Response to Inspectors Question regarding INQ/131 and Mr Patmore's evidence INQ/132

Introduction

This note has been prepared in response to questions raised regarding the 'Addendum to Note on Floodplain Compensation Storage provision north of Robertsbridge Station' dated 30th July 2021, which was submitted to provide further information to the 'Note on Floodplain Compensation Storage provision north of Robertsbridge Station' dated 28th July 2021.

This note also provides some further information in response to Mr Patmore's evidence 'Review of Flood Compensation Options (INQ/132) dated 2nd August 2021.

Part 1 - Response to Inspectors questions regarding INQ/131

1. Is there no scope for flood compensation between 9.53 and 9.56mAOD?

   As stated in the addendum (INQ/131), there is scope for flood compensation between 9.53 mAOD and 9.56 mAOD if the area is extended northwards slightly towards the drainage ditch that runs parallel to the embankment.

   Further to this as outlined in Part 2 below. Additional land is available in this elevation range at Salehurst Halt.

2. Fig 2 profile in **INQ/114** goes up to 15m whereas note refers to up to 21m. Please explain – and explain implications?

   This was an error – addendum updated with red text. No implications.

   Please note also that there is a typing in INQ/131 addendum – response 2 refers to "9.65" which should read "9.56".

   Addendum has been updated.

Part 2 - Response to INQ/132

Some further information is provided below in response to Mr Patmore's evidence INQ/132 Landowner's Technical Note on Compensation in response to INQ/114 dated 2nd August 2021

Response to 'Points of clarification on Note INQ/114':

1) Note INQ/114 was written in response to the Inspectors questions regarding Area 1. It did not seek to add further information that had not been requested regarding the section east of the Mill Stream at this stage of the inquiry. Further information on calculations for land to the east are provided below.

2) The reduction in storage requirement once the updated climate change guidance is taken into consideration will be at the higher elevations. However, the impact of applying the latest

climate change guidance becomes more significant when considering the section between Moat Farm and Junction Road, where there is an existing embankment. Figure 1 illustrates that at some locations a lower maximum flood level reduces the level up to which floodplain compensatory storage is calculated to below the level at which alterations to the existing embankment are proposed.

3) As stated in INQ/114, "The estimated volume of the embankment from The Clappers/Northbridge Street to the A21 up to the maximum flood level predicted for the 1% AEP design event with 105% climate change allowance, is approximately 2,500 m^3." The value of 3360m^3 in Table 1 includes some of the embankment downstream of the A21. This is explained in note INQ/114. However, Mr Patmore acknowledges these are similar in scale to the values he calculated. As stated previously and agreed by Mr Patmore the final volume requires cannot be finalised until the detailed design stage. Further discussion of the methods used to calculate the required volumes are provided below and demonstrate the potential variation in calculated volumes depending on the assumptions made.

   Response to 'Flood Compensation - Potential volumes involved'

   The assumptions made in WSP (Mr Patmore's) calculations were discussed in INQ/113 and include the assumption that the top of the embankment is at the rail level and 1 in 3 embankment slopes throughout. Table 1 below demonstrates that using the top of ballast level rather than the rail level reduces the volumes calculated and that undertaking the calculation up to the 1% AEP with climate change design flood event maximum water level further reduces the volumes required, where the embankment is not overtopped.

   We have reviewed Mr Patmore's calculations in OBJ-1002-CP-06, Technical Note on volumes dated 23rd July 2021. The following bridges do not appear to have been accounted for in the same manner as the other culverts/bridges have been in the calculations:

   - Bridge 15 (60m) from chainage 1330 to 1390 does not appear to have been accounted for and would reduce Mr Patmore's total of 10831 m^3 for the eastern section by 803 m3.
   - Bridge 16 (50m) from chainage 1550 to 1600 does not appear to have been accounted for and would reduce Mr Patmore's total of 10831 m^3 for the eastern section by a further 70 m^3.
   - Bridge 17 (70m) from chainage 1720 to 1790 does not appear to have been accounted for and would reduce Mr Patmore's total of 10831 m^3 for the eastern section by a further 100 m^3.

The calculations in OBJ-1002-CP-06 do not account for areas of cut along the proposed embankment including:

- From chainage 1820 to 2070 the drawings show that the railway will be lower than existing ground levels, due to cutting through higher land along the route at Salehurst. This equates to between approximately 350 and 550 m^3 of cut or removal of material. Further reprofiling of land in this area could contribute to floodplain compensation storage.

- From chainage 2220 to 2260 the existing embankment will be lowered removing approximately a further 70 to 80 m^3.

Taking these sections into account reduces Mr Patmore's estimate for the eastern section to approximately 9000 m^3.

Table 1 compares the volumes presented in Mr Patmore's evidence to calculations undertaken by Capita using the same method. The Capita calculations have used the latest LIDAR to define ground levels, and the top of the existing embankment east of Moat Farm. As shown in Figure 1 the ground level stated in the Halcrow Gradient Profile drawings as contained in Appendix B1 of OBJ/1002/CP-02, do not capture the top of the existing embankment. This explains the discrepancies between the Capita calculations and the volumes presented in Mr Patmore's evidence.

Table 1 also includes further calculations undertaken by Capita using the same method as WSP (Mr Patmore). The further calculations undertaken by Capita demonstrate how the range of estimated volumes vary when considering the top of ballast as the top of the embankment and the variation when the 1% AEP with 105 % allowance for climate change maximum flood level is accounted for in the volume estimates. Further variation in the estimated volumes would be expected if the 1 in 3 slope assumption were changed for part or all of the route. The embankment slope may be steeper in some areas, which would reduce the volumes calculated, however the accommodation crossing ramps have not been included in the calculations.

