Melksham Link

Wiltshire Council Planning Application ref. W/12/01080/FUL

Supplementary Report

Providing information to update and supplement the Environmental Statement of February 2016, and the Addendum Report of March 2018, on behalf of the Wilts & Berks Canal Trust.

January 2019

Publication and Comment

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The Administrator
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Supplementary Report Contents

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Chapter 1 – Introduction

1.1. This report provides supplementary information to the Melksham Link Environmental Statement (ES) published by the Wilts & Berks Canal Trust (WBCT) in February 2016 and the Addendum Report (AR) published by WBCT in March 2018.

1.2. The ES updated many of the documents that accompanied the full planning application that WBCT made to Wiltshire Council (WC) in June 2012 (W/12/01080/FUL), and this report provides further updates.

1.3. The Melksham Link canal development is a proposed new waterway between the Kennet & Avon Canal at Semington, and the River Avon at Melksham, together with towpath, bridges and access roads. The proposals also include works to the river to enable navigation to upstream of Melksham Gate Weir.

1.4. The information in this report incorporates that requested by the Environmental Agency (EA) in a letter from Ms Ellie Challans (EA) to James Taylor (WC Senior Planning Officer) dated 8th June 2018 (Appendix 1.1).

1.5. This report has been produced jointly by consultants Black & Veatch Ltd (B&V) and the WBCT Melksham Link Project Team, and includes information from Hydro-Morph Ltd. B&V has worked closely with the WBCT Team over the past 13 years on this project, particularly on Flood Risk Assessment and Water Framework Directive (WFD) Assessment. Details of consultants are provided in Appendix 1.2, and CVs of the Melksham Link Project Team are included in Appendix 1.3.

1.6. The contents of this report are as follows:

Chapter 1 - Introduction

Chapter 2 - Additional Hydraulic Details

Chapter 3 - Water Framework Directive Update

Appendices

Chapter 2 – Additional Hydraulic Details

2.1 Introduction

Black & Veatch have provided the information in this chapter to supplement that given in the ES (chapter 9) and the Addendum Report (chapter 3). The base hydraulic model has been updated to reflect the current design of the proposed new weir and the training bank. The issues addressed here are as follows:

- Flood risks in the River Avon
- Flow velocities at Melksham Town Bridge
- The effects on the river of lock operation in low flow conditions
- The flooding implications of a blockage of the Berryfield Brook culvert
- A review of Canoe/Fish/Eel Pass design

2.2 New Weir and Training Bank Model

2.2.1 Background

The Melksham base model has been updated to replicate the proposed new weir and training bank model.

2.2.2 Data

The following information was provided by the Wilts and Berks Canal Trust. The drawings are the same as provided in the Addendum Report so are not reproduced again in this report:

- Melksham link new weir preliminary design (Drawing no WBCT/10/1017)
- Melksham link new weir adjustable weir crest detail (Drawing no WBCT/ 10/1018)
- Challymead Bridge to Town Bridge, Melksham (Drawing no WBCT/10/032)
- Dredging & training bank design (Drawing no WBCT/10/033)
- The dimensions of the proposed “Narrow Lock” alongside Melksham Gate Weir have been corrected

The proposed weir crest is at 30.60mAOD, with the boards in place. To maintain the conveyance, the training bank construction is assumed to be excavated from the river bed so the cross-sectional area of the watercourse does not change. This will ensure that the introduction of the training bank will not reduce the conveyance of the River Avon through the town.

Figure 1 shows the cross section of the proposed weir. The training bank location and a typical cross section are shown in Figure 2.

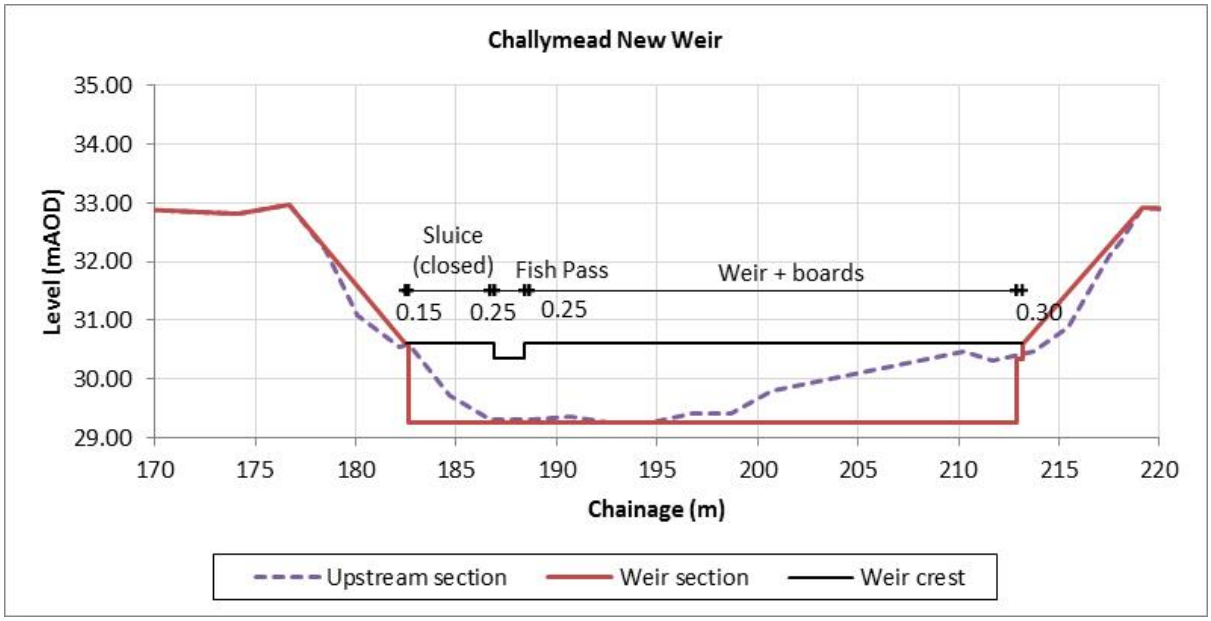


Figure 1 – Melksham Link: new weir at Challymead

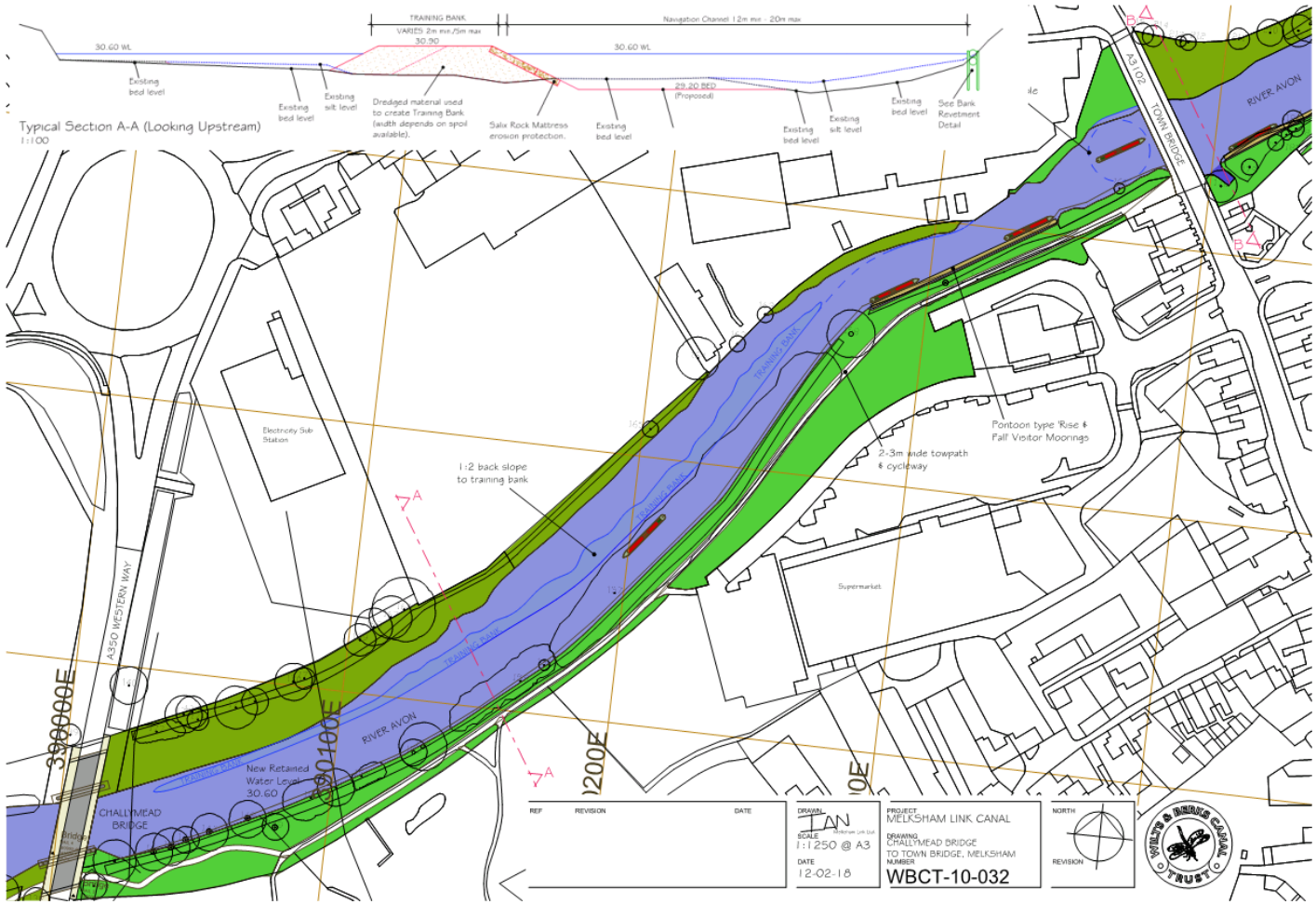


Figure 2 – Training Bank Reach

2.3 Model results – Flood Risk Assessment

The flood levels in River Avon are summarized in Table 1, which compares the existing situation and the new design. It can be seen from the table that here are no differences in flood levels for all flood flows. This is as expected because the new weir is submerged.

Table 1 – Flood levels in River Avon

Annual chance flood (1 in X)	Model/ Difference	Melksham Gate		Town Bridge		Challymead Bridge		New weir		1.1km d/s of new weir
		U/s	D/s	U/s	D/s	U/s	D/s	U/s	D/s	
		Water level (mAOD)								
2	Existing	33.58	33.52	33.46	33.42	33.31	33.31	33.30	33.30	32.97
	With scheme	33.57	33.51	33.45	33.41	33.31	33.31	33.30	33.30	32.97
	Difference (m)	-0.01	-0.01	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00
5	Existing	33.90	33.83	33.76	33.70	33.56	33.56	33.54	33.54	33.21
	With scheme	33.90	33.82	33.75	33.69	33.56	33.56	33.54	33.54	33.21
	Difference (m)	0.00	-0.01	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00
10	Existing	34.10	34.01	33.94	33.87	33.71	33.70	33.69	33.68	33.34
	With scheme	34.10	34.01	33.93	33.86	33.71	33.70	33.69	33.68	33.34
	Difference (m)	0.00	0.00	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00
25	Existing	34.38	34.25	34.17	34.08	33.89	33.88	33.86	33.86	33.50
	With scheme	34.38	34.24	34.16	34.07	33.89	33.88	33.86	33.86	33.50
	Difference (m)	0.00	-0.01	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00
50	Existing	34.60	34.44	34.36	34.25	34.03	34.02	34.00	34.00	33.63
	With scheme	34.60	34.43	34.35	34.24	34.03	34.02	34.00	34.00	33.63
	Difference (m)	0.00	-0.01	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00
100	Existing	34.86	34.64	34.56	34.42	34.18	34.17	34.15	34.15	33.76
	With scheme	34.86	34.64	34.55	34.42	34.18	34.17	34.15	34.15	33.76
	Difference (m)	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00

Table 2 shows the flood levels for higher roughness on the non-navigation channel. In this test it is assumed that the roughness coefficient (n value) in the non-navigation part of the channel is increased from 0.045 to 0.06. An n value of 0.06 is relatively high (representing significant areas of weed) and would not be expected to be exceeded with appropriate maintenance. There are small differences (1cm) in flood levels for the higher roughness results in some limited flows. This analysis shows that the flood levels on the River Avon are relatively insensitive to increased roughness in the non-navigation channel.

Table 2 – Flood levels in River Avon (higher roughness on the non-navigation channel)

Annual chance flood (1 in X)	Model/ Difference	Melksham Gate		Town Bridge		Challymead Bridge		New weir		1.1km d/s of new weir
		U/s	D/s	U/s	D/s	U/s	D/s	U/s	D/s	
		Water level (mAOD)								
2	Existing	33.58	33.52	33.46	33.42	33.31	33.31	33.30	33.30	32.97
	With scheme	33.58	33.52	33.46	33.42	33.31	33.31	33.30	33.30	32.97
	Difference (m)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Existing	33.90	33.83	33.76	33.70	33.56	33.56	33.54	33.54	33.21
	With scheme	33.90	33.83	33.76	33.70	33.56	33.56	33.54	33.54	33.21
	Difference (m)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	Existing	34.10	34.01	33.94	33.87	33.71	33.70	33.69	33.68	33.34
	With scheme	34.11	34.01	33.94	33.87	33.71	33.70	33.69	33.68	33.34
	Difference (m)	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	Existing	34.38	34.25	34.17	34.08	33.89	33.88	33.86	33.86	33.50
	With scheme	34.39	34.25	34.17	34.08	33.89	33.88	33.86	33.86	33.50
	Difference (m)	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	Existing	34.60	34.44	34.36	34.25	34.03	34.02	34.00	34.00	33.63
	With scheme	34.61	34.44	34.36	34.25	34.03	34.02	34.00	34.00	33.63
	Difference (m)	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100	Existing	34.86	34.64	34.56	34.42	34.18	34.17	34.15	34.15	33.76
	With scheme	34.87	34.65	34.56	34.43	34.18	34.17	34.15	34.15	33.76
	Difference (m)	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00

Flood velocities in the channel are presented in Table 3. In general, velocities are relatively low, reflecting the width of the river channel through Melksham.

