6.1	Pond 3.2	SWMH 15.4	28.7	0.963	0.325	1.7798	
1440 minute summer	SWMH 6.2	6.2	SWMH 6.1	28.8	1.136	0.332	0.1155	
1440 minute summer	SWMH 6.3	6.3	SWMH 6.2	28.8	1.253	0.317	0.1048	
1440 minute summer	SWMH 6.4	6.4	SWMH 6.3	28.9	1.289	0.359	0.1338	
1440 minute summer	SWMH 6.5	6.5	SWMH 6.4	29.3	1.196	0.569	0.4466	
1440 minute summer	SWMH 7.1	7.1	SWMH 1.3	0.2	0.209	0.009	0.0205	
1440 minute summer	SWMH 7.2	7.2	SWMH 7.1	0.2	0.313	0.009	0.0025	
1440 minute summer	SWMH 7.2	Infiltration		1.4				
1440 minute summer	SWMH 8.1	8.1	SWMH 6.4	-0.4	0.088	-0.007	0.5601	
1440 minute summer	SWMH 8.1	Infiltration		5.7				
1440 minute summer	SWMH 9.1	Pond 3.1	SWMH 15.4	4.3	0.171	0.086	1.2590	
1440 minute summer	SWMH 9.2	9.2	SWMH 9.1	4.3	0.162	0.062	3.9815	
1440 minute summer	SWMH 9.3	9.3	SWMH 9.2	4.7	0.456	0.067	6.3392	
1440 minute summer	SWMH 9.4	9.4	SWMH 9.3	4.7	0.567	0.068	2.2171	
1440 minute summer	SWMH 9.5	9.5	SWMH 9.4	4.7	0.701	0.030	0.2432	
1440 minute summer	SWMH 10.1	10.1	SWMH 5.1	3.4	0.325	0.056	0.9974	
1440 minute summer	SWMH 11.1	Pond 1.1	SWMH 14.3	25.4	0.361	0.513	4.4336	

Results for 100 year +20% CC 1440 minute summer. 2880 minute analysis at 30 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	SWMH 11.2	2070	72.962	0.952	338.5	1.0763	0.0000	SURCHARGED
1440 minute summer	SWMH 11.3	930	72.728	0.702	194.6	0.7938	0.0000	SURCHARGED
1440 minute summer	SWMH 11.4	1380	72.711	0.661	35.7	0.7475	0.0000	SURCHARGED
1440 minute summer	SWMH 11.5	1380	72.708	0.554	19.5	0.6266	0.0000	SURCHARGED
1440 minute summer	SWMH 11.6	1380	72.709	0.403	19.9	0.4557	0.0000	SURCHARGED
1440 minute summer	SWMH 11.7	1380	72.710	0.252	19.9	0.2849	0.0000	OK
1440 minute summer	SWMH 11.8	1230	72.710	0.130	19.9	1.7569	0.0000	OK
1440 minute summer	SWMH 12.1	1140	72.687	0.687	17.1	0.7767	0.0000	SURCHARGED
1440 minute summer	SWMH 12.2	1140	72.687	0.647	17.2	0.7315	0.0000	SURCHARGED
1440 minute summer	SWMH 12.3	1140	72.687	0.457	17.5	0.5168	0.0000	SURCHARGED
1440 minute summer	SWMH 12.4	1140	72.687	0.227	17.5	0.2569	0.0000	OK
1440 minute summer	SWMH 12.5	1140	72.687	0.187	17.5	1.7692	0.0000	OK
1440 minute summer	SWMH 13.1	1440	72.706	0.556	0.9	0.6289	0.0000	SURCHARGED
1440 minute summer	SWMH 13.2	1350	72.706	0.496	1.0	0.5614	0.0000	SURCHARGED
1440 minute summer	SWMH 13.3	1260	72.706	0.426	0.8	0.4812	0.0000	SURCHARGED
1440 minute summer	SWMH 13.4	1410	72.708	0.358	3.5	0.4046	0.0000	SURCHARGED
1440 minute summer	SWMH 13.5	900	72.697	0.307	7.3	55.3402	0.0000	SURCHARGED
1440 minute summer	SWMH 14.1	660	71.976	0.026	1.7	0.0000	0.0000	OK
1440 minute summer	SWMH 14.2	1350	72.706	0.731	1.8	0.8269	0.0000	SURCHARGED
1440 minute summer	SWMH 14.3	1350	72.706	0.706	25.4	318.1295	0.0000	SURCHARGED

Link Event	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute summer	SWMH 11.2	11.2	SWMH 11.1	259.2	3.727	3.515	0.1587	
1440 minute summer	SWMH 11.3	11.3	SWMH 11.2	-166.1	-2.360	-2.144	0.2303	
1440 minute summer	SWMH 11.4	11.4	SWMH 11.3	-30.4	-0.432	-0.461	0.4744	
1440 minute summer	SWMH 11.5	11.5	SWMH 11.4	19.3	0.442	0.276	1.8266	
1440 minute summer	SWMH 11.6	11.6	SWMH 11.5	19.5	0.680	0.280	2.6911	
1440 minute summer	SWMH 11.7	11.7	SWMH 11.6	19.9	0.808	0.285	2.5525	
1440 minute summer	SWMH 11.8	11.8	SWMH 11.7	19.9	0.859	0.272	1.2855	
1440 minute summer	SWMH 12.1	Pond 2.1	SWMH 17.3	17.1	0.242	0.345	6.0050	
1440 minute summer	SWMH 12.2	12.2	SWMH 12.1	17.1	0.243	0.204	0.4924	
1440 minute summer	SWMH 12.3	12.3	SWMH 12.2	17.2	0.425	0.212	2.5070	
1440 minute summer	SWMH 12.4	12.4	SWMH 12.3	17.5	0.850	0.200	2.3486	
1440 minute summer	SWMH 12.5	12.5	SWMH 12.4	17.5	0.901	0.223	0.4119	
1440 minute summer	SWMH 13.1	Pond 1.2	SWMH 14.3	1.1	0.323	0.020	0.5148	
1440 minute summer	SWMH 13.2	13.2	SWMH 13.1	-1.0	0.327	-0.015	0.1487	
1440 minute summer	SWMH 13.3	13.3	SWMH 13.2	-0.8	0.343	-0.013	0.1827	
1440 minute summer	SWMH 13.4	13.4	SWMH 13.3	-1.6	0.338	-0.026	0.1882	
1440 minute summer	SWMH 13.5	13.5	SWMH 13.4	0.9	0.342	0.013	0.0941	
1440 minute summer	SWMH 13.5	Infiltration		2.6				
1440 minute summer	SWMH 14.2	14.2	SWMH 14.1	1.7	0.627	0.028	0.0051	245.1
1440 minute summer	SWMH 14.3	14.3	SWMH 14.2	1.8	0.172	0.034	0.0906	

Results for 100 year +20% CC 1440 minute summer. 2880 minute analysis at 30 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	SWMH 15.1	1440	71.334	0.034	2.3	0.0000	0.0000	OK
1440 minute summer	SWMH 15.2	1440	71.376	0.036	2.3	0.0410	0.0000	OK
1440 minute summer	SWMH 15.3	1440	72.684	1.090	2.3	1.2333	0.0000	SURCHARGED
1440 minute summer	SWMH 15.4	1440	72.685	0.985	32.5	590.5580	0.0000	SURCHARGED
1440 minute summer	SWMH 16.1	1170	72.688	0.458	1.3	0.5181	0.0000	SURCHARGED
1440 minute summer	SWMH 16.2	1170	72.689	0.409	3.6	0.4623	0.0000	SURCHARGED
1440 minute summer	SWMH 16.3	1200	72.687	0.357	2.3	0.4035	0.0000	SURCHARGED
1440 minute summer	SWMH 16.4	870	73.250	0.870	17.3	102.9511	0.0000	FLOOD RISK
1440 minute summer	SWMH 17.1	660	71.974	0.024	1.7	0.0000	0.0000	OK
1440 minute summer	SWMH 17.2	1170	72.686	0.711	3.2	0.8045	0.0000	SURCHARGED
1440 minute summer	SWMH 17.3	1170	72.686	0.686	17.8	288.2270	0.0000	SURCHARGED
1440 minute summer	SWMH 18.1	870	72.560	0.206	20.0	135.4268	0.0000	OK

Link Event	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute summer	SWMH 15.2	15.2	SWMH 15.1	2.3	0.573	0.051	0.0217	354.7
1440 minute summer	SWMH 15.3	15.3	SWMH 15.2	2.3	0.542	0.059	0.1900	
1440 minute summer	SWMH 15.4	15.4	SWMH 15.3	2.3	0.170	0.058	0.7040	
1440 minute summer	SWMH 16.1	Pond 2.2	SWMH 17.3	-1.2	0.363	-0.027	1.3091	
1440 minute summer	SWMH 16.2	16.2	SWMH 16.1	-1.6	0.441	-0.029	0.1666	
1440 minute summer	SWMH 16.3	16.3	SWMH 16.2	2.4	0.495	0.039	0.1415	
1440 minute summer	SWMH 16.4	16.4	SWMH 16.3	2.3	0.533	0.033	0.1061	
1440 minute summer	SWMH 16.4	Infiltration		7.0				
1440 minute summer	SWMH 17.2	17.2	SWMH 17.1	1.7	0.688	0.024	0.0034	248.4
1440 minute summer	SWMH 17.3	17.3	SWMH 17.2	3.2	0.287	0.046	0.0569	
1440 minute summer	SWMH 18.1	18.1	SWMH 11.5	-13.6	-0.238	-0.127	1.5088	
1440 minute summer	SWMH 18.1	Infiltration		9.0				

Results for 100 year +20% CC 1440 minute winter. 2880 minute analysis at 30 minute timestep. Mass balance: 99.16%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	SWMH Con	690	71.861	0.041	3.1	0.0000	0.0000	OK
1440 minute winter	SWMH 1.1	690	71.876	0.046	3.1	0.0518	0.0000	OK
1440 minute winter	SWMH 1.2	690	71.997	0.042	3.1	0.0480	0.0000	OK
1440 minute winter	SWMH 1.3	660	72.099	0.043	3.1	0.0490	0.0000	OK
1440 minute winter	SWMH 1.4	1170	72.981	0.815	3.0	0.9219	0.0000	SURCHARGED
1440 minute winter	SWMH 1.5	1170	72.981	0.781	11.8	224.2416	0.0000	SURCHARGED
1440 minute winter	SWMH 2.1	1170	72.981	0.781	0.2	0.8838	0.0000	SURCHARGED
1440 minute winter	SWMH 2.2	1170	72.982	0.501	0.2	0.5661	0.0000	SURCHARGED
1440 minute winter	SWMH 2.3	1170	72.982	0.285	0.1	0.3219	0.0000	SURCHARGED
1440 minute winter	SWMH 2.4	1440	73.866	0.856	0.3	0.9676	0.0000	SURCHARGED
1440 minute winter	SWMH 2.5	1440	73.865	0.565	2.8	67.3372	0.0000	SURCHARGED
1440 minute winter	SWMH 3.1	1230	72.985	0.785	11.8	0.8877	0.0000	SURCHARGED
1440 minute winter	SWMH 3.2	1230	72.988	0.772	12.2	0.8730	0.0000	SURCHARGED
1440 minute winter	SWMH 3.3	1230	72.987	0.755	11.8	0.8540	0.0000	SURCHARGED
1440 minute winter	SWMH 3.4	1230	72.990	0.758	11.8	0.8572	0.0000	SURCHARGED
1440 minute winter	SWMH 3.5	1230	72.995	0.422	2.4	0.4768	0.0000	SURCHARGED
1440 minute winter	SWMH 3.6	750	73.009	0.029	2.4	0.0921	0.0000	OK
1440 minute winter	SWMH 4.1	1410	73.866	0.566	2.3	0.6397	0.0000	SURCHARGED
1440 minute winter	SWMH 4.2	1440	73.869	0.539	3.3	0.6093	0.0000	SURCHARGED
1440 minute winter	SWMH 4.3	1440	73.866	0.501	2.2	0.5666	0.0000	SURCHARGED
1440 minute winter	SWMH 4.4	1440	73.867	0.467	2.3	1.4060	0.0000	SURCHARGED

