8 Grafham Road Drain detailed assessment

8.1 Description and existing flood risk

8.1.1 Grafham Road Drain is located to the west of the scheme and is classified as an IDB drain. It originates in Grafham and then flows eastwards towards the A1 (TL 1975 6962). The watercourse is conveyed under the A1 via an existing 1.5m diameter culvert. Downstream of the A1 the Drain flows north-east towards Brampton and its confluence with the Brampton Brook is south of Brampton (NGR: TL 2029 7077).

8.1.2 The Grafham Road Drain floodplain is defined from Brampton Wood (to the west) to the A1 by the Environment Agency Flood Zone 3 mapping. Downstream of the A1, the area within Flood Zone 3 expands, merging with the floodplain of the Brampton Brook.

8.1.3 The Environment Agency/Mott MacDonald Great Ouse model (2015) has been adapted for modelling of the Grafham Road Drain. A description of the updates made to the model can be found in *Annex D3.* Modelled peak water levels from the model for the existing condition are summarised in *Table 8.1*.

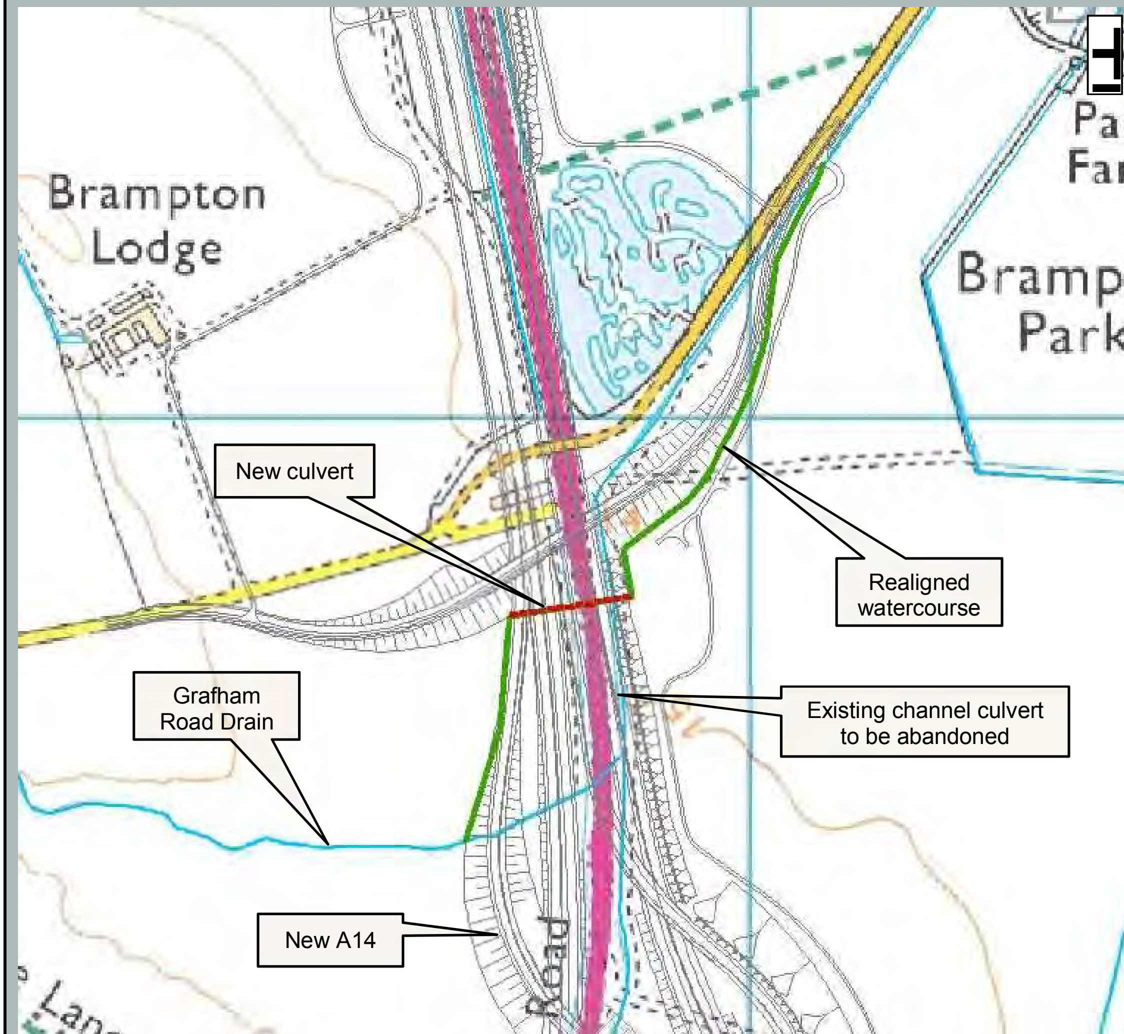
Table 8.1: Grafham Road Drain existing condition - modelled water levels

Location	Model node	Peak water level (mAOD)		
		5% AEP	1%AEP	1% + CC
Upstream extent of reach	GRD_2077	20.42	20.58	20.66
Upstream of realigned section	GRD_1489	15.93	16.31	16.39
Downstream of realigned section	GRD_0483	11.67	11.77	11.85
Confluence with Brampton Brook	GRD_0000	10.01	10.23	10.33

8.2 With-scheme flood risk

8.2.1 It is proposed to divert the Grafham Road Drain (see *Box 8.1*) to accommodate the scheme. The Drain would be diverted upstream of the new A14 (NGR: TL 1970 6956) to flow north along the toe of the new A14 embankment and then it would be conveyed under both the A1 and A14 via a 122m long, 2.4m diameter culvert: CU124 (NGR: TL 1975 6979).

Box 8.1: Re-alignment of Grafham Road Drain



8.2.2 The culvert has been sized to convey the estimated 1% (1 in 100) plus an allowance for climate change peak flow of 6m^3/s; details of the flow estimation can be found in *Annex I*. Downstream of the A14 and A1 the Drain would be diverted north and then east, along the southern embankment toe of Grafham Road before joining its original alignment at NGR: TL 2008 7026.

8.2.3 The watercourse from the south is not an IDB Drain and is believed to provide field drainage. This would be connected into the proposed earthworks drains and would continue to drain to the Grafham Road Drain.

8.2.4 Hydraulic modelling has been undertaken to assess the potential impact of the scheme upon water levels as summarised in *Table 8.2*. This modelling includes the channel realignments and the proposed culvert.

Table 8.2: Grafham Road Drain with-scheme condition – modelled water levels

Location	Model node	Peak water level (mAOD)	
		5% AEP	1%AEP
Upstream extent of reach	GRD_2077	20.41	20.56
Upstream of realigned section	GRD_1489	15.69	15.78
Downstream of realigned section	GRD_0483	11.62	11.66
Confluence with Brampton Brook	GRD_0000	9.90	10.00

8.2.5 The difference between the existing and with-scheme peak water levels on the Grafham Road Drain are summarised in *Table 8.3*.

Table 8.3: Grafham Road Drain relative change in peak water level

Location	Model node	Peak water level (mAOD)	
		5% AEP	1%AEP
Upstream extent of reach	GRD_2077	-0.01	-0.02
Upstream of realigned section	GRD_1489	-0.24	-0.53
Downstream of realigned section	GRD_0483	-0.05	-0.11
Confluence with Brampton Brook	GRD_0000	-0.11	-0.23

8.2.6 A comparison of existing and with-scheme peak water levels indicates that peak water levels would decrease upstream and downstream of the new A14 crossing for all return periods.

8.3 Proposed mitigation

8.3.1 Level-for-level floodplain compensation storage is proposed to mitigate for the loss of existing floodplain. Floodplain compensation would be provided up to the design water level of the 1% (1 in 100) AEP event plus an allowance for climate change to replace the floodplain lost as a result of the scheme.

8.3.2 The locations of the areas of floodplain loss and compensation are indicated in *Annex N Figure 7*. Two floodplain compensation areas are included upstream/west of the A14 and Borrow pit 2 downstream/east of the A14 will also be used. A schedule of the floodplain compensation areas is included in *Table 8.4*.

8.3.3 Borrow Pit 2 would be utilised as floodplain compensation (FpC 03). There is a discrepancy between the flood extent predicted by the model used to assess the scheme and the flood zones published by the Environment Agency. The current model has been developed with additional topographic data and therefore provides a more accurate representation of the watercourse (see *Annex D3*). Mitigation measures would be protected through a submission by Highways England to the Environment Agency following the completion of construction, please see *Section 30.3*.

Table 8.4: Grafham Road Drain floodplain compensation summary

Watercourse	Loss volume	Design flood level	Min. loss level	Compensation area ref	Max. level	Min. level
	(m^3)	(mAOD)	(mAOD)		(mAOD)	(mAOD)
Grafham Road Drain	9,047	15.70	13.00	FpC01	15.70	15.41
				FpC02	15.70	14.65
				FpC03	15.70	13.00

8.3.4 The detailed calculations are included for each area of floodplain loss and each floodplain compensation area in *Annex F*.

8.4 Conclusion

8.4.1 The magnitude of the flood risk impact of the scheme has been assessed as minor beneficial as a result of the provision of floodplain compensation that results in a reduction in peak water levels. In accordance with DMRB guidance this classifies the significance of the effect of the scheme as neutral. as summarised in *Table 8.5.*

Table 8.5: Grafham Road Drain Summary

Importance	Flood Risk Issue(s)	Proposed Mitigation	Magnitude of impact	Significance of effect
Low	Loss of floodplain	Floodplain compensation	Minor Beneficial	Neutral

9 IDB Drain No.1 detailed assessment

9.1 Description and existing flood risk

9.1.1 IDB Drain No.1 originates just upstream of Mill Road in Buckden. From here it flows northwards, roughly parallel with the river Great Ouse, prior to the confluence north of Brampton Park Golf Course.

9.1.2 The Drain is situated within Flood Zone 3 of the river Great Ouse, which is itself considered to have the greater influence on flood water levels in the vicinity. At this location, the estimated 1% AEP peak flow on the IDB Drain is $1.2m^3/s$ and for the river Great Ouse is $81.2m^3/s$. It was therefore not deemed necessary to model the IDB Drain No.1.

9.1.3 At the point at which the new A14 is proposed to cross IDB Drain No.1 it flows parallel to the river Great Ouse within the Great Ouse floodplain. The 1% AEP flood extent of the river Great Ouse confirms this. The new A14 viaduct would free span the IDB Drain No.1 and is therefore not anticipated to impact flows within this watercourse. Therefore, no mitigation would be required.

9.2 Conclusion

9.2.1 The IDB Drain has not been modelled as it’s flood risk is greatly dominated by the river Great Ouse.

10 River Great Ouse detailed assessment

10.1 Description and existing flood risk

10.1.1 The river Great Ouse is designated as a Main River throughout the area of interest.

10.1.2 The river Great Ouse catchment has suffered a series of historic flood events. The most notable on record were in 1947, 1998 and 2001. The 1947 flood event was, in most areas, the most severe on record. However, since that time numerous flood defences and improvements have been undertaken, which in most areas have mitigated against a future event of the same extent and nature (see SFRA *Figure 3.1* and *Figure 3.2* in *Annex C* for the historic flood outlines).

10.1.3 The scheme crosses the river Great Ouse north of Offord Cluny (NGR: TL 2166 6834) via a new viaduct. A recently updated Environment Agency model of the river Great Ouse has been used to establish baseline conditions and assess the potential impact of the scheme on the watercourse and its floodplain. The model is a combined 1D-2D ISIS-TuFlow, constructed in 2015 (see *Annex D4* for further details). The existing modelled water levels are presented in *Table 10.1*.

Table 10.1: River Great Ouse existing condition - modelled water levels

Location	Model node	Peak water level (mAOD)		
		4% AEP	1% AEP	1% AEP + CC
1.3km upstream of proposed A14 (approx. Mill Road, Offord Cluny)	GtO28300	11.81	11.93	12.06
200m upstream of proposed A14	GtO27200	11.48	11.63	11.77
At proposed A14 viaduct	GtO27000	11.43	11.58	11.73
200m downstream of proposed A14	GtO26800	11.32	11.56	11.71
2.0km downstream of proposed A14	GtO25000	11.04	11.13	11.23

10.1.4 Where the new A14 crosses the river Great Ouse, Flood Zone 3 is approximately 1km wide. Upstream of this location, there are properties within the flood zone at Buckden Marina and Offord Cluny.

10.1.5 The river Great Ouse is navigable and the Environment Agency are the navigation authority. Discussions with the Environment Agency concluded that the soffit of any new structure over the river Great Ouse should provide the waterways standard of a minimum 3m clearance above the normal water level of 10.05m AOD, across the 9m width of channel.

10.2 With-scheme flood risk

10.2.1 The new A14 crossing over the river Great Ouse would consist of a viaduct with small embankments at either end; the viaduct would also span IDB Drain No.1. The viaduct consists of 14 arches, one which spans the river

Great Ouse, seven on the left/west bank of the river Great Ouse, one of which also crosses IDB Drain No.1 and seven on the right bank. The design of the viaduct piers will be addressed further at detailed design stage to minimise their impact to the watercourse, flood risk and maintenance access (as recorded in a Statement of Common Ground between Highways England and the Environment Agency). The embankments at either end extend approximately 130m into the floodplain on the left/west embankment and up to 60m on the right/east. An island is included to accommodate a highway attenuation pond and viaduct supports between piers 8 and 9 on the right/east bank of the river Great Ouse.

10.2.2 The viaduct, island and the two embankments have been included in the 1D-2D hydraulic model for the with-scheme scenario. The preliminary design drawing A14-ACM-BN-05-DR-S-00021 has been included in *Annex H*, which provides the details of the crossing. The structure has been designed to satisfy the navigation requirement.

10.2.3 A minimum clear width of 9m from the top of the right/east bank of the river Great Ouse will be provided for ongoing maintenance activities by the Environment Agency.

10.2.4 The with-scheme scenario modelled water levels are summarised in *Table 10.2*.

Table 10.2: River Great Ouse with-scheme condition – modelled water levels

Location	Model node	Peak water level (mAOD)	
		4% AEP	1%AEP
1.3km upstream of proposed A14 (approx. Mill Road, Offord Cluny)	GtO28300	11.81	11.94
200m upstream of proposed A14	GtO27200	11.49	11.63
At proposed A14 viaduct	GtO27000	11.43	11.58
200m downstream of proposed A14	GtO26800	11.41	11.56
2.0km downstream of proposed A14	GtO25000	11.04	11.13

10.2.5 The with-scheme levels (*Table 10.2)* have been compared to the existing water levels (*Table 10.1*) to assess the change in peak water levels and the comparison is summarised in *Table 10.3*. The results indicate that the change in in-channel water level for the 1% (1 in 100) AEP event with-scheme is a peak of 0.01m water level rise approximately 200m upstream of the crossing.

Table 10.3: River Great Ouse relative change in peak water level

Location	Model node	Change in peak water level (m)	
		4% AEP	1%AEP
1.3km upstream of proposed A14 (approx. Mill Road, Offord Cluny)	GtO28300	0.00	0.003
200m upstream of proposed A14	GtO27200	0.005	0.01
At new A14 viaduct	GtO27000	0.00	0.00
200m downstream of proposed A14	GtO26800	0.00	0.00
2.0km downstream of proposed A14	GtO25000	0.00	0.00

10.2.6 Hydraulic modelling indicates that the rise in upstream flood levels is the result of two mechanisms; the loss of floodplain due to the construction of the left/west embankment and the island reducing cross-sectional flow area and in turn flow conveyance.

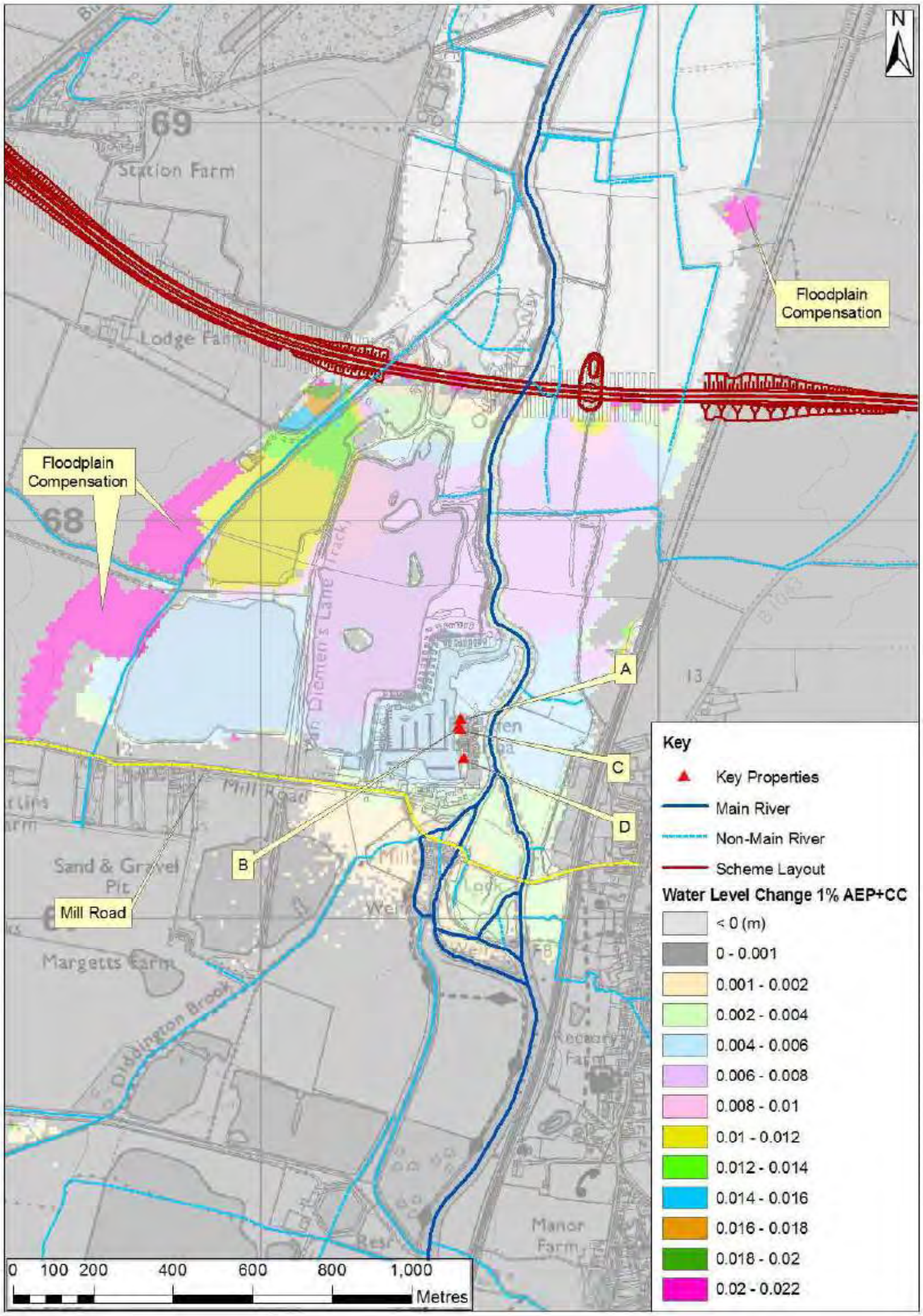
10.2.7 The change to predicted water levels across the floodplain would be greatest immediately upstream of the left/west bank embankment and the island (see *Box 10.1*), The increase in peak water level would reduce progressively further upstream. The peak rise in water levels behind these two elements is summarised in *Table 10.4*.

Table 10.4: River Great Ouse relative change in floodplain water levels

Location	Change in peak water level (m)	
	4% AEP	1%AEP
Upstream of left/east embankment	0.01	0.02
Upstream of island	0.02	0.02

10.2.8 It should be noted that the levels in *Table 10.4* are localised upstream of each structure. The rise of 0.02m for the 1% (1 in 100) AEP event extends approximately 50m upstream of the left/west embankment and 10m of the island. The rise in upstream water level greater than 10mm for the 1% (1 in 100) AEP event extends 70m upstream of the island and 600m upstream of the left/west embankment for the same event. Neither area of water level rise affects property.

Box 10.1: river Great Ouse change to 1% AEP (1 in 100) plus climate change water levels



10.2.9 As a result of the crossing no properties would experience a rise in water level greater than 10mm for all events up to and including the 1% (1 in 100) AEP.

Impact on Buckden Marina

10.2.10 While the new river Great Ouse crossing will increase peak water levels locally upstream it is not predicted to affect property (as opposed to farmland). However four properties (labelled A to D in *Box 10.1*) at Buckden Marina are predicted to experience a negligible change in the 1% (1 in 100) AEP plus climate change event peak water levels as a result of the scheme. A property threshold survey was undertaken at Buckden Marina which confirmed that each of these properties would have a minimum of 0.6m freeboard and would not flood for at least the 1% (1 in 100) AEP plus climate change event as summarised in *Table 10.5,* this is considered to be a negligible change to the current situation.

Table 10.5: Comparison of threshold levels and design water level of properties at Buckden Marina

Property Ref	Ground Level (mAOD)	1% + CC AEP Event Water Level		Property Threshold Level (mAOD)	Height Above Flood Level (m)		Change in Water Level (mm)
		Existing	With-scheme		Existing	With-scheme	
A	11.85	11.985	11.988	12.72	0.735	**0.732**	3
B	11.90	11.989	11.994	12.75	0.761	**0.756**	5
C	11.98	11.989	11.994	12.80	0.811	**0.806**	5
D	11.88	11.996	12.002	12.62	0.624	**0.618**	6

Impact on safe access

10.2.11 Mill Road crosses the river Great Ouse floodplain between Buckden and Offord Cluny approximately 1km upstream/south of the new crossing. With reference to Box 10.1 the water level rise for the 1% (1 in 100) AEP plus climate change event is up to 4mm and generally around 2mm. This is considered a negligible change to existing predicted peak water levels and it is not considered that the scheme will pose an impediment to safe movement along this road beyond the existing situation.

10.3 Proposed mitigation

10.3.1 Level-for-level floodplain compensation storage would be provided to mitigate for the loss of floodplain up to the 1% (1 in 100) AEP plus an allowance for climate change peak water level. Two areas for floodplain compensation are proposed on the left bank, upstream of the new A14 crossing. A third area of floodplain compensation is proposed on the right bank, north/downstream of the A14 crossing to mitigate for the loss of floodplain as a result of the construction of an attenuation pond.

10.3.2 A highway attenuation pond is located within the floodplain of the river Great Ouse, on the downstream side of the new A14 within a new island. The pond would be bunded to remain operational during times of flood and has therefore been included in the calculation of floodplain loss.

10.3.3 The location of the areas of floodplain loss and compensation are indicated in *Annex N Figure 10*. A schedule of the floodplain compensation areas is included in *Table 10.6*.

10.3.4 Liaison has been undertaken with landowners affected by an increase in peak water levels greater than 0.01m for the 1% (1 in 100) AEP event during the DCO examination process as agreed with the Environment Agency. Their acceptance of this change is documented in *Annex Q*.

Table 10.6: Great Ouse floodplain compensation summary

Watercourse	Loss volume	Design flood level	Min. loss level	Compensation area ref	Max. level	Min. level
	(m^3)	(mAOD)	(mAOD)		(mAOD)	(mAOD)
Great Ouse	53,254	11.88	9.98	FpC45	11.88	10.21
				FpC46	11.88	10.00
				FpC47	11.88	10.90

10.3.5 The detailed calculations are included for each area of floodplain loss and each floodplain compensation area in *Annex F*.

10.4 Conclusion

10.4.1 Following DMRB guidance, as described in *Section 1.8*, with consideration for the numbers of properties within the floodplain upstream of the scheme crossing, the importance of flood risk on the river Great Ouse has been assessed as very high. The new crossing would result in a peak water level rise for the 1% (1 in 100) AEP event of 0.02m within the floodplain which would represent an impact of minor magnitude and effect of slight significance for the river Great Ouse as a whole as summarised in Table 10.7. It should be noted that this peak rise in water level only affects undeveloped land and not property.

10.4.2 The scheme is predicted to increase peak water levels to four properties at Buckden Marina for the 1% (1 in 100) AEP plus climate change event by up to 6mm. However this is considered to be a negligible change because the property thresholds will retain a minimum freeboard of 0.6m above the peak water level, The properties will therefore not flood from such an event and consequently the impact on them is considered to be negligible and non-material. Such an impact would be classified as a negligible under DMRB guidance and result in the effect being deemed to be of neutral significance to properties at Buckden Marina.