Table 3 – Flood velocities in River Avon

Annual chance flood (1 in X)	Model/ Difference	Melksham Gate		Town Bridge		Challymead Bridge		New weir		1.1km d/s of new weir
		U/s	D/s	U/s	D/s	U/s	D/s	U/s	D/s	
		Velocity (m/s)								
2	Existing	0.67	0.68	0.67	0.68	0.48	0.48	0.53	0.53	0.78
	With scheme	0.67	0.68	0.67	0.68	0.48	0.48	0.53	0.53	0.78
	Difference	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Existing	0.82	0.83	0.78	0.80	0.59	0.59	0.60	0.60	0.83
	With scheme	0.82	0.84	0.78	0.80	0.59	0.59	0.60	0.60	0.83
	Difference	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	Existing	0.91	0.93	0.85	0.87	0.65	0.66	0.63	0.63	0.87
	With scheme	0.91	0.93	0.85	0.88	0.65	0.66	0.63	0.63	0.87
	Difference	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
25	Existing	1.03	1.06	0.94	0.97	0.75	0.75	0.68	0.68	0.93
	With scheme	1.03	1.06	0.94	0.97	0.75	0.75	0.68	0.68	0.93
	Difference	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	Existing	1.12	1.16	1.01	1.05	0.82	0.82	0.71	0.71	0.97
	With scheme	1.12	1.16	1.01	1.05	0.82	0.82	0.71	0.71	0.97
	Difference	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100	Existing	1.21	1.27	1.08	1.13	0.90	0.90	0.75	0.75	1.06
	With scheme	1.21	1.27	1.09	1.13	0.90	0.90	0.75	0.75	1.06
	Difference	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00

2.4 Flow Velocities at Town Bridge

Table 4 illustrates the velocities through the Town Bridge structure. The analysis represents the average velocity through the bridge arches. The HEC-RAS model is a 1D representation of the river and cannot provide detailed 3D flow velocities. As expected, the velocities are higher through the bridge structure than in the adjacent river sections. There is no significant difference in flow velocity when comparing the existing and with-scheme conditions.

Table 4 – Town Bridge velocity

Annual chance flood (1 in X)	Model/ Difference	U/s	D/s
		Velocity (m/s)	
2	Existing	0.99	1.00
	With scheme	1.00	1.00
	Difference	0.01	0.00
5	Existing	1.20	1.20
	With scheme	1.20	1.21
	Difference	0.00	0.01
10	Existing	1.33	1.34
	With scheme	1.33	1.34
	Difference	0.00	0.00
25	Existing	1.51	1.52
	With scheme	1.51	1.52
	Difference	0.00	0.00
50	Existing	1.65	1.67
	With scheme	1.66	1.67
	Difference	0.01	0.00
100	Existing	1.81	1.83
	With scheme	1.82	1.83
	Difference	0.01	0.00

2.5 Locks Operation Modelling

2.5.1 Background

Modelling has been undertaken to show how the operation of the two locks (River Avon Bottom Lock and Melksham Gate Lock) impacts on levels in the River Avon during low flows. Significant pulsating changes in water levels and flows could have a detrimental impact on environmental interests, and the modelling has been undertaken to improve understanding and address this risk.

2.5.2 Data

The following information was provided by the Wilts and Berks Canal Trust:

- New weir and dredging & training bank design (see above).
- Locks dimension and operation (See Table 5).

Table 5 – Dimension and operation of the locks

Description	Melksham Gate Lock	R. Avon Bottom Lock
Dimension		
• Width (m)	2.3	4.3
• Length (m)	23	23
• Fall (m)	2.1	2.9
• Volume (m^3)	111	287
Operation		
• Fill (min)	5	7
• Move (min)	3	3
• Discharge (min)	5	7
• Leave (min)	3	3
• Total cycle (min)	16	20

2.5.3 Methodology

The model used to investigate this is the 'with navigation' model with the following assumptions:

- The Melksham Link new weir (see Table 6) and dredging/training bank are in place.
- The Melksham Gate is closed.
- Constant low river flow of 1 m^3/s (Q95) and then impose flows from the locks. The locks take 5 to 7 minutes to discharge (see Table 5). The flows are given in Table 7.
- Melksham Gate Lock inflow is at the Melksham Gate and R. Avon Bottom Lock inflow is between Challymead Bridge and the new weir.

- The model was run for a 'random' summer 4-hour period, with an average frequency of two operations an hour – so eight operations in total for each lock. Some cycles are overlapped when looking at the both locks (see Figure 3).
- Changes in water levels were observed in River Avon.

Table 6 – New Weir details

Description	Width (m)	Crest Level (mAOD)	Note
Bottom hinged sluice	4.00	30.60	Closed
Fish pass	1.50	30.35	
Weir + boards	24.20	30.60	

Table 7 – Locks flows and volumes

Time (minute)	Flow (m^3/s)		Volume (m^3)	
	Melksham Gate Lock	R. Avon Bottom Lock	Melksham Gate Lock	R. Avon Bottom Lock
0	0	0	0	0
1	0.617	1.195	19	36
2	0.494	1.024	52	102
3	0.370	0.854	78	159
4	0.247	0.683	96	205
5	0.123	0.512	107	241
6	0	0.341	111	266
7	0	0.171	111	282
8	0	0	111	287

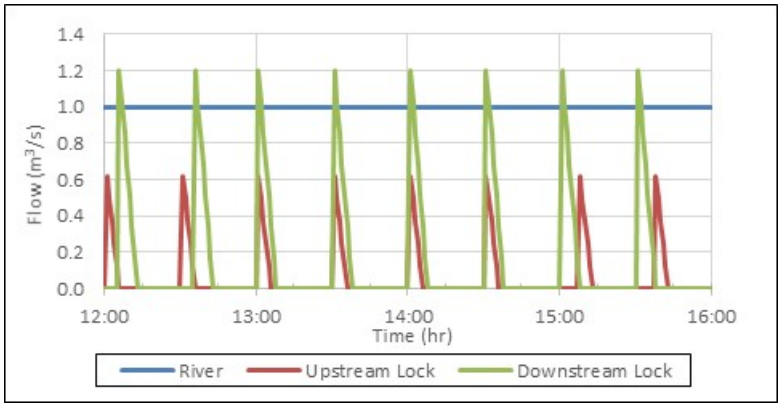


Figure 3 – Model inflows

For the purposes of the modelling, it is assumed that there is no back-pumping from the River Avon at the River Avon Bottom Lock. Back pumping would tend

to reduce the impact of lock operation on water levels on the River Avon and conservatively this has been ignored. Back-pumping simply recirculates water and is not consumptive.

2.5.4 Model Results

Model results are summarised in Table 8. Figure 4 shows the water level and flow plots in the River Avon. These show that:

- The change in water levels is negligible (2-8cm) because of the large storage capacity in the river relative to the locks. The change in velocities is very small (0.01m/s).
- The inevitable pulsating nature (20mm) shown on Figure 4 is from operation of the locks. In reality, the shape of the hydrographs will be different depending on the lockage time and back-pumping of the locks. During peak times it is estimated that the lockage could occur every 15 minutes and the back-pumping could be continuous[1].
- Downstream of the new weir the pulsating nature identified upstream of the weir is essentially absent. This is because the weir routes the flow, i.e. the storage capacity of the reach upstream of the new weir and the hydraulic characteristics of the weir dampens out the 'spikes' that are observed upstream. With back pumping the gradual rise in water levels shown (albeit only 80mm) is unlikely to occur as the change really reflects the additional flow coming from the locks. In any case the maximum rate of rise of about 35mm/hour in water level is very small, compared to natural variation.
- In higher flows than the Q95, any impact on levels due to the locks is unlikely to be noticeable.

Table 8 – Water levels and velocity in River Avon

Location	Section	Base	Peak	Diff. (m)	Base	Peak	Diff. (m/s)
		Water level (mAOD)			Velocity (m/s)		
Melksham Gate (u/s)	16.3	32.74	32.74	0.00	0.01	0.01	0.00
Melksham Gate (d/s)	16.2	30.67	30.69	0.02	0.03	0.03	0.00
Town Bridge (u/s)	14.75	30.66	30.69	0.03	0.06	0.06	0.00
Town Bridge (d/s)	14.25	30.66	30.68	0.02	0.06	0.06	0.00
Challymead Bridge (u/s)	8.1	30.66	30.68	0.02	0.03	0.02	-0.01
Challymead Bridge (d/s)	7.9	30.66	30.68	0.02	0.03	0.02	-0.01
Proposed new weir (u/s)	7	30.66	30.68	0.02	0.04	0.05	0.01
Proposed new weir (d/s)	6.4	30.37	30.41	0.04	0.05	0.06	0.01
0.4km d/s of new weir	5	29.54	29.61	0.07	0.07	0.08	0.01
0.6km d/s of new weir	4	29.53	29.61	0.08	0.12	0.13	0.01
0.8km d/s of new weir	3	29.53	29.60	0.07	0.07	0.07	0.00
1.1km d/s of new weir	2	29.52	29.60	0.08	0.10	0.11	0.01

