High Speed 2 - 1MC06 - Stage One C2 - MWCC – North Portal of Chiltern Tunnels to Brackley

Schedule 17 CDC P1 South Heath Drainage Mitigation Report

1MC06-CEK-TP-REP-CS03_CL05-000006

Rev	Date	Author	Checked by	Approved by	Revision Details	EKFB Reviewer
C01	01/02/2022	R.Hallado	L.Ramos	A.Barbour	First Issue	David Jones

Stakeholder review required (SRR)	Purpose of SRR
☐ County / District / London Borough Council	☐ Acceptance
☐ LOV	☐ Approval
☐ LUL	☐ No Objection
☐ NRL	☐ Consent
☐ TFL	
☐ Utilities Company	
☐ Other (please specify)	

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1 Introduction

1.1 HS2 Project

High Speed 2 (HS2) is a high-speed railway linking London, Birmingham, the East Midlands, Leeds and Manchester. This document covers Phase 1 of the project between London and Birmingham as shown in Figure 1:

Figure 1: HS2 location.

1.2 Scope of this report

This drainage report has been developed to accompany the Schedule 17 application package CDC P1 (Document number: 1MC06-CEK-TP-CRO-CS03_CL05-000003) and provides supporting drainage documentation that has been requested by the Lead Local Flood Authority which in this package is Buckinghamshire Council.

1.3 Location

Schedule 17 application package CDC P1 is located within South Heath Cutting (part) between chainage 47+100 to 48+700. It is noted that the area from Chainage 48+700 to 49+000 is currently excluded from this application.