Table 10.7: River Great Ouse Summary

Importance	Flood Risk Issue(s)	Proposed Mitigation	Magnitude of impact	Significance of effect
Very High	Loss of floodplain Minor constriction of flow path	Floodplain compensation	Minor Adverse	Slight Adverse

11 West Brook detailed assessment

11.1 Description

11.1.1 Please refer to *Annex N Figure 11* for a location plan of the West Brook in relation to the scheme.

11.1.2 The West Brook (also known as Hall Green Brook) is located at approximately the centre of the new A14 scheme. The brook is designated as a Main River from west of Hilton village. It flows north-east to its confluence with the river Great Ouse north of Fenstanton (NGR: TL 3208 6985).

11.1.3 A number of Award Drains (including Huntingdon Award Drain to the west and Hilton Drain to the east) outfall into West Brook in the vicinity of the new A14.

11.1.4 The scheme crosses the realigned West Brook at NGR: TL 2964 6767, adjacent to Potton Road (B1040) on a bridge, see *Box 11.1*.

11.1.5 Works on the West Brook at this location would require consent from the Environment Agency under the protective provisions in the DCO. Similarly works to the Award Drains would require consent from Huntingdonshire District Council.

11.2 Existing flood risk

11.2.1 The *SCDC/CCC SFRA* (WSP, 2010) makes reference to historic flooding on the West Brook in March 1947, October 1993, Easter 1998 and October 2001. However, it could be that this flooding was caused more by backing-up from the river Great Ouse than directly from the West Brook itself.

11.2.2 The *2009 FRA* (Highways Agency, 2009a) refers to flooding problems at 'The Nursery' (NGR: TL 3087 6766) resulting from siltation of the Hilton Road Award Drain.

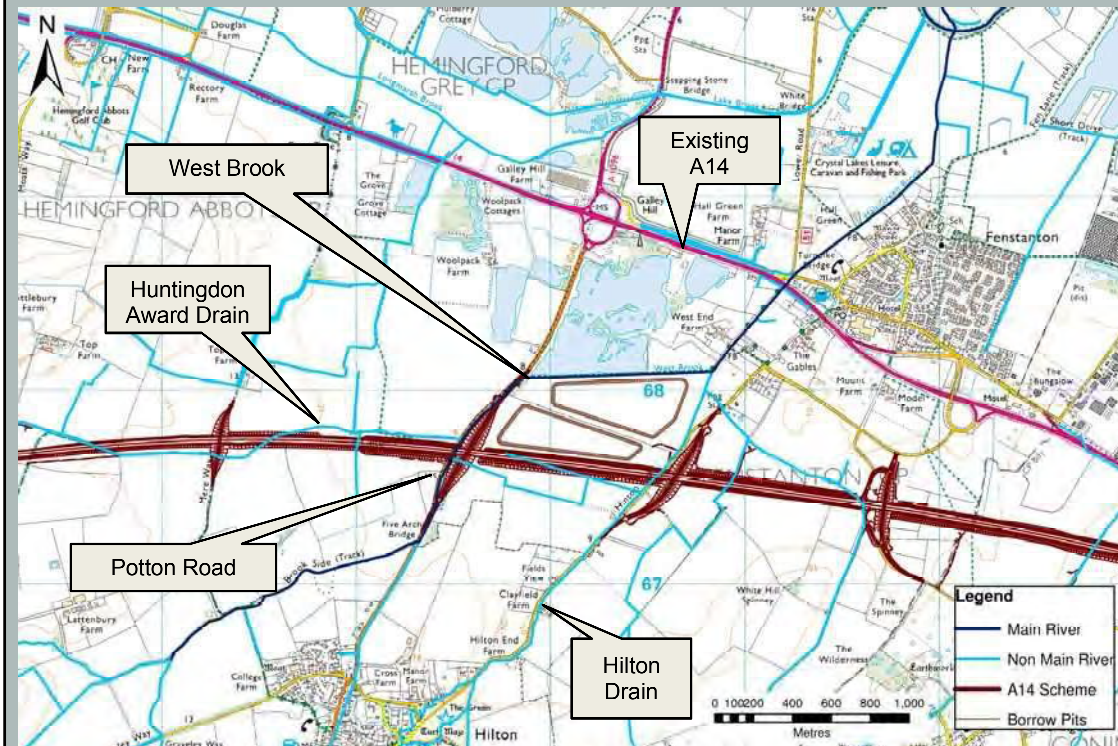
11.2.3 The *2009 FRA* (Highways Agency, 2009a) referred to significant flooding problems in the village of Hilton, in particular during October 2001, when a number of properties were flooded. However, anecdotal reports in the FRA indicate that it was surface water flooding resulting from culvert and/or ordinary watercourse blockage due to insufficient maintenance rather than solely the result of exceedance of channel capacity (i.e. fluvial flooding). The Environment Agency believe that this flooding event in Hilton was not influenced by the West Brook or river Great Ouse.

11.2.4 A new hydraulic model of the West Brook and two Award Drains has been constructed for this FRA which combines the most recent Environment Agency West Brook hydraulic model and the Mike11 model of the Huntingdon Award Drain and Hilton Drain, developed for the *2009 FRA* (Highways Agency, 2009a). They have been augmented with additional topographic channel cross sections completed in 2015. The new model has been used to derive water levels on these watercourses. Please refer to the model build report in *Annex D5* for further details.

11.2.5 Modelled baseline water levels for the West Brook, Huntingdon Award Drain and Hilton Drain are presented in *Table 11.1*.

11.2.6

Box 11.1: West Brook location plan



11.2.7 The hydraulic model produces a revised flood extent to that included on the published Flood Zone map, as indicated in *Box 11.2*. The existing/baseline 1% (1 in 100) AEP flood extent is significantly reduced. The modelled flood extent is particularly reduced west of Potton Road downstream of the scheme; west of Hilton Road, close to The Gables and upstream of the proposed A14. The new flood extents in *Box 11.2* are based on the 'Defended' model scenario (i.e. it includes the effect of flood defences). The 'Undefended' scenario is used to update the published flood zones but the EA has not yet published the flood zones from the new West Brook hydraulic model. A review of the flood defences and Areas Benefitting from Defences, as provided by the Environment Agency, indicates no defences present which would be likely to influence water levels in the West Brook at this location. Those defences that are present appear to be protection from flooding on the river Great Ouse rather than the West Brook. This revised modelling has been used to assess the potential impact of the scheme and consequently any need for mitigation. A full explanation of the changes to the flood zone extent are included in *Annex D5*.

Box 11.2: West Brook existing condition – modelled 1% AEP flood extent between existing and proposed A14.

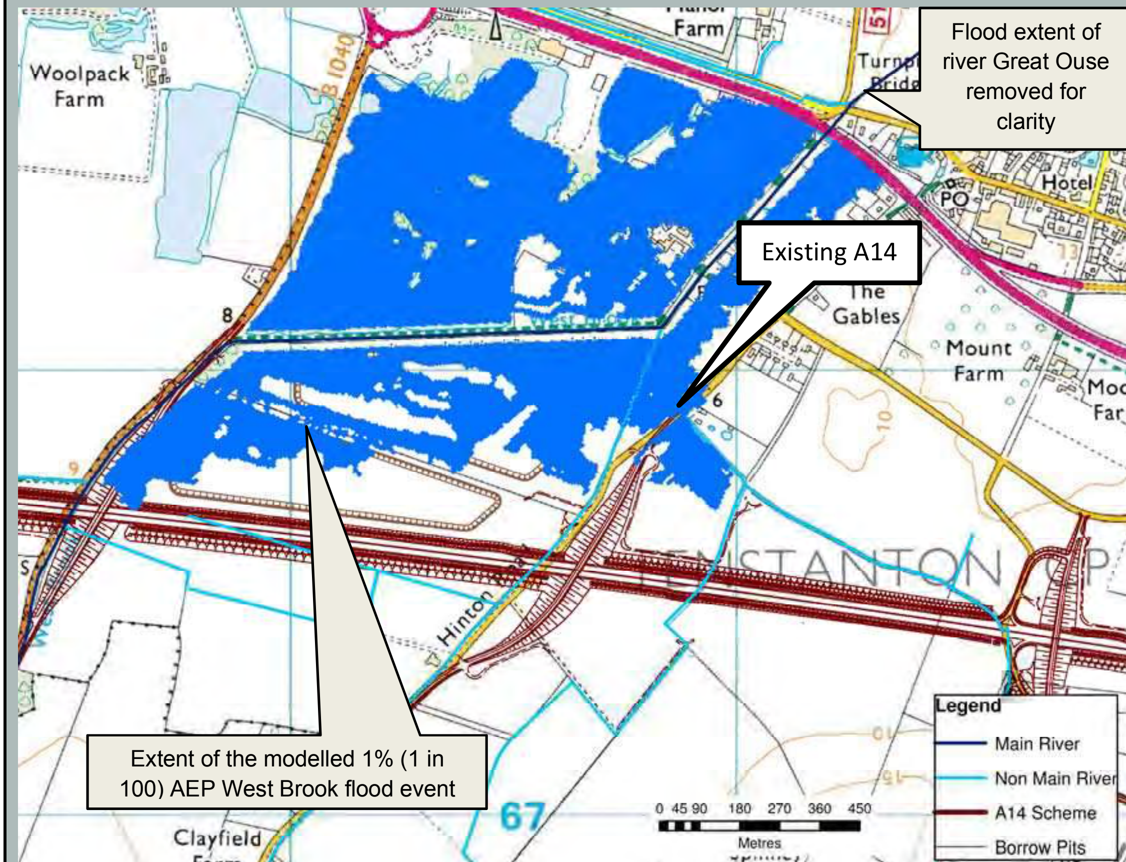


Table 11.1: West Brook existing condition - modelled water levels

Location and chainage	Model node	Peak water level (mAOD)		
		4% AEP	1% AEP	1% AEP + CC
West Brook				
1.94km upstream of new A14	HGB5740	11.43	11.69	11.87
185m upstream of new A14	HGB3985	8.65	8.97	9.15
Immediately upstream A14 crossing	HGB3800	8.35	8.56	8.62
200m downstream of new A14	HGB3600	8.07	8.23	8.28
2.11km downstream of new A14	HGB1686	6.49	6.60	6.76
Huntingdonshire Award Drain				
800m upstream of proposed A14 culvert (Ch12+250)	AWD_2761	20.83	20.93	20.99
Immediately upstream of proposed A14 culvert (Ch12+250)	AWD_1962	14.59	14.72	14.78
Upstream of Mere Way proposed culvert	AWD_1475	12.49	12.62	12.69
Upstream of proposed A14 culvert (Ch13+340)	AWD_1137	11.25	11.41	11.50
491m downstream of proposed A14 culvert (Ch13+340)	AWD_0425	8.66	8.89	9.01
Immediately upstream of Potton Road culvert	AWD_0007	8.25	8.48	8.55
Eastern Award Drain / Hilton Road Drain				
583m upstream of proposed A14	HID_1200	8.09	8.35	8.56
Upstream of proposed A14	HID_0770	7.36	7.69	7.89
Immediately downstream of proposed A14	HID_0558	7.25	7.63	7.84

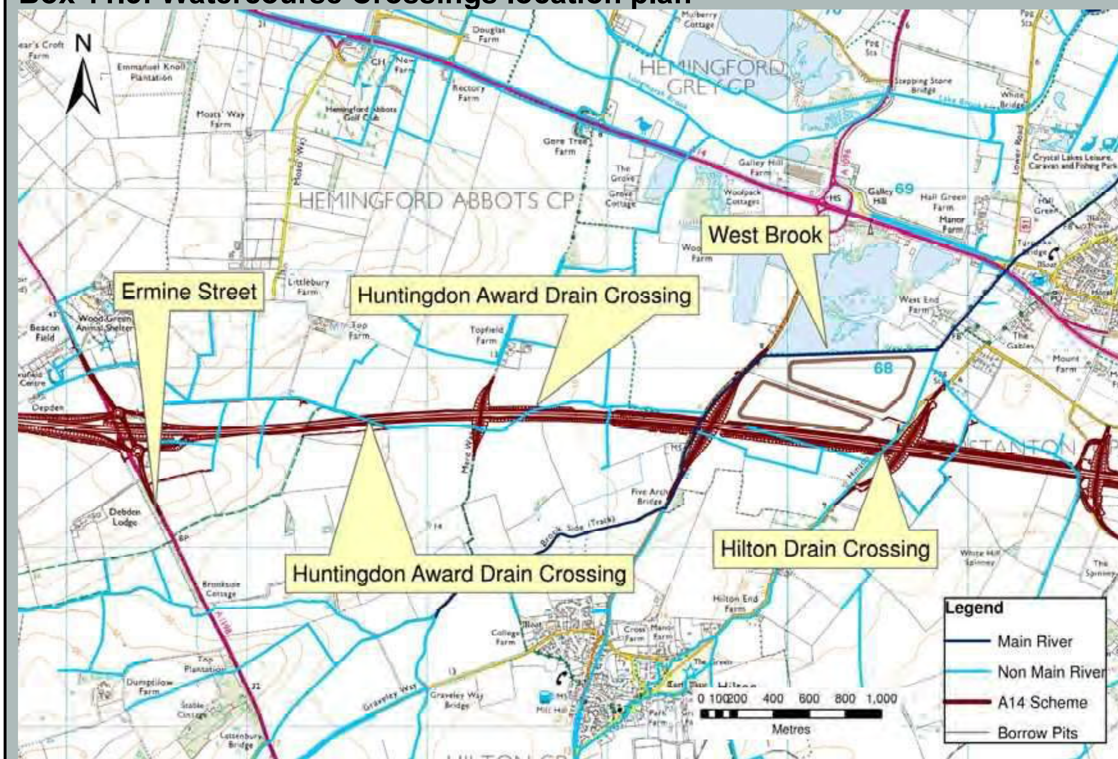
NB: Scheme chainages have been added where required to aid location identification

11.3 With-scheme flood risk

11.3.1 The new A14 would cross the West Brook on a new bridge. The bridge would consist of a single span of 11m and would be 31m long (the width of the A14 carriageway). A minor realignment of the brook would also be undertaken in the vicinity of the new A14 to allow for the Potton Road embankment. The re-alignment would follow the embankment toe on the east side. The newly realigned channel would be designed to provide a similar cross-sectional dimension, gradient and floodplain profile to existing. The outline-design for this would be progressed into the next detailed design stage. The crossing and re-alignment have been added to the hydraulic model to test their potential impact on flood risk. Please refer to drawing A14-JCB-BN-14-DR-S-00001 in *Annex H*.

11.3.2 The Huntingdon Award Drain flows parallel with the new A14 to the west of the West Brook, crossing the new road alignment twice approximately 1km and 1.8km west of the West Brook *(See Box 11.3)*. The Huntingdon Award Drain follows the low topography in the areas and therefore all of the surrounding land drains to it. The new A14 would cut off some drainage paths and to allow for this, drainage ditches would be constructed parallel to the A14 from Ermine Street to their outfall with the West Brook. The changes in land drainage are considered to have a negligible impact and therefore they have not been modelled. This is due to the small catchments affected by each drain, and the minimal change in volume of flow entering the watercourse.

Box 11.3: Watercourse Crossings location plan



11.3.3 The Eastern Award Drain/Hilton Road Drain would be crossed by the new A14 approximately 1km to the east of West Brook. It is proposed to convey this Drain under the new road via an 105m long, 2.7m wide by 2.4m high box culvert (CU182).

11.3.4 Two borrow pits are to be excavated in the area to the north of the proposed A14, within existing floodplain.

11.3.5 The modelling results representing the proposed scenario are summarised in *Table 11.2*.

Table 11.2: West Brook with-scheme condition – modelled water levels

Location	Model node	Peak water level (mAOD)	
		4% AEP	1%AEP
West Brook			
1.94km upstream of new A14	HGB5740	11.43	11.69
185m upstream of new A14	HGB3985	8.61	8.88
Immediately upstream A14 crossing	HGB3800	8.31	8.51
200m downstream of new A14	HGB3600	8.03	8.19
2.11km downstream of new A14	HGB1686	6.46	6.60
Huntingdonshire Award Drain			
800m upstream of proposed A14 culvert (Ch12+250)	AWD_2761	20.83	20.93
Immediately upstream of proposed A14 culvert (Ch12+250)	AWD_1962	14.55	14.67
Upstream of Mere Way proposed culvert	AWD_1475	12.19	12.33
Upstream of proposed A14 culvert (Ch13+340)	AWD_1137	11.23	11.37
491m downstream of proposed A14 culvert (Ch13+340)	AWD_0425	8.57	8.80
Immediately upstream of Potton Road culvert	AWD_0007	8.21	8.45
Eastern Award Drain / Hilton Road Drain			
583m upstream of proposed A14	HID_1200	8.09	8.34
Upstream of proposed A14	HID_0770	7.36	7.59
Immediately downstream of proposed A14	HID_0558RE	6.73	6.90

11.3.6 The with-scheme modelled water levels (*Table 11.2*) have been compared to the existing (*Table 11.1*) to determine the potential impact of the scheme. The difference between the levels is presented in *Table 11.3*.

Table 11.3: West Brook and Award Drains relative change in peak water level

Location	Model node	Peak water level (mAOD)	
		4% AEP	1%AEP
West Brook			
1.94km upstream of proposed A14	HGB5740	0.00	0.00
185m upstream of proposed A14	HGB3985	-0.04	-0.09
Immediately upstream of A14 crossing	HGB3800	-0.04	-0.05
200m downstream of proposed A14	HGB3600	-0.04	-0.04
2.11km downstream of proposed A14	HGB1686	-0.03	0.00
Huntingdonshire Award Drain			
800m upstream of proposed A14 culvert (Ch12+250)	AWD_2761	0.00	0.00
Immediately upstream of proposed A14 culvert (Ch12+250)	AWD_1962	-0.04	-0.05
Upstream of Mere Way proposed culvert	AWD_1475	-0.30	-0.29
Upstream of proposed A14 culvert (Ch13+340)	AWD_1137	-0.02	-0.04
491m downstream of proposed A14 culvert (Ch13+340)	AWD_0425	-0.09	-0. 09
Immediately upstream of Potton Road culvert	AWD_0007	-0.04	-0.03
Eastern Award Drain / Hilton Road Drain			
583m upstream of proposed A14	HID_1200	0.00	-0.01
Immediately upstream of proposed A14	HID_0770	0.00	-0.10
Immediately downstream of proposed A14	HID_0558/ HID_0558RE	-0.52	-0.73

11.3.7 A comparison of the modelled water levels on the West Brook indicate that the scheme would result in no increase to water levels both upstream and downstream of the new crossing for the 1% (1 in 100) AEP event. The change in 1% (1 in 100) AEP water levels is presented in *Box 11.4*.

11.3.8 The scheme would not increase 1% (1 in 100) AEP water levels on the Huntingdon Award Drain.

11.3.9 The scheme would not increase 1% (1 in 100) AEP water levels on the Hilton Drain.

11.3.10 *Box 11.3* indicates that for the 1% (1 in 100) AEP event the scheme results in a reduction in peak water levels in the floodplain against the existing situation. Water levels are predicted to rise within proposed borrow pits, floodplain compensation areas and a small area adjacent to the borrow pits. The borrow pit has been divided into two due to the presence of utilities below ground.

11.3.11 The proposed borrow pit has been modelled as being full of groundwater as a conservative approach. Seasonal fluctuation in groundwater levels could result in the availability of additional flood water storage within the Borrow Pit to that assumed in the model. The borrow pit has not been considered as a flood compensation area. The depth change indicated in the borrow pit in *Box 11.4* includes the groundwater modelled as being present prior to the flood event.

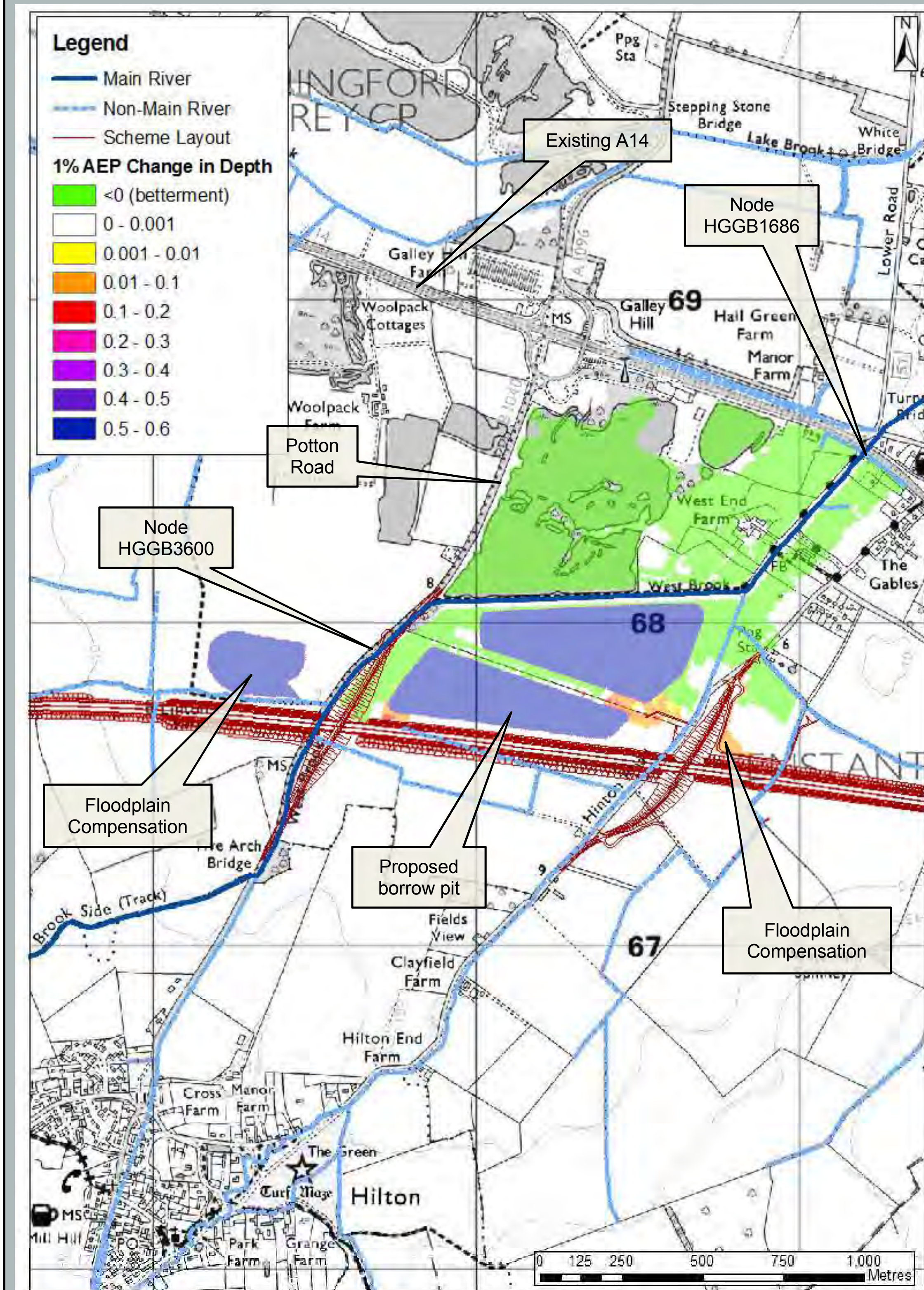
11.3.12 Floodplain compensation has been proposed as mitigation for loss of floodplain as a result of the scheme. It should also be noted that the scheme footprint would only intersect the modelled 1% (1in 100) AEP floodplain on the Potton Road embankment immediately downstream of the crossing.

11.3.13 There is an area of approximately 0.008 km^2 between the borrow pits indicated in *Box 11.4* which is predicted to experience an increase in flood depth greater than 10mm when compared to the existing situation for the 1% (1 in 100) AEP event. This is understood to result from the connectivity of the southern borrow pit with the floodplain for the West Brook. This results in a flow path for flood water from the brook to an existing area of lower ground and is not the result of an increase in water levels in the watercourse. It is not possible to lower ground levels between the two borrow pit sections due to the utilities present in this area. Therefore prevention of the flooding in this area would require bunds or similar raised structures to restrict the connectivity across the floodplain and thus divert flood flows elsewhere which may result in a reduction in the benefits of the scheme downstream. Water levels increase by up to 350mm for the 1% (1 in 100) AEP event in a very small proportion of the area consequently the potential impact of the scheme has therefore been assessed as major adverse at this location. However the water level rise does not affect property and this location is within an area to be permanently acquired by Highways England; consequently no other landowners will be affected. As such the significance of the effect of the scheme is considered slight adverse (summarised in *Table 11.5*). .