1 Melksham Link – Estimating Effect of Lock Discharge & Abstraction on River Avon, Paul Lenaerts, 19th April 2017.

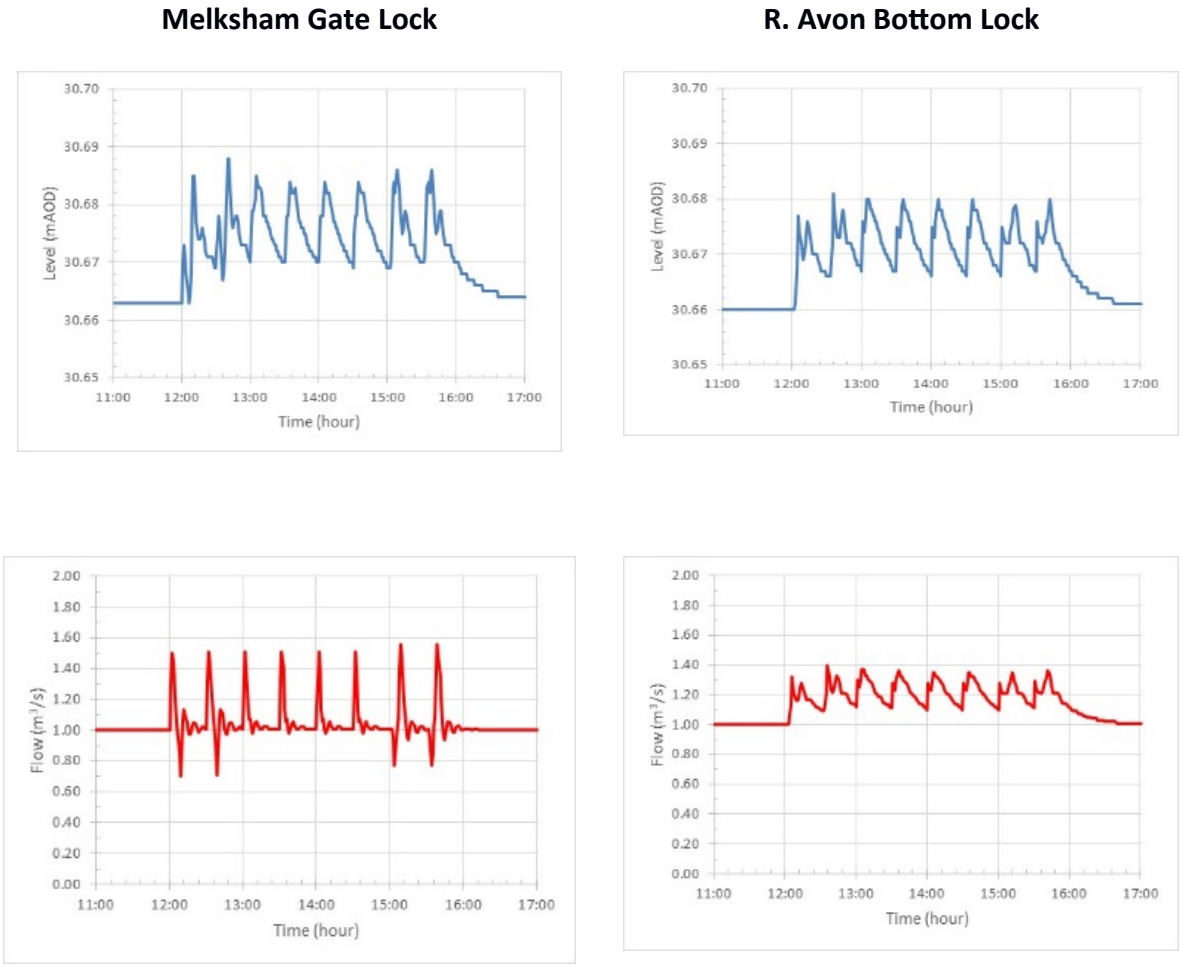


Figure 4a – Water levels and flows in River Avon

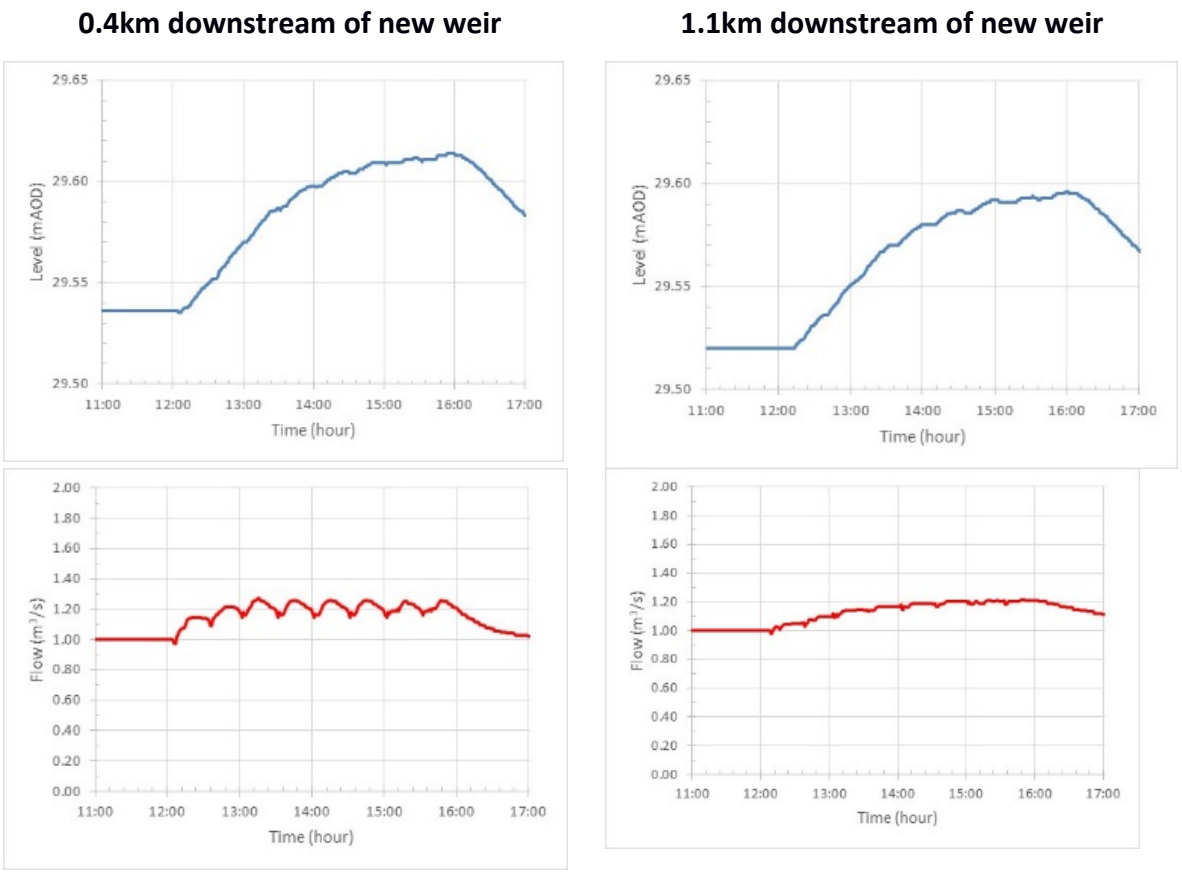


Figure 4b – Water levels and flows in River Avon

2.6 Berryfield Brook Culvert – Implications of Blockage

The area around the proposed Berryfield Brook culvert is currently "at risk" of flooding from surface water as illustrated in figure 7 below, which is an extract from the government's Long Term Flood Risk information at:

https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?easting=390030&northing=162258

In addition, any blockage of the existing Berryfield Brook could add to this flood risk.

The construction of the proposed canal and culvert would potentially increase the flood risk in the area, but only if there is a blockage of the culvert. In order to minimise this risk, it is now proposed that the level of the coping on the upstream side of the canal be lowered to 36.85 AOD along a 30m length above the culvert to provide a route into the canal for flood water (see figure 5).

WBCT has been asked to provide an illustration of the flooding implications of a total blockage of the culvert and this is given in figure 6. This illustrates the floodplain extent upstream of the culvert with a flood level of 36.85m AOD and shows that potentially 4 properties could be flooded above threshold in this scenario and a further 8 would be surrounded with water.

By comparing the two maps (figures 6 and 7), it can be seen that the areas at risk are very similar. Even with a total blockage, the flood risk to the area would not significantly increase as a result of the development.

It should be emphasised that the possibility of a total blockage is highly unlikely. In designing the new culvert, facilities have been provided to enable access to the upstream side to allow for the removal of any potential blockage material. The state of the culvert will be monitored by the navigation authority maintenance team on a regular basis.

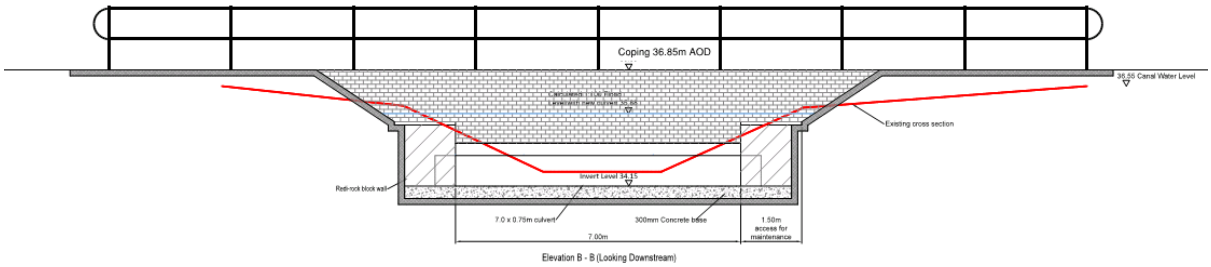


Figure 5 – Berryfield Brook Culvert (see Drawing WBCT/10/023)

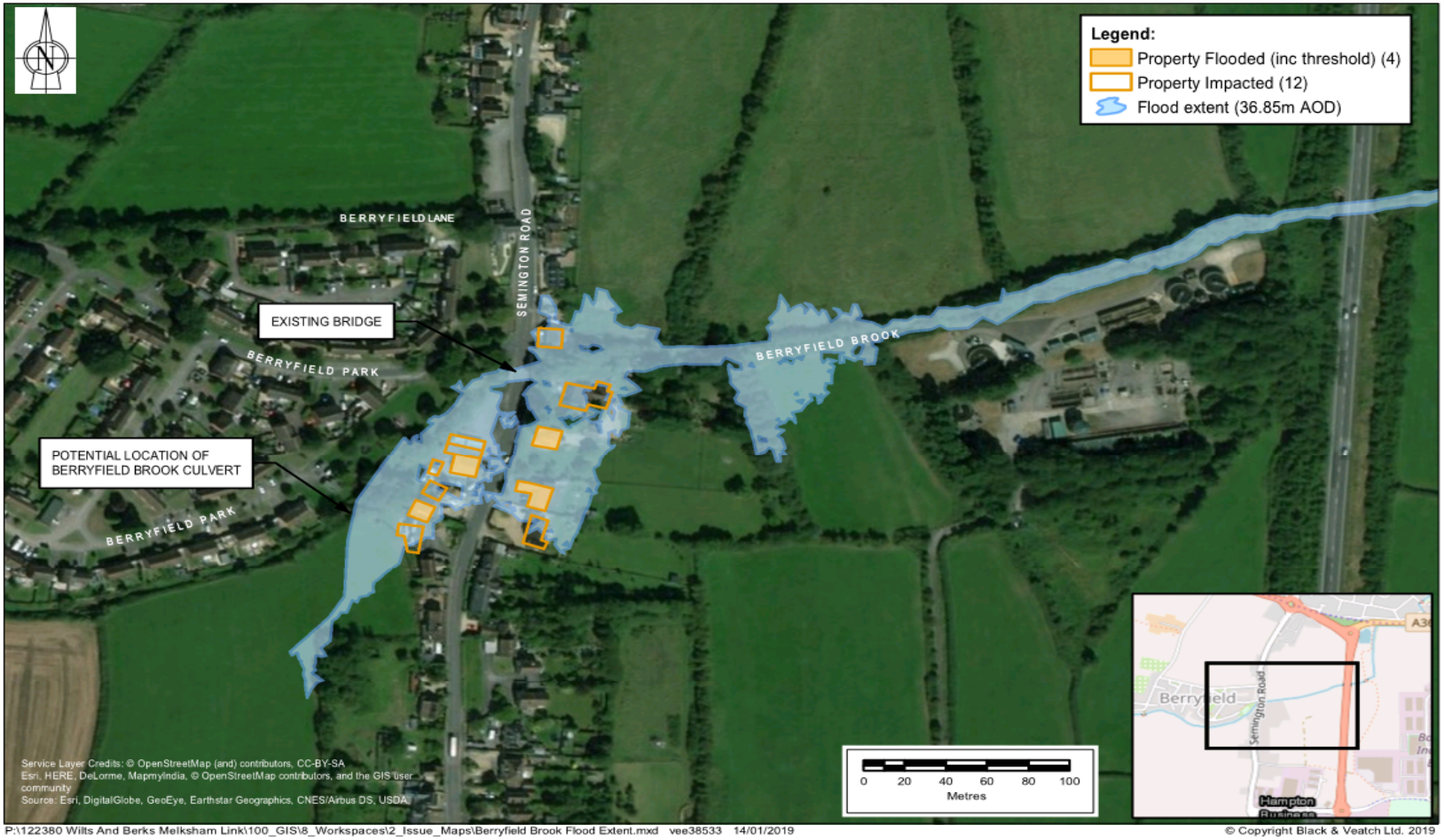


Figure 6 – Berryfield Brook, floodplain upstream of culvert flood level 36.85m

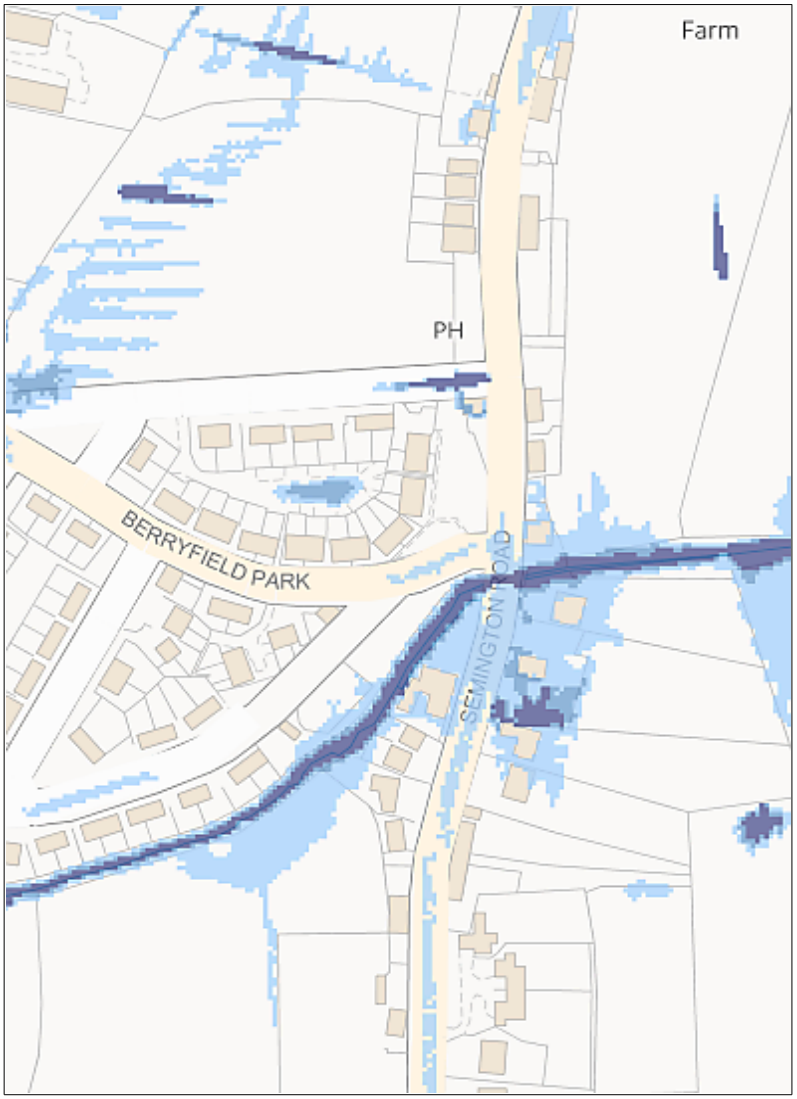


Figure 7 – Berryfield Brook, current flood risk from surface water

2.7 Combined Canoe, Fish and Eel Pass

Concerns were raised regarding the conjunctive use of fish and canoe passes and the potential conflict. Further information on the proposed combined Canoe, Fish and Eel Pass is provided below.

The Fish Pass Manual produced by the Environment Agency (v2.2, Nov 2010) and now republished by the Institute of Fisheries Management includes 'Brush-furnished Fishway & Canoe-Fishway'. The guidance states that for use by canoes minimum water depths in the pass should exceed 400-500mm, whereas the lower limits for fish are 100mm (coarse fish, small trout, eel etc) to 300mm (large migratory salmonids). The brushes are spread evenly across the channel with gaps of 200-400mm depending on the species and size of fish targeted, so that fish can swim between, through and over them as required. Velocities are lowest between and within the brushes.

The fish pass manual does not highlight any issues associated with injuries or killing of fish in this type of pass. Conjunctive use by canoes does provide a residual risk of disturbance. However, it is not expected that the Melksham pass would be in frequent or continuous use for canoeists, so the risk of disturbance remains modest.

The Fish Pass Manual lists the advantages of these passes as 'suitable for a wide range of species & sizes of fish, conjunctive use with boats, passage for vertebrates and invertebrates, [and] provides habitat for fish and invertebrates'. It reports that while the first brush passes in the UK were installed relatively recently, over thirty-five examples had been constructed in Continental Europe (as of 2010) since their development in around 2002, of which approximately half provide passage for boats including canoes and kayaks as well as fish.

Brush passes for use by both fish and canoes have been constructed in the UK at:

- Porters Lock (2009), Eldridges Lock (2009), and Tonbridge Lock (2011) on the River Medway
- Radcot Lock on the River Thames (2011) – a semi-natural pass with brushes at key points

It is understood that the Environment Agency are recommending the use of a furnished brush pass for combined fish and canoe passage to the Maidenhead Waterways Restoration Group.

Further detailed design will be undertaken to maximise the performance of the fish pass, and build upon experience from other facilities.

