TECHNICAL NOTE

TO:	Kelvin Limbrick	DATE:	12 October 2018
FROM:	Krishna Dey	CC:	Lauriane Allard/Tahira Tewaz
PROJECT NAME:	Peak District (East) VIP Project: River Don Hydraulic Modelling – Bridge Impact Assessment		
PROJECT NO:	41523999		
SUBJECT:	Bridge Impact Assessment: ISIS-Tuflow Impact Assessment Modelling		
FILE LOCATION:	\ukwar4s01\data_cad\National Grid - Peak District Modelling\ISIS-Tuflow\Technical Note Bridge modelling\		

1 INTRODUCTION

Stantec has been instructed by National Grid to undertake an impact assessment on flood level and velocity due to the construction of two new bridges (Permanent Bridge 1 and Temporary Bridge 2) on the River Don, as part of the Peak District (East) Visual Impact Provision (VIP) Project. The purpose of this assessment is to help inform the environmental and flood risk assessments of the Peak District (East) VIP scheme. The location of the proposed bridges is shown in Appendix A.

This Technical Note presents the results of the modelling work undertaken to identify the potential impact of th construction of these bridges on flood level and velocity.

2 MODELLING METHODOLOGY

2.1 Modelling Approach

The 1D-2D linked ISIS-Tuflow hydraulic model of the River Don and its tributaries built by Stantec in 2017 was used to assess the impacts of the proposed bridges on the River Don. The proposed Permanent Bridge 1 replaces an existing access bridge located at ISIS River node DON01_2460. The details of Permanent Bridge 1 are shown in Appendix B. Temporary Bridge 2 is located at ISIS River node DON01_1358; the details of this bridge are shown in Appendix C.

2.2 Bridge representation in the 1D Model

The Permanent Bridge 1 replaces the existing access bridge located at ISIS River node 'DON01_2460'. The start of the Permanent Bridge 1 opening was placed at a distance of 3.75m (half the width of the opening) from the left of the cross-section w.r.t to the lowest bed level (at cross section chainage 11.021m) of the u/s cross-section, DON01_2460 (i.e. at chainage 7.271m (11.021m - 3.75m)) and the end of the Permanent Bridge 1 opening was placed at a distance of 3.75m towards the right of the cross-section (i.e. at chainage 14.771m (11.021m + 3.75m)).

The Temporary Bridge 2 was placed at ISIS node DON01_1358. Two points were added manually at the left and right bank of the cross-section (DON01_1358) to reflect ground elevations 269.5m AOD (left abutment) and 271.6m AOD (right abutment) respectively to form the bridge opening for Temporary Bridge 2. This bridge was placed perpendicular to the flow direction.

The width and height of the bridge opening, soffit level, deck level and the corresponding flow area are shown in Table 1 for the proposed Permanent Bridge 1 and Temporary Bridge 2 along with existing bridge dimension to be replaced by Permanent Bridge 1. The proposed Permanent Bridge 1 will increase the flow area by ca. 59% compared to the existing bridge.

Table 1: Bridge dimensions - Permanent Bridge 1 and Temporary Bridge 2

ISIS Node	Width of Opening (m)	Height of Opening (m)	Soffit Level (m AOD)	Deck Level (m AOD)	Flow Area (m^2)	Remarks
DON01_2460 (Permanent Bridge 1) - Existing	7.780	1.995	285.716	286.20	15.52	This is the existing Bridge. Deck level represents the average level calculated.
DON01_2460 (Permanent Bridge 1) - Proposed	7.500	3.290	287.010	287.01	24.67	The existing bridge above will be replaced by this proposed bridge.
DON01_1358 (Temporary Bridge 2)	18.449	3.645	272.100	273.80	67.25	Proposed Bridge, bridge was placed perpendicular to the flow direction.

2.3 Design Runs

The proposed bridge scenarios as described in Section 2.2 above were run for the 1 in 100 year and the 1 in 100 year + climate change events. The results from these runs were compared with the existing results (i.e. base simulations for the same events carried out in 2017) in order to prepare the difference maps for flood level and velocity for the entire model domain.

2.3.1 Mass Balance Check

The mass balance check is a good indicator of the performance of the ISIS-TUFLOW model. The cumulative mass balance errors (ME) at the end of the simulations are shown in Table 2. The TUFLOW Manual states that for most models the mass balance is usually within +/- 1% but 2 or 3% can be acceptable depending on the objectives of the modelling (please refer to Table 14-1, TUFLOW Manual, Build 2016-03-AE). The cumulative mass balance error for the base and option simulations lies under 1%, which is considered excellent.

Table 2: Cumulative Mass Balance Error for 'base' and 'option' simulations

Model File Name (.TCF)	Type	Scenarios	Cumulative Mass Error (%)
DON_CB_SG_100yr_new_v6.tcf	Base	100 Year	-0.41
DON_CB_SG_100yr_new_v8.tcf	Option	100 Year	-0.44
DON_CB_SG_100yr+20%cc_new_v2.tcf	Base	100 Year + 20%CC	-0.39
DON_CB_SG_100yr+20%_new_v8.tcf	Option	100 Year + 20%CC	-0.40

2.3.2 Model Run Files

Table 3 shows the software version used for this ISIS-TUFLOW modelling. The model run times for the 'base' and 'option' simulations were generally 1.1 hours to complete each run. A detailed model run log is produced as spreadsheet.

