HIGHWAYS AGENCY

Fluvial Hydraulic Modelling Report

1. Basic Model Information

Model Name:	A14 Covell's Drain	
Primary Watercourses / Water Bodies	Covell's Drain	
Designation	Non-main river	
Model ID	The following table presents information regarding the Existing and Scheme Model Scenario ID	
Model Scenario ID	**Scenario**	**Return Period**
A14_COV_BL_025_004.DAT	Existing Model	1 in 25 years (4% AEP)
A14_COV_BL_100_004.DAT		1 in 100 years (1% AEP)
A14_COV_BL_100CC_004.DAT		1 in 100 years + 20% (1%+CC AEP)
A14_COV_BL_025_004_Design.DAT	Scheme Model	1 in 25 years (4% AEP)
A14_COV_BL_100_004_Design.DAT		1 in 100 years (1% AEP)
A14_COV_BL_100CC_004_Design.DAT		1 in 100 years + 20% (1%+CC AEP)

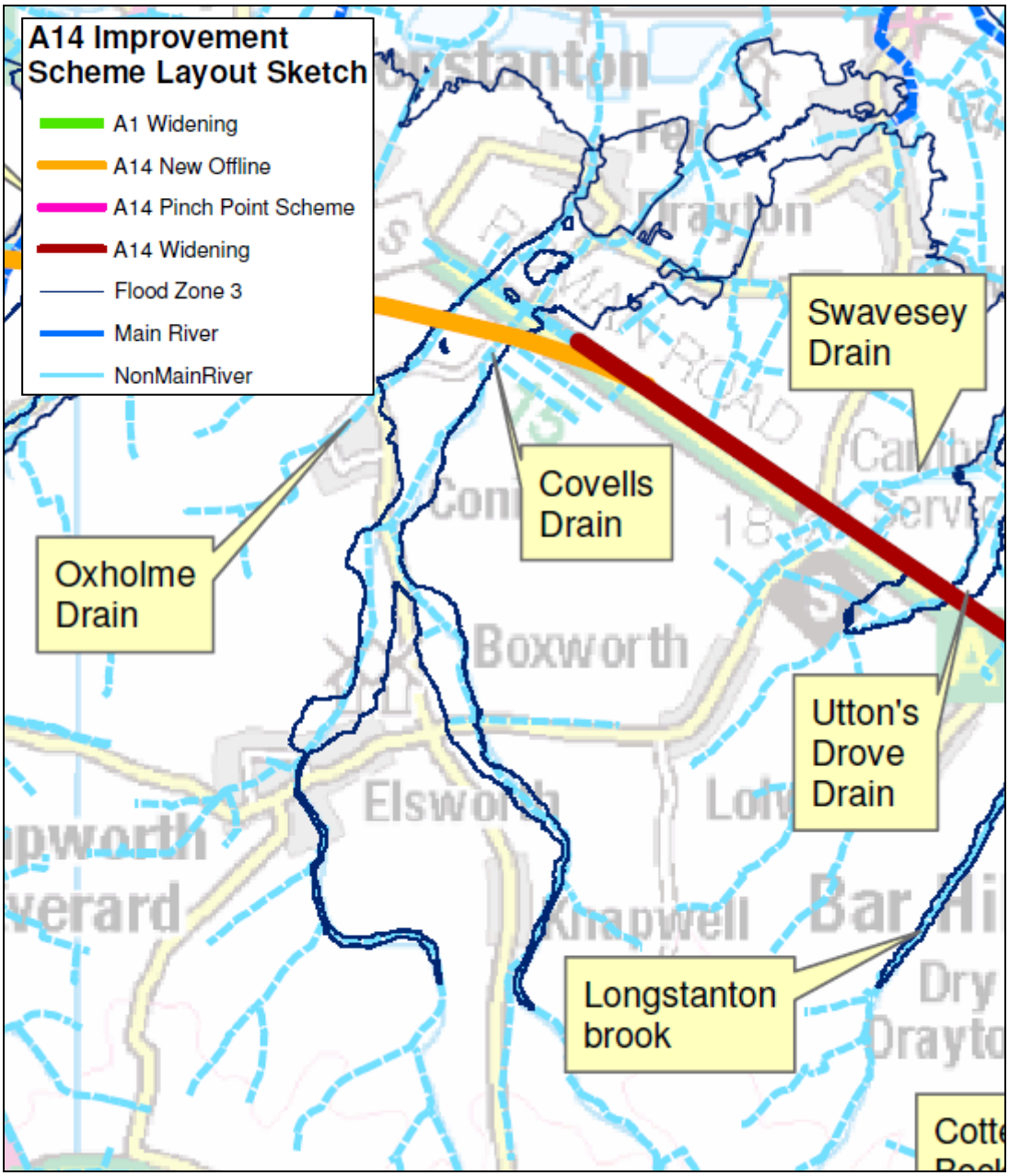