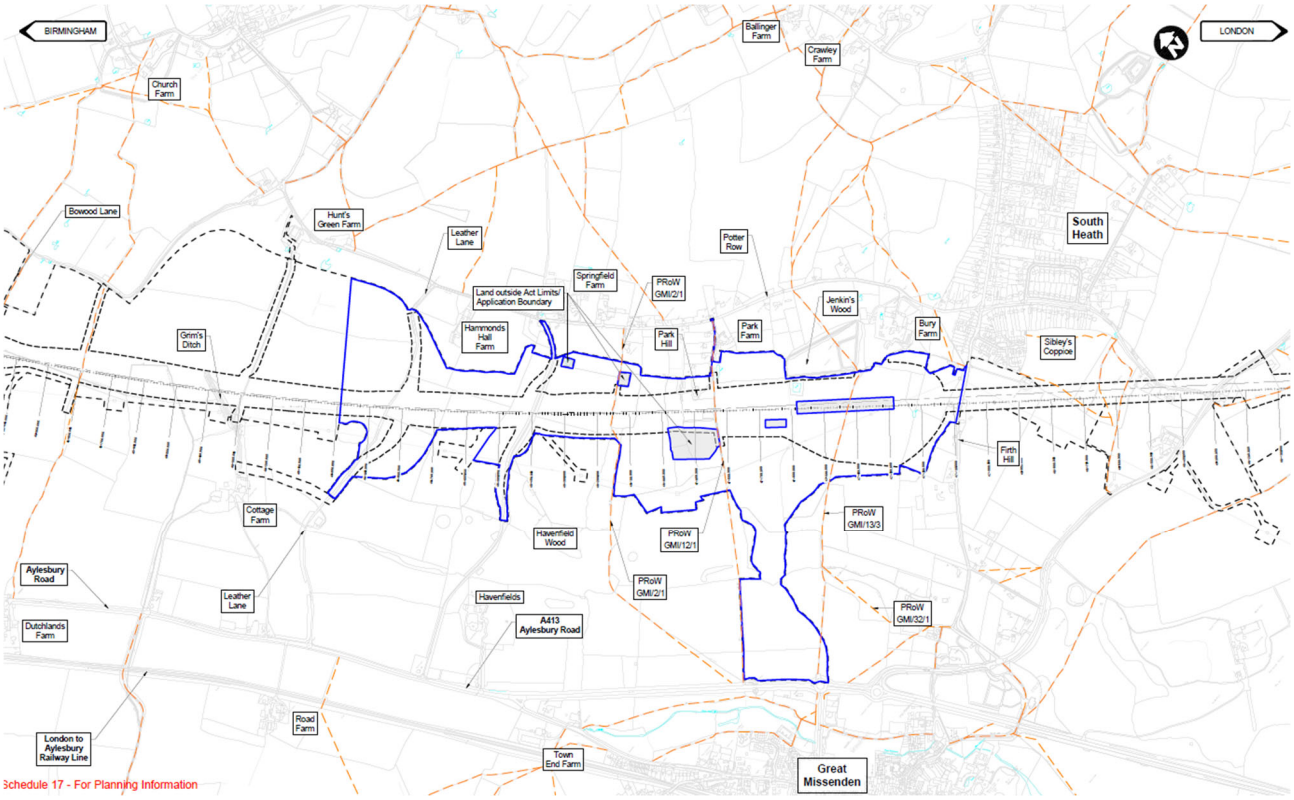


Figure 2: Schedule 17 Package CDC P1 location.

2 Drainage

2.1 Drainage catchments

There is 1 no. Highway, 2no. Land and 1 no. Track drainage models within this Schedule 17 application package, these being:

- C2.L.2 – Land drainage catchment;
- Havenfield Wood Accommodation Overbridge (eastern catchment)
- C2.L.6 – Land drainage catchment; and
- C2.T.1 – Track drainage catchment.

2.1.1 C2.L.2 – Land drainage catchment

This land drainage catchment takes overland flow and side slope run-off from the HS2 landscape bund between chainage 47+180 and chainage 48+270, as well as run-off from the landscape bund around the Chiltern North Tunnel Portal. The run-off is intercepted by a combination of open ditches and filter drains which ultimately discharge to land drainage infiltration pond “C2.L.2-PND-0472” (Labelled drainage pond 3 on the drawings). The post development run-off is attenuated in land drainage infiltration pond “C2.L.2-PND-0472” with the overland flow passing through. A review of the pre-and post-development run-off has been undertaken to ensure the existing downstream flow rate is maintained.

2.1.2 Havenfield Wood Footpath GMI/2 Accommodation Overbridge (highway drainage)

2.1.2.1 (Eastern catchment)

This highway drainage catchment takes highway run-off from the east of HS2 and any overland flow which drains to the existing highway. The existing highway has no formal drainage, with surface water run-off discharging east to west. The proposed highway (eastern catchment) is drained via a filter drain system to ensure all surface water is intercepted prior to the proposed overbridge. The filter drain system discharges into land drainage attenuation pond “C2.L.6-PND-0485” (labelled drainage pond 4 on the drawings).

2.1.2.2 (Western catchment)

The overbridge is drained via a bridge deck drainage system, which outfalls into a filter drain system to the west of HS2. This filter drain system discharges into the land ditch network, which utilise check dams for storage before discharging into a flow spreader. The flow spreader discharges surface water run-off back onto the existing highway thereby replicating the existing situation.

2.1.3 C2.L.6 – Land drainage catchment

This land drainage catchment takes overland flow and side slope run-off from the HS2 landscape bund between chainage 48+259 and chainage 48+750. The run-off is intercepted by a combination of open ditches and filter drains which ultimately discharge to attenuation pond “C2.L.6-PND-0485” (Labelled drainage pond 4 on the drawings). Attenuation pond “C2.L.6-PND-0485” has been designed to attenuate the highway and land drainage post development catchment, with overland flow passing through the pond. The pond discharges into Havenfield Wood Drop Inlet Culvert which outfalls to the western side of HS2 into a land drainage ditch. The land drainage ditches ultimately discharge into the same flow spreader as the western highway catchment. A review of the pre-and post-development run-off has been undertaken to ensure the existing downstream flow rate is maintained.

2.1.4 C2.T.1 – Track drainage catchment

This track drainage catchment takes surface water run-off from the railway line and the cutting side slopes between chainage 47+405 and chainage 48+519m. The track drainage network utilises filter drains which discharges into an infiltration pond "C2.T.1-PND 0476" (Labelled ponds 1 & 2 on the drawings).

South Heath Cutting is classified as a dry cutting as the existing groundwater level is below the formation of the cutting.