Table 3: Software version with reference to TUFLOW Control File

Model File Name (.TCF)	Type	Simulation Duration (hour)	ISIS/Flood Modeller Version	TUFLOW Version
DON_CB_SG_100yr_new_v6.tcf	Base	11	ISIS VER = 6.7.2.117	2016-03-AC-iSP-w64
DON_CB_SG_100yr_new_v8.tcf	Option	11	ISIS VER= 6.7.0.110	2016-03-AC-iSP-w64
DON_CB_SG_100yr+20%cc_new_v2.tcf	Base	11	ISIS VER= 6.7.2.117	2016-03-AC-iSP-w64
DON_CB_SG_100yr+20%_new_v8.tcf	Option	11	ISIS VER= 6.7.0.110	2016-03-AC-iSP-w64

2.4 Assessment of results for 'Base' and 'Option' Simulations

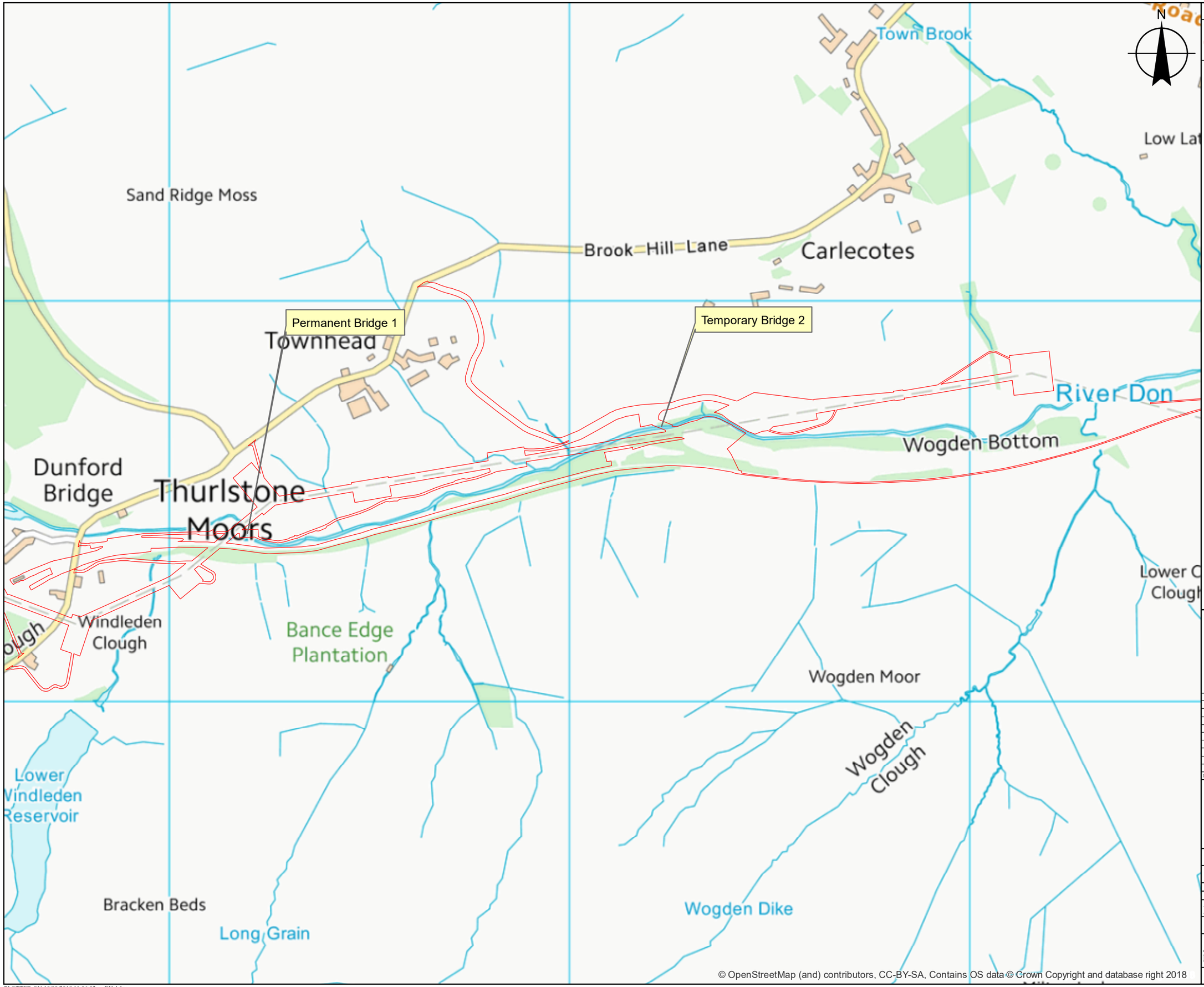
Difference maps for flood level and velocity have been produced by subtracting the 'base' from the 'option (proposed)' simulations as shown in Appendix D and E respectively for the 1 in 100 year and the 1 in 100 year + 20% for climate change events. The difference maps for both level and velocity show only localised changes and in places many of these changes are reductions in flood level due to the greater flow area of the proposed bridges (see Table 1). These 'difference' flood maps demonstrate that the construction of proposed bridges over the River Don would not have any significant impact on flood levels and velocities under the 1 in 100 year and the 1 in 100 year (plus climate change scenario). The proposed new bridges over the River Don would not, therefore, have a detrimental impact on flood risk elsewhere.

3 CONCLUSIONS

This Technical Note summarises the results of a detailed impact assessment on flood level and velocity due to the construction of two proposed new bridges over the River Don. Stantec's existing ISIS-TUFLOW linked model of the River Don and its tributaries has been used to inform this assessment. The assessment demonstrates that the proposed new bridges would not be expected to result in an increase in flood risk either on site or elsewhere.