Chapter 3 – Water Framework Directive Update

3.1 Introduction

The March 2018 Addendum Report proposed a training bank in the River Avon to improve the channel along part of the newly impounded reach, and the EA acknowledged that this new feature had merit from an ecological perspective. This proposal, together with the plans for erosion protection around Town Bridge, has now been included in an updated WFD Assessment (Appendix 2 to this report). The revised WFD Assessment also takes account of cycle 2 2016 WFD water body status and includes further suggestions for mitigation.

3.2 Conclusions

3.2.1 The revised WFD Assessment concludes that there is potentially a risk to WFD compliance associated with the proposed new Challymead weir, with potential permanent negative effects on river continuity and fish passage. The assessment concludes that mitigation is required to ensure the scheme is compliant.

3.2.2 Following further consultation with the Bristol Avon Rivers Trust in January 2019, a list of suitable sites for weir removal has been drawn up along the Bydemill Brook, a tributary which joins the Avon further upstream at Lacock. These will need to be taken forward as the scheme develops.

3.2.3 The inclusion of “State of the Art” combined fish & eel passes in the new weir and at Melksham Gate weir will significantly improve the current situation where the 1950s fish pass at the old weir is ineffective.

3.2.4 Regarding the possible impact of the proposals on spawning grounds, our studies have identified that the closest bed gravel deposits occur downstream of the proposed weir in the unmodified reaches.

3.2.5 The updated modelling of river flows reported in Chapter 2 confirms that minimal impact on the river environment would be caused by operation of the locks.

Appendix 1 – Introduction

Contents

Appendix 1.1

Letter from EA to WC Planning

8th June 2018

Mr James Taylor
Wiltshire Council
Development Control West
County Hall Bythesea Road
Trowbridge
Wiltshire
BA14 8JN

Our ref: WX/2012/122351/10-L01
Your ref: W/12/01080/FUL

Date: 08 June 2018

Dear Mr Taylor

ENVIRONMENTAL STATEMENT ADDENDUM - CREATE NEW WATERWAY AND TOWPATH FOR WILTS & BERKS CANAL BETWEEN KENNET & AVON CANAL AND R. AVON INC. FOOTPATH, CYCLEWAY AND 10x BRIDGES PLUS NEW ACCESS ROADS TO BERRYFIELD (MELKSHAM CANAL LINK)

MELKSHAM CANAL LINK, LAND NORTH WEST OF SEMINGTON BRIDGE, CANAL BRIDGE, MELKSHAM

Thank you for re-consulting the Environment Agency on the above planning application.

We have reviewed the Environmental Statement Addendum by Black & Veatch, dated March 2018, plus six revised drawings all dated 11 April 2018 on the LPA website (not on the actual drawings).

We **maintain our objection** for the reasons explained below.

Water Resources
It is stated that there could be a constant abstraction of 0.34 m^3/sec (page 3-10, 2nd bullet) based on a lockage every 15 minutes. So the flow rate modelled as 1 m^3/sec (page 3-6) will already have been reduced to 0.66m^3/sec. We need to see the impact of the different operating combinations on a time series of flows including an **abstraction** only (referred to as back-pumping in the submitted document) scenario, in addition to combined abstraction and discharge regimes. As we have stated previously we are happy to be presented with different operating conditions, i.e. using different assumptions about lockage, but we must see a time series of the combined abstraction and discharge regime. So far, the information presented only discusses discharge, or lockage as it is called in the text. We are particularly concerned with how the flow downstream of the new weir will change under the different operating conditions. From a water resources perspective it is the impacted **flow regime** (the rise and fall of river water levels as locks are operated) that is important, not the actual levels. This information was clearly requested in the notes of our meeting with the applicant and their consultant on 27 April 2017.

The exemption from water resource licencing has been removed, therefore a licence will now be required in line with Environmental Permitting legislation. As part of this process the applicant will be required to supply information on the impact of the proposals on the flow in

the river. It is likely that any licence granted will have a Hands Off Flow (HOF) condition. This means abstraction must be stopped or reduced when river levels are low. Comments on this planning application will not affect our determination of an abstraction licence.

New weir and locking

If the new weir has a crest level of 30.60 and the upstream water level is 30.65, it is suggested that there will be a 2cm increase (p.3-10, 1st bullet) in levels under the 2-lock operation. What does this equate to in flow downstream of Challymead weir?

It is unclear how there can be a drop in level Fig 7 (3) (p.3-11) with the downstream lock operation.

Section 3.4 states the volume and discharge time have been assumed to be the same as for lock 2. This does not make sense as the volumes are different as shown in fig 6. It is imperative to use the correct volumes and times as these are critical to understanding the potential changes to the flow regime particularly given the scale of the impacts proposed.

Figure 5 (p.3-8) shows the volume of lock 1 to be 120m^3, not 300m^3 as stated in section 3.4, methodology 4th bullet (p.3-6).

Geomorphology

Flow Pulsing

Section 3.4 of the ES Addendum Report (March 2018) does not address the potential impact of potential flow pulsing on flow regime downstream of the proposed new weir. The report only considers the potential change in water levels at Town Bridge within the heavily modified and proposed impounded reach. The channel downstream of the proposed new weir is relatively natural in terms of its channel form and flow characteristics and it is this reach in particular that an impact assessment is required for. Modelling the impact within an impounded and over-wide rectangular reach will obviously underestimate the potential impact in the relatively natural downstream channel and without further information on this issue our objection remains in place.

Appendix 3, Table D1 states that the hydrological regime downstream of the proposed new weir remains unchanged – this statement does not reflect the potential for flow pulsing as noted above. According to the analysis presented in Section 3.4 of the ES Addendum Report the maximum instantaneous rate of lockage discharge from Lock 2 would result in a doubling of the Q95 natural river flow and it is the impact of this on the natural downstream channel that requires assessment.

Training Bank

The proposal to construct a training bank through the newly impounded reach is a new design feature of this application. The oversized and artificial cross-section of the channel in this reach would support channel narrowing as a form of restoration and we agree with the recent geomorphological survey that, from an ecological perspective, creating a two-stage channel that allows for naturalization of the right bank has merit. While the report states that there will be no impact on channel capacity, because the volume of the training bank will be achieved from the excavation of the bed in the navigation channel, this makes the assumption that over time the right bank will not become heavily vegetated to the extent that conveyance is reduced.

There are a number of construction issues with the training bank, that require addressing for this element to be acceptable from an ecological perspective, for example:

1. How will the wet bed sediment be held in place to create a stable bank and prevent a major silt release impacting the natural downstream channel?
2. What assessment has been made of the existing bed sediment to assess its suitability for use in creating a stable bank?
2. How will the upper surface of the bank be protected from scour under high flows when inundated?

The potential construction impacts of the training bank should be included in the WFD assessment as should the potential future maintenance dredging impacts for the associated navigation channel. The newly impounded reach will act as an efficient silt trap and whilst we agree that high flows may mobilise some fine sediment deposits it is not reasonable to assume that regular maintenance dredging will not be required to maintain the navigation channel – questions that require addressing regarding maintenance dredging will include what method of dredging will be used, where the arisings will be disposed of, and how frequently this is likely to be required.

Town Bridge

Excavating the bed of the channel under Town Bridge clearly carries a risk of inducing scour that affects the bridge piers which 'rock-rolls' may not adequately address. This is not an Environmental Permitting issue for the Environment Agency but we would advise that this aspect of the design is reviewed by an appropriately qualified and experienced bridge engineer – i.e. one familiar with bridge scour and river processes.

Flood Risk

Under the Flood Risk section of our letter dated 12 May 2017 (appendix 1.2 ES addendum), we provided bold text comments for the benefit of the LPA and the applicant/agent as to what additional information was expected to satisfy our flood risk concerns. These concerns have not been fully addressed in the revised ES and amended drawings. We offer the following observations:

1. **Weir Crest Level -** Referring to point i) in our letter of 12 May 2017 – drawing WBCT/10/017 rev 7, WBCT-10-32 (appendix 4) and WBCT-10-033 (appendix 4) all show the concrete weir crest level to be 30.35mAOD and the crest level of the drop-in boards to be 30.60mAOD which will retain upstream water levels at that figure. A level of 30.60mAOD is also stated in table 2 (p.3-6). We recall that the modelling we have reviewed used a level of 30.35mAOD. If the weir crest level is to be 30.60mAOD, modelling will need to be re-run and re-reviewed by the Environment Agency using this crest level.
2. **Culvert Blockage -** Regarding point iii) of our letter of 12 May 2017, the recent submissions still do not provide illustration of what land will be flooded in the event of blockage of the Berryfield Brook culvert (where the canal is proposed to cross over Berryfield Brook). There are properties/land in between Semington Road and Berryfield Brook which could be at an increased risk of flooding from culvert blockage. We need to see a graphic illustration (i.e. a map with illustrations) of what area is likely to be flooded for the different blockage scenarios which have been discussed in Appendix 3.2, page 7.

Training Bank

The new design element of the training bank will need to be included within a revised FRA to ensure no impact on flood levels and for this to be a realistic test this assessment should allow for significant vegetation (including trees) to become established on the right bank. In addition, it should be noted that Section 4.4 describes some aspirational future environmental enhancements to the training bank and Town Bridge reach, all of which would further impact the flood conveyance properties of the reach.

Biodiversity & Ecology

We have reviewed the additional information in relation to Biodiversity and note that it is recommended that repeat protected species surveys will be required to inform mitigation measures. There is still uncertainty regarding impacts of dredging and weir installation on protected species - we must be satisfied there will be no long-term significant adverse impacts on key species and habitats as a result of this proposal. On this basis we maintain our concerns.

Fisheries

There is still insufficient fisheries information provided in the Addendum Report

Environmental Statement March 2018. The fisheries mitigation proposals that are mentioned in the Addendum Report, section 4.3, are not sufficient to compensate for the “permanent negative” impact of the new weir, identified in the 2015 WFD Assessment. There is still insufficient detail on mitigation proposed to offset the impact of a new barrier across the River Avon, with particular concern being the stretch above the proposed new weir, which contains important spawning grounds.

There are also concerns regarding the impact of flow pulsing on the fisheries habitats, spawning and fry nursery areas downstream of the proposed weir. Has the impact of this with regards to fisheries been assessed, and how will this be mitigated?

Fish/Eel/Canoe Pass

None of the submitted new plans provide sufficient detail of the design of the newly proposed combined fish/eel/canoe pass (referred to in section 2.4.1, page 2-3) on the modified design of the Challymead Weir, so we still cannot assess whether this will mitigate the concerns over fish passage and migration. The Apem Report Ref: 413812 written in June 2015 suggests the following fish and eel passage solutions: i) A Larinier super-active-baffle pass; and ii) A bristle-brush, pool-and-traverse pass. However, it is not clear how a canoe pass can be successfully incorporated into this. We wish to see greater detail showing how fish and eels are not injured or killed by canoes using the pass.

We would suggest that Environment Agency survey data, conducted downstream of the proposed location of the new weir (as part of the Core Fish Monitoring Programme) should be used to aid the design of a suitable, separate fish and eel pass on the Challymead Weir. This data is available from the Environment Agency by request through the Wessex Enquiries Team - wessexenquiries@environment-agency.gov.uk

I hope the above points are helpful and that our outstanding concerns are clear. Please contact me if you wish to discuss any of the above.

Yours sincerely

Ms Ellie Challans
Sustainable Places - Planning Advisor

Direct dial 02030 259311
Email swx.sp@environment-agency.gov.uk

cc Mr Jack Mason – Black & Veatch Ltd
Paul Lenaerts – Wilts & Berks Canal Trust
Ken Oliver – Wiltshire Council

Appendix 1.2

Contributing Consultants

Appendix 1.2 - Contributing Consultants

Black & Veatch are an experienced engineering consultancy specialising in water, river engineering and environmental design and assessment. Black & Veatch have supported the technical development of the Melksham river route navigation for over 13 years.

https://www.bv.com/

Hydro-Morph Ltd is small independent environmental consultancy set up by Jane Moon to provide geomorphological, river restoration, flood risk, land drainage, river and coastal consultancy services to both large engineering firms and small private clients. Services include geomorphological assessments (river, estuarine and coastal), WFD compliance assessments, fluvial audits, river restoration appraisal and design, flood risk and land drainage assessments and project management.

Jane Moon *Director*
MSc, CSci, MCIWEM, FGS

jane.moon@hydro-morph.co.uk

Appendix 1.3

Melksham Link Project Team

Appendix 1.3 – The Melksham Link Project Team

The following are the volunteer members of the Wilts & Berks Canal Trust who make up the project team for the Melksham Link project:

Dr David Cook – Environment & Sustainability Adviser

Qualifications: B.Sc Physical Geography – University of Birmingham
M.Sc Meteorology and Climatology – University of Birmingham
Ph.D Civil Engineering (Hydrology) – University of Manchester
Diploma in Management Studies – Henley Management College
Postgraduate Certificate in Education – University of Birmingham
Chartered Water and Environmental Manager
Member, Chartered Institute of Water and Environmental Managers

Dave took early retirement in the summer of 2009 from Thames Water where he was Water Resources Manager. A climatologist and hydrologist by academic background he is also a chartered environmental manager. He has over 30 years of experience in the planning, promotion, development and management of water resources. This was mainly in the Thames catchment but also elsewhere in the UK and overseas as a consultant. He has significant project management experience with Thames, including immediately prior to retirement, managing some of the technical and environmental studies into the potential Thames Water reservoir near Abingdon. He was invited to join WBCT in 2009 by the then Chairman, John Laverick.

John Laverick MBE – Team Member

Qualifications: Chartered Engineer
Fellow of the Institution of Civil Engineers
Member of the Institution of Structural Engineers
Fellow of the Chartered Management Institute

After an impressive career in maritime civil engineering, John moved to Norfolk where he project managed, in close association with the Norfolk Wildlife Trust and the Environment Agency, the restoration of Barton Broad. He then moved to Wiltshire for his final years of full-time employment with British Waterways. Here he managed the £30 million Heritage Lottery Fund project restoring the Kennet & Avon Canal under the watchful eye of Lottery-appointed monitors English Nature, English Heritage and The Countryside Agency. During this period, and into retirement, he served as a voluntary board member on the Environment Agency's Management Group for the Upper River Thames. In retirement he became Chair of the Wilts & Berks Canal Trust, recently taking more of a 'back seat' as Vice President of that Trust. He was appointed an MBE in the 2016 New Year Honours List for voluntary service to Waterways Management and Restoration.