2. Survey Data and Base Mapping

2.1 Base Mapping:	1 to 10,000 Scale Raster Reference: TL3060
2.2 DTM for 2D Model domain:	N/A 1D Model
2.3 River channel/Structures survey	All survey data have been retained as in existing model. Number of cross-sections included in this model: 29

3. Baseline Hydraulic Model Schematisation

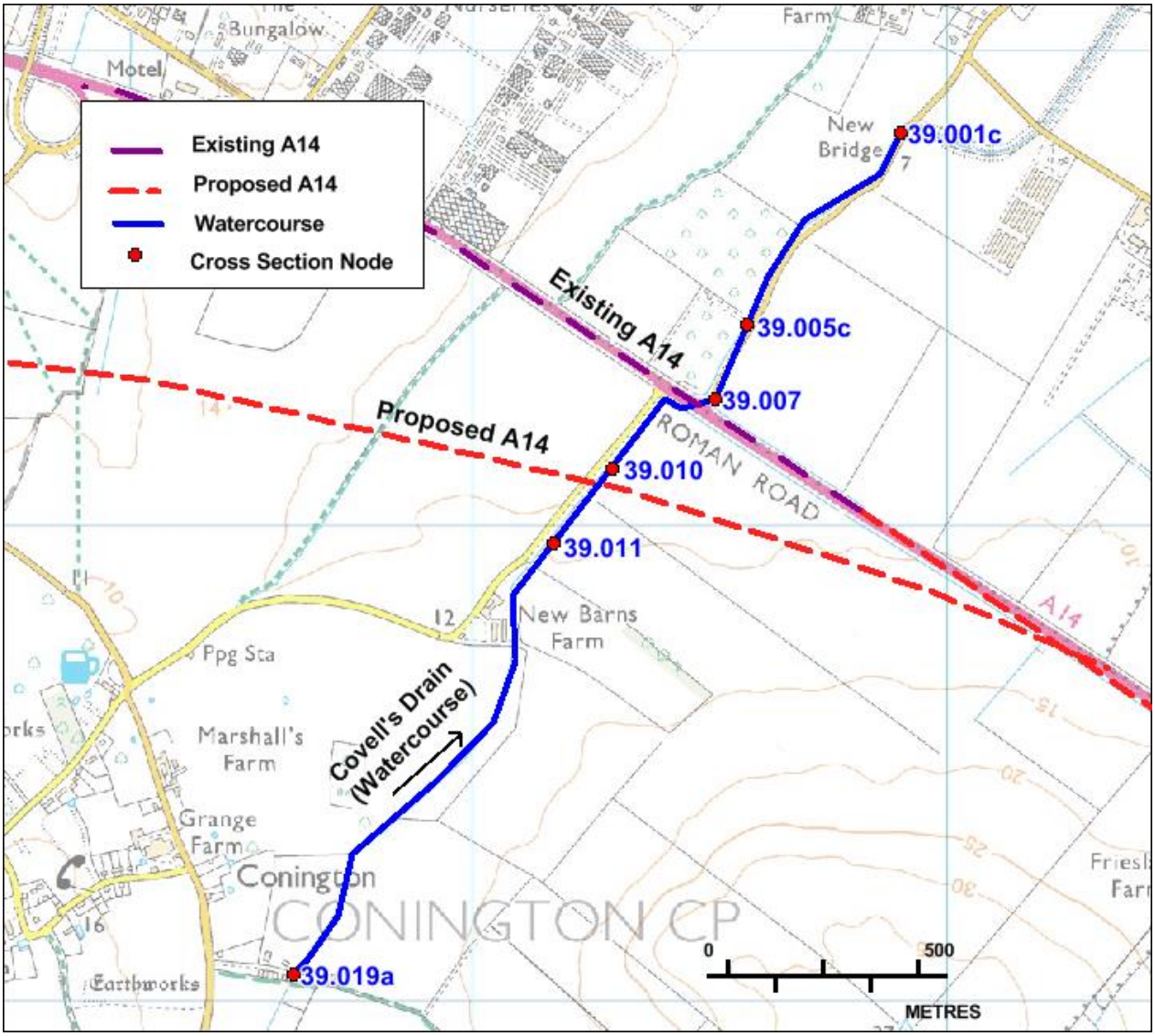
3.1 Software:	**1D domain:**	ISIS Version 3.7.0.233 (32 bit - Single Precision)
	2D domain(s):	N/A
3.2 Baseline model:	Atkins 2009 ISIS 1D Model	
3.3 Baseline Model Reference	Atkins (2009) Ellington to Fen Ditton Phase 1a: A14 Hydraulic Modelling Report	
3.4 Model area / extent:	The areal extent of the model and model schematisation in the proximity of the new A14 are presented in the following figures	