Appendix A

Location of Proposed 2 Bridges (Permanent Bridge 1 and Temporary Bridge 2)



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NOTES

1. ALL DIMENSIONS IN MILLIMETRES AND ALL LEVELS IN METRES UNLESS SHOWN OTHERWISE

0 0.225 0.45
km

REFERENCES

DRAWING NUMBER	DRAWING TITLE

Legend

Site Boundary

CURRENT VERSION INFORMATION

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nationalgrid

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...	SE 17749 03309	...	KD

Project Group: ...
Sub Process: ...
Location / Town: Sheffield, S36 4TD UK
Site Name: Carlecotes, Sheffield
Project Name: River Don Flooding Study
Contract Name:
Drawing Title: Appendix A Location of bridges for impact assessment modelling

Drawing No.:	Scale:	Sheet Size:	Rev:
01	1:8,500	A3	A

PLOTTED ON 10/09/2018 11:06:02 BY kdey
LOCATION : L:\National Grid - Peak District Modelling\ISIS-Tuflow\Technical Note Bridge modelling\Appendices\Appendix A - Location of bridges for impact assessment.mxd

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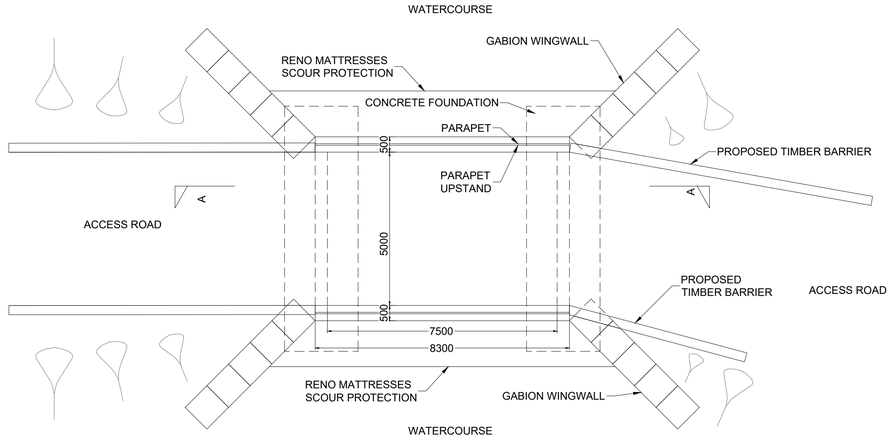
Appendix B

Details of the Proposed Permanent Bridge 1

PERMANENT BRIDGE 1 LOCATION PLAN



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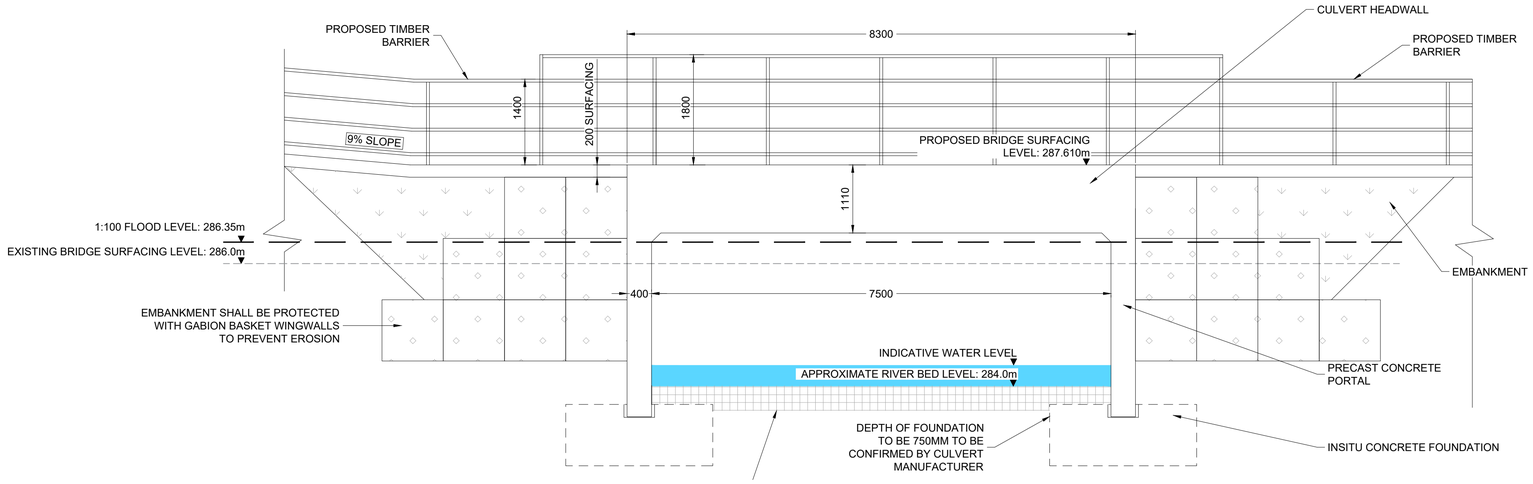

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(NORTH SIMILAR)
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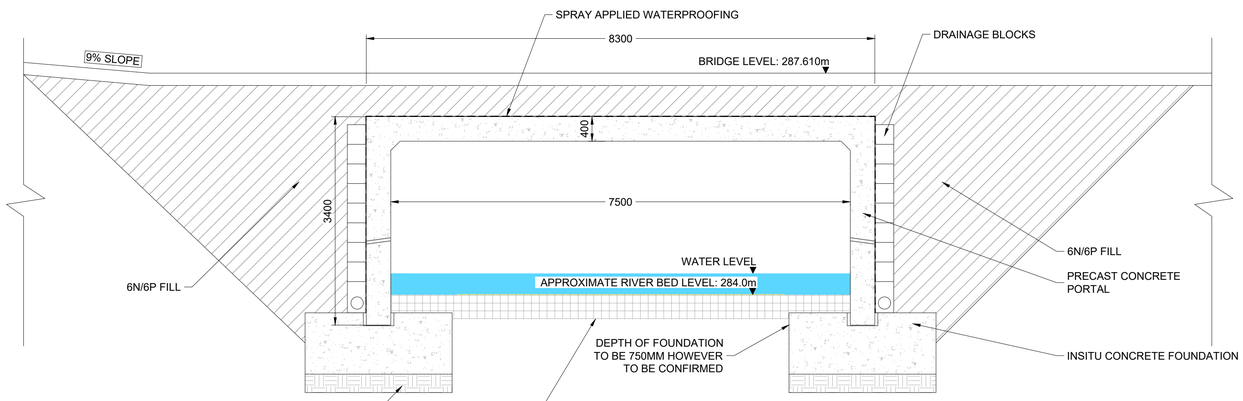

