Cambridge South East Transport Phase 2

Environmental Statement

Appendix 10.13 Scenario Modelling for Rivers Biodiversity Net Gain

31st July 2023

Introduction

10.13.1 The Biodiversity Net Gain (BNG) Assessment concluded that the Proposed Development, based on the design at the time of publication of the report, would result in a net loss of River Biodiversity Units (RBUs). The baseline Rivers/Streams RBUs were 12.53 and the predicted total net change was a loss of -1.32%, because there would be a reduction in condition at the Babraham and Stableford crossings.

10.13.2 A scenario modelling exercise, as presented in this appendix, was undertaken to see whether it would be possible to enhance the river lengths within the Site boundary in order to achieve the BNG target of 20% net gain. Two different possible scenarios have been tested:

- Realignment of the River Granta at D2-S1 (the sub-reach immediately upstream of the River Granta (Babraham) Crossing, Structure 8)
- In-channel enhancement

Realignment option

10.13.3 One method to increase RBUs would be to increase the river length through realigning the current channel and creating a longer meandering planform. Realignment also provides an opportunity to improve river condition to gain further RBUs. The feasibility of this option was investigated as follows.

10.13.4 This option is focused on the River Granta sub-reach D2-S1, which is at Moderate condition in the baseline assessment and 0.373 km in length. This is the only sub-reach where there is opportunity for realignment as there is not the space to increase river length elsewhere within the Site boundary.

10.13.5 The increase in river length that would be needed to reach the 20% net gain target depends on assumed change in river condition:

- If the condition was unchanged (i.e., it remains at Moderate), it would be necessary to increase the length of this sub-reach from 373 m to 598 m (so by 225 m). This equates to a 60% increase in length.
- If the condition could be improved to Fairly Good the river length would need to be increased to 485 m (i.e., by 112 m): a 30% increase in length. This is a much more achievable increase in length but is still significant.
- If the condition were improved to Good, the length would need to be increased to 416 m (i.e., by 43 m): a 12% increase in length. Although only a small length increase would be needed, it is unlikely that it would be possible to improve the sub-reach condition to this extent. The in-channel enhancement scenario investigation found that this sub-reach has a maximum possible condition of Fairly Good given the typology of the river and external constraints.

10.13.6 The increases of river length that would be necessary to meet the target are not considered feasible within the Site boundary. The existing river slope is only 0.13% (based on measuring the distance between Ordnance Survey map contours), meaning that there is already limited gradient in the system. Increasing the river length would further reduce this gradient and may in fact mean that the realignment leads to a reduction in condition by reducing stream power, removing the opportunity to create and maintain high-energy habitats and encouraging fine sediment deposition. If condition could be improved, the length of channel needed to achieve 20% is reduced, but there is lower confidence that such a condition could be achieved. It would not be feasible to artificially increase the slope through this section as this would mean impounding the upstream section of watercourse resulting in a reduction in its condition through flow changes.

10.13.7 Additionally, the current Site boundary is positioned at the centreline of the river through this sub-reach. This would limit the realignment to works on the left bank only, thereby restricting the improvements that could be achieved.

10.13.8 Taken together, these difficulties mean that realignment is unlikely to be a feasible option to achieve 20% net gain. There is high uncertainty that it would be possible to realign the river and even maintain the condition at Moderate, let alone improve condition. This option is considered a red risk.

In-channel enhancement option

10.13.9 In-channel and bankside (within 10 m of the bank top) improvements may be able to increase river condition, without changing the river length, and thereby provide additional biodiversity units. The feasibility of this option was investigated as follows.

10.13.10 A desktop exercise investigated the ways in which possible enhancements to a sub-reach would affect condition scores was conducted by interrogating the baseline MoRPh data and relating this to the indicator scores, in order to determine the maximum feasible improvement that could be made given catchment and Site constraints.

10.13.11 Cartographer calculates 32 indicators of river condition for each MoRPh sub-reach which are scaled according to river type (determined through the desk study component of the river condition assessment), to produce the final river condition score for each sub-reach. Improvements to indicator scores could lead to an improvement in the overall condition score and therefore an increase in the RBUs.

10.13.12 This exercise focused on the River Granta sub-reaches D1-S1 and D2-S1 as they are unaffected by the Proposed Development crossings and therefore are the most feasible sections for in-channel enhancements within the Site boundary. Possible improvements to the river indicator scores for these sub-reaches have been modelled in Table A10.13.1. This only includes potential improvements to the channel and bank within the Site, so therefore focuses on one bank only (the right bank of D1-S1 and the left bank of D2-S1). Each indicator was investigated using expert judgement to identify where the baseline conditions could be altered through enhancements in order to drive changes in the indicator score, based on the indicator values that underpin the scores[1]. A commentary is included in the table as to the enhancement that would therefore be required to generate an improvement in score. Where constraints relating to the catchment or Site mean it would not be feasible to improve scores, this is also noted.