Link Event	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute winter	SWMH 1.1	1.1	SWMH Con	3.1	0.490	0.044	0.0157	436.0
1440 minute winter	SWMH 1.2	1.2	SWMH 1.1	3.1	0.480	0.044	0.1998	
1440 minute winter	SWMH 1.3	1.3	SWMH 1.2	3.1	0.500	0.044	0.1563	
1440 minute winter	SWMH 1.4	1.4	SWMH 1.3	2.9	0.487	0.042	0.1682	
1440 minute winter	SWMH 1.5	1.5	SWMH 1.4	3.0	0.225	0.025	0.2097	
1440 minute winter	SWMH 2.1	Pond 4.2	SWMH 1.5	0.2	-0.034	0.019	0.8044	
1440 minute winter	SWMH 2.2	2.2	SWMH 2.1	0.2	0.056	0.012	0.4413	
1440 minute winter	SWMH 2.3	2.3	SWMH 2.2	0.2	0.273	0.011	0.3417	
1440 minute winter	SWMH 2.4	2.4	SWMH 2.3	0.1	0.274	0.005	0.2551	
1440 minute winter	SWMH 2.5	2.5	SWMH 2.4	0.3	0.091	0.009	0.1775	
1440 minute winter	SWMH 3.1	Pond 4.1	SWMH 1.5	11.8	0.262	0.238	3.1041	
1440 minute winter	SWMH 3.2	3.2	SWMH 3.1	11.8	0.193	0.166	0.2703	
1440 minute winter	SWMH 3.3	3.3	SWMH 3.2	12.2	0.272	0.175	0.2851	
1440 minute winter	SWMH 3.4	3.4	SWMH 3.3	11.8	0.366	0.162	0.2586	
1440 minute winter	SWMH 3.5	3.5	SWMH 3.4	2.3	0.174	0.035	0.7945	
1440 minute winter	SWMH 3.6	3.6	SWMH 3.5	2.4	0.777	0.037	0.5481	
1440 minute winter	SWMH 4.1	Pond 5	SWMH 2.5	2.8	0.363	0.100	0.1658	
1440 minute winter	SWMH 4.2	4.2	SWMH 4.1	2.3	0.273	0.042	0.1064	
1440 minute winter	SWMH 4.3	4.3	SWMH 4.2	3.3	0.431	0.061	0.1263	
1440 minute winter	SWMH 4.4	4.4	SWMH 4.3	2.2	0.529	0.044	0.1487	

Results for 100 year +20% CC 1440 minute winter. 2880 minute analysis at 30 minute timestep. Mass balance: 99.16%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	SWMH 5.1	1230	72.993	0.651	10.0	0.7359	0.0000	SURCHARGED
1440 minute winter	SWMH 5.2	1230	72.992	0.392	7.4	2.8527	0.0000	SURCHARGED
1440 minute winter	SWMH 6.1	1410	72.811	0.951	21.3	1.0755	0.0000	SURCHARGED
1440 minute winter	SWMH 6.2	1380	72.813	0.873	21.4	0.9876	0.0000	SURCHARGED
1440 minute winter	SWMH 6.3	1410	72.811	0.791	21.4	0.8941	0.0000	SURCHARGED
1440 minute winter	SWMH 6.4	1410	72.813	0.713	21.6	0.8062	0.0000	SURCHARGED
1440 minute winter	SWMH 6.5	1410	72.812	0.602	22.2	11.8597	0.0000	SURCHARGED
1440 minute winter	SWMH 7.1	510	72.160	0.010	0.2	0.0113	0.0000	OK
1440 minute winter	SWMH 7.2	1020	72.479	0.279	4.3	64.3698	0.0000	SURCHARGED
1440 minute winter	SWMH 8.1	990	72.827	0.577	14.0	197.0560	0.0000	SURCHARGED
1440 minute winter	SWMH 9.1	1410	72.812	1.112	3.3	1.2573	0.0000	SURCHARGED
1440 minute winter	SWMH 9.2	1410	72.812	0.884	3.6	0.9995	0.0000	SURCHARGED
1440 minute winter	SWMH 9.3	1410	72.812	0.524	3.6	0.5923	0.0000	SURCHARGED
1440 minute winter	SWMH 9.4	1410	72.812	0.396	8.0	0.4475	0.0000	SURCHARGED
1440 minute winter	SWMH 9.5	1410	72.812	0.312	3.6	1.0414	0.0000	SURCHARGED
1440 minute winter	SWMH 10.1	1230	72.995	0.295	2.6	0.8861	0.0000	SURCHARGED
1440 minute winter	SWMH 11.1	2640	72.951	0.951	335.3	1.0761	0.0000	SURCHARGED

Link Event	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute winter	SWMH 5.1	5.1	SWMH 3.4	9.7	0.301	0.128	1.6618	
1440 minute winter	SWMH 5.2	5.2	SWMH 5.1	7.4	0.511	0.109	4.8667	
1440 minute winter	SWMH 6.1	Pond 3.2	SWMH 15.4	21.3	0.908	0.242	1.7798	
1440 minute winter	SWMH 6.2	6.2	SWMH 6.1	21.3	1.119	0.246	0.1155	
1440 minute winter	SWMH 6.3	6.3	SWMH 6.2	21.4	1.225	0.235	0.1048	
1440 minute winter	SWMH 6.4	6.4	SWMH 6.3	21.4	1.260	0.266	0.1338	
1440 minute winter	SWMH 6.5	6.5	SWMH 6.4	21.5	1.157	0.417	0.4466	
1440 minute winter	SWMH 7.1	7.1	SWMH 1.3	0.2	0.160	0.009	0.0205	
1440 minute winter	SWMH 7.2	7.2	SWMH 7.1	0.2	0.313	0.009	0.0025	
1440 minute winter	SWMH 7.2	Infiltration		1.4				
1440 minute winter	SWMH 8.1	8.1	SWMH 6.4	-0.4	0.081	-0.008	0.5601	
1440 minute winter	SWMH 8.1	Infiltration		5.7				
1440 minute winter	SWMH 9.1	Pond 3.1	SWMH 15.4	3.3	0.173	0.066	1.2590	
1440 minute winter	SWMH 9.2	9.2	SWMH 9.1	3.3	0.176	0.047	3.9815	
1440 minute winter	SWMH 9.3	9.3	SWMH 9.2	3.6	0.450	0.051	6.3392	
1440 minute winter	SWMH 9.4	9.4	SWMH 9.3	3.6	0.525	0.052	2.2791	
1440 minute winter	SWMH 9.5	9.5	SWMH 9.4	8.0	0.665	0.051	0.3054	
1440 minute winter	SWMH 10.1	10.1	SWMH 5.1	2.6	0.316	0.043	1.0385	
1440 minute winter	SWMH 11.1	Pond 1.1	SWMH 14.3	18.0	0.272	0.365	4.4336	

Results for 100 year +20% CC 1440 minute winter. 2880 minute analysis at 30 minute timestep. Mass balance: 99.16%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	SWMH 11.2	2820	73.069	1.059	187.5	1.1981	0.0000	SURCHARGED
1440 minute winter	SWMH 11.3	1320	72.792	0.766	251.8	0.8659	0.0000	SURCHARGED
1440 minute winter	SWMH 11.4	1410	72.793	0.743	38.8	0.8405	0.0000	SURCHARGED
1440 minute winter	SWMH 11.5	1410	72.794	0.640	18.2	0.7240	0.0000	SURCHARGED
1440 minute winter	SWMH 11.6	1410	72.793	0.487	18.1	0.5504	0.0000	SURCHARGED
1440 minute winter	SWMH 11.7	1410	72.793	0.335	15.0	0.3790	0.0000	SURCHARGED
1440 minute winter	SWMH 11.8	1410	72.794	0.214	15.0	2.8933	0.0000	OK
1440 minute winter	SWMH 12.1	1320	72.763	0.763	13.0	0.8631	0.0000	SURCHARGED
1440 minute winter	SWMH 12.2	1320	72.763	0.723	13.0	0.8180	0.0000	SURCHARGED
1440 minute winter	SWMH 12.3	1320	72.763	0.533	13.2	0.6033	0.0000	SURCHARGED
1440 minute winter	SWMH 12.4	1320	72.764	0.304	13.2	0.3434	0.0000	SURCHARGED
1440 minute winter	SWMH 12.5	1320	72.764	0.264	13.2	2.4919	0.0000	OK
1440 minute winter	SWMH 13.1	1380	72.791	0.641	1.2	0.7247	0.0000	SURCHARGED
1440 minute winter	SWMH 13.2	1380	72.791	0.581	1.2	0.6566	0.0000	SURCHARGED
1440 minute winter	SWMH 13.3	1380	72.790	0.510	0.5	0.5773	0.0000	SURCHARGED
1440 minute winter	SWMH 13.4	1350	72.790	0.440	1.3	0.4980	0.0000	SURCHARGED
1440 minute winter	SWMH 13.5	990	72.707	0.317	5.5	57.8103	0.0000	SURCHARGED
1440 minute winter	SWMH 14.1	600	71.976	0.026	1.7	0.0000	0.0000	OK
1440 minute winter	SWMH 14.2	1380	72.790	0.815	1.7	0.9218	0.0000	SURCHARGED
1440 minute winter	SWMH 14.3	1380	72.790	0.790	18.0	369.9526	0.0000	SURCHARGED

Link Event	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute winter	SWMH 11.2	11.2	SWMH 11.1	293.8	4.172	3.984	0.1587	
1440 minute winter	SWMH 11.3	11.3	SWMH 11.2	-176.7	-2.510	-2.282	0.2303	
1440 minute winter	SWMH 11.4	11.4	SWMH 11.3	-34.0	-0.483	-0.515	0.4744	
1440 minute winter	SWMH 11.5	11.5	SWMH 11.4	14.9	0.456	0.213	1.8266	
1440 minute winter	SWMH 11.6	11.6	SWMH 11.5	18.2	0.646	0.261	2.6911	
1440 minute winter	SWMH 11.7	11.7	SWMH 11.6	18.1	0.748	0.259	2.6911	
1440 minute winter	SWMH 11.8	11.8	SWMH 11.7	15.0	0.797	0.205	1.7300	
1440 minute winter	SWMH 12.1	Pond 2.1	SWMH 17.3	13.0	0.240	0.262	6.0050	
1440 minute winter	SWMH 12.2	12.2	SWMH 12.1	13.0	0.211	0.155	0.4924	
1440 minute winter	SWMH 12.3	12.3	SWMH 12.2	13.0	0.425	0.161	2.5070	
1440 minute winter	SWMH 12.4	12.4	SWMH 12.3	13.2	0.804	0.151	2.5914	
1440 minute winter	SWMH 12.5	12.5	SWMH 12.4	13.2	0.834	0.168	0.5415	
1440 minute winter	SWMH 13.1	Pond 1.2	SWMH 14.3	-1.2	0.173	-0.022	0.5148	
1440 minute winter	SWMH 13.2	13.2	SWMH 13.1	-1.2	0.328	-0.018	0.1487	
1440 minute winter	SWMH 13.3	13.3	SWMH 13.2	-0.5	0.343	-0.009	0.1827	
1440 minute winter	SWMH 13.4	13.4	SWMH 13.3	-0.9	0.338	-0.014	0.1882	
1440 minute winter	SWMH 13.5	13.5	SWMH 13.4	-0.8	0.343	-0.012	0.0941	
1440 minute winter	SWMH 13.5	Infiltration		2.6				
1440 minute winter	SWMH 14.2	14.2	SWMH 14.1	1.7	0.627	0.028	0.0051	248.4
1440 minute winter	SWMH 14.3	14.3	SWMH 14.2	1.7	0.227	0.032	0.0906	

Results for 100 year +20% CC 1440 minute winter. 2880 minute analysis at 30 minute timestep. Mass balance: 99.16%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	SWMH 15.1	1410	71.335	0.035	2.4	0.0000	0.0000	OK
1440 minute winter	SWMH 15.2	1410	71.377	0.037	2.4	0.0421	0.0000	OK
1440 minute winter	SWMH 15.3	1410	72.811	1.217	2.4	1.3767	0.0000	SURCHARGED
1440 minute winter	SWMH 15.4	1410	72.812	1.112	24.3	680.6896	0.0000	SURCHARGED
1440 minute winter	SWMH 16.1	1380	72.764	0.534	1.7	0.6038	0.0000	SURCHARGED
1440 minute winter	SWMH 16.2	1320	72.763	0.483	1.2	0.5458	0.0000	SURCHARGED
1440 minute winter	SWMH 16.3	1350	72.763	0.433	1.8	0.4896	0.0000	SURCHARGED
1440 minute winter	SWMH 16.4	930	72.795	0.415	13.0	97.5464	0.0000	SURCHARGED
1440 minute winter	SWMH 17.1	600	71.974	0.024	1.7	0.0000	0.0000	OK
1440 minute winter	SWMH 17.2	1320	72.763	0.788	4.9	0.8909	0.0000	SURCHARGED
1440 minute winter	SWMH 17.3	1320	72.763	0.763	13.6	330.3813	0.0000	SURCHARGED
1440 minute winter	SWMH 18.1	930	72.558	0.204	15.1	132.9076	0.0000	OK