SECTION A - A
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LOCATION PLAN

DRAFT
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	Description	Cre'd	Chk'd	App'd	Date
P5	BRIDGE WIDTH REDUCED	ST	BH	RR	14/05/18
P4	BRIDGE REPLACED WITH PRECAST CONCRETE PORTAL	DR	RR	RR	07/12/17
P3	NOTE ABOUT TEMPORARY WORKS ADDED	PH	RR	RR	29/09/17
P2	BRIDGE ABUTMENTS AMENDED	PH	RR	RR	27/09/17
P1	FIRST ISSUE	PH	RR	RR	21/09/17

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Master Scheme No:	Sub-Scheme No:	Site:
33492	–	400KV OHL

Scheme Name: VISUAL IMPACT PROVISION – WORK PACKAGE 1
PEAK DISTRICT NATIONAL PARK

Document Title:

PERMANENT BRIDGE GENERAL ARRANGEMENT

Created by:	Date:	Checked by:	Date:	Approved by:	Date:
P.HADJINIKODIMOU	21/09/17	R.RAVEENDRAN	21/09/17	R.RAVEENDRAN	21/09/17

Development Eng:	Document Type:	Scale:	Format:	Sheet(s):	Rev:
D.SPURR	2D DRAWING	VARIES	A1	1 OF 1	P5

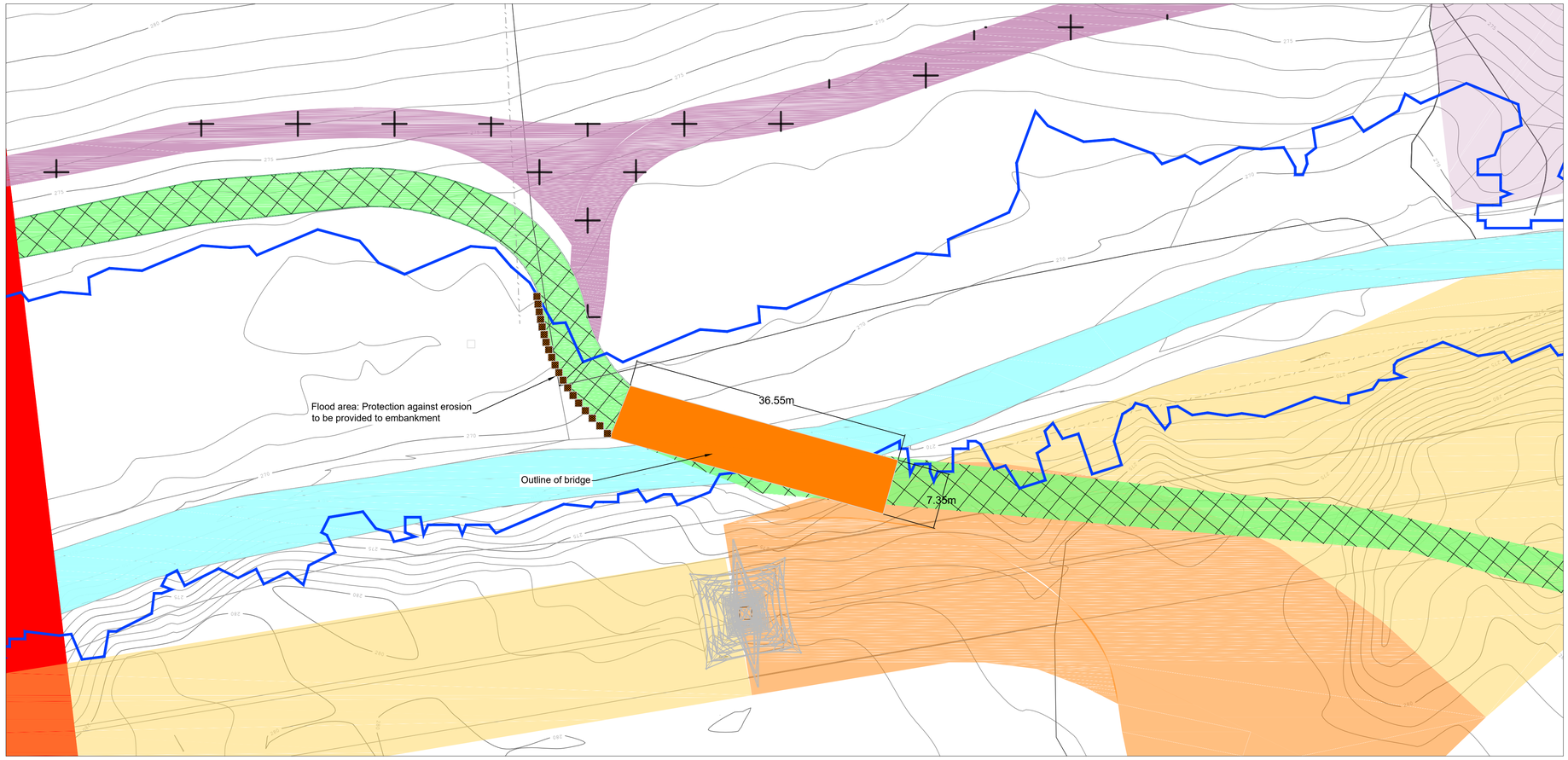
National Grid Document Number:

PDD–33492–LAY–057

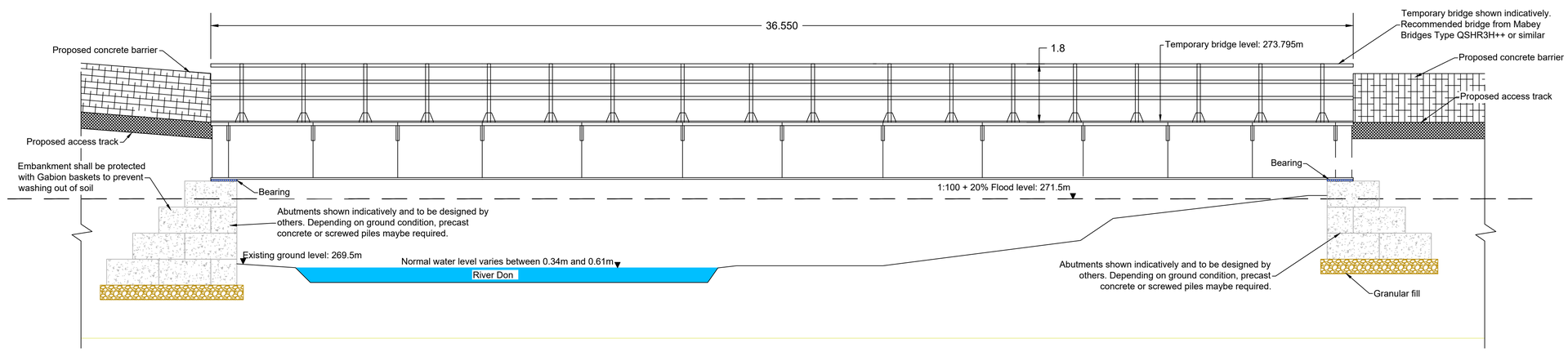
FEED Document Number:

Appendix C

Details of the Proposed Temporary Bridge 2



TEMPORARY BRIDGE LOCATION PLAN



TEMPORARY BRIDGE - SIDE ELEVATION

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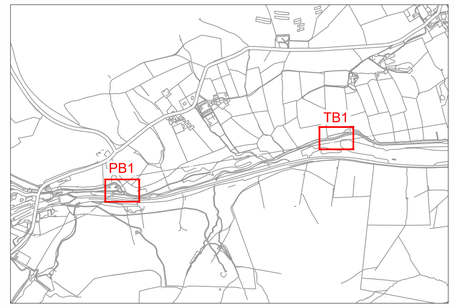
LOCATION PLAN



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P3	NOTE ABOUT TEMPORARY WORKS ADDED	PH	RR	RR	29/09/17
P2	BRIDGE ABUTMENTS AMENDED	PH	RR	RR	27/09/17
P1	FIRST ISSUE	ST	RR	RR	21/09/17
	Description	Cre'd	Chk'd	App'd	Date

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Master Scheme No:	Sub-Scheme No:	Site:
33492	–	400KV OHL

Scheme Name: VISUAL IMPACT PROVISION – WORK PACKAGE 1
PEAK DISTRICT NATIONAL PARK

Document Title:

TEMPORARY BRIDGE
SIDE ELEVATION

Created by:	Date:	Checked by:	Date:	Approved by:	Date:
S.THARMARAJLINGAM	08/12/17	B.HOLLAND	08/12/17	R.RAVEENDRAN	08/12/17

Development Eng:	Document Type:	Scale:	Format:	Sheet(s):	Rev:
D.SPURR	2D DRAWING	1:50	A1	1 OF 1	P4