[1] Gurnell, A.M., England, J., Scott, S.J. and Shuker, L.J. (2022) A Guide to Assessing River Condition. Part of the Rivers and Streams Component of the BioDiversity Net Gain Metric. BM3.1 Version.

Table A10.13.1 Results of the desktop exercise to estimate the maximum achievable enhancement to the condition of sub-reaches D1-S1 and D2-S1

Sub-reach name			D1-S1			D2-S1		
			Baseline	Scenario	Justification	Baseline	Scenario	Justification
Bank top	Vegetation structure	B1	2	3	The vegetation structure indicator score is limited by the scarcity of moss on both banks and short herbs/grasses on the right bank. An increase in the cover of short herbs/grasses on the right bank is feasible, increasing the score to 3. However, it is unlikely that it would be possible to increase moss coverage to the extent needed.	2	2	Improvement to this score is unlikely as it would require an increase in moss, trees on the right bank, or scrub on the left bank. It is unlikely that it would be possible to increase moss coverage to the extent needed and it would not be possible to make changes to the right bank at this sub-reach. Providing more scrub on the left bank would not be enough on its own to improve the indictor score.
	Tree feature richness	B2	0	1	Tree planting and the application of large wood on the right bank top would result in an increase in score.	0	1	Tree planting and the application of large wood on the left bank top would result in an increase in score.
	Water related features	B3	0	0	No change is possible as there is no available space for the construction of water related features within 10 m of the bank top. The designed ponds included within the landscape plan at the time of writing are more than 10 m away so would not affect this score.	0	1	Building a connected pond (backwater) on the left bank would improve this score.
	Invasive species	B4	-1	-1	Himalayan balsam is present on the banks throughout this section and nearby reaches. Successful removal of the species would be challenging given its abundance in the wider catchment. Therefore, no change in the score is assumed.	0	0	Ongoing maintenance of Himalayan balsam may be needed to maintain this score at 0.
	Managed ground cover	B5	-3	-2	The baseline score of -3 is likely to be an overestimation as the dominant ground cover is recorded as extensive plantation, whereas aerial imagery suggests that it is a strip of adjoining broadleaved woodland rather than a plantation. Assuming, however, that this baseline score is correct, changing the right bank ground cover to an 'enhanced grass margin' (as specified in the landscape plan) would improve the score to -2. It would not be possible to modify the left bank due to the location of the RLB being the centre of the channel.	-3	-2	The left bank would change from cereal crop to 'other neutral grassland' (referred to as 'wildflower meadow' in the landscape plan), which is not a managed ground cover type. The right bank is included in the temporary land take but will be returned to the farmer, so it is assumed that this will stay as arable. This limits the possible improvement to a maximum of -2.
Bank face	Riparian vegetation structure	C1	1	2	The riparian vegetation structure at this site is limited but could be improved by increasing the cover of mosses or short herbs/grasses on either bank, or trees on the left bank. It is feasible that the coverage of short herbs/grasses could be increased on the right bank, improving the score to 2. Changes to the left bank are not possible at this sub-reach, and an increase in moss coverage to the extent needed is unlikely, limiting the potential for improvement.	2	2	The riparian vegetation structure at this site could be improved by increasing the cover of mosses on either bank or short herbs/grasses on the right bank. An increase in moss coverage to the extent needed is unlikely and it is assumed that changes to the right bank will not be possible, therefore no change is possible.