Areal Extent of Covell's Drain

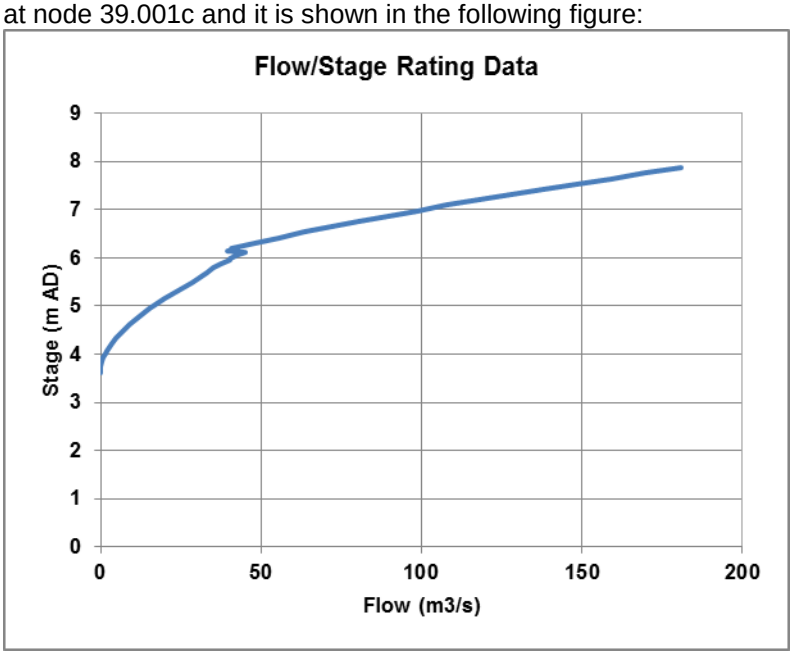


Baseline model schematisation including upstream and downstream model nodes

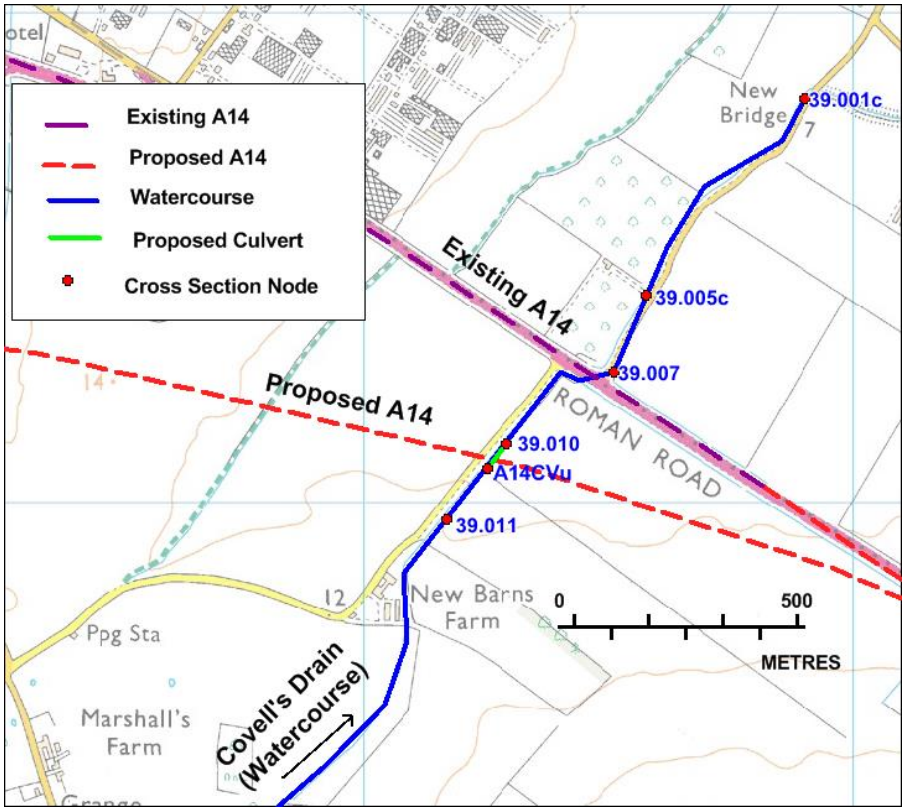
Distance in between cross sections nodes have been approximated based on ISIS 1D model distances. The location of all nodes is approximate. The image below shows only key nodes and not all the nodes present in the ISIS model.



3.5 Model reaches:	The following model reaches as shown on the maps referred above have been defined in the model:	
Watercourse name	**Upstream model node**	**Downstream model node**
Covell's Drain	39.019a	39.001c
Total model length (km):	2.334	
3.6 Key Model structures:	N/A	
3.6 Floodplain schematisation	Floodplain areas have been modelled using a 1D approach in the ISIS model, using extended cross sections	
3.7 Model Boundaries - Inflows	Hydrological flow hydrographs are input into the model as point inflows at locations indicated in the table below:	
(a) Existing Model	Peak inflows (m^3/s) are summarised in the table below for the existing model.	

Input Node in the Hydraulic Model	Annual Exceedance Probability		
	4%	1%	1% + CC
39.019a	7.824	9.99	11.413
3.8 Model Boundaries – Downstream Conditions	Downstream boundary conditions adopted in the model are as follows:		
	The outflows at the downstream end of the model extent are modelled using a flow-head boundary type. This boundary condition was applied at node 39.001c and it is shown in the following figure: 		