2.2 Outfall

The outfalls for the highway, land and track drainage catchments follow the order of priority below:

- Into the ground (soakaways / infiltration);
- To a surface water body (watercourses);
- To a canal;
- To a surface water sewer; and
- To Combined sewer

The outfalls have been determined based on the location and the following outfall is being provided

Catchment (…)	**Outfall type (…)**
C2.L.2 – Land drainage catchment	Infiltration to ground
C2.L.6 – Land drainage catchment + Havenfield Wood Accommodation Overbridge	Eastern catchment – to land drainage culvert Western catchment to existing highway – to surface
C2.T.1 – Track drainage catchment	Infiltration to ground

Table 1: Outfall Types.

2.3 Pond design

The infiltration ponds have been designed to accommodate the 1 in 100 year storm event with a 40% climate change allowance with a factor of safety of 10. The discharge rate from the infiltration ponds is based on the ground investigation infiltration data.

The attenuation ponds have been designed to accommodate the 1 in 100 year storm event with a 40% climate change allowance. The discharge rate from the attenuation pond will be based on the calculated Q_{BAR} greenfield run-off rate.

2.3.1 Greenfield runoff rates

Greenfield run-off rates have been calculated for each catchment and are given in Table 2.

Catchment (…)	Calculated Greenfield run-off rate (Q_{BAR} – L/S/Ha)
C2.L.2 – Land drainage catchment	Not applicable – discharge to ground
C2.L.6 – Land drainage catchment	227 (QBAR) (Greenfield run-off rate = 23.97 l/s)
C2.T.1 – Track drainage catchment	Not applicable – discharge to ground

Table 2: Greenfield run-off rates (Q_{BAR}).

Refer to Appendix A for greenfield run-off calculations.

2.3.2 Infiltration rates

Infiltration rates have been determined from site investigation infiltration testing and are given in Table 3.

Catchment (…)	Infiltration rate (m/hr)
C2.L.2 – Land drainage catchment	0.126
C2.L.6 – Land drainage catchment	Not applicable
C2.T.1 – Track drainage catchment	0.138

Table 3: Infiltration rate data (m/hr)

2.3.3 Attenuation volumes

The required attenuation volume has been calculated for each pond and the volumes are given in Table 4.

Catchment (…)	Pond Reference (…)	Attenuation volume required (m^3)	Attenuation volume provided (m^3)
HS2 "C2.L.2" – Land drainage catchment	3	578	579
HS2 "C2.L.6" – Land drainage catchment	4	219.58	220
HS2 "C2.T.1" – Track drainage catchment	1 + 2	10,457	3138 + 7320 = 10,458 (total)

Table 4: Attenuation volumes

Refer to Appendix B for MicroDrainage calculations.

The ponds have been designed with a freeboard and exceedance weir as per CIRIA C753 "The SUDs Manual" as illustrated in Figure 10:

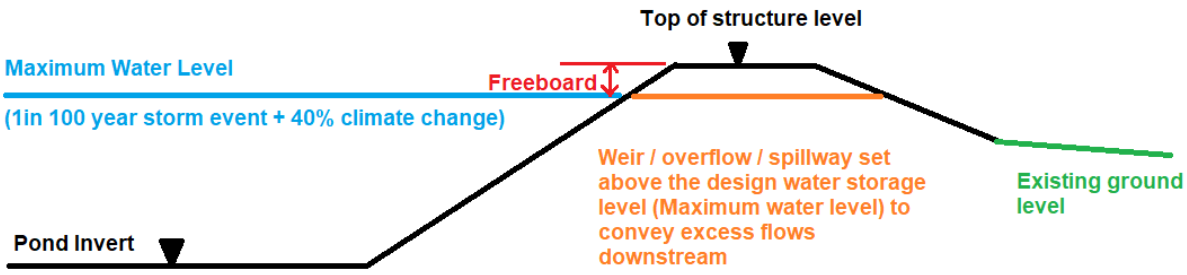


Figure 3: Pond freeboard and exceedance weir layout

2.3.4 Drawings

For drawings refer to Schedule 17 package CDC P1.