Sub-reach name			D1-S1			D2-S1		
			Baseline	Scenario	Justification	Baseline	Scenario	Justification
	Tree feature richness	C2	1	2	The baseline score of 1 relates to discrete organic accumulations on both banks. It would be feasible to add large wood on the left bank and to encourage trailing branches with some planting on trees on the banks. Eventually planting might create fallen/leaning/J shaped trees, which would further improve the score, but this is unlikely to happen quickly and uncertain to occur. This means the max indicator score that could be foreseeably achieved is 2.	1	1	The baseline score of 1 is caused by trailing tree branches on the left bank. It would be feasible to add large wood on the left bank and to increase the number of trailing branches with some planting. Eventually planting might create fallen/leaning/J shaped trees, which would further improve the score, but this is unlikely to happen quickly and uncertain to occur. This means the max indicator score that could be foreseeably achieved is 1 (so no change).
	Natural bank profile extent	C3	2	3	Reprofiling the right bank so that it has greater variability in profile (only gentle slope is recorded in the baseline) could increase this score. It would be necessary to create variation in the bank profile (such that there is both a dominant and subdominant natural bank profile). Without reprofiling the left bank, it would not be possible to achieve a score of 4, so the maximum score for this indicator is 3.	1	3	Reprofiling the whole of the left bank could improve this score. It would be necessary to create variation in the bank profile (such that there is both a dominant and subdominant natural bank profile for all modules). As the banks are currently nearly all artificial two-stage this should be feasible.
	Natural bank profile richness	C4	2	3	Reprofiling the right bank so that it has greater variability in profile (noting that only gentle slope is recorded in the baseline) would increase this score. To achieve a score of 4, it would be necessary to create at least four natural bank profile types on the right bank. There is limited space to work with, so the maximum score has been conservatively estimated at 3.	2	4	The natural bank profile richness could be improved by re-profiling. It would be possible to get to a score of 4 as long as reprofiling meant that there were four natural bank profile types on the left bank .
	Natural bank material richness	C5	3	3	The baseline bank sediment is a mixture of earth, silt and sand. It is assumed that this would be unchanged.	1	1	The bank material is 100% earth. This is not feasible to change.
	Bare sediment extent	C6	4	3	The changes to the right bank outlined in the landscape plan (i.e., the transition from woodland to 'enhanced grass woodland') would reduce the extent of shading and could reduce the amount of bare sediment extent, although it is assumed that the left bank would be unchanged. If the left bank stayed the same and there was no bare sediment on the right bank the score would be 3, so this is used as a conservative estimate of the score.	3	3	Tree planting/maintaining tree cover could ensure that at least some bare sediment is maintained. Maintaining a score of 3 should be possible using this method.

Sub-reach name			D1-S1			D2-S1		
			Baseline	Scenario	Justification	Baseline	Scenario	Justification
	Artificial bank profile extent	C7	-2	-2	The baseline score is -2 because one module has an 'obviously reshaped' bank profile on the left bank. It is assumed that no changes are possible to the left bank so no change to this score is possible.	-2	-2	The baseline score is thought to be an underestimation as although the bank profile is recorded as 'artificial two-stage' for four of five modules (both banks), the bank profile is also scored as 'absent' for three of five modules. Assuming that it should actually be recorded as 'extensive', the baseline score should be -4, and the max improvement that would therefore be possible would be -3. Reprofiling the left bank would improve condition by removing artificial bank profiles on this bank. Assuming that the MoRPh data as recorded is accurate, this would not be enough to change the score.
	Reinforcement extent	C8	-2	-2	The baseline score reflects reinforcement on the left bank (concrete reinforcement is extensive in one module). It is assumed that no changes are possible to the left bank so no change to the score.	0	0	No change
	Reinforcement material severity	C9	-1	-1	Th baseline score reflects reinforcement on the left bank (concrete reinforcement is extensive in one module). It is assumed that no changes are possible to the left bank so no change to the score.	0	0	No change
	Invasive species	C10	-1	-1	Himalayan balsam is present on the banks throughout this section and nearby reaches. Successful removal of the species would be challenging given its abundance in the wider catchment. Therefore, no change in the score is assumed.	-2	-2	Himalayan balsam is present on the banks throughout this section and nearby reaches. Successful removal of the species would be challenging given its abundance in the wider catchment. Therefore, no change in the score is assumed.
Water margin	Aquatic vegetation extent	D1	2	3	The aquatic vegetation recorded in the baseline is emergent broad/linear leaved, with no liverworts/mosses/lichens or amphibious plants. Creating dappled shade and providing improvement marginal habitat through reprofiling the right bank could improve the score to 3, but achieving a score of 4 is unlikely.	2	3	The baseline vegetation is mostly emergent broad/linear leaved, with no liverworts/mosses/lichens and a few trace amphibious plants. It's possible you could get to a score of 3 by creating dappled shade and providing improved marginal habitat (reprofiling/berms/backwaters) but achieving a score of 4 is unlikely.
	Aquatic morphotype richness	D2	2	3	As above, creating dappled shade and providing improved marginal habitat could support improvement here.	2	3	As above, creating dappled shade and providing improved marginal habitat could support improvement here.
	Physical feature extent	D3	2	2	In the baseline, berms are extensive on the right bank, as are stable cliffs on the left bank. Given that the left bank is assumed to be unchanged, and there is limited space to affect the right bank, there is no change for this score.	1	3	By reprofiling the banks, it would be possible to increase the extent of berms/benches. It would also be feasible to add backwaters. This score could therefore be improved to 3.
	Physical feature richness	D4	2	2	As above	1	3	As above