Link Event	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute winter	SWMH 15.2	15.2	SWMH 15.1	2.4	0.581	0.054	0.0225	368.5
1440 minute winter	SWMH 15.3	15.3	SWMH 15.2	2.4	0.550	0.062	0.1972	
1440 minute winter	SWMH 15.4	15.4	SWMH 15.3	2.4	0.162	0.061	0.7040	
1440 minute winter	SWMH 16.1	Pond 2.2	SWMH 17.3	-1.0	0.339	-0.023	1.3091	
1440 minute winter	SWMH 16.2	16.2	SWMH 16.1	1.7	0.441	0.030	0.1666	
1440 minute winter	SWMH 16.3	16.3	SWMH 16.2	-1.7	0.495	-0.027	0.1415	
1440 minute winter	SWMH 16.4	16.4	SWMH 16.3	-1.4	0.533	-0.020	0.1061	
1440 minute winter	SWMH 16.4	Infiltration		7.0				
1440 minute winter	SWMH 17.2	17.2	SWMH 17.1	1.7	0.688	0.024	0.0034	250.0
1440 minute winter	SWMH 17.3	17.3	SWMH 17.2	4.9	0.302	0.071	0.0569	
1440 minute winter	SWMH 18.1	18.1	SWMH 11.5	6.6	0.099	0.061	1.5088	
1440 minute winter	SWMH 18.1	Infiltration		9.0				

Appendix C

Estimation of Run-off from Stream Catchment

IH124 Estimation of Q_{100} and Q_{1000}			
$Q_{BAR\ RURAL} = 0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$			
Characteristic	**Value**	**Unit**	**Source**
Area (A)	1.0	km^2	FSU
Average Annual Rainfall (SAAR)	715	mm	FSU
G1 % =	0	%	Fig I 4.18
G2 % =	0	%	Fig I 4.18
G3 % =	0	%	Fig I 4.18
G4 % =	0	%	Fig I 4.18
G5 % =	100	%	Fig I 4.18
Soil index (G) =	0.50	%	
$Q_{BAR\ RURAL}$ =	0.52	m3/sec	
CWI =	106.3		Fig I 6.62
CIND =	45.96		Eqn 7.2
NC =	0.75		Eqn 7.3
URBAN =	0.4		FSU
$Q_{BAR\ URBAN} / Q_{BAR\ RURAL}$ =	1.367		Eqn 7.4
Q_{BAR} =	0.717	m3/sec	
Q_{100} / Q_{BAR} (Ireland)	1.96		FSR - Ireland
$Q_{1,000} / Q_{BAR}$ (Ireland)	2.6		FSR - Ireland
Q_{100} =	1.406	m3/sec	
$Q_{1,000}$ =	1.865	m3/sec	
Factorial Error Factor =	1.651		Page 37 IOH124
Climate Change Factor =	1.2		FRMG
Q_{100} =	**2.79**	**m3/sec**	
$Q_{1,000}$ =	**3.69**	**m3/sec**	

FSU Update estimation of Q_{100} & Q_{1000}			
Characteristic	**Value**	**Unit**	**Source**
Area	1.0	km^2	FSU Portal
SAAR	715	mm	FSU Portal
BFI_{soil}	0.520		FSU Portal
FARL	1.0		FSU Portal
S1085	0.10	m/km	FSU Portal
$QMED_{rural}$	0.09	m3/s	
URBEXT	0.36		FSU Portal
$QMED_{urban}$	0.14		
Climate Change Factor	1.2		OPW
Q_{100} / $QMED_{rural}$	2.77		FSU Portal
Q_{1000} / $QMED_{rural}$	3.74		FSU Portal
Q_{100}	**0.473**	**m3/sec**	
$Q_{1,000}$	**0.639**	**m3/sec**	

FSU-3V estimation of Q_{100} & Q_{1000}			
Characteristic	**Value**	**Unit**	**Source**
Area	1.0	km^2	FSU Portal
BFI_{soil}	0.520		FSU Portal
SAAR	715	mm	FSU Portal
QMED	0.041	m3/s	
Climate Change Factor	1.2		OPW
Q_{100} / QMED	2.77		
Q_{1000} / QMED	3.74		
Q_{100}	**0.136**	**m3/sec**	
$Q_{1,000}$	**0.183**	**m3/sec**	

FSU-7V estimation of Q_{100} & Q_{1000}			
Characteristic	**Value**	**Unit**	**Source**
Area	1.0	km^2	FSU Portal
BFI_{soil}	0.520		FSU Portal
SAAR	715	mm	FSU Portal
FARL	1.0		FSU Portal
DRAIND	0.72	km/km^2	
S1085	0.10	m/km	FSU Portal
ARTDRAIN	0.00		
$QMED_{rural}$	0.072	m3/s	
URBEXT	0.36		FSU Portal
$QMED_{urban}$	0.11		
Climate Change Factor	1.2		OPW
Q_{100} / $QMED_{rural}$	2.77		FSU Portal
Q_{1000} / $QMED_{rural}$	3.74		FSU Portal
Q_{100}	**0.375**	**m3/sec**	
$Q_{1,000}$	**0.506**	**m3/sec**	

FEH-Statistical estimation of Q_{100} & Q_{1000}			
Characteristic	**Value**	**Unit**	**Source**
Area	1.0	km^2	FSU Portal
SAAR	715	mm	FSU Portal
FARL	1.0		FSU Portal
BFI_{soil}	0.520		FSU Portal
QMED	0.27	m3/s	
Climate Change Factor	1.2		OPW
Q_{100} / QMED	2.77		FSU Portal
Q_{1000} / QMED	3.74		FSU Portal
Q_{100}	**0.885**	**m3/sec**	
$Q_{1,000}$	**1.195**	**m3/sec**	

Technical Appendix 11.1: Ecological Impact Assessment Report

Ecological Impact Assessment

Profile Park Data Centre

13/12/2021

Disclaimer

Neo Environmental Limited shall have no liability for any loss, damage, injury, claim, expense, cost or other consequence arising as a result of use or reliance upon any information contained in or omitted from this document.

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Contents

EXECUTIVE SUMMARY

2.1. An Ecological Impact Assessment (EcIA) has been undertaken for a former residential property and associated lands to assess the potential impacts from the Proposed Development on local ecology. Baseline information within the ecological assessment comprises of an initial desk-based assessment and a Fossitt habitat survey, which was extended to identify the presence or likely absence of protected species. These have been outlined within the relevant sections of this report.

2.2. The desk-based assessment identified four Special Areas of Conservation (SACs) and three Special Protection Areas (SPA) within 15km of the Application Site boundary. Within 5km of the site boundary there are two Proposed Natural Heritage Areas (pNHAs). The site has a hydrological connection with the River Liffey and by extension, South Dublin Bay and the River Tolka Estuary SPA, but the AA concludes that there will be **no adverse impacts** to the integrity for any Natura 2000 sites from the Proposed Development.

2.3. A total of eight habitat types were noted during the Fossitt habitat survey undertaken in June 2021. The main habitat types recorded within the Application Site are Improved grassland (GA1), and treeline (WL2). The lands directly under and adjacent to the Proposed Development are considered to be of **low** ecological value.

2.4. From the current survey findings and impact assessment conducted it is considered that the Proposed Development is **unlikely to have significant impacts** on local wildlife. However, as a precautionary measure, several mitigation measures have been outlined within this report to reduce any potential impacts for local ecology. These include:

- A 30m buffer around any badger setts;
- Pre-commencement surveys for badger and otter; and
- Addition of artificial habitats such as bat boxes.

2.5. Furthermore, a Biodiversity Management Plan (BMP) has been produced as part of the planning application. This encompasses enhancement and compensatory measures to ensure the Proposed Development will have a net **beneficial effect** for local wildlife.

INTRODUCTION

Background

2.6. Neo Environmental Ltd has been appointed by Ramboll on behalf of Vantage Data Centers Dub 11 Limited (the "Applicant") to undertake an Ecological Impact Assessment for a proposed data centre (the "Proposed Development") on lands within Profile Park, Clondalkin, Dublin (the "Application Site").

Development Description

2.7. The development will consist of the demolition of the abandoned single storey dwelling and associated buildings (206 sqm), and the construction of 2 no. two storey data centers with plant at roof level of each facility and associated ancillary development that will have a gross floor area of 41,105sqm. The proposed development will include a range of SuDs features and enhancements to the Baldonnel Stream.

Site Description

2.8. The site currently comprises a small single story former residential dwelling with one outbuilding/shed and associated garden, with unmanaged agricultural grassland, treelines and the Baldonnel stream. The site is situated in southwest Dublin and is situated within an industrial area, to the west of Grange Castle golf Course.

Scope of the Assessment

2.9. An Ecological Impact Assessment was completed at the Application Site. The aims of this report are to:

- Determine the main habitat types within and immediately adjacent to the Application Site in relation to the Proposed Development footprint;
- Identify any actual or potential habitat or species constraints pertinent to the development of the Application Site and to identify how the Proposed Development can avoid, mitigate and, if necessary, compensate for impacts on these actual or potential constraints;
- Assess the potential impacts of the Proposed Development during the construction, operation and decommissioning phases;
- Provide mitigation to reduce the impacts of the activities undertaken during the various phases of the Proposed Development; and

- Identify potential opportunities for the Proposed Development to enhance and add to the biodiversity resource within the site.

2.10. This allows for the identification of potential ecological impacts and the compilation of appropriate mitigation measures where applicable.

Statement of Authority

2.11. The assessment has been conducted by ecologists registered with the Chartered Institute of Ecology and Environmental Management ("CIEEM"). All work has been carried out in line with the relevant professional guidance; CIEEM's Guidelines for Preliminary Ecological Appraisal[1] and the Environment, Heritage and Local Government's Guidance on Appropriate Assessments[2].

2.12. Ashleen Blom BSc (Hons) MSc is a senior ecologist with 4 years' professional experience in ecological consultancy. She has worked as part of multidisciplinary and dedicated ecology teams contributing towards projects in education, commercial, defence, energy, residential, and infrastructure sectors in Northern Ireland. She has contributed towards large multidisciplinary and small-scale private developments. Ashleen has experience in completing Phase 1 habitat surveys across a variety of habitats. She also has experience in protected species surveys including bat, otter, smooth newt and badger. She has experience classifying Potential Roosting Features for bats in trees and structures and classifying habitats for their potential to support foraging and commuting bats. Ashleen has experience in completing invasive species surveys including invasive aquatic species.

2.13. Dara Dunlop is a Qualifying Member of CIEEM with circa 3 years' experience in the ecology sector, including working for an ecological consultancy, undertaking a range of protected species surveys and extended phase 1 habitat surveys for industrial schemes, and land management of designated sites. Dara has co-authored a number of reports including Ecological Impact Assessments and Protected Species Reports for various developments.

[1] CIEEM, 2017. Guidelines for Preliminary Ecological Appraisal. Available at www.cieem.net

[2] Environment, Heritage and Local Government, 2009. Appropriate Assessment of Plans and Projects in Ireland, Guidance for Planning Authorities. Available at www.npws.ie

LEGISLATION AND PLANNING POLICY CONTEXT

European Legislation

2.14. European legislation relevant to the proposed development is outlined within **Table 2-1** below.

Table 2-1: Relevant European Legislation

Directive	Main Provisions
EU Habitats Directive 92/43/EEC	The EU Habitats Directive sets out the framework for the designation and protection of sites for nature conservation for species and habitats listed in Annex II, IV and V. The directive was adopted in 1992 as a response to the Bern Convention. *"The main aim of the Habitats Directive is to promote the maintenance of biodiversity by requiring Member States to take measures to maintain or restore natural habitats and wild species listed on the Annexes to the Directive at a favourable conservation status, introducing robust protection for those habitats and species of European importance"* The protection of species outlined in the Habitats Directive is transposed into national legislation principally by 'EC (Natural Habitats) Regulations 1997 (amended)'[3].
The Birds Directive 2009/147/EC	European Union members meet their obligations for bird species under the Bern Convention and Bonn Convention, and more generally by the means of the EU Birds Directive. The Birds Directive sets out the criteria for Special Protection Areas including; a list of species requiring protection in Annex 1 of the Directive and mechanisms for protecting wild birds naturally occurring in Europe. This Directive is transposed into national legislation principally by the 'EC (Birds and Natural Habitats) Regulations 2011'[4]. The Directive provides a framework for the conservation and management of, and human interactions with, wild birds in Europe. It sets broad objectives for a wide range of activities, although the

[3] Office of the Attorney General (1997), European Communities (Natural Habitats) Regulations 1997 (amended 1998, 2005), available at www.irishstatutebook.ie

[4] Office of the Attorney General (2011), European Communities (Birds and Natural Habitats) Regulations 2011, available at www irishstatutebook.ie

	precise legal mechanisms for their achievement are at the discretion of each Member State.
Environmental Liability Directive 2004/35/EC	The Environmental Liability Directive aims to make those causing damage to the environment (water, land and nature) legally and financially responsible for that damage. The directive covers environmental damage caused by or resulting from occupational activities to species and natural habitats protected under the 1992 Habitats Directive and the 1979 Wild Birds Directive. Damage to protected species and natural habitats is "*any damage that has significant adverse effects on reaching or maintaining the favourable conservation status of such habitats or species*".
Bern Convention	The Bern Convention came into force in 1982, with the principal aims to ensure conservation and protection of wild plant and animal species and their natural habitats (listed in Appendices I and II of the Convention), to increase cooperation between contracting parties, and to regulate the exploitation of those species (including migratory species) listed in Appendix III.
Bonn Convention	The Bonn convention came into force in 1985. Contracting Parties work together to conserve migratory species and their habitats by providing strict protection for endangered migratory species (listed in Appendix I of the Convention), concluding multilateral Agreements for the conservation and management of migratory species which require or would benefit from international cooperation (listed in Appendix II), and by undertaking cooperative research activities.