Mike Lee BEM – Waterway Engineer

Qualifications: Chartered Engineer
Member of the Institution of Civil Engineers
Military Engineer with the Royal Engineers
Diploma in Management Studies. Woolwich Polytechnic 1973

Mike's initial training was in Dock and Harbour Engineering, working on the River Thames. He was called up for National Service in 1955 and gained a commission in the Royal Engineers. After leaving the army, Mike joined Kent River Authority and became Divisional Engineer, North Kent in 1961 with responsibility for 80 miles of sea walls and 250 miles of Main River watercourses.
Mike moved to Bath in 1974, working for Wessex Water Authority as Principal Engineer. In his spare time, he volunteered for the K&A Canal restoration team. Following his retirement, Mike joined the K&A Heritage Lottery Design Team, working with John Laverick. Mike was subsequently awarded the British Empire Medal in 2016 for services to the restoration of the K&A.
Mike joined the Wilts & Berks Canal Trust in 2008 and served as Co-Engineering Director until 2013.

Paul Lenaerts – Project Manager

Qualifications: B.Sc Aeronautical Engineering, Loughborough University 1968
M.Sc. Systems Engineering, Brunel University 1973

After an early career in Engineering, Paul spent the last 20 years of employment as HR Manager for YJ Lovell Construction Group before retiring early to pursue his own property development projects. He joined Wilts & Berks Canal Trust in 2007, initially as an "armchair" member. In 2012 he was persuaded by neighbour John Laverick to take on the role of Project Manager for the Melksham Link Project.

Steve Roberts – Team Member

Qualifications: B.A. Computer Science, Cambridge 1972

Steve is a retired software engineer with an interest in renewable energy technologies, and an investor in solar and wind generation. He joined the Wilts & Berks Canal Trust as a volunteer in 2013, working on restoration and maintenance at the Chippenham sites, and has been Treasurer of the local branch since 2015.

John Webb – Team Member

Qualifications: National Diploma in Building
Chartered Quantity Surveyor
Fellow of the Royal Institution of Chartered Surveyors
Fellow of the Chartered Institute of Arbitrators

Having spent 17 years with a national firm of contractors progressing from Quantity Surveyor to Project Manager, John established his own firm providing Surveying and Project Management services to the construction industry in the public and private sectors. Latterly, he was retained as an arbitrator and expert witness in building and civil engineering disputes both in the UK and worldwide.
John has travelled most of the UK canal network in his own narrowboat and is an active volunteer for both the K&A Canal Trust and the Wilts & Berks Canal Trust. He first became involved with the Melksham Link project in 2003 when he was Chair of the local branch of the Inland Waterways Association. In his role as a member of the Project Team, John has had a major input on the financial aspects of the scheme.

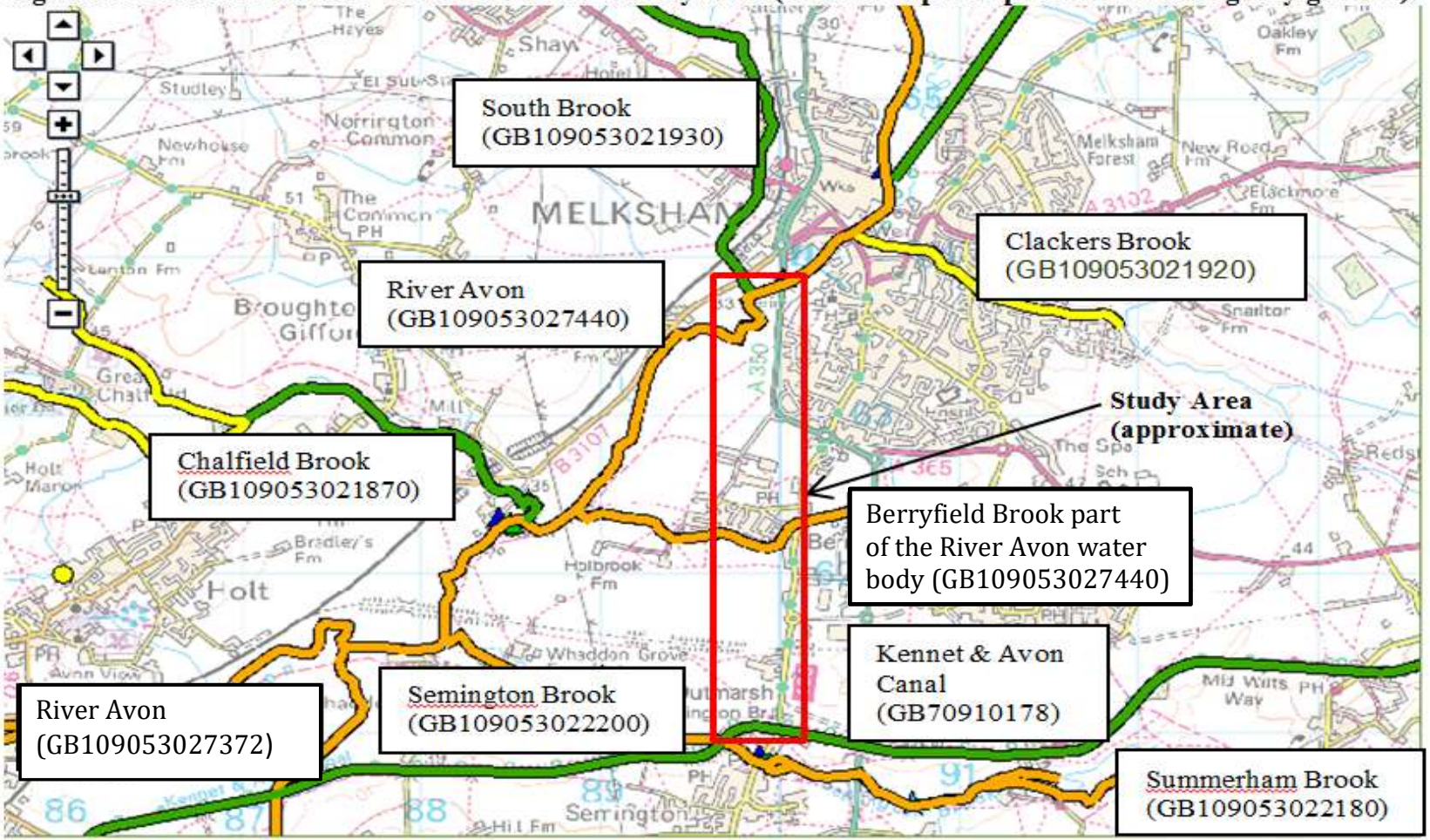
Appendix 2 – Updated WFD Assessment

Contents

Appendix 2.1

Water Body Map

Figure 2.1: Location of WFD water bodies in the Study Area (source: http://maps.environment-agency.gov.uk/).



Appendix 2.2

Description of Work

STEP 1 - Describe modifications and identify WFD water bodies that could be affected. Include map of water bodies.

* Details contained with Wilts & Berks Preliminary Assessment Report, Dec 2013.

Proposed Actions / Modification	Detailed description of the modification	Water bodies affected									
		RIVER							CANAL		GROUNDWATER
		River Avon GB109053027440	River Avon conf Semington Bk to Netham Dam GB109053027370	South Brook - source to conf R Avon (Brist) GB109053021930	Semington Brook - Milebourne Str to conf R Avon (Brist) GB109053022200	Summerham Brook - Poulshot Str to conf Semington Brook GB109053022180	Clackers Brook - source to conf R Avon (Brist) GB109053021920	Chalfield Brook - conf GanBk to conf Semington Brook GB109053021870	Kennet & Avon Canal GB70910178	Wiltshire Berkshire Canal GB70610061	Bristol Avon Forest Marble GB40902G302900
(1) New junction with the Kennet & Avon Canal	The layout proposed for the junction is that shown on Drawing WBCT/10/001. The canal edge of the new junction is proposed to be constructed from 3m long galvanised steel sheet piles. It will include a new boat landing area. Where it joins the Kennet and Avon the water body will be 30m across at its widest point. The surrounding area will be landscaped, including hedge and tree planting. The junction is located approximately 75m west of the historic junction to the Wilts & Berks Canal. A new footbridge will be constructed across the new canal.	x	x	x	x	x	x	x	✓	x	x
(2) New junction with the River Avon	The layout proposed for the junction is that shown on Drawing WBCT/10/004. The channel between the tail of the bottom river lock and the river will be excavated so that under normal river conditions a navigation channel depth of 1.6m is achieved. The sides of this channel are proposed to be formed by steel sheet piles with the top of these level with the normally expected water level. The outer face of the piling is to be protected against damage from boats by an extruded "D" shaped neoprene section. Reed bed planting will be undertaken behind the piling on the upstream side of the new channel. The two river locks and this section of the canal waterway are very visible from Western Way and landscaping and tree planting will be undertaken. This area is possibly to be seen as a "Gateway to Melksham" and the green waterside space created at the river/canal junction can hopefully be developed for amenity purposes.	✓	x	x	x	x	x	x	x	x	x
(3) Berryfield Brook crossing	The layout of this structure is shown on Drawing WBCT/10/003A Rev 3 and WBCT/10/023. It is proposed that the bed of the existing Berryfield Brook channel is lowered by 0.65m to allow for the construction of a 7m wide culverted base. The culvert base is proposed to be constructed from 0.3m thick graded crushed stone on which is to be laid a precast concrete culvert section. The walls of the new channel are proposed to be constructed from Redi-Rock inter-locking dry laid precast concrete block system. To avoid scour and to provide stabilisation the banks will be lined with Redi-Rock for approximately 60m upstream and 100m downstream along the left-hand bank and 40m downstream along the left-hand bank. 'Soft' revetment will also be used to encourage the growth of natural vegetation along the final 50m of the right-hand bank downstream of the culvert. The ends of the lined water course are proposed to have splayed reinforced concrete side walls and the bed junction stabilised.	✓	x	x	x	x	x	x	x	x	x
(4) Erosion protection - at Town Bridge	The centre arch of Town Bridge is proposed to take the navigation channel (see drawing WBCT/10/034). It is anticipated that scour protection will be necessary to ensure the pier foundations are not compromised by boat wash. The use of rock mattresses is proposed for this purpose.	✓	x	x	x	x	x	x	x	x	x
(5) New weir in River Avon below Challymead Bridge (enabling 900m length of the River Avon to be used for boat navigation)	The location of the new weir is shown on Drawing BCT/10/004 Rec 3, Drawing WBCT/10/017, Drawing WBCT/10/18. The weir is designed to consist of a fixed weir at a level of 30.35m AOD (existing bed level is 29.5m AOD) and removable weir boards, which will retain a level of 30.60m AOD under normal flow conditions. As this level is the normal summer level, the effect of the weir will only be noticeable in very low flow conditions. On the southern bank it is proposed to construct a 4m wide tilting weir/sluice gate to allow the level to be dropped for inspection and maintenance. It is also proposed to incorporate a combined fish, eel and canoe pass into the structure of the weir. Anti- scour bank protection is proposed along a short length of channel downstream of the new weir, where the river doubles back on itself close to the bottom of the two river locks. The planting of selective willows behind this revetment will provide additional stabilisation. Proposed operation: In the winter the weir boards could be removed and it is also envisaged that the sluice would be left open in the winter to help reduce the rate of siltation upstream. Under flood conditions the downstream water level will rise to a point where the weir is completely covered i.e. 'drowned out', which is likely on 1:2 year flood return period.	✓	✓	x	x	x	x	x	x	x	x
(6) Melksham Gate flood gate to be extended to incorporate an additional fish pass, a canoe pass, a new lock and a hydropower turbine	The existing 'Melksham Gate' weir and sluice gate will be retained and a new narrow lock built on the southern side (left bank) of the channel. An additional fish pass will also be constructed (the current one is ineffective) together with a canoe pass. A hydropower turbine will also be incorporated into the new structure. It is also proposed to re-profile the south bank to provide bankside or pontoon moorings.	✓	x	x	x	x	x	x	x	x	x
(7) Dredging and re-profiling of the River Avon to ensure depth of navigable channel	It is proposed to dredge a length of the River Avon from upstream of the Town Bridge down to the new weir. Four locations have been identified totaling a length of approximately 400m. The dredged profile will form the navigable channel and will be limited to a width of 10 to 12m (less than half the width of the current channel) but wider at two mooring areas and one turning area. It is proposed to try and use the dredged spoil to reshape the left bank around Challymead Bridge and for minor bank regrading (re creation of willow bank margins).	✓	x	x	x	x	x	x	x	x	x
(8) Changes in water demand due to construction of 3km of new canal	It is proposed that the River Avon will provide all the water supply required to both fill and maintain the water level within the new canal. A water balance assessment undertaken shows that backpumping and pumping of water from the River Avon is likely to be required throughout the year to maintain water within the new canal link. The canal will be lined to prevent any potential leakage to groundwater.	✓	✓	x	x	x	x	x	x	x	x
(9) Operation of the Melksham Gate Lock (Lock 1) and Bottom River Lock (Lock 2) - single operation and combined operation effects	A new 'Narrow lock' is to be cut into the existing LH bank to enable craft to navigate past the weir (Melksham Gate Lock (lock 1). Another lock will be constructed within the new junction of the canal (Bottom River Lock (lock 2). Operation of the locks could occur separately or in combination.	✓	x	x	x	x	x	x	x	x	x

(10) Training bank along the River Avon between Town Bridge and Challymead Bridge	The location of the new training wall is shown on Drawing WBCT/10/032 and Drawing WBCT/10/033. It is proposed to narrow a 225m length of the main River Avon channel through Melksham by constructing a training bank. The training bank would extend from c130m downstream of Town Bridge (where the existing channel widens), to c20m above Challymead Bridge. The width of the bank will vary between 2-5m wide. It is to be formed from material dredged from the new navigation channel, which is to be retained by rock mattress or similar on the navigation side of the bank. This construction method will ensure the cross-sectional area of the watercourse does not change, to ensure that the introduction of the training bank will not reduce the conveyance of the River Avon through the town. The bank top would be at a level 300 to 400mm above the retained water level of 30.60 AOD. The navigation channel would be between the training bank and the existing LH bank of the river, with a depth of 1.4m and varying in width from 12m to 20m. On the other side of the training bank, between it and the existing RH bank, would be a shallow marginal channel which will not be accessible to boats and could support permanent vegetation (i.e. reed beds). It is proposed that the opposite bank adjacent to the training wall (c. 225m length) should be stabilised using rock rolls or similar 'soft' engineered product to prevent erosion but to facilitate accretion of silt.	✔	x	x	x	x	x	x	x	x	x

Appendix 2.3

Screening of Water Bodies

STEP 1 - Identify WFD water bodies that could be affected by scheme and confirm which require assessment. Include map of water bodies.

