

Table D.1: Floodplain Storage Loss and Compensation Assessment

S.N	Site Ref	Location between junctions	Fp Volume Loss, m3	Fp Compensation Volume, m3	GIS Overlay Map Number	Topographical data / method used for floodplain loss calculation	Remarks
Offline Side Roads:							
1	Ascot Road	J 8/9 - 7	90.0	258.0	514451-MUH-SR-ZZ-DR-DR-301319 / Rev H	HE 5M Lidar - Raster Cut/Fill analysis	Volume for Volume
2	Monkey Island Lane	J 8/9 - 7	1230.0	2232.0	514451-MUH-SR-ZZ-DR-DR-301322 / Rev H	EA 1M Lidar - CS method	Volume for Volume & Level for Level compensation presented (Option 1)
		J 8/9 - 7	675.0	969.4	514451-MUH-00-ZZ-DR-DR-400229	EA 1M Lidar - CS method	Volume for Volume & Level for Level compensation presented (Option 2)
3	Marsh Lane	J 8/9 - 7	0.0	-		HE 5M Lidar - Raster Cut/Fill analysis	-
4	Wood Lane	J 7 - 6	120.0	134.9	514451-MUH-SR-ZZ-DR-DR-301325 / Rev H	EA 1M Lidar - CS method	Volume for Volume & Level for Level compensation presented (update 2016-01-06)
5	Datchet Road	J 6 - 5	0.0	-		HE 5M Lidar - Raster Cut/Fill analysis	
6	Riding Court Road	J 6 - 5	49.0	93.0	514451-MUH-SR-ZZ-DR-DR-301324 / Rev G	EA 50CM Lidar - CS method	Volume for Volume compensation presented
7	Old Slade Lane	J 5 - 4	0.0	-		HE 5M Lidar - Raster Cut/Fill analysis	
8	Oldway Lane	J 7 - 6	0.0	-		HE 5M Lidar - Raster Cut/Fill analysis	
9	Recreation ground	J 6 - 5	0.0	-		HE 5M Lidar - Raster Cut/Fill analysis	
10	Lake End Road	J7	0.0	-		EA 1M Lidar - CS method	
11	Huntercombe Spur	J7	0.0	-		EA 1M Lidar - CS method	
Online Widening:							
1	R6	J 5 - 4	116.9	265.2		HE Surveyed CS - CS method	Volume for Volume & Level for Level compensation presented
2	R7	J 5 - 4	0.0	-	514451-MUH-00-ZZ-DR-DR-400134	HE Surveyed CS - CS method	
3	R32	J 8/9 - 7	223.0	456.7	514451-MUH-00-ZZ-DR-DR-400126	CH2MHill CS - CS method	Volume for Volume & Level for Level compensation presented
4	R31	J 8/9 - 7	0.0	-		HE 5M Lidar - CS method	
5	E6-B2	J 8/9 - 7	0.0	-		HE 5M Lidar - CS method	
6	R29	J 8/9 - 7	87.5	365.2	514451-MUH-00-ZZ-DR-DR-400128	HE Surveyed CS - CS method	Volume for Volume compensation. Additional volume 252.2 m3 (252.2 m3 =365.2-113) is available for compensation for R29 after deducting 113 for Bray Bridge
7	R30	J 8/9 - 7	33.9	33.9	514451-MUH-00-ZZ-DR-DR-400129	HE Surveyed CS - CS method	This 33.9m3 volume would be incorporated in Monkey Island Lane compensation, being in the same location and no separate suitable area found.
8	E6-A1	J 8/9 - 7	0.0	-		HE Surveyed CS - CS method	