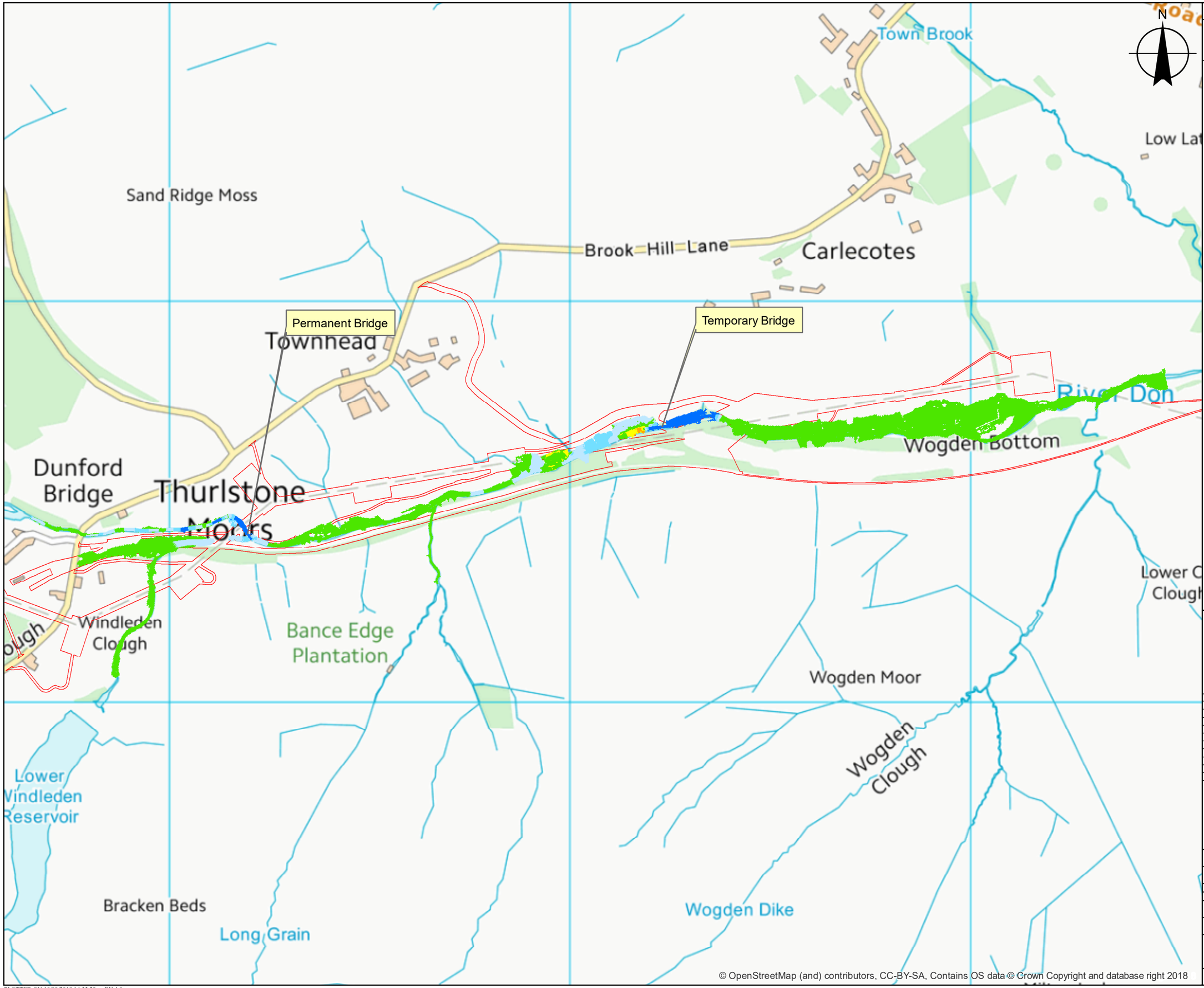
National Grid Document Number:

PDD–33492–LAY–058

FEED Document Number:

Appendix D.1

Difference Map - Flood Level, 1 in 100 Year



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NOTES

1. ALL DIMENSIONS IN MILLIMETRES AND ALL LEVELS IN METRES UNLESS SHOWN OTHERWISE

0 0.225 0.45
km

REFERENCES

DRAWING NUMBER	DRAWING TITLE

Legend

Difference in Flood Level (m)

- > -0.12
- -0.12 - -0.07
- -0.07 - -0.02
- -0.02 - +0.02
- 0.02 - 0.07
- 0.07 - 0.12
- > 0.12
- Site Boundary

CURRENT VERSION INFORMATION

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Project Group:	Sub Process:
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Location / Town: Sheffield, S36 4TD UK
Site Name: Carlecotes, Sheffield
Project Name: River Don Flooding Study
Contract Name:
Drawing Title: Appendix D.1 Flood Level Difference Map - 1 in 100 Year

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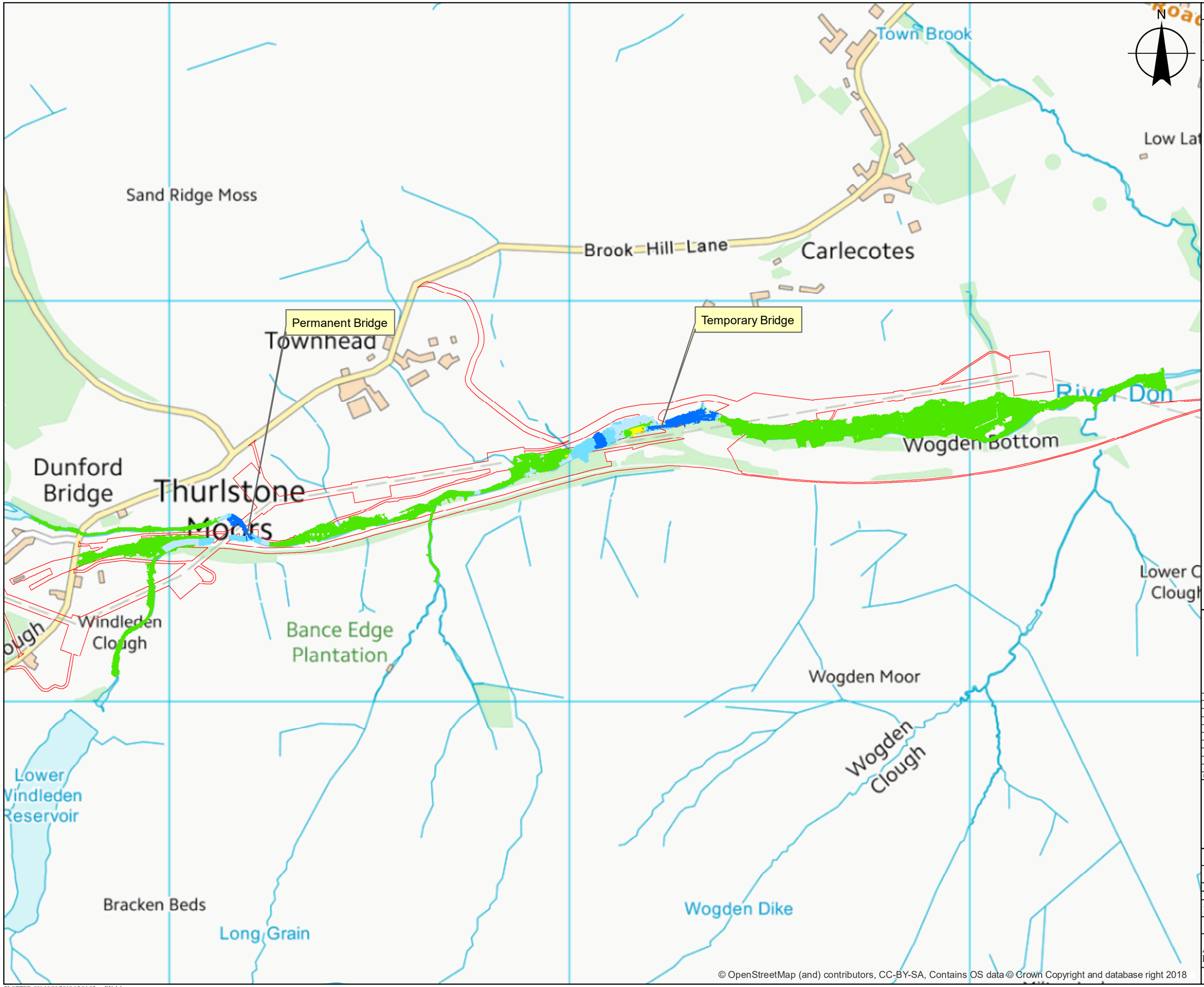
Appendix D.2