Water body Name	Water body ID	Heavily Modified Designation	Updated 2016 WFD status	Screen in or out of WFD Assessment	Reasoning
R Avon (Brist) conf R Marden to conf Semington Bk (River)	GB109053027440	No	Moderate Status	**IN**	This waterbody is located within the proposed works area. It is 24km in length and includes a short 2km stretch of the Berryfield Brook, which is directly crossed by the proposed canal route. As a part of the restoration of the Wilts & Berks Canal it is proposed to use a 900m long section of the River Avon as a navigation channel to allow the canal to pass through the centre of Melksham, Wiltshire. The scheme therefore has the potential for direct and indirect effects on biological quality and supporting physico-chemical and hydromorphological elements. It has therefore been screened in for further assessment.
Bristol Avon (Semington Bk to By Bk (River)	GB109053027372	Yes - HMWB	Moderate Potential	**IN**	This water body is a continuation of the River Avon some 3.6km downstream from the proposed works. There will not be any direct impact on the water body resulting from the proposed works, however there is the potential for indirect impacts due to changes in hydromorphology (i.e. sediment dynamics), fish passage and changes in water demand. This water body has therefore been screened in for further assessment.
South Brook - source to conf R Avon (Brist) (River)	GB109053021930	No	Good Status	**OUT**	The South Brook flows into the River Avon immediately downstream from the proposed works. The proposed works will be limited to the River Avon water body and therefore there will be no direct impacts on this water body resulting from the scheme. Indirect impacts are considered to be negligible as the water body is below the area of works and therefore will not be impacted by the change in water level. This water body has therefore been screened out of further assessment.
Semington Brook-Milebourne Str to conf R Avon (Brist) (River)	GB109053022200	No	Moderate Status	**OUT**	There are a number of existing surface water abstractions along this water body (including a feed for the Kennet & Avon Canal). The ecological status of the water body is known to be vulnerable to low flows especially in the upper reaches. The stream has been highlighted as one where there is "no water available" under the Environment Agency's Catchment Abstraction Management Plan. This indicates that there is no water available for licensing at low flows although abstraction may be permitted at higher flows. The new canal link proposes to use a new supply from the River Avon and will not take any flow from the Kennet & Avon Canal system. Therefore there will be no change in water demand which could impact (directly or indirectly) on this water body. This water body has therefore been screened out of further assessment.
Summerham Brook - Poulshot Str to conf Semington Brook (River)	GB109053022180	No	Poor Status	**OUT**	The Kennet and Avon Canal abstracts water from this catchment (unlicensed). The new canal link proposes to use a new supply from the River Avon and will not take any flow from the Kennet & Avon Canal system. Therefore there will be no change in water demand which could impact (directly or indirectly) on this water body. This water body has therefore been screened out of further assessment.
Clackers Brook - source to conf R Avon (Brist) (River)	GB109053021920	No	Poor Status	**OUT**	The Clackers Brook flows into the River Avon in Melksham just upstream of Town Bridge but below Melksham Gate. The proposed works will be limited to the River Avon water body therefore there is unlikely to be any direct impact from the scheme. The water level within the River Avon will be retained by the new weir at the normal summer level of 30.60m AOD. Studies undertaken in 2010 have been used to inform the design of the weir crest level to avoid any impact on the adjacent Clackers Brook. The effect of the weir will only be noticeable in very low flow conditions and will not extend to the Clackers Brook, therefore indirect impacts on the Clackers Brook are considered to be negligible. This water body has been screened out of further assessment.
Chalfield Brook - conf GanBk to conf Semington Brook (River)	GB109053021870	No	Moderate Status	**OUT**	The Chalfield Brook flows into the River Avon approximately 2.7km downstream of the proposed works in Melksham. There is unlikely to be any direct impacts from the scheme and indirect impacts are considered to be negligible. This water body has therefore been screened out of further assessment.
Kennet and Avon Canal (Canal)	GB70910178	Artificial – Navigation	Good Potential	**OUT**	A new canal junction is proposed at Semington Road Bridge which will involve some localised works along the downstream end of the Kennet & Avon Canal. The work will essentially reinstate a historic connection and therefore while there may be localised effects it is not envisaged that there will be any long-term negative effect on the canal at the water body scale. The proposed canal link will be separated from the existing K&A canal with a new lock at Berryfield. This will help to keep the water within the new canal seperate from the K&A. The new canal link proposes to use a supply from the River Avon and will not take any flow from the Kennet & Avon Canal system (which is known to be depleted). Therefore there will be no change in water demand which could impact (directly or indirectly) on this water body. This water body has therefore been screened out of further assessment.
Wiltshire Berkshire Canal (Canal)	GB70610061	Artificial – Navigation	Good Potential	**OUT**	The RBMP refers to a Wiltshire Berkshire Canal which joins the River Avon upstream of the proposed works. This is the disused leg of the historic Wilts & Berks Canal, which when restored, will join into the River Avon well upstream of the proposed works. The works will be limited to the River Avon water body therefore there is unlikely to be any direct or indirect impact on this water body from the scheme. This water body has therefore been screened out of further assessment.
Bristol Avon Forest Marble (Groundwater)	GB40902G302900	N/A	Poor (quantitative and chemical	**OUT**	This water body has been classed as poor quantitative status. None of the proposed works will impact upon the connectivity with groundwater as their influence is confined to surface water flow. There is not predicted to be any effect on connection to groundwater as a result of the proposed works. Groundwater has therefore been screened out of further assessment.

Appendix 2.4

Baseline Data

WFD Quality Elements (for River water body)	River Avon (Brist) conf R Marden to conf Semington Brook ID GB109053027440			Bristol Avon (Semington Bk to By Bk (River) 22km ID GB109053027372		
Hydromorphological Supporting Conditions	**Catchment Data Explorer classification data - 2016**	**Additional baseline information**	**Source**	**Catchment Data Explorer classification data - 2016**	**Additional baseline information**	**Source**
Quantity and dynamics of flow	Supports Good	The source of the River Avon is above the ancient town of Malmesbury. From here it flows in a southerly direction down through through Wiltshire and Somerset to the Severn Estuary and Avonmouth near Bristol. The River Avon upstream of Melksham is approximately 46km long (24km as this water body) and is main river for the majority of this length. The River Avon is a typical, meandering lowland river which, through the town of Melksham has been significantly altered and modified to provide flood relief. A sluice and weir structure (Melksham Gate) was constructed along the River Avon in the 1960's to control flows on the River Avon to provide flood relief to the town and to provide a constant water level along the river for amenity purposes. The river was both widened and shortened. The river typically has a width of between 30-40m and is some 50% wider than the ideal 'regime' width upstream and downstream. Flow dynamics vary along the length of the river due to the degree of modfication and mix of natural and hard engineered channel banks. Flow is typically slow and uniform. Hydraulic modelling of the existing baseline has been undertaken by Black & Veatch in May 2015 and in Jan 2019 to inform the assessment on quantity and dynamics of flow.	Water Resources Development Strategy Study for the Wilts & Berks Canal, Nov 2007. Appendix D Geomorphological Assessment. Black & Veatch May 2007. Wilts & Berks Low Flow Results, Black & Veatch, May 2015. Hydraulic modelling undertaken by Black & Veatch in 2014 and summarised in Appendix D ofthe Geomorphological Technical Note - Weir Assessment, Feb 2018. Wilts & Berks Canal Trust - Additional Hydraulic Details Technical Note, Jan 2019.	Supports Good	Downstream of Melksham there has been very little natural channel migration between 1888 to present; suggesting that the channel, in terms of width/depth profile is stable and broadly in-regime.	Appendix D Geomorphological Assessment. Black & Veatch May 2007.
Connection to groundwater	Supports Good	The solid geology underlying the study area of the proposed canal route is dominated by Jurassic Oxford Clay. The Clay is overlain along the majority of the canal route by river valley deposits, including alluvium, terrace gravel and head deposits. There are a number of limited locations along the preffered route where Clay is not overlain by drift deposits. Two borehole records have been obtained for the central Melksham area near the River Avon and close to the offtake to the proposed canal route. The topsoil cover overlies superficial drift alluvium deposits described as soft to firm silty sandy clay overlying soft to firm organic sand and gravel. The drift cover extends to a depth of between 4.7-5.0m and overlies Oxford Clay, which is a stiff blue, fissured clay with shell fragments. Groundwater was encountered at a depth of around 2.1-2.6m.	Appendix D1 Soils and Geology. Black & Veatch May 2007.	Supports Good	No information.	N/A
River continuity	Supports Good	The channel of the River Avon is well-connected to the adjacent floodplain upstream and downstream of Melksham and has a typical lowland meandering planform. Through Melksham, the floodplain is built-up and water levels are managed to prevent out of bank flooding. Longitudinal connectivity for sediment transfer and fish passage is affected by the presence of various structures including: 1) Melksham Gate (sluice and weir structure) 2) Challymead Bridge, 3) Bath Road Bridge, and 4) Scotland Road Footbridge. Sediment is transported through the reach as either bedload or in suspension. The existing supply of bedload along this stretch of river is interrupted by various structures, of which Melksham Gate is the most significant barrier to sediment transfer. This will limit the volume available to be deposited within the reach. The 2018 geomorphological assessment determined that there is unlikely to be any significant bedload sediment transfer in the over wide and modified reach downstream of Melksham Gate during low flow conditions. During normal/high flow velocities the potential for bedload sediment transport increases and will remobilise previously deposited sediment. Given the degree of stable and vegetated deposits along the over wide reach downstream of Melksham gate it is likely that sediment is only remobilised during the higher end of flows and when there is the highest volume of sediment available to transport.	Appendix D Geomorphological Assessment. Black & Veatch May 2007. Geomorphological Technical Note - Weir Assessment, Feb 2018.	Supports Good	Downstream of Melksham there are various bridges and structures along the reach which impact on lateral and longitudinal connectivity, but floodplain connection is generally good.	Wilts & Berks Low Flow Results, Black & Veatch, May 2015.
Width/depth variation	Supports Good	The average channel width upstream and downstream of Melksham is typically around 20m with varying depths including shallows and deeper pools and a gentle flow from northeast to southwest. The banks are 3-4m high/wide, shallow to sloping though occasionally steep. The width increases through Melksham to around 30-40m wide. As a result of the re-routing and widening works carried out along the river though Melksham in 1958, the channel is now up to 50% wider than the natural channel width. Depth varies depending on channel engineering and maintenance. It is understood that little or no dredging of the river has been undertaken since the flood risk scheme was constructed in the 1960s. A sluice and weir structure (Melksham Gate) was constructed at this time to provide flood relief to the town and to provide a constant water level along the river for amenity purposes. The weir penned artificially high water levels upstream; for a distance of around 5km upstream during normal flows and around 3km upstream during high flows. Analysis of historic mapping (1888) shows that there have been some changes in the channel planform (shape) along the River Avon. The most major channel change has resulted from the re-routing of the channel in the 1960's, carried out as part of a flood alleviation scheme for Melksham. There has been very little natural channel migration between 1888 to present; providing further evidence that the channel, upstream and downstream of Melksham at least, in terms of width/depth profile is stable and in-regime. With the exception of the local sediment deposition around Town Bridge, it does not appear that significant geomorphological problems were generated by the widening of the river in the 1960's. The May 2007 study concluded that this reach of the River Avon does not appear to be that highly responsive to channel changes (i.e. the rate of geomorphological change is not fast), which would suggest that further geomophological changes, in response to further modification, may also be modest.	Appendix D Geomorphological Assessment. Black & Veatch May 2007. Geomorphological Technical Note - Weir Assessment, Feb 2018.	Supports Good	Downstream of Melksham the channel is more characteristic of a lowland meandering river. The width/depth profile is broadly in regime typically around 15-20m wide.	Wilts & Berks Low Flow Results, Black & Veatch, May 2015.
Structure and substrate of the bed	Supports Good	The floodplain of the River Avon is composed of Alluvium drift which has associated clayey soils. Due to the nature of the soil, geology and shallow gradient of the catchment, the watercourse of the River Avon and adjacent tributaries tends to be dominated by fine sediments (sand/silt and clay), with coarse gravel sediment in some localised areas. There are a number of known existing sedimentation issues along the River Avon channel through Melksham. The most notable issue is associated with over-widened channel around Town Bridge. A large volume of sediment has deposited along the right bank, much of which is now stabilised by vegetation growth. Downstream of this location a shoal has also formed on a river bend opposite the Sainsburys supermarket. Dredging used to be undertaken to remove excess silt from the channel. It is understood that little or no dredging of the river has been undertaken since the flood risk scheme was constructed in the 1970s.	Appendix D Geomorphological Assessment. Black & Veatch May 2007. Geomorphological Technical Note - Weir Assessment, Feb 2018.		The floodplain of the River Avon is composed of Alluvium drift which has associated clayey soils. Due to the nature of the soil, geology and shallow gradient of the catchment, the watercourse of the River Avon and adjacent tributaries tends to be dominated by fine sediments (sand/silt and clay), with coarse gravel sediment in some localised areas. The channel immediately downstream of Melksham in largely unmodified and the channel maintains an excellent naturally meandering habitat with gravelly bed substrate.	Appendix D Geomorphological Assessment. Black & Veatch May 2007.
Structure of the riparian zone	Supports Good	Despite the artificial nature of the watercourse, local observations suggest that the channel has stabilised to its new alignment and now supports an interesting diversity and abundance of flora and fauna. The River Avon through Melksham is tree lined predominantly with willow although there are some alder, hawthorn and ash trees. There are also a number of standing deadwood trees, which are important ecologically as they will support a diverse community of invertebrate species and are potentially important bat roosts. The banks are generally hard engineered. Bedload within the reach upstream of the proposed weir is typically sand and coarse silt. Marginal vegetation through the reach of the Avon comprises yellow flag iris, true bulrush, reed, reed sweet grass, purple loosestrife, greater willowherb, nettle and branched bur reed. In some areas bramble and hawthorn are encroaching. Non-native invasive Himalayan Balsam (*Impatiens glandulifera)* occurs rarely. Further upstream hard engineered banks give way to more natural banks which support a mix of marginal vegatation. The river is lined predominantly with willow although there are some alder, hawthorn and ash trees. Immediately upstream of the town both banks of the River Avon are grazed, and the banks show evidence of poaching.	Melksham River Route Study - Appendix F: Environmental Assessment (May 2007) Geomorphological Technical Note - Weir Assessment, Feb 2018.	Supports Good	There is an extensive and varied riparian zone comprising of a mixture of shrubs/scrub and trees.	Wilts & Berks Low Flow Results, Black & Veatch, May 2015.