11.3.14 Other areas that will experience an increase in flood depth compared to the existing situation are the borrow pit and flood compensation areas. The increase in flood depth in the borrow pit is in part due to the modelled presence of groundwater which has been assumed to fill the borrow pit. The maximum modelled depth of flood water above this assumed groundwater level in the borrow pits is 0.17m in the 1% (1 in 100) AEP event.

11.3.15 An area of approximately 0.65km^2 experiences a decrease in peak water level of 10mm or greater for the 1% (1 in 100) AEP event as a result of the scheme. This area includes sections of floodplain close to properties on Hinton Road.

Box 11.4: West Brook with-scheme change in 1% AEP peak water levels



NB: Comparison water levels are in metres.
Scheme beyond Hilton Road embankment not included within model as no out of bank flooding in the vicinity.

11.4 Proposed mitigation

11.4.1 With-scheme peak water levels in the West Brook are included in *Table 11.3* and are either reduced or remain the same as for the existing situation.

11.4.2 Floodplain compensation storage will be provided to mitigate for the minor encroachment into the floodplain. The floodplain compensation has been included within the with-scheme modelling.

11.4.3 Floodplain compensation would also be provided to mitigate for the minor encroachment into the floodplain for the Hilton Drain by the Hilton Road embankment.

11.4.4 The location of the areas of floodplain loss and compensation are indicated in *Annex N Figure 11*. A schedule of the floodplain compensation areas is included in *Table 11.4*.

Table 11.4: West Brook and Award Drain floodplain compensation summary

Watercourse	Loss volume	Design flood level	Min. loss level	Compensation area ref	Max. level	Min. level
	(m^3)	(mAOD)	(mAOD)		(mAOD)	(mAOD)
West Brook (Potton Road Embankment)	9.414	8.37	7.63	FpC35	8.37	7.90
West Brook (A14 Embankment)	2,498	8.00	7.42	FpC35	8.37	7.90
Hilton Drain	582	6.88	6.70	FpC50	6.88	6.50

11.4.5 Floodplain compensation area FpC35 has been located as close as practicable to the area of loss on the West Brook and FpC50 Hilton Drain. However, FpC35 is located on the Huntingdon Award Drain rather than on the West Brook. It was not possible to identify any areas appropriate for level for level floodplain compensation on the West Brook in close proximity to the scheme, which were not already in the flood zone and where bank and water levels on the West Brook would allow the floodplain compensation to be constructed without impacting on flows outside of flood events. The hydraulic modelling of the FpC's has indicated that provision of floodplain compensation storage on the Huntingdon Award Drain does still result in a reduction of peak water level on the West Brook downstream of the confluence with the Huntingdon Award Drain.

11.4.6 The main body of FpC50 is located approximately 220m from the Hilton Drain, with a narrow channel connecting the two. This is due to a shortage of available land at a higher level close to the watercourse that is not part of the existing floodplain or that would open up new flow paths and result in flooding in other areas. The compensation areas were modelled as connected to the watercourses as described above.

11.4.7 The detailed calculations are included for each area of floodplain loss and each floodplain compensation area in *Annex F*.

11.5 Conclusion

11.5.1 The flood risk impact of the scheme has been assessed as negligible on Hilton Drain and Huntingdon Award Drain and major adverse on the West Brook.

11.5.2 The scheme does not impact upon flood risk in the village of Hilton upstream/south of the A14.

11.5.3 The provision of floodplain compensation as mitigation for areas lost and the reduction in water levels due to the scheme will result in a number of areas with a reduction in flood risk due to the scheme. A small area between the proposed borrow pit sections will experience an increase in flood depth in the 1% (1 in 100 year) AEP event due to the scheme. This is attributed to the connectivity of the borrow pit and the floodplain, subsequently introducing a flow path to an area of existing low ground. There is no property within the area affected by this rise in levels. This area is to be permanently acquired by Highways England for the scheme.

11.5.4 Overall the scheme is considered to have a neutral effect on flood risk for the Huntingdon Award Drain and the Hilton Road Drain, and a slight adverse effect locally on flood risk for the West Brook. This is due to the area of West Brook floodplain with increased flood depth of greater than 100mm, resulting in a major adverse magnitude of impact, but as this occurs in an area to be permanently acquired by Highways England for the scheme and it does not affect property, the significance of this is considered to be slight, *Table 11.5* provides a summary.

Table 11.5: West Brook summary

Watercourse	Importance	Flood Risk Issue(s)	Proposed Mitigation	Magnitude of impact	Significance of effect
West Brook	Medium	Loss of floodplain Area of floodplain with increased depth	Floodplain compensation	Major Adverse	Slight Adverse
Hunts Award Drain	Low	Loss of floodplain	Floodplain compensation	Negligible	Neutral
Hilton Road Drain	Low	Loss of floodplain	Floodplain compensation	Negligible	Neutral

12 Oxholme Drain detailed assessment

12.1 Description and existing flood risk

12.1.1 Oxholme Drain is an Award Drain flowing from the south-west of Conington north-east towards its confluence with the river Great Ouse north of Fen Drayton Nature Reserve. Oxholme Drain is awarded to SCDC for maintenance. The Environment Agency's published Flood Zone map (see *Figure 17.2* in *Volume 2* of the *ES* and in *Annex B*) identifies a wide extent of Flood Zone 3 in the vicinity of the scheme, encompassing both Oxholme Drain and Covell's Drain. Covell's Drain is discussed further in *Section 13*.

12.1.2 Consultation with the Environment Agency identified historic incidents of flooding upstream of the scheme in the village of Conington. The *2009 FRA* (Highways Agency, 2009a) attributed this to a lack of maintenance on the watercourse and a complexity of hydraulic structures in the village.

12.1.3 Due to the wide extent of Flood Zone 3, a 1D hydraulic model was obtained for Oxholme Drain from the Environment Agency to establish existing water levels and assess the potential impact of the scheme. Due to areas of shared floodplain this model has been combined with a 1D hydraulic model for Covell's Drain, also provided by the Environment Agency. A 2D domain has been created for key areas within the model.

12.1.4 The estimate of existing peak water levels based on hydraulic modelling of the Oxholme Drain in the vicinity of the scheme is included in *Table 12.1*.

Table 12.1: Oxholme Drain existing condition - modelled water levels

Location	Model node	Peak water level (mAOD)		
		5 % AEP	1% AEP	1% AEP + CC
Upstream model node	8.031	12.29	12.38	12.44
Upstream of proposed u/s culvert	38.017_copy	9.18	9.32	9.37
152m u/s of proposed A14	38.017	9.04	9.18	9.23
u/s of proposed A14	OX_A14CVTu	8.94	9.07	9.13
Upstream of proposed d/s culvert	38.015copy	8.00	8.16	8.21
Downstream model node	38.001b	4.82	4.99	5.09

12.2 With-scheme flood risk

12.2.1 Oxholme Drain is located towards the eastern end of the new A14 section. It currently flows beneath the existing A14 in a 1.8m diameter culvert. It is proposed to convey the Drain beneath the new A14 via a 98m long 2m diameter culvert (CU196) approximately 450m upstream/south-west of the existing A14.

12.2.2 The proposed condition for the Oxholme Drain has been represented by inserting the new culvert into the model. Table 12.2 summarises the with-scheme modelling results.

Table 12.2: Oxholme Drain with-scheme condition - modelled water levels

Location	Model node	Peak water level (mAOD)		
		5 % AEP	1% AEP	1% AEP + CC
Upstream model node	38.031	12.29	12.38	12.44
Upstream of proposed u/s culvert	38.017_copy	9.14	9.28	9.34
152m u/s of proposed A14	38.017	8.97	9.12	9.16
u/s of proposed A14	OX_A14CVTu	8.80	8.94	9.01
Upstream of proposed d/s culvert	38.015copy	7.96	8.11	8.17
Downstream model node	38.001b	4.82	4.99	5.09

12.2.3 The with-scheme modelled water levels (*Table 12.2*) have been compared to the existing (*Table 12.1*) to determine the potential impact of the scheme. The difference between the levels is presented in *Table 12.3*.

Table 12.3: Oxholme Drain relative change in peak water level

Location	Model node	Peak water level (mAOD)		
		5 % AEP	1% AEP	1% AEP + CC
Upstream model node	38.031	0.00	0.00	0.00
Upstream of proposed u/s culvert	38.017_copy	-0.04	-0.04	-0.03
152m u/s of proposed A14	38.017	-0.07	-0.06	-0.07
u/s of proposed A14	OX_A14CVTu	-0.14	-0.13	-0.12
Upstream of proposed d/s culvert	38.015copy	-0.04	-0.05	-0.04
Downstream model node	38.001b	0.00	0.00	0.00

12.2.4 A comparison of the modelled water levels on the Oxholme Drain indicates that the scheme will result in a decrease in water levels both upstream and downstream of the new crossing for the 1% (1 in 100) AEP event.

12.2.5 For all events, there is no change in flood extent as a result of the scheme. Modelled water levels decrease or remain unchanged in the post-scheme scenario for Oxholme Drain in all events. Further downstream, there is a reduction in flood depth of floodplain in all events. As no flooding from Oxholme Drain is predicted for any event, this consequently will not result in the loss of any floodplain.

12.3 Conclusion

12.3.1 The results of a comparison of existing and with-scheme scenarios indicate that the scheme would not increase water levels on the watercourse.

12.3.2 There is a reduction in flood risk in the 1% (1 in 100) AEP event; based on the anticipated decrease in water levels for the post-scheme scenario the magnitude of impact has been classified as minor beneficial. As the change does not affect property, significance of the effect is considered neutral.

Table 12.4: Oxholme Drain summary

Importance	Flood Risk Issue(s)	Proposed Mitigation	Magnitude of impact	Significance of effect
Low	Disruption of surface water flow path	None	Minor Beneficial	Neutral

13 Covell's Drain detailed assessment

13.1 Description and existing flood risk

13.1.1 Covell's Drain is located to the east of Oxholme Drain. The Drain has been awarded to SCDC for maintenance. The Award Drain is formed of a number of drains, with an upstream extent close to the A428 (NGR: TL 3331 5999). The drain flows north through Elsworth, Boxworth and Conington, prior to reaching the new A14 crossing (NGR: TL 3324 6709). The existing A14 is located approximately 230m downstream of the scheme and from here the Covell's Drain flows north-east and passes Fen Stanton and Swavesey, prior to an outfall into the river Great Ouse approximately 550m downstream of Covell's Bridge (NGR: TL 3529 7013).

13.1.2 The Environment Agency published flood map identifies an area of Flood Zone 3 that connects Oxholme Drain and Covell's Drain floodplains in the vicinity of the scheme. There is no record of historic flooding in this area, but it has been recorded further downstream at Fen Drayton.

13.1.3 Covell's Drain is included in the Environment Agency's 2014 river Great Ouse hydraulic model; however, coverage does not extend sufficiently upstream to fully assess the potential impact of the scheme. Instead, the 1D model constructed for the *2009 FRA* (Highways Agency, 2009a) has been used and combined with the 1D model for the Oxholme Drain. The existing conditions have been established and assessment made of the potential impact of the scheme on peak water levels in the watercourse. The existing peak water levels are summarised in *Table 13.1*.

Table 13.1: Covell's Drain existing condition - modelled water levels

Location	Model node	Peak water level (mAOD)		
		5% AEP	1% AEP	1% AEP + CC
Upstream model node	39.019	11.55	11.75	11.88
198m u/s of proposed A14	39.011	8.70	8.94	9.11
u/s of proposed A14	COV_A14CVu	8.38	8.63	8.79
d/s of proposed A14	39.010	8.27	8.51	8.66
Downstream model node	39.001c	4.36	4.45	4.52

13.2 With-scheme flood risk

13.2.1 The with-scheme condition has been modelled, through the inclusion of culvert CU199 and the road embankment, in the existing model. The Drain is proposed to be conveyed beneath the new A14 via a new 60m long, 3m high, 4m wide box culvert (CU199). The modelled with-scheme peak water levels are summarised in *Table 13.2.*

Table 13.2: Covell's Drain with-scheme condition – modelled water levels

Location	Model node	Peak water level (mAOD)		
		5% AEP	1% AEP	1% AEP + CC
Upstream model node	39.019	11.55	11.75	11.88
198m u/s of proposed A14	39.011	8.67	8.92	9.08
u/s of proposed A14	COV_A14CVu	8.31	8.56	8.73
d/s of proposed A14	39.010	8.25	8.49	8.64
Downstream model node	39.001c	4.36	4.45	4.51

13.2.2 The with-scheme modelled water levels (*Table 13.2*) have been compared to the existing (*Table 13.1*) to determine the potential impact of the scheme. The difference between the levels is presented in *Table 13.3*.

Table 13.3: Covell's Drain relative change in peak water level

Location	Model node	Peak water level (mAOD)		
		5% AEP	1% AEP	1% AEP + CC
Upstream model node	39.019	0.00	0.00	0.00
198m u/s of proposed A14	39.011	-0.03	-0.02	-0.03
u/s of proposed A14	COV_A14CVu	-0.07	-0.07	-0.06
d/s of proposed A14	39.010	-0.02	-0.02	-0.02
Downstream model node	39.001c	0.00	0.00	-0.01

13.2.3 The model indicates that the scheme would result in a decrease in water levels upstream and downstream of the new A14. Consequently the potential significance of the effects has been classified as neutral and no mitigation is required.

13.2.4 For all events, there is no change in flood extent as a result of the scheme. Modelled water levels decrease or remain unchanged in the post-scheme scenario for Covell's Drain in all events. Further downstream, there is a reduction in flood depth of floodplain in all events. As no flooding from Covell's Drain is predicted for any event, this consequently will not result in the loss of any floodplain.

13.3 Conclusion

13.3.1 There is a reduction in flood risk in the 1% (1 in 100) AEP event; based on the anticipated decrease in water levels for the post-scheme scenario the magnitude of impact has been classified as minor beneficial. As the change does not affect property, significance of the effect is considered neutral. This is summarised in *Table 13.5*.

Table 13.5: Covell's Drain summary

Importance	Flood Risk Issue(s)	Proposed Mitigation	Magnitude of impact	Significance of effect
Medium	None	None	Minor Beneficial	Neutral

14 Utton's Drove Drain detailed assessment

14.1 Description and existing flood risk

14.1.1 Utton's Drove Drain is located towards the east of the scheme along the existing section of the A14 which would be widened. The Drain is classified as an Award Drain, awarded to SCDC for maintenance. A number of tributaries enter from its source south of Boxworth to its confluence with Swavesey Drain at Cow Fen (NGR: TL 3772 6852).

14.1.2 There is no record of historic flooding in the vicinity of the A14. However, Flood Zone 3 mapping indicates extensive potential flooding upstream and downstream of the road on Utton's Drove Drain.

1D hydraulic modelling has been undertaken to assess the potential impact of the scheme. Utton's Drove Drain was included in the 2014 Environment Agency river Great Ouse hydraulic model, however, its coverage is insufficient to fully test the potential impact of the scheme. Instead a hydraulic model developed for the *2009 FRA* (Highways Agency, 2009a) has been used to establish baseline water levels and assess the potential impact on Utton's Drove Drain. This model has been modified to improve the representation of the watercourse. Details of the changes made can be found in *Annex D9*. The existing conditions have been established and assessment made of the potential impact of the scheme on peak water levels in the watercourse. The existing peak water levels are summarised in *Table 14.1*.

Table 14.1: Utton's Drove Drain existing condition - modelled water levels

Location	Model node	Peak water level (mAOD)		
		5% AEP	1% AEP	1% AEP+ CC
107m upstream of proposed upstream culvert	1.001	14.74	14.89	14.96
Upstream of proposed upstream culvert	48.005CVTu	13.31	13.40	13.42
Downstream of proposed upstream culvert	48.005CVTd	13.27	13.38	13.42
Upstream of A14 (at proposed extension inlet location)	A14_CVTu	13.24	13.33	13.38
Downstream of A14	48.002	12.04	12.20	12.30
Upstream of proposed downstream culvert	48.001CVTu	11.93	12.07	12.16
Downstream of proposed downstream culvert	48.001	11.85	12.00	12.08
107m downstream of proposed downstream culvert	3.018	11.25	11.38	11.46

14.2 With-scheme flood risk

14.2.1 It is proposed to widen the A14 where it crosses Utton's Drove Drain. Three crossings would be constructed on the watercourse to accommodate the scheme. The widened A14 would require a 38m long 1.8m box culvert extension (CU203), whilst new crossings are proposed for access roads either side of the A14: the crossing to the south would be a 10m long bridge over the watercourse and CU223 to the north would be a 10m long culvert, 2.5m in diameter but with a flattened invert to give a max height of 2m.

14.2.2 The three crossings and the new road embankment have been inserted into the hydraulic model to assess the impact of the scheme. The modelling results representing the unmitigated with-scheme scenario are summarised in *Table 14.2*.

Table 14.2: Utton's Drove Drain with-scheme condition - modelled water levels

Location	Model node	Peak water level (mAOD)	
		5% AEP	1%AEP
107m upstream of proposed upstream culvert	1.001	14.74	14.88
Upstream of proposed upstream culvert	48.005CVTu	13.11	13.36
Downstream of proposed upstream culvert	48.005CVTd	12.99	13.16
Upstream of A14 (at proposed extension inlet location)	A14_CVTu	12.53	12.77
Downstream of A14	48.002	12.20	12.37
Upstream of proposed downstream culvert	48.001CVTu	11.91	12.10
Downstream of proposed downstream culvert	48.001	11.84	11.99
107m downstream of proposed downstream culvert	3.018	11.25	11.38

14.2.3 The with-scheme modelled water levels (*Table 14.2*) have been compared to the existing (*Table 14.1*) to determine the potential impact of the scheme. The difference between the levels is presented in *Table 14.3*.

Table 14.3: Utton's Drove Drain relative change in peak water levels

Location	Model node	Peak water level (mAOD)	
		5% AEP	1%AEP
107m upstream of proposed upstream culvert	1.001	0.00	0.00
Upstream of proposed upstream culvert	48.005CVTu	-0.18	-0.09
Downstream of proposed upstream culvert	48.005CVTd	-0.30	-0.22
Upstream of A14 (at proposed extension inlet location)	A14_CVTu	-0.71	-0.56
Downstream of A14	48.002	0.16	0.16
Upstream of proposed downstream culvert	48.001CVTu	-0.02	0.03
Downstream of proposed downstream culvert	48.001	-0.01	0.00
107m downstream of proposed downstream culvert	3.018	0.00	0.00

14.2.4 *Table 14.3* indicates that the scheme would result in a negligible or minor beneficial impact on water levels both upstream and downstream of the A14, other than a localised increase between the A14 and the downstream culvert (CU223) beneath the access track to the north of the A14. This increase is caused by the change in hydraulic regime caused by the extended culvert. The increase in peak water level is restricted to a 36m length of Utton's Drove Drain that is within the scheme boundary and land to be permanently acquired by Highways England. The water level remains in-channel at this location for all events tested.

14.2.5 The flood extent upstream of the A14 is predicted to change for the 1% AEP (1 in 100) plus climate change event. A comparison of the modelled flood extents and Flood Zone 3 can be found in *Annex D9*. There is no out of bank flooding in the other simulated events. The increase in peak water level is a maximum of 0.07m for the 1% AEP (1 in 100) plus climate change event and is contained within an area to be permanently acquired by Highways England for the scheme between access tracks and drainage balancing ponds.

14.2.6 Swavesey Internal Drainage Board have made representations regarding the impact of changes in flow on Utton's Drove Drain affecting the Swavesey Drain. The confluence of the two watercourses is approximately 4km downstream/north of the A14. *Table 14.3* indicates that the increase in water levels as a result of the scheme is limited to a localised stretch of watercourse which extends for approximately 30m downstream of the A14 and no further. Additionally as indicated in *Section 24* attenuation facilities are included to mitigate for any increase in drainage runoff from the road and ensure peak flows do not increase compared to the existing situation.

14.3 Proposed mitigation

14.3.1 To mitigate for the loss of floodplain as a result of the scheme it is proposed to introduce level-for-level floodplain compensation. Three floodplain compensation areas are proposed upstream of the main A14 carriageway, as close as practicable to the area of loss.

14.3.2 The location of the areas of floodplain loss and compensation are indicated in *Annex N Figure 14.* A schedule of the floodplain compensation areas is included in *Table 14.4*.

Table 14.4: Utton's Drove Drain floodplain compensation summary

Watercourse	Loss volume	Design flood level	Min. loss level	Compensation area ref	Max. level	Min. level
	(m^3)	(mAOD)	(mAOD)		(mAOD)	(mAOD)
Utton's Drove	1,677	13.37	12.93	FpC48	13.37	13.14
				FpC57	13.37	12.93
				FpC58	13.37	12.93

14.3.3 The detailed calculations are included for each area of floodplain loss and each floodplain compensation area in *Annex F*.

14.4 Conclusion

14.4.1 The magnitude of the scheme's impact on flood risk has been classified as minor adverse as the rise in peak water levels in the 1% (1 in 100) AEP event is constrained to a short length of the watercourse between culverts immediately downstream of the A14 and there is no change further downstream, beyond the scheme. Floodplain compensation is proposed to mitigate for the loss of floodplain. The small area that is predicted to experience an increase in flood risk is within an area to be permanently acquired for the scheme. Consequently the significance of the effect of the scheme on flood risk is neutral, as summarised in *Table 14.5*.

Table 14.5: Utton's Drove Drain summary

Importance	Flood Risk Issue(s)	Proposed Mitigation	Magnitude of impact	Significance of effect
Low	Loss of floodplain	Floodplain compensation	Minor adverse	Neutral

15 Swavesey Drain detailed assessment

15.1 Description and existing flood risk

15.1.1 Swavesey Drain is located towards the east of the scheme along the existing section of the A14 which would be widened. The Drain is classified as an Award Drain, awarded to SCDC for maintenance.

15.1.2 Swavesey Drain is classified as a Main River from Highfield Farm, just upstream of Ramper Road and east of Swavesey (NGR: TL 3737 6742). Where the new A14 crosses the Swavesey Drain, upstream of the village of Swavesey, it is classified as an Award Drain.

15.1.3 There are no records of historic flooding of Swavesey Drain in the vicinity of the A14 and no mapped Flood Zone within the proposed extent of the scheme. Based on this current lack of flood risk in the Swavesey Drain at the location of the A14 crossing, it has been concluded that the scheme would not impact flood risk and the Swavesey Drain has therefore not been modelled.

15.2 With-scheme flood risk

15.2.1 The existing A14 is proposed to be widened where it crosses the Swavesey Drain. The current 1.8m width culvert (CU202) would be maintained and the length increased by 25m to convey the Drain under the widened carriageway.

15.2.2 Two new culverts would be installed to convey the Drain under a side road to the south/upstream of the A14; CU219 (a 1.8m high by 1.8m wide box culvert) and a local access road to the north/downstream of the A14 (CU220 a 1.8m high by 2.1m wide box culvert). The culverts have been designed to convey the 1% (1 in 100) AEP plus an allowance for climate change peak flow of 2.01m^3/s. This was derived using the Flood Estimation Handbook statistical method (*Annex I*).

16 Longstanton Brook detailed assessment

16.1 Description and existing flood risk

16.1.1 Longstanton Brook is located towards the east of the scheme. The brook is an Award Drain, awarded to SCDC for maintenance. The watercourse originates to the south-west of Childerley, and flows north-east, passing Bar Hill and through Longstanton, prior to its confluence with Swavesey Drain near Cow Fen. The brook currently flows beneath the existing A14 to the north of Bar Hill (NGR: TL 3802 6419).

16.1.2 The published Flood Zone 3 extent indicates flooding upstream of Bar Hill and the A14 but peak water levels remain in-bank in the vicinity of the scheme and downstream.

16.1.3 The village of Longstanton has flooded on several occasions in 1993, 2001 and 2014 from both Longstanton Brook and surface water flooding.