MIDP Document number	MIDP Document title
1MC06-CEK-TP-DLO-CS03_CL05-000004	South Heath Cutting Site Location Plan
1MC06-CEK-TP-DPL-CS03_CL05-000089	South Heath Cutting Drainage Plan Sheet 1
1MC06-CEK-TP-DPL-CS03_CL05-000090	South Heath Cutting Drainage Plan Sheet 2
1MC06-CEK-TP-DDE-CS03_CL05-000032	South Heath Cutting Pond Details and Sections Sheet 1 of 2
1MC06-CEK-TP-DDE-CS03_CL05-000033	South Heath Cutting Pond Details and Sections Sheet 2 of 2

Table 5: Reference Drawings

APPENDIX A

Greenfield run-off rate calculations

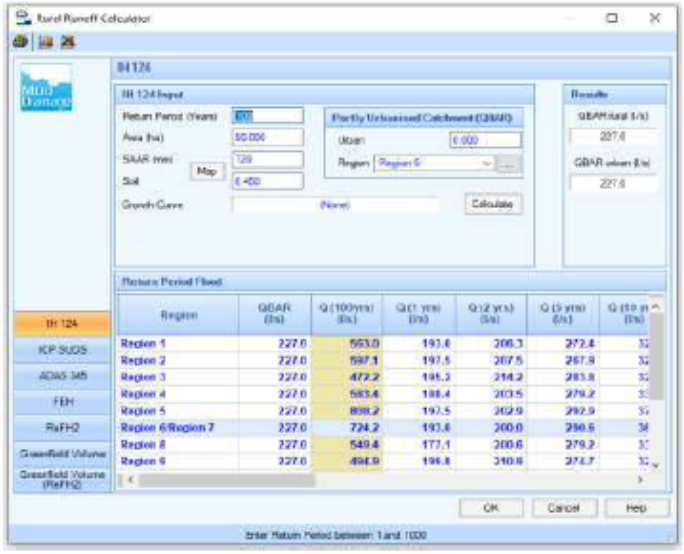
Number of Pages: 1

Catchment C2.L.6

Greenfield Runoff Rate- C2.L.6 Catchment

IH124 Method - 50ha review

Catchment Reference	C2.L.6



Catchment Proportion Review

As per the Technical standard for rural catchments less than 50ha the IH124 method shall be used reducing the flow in proportion to the actual catchment

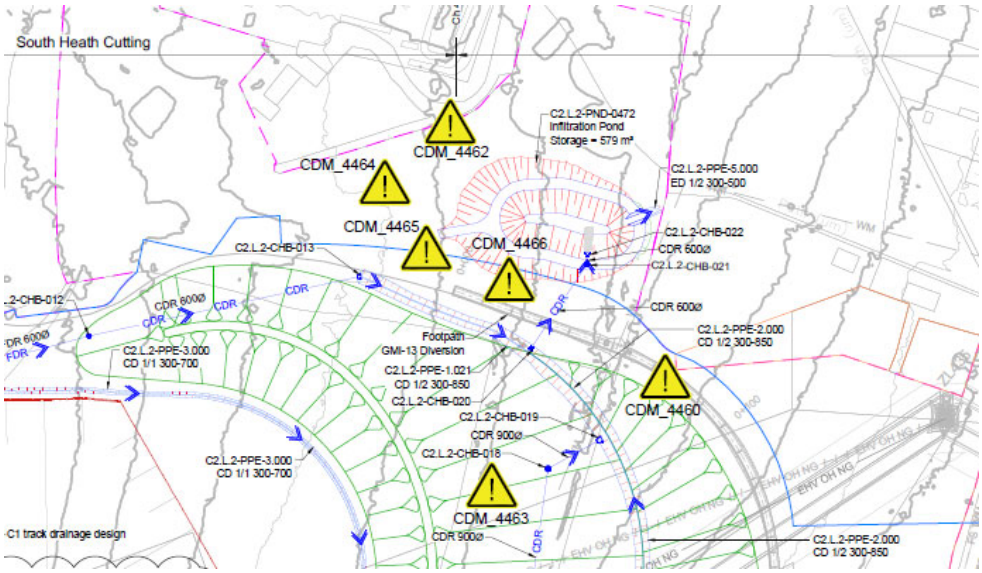
Design period	=	1 in 100	year storm event
Area as per TN	=	50.00	Ha
Actual net catchment area	=	5.28	Ha
Qbar	=	227.00	l/s
Qbar/50ha	=	4,54	l/s/ha
Greenfield Runoff Rate	=	**23.97**	l/s