Physico-chemical Supporting Elements						
Thermal conditions	High status	No information.	N/A	Good	No information.	N/A
Oxygenation conditions (DO)	High status	No information.	N/A	Good	No information.	N/A
Acidification status (pH)	High status	No information.	N/A	High	No information.	N/A
Nutrient conditions (Phosphates)	Poor	Berryfield Brook which feeds the River Avon south of Melksham (and is included within this water body classification) receives a dry weather flow of 2182m3 per day from Bowerhill Sewage Treatment Works (STW). The effluent quality specified is of a standard considered acceptable for discharge to a natural stream by the Environment Agency.	Water Resources Development Strategy Study for the Wilts & Berks Canal, Nov 2007.	Moderate	No information.	N/A
Specific Pollutants	High status	No information.	N/A	High	No information.	N/A
Biological Quality Elements						
Phytoplankton	No classification data	No information.	N/A	No classification data	No information.	N/A
Macrophytes and phytobenthos	Moderate status	Aquatic vegetation (macrophytes) were observed within the River Avon at Melksham during a river survey undertaken in 2013. This indicates that there is likely to be a mixture of shallow, faster flowing water with clean gravel substrate where macrophytes are more prevalent. Species including Yellow Water Lily *Nuphar lutea* and water milfoil (*Myriophyllum* species) were identified. Lush emergent vegetation is present on occasional gravel/sand bars in the river including Reed Sweet Grass and Common Club Rush *Schoenoplectus lacustris* .	Melksham River Route Study - Appendix F: Environmental Assessment, May 2007 Melksham Canal Link Extended Phase 1 Survey, Sept 2013	Good	No information.	N/A
Benthic invertebrate fauna	Good status	An macro-invertebrate survey was undertaken in April 2015, which identified macroinvertebrate samples of 'Fairly high' conservation value at both Conigre Mead and at the Challymead site. This was based more on species diversity rather than on the rarity value of individual species. A total of 48 records were returned from W&SBRC for notable invertebrate species within the 2 km canal route search area. The majority of these were records of important and diverse populations of aquatic invertebrate recorded from the riparian habitats adjacent to Conigre Mead LNR. The most significant aquatic macroinvertebrate recorded is the Little Whirlpool Ram's Horn Snail, which is a European protected species and was recorded at the Conigre Mead WWT Reserve. The survey undertaken in April 2015 did not identify any species at that time and summised that it's occurrence in the area is more likely to be associated with the ponds within the Conigre Mead or nearby ditches rather than from the river itself. A species search (undertaken for the Phase 1 Survey) found records of the Libellula fulva (Scarce Chaser) along the River Avon.Whilst Scarce Chaser is not listed within Section 41 of the NERC Act (2006) or previously as a UK Biodiversity Action Plan (UK BAP) species, the insect was afforded LBAP status within the Wiltshire LBAP (2002). The habitat within the Bristol Avon was described as being 'of local importance for its dragonfly and damselfly population,' with particular reference to Scarce Chaser and White-legged Damselfly *Platycnemis pennipes* . Such habitat was encompassed within the 'Rivers, streams and associated habitat' Wiltshire LBAP classification.	Melksham River Route Study - Appendix F: Environmental Assessment, May 2007 Melksham Canal Link Extended Phase 1 Survey, Sept 2013 Aquatic macroinvertebrate surveys of the Bristol Avon at Conigre Mead and Challymead, Melksham. May 2015.	High	No information.	N/A
Fish fauna	High status	The fish community present within the River Avon is characteristic of a lowland river, supporting a good mix of coarse fish as well as some migratory species, notably eels and brown trout. A fish survey was carried out along the River Avon and recorded a range of coarse fish species including Dace, Roach, Chub, Pike, Gudgeon, Bream, Perch and Barbel. In addition eels were also recorded but no salmonids. Only a single record for Bullhead was recorded during a W&SBRC search for notable fish species. The majority of species identified are therefore considered to be non-migratory. The river through Melksham provides some suitable habitat for fish species and also for spawning. A habitat survey identified nine potential spawning sites along the River Avon thriough Melksham, due to the presence of clean and silted gravel along the bed. Ten areas were classified as important fry refuges for all species and ranged from bank depressions with macrophyte growth to large beds of emergent vegetation. Downstream of Challymead Bridge is the most important section for spawning and fry habitat as it holds the largest area of clean potential spawning gravels and fry refuge areas. The stretch between Challymead Bridge and the Town Bridge had the least spawning and fry habitat as this was a deep glide with little depth or flow variation or river bed features. The river is well used for recreational angling, particularly along reach near Conigre Mead LNR and there are a number of angling groups located within Melksham. The Berryfield Brook is included in the River Avon water body classification. Smaller streams feeding the River Avon are likely to support brown trout (although potentially not Berryfield Brook which has poor water quality due to the discharge from the Bowerhill Sewage Treatment Works (STW).	Melksham River Route Study - Appendix F: Environmental Assessment, May 2007 Melksham Canal Link Extended Phase 1 Survey, Sept 2013 HBS Fisheries Fish & habitat Survey Report, 2013. APEM. Melksham Link fisheries assessment, 2015.	No classification data	Downstream of Melksham the river provides an important coarse fishery, dominated by species such as Chub, Roach, Dace and Barbel. Some migratory species can also be found, notably eels.	Internet source
HMWB Mitigation Measures						
Manage disturbance	N/A (not HMWB)	N/A	N/A	All currently 'in place'	N/A	N/A
Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone						
Avoid the need to dredge (e.g. minimise under-keel clearance; use fluid mud navigation; flow manipulation or training works)						
Prepare a dredging / disposal strategy						
Reduce impact of dredging						
Reduce sediment resuspension						
Alter timing of dredging / disposal						
Bank rehabilitation / reprofiling						
Site selection (dredged material disposal) (e.g. avoid sensitive sites)						
Awareness raising / information boards (boat wash / sources of fine sediment)						
Phased de-watering and other techniques						
Selective vegetation control regime						
Appropriate vegetation control technique						
Appropriate timing (vegetation control)						
Modify vessel design						
Vessel Management						
Sediment management						

* Data taken from the Severn RBMP.

Key

- Element classified at bad status
- Element classified at poor status
- Element classified at moderate status, or mitigation measure not 'in place'
- Element classified at good status, or mitigation measure 'in place'
- Element classified at high status

Appendix 2.5

Compliance Assessment

STEP 3 - Assess potential change of each modification on quality elements (a) and contribution to mitigation measures (b). Highlight assumptions and actions for next stages of project.