9	E6-B1	J 8/9 - 7	10.4	26.0	514451-MUH-00-ZZ-DR-DR-400131	EA 50CM LIDAR CS mehtod	Updated on 2016-01-25 using CS extracted from EA 50CM LIDAR
10	R28	J 8/9 - 7	0.6	Negligible		HE Surveyed CS - CS method	R28 & G6-07 combined
11	R40	J 12 - 11	0.0	-		HE 5M Lidar - CS method	
12	E9-B2	J 12 - 11	0.0	-		HE 5M Lidar - CS method	
13	E9-A1	J 12 - 11	129.9	526.0	514451-MUH-00-ZZ-DR-DR-400133	HE Surveyed CS - CS method	Volume for Volume & Level for Level compensation presented (update 2016-01-06)
14	E7-B2	J 10 - 8/9	0.0	-		HE 5M Lidar - Raster Cut/Fill analysis	
15	G6-07	J 8/9 - 7	0.0	-		HE 5M Lidar - Raster Cut/Fill analysis	
16	R10	J 6 - 5	0.0	-		HE 5M Lidar - Raster Cut/Fill analysis	
17	R11	J 6 - 5	0.0	-		HE 5M Lidar - Raster Cut/Fill analysis	
18	R8/9	J 5 - 4	0.0	-		HE 5M Lidar - Raster Cut/Fill analysis	
19	E8-A2	J 11 - 10	20.4	37.5	514451-MUH-00-ZZ-DR-DR-400194	HE Surveyed CS - CS method	Volume for Volume compensation presented
20	R18	J 7 - 6	2130.1	3884.5	514451-MUH-00-ZZ-DR-DR-400157	EA 1M Lidar - CS method	Volume for Volume & Level for Level compensation for combined R18 & R19 (Sheet 1 of 4)
21	R19	J 7 - 6	1590.4			EA 1M Lidar - CS method	updated using gravity box drain
	R18				514451-MUH-00-ZZ-DR-DR-400223	EA 1M Lidar - CS method	Volume for Volume & Level for Level compensation for combined R18 & R19 (Sheet 2 of 4)
	R19					EA 1M Lidar - CS method	updated using gravity box drain
	R18				514451-MUH-00-ZZ-DR-DR-400224	EA 1M Lidar - CS method	Volume for Volume & Level for Level compensation for combined R18 & R19 (Sheet 3 of 4)
	R19					EA 1M Lidar - CS method	updated using gravity box drain
	R18				514451-MUH-00-ZZ-DR-DR-400225	EA 1M Lidar - CS method	Volume for Volume & Level for Level compensation for combined R18 & R19 (Sheet 4 of 4)
	R19					EA 1M Lidar - CS method	updated using gravity box drain
22	R16	J 6 - 5	15.5	20.2	514451-MUH-00-ZZ-DR-DR-400158	EA 50CM Lidar - CS method	Volume for Volume & Level for Level compensation presented (update 2016-01-06)
23	R17	J 6 - 5	496.8	1103.4		EA 50CM Lidar - CS method	Volume for Volume & Level for Level compensation presented (update 2016-01-06)
24	E3-B1	J 5 - 4	0.1	Negligible		EA 1M Lidar - CS method	
25	Windsor Rail Bridge	J 6 - 5	2.0	2.0		EA 50CM Lidar -CS method (Ref: R17)	Already incorporated in the compensation for embankment widening for R17
26	The Bridge expansion at Bray	J 8/9 - 7	113.0	113.0		HE Surveyed CS- CS method (Ref: R29)	The approximated floodplain storage loss of 113m3 would be compensated together with R29, as they are in the same flood plain.