Sub-reach name			D1-S1			D2-S1		
			Baseline	Scenario	Justification	Baseline	Scenario	Justification
	Artificial features	D5	-2	-2	The baseline score is -2 due to three pipes/outfalls and one intermediate deflector on the left bank. It is assumed that this would not be possible to change.	0	0	No change
Channel	Aquatic morphotype richness	E1	1	2	Only emergent linear-leaved plants are recorded, so there is only one morphotype present. Increasing this to two or three would improve the score to 2. Improving the right bank marginal habitat and providing dappled shade could provide opportunity for this.	3	3	There are five of nine morphotypes represented in the baseline (emergent broad/linear leaved, free floating, amphibious, and submerged fine leaved). Increasing the number of morphotypes to the extent that a score of 4 is achieved is deemed unlikely.
	Tree feature richness	E2	2	2	This baseline score of 2 reflects vegetation shading the channel and the presence of discrete organic material deposits. It would be possible to add large wood to the channel. But this would not be enough to improve the score.	1	2	This baseline score of 1 reflects vegetation shading the channel. Adding large wood to the channel would be enough to improve the score to 2.
	Hydraulic richness	E3	1	1	The baseline flow is nearly entirely smooth with a tiny amount of no perceptible flow. Adding in-channel large wood could be used to increase rippling, but this may not be possible due to the RLB being located at the centreline of the channel. A conservative estimate of no change is therefore applied.	1	2	The baseline flow is nearly entirely smooth with a tiny amount of rippled flow. Adding backwaters/berms would help create areas of no perceptible flow. Adding in-channel large wood could be used to increase rippling. The watercourse is not a high energy system so it's unlikely you could get any of the higher energy flows, therefore the maximum possible score is 2.
	Natural feature extent	E4	0	1	It may be possible to introduce pools and riffles which would improve this score.	2	2	The baseline score of 2 is based upon the presence of riffles and pools. None of the other potential natural features would be suitable for this river typology so no change is possible.
	Natural feature richness	E5	0	1	As above	1	1	As above
	Material richness	E6	3	3	No change expected as coarse and fine materials are already present.	3	3	No change expected as coarse and fine materials are already present.
	Bed siltation	E7	-2	-2	A continuous silt layer is recorded at one site. It is assumed that this is associated with the deflector/reinforcement also recorded in this module, therefore it would not be possible to change this.	0	0	Constructing berms would locally narrow the channel and encourage the bed to remain clear of silt, thereby maintaining a score of 0 for this negative indicator.
	Reinforcement extent	E8	-1	-1	One module is reinforced by brick/laid stone. This is likely to be associated with the bridge, and so it is assumed that this could not be removed.	0	0	No change
	Reinforcement severity	E9	-2	-2	As above	0	0	No change
	Artificial feature severity	E10	0	0	No change	0	0	No change

Sub-reach name			D1-S1			D2-S1		
			Baseline	Scenario	Justification	Baseline	Scenario	Justification
	Invasives	E11	-1	-1	Himalayan balsam is present on the banks throughout this section and nearby reaches. Successful removal of the species would be challenging given its abundance in the wider catchment. Therefore, no change in the score is assumed.	-1	-1	Himalayan balsam is present on the banks throughout this section and nearby reaches. Successful removal of the species would be challenging given its abundance in the wider catchment. Therefore, no change in the score is assumed.
	Filamentous algae	E12	0	0	Some dappled shade from trees would be maintained to help keep filamentous algae from developing. thereby maintaining a score of 0 for this negative indicator.	0	0	Some dappled shade from trees would be maintained to help keep filamentous algae from developing, thereby maintaining a score of 0 for this negative indicator.
Totals	Average positive index		1.58	2.11		1.53	2.26	
	Average negative index		-1.38	-1.31		-0.62	-0.54	
	Condition Score		0.19	0.80		0.91	1.72	
	River Type		H	H		H	H	
	Final Condition Class		Fairly Poor	Moderate		Moderate	Fairly Good	

10.13.13 The results of this stress test showed that it was possible to improved D1-S1 to Moderate and D2-S1 to Fairly Good based on improvements to one bank only. The condition score for sub-reach D1-S1 could be improved from 0.19 to 0.80, and the score for D2-S1 from 0.91 to 1.72. This represents an improvement of one condition class for both sub-reaches. The findings of this exercise suggest that it would not be possible to improve condition of any sub-reach by more than one condition class over existing baseline condition.