16.1.4 A new hydraulic model of Longstanton Brook has been developed to estimate existing peak water levels and to test the impact of the scheme on flood risk. The existing (baseline) flood levels are summarised in *Table 16.1*. Details of the model build are included in *Annex D12*. The modelled flood extents indicate that flows remain in-bank throughout the study area up to and including the 1% AEP (1 in 100) plus climate change event, with the exception of a small area approximately 800m upstream of the scheme.

Table 16.1: Longstanton Brook existing condition modelled peak water levels

Location	Model node	Peak water level (mAOD)		
		5% AEP	1% AEP	1% AEP+ CC
260m upstream of proposed A14 culvert	LB1721	20.27	20.46	20.56
Immediately upstream of proposed upstream culvert	LB1513	19.28	19.47	19.57
Immediately upstream of proposed A14 culvert	LB1461	18.94	19.17	19.29
Immediately upstream of proposed downstream track crossing culvert	LB1434In3CP1	18.22	18.38	18.46
Immediately upstream of proposed downstream slipway crossing culvert	LB1434In4CP	18.12	18.28	18.36
300m downstream of proposed A14 culvert	LB1135	17.32	17.56	17.69

16.2 With-scheme flood risk

16.2.1 As part of the scheme Bar Hill junction is proposed to be upgraded. Three additional access roads are proposed to be introduced to the west of the junction, all of which would cross the Longstanton Brook. One crossing would be on the upstream side of the existing A14 and two downstream. To accommodate the access roads the existing 1.8m wideA14 box culvert (CU205) would be extended to a length of 57m. A new 1.8m width 6m long crossing would convey the brook under a local access road to the south/upstream of the A14. A new 1.8m high by 3m wide box culvert (CU234) and 1.8m width 10m long crossing would convey the brook beneath slip roads, north/downstream of the A14.

16.2.2 The with-scheme modelled water levels are included in *Table 16.2.*

Table 16.2: Longstanton Brook with-scheme condition – modelled water levels

Location	Model Node	Peak Water level (mAOD)	
		5% AEP	1% AEP
260m upstream of proposedA14 culvert	LB1721	20.27	20.46
Immediately upstream of proposed upstream culvert	LB1513	19.29	19.47
Immediately upstream of proposed A14 culvert	LB1461	18.94	19.17
Immediately upstream of proposed downstream track crossing culvert	LB1434In3CP1	18.19	18.36
Immediately upstream of proposed downstream slipway crossing culvert	LB1434In4CP	18.06	18.24
300m downstream of proposed A14 culvert	LB1135	17.32	17.56

16.2.3 The existing and with-scheme peak water levels have been compared in *Table 16.3* to present the impact of the scheme.

Table 16.3: Longstanton Brook relative change in peak water levels

Location	Model Node	Peak Water level (mAOD)	
		5% AEP	1% AEP
260m upstream of proposedA14 culvert	LB1721	0.00	0.00
Immediately upstream of proposed upstream culvert	LB1513	0.01	0.00
Immediately upstream of proposed A14 culvert	LB1461	0.00	0.00
Immediately upstream of proposed downstream track crossing culvert	LB1434In3CP1	-0.03	-0.02
Immediately upstream of proposed downstream slipway crossing culvert	LB1434In4CP	-0.06	-0.04
300m downstream of proposed A14 culvert	LB1135	0.00	0.00

16.2.4 *Table 16.3* indicates that peak water levels reduce immediately downstream of the scheme, and that there is negligible change along the remainder of Longstanton Brook, with levels at the upstream and downstream extents of the model unchanged from the baseline. As there is no out-of-bank flooding within the scheme extents, the scheme does not result in the loss of floodplain and consequently no mitigation measures are required.

16.3 Conclusion

16.3.1 As there is no loss of floodplain due to the scheme, and the only change in peak level flows is a minor localised reduction, the scheme's effect on flood risk on Longstanton Brook is considered to be neutral, as summarised in *Table 16.4.*

Table 16.4: Longstanton Brook summary

Importance	Flood Risk Issue(s)	Proposed Mitigation	Magnitude of impact	Significance of effect
High	None	None	Negligible	Neutral

17 Oakington Brook detailed assessment

17.1 Description and existing flood risk

17.1.1 Oakington Brook rises to the south-west of Dry Drayton where it flows north and east, through the east of Bar Hill prior to crossing the existing A14 at NGR: TL 3874 6369. Downstream of the A14 the brook is designated as Main River and flows eastwards through Oakington, prior to its confluence with Beck Brook (also known as Cottenham Lode) to the north-east of the village (NGR: TL 4188 6469).

17.1.2 The published Environment Agency Flood Zone map indicates a wide Flood Zone through Bar Hill upstream of the A14. It then continues as it crosses the A14 and then through the village of Oakington, located 2.5km downstream of the A14. The previous FRA referred to known flooding problems in the village.

17.1.3 The Environment Agency's historic flood map identifies flooding 1.8km north/downstream of the A14 in Oakington in May 1978 and October 2001.

17.1.4 The Environment Agency's Beck Brook model includes the Oakington Brook. This model has been updated as part of this study to assess the impact of the scheme. The changes made are described in the modelling report in *Annex D10*. The existing modelled peak flood levels are presented in *Table 17.1*.

17.1.5 The Environment Agency provided recorded water levels at their gauge located 1,650m downstream of the A14 crossing (NGR TL 40427 63872). This included three flood events used to calibrate and verify the new Oakington hydraulic model to increase its accuracy. Full details of the calibration process are included in *Annex D10*.

Table 17.1: Oakington Brook existing condition - peak water levels

Location	Model node	Peak water level (mAOD)		
		4% AEP	1% AEP	1% AEP + CC
715 m upstream of proposed A14	CH4400	21.57	22.39	22.79
231m upstream of proposed A14	CH3893	19.16	19.52	19.80
upstream of proposed A14	CH3635	17.88	18.62	19.18
downstream of proposed A14	CH3600	17.12	17.33	17.41
200m downstream of proposed A14	B3500	15.93	16.14	16.23

17.2 With-scheme flood risk

17.2.1 The A14 road footprint is proposed to be widened northwards (downstream) at the brook, requiring the extension of the existing culvert (CU206) by 6m. It would be 1.1m high by 1.3m wide, an extension of the existing dimensions. The scheme includes the construction of a new access road to the north/downstream of the A14, crossing Oakington Brook which requires a new box culvert (CU240) 40m long, 1.5m high and 1.8m wide.

17.2.2 The new culverts and the road embankment have been inserted into the existing scenario model to test the impact of the scheme on flood risk. The modelling results representing the with-scheme scenario are summarised in *Table 17.2*.

Table 17.2: Oakington Brook with-scheme condition –peak water levels

Location	Model node	Peak water level (mAOD)	
		4% AEP	1%AEP
715 m u/s of proposed A14	CH4400	21.57	22.39
231m u/s of proposed A14	CH3893	19.16	19.52
u/s of proposed A14	CH3635	17.88	18.63
d/s of proposed A14	CH3600	17.06	17.29
200 m d/s of proposed A14	OB3500	15.93	16.14

17.2.3 The with-scheme predicted water levels (*Table 17.2*) have been compared to the existing (*Table 17.1*) to assess the potential change in water level as a result of the scheme. The comparison is summarised in *Table 17.3*.

Table 17.3: Oakington Brook relative change in peak water levels

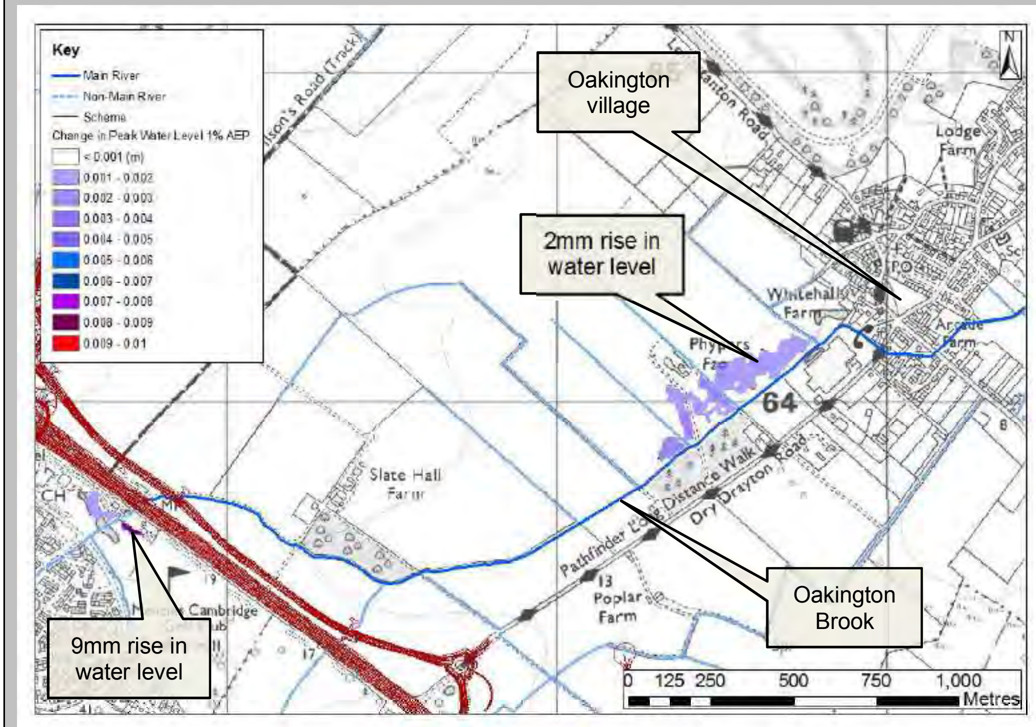
Location	Model node	Peak water level (mAOD)	
		4% AEP	1%AEP
715m upstream of proposed A14	CH4400	0.00	0.00
231m upstream of proposed A14	CH3893	0.00	0.00
Upstream of proposed A14	CH3635	0.00	0.01
Downstream of proposed A14	CH3600	-0.06	-0.04
200m downstream of proposed A14	OB3500	0.00	0.00

17.2.4 The change in peak water levels presented in *Table 17.3* indicates that the scheme would result in a small decrease in peak water levels a short distance downstream of the scheme.

17.2.5 The modelling does indicate that there is a very small increase in peak water levels immediately upstream of the A14 in the floodplain as indicated in Box 17.1. The rise does not affect property and is limited to the golf course. The peak water level rise on the western side of the brook is 1mm and on the right; 9mm for the 1% (1 in 100) AEP event. The majority of the area of predicted rise on the left bank is an existing lake and on the right a line of existing trees.

17.2.6 As there is no out-of-bank flooding that interacts with elements of the scheme, the scheme does not result in the loss of floodplain and consequently no mitigation measures are required.

Box 18.1: Change in peak water levels in Oakington Brook for the 1% (1 in 100 AEP event



17.2.7 Downstream of the A14 the model predicts a very small increase in peak water levels in the floodplain west of the watercourse. The peak level rise at this location as indicated in Box 17.1 is less than 2mm for the 1% (1 in 100) AEP event. This area of water level increase is open land and it does not affect property.

17.2.8 The hydraulic model predicts no change to existing flood extents and levels within the village of Oakington downstream of the A14 for all events.

17.3 Conclusion

17.3.1 The scheme results in a small reduction in peak water levels on the Oakington Brook immediately upstream and downstream of the scheme. There is a small rise in peak water levels upstream of the scheme in the floodplain, this rise is classified as neutral significance because it is less than 10mm for the 1% (1 in 100) AEP. The increase in peak water level downstream of the A14 is less than 2mm and would therefore also be classified as neutral significance. Neither rise in water level affects property.

17.3.2 The overall assessment of flood risk impact on Oakington Brook is considered negligible as the predicted rise in water levels is less than 10mm and does not affect property. Consequently the significance of the scheme's effect on flood risk has been classified as neutral, as summarised in *Table 17.4.*

Table 17.4: Oakington Brook summary

Importance	Flood Risk Issue(s)	Proposed Mitigation	Magnitude of impact	Significance of effect
Very High	Rise in flood levels	None	Negligible	Neutral

18 Beck Brook (Cottenham Lode) detailed assessment

18.1 Description and existing flood risk

18.1.1 Beck Brook (also known as the Cottenham Lode) is located to the eastern end of the scheme, close to Girton junction. The brook rises to the east of Dry Drayton, from where it flows east until it reaches the existing A14 (NGR: TL 4066 6221). Downstream of the A14, the Beck Brook is designated as a Main River and flows north-east towards the north of Girton, before flowing north-west to its confluence with Oakington Brook to the east of Oakington (NGR: TL 4190 6469).

18.1.2 The Environment Agency's published Flood Zone map (*Figure 17.2* in *Volume 2* of the *ES* and in *Annex B*) indicates flooding both upstream and downstream of the existing A14.

18.1.3 The Environment Agency's historic flood map identifies flooding downstream of the A14 in Girton in May 1978 and October 2001. Flooding also occurred in 2012 reaching property thresholds and again in 2014. The Environmental Statement includes a summary of information available at the time and subsequently additional information has been identified. It is understood through liaison with the Environment Agency that the causes of flooding in Girton are believed to be:

- Obstruction to flows due to service crossings upstream and downstream of Oakington road bridge (approximately 460m downstream of the confluence of the two brooks). It is understood that a scheme has been completed whereby the services have now all been relocated below the river bed at this location to aid flood flow conveyance through the bridge;
- Backing up of sewers and drains from the Beck Brook along Fairway at its confluence with the Washpit Brook;
- Water spilling over Dodford Lane into Fairway; and
- High water levels in the brooks may also cause backing-up of surface water sewers potentially exacerbating flooding.

18.1.4 The JBA/Environment Agency ISIS/TUFLOW 1D/2D Model (2013) has formed the basis of the model of the watercourse. Modifications made to this model are explained in *Annex D13*. The predicted existing peak water levels are summarised in *Table 18.1*.

Table 18.1: Beck Brook existing condition - modelled peak water levels

Location	Model node	Peak water level (mAOD)		
		5% AEP	1% AEP	1% AEP + CC
u/s boundary of model 680m u/s of proposed u/s culvert	BCK_1093	16.46	16.60	16.67
u/s of proposed u/s culvert	BCK_0412	14.01	14.08	14.12
228m u/s of proposed A14 culvert	BCK_0240d	13.42	13.51	13.56
45m u/s of proposed A14 culvert	BCK_0057d	12.96	13.08	13.17
u/s of proposed A14 culvert	BCK_0020d	12.65	12.88	13.06
u/s of proposed d/s culvert	BCK02_0388u	12.26	12.45	12.53
d/s of proposed d/s culvert	BCK02_0373d	12.24	12.44	12.50
188m d/s of proposed d/s culvert	BCK02_0185	12.12	12.32	12.38
d/s end of model 373m d/s of proposed d/s culvert	BCK02_0000	11.26	11.44	11.60

18.2 With-scheme flood risk

18.2.1 The existing A14 crossing of the Beck Brook would be widened. The existing 3m high by 3m wide A14 box culvert (CU306) would be extended in length by 12m to a total length of 51m. The access road to the south would require the construction of a new 3m wideculvert (CU305). A new bridleway would be constructed to the north of the A14 across the floodplain.

18.2.2 The extended and new culverts and the road embankments have been inserted into the existing model to test the impact of the scheme on flood risk. The predicted water levels under the with-scheme scenario are summarised in *Table 18.2*.

Table 18.2: Beck Brook with-scheme condition – modelled water levels

Location	Model node	Peak water level (mAOD)	
		5% AEP	1%AEP
u/s boundary of model 680m u/s of proposed u/s culvert	BCK_1093	16.46	16.60
u/s of proposed u/s culvert	BCK_0412	13.97	14.14
228m u/s of proposed A14 culvert	BCK_0240d	13.41	13.51
45m u/s of proposed A14 culvert	BCK_0057d	12.80	13.01
u/s of proposed A14 culvert	BCK_002d	12.60	12.83
u/s of proposed d/s culvert	BCK02_0388u	12.26	12.46
d/s of proposed d/s culvert	BCK02_0373d	12.23	12.44
188m d/s of proposed d/s culvert	BCK02_0185	12.10	12.33
d/s end of model 373m d/s of proposed d/s culvert	BCK02_0000	11.25	11.45

18.2.3 The with-scheme predicted water levels (*Table 18.2*) have been compared to the existing (*Table 18.1*) to assess the potential change in water level as a result of the scheme. The comparison is summarised in *Table 18.3*.

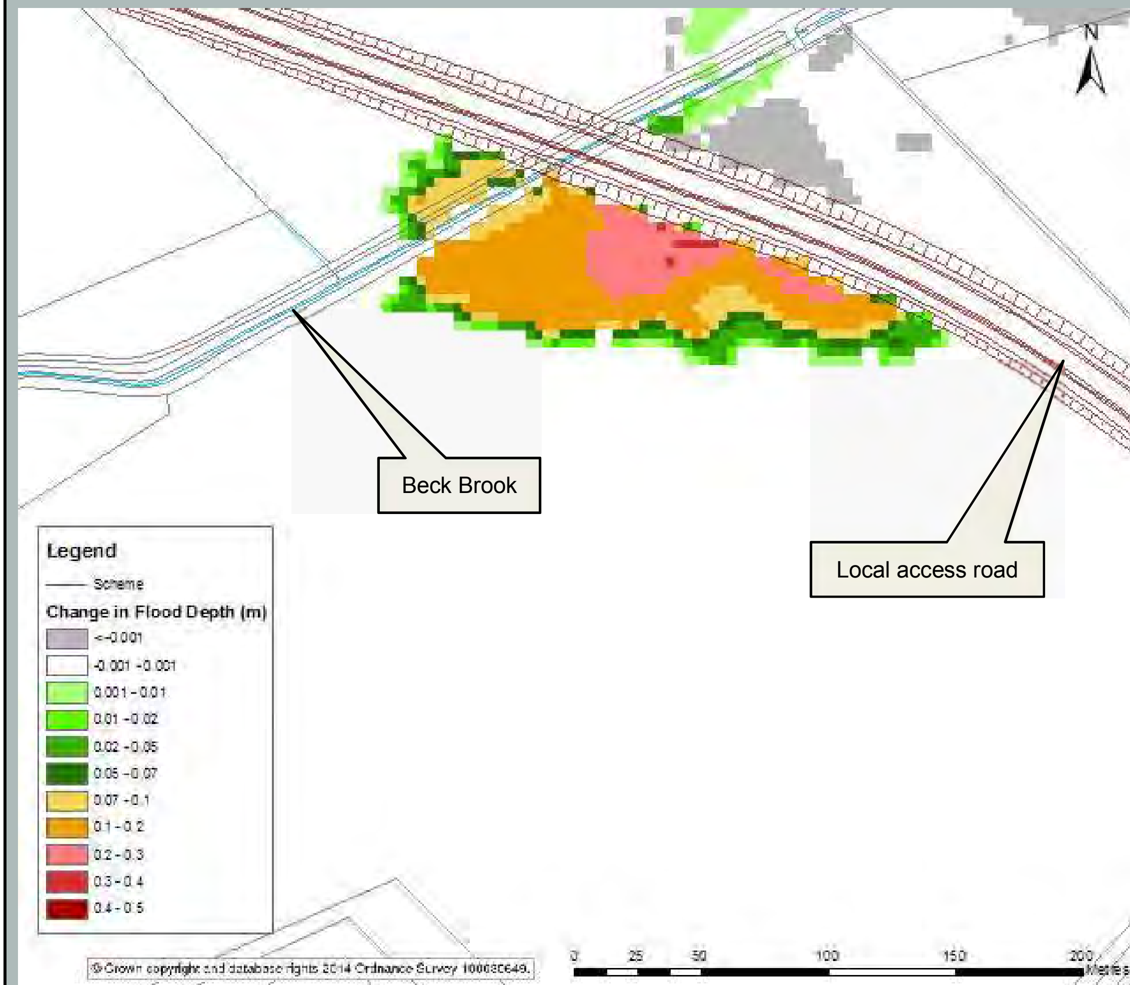
Table 18.3: Beck Brook relative change in peak water levels

Location	Model node	Peak water level (mAOD)	
		5% AEP	1%AEP
u/s end of model 680m u/s of proposed u/s culvert	BCK_1093	0.00	0.00
u/s of proposed u/s culvert	BCK_0412	-0.04	0.06
228m u/s of proposed A14 culvert	BCK_0240d	-0.01	0.00
45m u/s of proposed A14 culvert	BCK_0057d	-0.16	-0.07
u/s of proposed A14 culvert	BCK_0020d	-0.05	-0.05
u/s of proposed d/s culvert	BCK02_0388u	0.00	0.01
d/s of proposed d/s culvert	BCK02_0373d	-0.01	0.00
188m d/s of proposed d/s culvert	BCK02_0185	-0.02	0.01
d/s end of model 373m d/s of proposed d/s culvert	BCK02_0000	-0.01	0.01

18.2.4 The change in peak water levels presented in *Table 18.3* indicates that the scheme would result in an increase in peak water levels downstream of the scheme in the 1% (1 in 100) AEP event less than 10mm.

18.2.5 Immediately upstream of the local access road to the south of the main A14 carriageway the scheme would induce an increase in peak water levels of 0.3m in the 1% (1 in 100) AEP event because the local access road embankment constricts the flow across the floodplain. The location of this increase is indicated in *Box 18.1*.

Box 18.1: Beck Brook with-scheme change in 1% AEP water levels



18.3 Proposed mitigation

18.3.1 To mitigate for the loss of floodplain as a result of the scheme it is proposed to introduce level-for-level floodplain compensation. One floodplain compensation area is proposed upstream of the main A14 carriageway, as close as practicable to the area of loss.

18.3.2 The location of the areas of floodplain loss and compensation are indicated in *Annex N Figure 18*. A schedule of the floodplain compensation areas is included in *Table 18.4.*

Table 18.4: Beck Brook floodplain compensation summary

Watercourse	Loss volume (m^3)	Design flood level (mAOD)	Min. loss level (mAOD)	Compensation area ref	Max. level (mAOD)	Min. level (mAOD)
Beck Brook	761	14.03	12.32	FpC30	14.03	12.32

18.3.3 The detailed calculations are included for each area of floodplain loss and each floodplain compensation area in *Annex F*.

18.3.4 There is an increase in flood risk to an area upstream/south of the local access road caused by the scheme. This is due to the local access road embankment cutting across existing floodplain restricting the conveyance of flow. This results in flood water building up against the road embankment, creating an increase in water levels. There is no property within the area with increased flood risk. Following consultation with the Environment Agency, Highways England has obtained written acknowledgement of the change in predicted peak water levels as documented in *Annex Q*.

18.4 Conclusion

18.4.1 The magnitude of the impact of the scheme has been assessed as major adverse because the rise in water level on the Beck Brook is greater than 100mm for the 1% (1 in 100) AEP event. The significance of the effect of the scheme on flood risk has been assessed as slight adverse because the area of increased flood risk does not include property and the increase in peak water levels on the Beck Brook downstream of the scheme is less than 10mm for the 1% (1 in 100) AEP event. Floodplain compensation is proposed to mitigate for the loss of floodplain, as summarised in *Table 18.3*.

Table 18.3: Beck Brook summary

Importance	Flood Risk Issue(s)	Proposed Mitigation	Magnitude of impact	Significance of effect
Low	Loss of floodplain	Floodplain compensation	Major Adverse	Slight adverse

19 Washpit Brook detailed assessment

19.1 Description and existing flood risk

19.1.1 Washpit Brook would pass under the scheme at Girton junction (NGR: TL 4157 6152). The brook is classified as an Award Drain (awarded to SCDC) from its source near the A1303 at High Cross, from where it flows north beneath the A428, the proposed A14 access road and then the new A14. Downstream of the A14 the brook is designated as a Main River and flows north prior to its confluence with the Beck Brook (also known as Cottenham Lode) to the north-west of Girton (NGR: TL 4200 6270).

19.1.2 The published Environment Agency Flood Zone map indicates a wide (160m) area of floodplain downstream of the existing A14.

19.1.3 The Environment Agency's historic flood map identifies flooding downstream of the A14 in Girton in May 1978 and October 2001.

19.1.4 The hydraulic model of the Washpit Brook extends less than 50m upstream of the existing A14 and is therefore not deemed appropriate for assessing the potential impact of the scheme on the brook. The Washpit Brook peak water levels provided by the Environment Agency for the *2009 FRA* (Highways Agency, 2009a) have been used, and are summarised in *Table 19.1*.