Other Sites Assessed as NOT impacting 100YrsCC flood plain storage

S.N.	Site Ref	Chainage	MP
1	R41	61865-61748	72/8+20 ~ 72/7+10
2	E4-B2	24500-24400	35/4+40 ~ 35/3+40
3	R15	24359-24193	35/3-1 ~ 35/1+40
4	R14	24137 - 24360	35/1-15 ~ 35/3
5	R13	24013-23865	35/0-50 ~ 34/8-6
6	R12	23850 - 24005	34/8-20 ~ 34/9+26
7	E4-A2	23750 - 23850	34/7+6 ~ 34/8-21
8	E4-B1	22650-22550	33/6-10 ~ 33/5-9
9	E4-A1	22100 - 22200	33/0+45 ~ 33/1+45

Total Sites assessed = 46

Table D.2: Summary of Floodplain Compensation Calculation results

S.N	Site ID	Location	Topographical data / method used for floodplain loss calculation	Floodplain Storage Volume Loss (m3)	Compensation Volume provided within Order Limits (m3)	% extra provided (by volume)	Land Area available for FpC within Order Limits (m2)	Type of FpC	Hydraulic Connectivity	Drawings / Maps	Site NGR
1	R18 (WB)	Junction 7-6 (CH 26500-27100)	EA 1M Lidar - CS method	2130.1							SU95495 79337
2	R19 (EB)	Junction 7-6 (CH 26550-27070)	EA 1M Lidar - CS method	1590.4	3884.5	+4%	The total area shown for compensation is about 6637 m2 (= 4719 EB+1918 WB). There are also additional area available on both EB and WB stretches.	Both Volumetric and Level for level	The results are now updated using box drain as a compensation for the whole stretch from chainage CH28280 to CH26850. It will have a minimum free board of 300mm on top of 100YrsCC flood level (Flood level = 20.67mAOD). Pipe links are proposed under the proposed ERA (CH 27700 -CH 27800). The westbound side compensation channel as proposed in earlier (CH 27600 - CH 28000) submission is not required with this new updated arrangements on the eastbound side using gravity box drains.	514451-MUH-00-ZZ-DR-DR-400157, 514451-MUH-00-ZZ-DR-DR-400223, 514451-MUH-00-ZZ-DR-DR-400224, 514451-MUH-00-ZZ-DR-DR-400225	SU95499 79377
3	R16 (EB)	Junction 6-5 (CH 25160 -25850)	EA 50CM Lidar - CS method	15.5	20.2	+30%	Alternative options that were identified are shown on map	Both Volumetric and Level for level (updated 2016-01-06)	Open Channel(OC) Hydraulic link is at CH 25650 (EB) where a nearby ditch is available at a lower level	514451-MUH-00-ZZ-DR-DR-400158	SU96703 79061
4	R 17 (WB)	Junction 6- 5 (CH 25260 -25830)	EA 50CM Lidar - CS method	496.8	1103.4	+122%	Compensation for Windsor bridge is also included in R17 as the embankment widening for the bridge is treated within R17.	Both Volumetric and Level for level (updated 2016-01-06)	OC Hydraulic link is at CH 25260 (WB) where a nearby ditch is at a level of 18.9mAOD to drain compensated water from compensation ditch bed level of 18.98mAOD		SU9671679027
5	R 06 (WB)	Junction 5-4b (CH 17445 -17600)	HE Surveyed CS - CS method	116.9	265.2	+126%	Alternative options that are identified are shown on map	Both Volumetric and Level for level	OC Hydraulic link is at CH 17700 (WB) where a nearby ditch is at a lower level	514451-MUH-00-ZZ-DR-DR-400134	TQ03880 78299
6	E9-A1 (WB)	Junction 12-11 (CH 56180 -56280)	HE Surveyed CS - CS method	129.9	526.0	+305%	Two other alternative options that are identified are shown on map	Both Volumetric and Level for level (updated 2016-01-06)	OC hydraulic link connects CH56100 to 56110 (WB) at 38.4mAOD, slightly lower level than compensation ditch	514451-MUH-00-ZZ-DR-DR-400133	SU70346 69253
7	Wood Lane Road	Junction 7- 6	EA 1M Lidar - CS method	120.0	134.9	+12%	As an alternative, there is also an extra land available on the western side that will result from dismantling the existing embankment of the Wood Lane for compensation if required.	Both Volumetric and Level for level (updated 2016-01-06)	Hydraulic connection link to the floodplains are shown for each options examined.	514451-MUH-SR-ZZ-DR-DR-301325	SU95001 79469