APPENDIX B

MicroDrainage calculations

Number of Pages: 3

C2.L.2



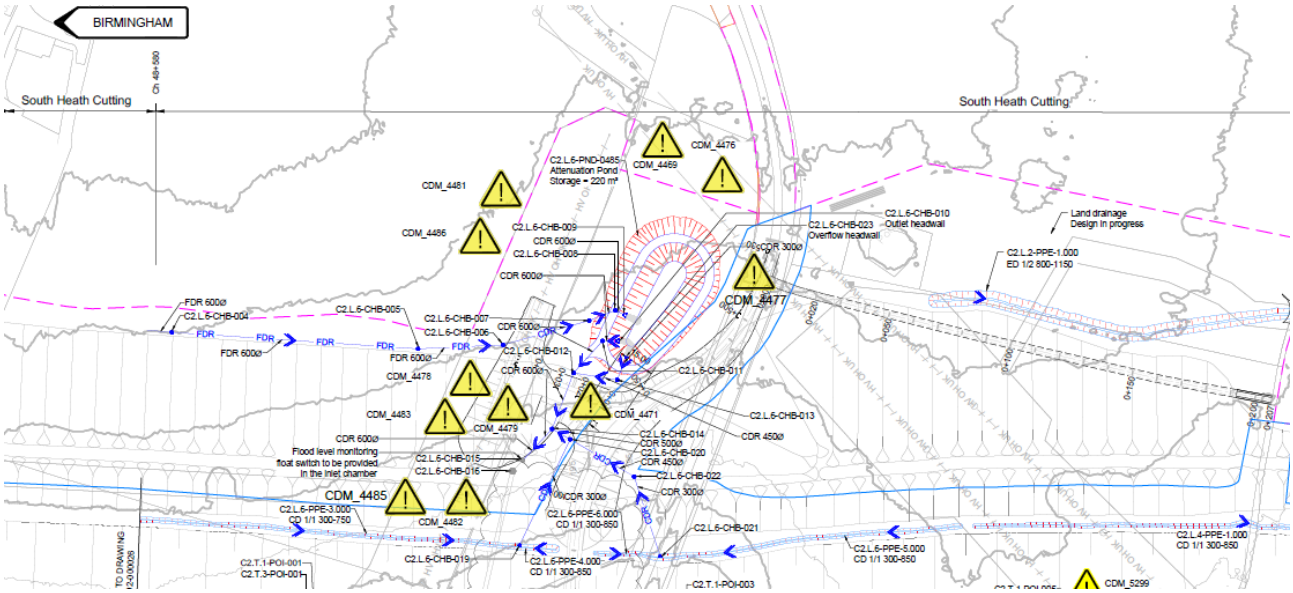
Arcadis Consulting Middle East Limited		Page 18
Level 5 Tower 6789 Ayala Avenue Brgy. Bel-Air Makati, 1209	HS2 Detailed Design C2.L.2 Catchment	Micro Drainage
Date 27/1/2022 5:54 pm File C2.L.2_Pond Check_1in100+40CC.MDX	Designed by Ryan Fortuno Checked by Juliet Sartillo	
Innovyze	Network 2019.1	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for C2.L.2_1in100+40%

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Maximum Vol (m³)	Maximum Velocity (m/s)	Pipe Flow (l/s)
1.024	C2.L.2-CHB-020	15 minute 100 year Winter I+40%	182.765	181.663	-0.342	0.000	0.39		4.006	2.8	327.8
1.025	C2.L.2-CHB-021	120 minute 100 year Summer I+40%	181.987	181.389	0.097	0.000	1.12		6.053	0.9	256.5
1.026	C2.L.2-CHB-022	120 minute 100 year Winter I+40%	181.687	181.288	0.000	0.000	0.91		1.237	1.0	236.3
1.027	C2.L.2-PND-0472	120 minute 100 year Summer I+40%	181.687	181.350	1.513	0.000	0.00	224.2	578.043	0.0	0.0