National Legislation

2.15. The principal national legislation governing the protection of wildlife and natural resources in Ireland is:

- The Wildlife Act 1976 (amended 2000)[5] - this is the principal legislation for the protection of wildlife in Ireland and outlines strict protection for species that have significant conservation value. The Act also provides a mechanism to give statutory protection to Natural Heritage Areas ("NHAs"). The amendment in 2000 broadens the

[5] Office of the Attorney General (1976) Wildlife Act 1976 (amended 2000), available at www.irishstatutebook.ie

scope of the Wildlife Acts to include most species, including the majority of fish and aquatic invertebrate species which were excluded from the 1976 Act.

- EC (Birds and Natural Habitats) Regulations 2011 (amended 2015)[6] - transposes the EU directives into law. It protects species and priority habitats considered to be of European interest.
- Flora Protection Order 2015[7] - this Order makes it illegal to cut, uproot or damage a listed species in any way. It is illegal to alter, damage or interfere in any way with their habitats. This protection applies wherever the plants are found.
- The EC (Water Policy) Regulations 2003[8] – transposes the Water Framework Directive into national law.

2.16. The regulations contained within the above referenced legislation have all been taken into account during the production of this ecological report.

Planning and Development Act, 2000 (as amended)[9]

2.17. Relevant sections regarding ecology within the Planning and Development Act 2000 (amended 2006) are as follows:

First Schedule, Part IV Environment and Amenities

"5. (a) Preserving and protecting flora, fauna and ecological diversity.

(b) Preserving and protecting trees, shrubs, plants and flowers.

6. Protecting and preserving (either in situ or by record) places, caves, sites, features and other objects of archaeological, geological, historical, scientific or ecological interest."

Fifth Schedule

"19. Any condition relating to the protection of features of the landscape which are of major importance for wild fauna and flora.

[6] Office of the Attorney General (2011) European Communities (Birds and Natural Habitats Regulations 2011 (amended 2015), available at www.irishstatutebook.ie

[7] Office of the Attorney General (2015) Flora Protection Order 2015, available at www.irishstatutebook.ie

[8] Office of the Attorney General (2003) European Communities (Water Policy) Regulations 2003, available at www.irishstatute book.ie

[9] Office of the Attorney General (2000) Planning and Development Act 2000, available at www.irishstatutebook.ie

20. Any condition relating to the preservation and protection of trees, shrubs, plants and flowers.

21. Any condition relating to the preservation (either in situ or by record) of places, caves, sites, features or other objects of archaeological, geological, historical, scientific or ecological interest.

22. Any condition relating to the conservation and preservation of—

(a) one or more specific—

(i) (I) natural habitat types in Annex I of the Habitats Directive, or

(II) species in Annex II of the Habitats Directive which the site hosts,

contained in a European site selected by the Minister for Arts, Heritage, Gaeltacht and the Islands in accordance with Annex III (Stage 1) of that Directive,

(ii) species of bird or their habitat or other habitat contained in a European site specified in Article 4 of the Birds Directive, which formed the basis of the classification of that site,

or

(b) any other area prescribed for the purpose of section 10(2)(c)."

Part XIV

"212. – (1) A planning authority may develop or secure or facilitate the development of land and, in particular and without prejudice to the generality of the foregoing, may do one or more of the following:

(f) secure the preservation of any view or prospect, any protected structure or other structure, any architectural conservation area or natural physical feature, any trees or woodlands or any site of archaeological, geological, historical;

(g) secure the creation, management, restoration or preservation of any site of scientific or ecological interest, including any Nature Conservation Site."

Planning Policy Statement 2015[10]

2.18. The aim of Planning Policy Statement 2015 is as follows:

"Planning legislation in Ireland seeks to ensure, in the interests of the common good, the proper planning and sustainable development of urban and rural areas."

[10]Environment, Community and Local Government (2015), Planning Policy Statement 2015, available at www.environ.ie

2.19. The Government outlined 10 key principles as a strategic guide in implementing the aim above. Relevant ecological principals outlined within this document include:

"4. Planning must support the transition to a low carbon future and adapt to a changing climate taking full account of flood risk and facilitating, as appropriate, the use of renewable resources, particularly the development of alternative indigenous energy resources.

8. Planning will conserve and enhance the rich qualities of natural and cultural heritage of Ireland in a manner appropriate to their significance, from statutorily designated sites to sites of local importance, and including the conservation and management of landscape quality to the maximum extent possible, so that these intrinsic qualities of our country can be enjoyed for their collective contribution to the quality of life of this and future generations.

9. Planning will support the protection and enhancement of environmental quality in a manner consistent with the requirements of relevant national and European standards by guiding development towards optimal locations from the perspective of ensuring high standards of water and air quality, biodiversity and the minimisation of pollution risk."

South Dublin Development Plan 2016–2022 [11]

2.20. The Plan sets out an overall strategy for the proper planning and sustainable development of the County and consists of a written statement and accompanying plans and maps

2.21. Chapter 9 of the Plan refers to the county's natural heritage and contains a number of key policies (outlined below), which aim to protect and enhance biodiversity and designated sites within the county:

HCL1: Objective 1: To protect, conserve and enhance natural, built and cultural heritage features and restrict development that would have a significant negative impact on these assets.

HCL1 Objective 2: To support the objectives and actions of the County Heritage Plan, including the preparation of a County Biodiversity Plan.

HCL12 Objective 1: To prevent development that would adversely affect the integrity of any Natura 2000 site located within and immediately adjacent to the County and promote favourable conservation status of habitats and protected species including those listed under the Birds Directive, the Wildlife Acts and the Habitats Directive.

HCL12 Objective 2 To ensure that projects that give rise to significant direct, indirect or secondary impacts on Natura 2000 sites, either individually or in combination with other plans or projects, will not be permitted unless the following is robustly demonstrated in accordance with Article 6(4) of the Habitats Directive and S.177AA of the Planning and Development Act (2000 – 2010) or any superseding legislation:

1. There are no less damaging alternative solutions available; and

[11] Available at: https://sdcc.ie/en/services/planning/development-plan/plan-2016-2022/plan-2016-2022.html

2. There are imperative reasons of overriding public interest (as defined in the Habitats Directive) requiring the project to proceed; and

3. Adequate compensatory measures have been identified that can be put in place.

HCL13 Objective 1 To ensure that any proposal for development within or adjacent to a proposed Natural Heritage Area (pNHA) is designed and sited to minimise its impact on the biodiversity, ecological, geological and landscape value of the pNHA particularly plant and animal species listed under the Wildlife Acts and the Habitats and Birds Directive including their habitats.

HCL13 Objective 2 To restrict development within a proposed Natural Heritage Area to development that is directly related to the area's amenity potential subject to the protection and enhancement of natural heritage and visual amenities including biodiversity and landscapes.

HCL15 Objective 1 To ensure that development does not have a significant adverse impact on rare and threatened species, including those protected under the Wildlife Acts 1976 and 2000, the Birds Directive 1979 and the Habitats Directive 1992.

HCL15 Objective 2 To ensure that, where evidence of species that are protected under the Wildlife Acts 1976 and 2000, the Birds Directive 1979 and the Habitats Directive 1992 exists, appropriate avoidance and mitigation measures are incorporated into development proposals as part of any ecological impact assessment

HCL15 Objective 3 To protect existing trees, hedgerows, and woodlands which are of amenity or biodiversity value and/ or contribute to landscape character and ensure that proper provision is made for their protection and management in accordance with Living with Trees: South Dublin County Council's Tree Management Policy 2015-2020.

2.22. The South Dublin County Council Development Plan for the period 2022 – 2028 is still under review.

South Dublin County Council Draft Biodiversity Action Plan 2015-2020[12]

2.23. The preparation of this Biodiversity Action Plan is an objective of the South Dublin County Heritage Plan and the South Dublin County Council Development Plan 2016-2022 The South Dublin County Biodiversity Plan was prepared in the context of a range of national and international plans for biodiversity protection and enhancement

2.24. The National Biodiversity Plan lists a range of actions for biodiversity that aim to achieve this vision, arranged under a series of 7 Strategic Objectives. These objectives are:

- the mainstreaming of biodiversity issues across the decision-making in all sectors;

[12]https://www.meath.ie/system/files/media/file-uploads/2019-06/County%20Meath%20Biodiversity%20Plan%202015-2020 pdf

- the strengthening of the knowledge base for conservation, management and sustainable use of biodiversity;
- increasing public awareness and appreciation of biodiversity and ecosystem services;
- the conservation and restoration of biodiversity and ecosystem services in the wider countryside;
- the conservation and restoration of biodiversity and ecosystem services in the marine environment;
- the expansion and improved management of protected areas and species; and
- the strengthening of international governance for biodiversity and ecosystem services.

Guidance Documents

BS 42020:2013 Biodiversity[13]

2.25. The British Standards Institute has published BS 42020:2013 Biodiversity. Code of practice for planning and development which offers a coherent methodology for biodiversity management. This document seeks to promote transparency and consistency in the quality and appropriateness of ecological information submitted with planning applications and applications for other regulatory approvals.

2.26. BS 42020:2013 cites CIEEM EcIA Guidelines as the acknowledged reference on ecological impact assessment. These guidelines provide recommendations on topics such as professional practice, proportionality, pre-application discussions, ecological surveys, adequacy of ecological information, reporting and monitoring.

CIEEM Guidelines

2.27. The Chartered Institute of Ecology and Environmental Management (CIEEM) have produced guidance on Ecological Impact Assessment[14] (EcIA) and Ecological Report Writing[15].

2.28. EcIA is a process of identifying, quantifying and evaluating potential effects from activities such as those related to development on habitats, species and ecosystems. This EcIA process follows the tasks set out in **Table 2-2**.

[13] BS 42020:2013 Biodiversity. Code of practice for planning and development
[14] CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater, Coastal and Marine.
[15] CIEEM (2017) Guidelines for Ecological Report Writing

Table 2-2: EcIA Process

Task	Description
Scoping	Determining the matters to be addressed in the EcIA, including consultation to ensure the most effective input to defining the scope. Scoping is an ongoing process – the scope of the EcIA may be modified following further ecological survey/research and during impact assessment.
Establishing the baseline	Collecting information and describing the ecological conditions in the absence of the proposed project, to inform the assessment of impacts.
Important ecological features	Identifying important ecological features (habitats, species and ecosystems, including ecosystem function and processes) that may be affected, with reference to a geographical context in which they are considered important.
Impact assessment	An assessment of whether important ecological features will be subject to impacts and characterisation of these impacts and their effects3. Assessment of the significance of the residual ecological effects of the project (those remaining after mitigation), including cumulative effects.
Avoidance, mitigation, compensation and enhancement	Incorporating measures to avoid, reduce and compensate negative ecological impacts and their effects, and the provision of ecological enhancements. Monitoring impacts and their effects. Evaluation of the success of proposed mitigation, compensation and enhancement measures.

2.29. The aims of their EcIA guidelines are to:

- promote good practice;
- promote a scientifically rigorous and transparent approach to EcIA;
- provide a common framework to EcIA in order to promote better communication and closer cooperation between ecologists involved in EcIA; and
- provide decision-makers with relevant information about the likely ecological effects of a project.