8	Ascot Road	Junction 8/9 - 7	HE 5M Lidar - Raster Cut/Fill analysis	90.0	258.0	+186%	Options for construction phase and other alternatives options are shown on map	Volumetric	Hydraulic pipe connectivity will be established at the southern at ref CH 400 (local) to the nearest flood plain within red boundary as shown on the map.	514451-MUH-SR-ZZ-DR-DR-301319	SU89357 78393
9	Riding Court Road	Junction 6-5	EA 50CM Lidar - CS method	49.0	93.0	+89%	Various options were examined as shown on the map as potential alternatives.	Volumetric	Hydraulic pipe connectivity will be established from the compensation area ref CH5120 to the opposite side of the road as shown	514451-MUH-SR-ZZ-DR-DR-301324	SU99063 77432
10	Monkey Island Lane	Junction 8/9-7	EA 1M Lidar - CS method	1264.0	2232.0	+76%	Options are limited because of space availability, however there is enough area available from reprofiling of embankment and dismantling of existing side road. 1230m3 for Monkey island and 34m3 for site R30 is also included in the required compensation volume.	Both Volumetric and Level for level	Hydraulic pipe connectivity will be established from both northern and southern wing of compensation ditch as shown.	514451-MUH-SR-ZZ-DR-DR-301322	SU91008 79251
		Junction 8/9-7	EA 1M Lidar - CS method	709.0	969.4	+36%	Options are limited because of space availability, however there is enough area available from reprofiling of embankment and dismantling of existing side road. 675m3 for Monkey Island and 34m3 for site R30 is also included in the required compensation volume.	Both Volumetric and Level for level	Hydraulic pipe connectivity will be established from both northern wing of compensation ditch as shown.	514451-MUH-00-ZZ-DR-DR-400229	SU91008 79251
11	R32 (WB)	Junction 8/9-7 (CH 33600 -33900)	CH2MHill CS -CS method	223.0	456.7	+104%	Alternative options that were identified are shown on map	Both Volumetric and Level for level	OC hydraulic link will connect at CH 37750 (EB). The compensation channel ditch will drain into the floodplain through an open channel ditch as shown	514451-MUH-00-ZZ-DR-DR-400126	SU89230 78592
12	R29 (EB)	Junction 8/9- 7 (CH 30820 to 31765)	HE Surveyed CS - CS method	87.5	252.2	+188 %	Compensation of 252.2 m3(=365.2-113m3 for BrayBridge) will be provided between CH 30880 to CH 31020 (WB)	Volumetric	Being in the same floodplain, compensation is provided between CH 30880 to 31020 (WB) and will be hydraulically linked with the floodplain by an open channel link from CH 31020 to the low ditch point	514451-MUH-00-ZZ-DR-DR-400128	SU91190 79437
13	Widsor Rail-Bridge expansion	Junction 6-5	EA 50CM Lidar - CS method	2.0	2.0	+0%	Compensation incorporated with Site R17	Volumetric	Refer to site R17	included in embankment widening with R17	SU96661 79039
14	Bridge Expansion at Bray	Junction 8/9-7	HE Surveyed CS- CS method (Ref: R29)	113.0	113.0	+0%	Compensation incorporated with Site R29	Volumetric (consists both river and floodplain volume)	Refer to site R29	The approximated floodplain storage loss of 113m3 is compensated combinely with R29, being in the same flood plain.	SU92131 79841
15	E8-A2 (WB)	Junction 11-10 (CH 50500 -50600)	HE Surveyed CS - CS method	20.4	37.5	+85%	Compensation will be provided from CH 50640 to 50700 as shown on the map.	Volumetric	The hydraulic connection for such compensation ditch will be provided using an open channel ditch to an invert level of 39.75mAOD at CH 50600 connecting to chainage CH 50640.	514451-MUH-00-ZZ-DR-DR-400194	SU75652 69536
16	R30 (WB)	Junction 8/9-7 (CH 31540 -31635)	HE Surveyed CS - CS method	33.9	33.9	0%	Compensation incorporated with the Monkeys Island Lane compensation	Volumetric	Refer to site Monley Island Lane	514451-MUH-00-ZZ-DR-DR-400129	SU91008 79251
17	E6-B1 (EB)**	Junction 8/9-7 (CH 30450 -30550)	EA 50CM LIDAR- CS method	10.4	26	+150%	Compensation is arranged CH 30550 - 30525	Volumetric	Hydraulic connectivity has been shown between CH 30525 and CH 30500	514451-MUH-00-ZZ-DR-DR-400131	SU91926 79808