PN	US/MH Name	Status
1.024	C2.L.2-CHB-020	OK*
1.025	C2.L.2-CHB-021	SURCHARGED
1.026	C2.L.2-CHB-022	SURCHARGED*
1.027	C2.L.2-PND-0472	SURCHARGED

C2.L.6

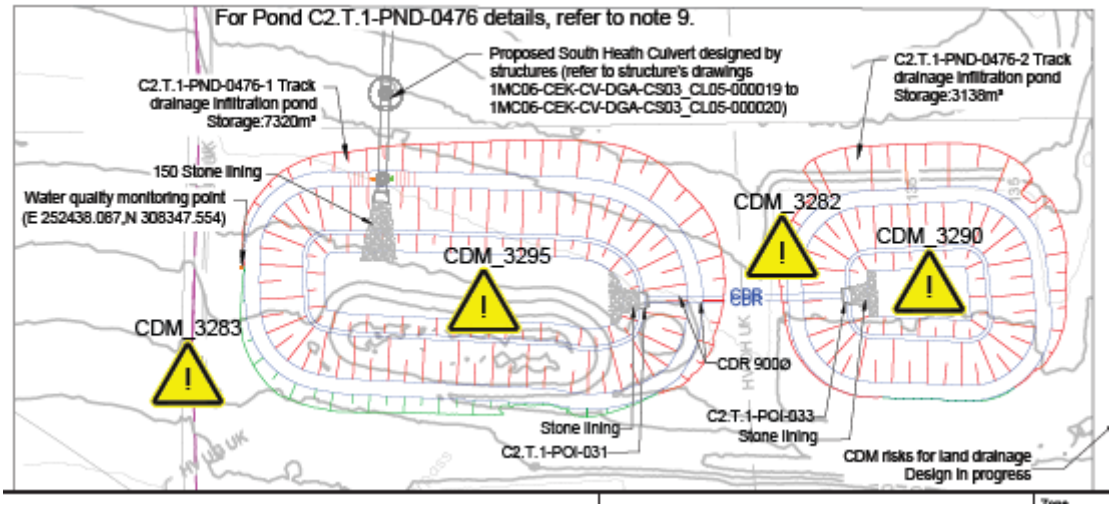


Arcadis Consulting Middle East Limited		Page 15
Level 5 Tower 6789 Ayala Avenue Brgy. Bel-Air Makati, 1209	HS2 Detailed Design C2.L.6 Catchment	
Date 1/3/2021 File C2.L6_Microdrainage Model Q100+40CC_Pond.MDX	Designed by Esperanza Lagman Checked by Juliet Sartillo	
Innovyze	Network 2019.1	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for C2.L.6 Microdrainage Model Q100+40CC