4. Scheme Model Build

4.1 Scenario Definition	Inclusion of a 60m rectangular culvert of 3.0m width and 2.5m height across new A14 alignment.
ISIS 1D Model	
4.2 Model Extent of the Affected area	**Scheme model schematisation including upstream and downstream model nodes** Distance in between cross sections nodes have been approximated based on ISIS 1D model distances. The location of all nodes is approximate. The image below shows only key nodes and not all the nodes present in the ISIS model. 
4.3 Modelling approach for the new structures	Proposed culvert is located 250m approximately from existing A14. ISIS node for the existing A14 is A14CVT. Proposed culvert is located between cross sections 39.011 and 39.010, at a distance of 60m from cross section 39.010. At this location a copy of cross section 39.010 has been placed, bed level was adjusted to preserve existing channel gradient. There is no bypassing or overtopping of the proposed structure.
4.4 Model Units added/removed	Proposed culvert was modelled using the following units: Culvert Inlet Unit = A14CVu Rectangular Conduit Unit (x2) = A14c1 and A14CVd Culvert Outlet Unit = A14CVd Introduced Cross section Unit = A14CVu (60m from Cross section 39.010)
4.5 Culvert Inverts	Upstream Invert: = 6.468m (As upstream open section level) Downstream Invert = 6.296m (As upstream open section level) Culvert Inlet Control Data = Conduit Type B used (k=0.495, M=0.667, C=0.0314, Y=0.82, Ki=0.5) Culvert Outlet Loss Coefficient = 1.0