** Updated using high resolution data (2016-01-25)

Table D.3: Surface Water Assessment spreadsheet for proposed open channel compensation site for R29

Type	Runoff Coefficient*, C	Area, (m2)	C*A, (m2)	unit
Asphaltic hard surface	0.95	5090	4836	m2
grass area	0.53	4312	2285	m2
Total Impermeable area =			7121	m2
			0.7121	ha

* Source: Hydrosystems Engineering and Management (Mays L.W. and Tung Y.K, McGraw-Hill Inc.)

FEH Intensity (mm/hr)	+ 20% CC mm/hr	Durations, D (hrs)	Total Surface Water (SW) Volume for existing ditch
80.1	96.1	6.0	4106.230

Proposed compensation ditch slope, S = 40 cm in 140m = 0.0029
 Mannings roughness coefficient**, n = 0.04

Mannings n value is taken assuming the channel with bushes on the sides for the worst case.

** Source: HEC-RAS River Analysis System (US Army Corps of Engineers, Hydraulic Engineering Centre)

The values for area and perimeters are measured directly from CAD file

Proposed Ditch capacity, considering normal flow and taking cross section at CH 30920 as a representative section

Ditch Channel Flow rate (Q) is calculated using the Manning Equation $V = 1/n \times R^{2/3} \times S^{1/2}$

Chainage	Cross sectional area within the ditch below 100yrs plus CC Fld Lvl (m2)	Wetted perimeter below 100yrs plus CC Fld Lvl, P(m)	Hydraulic Radius below the 100yrs plus CC Fld Lvl, R(m) = Cross Sectional Area/ Wetted perimeter	Ditch Flow rate below the 100yrs plus CC Fld Lvl, Q (m3/s)	Additional ditch cross sectionl area above flood level, dA (m2)	Additional ditch wetted perimeter above the 100yrs plus CC Fld Lvl, dP (m2)	Total ditch cross sectional area At (m2)	Total ditch wetted perimeter, Pt (m)	Total ditch area hydraulic radius, Rt (m)	Total ditch flow capacity (m3/s)	Additional flow capacity available above the 100yrs plus CC Fld Lvl (m3/s)
CH 30920	2.52	5.3485	0.471	2.039	1.013	0.611	3.533	5.959	0.593	3.332	1.29

Summary result for proposed ditch capacity against surface water generation

Time hour	Time min	Actual SW volume from rainfall discharging into the existing ditch (m3)	Proposed Ditch SW Flow capacity above the 100Yrs plus CC flood level (m3/s)	Proposed Ditch SW additional volume capacity above the 100Yrs plus CC flood level (m3)	Results
0.25	15	171.1	1.29	1163.9	The actual volume of surface water generation from rainfall discharging into the existing ditch is less than the additional flow capacity available within the proposed compensation ditch during a 1 in 100 year 6 hour storm event. The proposed ditch would therefore not result in any increased flood risk for the existing ditch drainage.
0.5	30	342.2	1.29	2327.8	
1	60	684.4	1.29	4655.7	
1.5	90	1026.6	1.29	6983.5	
2	120	1368.7	1.29	9311.4	
2.5	150	1710.9	1.29	11639.2	
3	180	2053.1	1.29	13967.1	
3.5	210	2395.3	1.29	16294.9	
4	240	2737.5	1.29	18622.8	
4.5	270	3079.7	1.29	20950.6	
5	300	3421.9	1.29	23278.5	
5.5	330	3764.0	1.29	25606.3	
6	360	4106.2	1.29	27934.2	