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Maximum Vol (m³)	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
1.003	C2.L.6-CHB-004	15 minute 100 year Winter I+40%	198.000	196.738	-0.285	0.000	0.53		5.780	1.5	217.5	OK
1.004	C2.L.6-CHB-005	15 minute 100 year Winter I+40%	197.193	196.195	-0.278	0.000	0.56		2.912	1.4	217.2	OK
1.005	C2.L.6-CHB-006	15 minute 100 year Winter I+40%	197.001	195.939	-0.350	0.000	0.36		2.248	1.9	216.9	OK
1.006	C2.L.6-CHB-007	15 minute 100 year Winter I+40%	196.804	195.563	-0.336	0.000	0.40		1.418	1.8	217.2	OK
1.007	C2.L.6-CHB-008	15 minute 100 year Winter I+40%	196.500	195.470	-0.139	0.000	0.95		1.995	0.9	216.9	OK
1.008	C2.L.6-CHB-009	15 minute 100 year Winter I+40%	195.600	195.227	-0.373	0.000	0.31		0.350	2.2	216.5	OK*
1.009	C2.L.6-PND-0485	120 minute 100 year Summer I+40%	196.000	195.036	-0.064	0.000	0.12	147.2	219.580	0.4	14.4	OK
1.010	C2.L.6-CHB-010	480 minute 100 year Summer I+40%	195.091	194.569	-0.522	0.000	0.04		0.168	0.7	14.3	OK*
1.011	C2.L.6-CHB-011	480 minute 100 year Winter I+40%	196.500	194.485	-0.566	0.000	0.01		0.048	2.0	14.3	OK
2.000	C2.L.6-CHB-013	360 minute 100 year Summer I+40%	196.115	194.584	-0.296	0.000	0.23		0.129	3.2	145.0	OK
1.012	C2.L.6-CHB-012	240 minute 100 year Winter I+40%	196.389	193.183	-0.460	0.000	0.12		0.191	3.3	155.3	OK
3.000	J14	15 minute 100 year Winter I+40%	195.927	195.466	-0.435	0.000	0.13		0.260	1.0	158.1	OK
3.001	J15	15 minute 100 year Winter I+40%	195.887	195.417	-0.470	0.000	0.13		0.766	1.4	155.4	OK
3.002	J16	15 minute 100 year Winter I+40%	195.806	195.402	-0.414	0.000	0.16		1.421	0.9	156.2	OK
3.003	J17	15 minute 100 year Winter I+40%	195.861	195.362	-0.418	0.000	0.13		2.288	1.0	154.7	OK
3.004	J18	15 minute 100 year Winter I+40%	195.869	195.357	-0.415	0.000	0.13		0.726	0.9	151.9	OK
3.005	J19	15 minute 100 year Winter I+40%	195.851	195.272	-0.424	0.000	0.17		4.363	0.9	150.2	OK
3.006	J20	15 minute 100 year Winter I+40%	195.753	195.247	-0.429	0.000	0.16		1.325	1.0	149.1	OK
3.007	J21	15 minute 100 year Winter I+40%	195.835	195.222	-0.434	0.000	0.16		1.255	1.0	147.3	OK
3.008	J22	15 minute 100 year Winter I+40%	195.716	195.193	-0.443	0.000	0.16		1.196	1.0	148.8	OK
3.009	J23	15 minute 100 year Winter I+40%	195.599	195.046	-0.570	0.000	0.12		0.384	2.5	149.2	OK
3.010	J24	15 minute 100 year Winter I+40%	195.412	194.841	-0.561	0.000	0.08		0.340	2.3	149.1	OK
3.011	J25	15 minute 100 year Winter I+40%	194.907	194.355	-0.539	0.000	0.12		0.509	1.9	148.3	OK
3.012	J26	15 minute 100 year Winter I+40%	194.756	194.204	-0.478	0.000	0.12		1.289	1.3	148.0	OK
3.013	J27	15 minute 100 year Winter I+40%	194.614	194.016	-0.593	0.000	0.09		0.392	3.2	148.9	OK

C2.T.1



Arcadis		Page 52
Karle Premium Old Airport Road Bangalore 560017	HS2 Track Drainage_Section C2 C2.T.1 Catchment	Micro Drainage
Date 16-12-2021 File C2.T.1-PND-0476.SRCX	Designed by Arjun K R Checked by Noushad Nadaf	
XP Solutions	Source Control 2019.1	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
960 min Winter	133.200	3.127	17.9	0.4	18.2	10215.1	O K
1440 min Winter	133.249	3.176	18.0	0.4	18.4	10443.1	O K
2160 min Winter	133.252	3.179	18.0	0.4	18.4	10457.1	O K
2880 min Winter	133.229	3.156	18.0	0.4	18.3	10351.7	O K
4320 min Winter	133.163	3.090	17.7	0.4	18.1	10045.0	O K
5760 min Winter	133.089	3.016	17.5	0.4	17.9	9712.1	O K
7200 min Winter	133.053	2.980	17.4	0.4	17.8	9547.8	O K
8640 min Winter	133.027	2.954	17.3	0.4	17.7	9434.4	O K
10080 min Winter	133.007	2.934	17.3	0.4	17.6	9346.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
960 min Winter	7.262	0.0	2780.4	954
1440 min Winter	5.113	0.0	2701.2	1422
2160 min Winter	3.581	0.0	5421.1	2120
2880 min Winter	2.787	0.0	5302.3	2796
4320 min Winter	1.973	0.0	4992.6	4108
5760 min Winter	1.558	0.0	9967.3	5240
7200 min Winter	1.310	0.0	9815.8	5624
8640 min Winter	1.145	0.0	9602.3	6576
10080 min Winter	1.027	0.0	9328.0	7472