4.6 Hydraulic Roughness of proposed units	Roughness coefficients based on design specifications using CIRIA Report 168 Bed roughness n = 0.03 (For natural channel) Wall/Soffit roughness n = 0.016 (For smooth concrete)
4.7 Design Detail Sources	Culvert dimensions *Proposed A14_Structures on Watercourses.xlsx* Road outline used to calculate approximate distance between proposed culvert ad current A14 alignment *A14-JAC-ZZ-00-M2-C-00001.dwg*

5. Hydraulic Model Outputs

5.1 Model simulations

The model outputs were processed to extract maximum stage values at key locations for the 4%, 1% and 1% + CC AEP.

a) Existing Model

Maximum Stage values for the Existing Model are provided in the table below at key locations

Location	Model node	Peak Water level (mAOD)		
		4%	1%	1% + CC
Upstream model node	39.019a	11.80	12.03	12.18
198m u/s of proposed A14	39.011	8.94	9.09	9.18
u/s of proposed A14	A14CVu	8.68	8.84	8.94
d/s of proposed A14	39.010	8.57	8.76	8.86
Downstream model node	39.001c	4.52	4.65	4.73

b) Scheme Model

Maximum Stage values for the Scheme Model are provided in the table below at key locations

Location	Model node	Peak Water level (mAOD)		
		4%	1%	1% + CC
Upstream model node	39.019a	11.80	12.03	12.18
198m u/s of proposed A14	39.011	8.97	9.14	9.32
u/s of proposed A14	A14CVu	8.69	8.94	9.12
d/s of proposed A14	39.010	8.57	8.75	8.86
Downstream model node	39.001c	4.52	4.65	4.73

Effect of proposed Structures

The following figures present a comparison between maximum stage for the Existing and Scheme Models for the 4%, 1% and 1% + CC AEP.

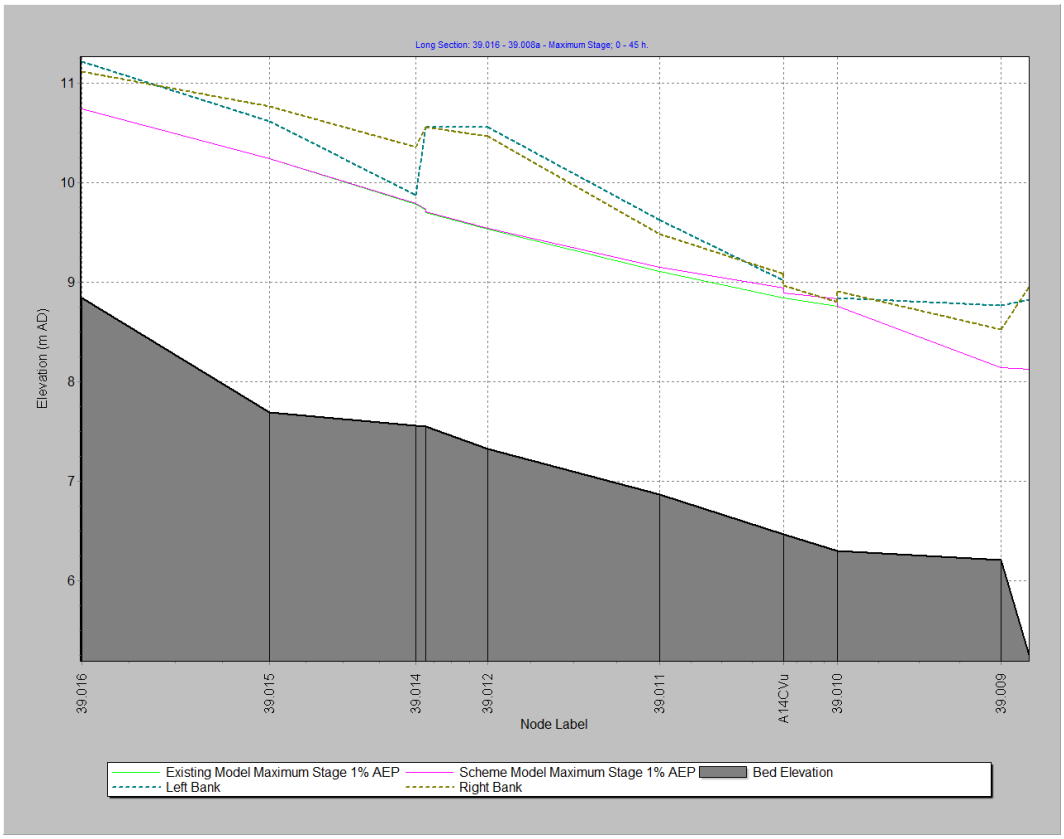
<u>25</u>
Max stage rise: 9mm
*Upstream reach length influenced: N/A