Table 19.1: Washpit Brook existing condition – modelled 1% AEP peak water levels

Location Description	Location (NGR)	Peak water level (mAOD)
Approximately 50m downstream of existing A1307	TL 41584 61566	10.50
Approximately 65m downstream of existing A1307	TL 41588 61591	11.14
Approximately 300m downstream of existing A1307	TL 41609 61829	11.13

19.2 With-scheme flood risk

19.2.1 The A14 footprint remains unchanged in this area with the only potential impact on the Washpit Brook being the construction of a bridleway on an embankment to the north-east of the A14 within Flood Zone 3.

19.3 Proposed mitigation

19.3.1 In the absence of a hydraulic model it is proposed to provide level-for-level floodplain compensation to mitigate for the loss of floodplain up to the 1% (1 in 100) AEP design water level. The *2009 FRA* (Highways Agency, 2009a) did not include an allowance for climate change and this has been established from the existing hydraulic model. The assessment includes the change in peak water level between 1% (1 in 100) AEP and the 1% (1 in 100) AEP plus an allowance for climate change is 0.07m. The design floodplain compensation water level is consequently 11.21m AOD.

19.3.2 The location of the areas of floodplain loss and proposed compensation are indicated in *Annex N Figure 19*. A schedule of the floodplain compensation areas is included in *Table 19.2*.

Table 19.2: Washpit Brook floodplain compensation summary

Watercourse	Loss volume	Design flood level	Min. loss level	Compensation area ref	Max. level	Min. level
	(m^3)	(mAOD)	(mAOD)		(mAOD)	(mAOD)
Washpit Brook	753	11.21	9.17	FpC28	11.24	9.17

19.3.3 The detailed calculations are included for each area of floodplain loss and each floodplain compensation area in *Annex F*.

19.4 Conclusion

19.4.1 As a result of the provision of floodplain compensation and culverts that maintain existing watercourse capacity, the magnitude of the impact of the scheme has been assessed as negligible. Consequently the scheme has a neutral effect upon flood risk on Washpit Brook as summarised in *Table 19.3*.

Table 19.3: Washpit Brook summary

Importance	Flood Risk Issue(s)	Proposed Mitigation	Magnitude of impact	Significance of effect
Low	Loss of floodplain	Floodplain compensation	Negligible	Neutral

20 First Public Drain, Awards north of Cambridge and the river Cam detailed assessment

20.1 Description and existing flood risk

20.1.1 There are a number of Award watercourses including the First Public Drain to the north of Cambridge between Girton and the river Cam. These fall under the jurisdiction of SCDC and CCC for maintenance. The previous scheme extended to the river Cam however the scheme footprint has now been reduced and does not cross any areas within Flood Zones 2 and 3 between Girton and the end of the scheme at Milton Junction. Therefore no further detailed assessment of flood risk has been undertaken.

21 Surface water flood risk

21.1 Existing flood risk

21.1.1 A review of the Environment Agency's updated Flood Map for Surface Water (uFMfSW) (Environment Agency, undated-a) indicates that the existing A14 is not at risk from surface water flooding. The extent of flood risk follows the river valleys as defined by Flood Zone 3. As the existing A14 carriageway is on embankment, raised approximately 1m above the floodplain, it is not anticipated that the road would be at risk of surface water flooding.

21.1.2 The Great Ouse CFMP (Environment Agency, 2011) does not list any areas within the scheme footprint as being at risk of surface water flooding.

21.1.3 A length of the existing A1 adjacent to the Cock Brook south of Alconbury is identified as at 'Low' surface water flood risk. However, liaison with the local IDB and Highway England has not identified any records of flooding at this location.

21.1.4 A review of the Girton SWMP (Hyder, 2012) and Cambridge and Milton SWMP (Hyder, 2011b) developed by the Cambridgeshire Flood Risk Management Partnership does not identify any areas of the scheme that are at risk of surface water flooding beyond that identified in the uFMfSW (which is available from the Environment Agency).

21.2 With-scheme flood risk

21.2.1 A review of the Environment Agency's *uFMfSW* has identified a series of locations that could intercept overland flow paths outside Flood Zone 3. Those within Flood Zone 3 are deemed to be accounted for via the detailed assessment of each watercourse. Plans of these locations are included in *Annex J*.

Cock Brook

21.2.2 The *uFMfSW* identifies an overland flow path flowing north-eastwards towards the existing A1 (NGR TL 1891 7383). It appears that this drains to the Cock Brook. The bridge over the brook would not be affected by the A1 widening works and therefore the scheme would not restrict this flow path.

East Coast mainline railway

21.2.3 A flow path travels westwards towards the East Coast mainline railway embankment north of the new A14 and then flows southwards to a drain which is culverted (TL 2204 6790) through an embankment before outfalling to the river Great Ouse. The scheme proposes drains to intercept field runoff and convey it through the road embankment towards the culvert under the East Coast mainline, maintaining the existing flow path.

Debden Top Farm

21.2.4 Two ditches convey two overland flow paths northwards. Both would be crossed by the scheme. Culverts would be provided at these crossings (NGR: TL 2484 6784 and TL 2521 6777) and sized to convey the 1% (1 in 100) AEP plus an allowance for climate change peak flow, ensuring no change to the identified flow path.

Huntingdonshire District Council Award Drain

21.2.5 The scheme crosses the Huntingdonshire Award Drain as it flows eastwards towards the West Brook. This has been included in the West Brook hydraulic model (*Section 11*). Therefore the scheme would mitigate for the potential detrimental impact upon flood risk via the provision of floodplain compensation (*Section 11.3*). Additionally the scheme would not alter the course of the current predicted flow path via the provision of culverts through the A14 embankment sized for the 1% (1 in 100) AEP plus an allowance for climate change peak flow.

Conington Road Bridge

21.2.6 The *uFMfSW* identifies two overland flow paths that the scheme would cross, approximately 170m west and 0.5km east of the Conington Road bridge (NGR: Tl 3159 6742 and TL 3221 6731 respectively). Existing drains at the crossing locations would be culverted, enabling the flow paths to continue to exist (through the embankment). The culverts would be sized to convey the 1% (1 in 100) AEP plus an allowance for climate change peak flow.

22 Groundwater flood risk

22.1 Existing flood risk

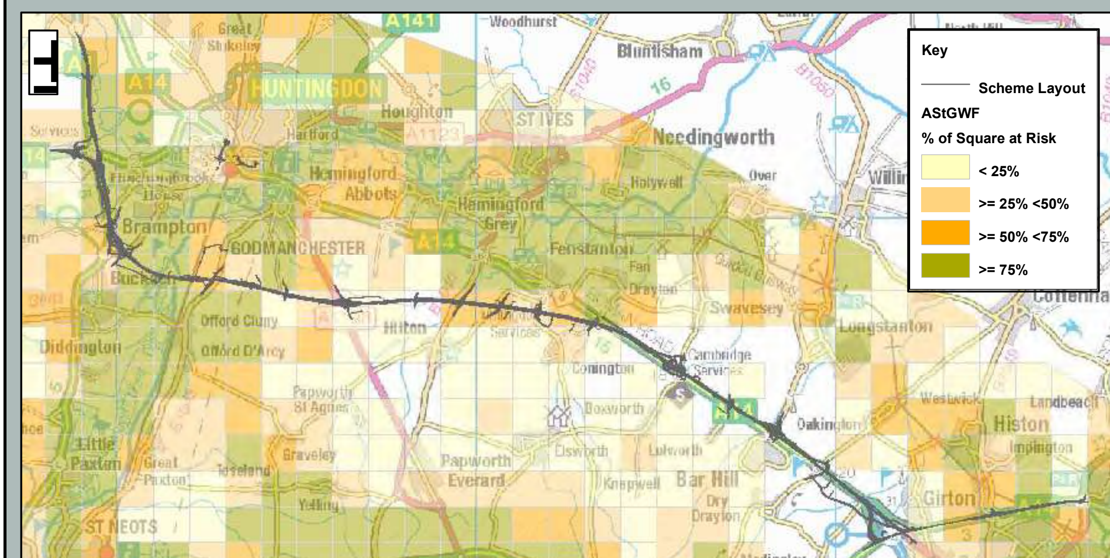
22.1.1 The SCDC/CCC SFRA (WSP, 2010) includes records of groundwater flooding on maps but there are no instances of flooding recorded in the vicinity of the scheme.

22.1.2 The HDC SFRA (Mott MacDonald, 2010) states that an assessment of groundwater flood risk would be undertaken in a separate report. This separate report is not currently available.

22.1.3 The Great Ouse CFMP (Environment Agency, 2011) does not list any areas within the scheme footprint as being at potential risk from groundwater flooding.

22.1.4 A review of the Environment Agency's Areas Susceptible to Groundwater Flooding (AStGWF) map (Environment Agency, undated-b) indicates the highest risk to be towards the west of the scheme, see *Box 22.1*.

Box 22.1: Areas susceptible to groundwater flooding



Source: Environment Agency 2014

22.1.5 Groundwater level information was available from the 2009 and 2011 monitoring phases of the scheme, comprising 116 observation boreholes across the project area. These data were limited to two rounds of readings. In addition, logging data was recorded at some selected locations, albeit some of the logged levels seem to have had calibration depth issues. A more extensive groundwater level monitoring dataset is available in the vicinity of the A1 at six boreholes, taken at approximately monthly intervals between 2002 and 2014.

22.1.6 Overall, the dataset available confirms the presence of shallow groundwater beneath the scheme within drift deposits. Groundwater levels were found to range from 0.2m below ground level (mBGL) to 4.8mBGL, with the average level being 1.6mbgl. The long term dataset from the A1 area shows an overall range of variation in groundwater levels of up to 2m, with short term, season to season variation of up to 1.8m at some boreholes.

22.1.7 The general shallow groundwater flow direction is expected to be in line with the topography and therefore generally south to north, with local variation around areas of higher ground and the river Great Ouse.

22.2 With-scheme flood risk

22.2.1 With reference to *Section 22.1* the SFRAs did not identify any records of groundwater flooding in the vicinity of the scheme.

22.2.2 Excavations are proposed across the scheme to provide material for the highway embankment. These borrow pits are illustrated in the watercourse plans comprising *Annex N*. It is proposed to retain these areas for amenity and recreation purposes and if excavated below the local groundwater level they would fill with water. Where borrow pits have also been designated as Floodplain Compensation Areas (parts of Borrow Pits 1 and 2), it is anticipated that there may be seasonal variations in groundwater levels that could result in groundwater spilling from the borrow pits. As the flow route taken will be via the floodplain compensation area spillway and into the receiving watercourse, it is not envisaged that this will result in any increase in groundwater flood risk.

22.2.3 *Section 4.113* of the *2009 FRA* (Highways Agency, 2009a) did allude to a potential risk of groundwater seepage from non-aquifer clay soils. This appears to be mainly restricted to the new offline A14 section which would be constructed on embankment. Therefore the flood risk is considered to be low. This risk would be investigated further at the detailed design phase and if required cut-off drains introduced to intercept seepage. The *2009 FRA* also suggested that the seepage is only likely to be experienced during construction as the groundwater is likely to be perched.

22.2.4 There is a length of new carriageway in cutting to the east of the river Great Ouse crossing. Groundwater investigations are ongoing. If groundwater is found to be a risk in this location, drainage would be introduced to keep the seepage away from the carriageway and to convey it safely to the receiving watercourse.

22.2.5 The scheme would mostly be constructed either on or above existing ground levels. Given the low risk of groundwater flooding in the existing condition it is not anticipated that the proposals would have an adverse effect on the risk of groundwater flooding.

22.2.6 Piling would be required where bridges are proposed (Ellington, Great Ouse and West Brook). However, these piles would not introduce a solid barrier to groundwater flows and therefore would not impact on the degree of flood risk.

23 Other sources of flood risk

23.1 Sewer flooding

Existing flood risk

23.1.1 The sewerage undertaker in the vicinity of the scheme is Anglian Water. The 2009 FRA (Highways Agency, 2009a) presented the outcome of consultation with Anglian Water which confirmed there were no recorded incidents or known flood risk from the Anglian Water sewerage system. Underground public sewerage asset utility plans provided by Anglian Water (for the 2009 FRA) are included within *Annex K.*

23.1.2 The SCDC/CCC SFRA (WSP, 2010) identifies three instances of sewer flooding in the vicinity of the Girton Interchange, but no further details were available.

23.1.3 For the 2009 FRA Anglian Water confirmed that there were no DG5 properties in the vicinity of the scheme.

With-scheme flood risk

23.1.4 Discharges from the scheme would not be to public sewer, consequently it is believed the scheme would not impact upon existing levels of flood risk from sewers.

23.2 Risk of dam failure

Existing flood risk

23.2.1 An extract of the published plan of risk of flooding from reservoirs obtained from the Environment Agency website is included as *Box 23.1*.

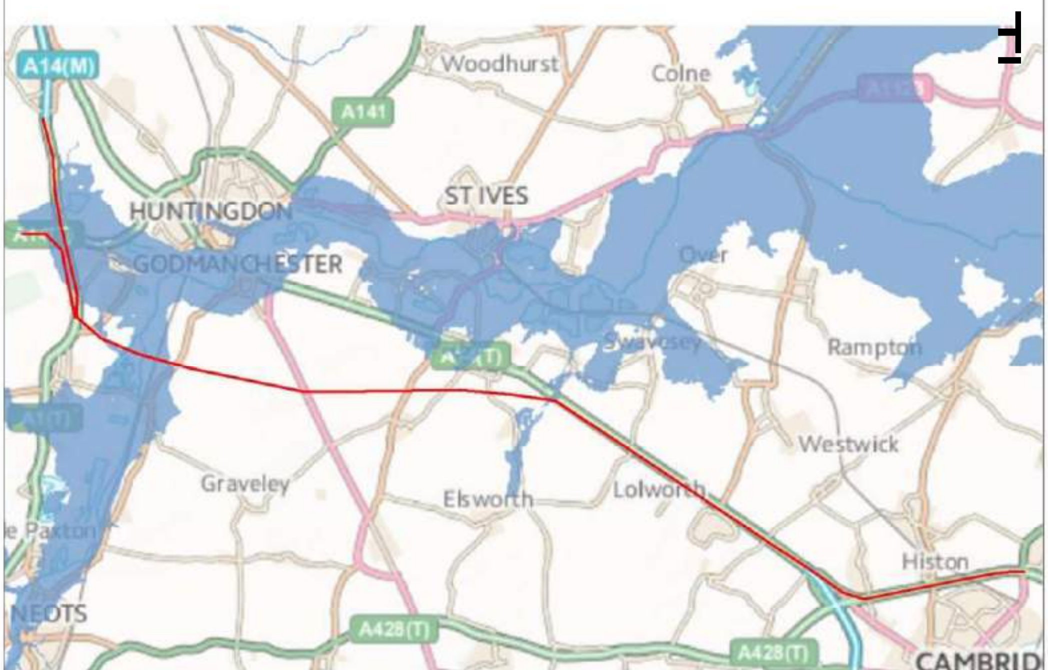
23.2.2 *Box 23.1* indicates that part of the new A14 Huntingdon southern bypass and the existing A1 and A14 to the west of Huntingdon are at risk of flooding should the Grafham Water dam (located to the south-west of Huntingdon) fail. Floodwater would follow the route of the Great Ouse valley, northwards towards Huntingdon and then eastwards north of the existing A14.

23.2.3 Although the consequences of flooding from failure of the Grafham Water dam are potentially high, due to the inspection regime for the reservoir the overall probability of failure is considered to be very low and not a factor to preclude development.

With-scheme flood risk

23.2.4 The risk of flooding from reservoirs due to dam failure is very low throughout the UK. The scheme would have no impact upon this source of flood risk.

Box 23.1: Risk of reservoir flooding map extract



23.3 Failure of flood defence infrastructure

Existing flood risk

23.3.1 No formal defences exist within the study area that would potentially impact on the scheme.

With-scheme flood risk

23.3.2 The scheme is not located within an Area Benefitting from Defences as defined by the Environment Agency. Therefore, a flood defence failure would not place the road at risk of flooding.

23.4 Temporary works

23.4.1 The details of the temporary works would be developed by the future scheme contractor however there are elements of the scheme that have been determined and would take the following approach:

- The location of site compounds will be confirmed during the detailed design phase as recorded in the Statement of Common Ground between the Environment Agency and Highways England. The location of site compounds will take into account the concerns of the

Environment Agency raised through their representations to the Examining Authority;

- FpC areas would be constructed ahead of any works which would cause loss of floodplain storage capacity;
- the requirement for temporary watercourse crossings and temporary culverts would be agreed with the relevant drainage authority prior to commencement of the works, this has been agreed through protective provisions as documented in a Statement of Common ground between Highways England and the Environment Agency;
- there is no requirement to store soil within Flood Zone 3 (1% AEP); and
- the temporary storage of soil within Flood Zone 2 will be developed in such a way as to not form a barrier to flow paths and the soil stored in a way so as to permit the free passage of water between them in accordance with EA requirements.

23.5 Flood warning and safe access

23.5.1 *DMRB HD 45/09* (Highways Agency et al., 2009) requires that the scheme remains operational and safe for users in times of flood (*Section 1.8.2*). To assess this a comparison between the scheme carriageway level and that of the 1% (1 in 100) AEP peak flood level of each watercourse has been undertaken. The results are summarised in *Table 23.1*.

Table 23.1: Comparison of peak flood and carriageway levels

Watercourse	Road Level (mAOD)	1% AEP Event		1% + CC AEP Event	
		Flood Level (mAOD)	Freeboard (m)	Flood Level (mAOD)	Freeboard (m)
Cock Brook	15.3	13.96	1.34	14.08	1.22
Ellington Brook – A1	20.8	12.63	8.17	12.68	8.12
Ellington Brook – A14	15.37	13.19	2.18	13.21	2.16
Brampton Brook (A1)	13.1	10.89	2.21	10.93	2.17
Brampton Brook (A14)	11.5	10.63	0.87	10.66	0.84
Grafham Road Drain	17.23	15.78	1.45	15.87	1.36
IDB Drain No.1	15.65	11.58	4.07	11.73	3.92
Great Ouse	17.48	11.58	5.9	11.73	5.75
West Brook	10.74	8.51	2.23	8.58	2.16
Hunts Award Drain	10.74	8.43	2.31	8.49	2.25
Hilton Road Drain	10.74	7.59	3.15	7.74	3.00
Oxholme Drain	11.76	8.94	2.82	9.01	2.75
Covell's Drain	12.41	8.56	3.85	8.73	3.68
Utton's Drove Drain	14.18	12.77	1.41	12.92	1.26
Longstanton Brook	20.62	19.17	1.45	19.29	1.33
Oakington Brook	18.93	18.60	0.33	19.18	- 0.25
Beck Brook	14.4	12.84	1.56	13	1.4
Washpit Brook	14	11.14	2.86	11.21	2.79

23.5.2 Based on the best available information all watercourses have a peak 1% AEP water level below the carriageway level.

23.5.3 The NPS requires that the road be safe for users for its lifetime, *Table 23.1* indicates that at one location (Oakington Brook) the lowest carriageway level is below the predicted peak water level for the 1% (1 in 100) AEP plus climate change event.

23.5.4 At Oakington Brook it is proposed to widen the existing A14 northwards (downstream). The existing A14 culvert places a constriction on the flow and hydraulic modelling demonstrates that peak 1% (1 in 100) AEP plus climate change water levels fall by approximately 1.8m from south to north (upstream to downstream), consequently the new carriageway will not be at risk of flooding under such an event. The southern carriageway levels are such that the extent of road predicted to be affected is approximately 150m long by at most 5m wide. At this location the road will comprise four lanes in each direction therefore at least two lanes will remain free of standing water during such an extreme flood event and safe for users during a flood event.

23.5.5 There are measures that could be introduced at a later date through an adaptive strategy to prevent flooding under such an event such as:

- A wall or bund to prevent flood water reaching the carriageway;
- Identification of a temporary bypass route for traffic to avoid the affected stretch of road;
- Raising of the road within the limits of deviation permitted by the Development Consent Order; or
- Emergency pumping facilities.

24 Scheme surface water drainage

24.1 Existing surface water drainage

24.1.1 Information on the existing drainage network appears to be limited. This section provides a summary of how the existing carriageway is drained.

A1 drainage network

24.1.2 The existing A1 drainage appears to consist of a combination of edge channel drains and filter drains discharging into ditches. The ditches then discharge into the various local watercourses. The number of outfalls to the watercourses is unknown.

24.1.3 There is an existing drainage pond immediately south of the Alconbury Junction on the east side of the A1 but there is no information to confirm its' drainage catchment. A site visit has confirmed its inlet and outlet and therefore it is assumed runoff is not infiltrated to ground.

A14 drainage network

24.1.4 Information on current drainage on the existing A14 is based on as-built drainage drawings from 1977 and survey/condition information. Certain sections of mainline drainage have been updated over the years to accommodate lay-bys etc. and some junction configurations have changed so associated drainage updates are unknown.

24.1.5 The existing A14 drainage consists predominantly of informal over the edge drainage to ditch or filter drains. Localised kerbed sections of highway around laybys and junctions include gullies which outfall directly to side ditches. Outflow from the existing mainline A14 highway drainage is generally un-attenuated. An element of storage is provided within widened storage ditches alongside the A14, but these volumes have not been quantified.

24.1.6 Some attenuation of flows is provided on the existing drainage system around junctions. At Junction 28 (Bar Hill Junction) a storage pond is located within the northern junction loop. At Junction 30 (Dry Drayton Junction) there are two attenuation ponds located within the loops of the junction. The degree of attenuation and their outfall route is unknown at this stage.

Cambridge Northern Bypass

24.1.7 Information on the existing drainage for the Cambridge northern bypass is very limited. The majority of this information has been collected from aerial images available on the internet. Some information has been obtained from Highways England but this is very limited and of doubtful accuracy because of the age of the information and subsequent road improvement works for which no records are available. No information is available for existing drainage at side roads and slip roads.

24.1.8 The Girton Interchange junctions are drained by kerbs and gullies. The A14 south/eastbound direction link at Girton Interchange appears to have over the edge drainage only, until it meets the main A14 carriageway. The existing A14 seems to be mainly kerb and gully drainage with sections of over the edge drainage towards Milton Junction.

24.1.9 The A428 west of the M11 underbridge is a balanced dual carriageway with a system of kerbs and gullies and also linear channel drainage. Drainage on the A428 east of the M11 underbridge is principally over the edge.

24.1.10 The M11 seems to be drained entirely by kerbs and gullies within the scheme area.

24.1.11 Runoff from the existing highway on all roads within this area is assumed to be un-attenuated with the exception of some carriageway in the proximity of an existing pond (NGR: TL 4143 6150) between Huntingdon Road and the south/eastbound A14 carriageway. This pond would be abandoned due to a new link road (as part of the scheme) passing over it and would be replaced by a larger attenuation and treatment pond immediately to the north.

24.2 With-scheme surface water drainage

24.2.1 The new road surface and widening of existing carriageways would result in an increase of impermeable area and consequently volumetric runoff for any given flood. Without mitigation this would result in an increase in peak discharge rates, potentially affecting the flood risk to downstream receptors. Therefore, the proposed surface water drainage system would mitigate these effects by limiting peak outflows and providing attenuation storage to achieve this.

24.2.2 The scheme includes mitigation for the additional runoff that would result from the additional impermeable area. The new surface water drainage system would attenuate runoff to greenfield rates. The discharge from any additional impermeable areas (up to the 1% (1 in 100) AEP storm event plus a 20% allowance for climate change) are to be attenuated to the greenfield runoff rate up to the 1% (1 in 100) AEP critical duration storm. The greenfield runoff rates developed for the scheme and included in the 2009 FRA (Highways Agency, 2009a) have been used and are detailed in *Table 24.1*.