METHODOLOGY

Zone of Influence

2.30. The Zone of Influence (ZOI) is the area encompassing all predicted negative ecological effects from a proposed scheme and is informed by the habitats present within the site and the nature of the proposals. Due to the scale and nature of the proposal, it is considered that the ZOI will fall within the distances from the proposed solar farm outlined in **Table 2-3** below. These were therefore considered appropriate for gathering information for the desk study.

Table 2-3: Study areas for ecological features

ECOLOGICAL FEATURE	STUDY AREA
International/European statutory designations	15km
National statutory designations	5km
Protected and Priority Species	2km
Fossitt habitat survey	50m

Desk Study

2.31. A desk-based assessment was undertaken to collate available ecological information for the Application Site and the surrounding area. This included a search of statutory designated sites within a 5km radius of the Proposed Development, including: Special Protection Areas (SPAs), Special Areas of Conservation (SACs), Ramsar Sites, Nature Reserves (NRs), Wildfowl Sanctuaries, Natural Heritage Areas (NHAs) and Proposed Natural Heritage Areas (pNHAs). The descriptions of each of these sites was obtained utilising the National Parks and Wildlife Service (NPWS) website[16].

2.32. A data search was conducted though the National Biodiversity Data Centre (NBDC) to obtain information regarding protected/notable species within 2km of the Application Site boundary. The Application Site is located at Irish Grid Reference (IGR) O 03717 30800.

2.33. Additional information on the suitability of habitat in the surrounding area for bats was also obtained from the NBDC in the form of a habitat suitability map. The map provided enhanced information on the recorded distribution of bats and broad-scale geographic patterns of occurrence and local roosting habitat requirements for Irish bat species.

[16] NPWS website; available at: http://www.npws.ie/protected-sites.

Field Survey

Fossitt Habitat Survey

2.34. A Fossitt habitat survey was undertaken on 17th June 2021 by Ashleen Blom (BSc (Hons) MSc). The Ecological Survey Area (ESA) covered all land within the Application Site and a 50m buffer around the entire site, where access was allowed.

2.35. Survey work was carried out in accordance with Fossitt habitat survey guidance[17]; habitats were mapped electronically in the field in order to produce a habitat map.

Species Scoping Survey

2.36. A species scoping survey was carried out to identify the presence of protected species, or the potential of the Application Site to support protected species. The aim of the survey was to provide an overview of the Application Site and to determine whether any further survey work was required.

2.37. No additional protected species surveys were undertaken at this time.

2.38. **Table 2-4** below outlines the relevant habitat and field signs that indicate the potential presence of protected or notable species within the ESA.

Table 2-4: Indicative Habitats and Field Signs of Protected Species

Taxon	Indicative Habitat(s)	Field Signs (In Addition to Sightings)
Bats	Roosts – trees, buildings, bridges, caves, etc. Foraging areas – e.g. parkland, water bodies, streams, wetlands, woodland edges and hedgerow. Commuting routes – linear features (e.g.) hedgerows, water courses, tree lines). See **Appendix C** for preferred foraging and commuting habitat for individual species.	In or on potential roost sites: droppings stuck to walls, urine spotting in roof spaces, oil from fur staining round roost entrances, feeding remains (e.g. moth wings under a feeding perch).
Badger *Meles meles*	Found in most rural and many urban habitats.	Excavations and tracks: sett entrances, latrines, hairs, well-worn paths, prints, scratch marks on trees.

[17] Fossitt (2000) A Guide to Habitats in Ireland

Taxon	Indicative Habitat(s)	Field Signs (In Addition to Sightings)
Otter *Lutra lutra*	Watercourses.	Holts (or dens), prints, spraints (droppings), slide marks into watercourses, feeding signs (e.g. fish bones).
Birds	Trees, scrub, hedgerow, field margins, grassland, buildings.	Nests, droppings below nest sites (especially in buildings of trees), tree holes.
Common lizard *Zootoca vivipara*	Rough grassland, log and rubble piles.	Sloughed skins.

Additional Surveys

2.39. Bat activity, breeding bird and Fossitt habitat surveys were competed in June 2020 by Scott Cawley. These surveys went on the inform the 2020 Ecological Impact Assessment report for a previous planning application on this site.

2.40. The following habitat types were identified within the Application site:

- Improved agricultural grassland (GA1)
- Amenity grassland (improved) (GA2)
- Dry meadows and grassy verges (GS2)
- Hedgerows (WL1)
- Treelines (WL2)
- Depositing/lowland rivers (FW2)
- Recolonising bare ground (ED3)
- Buildings and artificial surfaces (BL3)

2.41. Breeding bird surveys were undertaken on the 18th June and 1st July 2020. A range of common bird species were noted using the site for foraging and breeding during these surveys. No nests were observed in vegetation or structures during the breeding bird surveys.

2.42. A ground level bat roost potential assessment of structures and trees was undertaken on 1st July 2020. No potential bat roost features were identified on trees within the Application Site. The residential building on site was considered to have low to moderate potential for roosting

bats while the other structure on site, a shed, was considered to have no bat roost potential. An internal inspection of the residential building was carried out on the 2nd July 2020 and no evidence of roosting bats was observed.

2.43. Two bat emergence and activity surveys were undertaken on the 8th June and 22nd July 2020. No bats were observed emerging from the two buildings on site, however common pipistrelle, soprano pipistrelle and Leisler's bat were recorded foraging and commuting with the Application Site.

2.44. Bat surveys have been updated for the 2021 survey season. Two emergence surveys were undertaken carried out on the dwelling and outbuilding proposed to be demolished on the 22nd June and 15 July 2021. Two walking transect surveys were undertaken on the 23rd June and 15th July 2021. The results of 2021 bat surveys are outlined in **Appendix D.**

2.45. The emergence surveys did not reveal any bats emerging from the cottage or the outbuilding. It is therefore considered that bats are **not currently roosting within the buildings proposed for demolition**.

2.46. The results of the transect and static surveys indicate that the site is used by low numbers of foraging bats.

Weather Conditions

2.47. **Table 2-5** describes the weather conditions at the time of survey giving air temperature (°C), wind speed (Beaufort force), cloud cover (percentage) and precipitation.

Table 2-5: Weather conditions at time of survey

Survey Date	Temperature (°C)	Wind	Cloud Cover (%)	Precipitation
17/06/2021	16	2	100	None
22/06/2021	15	1 Westerly	100	Light rain approximately 1 hour after sunset.
15/07/2021	20	1 Westerly	0	None

Limitations

2.48. Results of the assessment undertaken by Neo Environmental are representative of the time that surveying was undertaken.

2.49. The absence of specific species records returned during the data search does not necessarily indicate absence of a species or habitat from an area, but rather that these have not been recorded or are perhaps under-recorded within the search area.

2.50. A Fossitt habitat survey does not aim to produce a full botanical or faunal species list or provide a full protected species survey, but enables competent ecologists to ascertain an understanding of the ecology of the site in order to:

- Identify broadly the nature conservation value of a site and preliminary assess the significance of any potential impacts on habitat/species recorded, and/or
- Confirm the need and extent of any additional specific ecological surveys that are required to identify the true nature conservation value of a site.

2.51. At the time of the initial survey, access was only permitted within the landownership boundary. The areas of land which formed the ESA which were not within the landownership boundary were viewed from field boundaries, with the use of binoculars, where needed. It is considered that the limited access to areas of land directly adjacent to the Proposed Development boundary has not unduly impacted upon the findings of the habitat or species scoping surveys.

Evaluation Methods

2.52. The evaluation of ecological receptors is based upon the CIEEM guidelines[18] (2018) which suggests that the value or potential value of an ecological resource or feature (for example a habitat type, species or ecosystems) should be determined within a geographical context (e.g. rare at a local level). Attributing a value to a receptor, which is also a designated site, is generally precise, as the designations themselves provide an indication of value.

Impact Assessment

2.53. The impact assessment process involves:

- identifying and characterising impacts and their effects
- incorporating measures to avoid and mitigate negative impacts and effects
- assessing the significance of any residual effects after mitigation
- identifying appropriate compensation measures to offset significant residual effects; and
- identifying opportunities for ecological enhancement.

[18] CIEEM (2018) Guidelines for the Ecological Impact Assessment in the UK and Ireland

2.54. The terms 'impact' and 'effect' are used commonly throughout ecological reports. Impact is defined as a change experienced by an ecological feature, while effect is defined as the outcome to an ecological feature from an impact. Impacts and effects can be positive, negative or neutral.

2.55. Assessment of potential impacts and effects needs to consider on-site, adjacent and more distant ecological features, including habitats, species and statutory and ecological designated sites.

2.56. This ecological impact assessment has been concluded by an experienced ecologist following CIEEM guidance[19].

BASELINE CONDITIONS

Designated Sites

2.57. The Proposed Development does not lie within or directly adjacent to any statutory or non-statutory designated environmental sites.

2.58. Within 15km of the Application Site boundary there are Four Special Areas of Conservation (SACs) and three Special Protection Area (SPA). Within 5km of the Application Site boundary there are two Proposed Natural Heritage Areas (pNHAs).

2.59. Each of these sites are outlined in **Table 2-6** below, and detailed within **Figure 1 of Appendix A**.

2.60. The site descriptions are derived from the original site citations available from NPWS[20].

Table 2-6: Designated Sites.

Site Code	Site Name	Qualifying Features	Distance (km), Direction	Potential Connectivity with the Proposed Development Site
SAC				
001398	Rye Water Valley/Carton	Petrifying springs with tufa formation (*Cratoneurion*) [7220]	5.71km northwest	None

[19] CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater, Coastal and Marine.

[20] http://www.npws.ie/protected-sites

		Vertigo angustior (Narrow-mouthed Whorl Snail) [1014] *Vertigo moulinsiana* (Desmoulin's Whorl Snail) [1016]		
001209	Glenasmole Valley SAC	Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites) [6210] Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) [6410] Petrifying springs with tufa formation (*Cratoneurion*) [7220]	7.91km southeast	None
002122	Wicklow Mountains SAC	Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) [3110] Natural dystrophic lakes and ponds [3160] Northern Atlantic wet heaths with *Erica tetralix* [4010] European dry heaths [4030] Alpine and Boreal heaths [4060] *Calaminarian* grasslands of the *Violetalia calaminariae* [6130] Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe) [6230] Blanket bogs (* if active bog) [7130] Siliceous scree of the montane to snow levels (*Androsacetalia*	9.62km southeast	None

		alpinae and *Galeopsietalia ladani*) [8110] Calcareous rocky slopes with chasmophytic vegetation [8210] Siliceous rocky slopes with chasmophytic vegetation [8220] Old sessile oak woods with Ilex and Blechnum in the British Isles [91A0] *Lutra lutra* (Otter) [1355]		
000397	Red Bog, Kildare SAC	Transition mires and quaking bogs [7140]	14.04km southwest	None
SPA				
004040	Wicklow Mountains SPA	Merlin (*Falco columbarius*) [A098] Peregrine (*Falco peregrinus*) [A103]	12.74km southeast	None
004024	South Dublin Bay and River Tolka SPA	Light-bellied Brent Goose (*Branta bernicla hrota*) [A046] Oystercatcher (*Haematopus ostralegus*) [A130] Ringed Plover (*Charadrius hiaticula*) [A137] Grey Plover (*Pluvialis squatarola*) [A141] Knot (*Calidris canutus*) [A143] Sanderling (*Calidris alba*) [A144] Dunlin (*Calidris alpina*) [A149] Bar-tailed Godwit (*Limosa lapponica*) [A157] Redshank (*Tringa totanus*) [A162] Black-headed Gull (*Chroicocephalus ridibundus*) [A179] Roseate Tern (*Sterna dougallii*) [A192]	14.90km northeast	Hydrologically connected through the River Liffey

		Common Tern (*Sterna hirundo*) [A193] Arctic Tern (*Sterna paradisaea*) [A194] Wetland and Waterbirds [A999]		
004063	Poulaphouca Reservoir SPA	Greylag Goose (*Anser anser*) [A043] Lesser Black-backed Gull (*Larus fuscus*) [A183]	14.98km southwest	None
pNHA				
	Grand Canal pNHA	Canal system banked by hedgerow, tall herbs, calcareous grassland, reed fringe, open water, scrub and woodland.	1.34km north	
	Liffey Valley pNHA	River system	4.22km northwest	

2.61. A tributary of the Griffeen River (Baldonnel Stream) flows east-west through the proposed development site and connects it to European sites in Dublin Bay via the surface water network c. 15.5km to the east. The following European sites are located in Dublin Bay: North Dublin Bay SAC, South Dublin Bay SAC, North Bull Island SPA and South Dublin Bay and River Tolka Estuary SPA.