Capita have also undertaken volume calculations in GIS software comparing the DTM (ground elevations based on LiDAR) and an approximate elevation model of the proposed railway. A summary of these calculations is provided in Table 2. The volumes estimated using the GIS method fall between the Capita Calculation 2 and Capita Calculation 4 volume estimates for the section east of the A21. The volumes calculated using the GIS method use a finer resolution to calculate volumes than the WSP spreadsheet method.

Tables 2 and 3 consider the approach and locations for providing floodplain compensation storage and demonstrate that based on high level calculations the require floodplain compensation storage can be accommodated in areas at appropriate elevations for level for level compensation.

The final calculations will need to take into consideration the detailed design of the embankment (both cut and fill), abutments, and access ramps and slopes.

Table 1: Comparison of embankment volume calculations using WSP method, assumes 1 in 3 slopes

	Chainage	WSP calculation	WSP calculation	Capita Calculation 1	Capita Calculation 2	Capita Calculation 3	Capita Calculation 4
		Rail Level	Rail Level (adjusted to include for bridges 15 to 17)	Rail Level (Ground level updated to latest LIDAR levels)	Top of Ballast Level - Assumes rail height 0.15m (Ground level updated to latest LIDAR levels)	Rail Level and accounting for 1% AEP with 105% climate change flood level, where this is below the rail level (Ground level updated to latest LIDAR levels)	Ballast Level and accounting for 1% AEP with 105% climate change flood level, where this is below the top of ballast level (Ground level updated to latest LIDAR levels)
West of A21	860 to 1100	3165	3165	2939	2557	2475	2268
East of A21							
B1-1	1160 to1390	2619	1815	1811	1590	1032	959
B1-2	1400 to 1810	986	816	690	414	651	407
	1820 to 2070		-341	-539	-805	-539	-805
B1-3	2070 to 2600	417	417	-60	-474	-89	-474
B1-4	2610 to 3200	1183	1183	936	430	311	192
B1-5	3210 to 3800	3317	3317	2510	1858	2018	1675
B1-6	3810 to 4210*	1903	1903	648	301	625	301
Total (East of A21)		10424	9109	5995	3315	4009	2255
	Adjusted for other areas of cut		9023				

*Chainage 4210 is Junction Road and the eastern extent of the 2017 planning permission, WSP calculation adjusted from chainage 4310 to 4210.

Table 2: Embankment volume calculations using GIS raster method. This method accounts for 1% AEP with 105% climate maximum flood level.

Location	**Chainage (approximate)**	**Volume, m^3**	**Comment**
The Clappers/Northbridge Street to A21	860 to 1100	2079	Similar to Capita Calculation 4. Primary area where land is available and being considered for Floodplain Compensation Storage is Area 1.
The A21 to Moat Farm	1130 to 2400	1389	Similar volume to that calculated using Capita Calculation 4 (Chainage 1160 to 1810). Primary areas where land is available and being considered for Floodplain Compensation Storage are Area 1 and at Salehurst Halt (edge of floodplain).
Moat Farm to Austin's Bridge	2400 to 3710	904	The GIS method assumed that the existing embankment would not be widened and used the top of ballast level. Once the height of the rail and ballast are considered it is anticipated that minimal changes to existing embankment will be required, other than some levelling along the top. Figure 1 illustrates how the different assumptions regarding using top of rail and top of ballast can impact on the calculation of the cross-sectional area and therefore the volume of the proposed railway embankment. The GIS method uses a finer resolution to calculate the volume than the WSP method which estimates volume based on rail level and one ground level which is extrapolated over 10 m along the proposed track. It is anticipated that minor adjustments in the track level (e.g. lower 10 to 30 cm) will mitigate much of the requirement for floodplain compensation storage along the existing embankment. In addition to this the 1% AEP with climate change allowance maximum flood level will be reduced and therefore the floodplain compensation requirements through this section will reduce as illustrated by the maximum flood levels shown in Figure 1. Area 4 has the potential to provide some compensatory storage for this section if required.
Austin's Bridge to Junction Road	3720 to 4210	434	See comments for chainage 2400 to 3710.
Total (East of A21)		2727	
Total (The Clappers/Northbridge Street to Junction Road)		4806	

Table 3: Land available for floodplain compensation storage

Location	**Volume available, m^3**	**Floodplain Compensation Storage at suitable level for embankment between chainage**	**Total required, m^3**
Area 1 (9.53 mAOD to 11.23 mAOD)	6410	860 to 1430	3360 (based on Capita Calculation 3 estimate)
Salehurst Halt (8.23 mAOD to 10.33 mAOD)	1821	1350 to 2070	798 (based on Capita Calculation 3 estimate)
		1820 to 2600	Can be managed within vertical alignment of railway at detailed design. This section includes both cut and fill and overall can provide some compensation for other sections of the proposed railway.
Area 4 (calculated between 5.23 mAOD to 6.2 mAOD). Note lowest elevation in this area is 4.93 mAOD, highest elevation is 6.2 mAOD.	3960	2600 to 4210	Approx. 1300 (based on GIS calculation) Approx. 2954 (based on Capita Calculation 3 estimate) Required volumes can also be partially managed within vertical alignment of railway at detailed design.
Total	12191		7112

Figure 1 – Existing embankment and indicative rail and ballast levels at Chainage 2970