10.13.14 It is assumed that it would not be possible to increase condition of the short sections of river that would be directly underneath the crossing structures (assumed to be 25 m in length based on the current design drawings). However, if it is assumed that the condition of the remainder of the watercourse within the Site could be improved by one condition class, this gives a total post-works net gain of 14.91% (Table A10.13.2). The net gain would be 14.65% if Hobson's Brook is excluded, noting that this watercourse is considered an 'other rivers or streams' and the River Granta is 'priority river', therefore improvement of Hobson's Brook could not compensate for unit losses on the River Granta. Enhancement of the river condition alone is therefore not enough to meet the 20% net gain target. This assumes that there is no delay in starting habitat enhancement.

Table A10.13.2 Potential gain of RBUs were the condition of all sub-reaches improved by one condition class (excluding the river length affected by the crossing structures)

Watercourse	Sub-reach	River condition change	Total post-work units	Total net gain
River Granta	D1-S1	Fairly Poor to Moderate	14.39 (12.91 if Hobson's Brook excluded)	14.91% (14.65% if Hobson's Brook excluded)
	D1-S3	Moderate to Fairly Good		
	D2-S1	Moderate to Fairly Good		
	D2-S2	Fairly Poor to Moderate		
Hobson's Brook	D4	Fairly Poor to Moderate		

10.13.15 Another option to increase units would be to remove encroachment (watercourse or riparian encroachment). Encroachment scores refer to the extent of encroachment of a development: (a) in the watercourse, and (b) in the riparian zone (10 m from the top of the riverbank). Encroachment within the watercourse is classified as 'no encroachment', 'minor' or 'major' whereas in the riparian zone encroachment is classed as 'no encroachment', 'minor', 'moderate' or 'major'. Table A10.13.3 shows the baseline encroachment details from the baseline assessment.

Table A10.13.3 Details of watercourse and riparian encroachment as recorded in the baseline assessment

Watercourse (sub-reach)	Extent of watercourse encroachment	Extent of riparian encroachment
River Granta (D1-S1)	Major – bed/bank reinforcement and a deflector	No encroachment
River Granta (D1-S3)	Major – bed/bank reinforcement and a weir	Minor – unvegetated footpath
River Granta (D2-S1)	No encroachment	No encroachment
River Granta (D2-S2)	No encroachment	No encroachment
Hobson's Brook (D4)	No encroachment	Moderate – unvegetated footpath

10.13.16 There would be limited benefit to RBUs from addressing the riparian encroachment at Hobson's Brook and D1-S3. Removing the encroachment at both sites, as well as improving the condition of the sub-reaches, would mean the total post-work units would be 14.68 (a net gain of 17.18%). Therefore, removal of the riparian encroachments provides only a small number of units and is not enough to achieve the 20% target.

10.13.17 Removing the watercourse encroachment at either D1-S1 or D1-S3 would provide a more notable benefit to the RBUs. It would still be necessary to improve condition of at least D1-S1 and D2-S1 as well as removing one of the major encroachments in these sub-reaches in order to reach 20% net gain:

- Improving the condition class of D1-S1 and D2-S1 by one class AND removing the major watercourse encroachment at D1-S1 would give total post-work units of 15.40 (22.96%)
- Improving the condition class of D1-S1, D1-S3, D2-S1, and D2-S2 by one class AND removing the major watercourse encroachment at D1-S3 would give total post-work units of 15.34 (22.44%)

10.13.18 There is high uncertainty over whether the watercourse encroachments at D1-S1 and D1-S3 (especially the weir) could be removed as there is limited available information about their purpose or structure. Further investigation would be necessary to determine whether or not removal of the encroachments is a feasible option.

10.13.19 Note that the potential improvements to the river condition score at D1-S1 may be higher than documented in Table A10.13.1 if the watercourse encroachment was also addressed. However, because the encroachments are on the left bank (which is not within the Site) these improvements were not reflected in the modelling exercise. Additional investigation would be needed.

10.13.20 There is reasonable certainty that you could increase condition of D1-S1 and D2-S1 given the results of the modelling exercise. This has a low green level of risk. However, there is a medium orange level of risk to get to 20% net gain by addressing the watercourse encroachment, because there is little information as to what these encroachments are and their purpose, therefore, high uncertainty as to whether they could be removed.