<u>100</u>
Max stage rise: 95mm
*Upstream reach length influenced: 329m

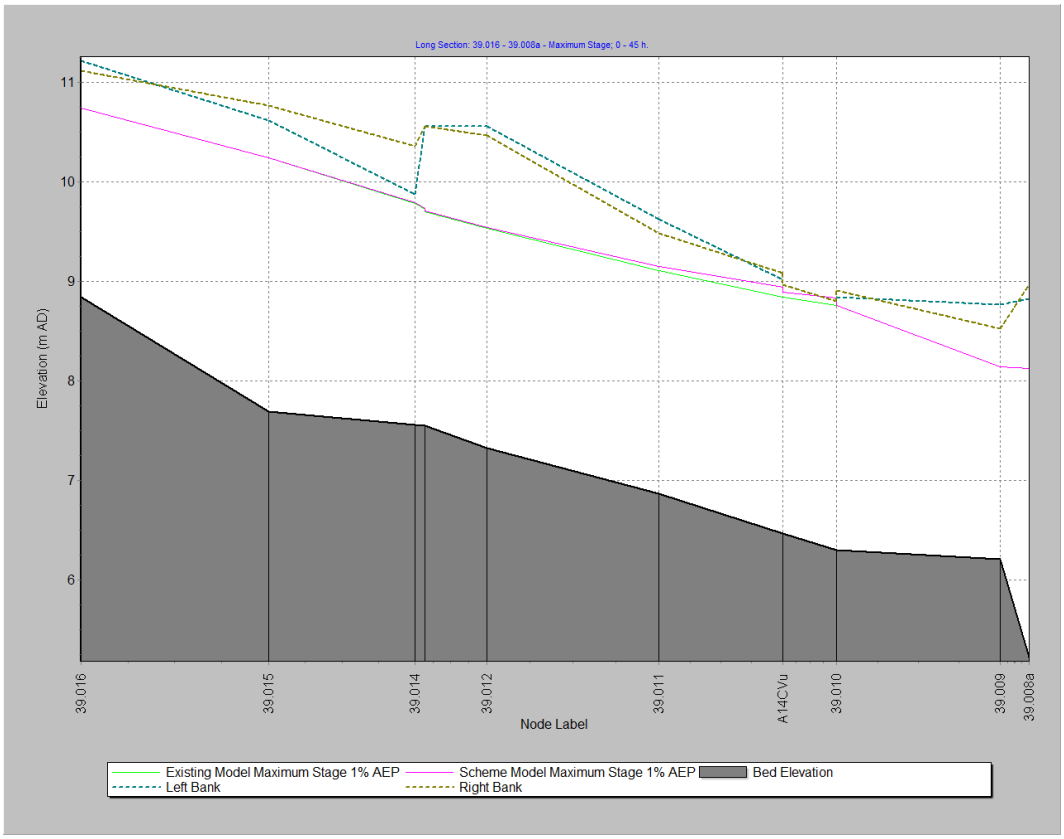
<u>100CC</u>
Max stage rise: 181mm
*Upstream reach length influenced: 409m

*upstream influence is presented for Water level increases greater than 10mm.