Difference Map - Flood Level, 1 in 100 Year + 20% CC



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NOTES

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0 0.225 0.45
km

REFERENCES

DRAWING NUMBER	DRAWING TITLE

Legend

Difference in Flood Level (m)

- > -0.12
- -0.12 - -0.07
- -0.07 - -0.02
- -0.02 - +0.02
- 0.02 - 0.07
- 0.07 - 0.12
- > 0.12
- Site Boundary

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Site Name: Carlecotes, Sheffield

Project Name: River Don Flooding Study

Contract Name:

Drawing Title: Appendix D.2
Flood Level Difference Map - 1 in 100 Year+20%CC

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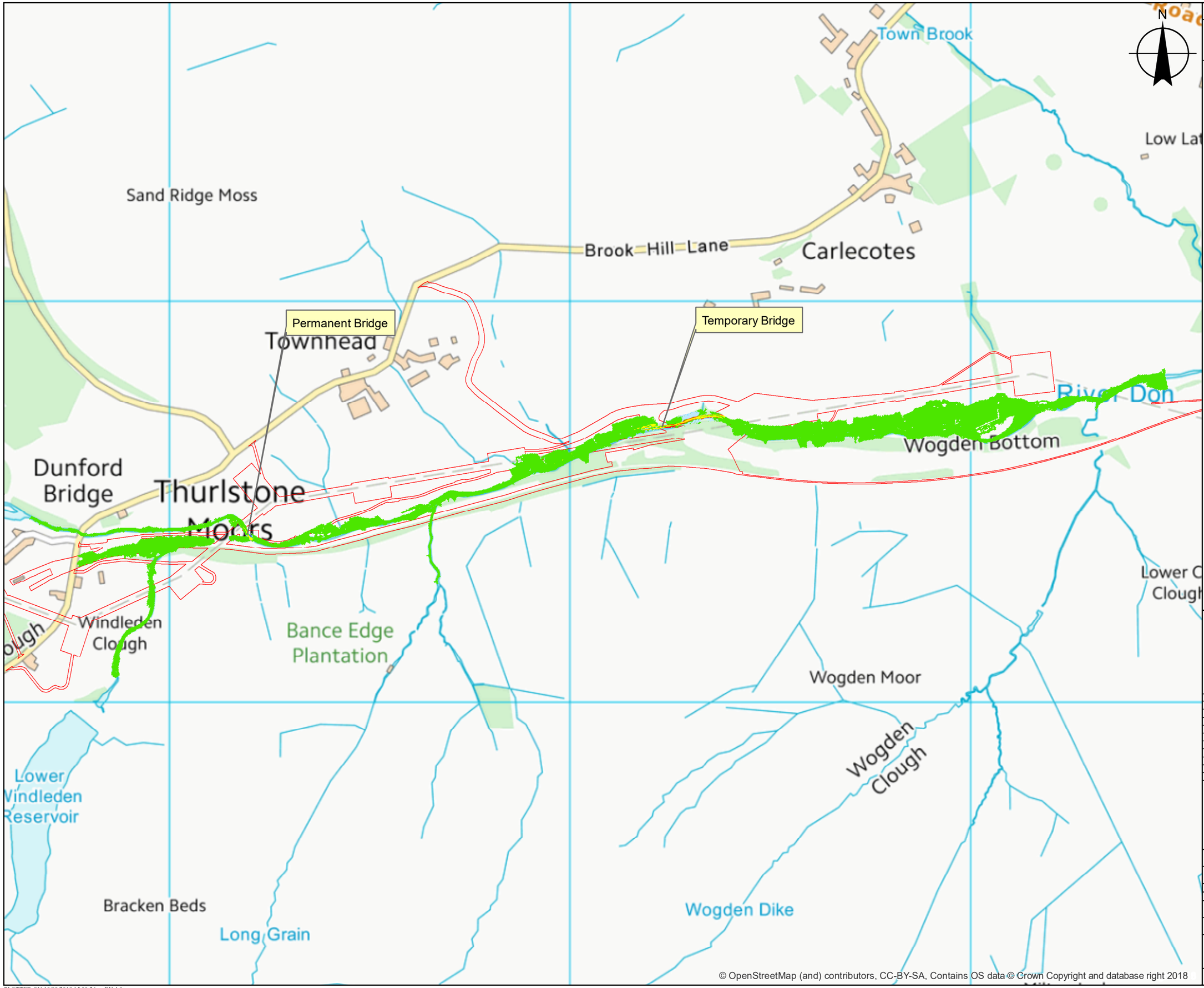
Appendix E.1

Difference Map - Flood Velocity, 1 in 100 Year



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REFERENCES

DRAWING NUMBER	DRAWING TITLE

Legend

Difference in Flood Velocity (m/s)

- > -2.00
- -2.00 - -1.50
- -1.50 - -0.50
- -0.50 - 0.50
- 0.50 - 1.50
- 1.50 - 2.00
- > 2.00
- Site Boundary

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Project Group: ...		Sub Process: ...	