2.62. The Proposed Development, located within Profile Park and surrounding lands are comprised largely of industrial developments and agricultural land. The majority of the Application Site is comprised of improved agricultural habitats. Other habitats of ecological value on the lands include hedgerow, treeline and drainage ditch habitat. There are some habitats of low ecological value on the Application Site such as recolonising bare ground, and spoil and bare ground.

2.63. All surface water runoff from the land currently discharges straight to ground and to the Baldonnel Steam, and from there it drains to the Grifeen River and then The Liffey and to Dublin Bay. There is no direct hydrological connection between the Application Site and the Rye Water Valley/Carton SAC, Glenasmole Valley SAC, Wicklow Mountains SAC/SPA, Red Bog, Kildare SAC and Poulaphouca Reservoir SPA.

2.64. There is however a connection between the site and the North & South Dublin Bays SACs, and the North Bull Island & South Dublin Bay and River Tolka Estuary SPAs, via the Baldonnel Stream.

Habitats

2.65. A Fossitt habitat survey undertaken in June 2021 identified eight habitat types within the survey boundary; each of these is outlined in **Table 2-7** below along with other relevant target notes. In addition, habitat map is shown in **Figure 2 of Appendix A**.

2.66. Habitats identified during the above survey are in line with the Ecological Assessment by Scott-Cawley in July 2020.

Table 2-7: Habitat types on site

HABITAT TYPE	SPECIES PRESENT	OTHER OBSERVATIONS/ POTENTIAL FOR SPECIES
Improved agricultural grassland (GA1)	Perennial rye grass (*Lolium perenne)*, Yorkshire fog (*Holcus lanatus)*, creeping buttercup (*Ranunculus repens)*, common nettle (*Urtica dioica)*, cock's-foot (*Dactylis glomerata*), vetch (*Vicia* sp.) great willowherb (*Epilobium hirsutum)* and thistle (*Cirsium* sp).	This habitat type encompasses the majority of the site. This area of grassland has been mostly unmanaged for a few years. In places creeping thistle and nettle dominate. In general, the sward height is high, with the species diversity being low. Some potential for foraging badger and Irish hare. Considered to be of low ecological value.
Amenity Grassland (improved) (GA2)	*Fescue* sp. Yorkshire fog, creeping buttercup, common nettle.	This small area has not been managed in many years and is rank. Some potential for foraging badger and Irish hare. Considered to be of low ecological value.
Treelines (WL2)	Ash (*Fraxinus excelsior*), elder (*Sambucus nigra*), hazel (*Corylus avellana*), hawthorn (*Crataegus monogyna*), blackthorn (*Prunus spinosa*), ivy (*Hedera helix*), and bramble (*Rubus fruticosus* agg).	Not well maintained, with some sections showing higher species diversity. Ash die back (*Hymenoscyphus fraxineus*) was noted in many ash trees on site. Providing bird nesting opportunities as well as foraging opportunities for many species. The hedgerow to the west of the site, has higher species diversity and is considered to be of moderate/high ecological value at a site level.
Buildings and Artificial Surfaces (BL3)	-	One shed/ outbuilding with heavy ivy and one former residential dwelling. Both noted to be of low potential to support roosting bats.

Recolonising Bare Ground (ED3)	-	This habitat is found in the south of the site surrounding the road. Low ecological value
Non-native shrub (WS3)	Butterfly bush (*Buddleja davidii*), *Fuchisa* sp. snowberry (*Symphoricarpos albus*).	A small number of managed non-native shrubs have been planted in the former residential dwelling garden. (Target Noted on **Figure 2** - too small to clearly identify within the habitat survey map)
Stream (FW2)	Yellow iris (*Iris pseudoacorus*), watercress (*Rorippa nasturtium-aquaticum*), duckweed *(Lenma sp.)*	Approximately 1m wide, expanding to 2m in the north east of the site, where it joins a culvert. Generally shallow with steep banks. The substrate appears to be a mixture of gravel and mud. Considered to be too narrow to support otter. Watercourses on site are consider to be an important water source for local ecology at the site level.
Dry meadows and grassy verges (GS2)	*Fescue* sp., Meadowsweet (*Filipendula ulmaria*), bush vetch (*Vica sepium*), Yorkshire fog, cock's-foot grass (*Dactylis glomerata*), creeping thistle, *Carex* sp., ladys bedstraw (*Galium verum),* herb Robert (*Geranium robertianum*), and common hogweed (*Heracleum sphondylium*).	Mostly found on the banks of the Baldonnell stream. In places shrubs such as hawthorn and dogrose are also beginning to grow. Low species diversity.

2.67. A small number of managed non-native shrubs have been planted in the former residential dwelling garden, comprising Butterfly bush (*Buddleja davidii*) and Fuchisa sp. snowberry (*Symphoricarpos albus*). The location of which is shown as a Target Note on **Appendix A: Figure 2.**

Protected and Notable Species

Desk Study

2.68. The potential presence of protected species within the study area was assessed through a data search conducted via the National Biodiversity Data Centre (NBDC). This identified records of invasive, rare, scarce and protected species within 2km of the Proposed Development location. The Application Site is located within the 2km grid squares O03F and O03K.

2.69. Additional information on the suitability of habitat in the surrounding area for bats was also obtained from the NBDC in the form of a habitat suitability map. The map provided enhanced information on the recorded distribution of bats, and broad-scale geographic patterns of occurrence and local roosting habitat requirements for Irish bat species.

2.70. In addition, the Fossitt habitat survey included a species scoping survey in order to assess the potential of the site to support protected species.

2.71. **Table 2-8** summarises the protected/notable species recorded within the search area, and their potential to be present within the Application Site.

Table 2-8: Summary of Biological Records

Species	Grids with Recordings of Species	Suitable Habitat or Field Signs Observed within Survey Area	Potential for Species within Application Site
MAMMALS			
Brown Long-eared Bat (*Plecotus auritus*)	O03F	Yes, suitable habitat present	Yes
Daubenton's Bat (*Myotis daubentonii*)	O03F	No, lacks suitable woodland and pond/river habitats	Yes
Lesser Noctule (*Nyctalus leisleri*)	O03F	Yes, identified in flight	Yes
Pipistrelle (*Pipistrellus pipistrellus sensu lato*)	O03F O03K	Yes, identified in flight	Yes
Soprano Pipistrelle (*Pipistrellus pygmaeus*)	O03F O03K	Yes, identified in flight	Yes

West European Hedgehog (*Erinaceus europaeus*)	O03F, O03K	Yes, hedgerow and treelines on site	Yes
American Mink* (*Mustela vison*)	O03K	No, lacks suitable wetland habitats	No
Eastern Grey Squirrel* (*Sciurus carolinensis*)	O03K	Yes, treelines present on site	Yes
BIRDS			
Black-headed Gull (*Larus ridibundus*)	O03F O03K	Yes, suitable habitat on site	Yes
Great Black-backed Gull (*Larus marinus*)	O03F	Yes, suitable habitat on site	Yes
Great Cormorant (*Phalacrocorax carbo*)	O03F O03K	No, lacks suitable wetland habitats	No suitable habitat on site
Herring Gull (*Larus argentatus*)	O03F	Yes, suitable habitat on site	Yes
Lesser Black-backed Gull (*Larus fuscus*)	O03F	Yes, suitable habitat on site	Yes
Little Grebe (*Tachybaptus ruficollis*)	O03F O03K	No, lacks suitable wetland habitats	No suitable habitat on site.
Mallard (*Anas platyrhynchos*)	O03F O03K	No, lacks suitable wetland habitats	No suitable habitat on site.
Mute Swan (*Cygnus olor*)	O03F O03K	No, lacks suitable wetland habitats	No suitable habitat on site.
Northern Lapwing (*Vanellus vanellus*)	O03F O03K	Yes, suitable habitat on site, however sward considered too long presently.	Yes
Tufted Duck (*Aythya fuligula*)	O03F O03K	No, lacks suitable wetland habitats	No suitable habitat on site.

Common Wood Pigeon (*Columba palumbus*)	O03K	Yes, suitable habitat on site	Yes
Barn Swallow (*Hirundo rustica*)	O03K	Yes, suitable habitat on site	Yes
Eurasian Tree Sparrow (*Passer montanus*)	O03K	Yes, suitable habitat on site	Yes
House Sparrow (*Passer domesticus*)	O03K	Yes, suitable habitat on site	Yes
Sand Martin (*Riparia riparia*)	O03K	Yes, suitable foraging habitat on site	Yes
Common Starling (*Sturnus vulgaris*)	O03K	Yes, suitable habitat on site	Yes
Common Coot (*Fulica atra*)	O03K	No, lacks suitable wetland habitats	No suitable habitat on site.
FLORA			
Indian Balsam* (Impatiens glandulifera)	N85K	Not identified on site. Often found along streams and river banks,	Yes
Japanese Knotweed* (*Fallopia japonica)*	O03K	Not identified on site, often found within older residential gardens, and areas of abandoned materials	Yes
Spanish Bluebell* (*Hyacinthoides hispanica*)	O03K	Not identified on site, often found within older residential gardens	Yes

*** indicates an invasive species**

2.72. Table 2-9 below details the results of the NBDC Bat Suitability Index search undertaken for the Proposed Development.

Table 2-9: Bat Suitability Index

Species	Index Score

Brown long-eared bat (*Plecotus auritus*)	40
Common pipistrelle (*Pipistrellus pipistrellus*)	41
Daubenton's bat (*Myotis daubentonii*)	19
Leisler's bat (Nyctalus leisleri)	41
Lesser horseshoe bat (*Rhinolophus hipposideros*)	0
Nathusius's pipistrelle (*Pipistrellus nathusii*)	19
Natterer's bat (*Myotis nattereri*)	26
Soprano pipistrelle (*Pipistrellus pygmaeus*)	35
Whiskered bat (*Myotis mystacinus*)	19

Baseline Results

Badger

2.73. No records of badger were returned from either grid squares relating to the site.

2.74. Although the habitats present on site offer suitable foraging opportunities, no evidence of badger was identified on site.

Bats

2.75. The bat suitability index is presented in **Table 2-9**. Records of brown long eared bat, Leisler's bat, soprano pipistrelle and pipistrelle species bat were identified in the desk study.

2.76. The majority of field boundaries on site are comprised of treelines with mature and semi-mature trees. No suitable roosting opportunities were identified within any trees on site. They do however offer commuting pathways to the wider landscape.

2.77. The derelict cottage and associated outbuilding within the ESA are classified as being of **low** potential to support roosting bats **(see photograph 4 and 5, Appendix E)**.

2.78. Nocturnal bat surveys were carried out on the 22nd June and 15th July 2021. No bats were identified emerging from the buildings on site. Common pipistrelle, soprano pipistrelle and Leisler's bat were observed in flight across the site. The areas which had the highest bat activity on site are the mature pine trees surrounding the former dwelling, and the treeline to the west. In these areas bats were foraging, with multiple passes recorded by each surveyor. Overall activity was considered to be **low.**

Otter

2.79. No records of otter were identified within 2km of the site.

2.80. The Application Site is not considered suitable for otters due to the only stream on site being unsuitable for otter due to its small size.

Pine Marten

2.81. No records of pine marten were identified as part of the desk study.

2.82. Pine martens are found in old growth woodland, which is absent from the site. As a result, it is considered unlikely that pine marten would be present on the site. In addition, no evidence of pine marten was identified on site

Hedgehog

2.83. One record of hedgehog was identified during the desk study; however no direct evidence of hedgehog was identified on site during the surveys undertaken. Habitats present on site, including treeline and hedgerow, do provide suitable foraging opportunities for hedgehog.

Other Mammals

2.84. Records of two invasive mammals namely grey squirrel and American mink were identified during the desk study.

2.85. Habitats recorded within the Application Site have low potential to support these species. American mink is often found near coastal areas and larger rivers, whereas grey squirrel prefer woodland and parkland habitats. Both of these species are widespread across Ireland, however the site lacks these species preferred habitats.

2.86. Rabbits (*Oryctolagus cuniculus)* were identified foraging to the south of the site.

Birds

2.87. Whilst no formal bird surveys were undertaken in this survey season, within the proposed ESA, the species scoping survey was completed to identify the presence of protected species, or the potential of the Application Site to support protected species. Incidental observations of bird species during this walkover survey were recorded to provide information for the assessment of potential bird activity within the Application Site.

2.88. Table 2-10 below lists the bird species observed during the site visits. Species listed as amber are those of medium conservation concern on the Birds of Conservation Concern Ireland 2020

– 2026[21] list due to declining populations. All species recorded were green-listed, i.e. of no immediate concern.