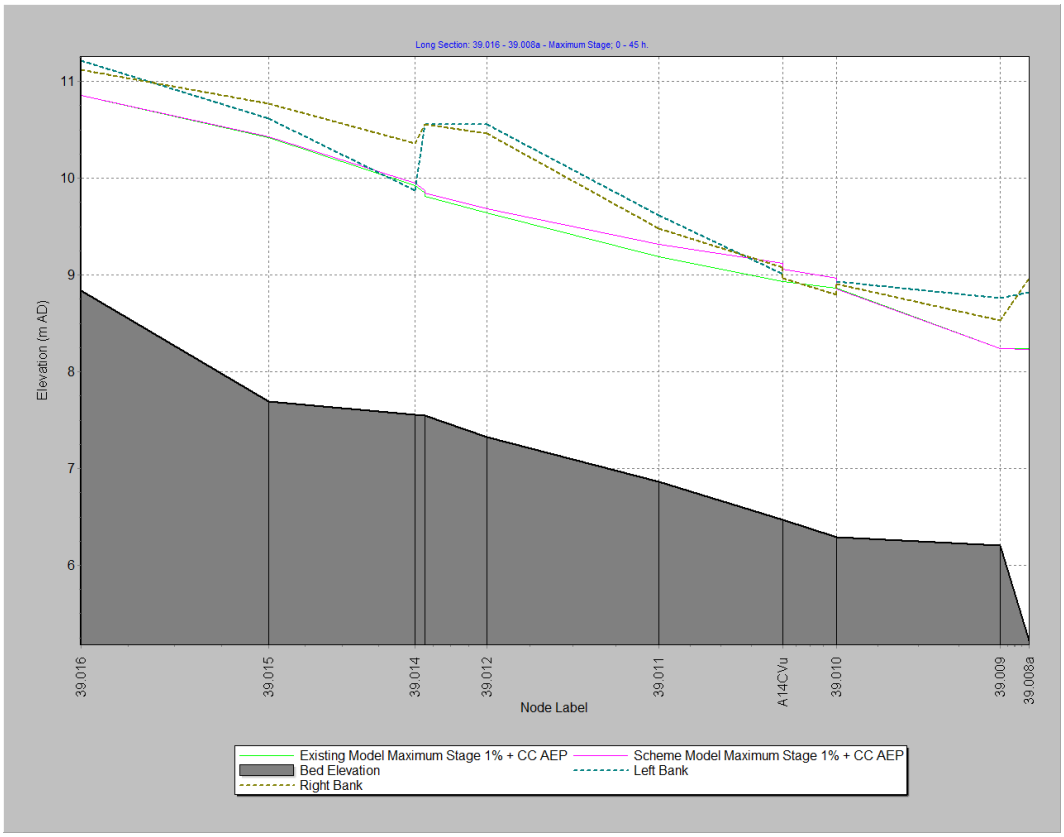
Maximum Stage Upstream and Downstream of proposed culvert – 4% AEP



Maximum Stage Upstream and Downstream of proposed culvert – 1% AEP



Maximum Stage Upstream and Downstream of proposed culvert – 1%+CC AEP



6. Key model assumption and limitations

- The supplied hydraulic models were assumed to be fit for purpose and no detailed review was undertaken for the purpose of Flood Risk Assessment of the A14 scheme.
- No cross section geo-referencing/schematics were provided with the model. The location of the proposed culvert was calculated based on design drawings for the proposed A14 alignment. The distance between the proposed A14 and existing A14 has been approximated from the drawings.
- In the baseline model, significant glass walling was identified in some locations. Any amendments to model to eliminate glass walling were beyond the scope of this comparative study.
- Cross section A14CVu placed 60m from cross section 39.010 is a copy of cross section 39.010 with lowered bed levels to retain existing channel gradient. At this location there is no survey or LiDAR data available at this time.
- Culvert Inlet design was assumed to feature 90° headwall and 45° bevels.
- No calibration or sensitivity testing simulations were carried out as part of this hydraulic modelling exercise