Location / Town: Sheffield, S36 4TD UK

Site Name: Carlecotes, Sheffield

Project Name: River Don Flooding Study

Contract Name:

Drawing Title: Appendix E.1 Flood Velocity Difference Map - 1 in 100 Year

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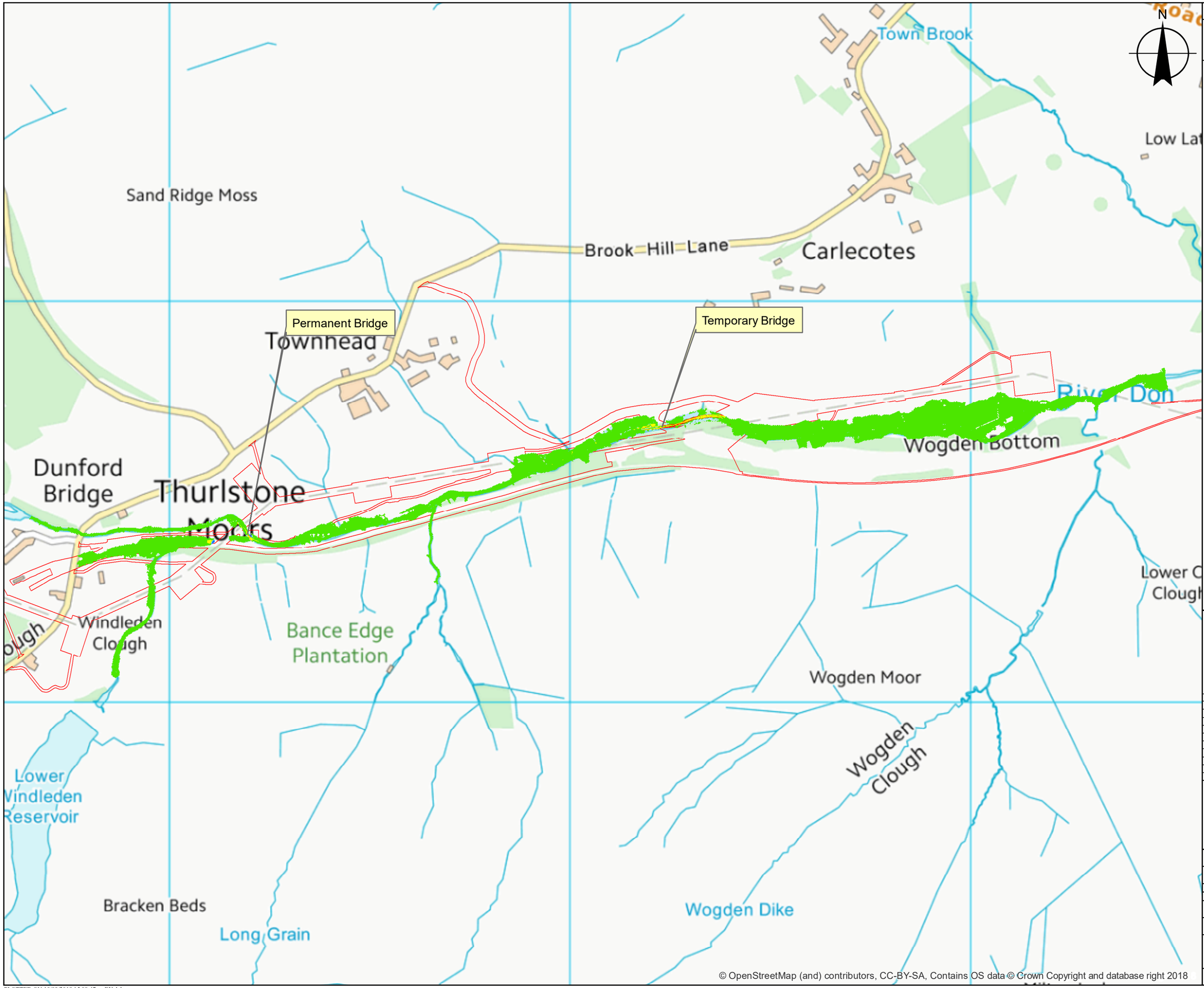
Appendix E.2

Difference Map - Flood Velocity, 1 in 100 Year + 20% CC



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NOTES

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0 0.225 0.45
km

REFERENCES

DRAWING NUMBER	DRAWING TITLE

Legend

Difference in Flood Velocity (m/s)

- > -2.00
- -2.00 - -1.50
- -1.50 - -0.50
- -0.50 - 0.50
- 0.50 - 1.50
- 1.50 - 2.00
- > 2.00
- Site Boundary

CURRENT VERSION INFORMATION

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Project Group:	Sub Process:
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Location / Town: Sheffield, S36 4TD UK

Site Name: Carlecotes, Sheffield

Project Name: River Don Flooding Study

Contract Name:

Drawing Title:

Appendix E.2
Flood Velocity Difference Map - 1 in 100 Year+20%CC

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