Table 24.1: Greenfield runoff rates

Location	100% AEP* (l/s/ha)	0.3% AEP (l/s/ha)	0.13% AEP (l/s/ha)	1% AEP (l/s/ha)
Ellington Road to Offord Road	3.6	10.0	13.2	14.8
Offord Road to Girton Road	3.4	9.5	12.6	14.0
Girton Road to Fen Ditton	4.4	12.2	16.4	18.1

**Please note: the 100% AEP equates to a 1 in 1 year probability flood event. It does not imply that an event is certain to occur in any one year.*

24.2.3 Limited information exists concerning the capacity, discharge rate and catchment areas of existing attenuation ponds. Consequently the methodologies and proposed flow control for all balancing ponds (set out in the *2009 FRA* (Highways Agency, 2009a) have been re-adopted (*Annex A*). This approach has been agreed in principle with the Environment Agency. The proposed discharge rates and flow control levels from the attenuation ponds would be as follows:

- 100% (1 in 1) AEP discharge rate – to match existing paved area 100% (1 in 1) AEP discharge rate plus 100% (1 in 1) AEP greenfield runoff rate for new paved areas when discharging to the same point;
- 20% (1 in 5) AEP level – to match existing paved area 20% (1 in 5) AEP discharge plus 20% (1 in 5) AEP greenfield runoff rate for new additional paved areas; and
- 1% (1 in 100) AEP plus 20% climate change level – to match existing paved area 1% AEP discharge plus 1% (1 in 100) AEP greenfield runoff rate for new additional paved areas.

24.2.4 The outflow from the ponds would be limited by the provision of a vortex control device with a suitable rating curve or a series of orifice plates would be installed in the outlet structure to limit the outflows to the prescribed rates listed above. The details of these structures would be developed during later design phases.

24.2.5 In locations where complex flow control devices would not be practicable then a single discharge rate would be used. As per previous Environment Agency requirements this would be limited to the 100% (1 in 1) AEP greenfield runoff rate for new additional paved areas and the 100% (1 in 1) AEP discharge for the existing paved areas.

24.2.6 The attenuation ponds have been designed to accommodate the 1% (1 in 100) AEP critical storm plus a 20% allowance for climate change. A schedule of all proposed ponds with the total impermeable area draining to them is located in *Annex I*. The swales and ponds would be lined to prevent infiltration of potentially contaminated runoff.

24.2.7 The general surface water drainage principles for the trunk roads (A14 and A1) are to collect surface water via a drainage channel located in the verge or central reserve and then convey the water to attenuation ponds prior to discharging to watercourses. In some areas the attenuation could be provided fully or partly within the conveyance system i.e. online storage. This online storage would similarly be designed to accommodate the 1% (1 in 100) AEP critical storm duration plus a 20% allowance for climate change.

24.2.8 Land drainage ditches would be installed at the toe of embankments to intercept flows from highway earthworks and overland flows. Ditches would also be installed at the top of highway cutting slopes to intercept overland flows before they reach the highway drainage system.

24.2.9 The existing surface water drainage systems on CambsCC (the local highway authority) roads are predominantly simple over the edge drainage into ditches. For these county roads proposed to be diverted or re-aligned the surface water drainage would replicate the existing drainage. It would be collected by gullies and conveyed to a drainage ditch. Connectivity of existing drainage ditches would be maintained.

24.2.10 The existing storage pond at the Bar Hill Junction is understood to provide floodplain compensation for a previous development at Bar Hill. The pond is managed by Bar Hill Parish Council and is located within the new southern loop of the junction. It would be retained but amended to suit the scheme highway earthworks. Additional storage could be provided in an attenuation pond located to the west of the junction if required, with both connected to the Longstanton Brook. The total storage volume of the pond(s) would be the same as the existing pond to retain the status quo. All existing local drainage utilising the existing pond would be accommodated. The pond would not receive any additional road drainage and therefore the future maintenance of the pond would remain solely with Bar Hill Parish Council.

24.2.11 All surface water management systems would be maintained to ensure that they were operating as designed for the design life of the scheme. All balancing ponds (except the Bar Hill ponds which would remain as Bar Hill Parish Council's responsibility) would be expected to be adopted and maintained by the relevant highway authority. This would also be the case for all culverts and bridge structures (including extensions of existing structures) under the new A14.

24.2.12 All maintenance activities would be undertaken in line with the Highways England Asset Maintenance and Operational Requirements. The specific road maintenance manual for the A14 would be issued for comment in due course.

Huntingdon town centre

24.2.13 The scheme in Huntingdon town centre consists of the removal of the existing A14 viaduct (NGR TL 2318 7188) and modifications to the local road network to accommodate this. The existing impermeable area of the viaduct which would be removed is 2.78 ha. The total proposed new impermeable area (primarily the local access roads) is 2.35ha. Therefore there would be an overall reduction in impermeable area of 0.43ha in this region of the scheme. A new single carriageway road would be constructed across Mill Common on the line of the existing A14, but at a lower level. This would connect to Brampton Road. A new single carriageway road would be constructed across Views Common (between Hinchingbrooke Hospital and Cambridgeshire Constabulary HQ) to provide a connection from the existing local roads and the existing A14 that would remain in place on the north side of the demolished viaduct.

24.2.14 The surface water runoff from the new road across Views Common would be attenuated in ponds at the northern and southern ends. The pond at the north of the new road would discharge into the existing A14 highway drainage. The pond to the south of the new road would discharge into Alconbury Brook either utilising or following the route of existing road drainage. The outflow from these two ponds would be attenuated to greenfield rates.

25 Sequential and Exception Test

25.1 The Sequential Test

25.1.1 The *NPPF* (DCLG, 2012a) includes the Sequential Test which aims to ensure that new development is steered away from the area of highest flood risk (Flood Zone 3) towards the lowest (Flood Zone 1). The Sequential Test takes into account vulnerability to flooding of the development and stipulates what is appropriate in each flood risk zone. *Table 2* of the *PPG* (DCLG, 2012b) classifies the vulnerability to flooding of types of development and *Table 3* of the *PPG* classifies whether the development is appropriate for each Flood Zone or whether the Exception Test needs to be applied for the development to progress.

25.2 Application of the Sequential Test

25.2.1 The scheme is located within all Flood Zones: 1, 2, 3a and 3b.

25.2.2 In terms of flood risk vulnerability the scheme is classified as 'Essential Infrastructure'. Therefore the development is appropriate in Flood Zones 1 and 2 but the Exception Test is required for Flood Zones 3a and 3b.

25.3 The Exception Test

25.3.1 If a development is proposed that is not 'appropriate' as defined in *Table 3* of the *PPG*, the Exception Test, as defined, is a method to demonstrate and help ensure that flood risk to people and property is managed satisfactorily, whilst allowing certain types of necessary development to progress in situations where suitable sites at lower risk of flooding are not available.

25.3.2 Both of the following elements need to be achieved for the Exception Test to be passed:

- it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared; and
- a site-specific flood risk assessment must demonstrate that the development would be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, reducing flood risk overall. [NB: the design-life for this scheme has been taken to be 100 years for the purposes of determining an allowance for climate change.]

25.3.3 The purpose of this FRA is to demonstrate compliance with point two of *Section 25.3.2*. The first bullet point has been addressed in the planning/Highways Act application and *Chapter 4* of the *ES*. Compliance with sustainability aspects of the NPS and a commentary on the environmental benefits of the scheme is provided in The Case for the Scheme update submitted at Deadline 9, (ref: HE/A14/EX/144).

25.4 Application of the Exception Test

25.4.1 Due to the linear nature of the scheme and the essential requirement that it runs parallel with the existing A14 the road cannot be relocated to avoid the areas of highest flood risk. Highways England has been through a lengthy options stage and has considered all environmental impacts and constraints.

25.4.2 This FRA demonstrates that the scheme would be safe for the users of the road. The road is not flooded for the 1% (1 in 100) AEP event. There is a risk of flooding to the existing A14 carriageway from the Oakington Brook under the 1% (1 in 100) AEP plus climate change event. However as stated in *Section 23.5.4* the road would still remain passable during such an event because at least half of the western bound carriageway (and all of the eastern bound) would not flood during a 1% (1 in 100) AEP plus climate change event without any further mitigation which would reduce the flooding further.

25.4.3 There are certain watercourses listed below where Highways England has been in liaison with affected landowners in respect of the predicted change to peak water levels. None involve any increased risk to property :

- Ellington Brook;
- river Great Ouse; and
- Beck Brook

25.4.4 The water level rises are considered to be insignificant and therefore non-material. The written responses of the landowners to the change in peak water levels are included in *Annex Q*, they have been accepted or acknowledged by all.

26 DMRB Assessment

26.1.1 In accordance with the approach outlined in *DMRB HD 45/09* (Highways Agency et al., 2009) an assessment of the importance, magnitude and significance of the scheme impact on flood risk for each watercourse has been undertaken. The outcome of the assessment is summarised in *Table 26.1.*

Table 26.1: DMRB assessment of mitigated scheme

Watercourse	Importance	Flood Risk Issue(s)	Proposed Mitigation	Magnitude of impact	Significance of effect
Alconbury Brook	Low	Loss of floodplain	Floodplain compensation	Negligible	Neutral
Cock Brook	Low	Loss of floodplain	Floodplain compensation	Minor Adverse	Neutral
Ellington Brook	Low	Loss of floodplain Reduction in flow width	Floodplain compensation	Major Adverse	Slight Adverse
Brampton Brook (u/s A1)	Low	Loss of floodplain	Floodplain compensation	Negligible	Neutral
Brampton Brook (d/s A1)	Very High	Loss of floodplain	Floodplain compensation	Minor Beneficial	Neutral
Grafham Road Drain	Low	Loss of floodplain	Floodplain compensation	Minor Beneficial	Neutral
IDB Drain No. 1	Low	Loss of floodplain	Floodplain compensation	Negligible	Neutral
River Great Ouse	Very High	Loss of floodplain Constriction of flow path	Floodplain compensation	Minor Adverse	Slight Adverse
West Brook/Hall Green Brook	Medium	Loss of floodplain	Floodplain compensation	Major Adverse	Slight Adverse
Oxholme Drain	Low	None	None required	Minor Beneficial	Neutral
Covell's Drain	Medium	None	None required	Minor Beneficial	Neutral
Utton's Drove Drain	Low	Loss of floodplain	Floodplain compensation	Minor Adverse	Neutral
Longstanton Brook	High	None	None	Negligible	Neutral

Watercourse	Importance	Flood Risk Issue(s)	Proposed Mitigation	Magnitude of impact	Significance of effect
Oakington Brook	Very High	None	None	Negligible	Neutral
Beck Brook / Cottenham Lode	Low	Loss of floodplain	Floodplain compensation	Major Adverse	Slight Adverse
Washpit Brook	Low	Loss of floodplain	Floodplain compensation	Negligible	Neutral

26.1.2 The significance of the potential impact of the scheme on each watercourse for the mitigated case is indicated in *Table 26.1*. This shows the significance of the scheme's effect to be neutral or slight adverse for all watercourses, and landowner discussions are required for all watercourses (with the exception of West Brook) where the schemes effect is considered to be slight adverse. The responses of the affected landowners to change in peak water levels is Included in *Annex Q* and all accept or acknowledge the change.

26.1.3 For the Washpit Brook the impact of the scheme has been assumed to be neutral. This is due to the provision of new culverts designed to convey the 1% (1 in 100) AEP plus an allowance for climate change peak flow and the provision of floodplain compensation. This is the same approach taken as for the *2009 FRA* (Highways Agency, 2009a).

27 Other flood risk considerations

27.1 Legacy

27.1.1 For this scheme, Highways England is seeking to collaborate with the Environment Agency and other flood risk management authorities to develop a solution which recognises local integrated transport and development needs and which improves social, economic, environmental, regeneration and amenity factors.

27.1.2 The mitigation of pre-existing flooding issues has been identified as a potential legacy of the scheme through additional works beyond those required to mitigate for the scheme's impact upon flood risk. Liaison has been undertaken with the Environment Agency who have identified the following locations that have experienced flooding and could benefit from the scheme:

- Brampton is at risk of flooding from surface water and the Brampton Brook. The Environment Agency have queried whether a flow splitting device could be installed in the vicinity of borrow pit 1 to re-direct peak flows from the Brook to the borrow pits or floodplain compensation areas to alleviate downstream flooding in Brampton;
- the Environment Agency queried whether borrow pit 2 could be utilised to receive surface water runoff from the proposed redevelopment of the nearby airbase;
- the Environment Agency has queried whether Water Framework Directive benefits could be realised by re-contouring the straight section of the Ellington Brook which could potentially also attenuate flows to the Alconbury Brook;
- Fenstanton flooded in 2001. The Environment Agency has queried whether works could be undertaken on the West Brook to alleviate flooding via the diversion of flows to borrow pit 3;
- Borrow pit 6 is close to Beck Brook in Girton. The Environment Agency has queried whether a diversion from Beck Brook to borrow pit 6 be considered to attenuate peak flows and alleviate downstream flooding in Girton; and
- reduce limiting outflows from attenuation ponds between Swavesey and Girton below greenfield rates to reduce flows downstream.

27.1.3 Legacy issues have not been hydraulically modelled nor addressed in this FRA. They are considered outside the current EIA/DCO process and would be subject to further discussion between Highways England and stakeholders at a subsequent stage of the design process.

27.2 Residual flood risk

27.2.1 Whilst the drainage systems would be designed in detail to the *DMRB* standards, as agreed with the Environment Agency, there remains a risk of flooding if they became overwhelmed by a rainfall event in excess of their design capacity.

27.2.2 The FRA has highlighted a potential risk of flooding to the existing A14 from Oakington Brook from the 1% (1 in 100) AEP plus climate change event. *Section 23.5.5* provides a number of potential mitigation measures that could be implemented as an adaptive approach. However the road will remain safely passable during such a flood event. This issue would be discussed further with Highways England through the scheme detailed design phases to determine the appropriate resilience measures (if any) to be enacted.

27.2.3 The attenuation ponds and swales have to date been designed with a minimum freeboard of 150mm, providing additional storage beyond their design capacity. If they became overtopped by an extreme event they would do so over a longer length due to the low longitudinal gradient resulting in a low velocity. The ponds would be located at low points and therefore would overtop into areas already at risk of fluvial flooding, rather than into new risk areas.

28 Culverts and blockage risk

28.1 Assessment of trash and security screens for culverts

28.1.1 An assessment for the provision of trash and security screens has been undertaken on all existing and new culverts in the scheme. The assessment has been carried out in accordance with the guidance in *Trash and Security Screen Guide* (Environment Agency, 2009), in particular *Table 4.4* and *Table 4.8*. Not all necessary information was available at the time the assessment was carried out and therefore some assumptions have been necessary. These are described in the following sections. The detailed results of the assessment are included in *Annex M*.

28.2 Trash screen assessment

28.2.1 In assessing the requirement for trash screens the scoring guidelines given in *Table 4.4* of Environment Agency (2009) have been used. To determine the appropriate score for each culvert the following approach has been taken:

- a probability score no higher than 3 has been used for determining the risk of blockage. None of the culverts were deemed to be in urban areas or woodland and none would have blockages more frequently than one in two years. A score of 1 to 3 was allocated according to the size of the culvert;
- a consequence score of either 2 or 3 has been assigned for each culvert. The reason for not having a score higher than 3 was that the culverts were located in fairly remote rural areas. Therefore the costs of flooding damages could be expected to be low. A score of 2 or 3 has been assigned depending on the size of the culvert as the majority of the cost would be in unblocking and repairing the culvert;
- for assessing the risk of damage to a culvert caused by debris a probability score of 2 has been used. The culverts would be located in open rural areas and therefore the likelihood of large debris entering the watercourses to cause damage has been deemed to be low; and
- a consequence score of either 2 or 3 has been assigned to each culvert depending on the size.

28.2.2 As a result of this approach none of the culverts scored higher than a 6 for either blockage risk or damage risk. Therefore, it has been determined that none of the culverts would require a trash screen.

28.3 Security screen assessment

28.3.1 In assessing the requirement for security screens to prevent people entering the culvert the scoring guidelines given in *Table 4.8* of Environment Agency (2009) have been used. To determine the appropriate score for each culvert the following approach has been taken:

- it has been assumed that all culverts would be laid at a gradient of between 1 in 250 and 1 in 1000 as the topography of the majority of the scheme is relatively flat;
- the culverts have been designed to accommodate the 1% (1 in 100) AEP plus an allowance for climate change event. However, more detailed information on the flow regimes of the watercourses was not available at the time of the assessment. Therefore a conservative approach of using a score of 3 for the full flow criteria as been used, i.e. sometimes flows full;
- a low safety score of either 1 or 2 out of the maximum 5 has been adopted for the majority of culverts as they are in remote rural areas and therefore there would be a low likelihood that people would enter them. A score of 3 has been used for culverts in the area of Bar Hill as they would be closer to residential properties; and
- at the time of the assessment the rate of rise of the watercourses was not known. A conservative approach of using a score of 3 has therefore been adopted for this criteria.

28.3.2 The result of this assessment is that all but one of the culverts do not score higher than 14 and therefore would not require security screens. One culvert scored 15 which would result in further assessment. However, this culvert would be located in a remote rural area within the highway boundary and would be fenced. Consequently, a security screen would not be required. Therefore it has been determined that none of the culverts would require a security screen.

28.4 Conclusion

28.4.1 The conclusion of the assessment is that none of the culverts would require a trash screen or a security screen. There was some outstanding information at the time of the assessment. Further study would be undertaken during the detailed design phase to confirm the findings of this assessment.

29 Maintenance Access

29.1.1 The Environment Agency requires access to main rivers to allow for maintenance activities to be undertaken. The exact means of provision for each watercourse is to be agreed during the detailed design period, as stated in a Statement of Common Ground with the Environment Agency (HE/A14/EX/165/SEB03).

30 Conclusions

30.1 Introduction

30.1.1 This FRA has been undertaken in accordance with *DMRB HD 45/09* (Highways Agency et al., 2009), the *NPPF/PPG* (DCLG, 2012a; DCLG, 2012b) and the *National Policy Statement for National Networks* (Department for Transport, 2014) to assess the potential impact of the A14 Cambridge to Huntingdon improvement scheme on existing levels of flood risk and to identify and develop mitigation measures as required. There are three watercourses (*Section 25.4.3*) where liaison has been undertaken to seek agreement to the predicted change in peak water levels with affected landowners. Their written responses are included in *Annex Q*; all either accept or acknowledge the change.

30.1.2 This FRA demonstrates how the scheme would aim to maintain existing levels of flood risk in accordance with the CFMP with the exception of those watercourses where further consultation on flood risk mitigation is required.

30.2 Fluvial flood risk

30.2.1 This FRA has been developed to demonstrate that the scheme would not have a deleterious impact upon flood risk.

30.2.2 Sections 1-3 of the scheme would predominantly be constructed on a new embankment and therefore reduce floodplain storage in areas currently located within Flood Zone 3. This is also the case in section 4 where the existing A14 is proposed to be widened, and sections 1 and 2 where the A1 is also proposed to be widened.

30.2.3 The scheme would increase peak water levels on a number of watercourses across the scheme. While DMRB guidance requires that any loss of floodplain is compensated for (*Section 1.8*), it was agreed with the Environment Agency as part of the 2009 FRA (Highways Agency, 2009a) that provided the results of hydraulic modelling demonstrate that the change in the 1% (1 in 100) AEP flood level is negligible (not greater than a 10mm increase and therefore within hydraulic modelling tolerance) floodplain compensation would not be required. This is classified as negligible impact under the DMRB guidance (*Section 1.8*). This approach has been continued and re-affirmed/agreed with the Environment Agency for this FRA.

30.2.4 The outcome of the DMRB assessment is summarised in *Table 29.1*; the assessment is based on the scheme including mitigation.

Table 29.1: DMRB assessment summary for mitigated scheme

Watercourse	Importance	Magnitude of impact	Significance of effect
Alconbury Brook	Low	Negligible	Neutral
Cock Brook	Low	Minor Adverse	Neutral
Ellington Brook	Low	Major Adverse	Slight Adverse
Brampton Brook (upstream)	Low	Negligible	Neutral
Brampton Brook (downstream)	Very High	Minor Beneficial	Neutral
Grafham Road Drain	Low	Minor Beneficial	Neutral
IDB Drain No. 1	Low	Negligible	Neutral
Great Ouse	Very High	Minor Adverse	Slight Adverse
West Brook / Hall Green Brook	Medium	Major Adverse	Slight Adverse
Oxholme Drain	Low	Minor Beneficial	Neutral
Covell's Drain	Medium	Minor Beneficial	Neutral
Utton's Drove Drain	Low	Minor Adverse	Neutral
Longstanton Brook	High	Negligible	Neutral
Oakington Brook	Very High	Negligible	Neutral
Beck Brook / Cottenham Lode	Low	Major Adverse	Slight Adverse
Washpit Brook	Low	Negligible	Neutral

30.2.5 With reference to *Section 1.8.10* none of these impacts are considered to be significant and none are considered material increases to peak water levels.

30.2.6 Hydraulic modelling for the scheme has identified two principal mechanisms that result in an increase in water level: the loss of floodplain storage; and the reduction in flow conveyance through a constriction (typically a bridge or culvert) significantly smaller than the width of the floodplain flow.

30.2.7 On watercourses where the impact has been determined not to be negligible and on non-modelled watercourses with a loss of floodplain, the potential increase in peak water levels would be mitigated for by the provision of floodplain compensation storage. Compensatory storage has been provided for losses up to the existing 1% (1 in 100) AEP plus an allowance for climate change level.

30.2.8 The water level rises predicted on the Ellington Brook, river Great Ouse and the Beck Brook have either been agreed or acknowledged by the affected landowners as documented in *Annex Q*..

30.2.9 The floodplain compensation storage areas would be located as close as possible to the scheme encroachment into the floodplain. Wherever possible both loss and compensation volumes have been calculated on a level-for-level basis in accordance with *CIRIA C624* (CIRIA, 2004) adopting 100mm high ‘slices’ and using 3D modelling software to demonstrate that sufficient compensation is provided for each lost ‘slice’.

30.3 Protection of mitigation measures

30.3.1 Where the flood extents developed through hydraulic modelling for the FRA differ from the Environment Agency’s published flood zones, Highways England would make representation to the Environment Agency as a ‘flood map challenge’ to update the flood zones. This process will also include the identification of all Floodplain Compensation areas as Flood Zone 3 to ensure they continue to provide the necessary mitigation. This is recorded in a Statement of Common Ground between Highways England and the Environment Agency.

30.4 Surface water flood risk

30.4.1 The scheme would intercept overland flow paths as identified using the *uFMfSW* (Environment Agency, undated-a). However, the scheme design makes provision for the continued conveyance of these flows via new culverts in the offline A14 section. Where they are proposed to cross the online A14 section or the A1 the existing culverts would be retained to convey the flow.

30.4.2 The scheme would not detrimentally impact upon existing surface water flood risk. In urban areas the scheme would not introduce any new impediments to overland flow. In rural areas the new A14 carriageway would be constructed on embankment. Culverts or bridges would convey flows at the base of valleys and would be designed to convey the 1% (1 in 100) AEP plus an allowance for climate change peak flow.

30.5 Groundwater flood risk

30.5.1 The scheme would not affect existing levels of groundwater flood risk. The majority of the new roads would be located on embankment and therefore not be at risk of groundwater flooding. At the section of cutting proposed to the east of the river Great Ouse crossing, if ongoing ground investigations identify a risk, toe drains would be introduced to intercept the groundwater and convey it safely away from the carriageway. The *uFMfSW* (Environment Agency, undated-a) identifies the western end of the scheme would be at the highest risk of groundwater flooding. The new carriageways would predominantly be on embankment in this area, reducing the risk of flooding.

30.6 Sewer flood risk

30.6.1 The scheme would not drain to any existing public sewers and would therefore not affect existing levels of flood risk from such infrastructure. Sewer flooding has not been recorded in any areas that could affect the scheme.

30.7 Flood risk from dam failure

30.7.1 The scheme would not impact upon the risk of flooding from dam failure.

30.8 Failure of flood defence infrastructure

30.8.1 The scheme would not be located within an Area Benefitting from Defences as defined by the Environment Agency. Therefore, a flood defence failure would not place the road at risk of flooding.

30.9 Safe access

30.9.1 The carriageway levels would be above the predicted 1% (1 in 100) AEP flood event level on all watercourses crossed by the scheme. There is a risk of flooding to the existing A14 from Oakington Brook from the 1% (1 in 100) AEP, a number of potential measures that could be implemented to address this are included in *Section 23.5.5.*, however the carriageway will remain passable during such an event.

30.10 Scheme drainage

30.10.1 The scheme would result in an increase in impermeable area, leading to additional volumetric runoff. Peak runoff rates from the new areas would be attenuated via ponds and discharged to receiving watercourses at greenfield rates.