Table 2-10: Bird Species Observed During the Fossitt Habitat Survey

Scientific Name	Common Name	BoCCI Status
Turdus merula	Blackbird	
Buteo buteo	Buzzard	
Corvus monedula	Jackdaw	
Pica pica	Magpie	
Columba palumbus	Wood pigeon	
Troglodytes troglodytes	Wren	

Herptiles

2.89. Whilst no reptile or amphibian was identified during the site surveys, the site offers potential habitat for common frog (*Rana temporaria*) and smooth newt (*Lissotriton vulgaris*).

Invertebrates

2.90. No records of notable or protected species were identified in the data search. In addition, only hoverflies *Syrphidae* sp., white tailed bumblebee *Bombus lucorum* and horseflies *Tabanidae* sp. were noted on site.

2.91. An assessment of benthic macroinvertebrates was completed on the section of the Baldonnel stream within the site, the results of which are detailed in **Appendix B**.

2.92. No notable species were identified during this stream assessment, the dominate species were Freshwater shrimp (*Gammerus sp.*) and Stone clingers (*Baetidae sp.*), biodiversity was considered to be low.

Flora

2.93. No protected species were returned as part of the data search. Only records of invasive species were identified on the data search.

2.94. Habitats on site are mainly agricultural in nature and are used for pasture and well maintained. No rare or notable species were noted on site during the survey.

[21] Available from https://birdwatchireland.ie/birds-of-conservation-concern-in-ireland/

IMPACT ASSESSMENT

Best Practice Pollution Prevention Measures

2.95. Standard best practice pollution prevention measures will be adhered to, which will reduce the potential for impacts on ecology during the construction stage. As these are standard requirements, they are separate to mitigation measures (which are outlined later in this report).

2.96. Relevant measures include, but are not limited to:

Pollution Prevention

- Hydrocarbons, greases and hydraulic fluids will be stored in a secure compound area;
- All plant machinery will be properly serviced and maintained, thereby reducing risk of spillage or leakage;
- All waste produced from construction will be collected in skips, with the construction site kept tidy at all times;
- Excavated soil will be stored on site or removed by a licensed waste disposal unit;
- All materials and substances used for construction will be stored in a secure compound and all chemicals will be stored in secure containers to avoid potential contamination;
- Location of spill kit to be known by all construction workers and used in the event of spillage or leakage.

Waste Management

- Skips are to be used for site waste/debris at all times, and collected regularly or when full;
- All hydrocarbons and fluids are to be collected in leak-proof containers and removed from site for disposal or recycling;
- All waste from construction is to be stored within the site confines and then removed to a permitted waste facility.

Environmental Monitoring

- Contractor is to nominate member of staff as the environmental officer with the responsibility to ensure best practice measures are implemented and adhered to, with any incidents or non-compliance issues being reported to project team.

Designated Sites

2.97. Seven designed sites were identified within 15km of the Proposed Development Site. Of these only one is considered to be connected, hydrologically through the Baldonnel stream on site; this is the South Dublin Bay and River Tolka Estuary SPA. This site is located approximately 29km downstream of the site and is designated due to its assemblage of Wetland and Waterbirds. There is no suitable habitat for these species within the Proposed Development site. Given this and the distances and dilution factors involved, there will be **no significant effects** on this Natura 2000 site.

The South Dublin Bay and River Tolka SPA

In the Absence of Mitigation

2.98. The South Dublin Bay and River Tolka SPA is located approximately 15km from the Application Site and is designated for a number of important Annex I habitats and Annex II species (see **Table 2-6** above). Hydrological connectivity exists between this SPA and the Application Site from the Baldonnel stream on site.

2.99. This SPA is designated due to its assemblages of wetland and waterbirds. As these species are mobile, there is potential for them to occur within the site; however, due to a lack of suitable habitat within the site, it is considered highly unlikely that these species would be present on site.

2.100. As a design measure a buffer has been included around the Baldonnel Stream to reduce the potential for contaminants from the Application Site to enter the aquatic system.

2.101. A Construction Environmental Management Plan (CEMP), as outlined in Chapter 5, has been produced in support of this application. This report outlines design and best practice measures for protecting the local environment, including terrestrial and aquatic habitats. These measures will significantly reduce the potential for contaminated surface waters entering the aquatic environment.

2.102. Given the large distance between the Application Site and the SPA, the dilution factor will result in a negligible impact upon the SPA and its qualifying species.

Recommended Mitigation Measures

2.103. It is recommended that all relevant pollution prevention guidelines are followed in order to prevent pollutants including hydrocarbons and silt entering the watercourse.

Residual Effects

2.104. Possible residual effects of the proposed development include the indirect loss of habitat due to water borne pollutants entering the stream on and adjacent to the site. With measures

included in the Proposed Development design and the use of best practice pollution prevention measures, it is unlikely that any waterbird or wetland bird will be affected by the Proposed Development. However, with the implementation of mitigation measures this will reduce any potential impacts further.

2.105. By ensuring potential pollution from construction is mitigated, there will be will **a negligible effect** upon on Annex I habitats and Annex II species that form part of the South Dublin Bay and River Tolka SPA.

Habitats

In the Absence of Mitigation

2.106. The construction of the Proposed Development will occur over land which has been identified improved agricultural grassland, stream, grassy verges and treeline. Grassland and treelines on site are considered to be of **low ecological value** and currently offer limited potential to support wildlife.

2.107. The Baldonnel stream is considered to be of **local importance.**

2.108. Direct habitat loss will only occur under the Proposed Development footprint in regard to the building structure, associated roadways and parking provisions. This includes treeline, grassy verges, improved agricultural grassland.

2.109. Other potential impacts during the construction phase include indirect loss or damage of habitats as a result of dust and other air- or water-borne pollution. As the construction phase will adhere to all relevant legislation and best practice construction and pollution prevention methods, this is expected to cause only **negligible** loss in a local context where these habitats are frequent. Overall habitat loss is **not considered to be significant** in terms of the Application Site's intrinsic habitat interest.

2.110. The Proposed Development will include the removal of small sections of treeline to facilitate the development. These habitats are abundant in the surrounding area, and it is considered that the small amount of habitat loss would **not be significant**.

2.111. It is therefore considered that the loss of habitat under the Proposed Development footprint **will not be significant**.

2.112. The landscape masterplan (by KFLA Architects) accompanying the application includes the planting of a wetland wildflower mix, wildflower meadow mix, berms and woodland planting on site.

Recommended Mitigation Measures

2.113. With the correct management in place during the lifespan of the Proposed Development, the potential of the site to support wildlife can be increased. The supporting landscape proposal

outlines the management proposals to enhance the site's ecological value and therefore increase its potential to support local wildlife.

Residual Effects

2.114. With implementation of measures included in the Proposed Development design, best practice measures implemented during the construction of the Proposed Development and the habitat management outlined, there will be **no significant negative residual effects**. With the proposed enhancement measures outlined within the Landscape Master Plan, and Appendix 11.3: Biodiversity Management Plan **net gains** are envisaged for local biodiversity.

Protected and Notable Species

In the Absence of Mitigation

2.115. Each section below details the potential impacts in the absence of mitigation for protected and notable species during the construction phase and the operational phase (expected to be >20 years) of the Proposed Development.

Bats

2.116. The Proposed Development will involve the removal of the derelict cottage and outbuilding, classified as having low bat roost potential. Emergence surveys undertaken in 2021 found that there are no bats roosting within these dwellings. Therefore, in the absence of mitigation the loss in this habitat will not damage or destroy an existing roost, therefore the loss of this habitat will have a **negligible effect** on local bat populations.

2.117. **Appendix 2C** of this report details the general/preferred foraging and commuting habitat of each bat species. Many species of bats in Ireland commute and forage along linear features, such as streams/river, hedgerow or woodland edges (especially true for Pipistrelle and *Myotis* species). However, on occasion they will cross open features; this is particularly the case for species with strong echolocation such as Leisler's bat (*Nyctalus leisleri*).

2.118. The majority of the Application Site is comprised of improved agricultural grassland; this habitat offers sub-optimal foraging habitat for bat species due to the limited number of prey species present. The loss of these habitats under the Proposed Development footprint **will not lead to a significant reduction** in foraging habitat for local bats.

2.119. Hedgerows and treelines provide suitable habitat for foraging and commuting bats. The small amount of treeline removal proposed **will not lead to a significant reduction** in foraging habitat for local bats, given the abundance of similar habitat in the surrounding landscape, and the poor quality of this habitat.

2.120. The site is currently subjected to high amounts of artificial light from neighbouring similar developments, and streetlighting. The increased amount of artificial light has the potential to reduce the suitability of this habitat to commuting and foraging bats.

Badger

2.121. Habitats on site are suitable to support badger, however no badger setts, or evidence of badger was identified on site during the site surveys.

2.122. Given that badgers are a highly mobile species and new setts may be built prior to construction, there is the potential for the disturbance of badger during the construction phase of the Proposed Development. During the construction phase, the Proposed Development can cause undue stress in a number of ways. Installation of security fencing or hoarding can disrupt badger paths and cut off foraging areas within a clan's territory. Excavations can destroy badger setts, and any excavations lefts overnight can trap badgers.

2.123. It is considered likely that the Proposed Development will have **a negligible effect on the local badger population.** Given the nature of the construction of the panels, length of time before the construction phase is complete, disturbance to the local population of badger is likely through a reduction in foraging areas, and disturbance caused by noise and vibration during construction. However, these effects are temporary.

Otter

2.124. Habitats within the Application Site are considered to be sub-optimal for otter, predominantly being agricultural grassland bound by hedgerows and treelines, with a stream, considered to be too narrow to support otter.

2.125. Pollution from contaminated surface or ground waters can potentially enter the aquatic system and affect otter indirectly. Best practice pollution prevention and integral design (i.e. not mitigation) measures have been adopted to minimise any effects from pollution. In addition to indirect impacts from pollution, foraging areas may be reduced by the installing of security fencing, otter can become trapped in trenches, and holt creation opportunity reduced by direct loss of habitat.

2.126. It is considered that the Proposed Development will have **a negligible effect upon the local otter population** as the habitats on site are suboptimal for otter.

Birds

2.127. Main impacts on bird species from developments include:

- Direct loss or deterioration of habitats.
- Indirect habitat loss as a result of displacement by disturbance.

2.128. The Proposed Development will occur on land that is currently of low ecological value and is subject to a level of disturbance from surrounding industrial developments. However, in the absence of mitigation there is **potential for significant effects** on breeding birds if construction works are undertaken between the months of March and August inclusive.

2.129. The construction phase may have a temporary adverse impact on breeding birds within and adjacent to the Application Site. This would result in an effect of **low** spatial and **medium-term** temporal magnitude. The effect may continue beyond a single bird generation but is expected to be sufficiently small for the local population to recover relatively soon. This effect would be **not significant** for the commoner species, but could be **significant** for Priority species and birds of conservation concern.

Herptiles

2.130. Drainage ditches offer potential habitat for supporting herptile species, particularly common frog. No common frog were observed during the ecological surveys, and no records were identified in the 2km data search of the site. However, their presence on site cannot be ruled out as the Baldonnel stream offers suitable habitat. It is considered that the Proposed Development will have a **negligible effect** upon this species as there will be no loss of suitable habitat.

2.131. It is considered unlikely that smooth newt are present within the Application Site, as there is no suitable habitat, and therefore the Proposed Development will have a **negligible effect** upon this species.

2.132. Habitats on site have the potential to be used by common lizard, however, given the abundance of similar habitat in the surrounding areas, it is considered that the loss of habitats under the Proposed Development footprint **will not lead to a significant reduction common lizard habitat** and therefore will have a **negligible effect** upon this species.

Flora

2.133. No protected flora species were identified within the Application Site. The desk study did not return any records of protected plants on or within 2km of the site and habitats surrounding the site are similar in nature to the Application Site.

Mitigation Measures and Further Survey

Bats

2.134. The Proposed Development will involve the removal of the derelict cottage and shed within the Application Site. Noctural bat surveys were undertaken in 2021 and the results of these surveys showed that there are no bats roosting within the dwellings proposed for removal.

2.135. The Proposed Development will involve the removal of 155m of treeline. These trees were assessed in 2020 and 2021, and no potential roosting features for bats were identified.

2.136. The Proposed Development will include the installation of 6 bat boxes, providing potential roosting habitat for the local bat population.

2.137. In addition, in order to retain dark zones for commuting bats, lighting will be cowled in order to direct artificial light from retained hedgerows which are currently used by bats to commute and forage. As detailed within the lighting Plan (by Burns McDonnell) accompanying the application light will be reduced to 1lux where possible; 1lux is considered to be similar to moonlight levels of light.

2.138. The landscape masterplan (by KFLA Architects) accompanying the application also includes the planting of native tree, shrub and wildflower species which will attract insects and provide foraging opportunities for bats.

2.139. With the implementation of these measures, **no significant effects** upon badger are predicted as a result of the Proposed Development.

Badger

2.140. No evidence of badger was identified on site; however, as badgers are a highly mobile species, it is recommended that a pre-construction badger survey is undertaken to assess the potential impacts on badger at the time of construction (in the event that new badger setts are present).

2.141. All excavations are to be securely covered or closed off at the end of each working day to prevent the accidental trapping of badgers. Where this is not possible, a means of escape (for example a ramp) must be included to allow safe exit from the excavation. Checks of any open excavations should be performed by site staff prior to each day's works. The proposed security fencing will have mammal gates or a gap of at least 10cm at the bottom to allow free movement of badgers through the site.

2.142. With the implementation of these measures, **no significant effects** upon badger are predicted as a result of the Proposed Development.

Otter

2.143. No otter or field signs of otter were identified within the site and it is considered that habitat within and adjacent to the Application Site is sub-optimal for otter. It is, however, recommended that a precautionary pre-commencement survey be undertaken prior to any construction works.

2.144. Standard best practise measures in regard to pollution prevention will be implemented to prevent contamination of the aquatic environment during the construction phase of the Proposed Development.

2.145. As part of the Proposed Development design, security fencing is to have mammal gates or a 10cm gap to allow free movement of otter through the site. All excavations during the construction phase of the Proposed Development will be securely covered. Where this is not possible, a means of escape (for example a ramp) and daily checks must be included to allow safe exit from the excavation. This will prevent the accidental trapping of this species.

2.146. With the implementation of these measures, **no significant effects** are predicted upon otter from the Proposed Development.

Birds

2.147. During the construction phase, (including site preparation), it is considered that potential disturbance impacts on bird species are likely.

2.148. Breeding birds are highly susceptible to disturbance, and therefore where works are to commence during the breeding season (March to August inclusive), bird surveys should be undertaken prior to the initiation of construction works. If breeding birds are identified within the site at this time, species-specific buffers will be implemented to protect nesting birds during construction.

2.149. Post construction, the creation of invertebrate-rich habitats will also provide a suitable food source for many bird species and will therefore result in **long-term positive effects** for birds.

Herptile

2.150. As part of the proposed ecological enhancement measures, a hibernaculum will be created. This will increase sheltering opportunities for herptiles. In addition, the creation of a wetland meadow will increase herptile foraging potential. These enhancements will result in **long-term positive effects** upon herptiles.

Invertebrates

2.151. In addition to the wildflower meadow to be planted, invertebrate hotels will also be created. The implementation of these measures will lead to the creation of an enhanced range of habitats for invertebrate species within the Application Site, leading to a **significant positive effect**.

Flora

2.152. The site currently is not overly diverse. Floristic diversity on site will increase through enhancements to the existing hedgerow network, use of native species and sowing of wetland wildflower areas and wildflower meadow. This will lead to a **long-term positive effect** on the site's flora.

Residual Effects

2.153. With the implementation of mitigation measures and further survey prior to and during the construction phase of the Proposed Development, it is considered that there will be **a negligible effect** upon protected or notable species.

CUMULATIVE EFFECTS

2.154. As well as singular effects, cumulative effects also need to be considered. Article 6 of the EU Habitats Directive and Regulation 15 of the European Communities (Natural Habitats) Regulations state that any plan or project that may, either alone or in combination with other plans or projects, significantly affect a designated site, should be the subject of an Appropriate Assessment.

2.155. Cumulative impacts can be an issue when multiple proposals each have a small impact on designated sites. If several proposals also have a small impact, the combined result can have a significant impact on a Natura site.

2.156. A search of the South Dublin County Council online planning portal was undertaken to identify any Projects or developments within 5km which could impact any Natura 2000 sites, either alone or in combination with the Proposed Development. These developments are outlined in **Table 2-11** below.

Table 2-11: Key Developments within 3km of the Proposed Development

Planning Reference	Project Type	Distance and Direction	Planning Status	Date Granted
SD21A/0167	Construction of a gas fired power plant with an electrical output of up to 125MW with associated balance of plant, equipment and buildings	<50m southeast	Additional Information Requested	19/08/2021
SD20A/0121	Construction of 3 two storey data centres with mezzanine floors at each level of each facility and associated ancillary development that will have a gross floor area of 80,269sq.m on an overall site of 16.5hectares.	150m west	Granted	29/07/2020
SD21A/0186	Construction of a 3 storey (part 4 storey) data centre known as 'DB8' to include data halls, electrical/plant rooms including internal generators, offices, lobbies, ancillary staff areas including	200m east	Additional Information Request	30/08/2021

	break rooms and toilets, stores, stair/lift cores throughout and photovoltaic panels at roof level.			
SD21A/0186	Construction of a 3 storey (part 4 storey) data centre known as 'DB8' to include data halls, electrical/plant rooms including internal generators, offices, lobbies, ancillary staff areas including break rooms and toilets, stores, stair/lift cores throughout and photovoltaic panels at roof level	250m east	Additional Information Requested	30/08/2021
SD20A/0295	Amendments and modifications to the permitted data centre development granted under Reg. Ref. SD18A/0134 - ABP Ref. ABP-302813-18 and the temporary substation permission granted under SD19A/0300 , Demolition of the existing single storey house of 'Erganagh' and the construction of a two storey data centre and delivery bays with associated three storey office block and services that will have a gross floor area of 35,426sq.m on an overall site of 9.2 hectares.	430m west	Granted	16/03/2021
SD14A/0023 and SD14A/0284	Construction of a two storey data storage facility (30,361sq.m.),	200m south west	Granted	23/02/2015
SD16A/0087	Site enabling works including demolition of existing vacant house and outbuildings (total floor area c.241sq.m), diversion of Baldonnel stream, provision of below ground attenuation and	30m north	Granted	09/05/2016

	associated landscape works on a site of c.9.4ha			
SD13A/0265	Construction of a single data centre with plant at roof level (total gross floor area 35,000 sq.m. as the approved SD13A/0143	370m north	Granted	24/03/2014
SD13A/0015	Construction of a single storey data centre with plant at roof level (total gross floor area 15,825sq.m.)	850m north west	Granted	21/03/2013
SD20A/0058	Demolition of the existing single storey house of 'Little Acre' and its associated garage and other buildings; Construction of a gas powered Power Plant with all its associated elements; the part single and part two storey property of Bulmer and an agricultural building to the east of the overall site will not be demolished; The Power Plant compound of 14,475sq.m will	1.4km west	Granted	17/12/2020
SHD3ABP-305267-19	1034 residential units comprising of (578 houses: 449 3-bed & 129 4-bed), 456 apartments: 142 1-bed, 224 2-bed, 90 3-bed), 2 childcare facilities (1 temporary, 1 permanent), 1 retail unit, 1 community facility and all associated site works.	1km east	Granted	04/08/2021
SD19A/0264	Warehouse with ancillary three storey office and staff facilities and associated development. The warehouse will have a parapet height of 17 metres with a gross floor area of 14,649sq.m including a	2.5km southwest	Granted	10/10/2019

	warehouse area (13,494sq.m), ancillary office areas (1099sq.m) and staff facilities (56sq.m); provision of a new vehicular access/egress onto the Jordanstown Road; internal roadways; pedestrian access; 152 ancillary car parking spaces; bicycle parking; HGV yard including 26 HGV parking stands and 18 loading docks; hard and soft landscaping			
SD20A/0258	Demolition of the existing dwelling (252sq.m) and associated domestic garage (49sq.m) and shed (12sq.m) located towards the north-west of the site and the construction of 3 warehouses with ancillary office and staff facilities and associated development	3km south	Granted	10/50/2021
SD20A/0319	Amend permitted logistics/warehouse units C and D and incorporate other amendments, providing for a resultant; Unit C, 7,937sq.m including 757sq.m ancillary office space (permitted 11,492sq.m total); Unit D, 12,050sq.m including 911sq.m ancillary office space (permitted 7, 856sqm total); Overall increase of 639sq.m for Units C and D; provision of maintenance ramp to swale; resultant amendments to site layout, minor revisions to flood mitigation strategy.	3km south	Granted	15/03/2021

SD18A/0180	Provision of a new 100,000m3 covered reservoir approximately 31,520sq.m	4.3km south	Granted	16/07/2018
SD15A/0388	Residential development consisting of 218 3 and 4 bed 2 storey houses and a creche of (246sq.m) to be built on a site of circa of 8.16ha which will form Phase 1 of development of the Boherboy Neighbourhood within the Fortunestown Local Area Plan (2012)	4.3km south east	Granted	15/07/2016

2.157. As the Proposed Development is situated within an industrial area, the majority of planning applications are for similar developments. Beyond 1km of the Application site, many sites to the north and east are residential in nature, with industrial and military areas also noted to the south.

2.158. It has been concluded, that with measures included in Proposed Development and the implementation of best practice measures, that it is likely that there will be **no significant cumulative** effects to designated sites or any other ecological feature in combination with any other development.

CONCLUSION

2.159. To minimise potential impacts on local wildlife, ecological measures have been incorporated into the Proposed Development as part of the iterative design process (see **Table 2-12** below). Standard best practice pollution prevention measures for the construction stage have also been outlined and considered as part of the impact assessment stage, prior to mitigation. These measures are also outlined within **Table 2-12**.

2.160. A total of eight habitat types were noted during the habitat survey undertaken in June 2021. The main impacts during the construction phase include the direct loss of habitat under the Proposed Development footprint and indirect loss of habitat due to disturbance and pollution. The **loss of 155m of treeline is considered to be negligible** to nature conservation within the local area.

2.161. The desk-based assessment identified four Special Areas of Conservation (SACs) and three Special Protection Area (SPA) within the 15km study zone. These designated sites have been outlined and fully assessed within the supporting Appropriate Assessment (AA) report. The South Dublin Bay and River Tolka Estuary SPA is the only designated site to have hydrological connectivity. There will be **no significant effect** on this designated site or any other statutory designated sites.

2.162. There are two Proposed Natural Heritage Areas (pNHAs) located within 5km of the Application Site.

2.163. Further surveys recommended as part of the relevant mitigation measures are provided within this report (please refer to **Table 2-13** below). These include pre commencement checks for badger and otter.

2.164. It is considered that the short-term disturbance from the Proposed Development **will not be significant on all ecological features** if the recommended mitigation is implemented. With the implementation of the Biodiversity Management Plan, **the potential of the site to support local wildlife will increase**, resulting in **long-term positive effects**.

Table 2-12: Integral design measures and standard best practice

Site/ Species	Potential Development Impacts	Phase of Development	Measures Implemented
INTEGRAL DESIGN MEASURES			
Aquatic environment	Pollution	Construction	3m buffer around drainage ditches and waterways, where possible.
Badger	Destruction/disturbance of setts and badger	Construction and Operational	30m buffer zone to be erected around each badger set.
	Exclusion from foraging habitat	Operational	Security fencing to have 10cm gap at base to allow free movement of badger through the site.
Otter	Exclusion from foraging habitat	Operational	Security fencing to have 10cm gap at base to allow free movement of otter through the site.
STANDARD BEST PRACTICE MEASURES			
Aquatic environment	Pollution	Construction	Best practice pollution prevention measures implemented prior to and throughout the construction phase to prevent contaminants entering the aquatic environment.
Badger	Accidental trapping within excavations	Construction	All excavations should be securely covered, or a suitable means of escape provided at the end of each working day.
Otter	Accidental trapping within excavations	Construction	All excavations should be securely covered, or a suitable means of escape provided at the end of each working day.

Table 2-13 Recommended mitigation measures

MITIGATION MEASURES			
Badger	Destruction of badger setts.	Pre-construction	Pre-commencement survey (Measures dependant on survey findings).

Otter	Disturbance	Pre-construction	Pre-commencement survey (Measures dependant on survey findings).
Breeding birds	Disturbance / destruction of nest (Only if works are undertaken between March and August)	Pre-construction	Pre-construction breeding bird survey on vegetation to be removed (only if works are undertaken between March and August inclusive) (Measures depend on survey findings).

APPENDICES

Appendix A – Figures

- Figure 1 – Environmental Designations Map
- Figure 2 – Habitat Map

Appendix B – Stream Assessment

Appendix C – Habitat of Bat Species in Ireland

Appendix D – Bat Survey Results

Appendix E – Site Photographs

Appendix A: Figures