30.11 Exception Test

30.11.1 In accordance with the Exception Test this FRA has demonstrated that:

1. the development would be safe for its lifetime (100 years);
2. the development would not exacerbate existing flood risk (subject to the watercourses listed in *Section 25.4.3* where the change in peak water levels does not affect any property and where there has been liaison with the affected landowners). Written acceptance or acknowledgement of the change in peak water levels has been received from all affected landowners as documented in *Annex Q*; and
3. the next design stage would investigate opportunities to mitigate pre-existing flood risk and how these could be incorporated into the scheme.

31 Bibliography

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32 Glossary

Term	Definition
ABD	Areas Benefitting (from flood) Defences.
AEP	Annual Exceedance Probability e.g. 1% AEP is equivalent to 1% (1 in 100) probability of flooding occurring in any one year (or, on average, once in every 100 years).
Award Watercourses/Drain	Smaller watercourses defined under the Enclosures Act, with their maintenance being under the Local Authority.
AStGWF	Areas Susceptible to Groundwater Flooding is a strategic scale map showing groundwater flood areas on a 1km square grid. It was developed specifically by the Environment Agency for use by Lead Local Flood Authorities (LLFAs) for use in Preliminary Flood Risk Assessment (PFRA) as required under the Flood Risk Regulations.
CambsCC	Cambridgeshire County Council.
CCC	Cambridge City Council.
CFMP	Catchment Flood Management Plan – considers all types of flooding, including from rivers, groundwater, surface water and tidal flooding, with the exception of flooding directly from the sea.
Climate Change	Long term variations in global temperature and weather patterns caused by natural and human actions.
DCLG	Department of Community and Local Government.
DCO	Development Consent Order.
Development	The carrying out of building, engineering, mining or other operations, in, on, over or under land, or the making of any material change in the use of a building or other land.
DMRB HA45/09	Design Manual for Roads and Bridges guidance for Road Drainage and the Water Environment, published by the Highways Agency.
DS	Downstream.
EA	Environment Agency.
ECML	East Coast Mainline.
EIA	Environmental Impact Assessment.
Flood and Water Management Act	Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which (partly) is to clarify the legislative framework for managing surface water flood risk in England.
Flood Zone Map	Nationally consistent delineation of 'high', 'medium' and 'low' probability of fluvial flooding , published on a quarterly basis by the Environment Agency.
Flood Zone 1 Low Probability	NPPF Flood Zone, defined as areas outside of Zone 2 Medium Probability. This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).

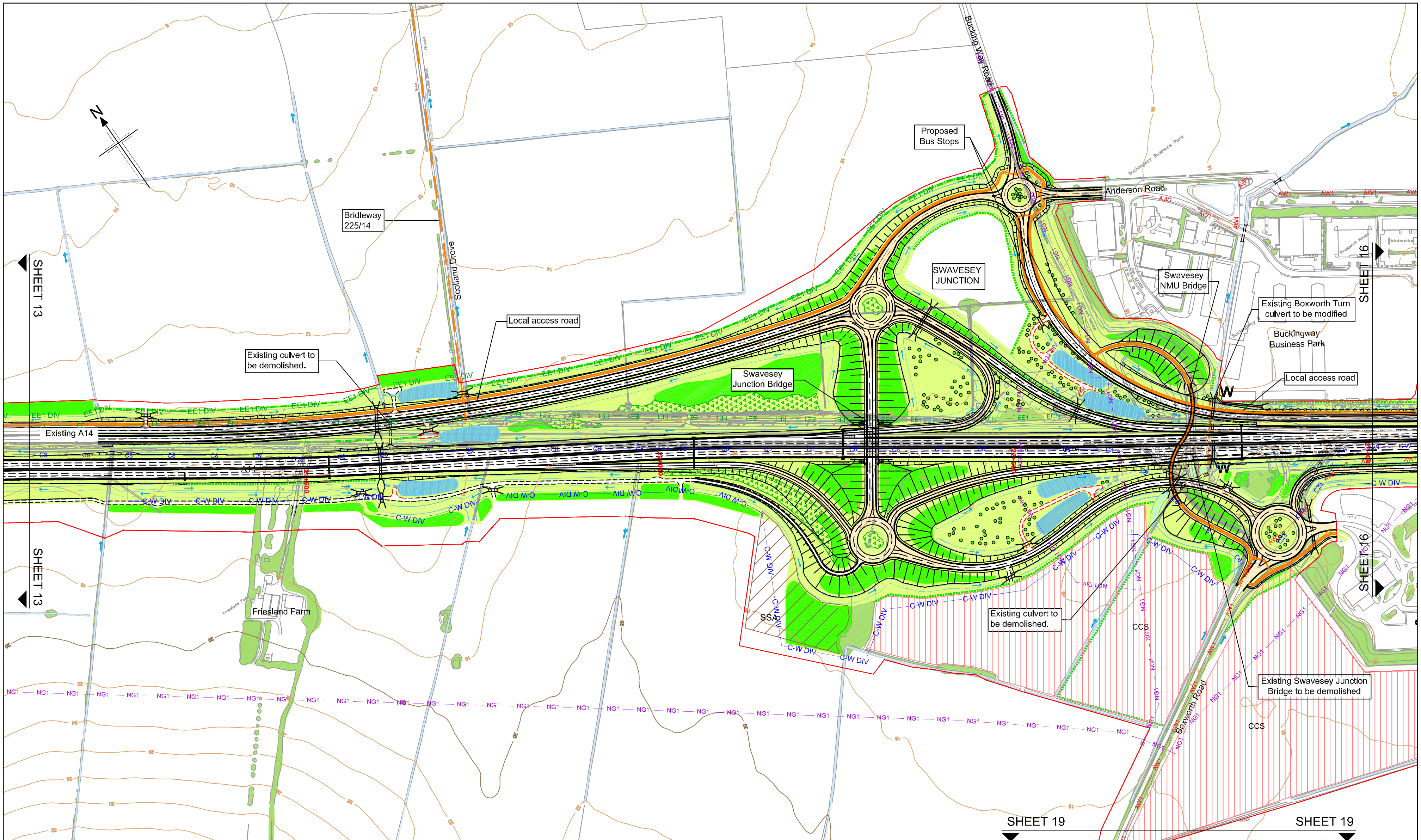
Term	Definition
Flood Zone 2 Medium Probability	NPPF Flood Zone comprising land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) in any year.
Flood Zone 3a High Probability	NPPF Flood Zone comprising land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) in any year.
FRA	Flood Risk Assessment.
Functional Floodplain (Zone 3b)	NPPF Flood Zone, defined as areas in which water *has* to flow or be stored in times of flood.
Greenfield Runoff Rate	The peak flow rate calculated as running off a green field surface, taking into account the local hydrological characteristics.
HA	Highways Agency.
HDC	Huntingdon District Council.
NMM	Highway Agency's Network Management Manual.
IDB	Internal Drainage Board – local public authority established in an area of special drainage need to manage local flood risk.
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers. N.B. Main River designation is not an indication of size, although it is often the case that they are larger than Ordinary Watercourses.
mBGL	Metres below Ground Level.
NGR	National Grid Reference.
National Planning Policy Framework (NPPF)	National planning policy, published by the Government in March 2012. It replaces most of the previous Planning Policy Statements, including that regarding flood risk (PPS25).
National Planning Practice Guidance (NPPG)	Supporting guidance to the NPPF, published by the Government in March 2014 as an online resource, available at: (http://planningguidance.planningportal.gov.uk/). It replaces previously published Government guidance, including that regarding flood risk.
Ordinary Watercourse/Non-Main River	All watercourses that are not designated Main River, and which are the responsibility of Local Authorities or, where they exist, Internal Drainage Boards. Note that Ordinary Watercourse does not imply a "small" river, although it is often the case that Ordinary Watercourses are smaller than Main Rivers.
Planning Policy Statement (PPS)	A series of statements issued by the Government, setting out policy guidance on different aspects of planning. The majority of PPSs have now been replaced by the National Planning Policy Framework (NPPF), including PPS25 regarding flood risk.
PPS23	Planning Policy Statement 23: Planning and Pollution Control.
PPS25	Planning Policy Statement 25: Development and Flood Risk – previous government planning policy regarding flood risk, which has now been replaced by the National Planning Policy Framework.

Term	Definition
Residual Risk	A measure of the outstanding flood risks and uncertainties that have not been explicitly quantified and/or accounted for as part of the design process.
Risk of Flooding from Surface Water Map	Map published by the Environment Agency identifying zones of High, Medium Low and Very Low risk of surface water flooding in England and Wales.
RWSC	Routine Winter Service Code.
SCDC	South Cambridgeshire District Council.
SFRA	Strategic Flood Risk Assessment – considers local flood risk and informs the planning process information on the future risk over a wide spatial area.
Supplementary Planning Document (SPD)	Documents adding further detail to the policies in the Local Plan. They can be used to provide further guidance for development on specific sites, or on particular issues, such as design. Supplementary planning documents are capable of being a material consideration in planning decisions but are not part of the development plan. *(NPPF definition)* SPDs are not subject to independent examination before adoption by a local planning authority.
Sustainable Development	"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (*The World Commission on Environment and Development, 1987*).
Sustainable Drainage System (SuDS)	Term covers the whole range of sustainable approaches to surface drainage management. They are designed to control surface water run off close to where it falls and mimic natural drainage as closely as possible. *(Based on NPPF flood risk guidance text)*
SWMP	Surface Water Management Plan.
uFMfSW	Updated Flood Map for Surface Water. The Environment Agency's map of surface water flood risk extents.
US	Upstream.

33 Annexes

Annex A – Environment Agency correspondence
Annex B – Scheme layout drawings
Annex C – Strategic flood risk assessment figures
Annex D – Hydraulic modelling reports
Annex E – Watercourse crossing schedule
Annex F – Floodplain loss and compensation calculations
Annex G – Climate change uplift summary
Annex H – Bridge crossings drawings
Annex I – Culvert flow calculations
Annex J – Surface water flow path sketches
Annex K – Anglian Water *plans*
Annex L – Attenuation pond schedule
Annex M – Culvert screen assessment
Annex N – Watercourse Plans
Annex O – FpC Sections and Loss Area Locations
Annex P – Peak Water Level Change Summarises to Landowners
Annex Q – Response of Affected Landowners to Water Level Change

33.1.1 Please note, for those reading this ES in hard copy, annexes A to Q are held on an accompanying CD.



Note: These General Arrangement Drawings should be read in conjunction with:

1. The General Arrangement Legend.
2. The Location Key Plan; and
3. The draft Development Consent Order and accompanying application documentation.

0 50 100 150 200 250 m
SCALE 1 : 2500 @ A1

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P01	21/08/2015	DCO NON-MATERIAL CHANGE ISSUE	ASC	JP	RRD	JB
P00	05/12/2014	DCO SUBMISSION	JPB	CTS	RRD	MB
Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd

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Section	Culvert ID	Main Line Chainage (m)	Easting	Northing	Existing/New	Upstream Extension Length (m)	Culvert Length (m)	Downstream Extension Length (m)	Watercourse/ Drain	Watercourse Name	Crossing	Catchment Area (ha)	1 in 100 year + 20% CC Flow (m3/s)	Structure to BD2/12 (D > 0.9m)	Structure Category to BD2/12	Structure Type	Culvert Diameter or Height (m)	Culvert Width (m) [Box Culverts]	No of New Headwalls Required	Upstream Extension IL	USIL	DSIL	Downstream Extension IL
Section 3	310	Hook Loop ch1+020	541023	261119	New		160.0			Tributary to Washpit brook	Hook Loop	From FEH	0.8	Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2		12.080	11.820	
Section 3	311	A428 ch30+300	541702	261244	Existing		71.9			Washpit Brook	A428	From FEH	2.2	Yes	Cat 0		1.05		2		10.500	10.150	
Section 3	312	A1307 ch 790	541602	261429	Existing		47.0			Washpit Brook	A1307	From FEH	3.4	Yes	Cat 0		1.2		2		10.500	10.220	
Section 3	309		541329	261431	Existing		70.9			Tributary to Washpit brook	M11	From FEH	1	Yes	Cat 0		1.2		2		11.000	10.640	
Section 3	309A		541383	261499	New		16.0				A14 Sliproad	2.5	0.02	No	N/A	N/A	0.9		2		10.680	10.600	
Section 3	313	A14 ch 1160	541579	261511	Existing		36.3			Washpit Brook	A14 Eastbound Link	FEH and addn'l 1.5	3.431	Yes	Cat 0		2		2		10.160	10.060	
Section 4	15	32+300	543667	261634	Existing					7th Public Drain	A14			Section Not Defined	N/A								
Section 3	8	Hook Loop ch1+600	541020	261637	New		19.0		Highway drain	-	A1307	1.5	0.01	No	N/A	N/A	0.6		2		13.810	13.710	
Section 4	416	32+450	543769	261653	Existing	11.9	51.6			Tributary to 7th Public Drain	A14	30	0.2	Yes	Cat 0		1.05		2		11.080	10.900	
Section 3	307	29+230	540775	261713	New		28.0			Tributaary to Beck Brook	LAR south side	From FEH	0.6	No	N/A	N/A	0.825		2		13.320	13.210	
Section 3	305	28+630	540352	262115	New		30.0		Main River	Beck Brook	LAR south side	From FEH	3.8	Yes	Cat 1	Precast Concrete Box Culvert	1.5	3	2		12.300	12.220	
Section 2	245	28+685	540476	262170	New		10.0		Highway Drain		Catch Hall Farm Access Track			Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2		12.000	11.900	
Section 3	306	28+820	540662	262212	Existing	12	51.1	4	Main River	Beck Brook	A14	From FEH	5.5	Yes	Cat 1		3	3	2		12.550	12.470	
Section 3	306a	28+850	540765	262223	New		15.0		Main River	Beck Brook	Bridleway			Yes	Cat 1	Precast Concrete Box Culvert	1.85	4	2				
Section 3	304A	28+023	539666	262238	New		15.0		Road Ditch	-	Land access	15.5	0.11	No	N/A	N/A	0.525		2		18.040	17.900	
Section 3	314	New acces track and NMU path ch 790	541593	262615	New		16.0			Washpit Brook	Access Track	FEH and addn'l 6.25	3.49	Yes	Cat 0	Precast Concrete Pipe Culvert	1.35		2		9.180	9.150	
Section 3	301	27+185	539461	262665	New		23.0		Local Ditch	-	LAR south side	21	0.17	No	N/A	N/A	0.9		2		19.670	19.470	
Section 3	303	27+875	539869	262722	New		9.0		Local Ditch Connection	-	Crematorium Access	8	0.25	No		N/A	0.675		2		17.000	16.900	
Section 3	1A	27+210	539698	262934	New		13.0		Local Ditch	-	Access track south side	6.8	0.07	Yes	Cat 0	Precast Concrete Pipe Culvert	1.5		2		17.700	17.630	
Section 2	244	27+605	539728	262943	New		47.3		Land Drain		A14			Yes	Cat 0	Precast Concrete Pipe Culvert	1.5		2		16.500	16.300	
Section 2	243	27+600	539756	263007	New		12.0		Land Drain		Access Track			Yes	Cat 0	Precast Concrete Pipe Culvert	1.35		2		16.100	16.000	
Section 2	207	27+104	539323	263258	Existing	6.8	30.0	6.6	Ordinary Watercourse	-	A14	46.3	0.85	Yes	Cat 0		0.97	1.82	2	15.000	14.960	14.990	14.850
Section 2	241	27+122	539359	263283	New		10.0		Ordinary Watercourse	-	Pond Access Track			Yes	Cat 0	Precast Concrete Box Culvert	1.2	1.8	2		14.800	14.750	
Section 2	242	27+128	539382	263306	New		28.4		Ordinary Watercourse	-	LAR			Yes	Cat 0	Precast Concrete Box Culvert	1.5	2.1	2		14.730	14.630	
Section 2	264	26+845	539151	263466	New		10.0		Highway Drain		Access Track			No	N/A	N/A	0.9		2		16.000	15.900	
Section 2	263	26+480	538911	263533	New		30.0		Land Drain		Gantry Build out			Yes	Cat 0	Precast Concrete Pipe Culvert	1.5		2		17.000	16.900	
Section 2	262	26+480	538806	263611	New		30.0		Land Drain		Gantry Build out			Yes	Cat 0	Precast Concrete Pipe Culvert	1.5		2		16.900	17.000	
Section 2	206	26+385	538743	263687	Existing		32.6	6	Main Watercourse	Oakington Brook	A14	594.4	8.27	Yes	Cat 0		1.13	1.34	1		16.660	16.390	16.300
Section 2	240	26+460	538850	263710	New		39.3		Main Watercourse	Oakington Brook	LAR			Yes	Cat 0	Precast Concrete Box Culvert	1.5	1.8	2		16.000	15.850	
Section 2	239	26+270	538686	263802	New		11.5		Highway Drain		Access Track			No	N/A	N/A	0.9		2		18.000	17.900	
Section 2	238	26+250	538691	263842	New		10.0		Highway Drain		Access Track			No	N/A	N/A	0.75		2		18.400	18.300	
Section 2	246	25+800	538201	263917	New		54.0		Flood Storage Area		Link Road			Yes	Cat 0	Precast Concrete Pipe Culvert	1.35		2		20.000	19.900	
Section 2	237	25+922	538452	264084	New		30.8		Highway Drain		LAR			Yes	Cat 0	Precast Concrete Pipe Culvert	1.35		2		17.250	17.100	
Section 2	235	25+860	538398	264107	New		23.0		Land Drain		NMU			Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2		17.400	17.300	
Section 2	236	25+856	537417	264147	New		34.1		Highway Drain		B1050 Slip Road			Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2		18.000	17.850	
Section 2	247	25+475	537976	264165	New		6.0			Longstanton Brook	NMU			Yes	Cat 2	Bridge	Bridge		2		18.950	18.900	
Section 2	205	25+512	538002	264197	Existing	4	25.8	53	Award Drain	Longstanton Brook	A14	529.8	7.47	Yes	Cat 0		1.8	1.82	2	18.875	18.854	18.286	18.050
Section 2	261	25+660	538265	264249	New		10.0		Land Drain		Access Track			No	N/A	N/A	0.9		2		18.500	18.400	
Section 2	233	25+532	538113	264261	New		10.0		Award Drain	Longstanton Brook	Pond Access Track			Yes	Cat 2	Bridge	Bridge		2		18.000	17.950	
Section 2	232	25+522	538095	264276	New		10.0		Highway Drain		Pond Access Track			No	N/A	N/A	0.9		2		18.300	18.200	
Section 2	234	25+549	538134	264286	New		26.4		Award Drain	Longstanton Brook	LAR			Yes	Cat 1	Precast Concrete Box Culvert	1.8	3	2		17.920	17.850	
Section 2	260	24+995	537557	264415	New		10.0		Ordinary Watercourse		Access Track			Yes	Cat 0	Precast Concrete Pipe Culvert	1.5		2		19.000	18.900	
Section 2	230	24+713	537329	264583	New		10.0		Ordinary Watercourse	-	Pond Access Track			Yes	Cat 0	Precast Concrete Box Culvert	1.5	1.8	2		16.100	16.000	
Section 2	229	24+400	536955	264589	New		11.0		Land Drain		Clare College Farm Access			No	N/A	N/A	0.9		2		19.800	19.500	
Section 2	204	24+707	537357	264640	Existing	31.4	33.7		Ordinary Watercourse	-	A14	67.5	1.19	Yes	Cat 0		1.1	1.83	1	15.900	15.736	tbc	
Section 2	228	24+368	537042	264783	New		108.0		Highway Drain		Robins Lane			Yes	Cat 0	Precast Concrete Pipe Culvert	1.35		2		15.200	14.800	
Section 2	227	24+280	537020	264897	New		42.2		Highway Drain		Robins Lane			Yes	Cat 0	Precast Concrete Pipe Culvert	1.35		2		13.300	13.100	
Section 2	224	24+123	536835	264906	New		10.0		Land Drain		Pond Access Track			Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2		13.700	13.650	
Section 2	226	24+269	537044	264952	New		30.0		Highway Drain		Lolworth Road			Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2		13.300	13.200	
Section 2	225	24+156	536904	264961	New		108.0		Highway Drain		-			Yes	Cat 0	Precast Concrete Pipe Culvert	1.35		2		12.900	12.500	
Section 2	222	23+833	536588	265059	New		10.0			Utton's Drove Drain	Pond Access Track			Yes	Cat 2	Bridge	Bridge		2		11.950	11.900	
Section 2	203	23+856	536658	265104	Existing	33.2	23.5	4.4		Utton's Drove Drain	A14	605.7	8.42	Yes	Cat 0		1.8	1.8	2	11.850	11.746	11.638	11.600
Section 2	223	23+860	536677	265143	New		10.0			Utton's Drove Drain	Pond Access Track			Yes	Cat 0	Precast Concrete Pipe Culvert	2.5		2		11.550	11.500	
Section 2	221	23+832	536649	265151	New		12.0		Highway Drain		Utton's Drove			Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2		11.900	11.800	
Section 2	258	23+400	536230	265305	New		10.0		Land Drain					Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2		13.700	13.600	
Section 2	259	23+420	536306	265374	New		10.0		Highway Drain					No	N/A	N/A	0.9		2		13.000	12.900	
Section 2	209	22+915	535797	265512	Existing	18.5	30.0	16.9	Land Drain		MSA Road			Yes	Cat 0		1.2		2	16.000	tbc	tbc	15.700
Section 2	257	23+125	536099	265617	New		10.0		Land Drain		NMU Track			No	N/A	N/A	0.9		2		14.000	13.950	
Section 2	256	22+805	535733	265626	New		10.0		Highway Drain		Access Track			No	N/A	N/A	0.75		2		15.600	15.700	
Section 2	202A	22+786	535698	265663	Existing		40.0		Award Drain	Swavesey Drain	Existing Overbridge approach			Section Not Defined	N/A								
Section 2	219	22+642	535673	265674	New		25.0		Award Drain	Swavesey Drain	Junction Side Road			Yes	Cat 0	Precast Concrete Box Culvert	1.8	1.8	2		13.600	13.500	
Section 2	254	22+490	535407	265698	New		10.0		Land Drain		Access Track			Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2		15.300	15.250	
Section 2	202	22+786	535761	265703	Existing	25.4	41.7		Award Drain	Swavesey Drain	A14 + Slip Road	121.5	2.01	Yes	Cat 0		1	1.8	1	13.345	13.295	13.245	
Section 2	250	22+820	535810	265715	New		65.0		Highway Drain		-			Yes	Cat 0	Precast Concrete Pipe Culvert	1.35		2		14.000	13.550	
Section 2	218	22+510	535454	265724	New		10.0		Highway Drain		Pond Access Track			No	N/A	N/A	0.75		2		16.000	15.950	
Section 2	220	22+787	535780	265731	New		22.2		Award Drain	Swavesey Drain	LAR			Yes	Cat 0	Precast Concrete Box Culvert	1.8	2.1	2		13.200	13.100	
Section 2	217	22+593	535619	265837	New		18.8		Highway Drain		A14 Slip Road			Yes	Cat 0	Precast Concrete Pipe Culvert	1.35		2		15.800	15.600	
Section 2	216	22+535	535650	265970	New		10.0		Highway Drain		Pond Access Track			No	N/A	N/A	0.75		2		16.000	15.950	
Section 2	215	22+378	535516	266067	New		44.7		Highway Drain		A14 EB Slip Roads			Yes	Cat 0	Precast Concrete Pipe Culvert	1.35		2		16.800	16.650	
Section 2	253	21+765	534880	266218	New		10.0		Land Drain		Access Track			Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2		15.300	15.200	
Section 2	214	21+609	534745	266300	New		35.0		Ordinary Watercourse	-	LAR	122.5	2.44	Yes	Cat 0	Precast Concrete Pipe Culvert	1.5		2		12.200	12.150	
Section 2	211	21+580	534725	266322	New		10.0		Land Drain		Pond Access Track			No	N/A	N/A	0.9		2		14.500	14.450	
Section 2	210	21+680	534853	266340	New		10.0		Highway Drain		Pond Access Track			No	N/A	N/A	0.9		2		12.200	12.150	
Section 2	213	21+609	534771	266340	New		44.5		Ordinary Watercourse	-	A14	122.5	2.44	Yes	Cat 0	Precast Concrete Pipe Culvert	1.5		2		12.100	11.950	
Section 2	252	21+730	534923	266356	New		10.0		Highway Drain		Scotland Drove			No	N/A	N/A	0.9		2		14.000	13.950	
Section 2	201	21+625	534806	266367	Existing		32.2		Ordinary Watercourse	-	Existing A14	122.5	2.44	Yes	Cat 0		1.5				12.117	11.952	
Section 2	212	21+609	534803	266396	New		10.0		Ordinary Watercourse	-	Access Track	122.5	2.44	Yes	Cat 0	Precast Concrete Pipe Culvert	1.5		2		11.900	11.850	
Section 2	251	21+280	534538	266586	New		10.0		Highway Drain		Access Track			No	N/A	N/A	0.75		2		12.000	11.950	
Section 1	197	17+540	532692	267033	New		4.0		Land Drain		Pond Access Track			Yes	Cat 2	Bridge	Bridge		2				
Section 1	199	18+050	533293	267079	New		60.0		IDB Drain	Covells Drain	A14	2267	10.5	Yes	Cat 1	Precast Concrete Box Culvert	3	4	2		7.100	6.600	
Section 1	195	16+400	531739	267122	New		6.0		Local Road/Land Drain		Access Track			No	N/A	N/A	0.675		2				
Section 1	194	16+400	531741	267171	New		6.0		Local Road/Land Drain		Access Track			No	N/A	N/A	0.675		2				
Section 1	196	17+540	533279	267188	New		98.0		Award Drain	Oxholme Drain	A14	202	2.54	Yes	Cat 0	Precast Concrete Pipe Culvert	2		2		7.940	7.550	
Section 1	196a	17+540	532820	267221	New		5.0		Award Drain	Oxholme Drain	Access Track												
Section 1	198	18+000	533375	267230	New		16.0		IDB Drain	Covells Drain	Access Track	2267	10.5	Yes	Cat 2	Bridge	Bridge		2				
Section 1	193	16+300	531705	267315	New		73.0		Land Drain		Connington Road			Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2				
Section 1	185	15+200	530393	267327	New		15.0		Land Drain		Access Track			No	N/A	N/A	0.675		2				
Section 1	184	15+300	530351	267340	New		5.0		Local Road Drain		Access Track	723	7.89	Yes	Cat 0	Precast Concrete Box Culvert	2.4	2.7	2				
Section 1	183	15+300	530368	267361	Existing		5.0		Local Road Drain		Access Track			No	N/A	N/A	0.675		0				
Section 1	189	16+300	531622	267367	New		19.0		Embankment Drain		Emergency Access Road			No	N/A	N/A	0.675		2				
Section 1	192	16+400	531714	267374	New		80.0		Surface water		Connington Road			No	N/A	N/A	0.675		2				
Section 1	191	16+400	531721	267421	New		75.0		Surface water		Connington Road			No	N/A	N/A	0.675		2				
Section 1	187	16+300	531592	267422	New		81.0		Local Road/Land Drain		A14	136	1.78	Yes	Cat 0	Precast Concrete Pipe Culvert	1.5		2		8.140	7.870	
Section 1	175	14+200	529417	267443	New		5.0		Land Drain		B1040 Potton Road			No	N/A	N/A	0.675		2				
Section 1	188	16+300	531662	267470	New		19.0		Embankment Drain		Emergency Access Road			No	N/A	N/A	0.675		2				
Section 1	161	11+050	526353	267502	New		8.0		Land Drain		Access Track			No	N/A	N/A	0.675		2				
Section 1	182	15+300	530563	267553	New		105.0		Local Road Drain	Hilton Road Drain	A14	723	7.89	Yes	Cat 0	Precast Concrete Box Culvert	2.4	2.7	2		6.100	5.800	
Section 1	181	15+300	530574	267561	New		45.0		Surface water		A14			No	N/A	N/A	0.675		2				
Section 1	162	11+050	526415	267564	New		21.0		Land Drain		A1198 Ermine Street			No	N/A	N/A	0.675		2				
Section 1	186	15+650	530950	267569	New		5.0		Embankment Drain		Pond Access Track			No	N/A	N/A	0.675		2				
Section 1	174	14+250	529527	267597	New		100.0		Award Drain	Huntingdonshire District Council Award Drain	B1040 Potton Road	272	3.2	Yes	Cat 0	Precast Concrete Pipe Culvert	2.2		2				
Section 1	190	16+400	531780	267626	New		6.0		Embankment Drain		Access Track			No	N/A	N/A	0.675		2				
Section 1	180	15+300	530633	267650	New		10.0		Land Drain	Hilton Road Drain	Pond Access Track	723	7.89	Yes	Cat 0	Precast Concrete Box Culvert	2.4	2.7	2				

Section	Culvert ID	Main Line Chainage (m)	Easting	Northing	Existing/New	Upstream Extension Length (m)	Culvert Length (m)	Downstream Extension Length (m)	Watercourse/ Drain	Watercourse Name	Crossing	Catchment Area (ha)	1 in 100 year + 20% CC Flow (m3/s)	Structure to BD2/12 (D > 0.9m)	Structure Category to BD2/12	Structure Type	Culvert Diameter or Height (m)	Culvert Width (m) [Box Culverts]	No of New Headwalls Required	Upstream Extension IL	USIL	DSIL	Downstream Extension IL
Section 1	**173**	14+250	529560	267656	New		110.0		Surface water discharge		B1040 Potton Road			No	N/A	N/A	0.675		2				
Section 1	**165**	13+000	528286	267660	New		65.0		Award Drain	Huntingdonshire District Council Award Drain	Mere Way	170	2.16	Yes	Cat 0	Precast Concrete Pipe Culvert	1.8		2				
Section 1	**170a**	14+400	529577	267680	New		31.0			West Brook	A14					Precast Beam with RC deck slab	Bridge		0				
Section 1	**163**	12+250	527606	267702	New		48.0		Award Drain	Huntingdonshire District Council Award Drain	A14	156	1.99	Yes	Cat 0	Precast Concrete Pipe Culvert	1.8		2		14.350	14.190	
Section 1	**172**	14+250	529574	267705	New		133.0		Surface water discharge		B1040 Potton Road			No	N/A	N/A	0.675		2				
Section 1	**167**	13+700	529003	267726	New		50.0		Award Drain	Huntingdonshire District Council Award Drain	A14	272	3.2	Yes	Cat 0	Precast Concrete Pipe Culvert	2		2		9.000	8.830	
Section 1	**153**	9+450	524656	267729	New		19.0		Land Drain		Access Track			No	N/A	N/A	0.45		2				
Section 1	**157**	9+900	525207	267735	New		4.0		Land Drain		Access Track			No	N/A	N/A	0.675		2				
Section 1	**171**	14+250	529612	267736	New		100.0		Award Drain	Huntingdonshire District Council Award Drain	B1040 Potton Road	272	3.2	Yes	Cat 0	Precast Concrete Pipe Culvert	2.2		2				
Section 1	**166**	13+340	528640	267744	New		64.0		Award Drain	Huntingdonshire District Council Award Drain	A14	272	3.2	Yes	Cat 0	Precast Concrete Pipe Culvert	1.8		2		10.090	9.880	
Section 1	**159**	11+050	526394	267751	New		12.5		Land Drain		Access Track			No	N/A	N/A	0.675		2				
Section 1	**152**	9+450	524664	267770	New		8.0		Land Drain		Silver Street			No	N/A	N/A	0.45		2				
Section 1	**156**	9+900	525213	267780	New		56.0		Land Drain		A14			Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2		37.000	36.800	
Section 1	**164**	13+000	528307	267783	New		65.0		Award Drain	Huntingdonshire District Council Award Drain	Mere Way	170	2.16	Yes	Cat 0	Precast Concrete Pipe Culvert	1.8		2				
Section 1	**151**	9+450	524656	267787	New		8.0		Land Drain		Access Track			No	N/A	N/A	0.45		2				
Section 1	**155**	9+500	524851	267798	New		4.0		Award Drain	Stoneymill Brook	Access Track	51	0.65	Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2				
Section 1	**179**	15+400	530786	267813	New		17.0		Land Drain	Hilton Road Drain	Access Track	723	7.89	Yes	Cat 0	Precast Concrete Box Culvert	2.4	2.7	2				
Section 1	**178**	15+400	530807	267813	New		17.0		Land Drain		Access Track			No	N/A	N/A	0.675		2				
Section 1	**154**	9+500	524853	267846	New		70.0		Award Drain	Stoneymill Brook	A14	51	0.65	Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2		37.240	34.930	
Section 1	**177**	15+400	530866	267882	New		18.0		Land Drain		Access Track			No	N/A	N/A	0.675		2				
Section 1	**176**	15+400	530873	267901	Existing		16.0		Land Drain		Hilton Road			No	N/A	N/A	0.9		0				
Section 1	**147**	7+250	522327	267906	New		13.0		Local Road Drain		Pond Access Track			No	N/A	N/A	0.825		2				
Section 1	**149**	7+250	522367	267915	New		12.0		Local Road Drain	Offord Road Drain	Access Track			Yes	Cat 0	Precast Concrete Pipe Culvert	1.05		2				
Section 1	**170**	14+400	529793	267969	New		17.5		Land Drain		B1040 Potton Road			No	N/A	N/A	0.675		2				
Section 1	**158**	10+850	526139	267987	New		5.0		Local Road Drain		Access Track			No	N/A	N/A	0.675		2				
Section 1	**169**	14+400	529832	268030	New		7.0		Local Road Drain		Access Track			Yes	Cat 0	Precast Concrete Pipe Culvert	1.05		2				
Section 1	**150**	8+400	523746	268078	New		27.0		Embankment Drain		Corpus Christi Access Track			Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2				
Section 1	**146**	7+250	522486	268128	New		8.0		Land Drain		Pond Access Track			No	N/A	N/A	0.75		2				
Section 1	**151a**	9+450	524642	268142	New		18.0		Land Drain		Access Track			No	N/A	N/A	0.525		2				
Section 1	**139**	5+900	521049	268219	New		91.0		Surface water discharge		Access Track			No	N/A	N/A	0.675		2				
Section 1	**143**	7+000	522400	268303	New		75.0		Land Drain		A14			Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2		14.750	14.500	
Section 1	**141**	6+700	522056	268308	New		133.0		Land Drain		A14			Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2		10.350	9.900	
Section 1	**148**	7+300	522707	268330	New		114.0		Land Drain	Offord Road Drain	A14			Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2		17.500	17.120	
Section 1	**140**	6+480	521836	268331	New		150.0		Land Drain		A14			Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2		9.850	9.350	
Section 1	**138**	5+900	521217	268344	New		56.0		Land Drain		Access Track			No	N/A	N/A	0.675		2				
Section 1	**139a**	6+250	521417	268364	New		31.0		Main Watercourse WFD	River Great Ouse	A14					Steel Composite RC Deck	Viaduct	475	0				
Section 1	**142**	6+700	522079	268384	New		8.0		Land Drain		Pond Access Track			No	N/A	N/A	0.675		2				
Section 1	**137**	5+900	521300	268436	New		12.0		Land Drain		Access Track			No	N/A	N/A	0.675		2				
Section 1	**144**	7+250	522730	268449	New		13.0		Local Road Drain		Access Track			No	N/A	N/A	0.525		2				
Section 1	**136**	5+900	521474	268529	New		10.0		IDB Drain	IDB Drain No 1	Access Track			No	N/A	N/A	0.675		2				
Section 1	**135**	4+700	520088	268885	New		17.0		Land Drain		Access Track			No	N/A	N/A	0.675		2				
Section 1	**134**	4+600	520061	268986	New		20.0		Land Drain		Buckden Road/A1 Link			No	N/A	N/A	0.675		2				
Section 1	**132**	4+800	520389	268987	New		7.0		Land Drain		Access Track			No	N/A	N/A	0.675		2				
Section 1	**133**	4+500	519992	269021	New		15.0		Land Drain		Buckden Road			No	N/A	N/A	0.675		2				
Section 1	**131**	4+700	520328	269036	New		39.0		Land Drain		Access Track			No	N/A	N/A	0.675		2				
Section 1	**129**	4+500	520535	269207	New		18.0		Land Drain		Access Track			No	N/A	N/A	0.675		2				
Section 1	**127**	4+200	519866	269316	New		73.0		Embankment Drain		A14/A1 Link Road			Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2				
Section 1	**128**	4+200	519963	269365	New		54.0		Embankment Drain		A14			Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2		15.350	15.150	
Section 1	**126**	4+000	519886	269557	New		87.0		Embankment Drain		A14			Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2		16.050	15.450	
Section 1	**125**	3+800	519762	269806	New		17.0		Embankment Drain		A14/A1 Link Road			Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2				
Section 1	**123**	3+700	519939	269896	New		5.0		Land Drain		Pond Access Track			No	N/A	N/A	0.675		2				
Section 1 (A1)	**124**	0+850	519799	269910	New		122.0		IDB Drain	Grafham Road Drain	A1/A14	532	6	Yes	Cat 0	Precast Concrete Pipe Culvert	2.4		2		12.340	12.000	
Section 1	**122**	3+500	519980	270080	New		30.0		Land Drain		Park Road			No	N/A	N/A	0.675		2				
Section 1	**121**	3+350	520081	270261	New		7.4		Land Drain		Access Track			No	Cat 1	N/A	0.9	3	2				
Section 1 (A1)	**119**	1+400	519700	270297	New		35.0		Embankment Drain		A1			Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2		12.040	11.920	
Section 1	**120**	3+250	519750	270308	New		52.0		Embankment Drain		A14			Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2		11.920	11.400	
Section 1 (A1)	**117**	1+950	519526	270859	New		59.0		Main Watercourse WFD	Brampton Brook	A1	92	0.9	Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2		10.440	10.090	
Section 1 (A1)	**117a**	1+950	519526	270859	New		9.5		Main Watercourse WFD	Brampton Brook	Access Track						1.2						
Section 1	**103**	2+700	519642	270860	Existing		15.0		Main Watercourse WFD	Brampton Brook	Access Track	96	0.92	No	Cat 0		0.79	1.59	0				
Section 1	**104**	2+700	519642	270860	Existing		44.0	12	Main Watercourse WFD	Brampton Brook	A14	96	0.92	Yes	Cat 0		1.5		1		9.830	9.770	9.750
Section 1	**104a**	2+700	519642	270860	New		17.0		Main Watercourse WFD	Brampton Brook	Access Track			Yes	Cat 0	Precast Concrete Pipe Culvert	1.5						
Section 1	**118**	2+700	519742	270885	New		5.0		Main Watercourse WFD	Brampton Brook	Pond Access Track	96	0.92	Yes	Cat 0	Precast Concrete Pipe Culvert	1.5		2				
Section 1	**118a**	2+700	519756	270886	New		5.0		Main Watercourse WFD	Brampton Brook	NMU	96	0.92	Yes	Cat 0	Precast Concrete Pipe Culvert	1.5		2				
Section 1	**118b**	2+600	519725	271005	New		5.0		IDB Drain		NMU			No	N/A	N/A	0.675		2				
Section 1	**116**	2+400	519364	271017	New		15.3		IDB Drain		Pond Access Track			Yes	Cat 0	Precast Concrete Pipe Culvert	1.5		2				
Section 1	**116a**	2+340	519522	271150	New		5.0		IDB Drain		NMU			Yes	Cat 0	Precast Concrete Pipe Culvert	1.5		2				
Section 1	**118c**	2+200	519629	271371	New		5.0		IDB Drain		NMU			No	N/A	N/A	0.675		2				
Section 1	**115a**	2+000	519385	271605	New		5.0		IDB Drain		NMU			No	N/A	N/A	0.675		2				
Section 1	**115**	1+745	519183	271638	New		64.0		IDB Drain		A14			Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2		11.050	10.840	
Section 1	**114**	1+500	518958	271677	New		10.0		Embankment Drain		Pond Access Track			No	N/A	N/A	0.675		2				
Section 1	**113**	1+350	518799	271686	New		23.0		Embankment Drain		Access Track			Yes	Cat 0	Precast Concrete Pipe Culvert	1.2		2				
Section 1 (A1)	**102b**	3+250	518830	272050	New		20		Ellington Brook	Ellington Brook	LAR					Precast beams with RC slab deck	Bridge						
Section 1 (A1)	**102a**	3+250	519390	272120	Existing		103		Ellington Brook	Ellington Brook	A1 and Slip roads					RC solid arch	Bridge		2				
Section 1 (A1)	**112**	3+600	519255	272490	New		25.0		IDB Drain		LAR						Bridge		2				
Section 1 (A1)	**102**	3+600	519305	272501	Existing	14	48.0	15	Ellington Relief Culvert		A1					Precast beams with RC slab deck		4.6	2				
Section 1 (A1)	**111**	3+700	519241	272577	New		20.0		Land Drain		Pond Access Track			No	N/A	N/A	0.675		2				
Section 1 (A1)	**101a**	5+100	519275	273842	New		5.0		Cock Brook	Cock Brook	Access Track						Bridge		0				
Section 1 (A1)	**110**	5+050	519116	273914	New		30.0		Land Drain		LAR			No	N/A	N/A	0.675		2				
Section 1 (A1)	**101**	5+100	519172	274007	Existing		71.5	62.5	Cock Brook	Cock Brook	A1	2932	13.68			Precast beams with RC slab deck	Bridge		1		tbc	12.400	11.400
Section 1	**130**	4+500	520430	2691910	New		8.0		Land Drain		Access Track			No	N/A	N/A	0.675		2				

FEH Mean Annual Flood

Input

Site Location	GB 519150 274000 TL 19150 74000
Area (ha)	2932.000
SAAR (mm)	556
URBEXT (1990)	0.0042
SPRHOST	53.750
BFIHOST	0.302
FARL	0.999

Results

QMED Rural (l/s) 4985.7 QMED Urban (l/s) 5007.0

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.433
Area (ha)	92.000	Urban	0.000
SAAR (mm)	544	Region Number	Region 5

Results	**l/s**
QBAR Rural	258.8
QBAR Urban	258.8
Q100 years	921.5
Q1 year	225.2
Q2 years	231.3
Q5 years	333.9
Q10 years	428.4
Q20 years	541.2
Q25 years	585.5
Q30 years	621.9
Q50 years	735.6
Q100 years	921.5
Q200 years	1084.5
Q250 years	1136.3
Q1000 years	1490.9

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.500
Area (ha)	532.000	Urban	0.000
SAAR (mm)	544	Region Number	Region 5

Results l/s

QBAR Rural	1686.2
QBAR Urban	1686.2
Q100 years	6002.8
Q1 year	1467.0
Q30 years	4051.0
Q100 years	6002.8

Babtie Group Ltd		Page 1 CU148
Miller House Lower Stone Street Maidstone ME15 6GB		Micro Drainage
Date 14/04/2014 11:51 File	Designed by greencf Checked by	
Micro Drainage	Source Control 2013.1.1	

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.430
Area (ha)	50.000	Urban	0.000
SAAR (mm)	540	Region Number	Region 5

Catchment area is only 25ha ∴ only take half of 100yr flow = 261.5l/s

Results	**l/s**
QBAR Rural	146.9
QBAR Urban	146.9
Q100 years	523.0
Q1 year	127.8
Q2 years	131.3
Q5 years	189.5
Q10 years	243.1
Q20 years	307.1
Q25 years	332.3
Q30 years	352.9
Q50 years	417.5
Q100 years	523.0
Q200 years	615.5
Q250 years	644.9
Q1000 years	846.2

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.472
Area (ha)	51.000	Urban	0.000
SAAR (mm)	541	Region Number	Region 5

Results	**l/s**
QBAR Rural	183.4
QBAR Urban	183.4
Q100 years	653.0
Q1 year	159.6
Q2 years	163.9
Q5 years	236.6
Q10 years	303.6
Q20 years	383.5
Q25 years	414.9
Q30 years	440.7
Q50 years	521.3
Q100 years	653.0
Q200 years	768.5
Q250 years	805.2
Q1000 years	1056.5

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.472
Area (ha)	50.000	Urban	0.000
SAAR (mm)	541	Region Number	Region 5

Results	**l/s**
QBAR Rural	180.2
QBAR Urban	180.2
Q100 years	641.6
Q1 year	156.8
Q2 years	161.0
Q5 years	232.5
Q10 years	298.3
Q20 years	376.8
Q25 years	407.7
Q30 years	433.0
Q50 years	512.2
Q100 years	641.6
Q200 years	755.1
Q250 years	791.2
Q1000 years	1038.1

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.497
Area (ha)	156.000	Urban	0.000
SAAR (mm)	543	Region Number	Region 5

Results	**l/s**
QBAR Rural	557.3
QBAR Urban	557.3
Q100 years	1984.1
Q1 year	484.9
Q2 years	498.0
Q5 years	719.0
Q10 years	922.4
Q20 years	1165.3
Q25 years	1260.7
Q30 years	1339.0
Q50 years	1583.9
Q100 years	1984.1
Q200 years	2335.2
Q250 years	2446.7
Q1000 years	3210.2

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.499
Area (ha)	170.000	Urban	0.000
SAAR (mm)	543	Region Number	Region 5

Results	**l/s**
QBAR Rural	606.9
QBAR Urban	606.9
Q100 years	2160.6
Q1 year	528.0
Q2 years	542.3
Q5 years	782.9
Q10 years	1004.4
Q20 years	1268.9
Q25 years	1372.8
Q30 years	1458.1
Q50 years	1724.8
Q100 years	2160.6
Q200 years	2542.9
Q250 years	2664.3
Q1000 years	3495.7

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Micro Drainage	Source Control 2013.1.1	

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.498
Area (ha)	177.000	Urban	0.000
SAAR (mm)	543	Region Number	Region 5

Results	l/s
QBAR Rural	626.4
QBAR Urban	626.4
Q100 years	2229.8
Q1 year	544.9
Q2 years	559.7
Q5 years	808.0
Q10 years	1036.6
Q20 years	1309.6
Q25 years	1416.8
Q30 years	1504.8
Q50 years	1780.1
Q100 years	2229.8
Q200 years	2624.4
Q250 years	2749.7
Q1000 years	3607.8

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Micro Drainage	Source Control 2013.1.1	

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.496
Area (ha)	253.000	Urban	0.000
SAAR (mm)	544	Region Number	Region 5

Results	**l/s**
QBAR Rural	855.2
QBAR Urban	855.2
Q100 years	3044.4
Q1 year	744.0
Q30 years	2054.5
Q100 years	3044.4

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (ha)	723.000	Urban	0.000
SAAR (mm)	550	Region Number	Region 5

Results	**l/s**
QBAR Rural	1785.5
QBAR Urban	1785.5
Q100 years	6356.3
Q1 year	1553.4
Q30 years	4289.6
Q100 years	6356.3

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.500
Area (ha)	136.000	Urban	0.000
SAAR (mm)	544	Region Number	Region 5

Results	**l/s**
QBAR Rural	500.8
QBAR Urban	500.8
Q100 years	1782.9
Q1 year	435.7
Q2 years	447.5
Q5 years	646.1
Q10 years	828.9
Q20 years	1047.1
Q25 years	1132.9
Q30 years	1203.2
Q50 years	1423.4
Q100 years	1782.9
Q200 years	2098.5
Q250 years	2198.6
Q1000 years	2884.8

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.500
Area (ha)	202.000	Urban	0.000
SAAR (mm)	545	Region Number	Region 5

Results	**l/s**
QBAR Rural	713.7
QBAR Urban	713.7
Q100 years	2540.9
Q1 year	620.9
Q2 years	637.8
Q5 years	920.7
Q10 years	1181.2
Q20 years	1492.3
Q25 years	1614.5
Q30 years	1714.7
Q50 years	2028.4
Q100 years	2540.9
Q200 years	2990.5
Q250 years	3133.3
Q1000 years	4111.1

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.500
Area (ha)	2267.000	Urban	0.000
SAAR (mm)	545	Region Number	Region 5

Results	**l/s**
QBAR Rural	6139.4
QBAR Urban	6139.4
Q100 years	21856.2
Q1 year	5341.3
Q30 years	14749.8
Q100 years	21856.2

FEH Mean Annual Flood

Input

Site Location	GB 533250 267050 TL 33250 67050
Area (ha)	2267.000
SAAR (mm)	545
URBEXT (1990)	0.0019
SPRHOST	51.310
BFIHOST	0.318
FARL	1.000

Results

QMED Rural (l/s) 3872.7 QMED Urban (l/s) 3880.5