3A - QUALITY ELEMENTS

Modification (refer to description of works summary table for details)	(2) New junction with the River Avon	(3) Berryfield Brook crossing	(4) Erosion protection at Town Bridge	(5) New weir in River Avon below Challymead Bridge (enabling 900m length of the River Avon to be used for boat navigation) and erosion protection along the River Avon		(6) Flood gate to be adapted to incorporate a new narrow lock and weir with fish pass, along with the possibility for future hydropower generator.	(7) Dredging of the River Avon (including new junction between the new canal and river)	(8) Changes in water demand		(9) Training bank along the River Avon between Town Bridge and Challymead Bridge	Risk to WFD compliance	Possible ways to mitigate adverse effects and enhancement opportunities
Water body	River Avon (Brist) conf R Marden to conf Semington Brook 24km ID GB109053027440	River Avon (Brist) conf R Marden to conf Semington Brook 24km ID GB109053027440	River Avon (Brist) conf R Marden to conf Semington Brook 24km ID GB109053027440	River Avon (Brist) conf R Marden to conf Semington Brook 24km ID GB109053027440	Bristol Avon (Semington Bk to By Bk (River) 22km ID GB109053027372	River Avon (Brist) conf R Marden to conf Semington Brook 24km ID GB109053027440	River Avon (Brist) conf R Marden to conf Semington Brook 24km ID GB109053027440	River Avon (Brist) conf R Marden to conf Semington Brook ID GB109053027440	Bristol Avon (Semington Bk to By Bk (River) 22km ID GB109053027372	River Avon (Brist) conf R Marden to conf Semington Brook 24km ID GB109053027440		
Hydromorphological Supporting Conditions												
Hydrology - quantity and dynamics of flow	A new 'overwide' section of channel will be created where the River Avon joins into the proposed canal. This will approximately double the existing width of the channel immediately downstream of Challymead Bridge. Hydraulic modelling undertaken by Black & Veatch in 2014 shows with the downstream weir operational there is likely to be a significant reduction in low flow velocity in this area of the channel from the existing baseline 'low flow' conditions (i.e. 80% during the Q95 flow). At higher flows (i.e. Q10) there is no significant change from the baseline, and the impact on flows will be hard to distinguish from the baseline (which is currently a depositional flow regime). This modification is therefore likely to exacerbate existing processes (i.e. sediment deposition) that already occurs within this area of over-widened channel. The modification and its spatial effect represent less than 0.1% of the length of the WFD water body and should therefore not cause deterioration of the current 'good' status of this supporting element, therefore the impact is assessed as assessed as **permanent but negligible at the water body scale.** The impact is however assessed as **permanent and negative** at the local scale.	The new 8m culvert and 160m lined channel on the Berryfield Brook has the potential to locally increase flow velocities due to the reduction in roughness caused by loss of bankside marginal vegetation and loss of bed substrate. In regards to the whole water body the works are limited in extent (160m length of channel), which represents less than 0.1% of the total water body length. However, the Berryfield Brook is approximately 3km in length so these works represent approximately 16% of the total brook length. The modification and its spatial effect represent less than 0.1% of the length of the WFD water body and should therefore not cause deterioration of the current 'good' status of this supporting element, therefore the impact is assessed as permanent but **negligible at the water body scale.** The impact is however assessed as permanent and **negative at the local scale.**	It is proposed that the canal navigation channel will make use of the existing central arch of Town Bridge. Hydraulic modelling undertaken for a range of high flows by Black & Veatch in Jan 2019 (Source: Wilts & Berks Canal Trust - Additional Hydraulic Details Technical Note, Jan 2019) shows that there is unlikely to be any change in flow velocity above baseline conditions at the bridge. **No impact.**	Hydraulic modelling shows that the hydrological regime downstream of the new weir will not change from existing conditions, except for immediately downstream of the new structure, where there is likely to be some localised change in flow dynamics caused by water flowing over the weir. Upstream of the weir, hydraulic modelling shows a significant reduction (80% during the Q95 flow) in flow velocity from existing baseline conditions. This effect reduces as flow increases such that during high flows (i.e. Q10) flow velocities are broadly the same as the existing baseline. The proposed weir will therefore exacerbate the slow flow conditions that currently occur within the over-widened section of the River Avon through Melksham, however the extent of the impact will only extend for approximately 750m upstream, which in terms of the whole water body, is 3% of the total water body length and in a reach that is already impounded. Therefore the impact is assessed as **permanent and negative at the water body scale (low magnitude) but due to the limited scale of the impact and degree of existing modification it should not cause a deterioration of the current 'good' status of this supporting element.**	Hydraulic modelling shows that the hydrological regime downstream of the new weir will not change from existing conditions. Therefore there is expeted to be no change within this quality element. **No impact.**	The existing 'Melksham Gate' structure is to be retained and a new hydropower turbine constructed adjacent to the weir. This will locally change flow dynamics immediately adjacent to the structure, however the impact is likely to be localised and **negligible at the water body scale**. As a result this modification should not affect the current 'good' status of this supporting element. The new 'narrow lock' is to be cut into the existing LH bank to enable craft to navigate past the weir. The operation of this lock could result in 'flow pulsing' causing a rapid increase in water depth as the lock is discharged into the river. This 'flow pulsing' effect could impact on the morphology of the downstream channel, particularly the unmodified natural reach downstream of the proposed Challymead weir. Hydraulic modelling undertaken by Black & Veatch in Jan 2019 has assessed the potential impact of lock operation and combined operation with the downstream River Avon bottom lock to represent a worst-case scenario. The results are reported in Wilts & Berks Canal Trust - Additional Hydraulic Details Technical Note, Jan 2019. The operation of the lock causes (low flow Q95) water level to be represented as a 'pulse' in the flow hydrograph, and that this rise in water level is relatively small in the modified 'overwide' channel through Melksham (around 20mm). This 'pulse' disappears further downstream of Challymead weir (within the narrower more natural stretch of the River Avon), as the storage capacity of the reach upstream of the new weir and the hydraulic characteristics of the weir dampens out the 'spikes' that are observed upstream. The model reports a more gradual rise in water level in this area (by up to 80mm - based on both locks being opened at the same time). Rising at a maximum rate of rise of about 35mm/hour which is very small in comparison to natural variation. Flow velocity only negligibly increases from baseline by 0.01m/s, In higher flows than the Q95, any impact on levels due to the locks is unlikely to be noticeable. Given the potential frequency of operation of the locks during the summer months the impact is assessed as **permanent and negative but low magnitude at the water body scale**. As a result, this modification should not affect	Dredging is proposed along a 400m length of channel through Melksham. Approximately half the width of the channel is proposed to be dredged and it is envisaged that this dredged profile will need to be maintained in order to retain sufficient depth for boats to navigate along the River to the new canal link. No additional modelling has been undertaken to determine the impact of dredging. Generally, however, dredging will increase the overall channel capacity, potentially leading to further additional deposition within the channel. The proposed dredging work is to be focused on removal of bed sediment in the centre of the channel and the banks will not be touched. The dredging work will be undertaken along approximately 400m length of the channel which is approximately 2% of the total water body length. Therefore the impact is assessed as permanent and **negative but low magnitude at the water body scale**. As a result this modification should not affect the current 'good' status of this supporting element.	A water balance assessment has been undertaken for the proposed new canal link, utilising water from the River Avon system. The assessment shows that to maintain enough water in the canal backpumping from the River Avon will be required throughout the year, including during periods of low flow. The assessment shows that the volume extracted during low flows (i.e. Q95) is a very small percentage of the total available flow (0.3%) therefore there will be negligible impact on the quantity of flow within the River Avon system. The impact on this water body is therefore considered to be **negligible at the water body scale.**	A water balance assessment has been undertaken for the proposed new canal link, utilising water from the River Avon system. The assessment shows that to maintain enough water in the canal backpumping from the River Avon will be required throughout the year, including during periods of low flow. The assessment shows that the volume extracted during low flows (i.e. Q95) is a very small percentage of the total available flow (0.3%) therefore there will be negligible impact on the quantity of flow within the River Avon system. The impact on this downstream water body is therefore considered to be **negligible at the water body scale.**	Hydraulic modelling undertaken by Black & Veatch in Jan 2019 has assessed the potential impact of the training wall on flows. The results are reported in Wilts & Berks Canal Trust - Additional Hydraulic Details Technical Note, Jan 2019. The results suggest that the training bank will have no impact on high flows within the River Avon. This is since the overall cross-section of the channel will be retained, as the bank is to be constructed from dredged material won from the navigation channel. This analysis also suggests that the flood levels on the River Avon are relatively insensitive to increased roughness in the non-navigation channel. Therefore, should the training bank be allowed to become vegetated (as is likely to occur and has occurred elsewhere within the overwise stretch of river in Melksham), this should not have a detrimental effect on the conveyance of high flows. The channel is 50% wider than its natural width through Melksham. The addition of the training bank will therefore help to retain a low flow channel during normal to low flow conditions. The impact on the flows is therefore likely to be permanent and positive at the local scale, becoming **negligible at the water body scale**.	No - For all the works proposed there is no risk to deterioration at the water body scale. There are however, some localised negative impacts identified which could have a combined (cumulative) negative effect on the water body. These are associated with: (2) the new canal junction (3) Berryfield Brook works; (5) the new weir, (6) operation of the locks; and (7) the dredging works. Further enhancement works could be undertaken to help minimise the local impacts and mitigate for any potential cumulative negative effects but this is not required for compliance.	**No mitigation required for compliance.** **Opportunities for consideration / environmental enhancement (but not required for compliance):** Canal junction - permanent vegetation (i.e. reeds) should be encouraged to establish on any silt deposits that form within the overwide canal junction, only in areas where they do not negatively impact on navigation. Berryfield Brook - the works should look to retain as much bank side vegetation as possible during the design development to reduce any impact on flow velocities (and loss of channel roughness). Soft-engineering solutions should be used where feasible to protect and retain the riparian margin of the channel. New weir - the operation of the sluice needs to be formalised to ensure that the sluice at the side of the weir is kept open during the winter months to help improve free flowing condition upstream. Lock operation - co-ordinate the operation of the Melksham Gate Lock (Lock 1) and Bottom River Lock (Lock 2) to minimise the combined -pulsing' effect. This will reduce the water level change downstream along the unmodified natural stretch of the River Avon. Dredge - compliance is based on a 400m dredged section which is approximately 12m wide (not across the whole channel width). A full topographic survey of the bed should ideally be undertaken prior to dredging to ensure that only material to create the navigable depth is removed. The material derived from the dredging should be used locally i.e. in the creation of soft embankments or in the willow plantation.
Hydrology - connection to groundwater	The proposed works will only impact upon surface water flow and therefore will not impact upon the connectivity with groundwater. **No impact.**	The proposed works will only impact upon surface water flow and therefore will not impact upon the connectivity with groundwater. **No impact.**	The proposed works will only impact upon surface water flow and therefore will not impact upon the connectivity with groundwater. **No impact.**	The proposed works will only impact upon surface water flow and therefore will not impact upon the connectivity with groundwater. **No impact.**	The proposed works will only impact upon surface water flow and therefore will not impact upon the connectivity with groundwater. **No impact.**	The proposed works will only impact upon surface water flow and therefore will not impact upon the connectivity with groundwater. **No impact.**	The proposed works will only impact upon surface water flow and therefore will not impact upon the connectivity with groundwater. **No impact.**	Currently supports 'not high' status. The proposed works will only impact upon surface water flow and therefore will not impact upon the connectivity with groundwater. **No impact.**		The proposed works will only impact upon surface water flow and therefore will not impact upon the connectivity with groundwater. **No impact.**	N/A	N/A
River continuity	River connectivity will be impacted by the construction of the junction into the canal from the River Avon. It is likely that sediment will be transferred and deposited in this area rather than being transferred and deposited within the River Avon channel. The Weir Assessment Technical Note produced by Hydro-Morph, Feb 2018 concluded that sediment supply is limited within the channel upstream of the new junction due to the presence of Melksham Gate. Sediment transfer is only likely during normal and high flows. The new junction will exacerbate the baseline depositional processes in this area, the impact of which at the water body scale is assessed as permanent but negligible at the water body scale and will not affect the existing 'good' status of this quality element. The banks of the channel are to be sheet piled for approximately 100m, with the top of these level with average expected water level. A reed bed will be established behind the piling on the upstream side of the new channel. This area will be able to flood during high flows so there will be no impact on lateral connectivity with the floodplain. **No impact.**	River connectivity will be impacted by the construction of an artificial culvert and lined banks along the Berryfield Brook. The 8m long box culvert is to be partly buried so it will be possible to maintain a natural mobile bed substrate through the culvert. The banks of the brook are to be lined for approximately 160m which may have an impact on lateral connectivity to the floodplain. The Berryfield Brook is not known to support habitat for migratory fish species due to poor water quality, however, this should not preclude it's potential for providing habitat in the future. Longitudinal connectivity will be impacted by the construction of a new culvert and artificial banks, which may negatively impact on fish passage along the whole length of the Brook. This represents approximately 12.5% of the Brook length but less than 0.1% of the total water body length, therefore the impact is assessed as permanent but **negligible at the water body scale**. The impact is however assessed as permanent and **negative at the local scale.**	Lateral connectivity is already compromised at Town Bridge. Existing scour protection (if required) at the bridge will have negligible impact over the existing baseline. **No impact.**	River connectivity will be negatively impacted by the construction of a new barrier (weir) across the River Avon in Melksham. It will form a new barrier to sediment transfer and also could impact on fish passage/connectivity throughout the River Avon system. The proposed works will include a fish pass which will to some degree help to mitigate for the obstacle to migration. The greatest impact is likely to be on sediment supply as the new barrier will reduce sediment transfer from upstream. The proposals include a tilting weir at the side of the fixed weir to enable free movement of sediment during the winter months (as it will be kept open), which will help to reinstate connectivity particularly during higher flows which transport more sediment. The overall impact is however considered to be **negative and permanent (moderate magnitude) as the works will create an additional barrier along the water body**. There is therefore a **risk of deterioration in this quality element unless suitable mitigation can be applied.**	River connectivity will be slightly impacted by the construction of the upstream weir as it will form a barrier to sediment transfer and also could impact on fish passage/connectivity throughout the River Avon system. The impact on this downstream water body in terms of sediment supply is likely to be negligible due to the addition of sediment from other sources coming into the river from elsewhere downstream of the weir. In addition, there are other downstream barriers along the River Avon (within the water body) which impact on connectivity for fish passage. Also the operation of the sluice gate (which will be opened in winter) will help to maintain sediment supply during the months when sediment transport is most effective. Therefore this modification is likely to have a **negligible effect on this quality element at the water body scale** and should therefore not affect the current 'good' status of this supporting element.	The existing 'Melksham Gate' structure is to be retained and a new fish pass is to be constructed. this will help to locally improve river connectivity for fish passage. There will be no change in sediment dynamics which will still be interrupted by the existing structure. The impact is therefore likely to be slightly **positive at the local scale** but **negligible at the water body scale**. As a result, this modification should not affect the current 'good' status of this supporting element. The operation of the new 'narrow lock' has negligible impact on velocities (0.01m/s) and is therefore unlikely to have any effect on sediment transfer processes either within the modified Melksham channel or the more natural channel downstream of Challymead weir, **No impact.**	The proposed dredging will not negatively impact on lateral connectivity to the floodplain as the river is already currently cut off from the floodplain through Melksham to prevent flooding within the town. It is also understood that sediment will be removed from the channel during dredging and reused elsewhere (potentially to improve the banks downstream to facilitate the construction of the canal tow path). This loss of sediment from ths system is likely to be negligible within the context of the wider River Avon sediment budget. The impact is therefore assessed as **negligible at the water body scale** and this modification should not affect the current 'good' status of this supporting element.			It is understood that little sediment transport occurs along the overwide channel within Melksham during low flows and most transport occurs during less frequent high flows, which can cause deposited sediment within the overwide channel to be remobilisation and transferred downstream. Hydraulic modelling shows that the training bank will have no impact on high flows and therefore sediment transfer processes should be unaffected. There is a risk however that material deposited to form the training bank could become mobilised during high flow events and this will need to be factored into the design of the bank. The impact on sediment continuity is therefore assessed as **permanent but negligible at the water body scale** and this modification should not affect the current 'good' status of this supporting element.	Yes - there is a risk of deterioration associated with the proposed new weir . Mitigation is required. There are also some localised negative impacts identified which could have a combined (cumulative) negative effect on the water body. These are associated with: (3) Berryfield Brook works; and (4) Erosion protection works along the downstream 'natural' channel, and (9) Training bank Further enhancement works could be undertaken to help minimise the local impacts and mitigate for any potential cumulative negative effects but this is not required for compliance.	**Actions required for WFD compliance:** New weir: The fish pass design needs to incorporate passage for as many species as possible. The scheme should look for opportunities to better connect the channel with the floodplain elsewhere along the River Avon water body to offset some of the negative effects of the new weir. Opportunities to remove impeding structures within any adjacent tributaries could be considered to help mitigate for some of the negative effects on river continuity resulting from the new weir. Discussion with the Bristol Avon Rivers Trust (BART) have identified a number of sites that could be considered as mitigation for the new weir on the River Avon. These structures are located along the Bydemill Brook, Wiltshire and are summarised in the table in Section 4 Mitigation. **Opportunities for consideration / environmental enhancement (but not required for compliance):** Berryfield Brook - Reduce the length of hard bank revetment required along the Berryfield Brook or replace with a soft engineering solution to maintain the vegetated riparian margin. This will also help to offset some of the local permanent effects. Training bank - Use of 'soft' engineereing solutions to encourage further trapping of sediment and to ensure sediment that is used to form the bank is retained. Vegetation could be also be allowed to establish along the bank, which would provide additional habitat along the river corridor.
Morphology - width and depth variation	The junction will create an 'overwide' section of channel, which will approximately double the existing width of the channel immediately downstream of Challymead Bridge. Hydraulic modelling suggests there will be a significant reduction in low flow velocity in this area, particularly during low flows (Q95), which could lead to sediment deposition within the channel. The Weir Assessment Technical Note produced by Hydro-Morph, Feb 2018 concluded that sediment supply is generally limited from upstream of the new junction due to the presence of Melksham Gate. Sediment transfer is therefore only likely during normal and high flows. It is therefore unlikely that there will be any significant bedload deposition in this area during low flow conditions. However, during normal to high flows, bedload transport is likely to occur and deposit sediment within the channel, as currently occurs in this area. The rate of siltation is however, likely to be slow as the supply is limited within the upstream reach due to the presence of Melksham Gate sluice. The impact of which is assessed as **permanent and negative at the local scale**, but **permanent and negligible at the water body scale**.	The new 8m long culvert will be of uniform width however the structure is to be partly buried so the depth will vary depending on the degree of sediment deposition within the channel. Bank protection measures (both hard engineered and soft) will fix the planform width of the channel for 160m. The works are local in scale, limited to less than 0.1% of the total water body length and therefore the impact is assessed as permanent but **negligible at the water body scale** and will not affect the existing 'good' status of this quality element. The impact is however assessed as permanent and **negative at the local scale.**	**No impact** on width and depth conditions at Town Bridge.	The proposed new weir will cause an increase in penned water level and flow area upstream, which will result in a reduction in flow velocity during normal and low flow conditions. Sediment is therefore likely to accumulate within the channel behind the weir during these conditions. The weir will therefore exacerbate and accelerate the sediment deposition that currently occurs within this artificially wide stretch of river. Currently sediment accumulates within the channel especially downstream of Town Bridge. This process is likely to be increased by these proposals. Over time there is likely to be a net accumulation of sediment within the channel (bed and banks). This is likely to impact on the long-term sustainability of canal navigation, without some additional intervention and management (i.e. dredging). The rate of change is currently not known, however it is expected to be modest and manageable given the historical response in this area. The proposed weir will therefore exacerbate deposition upstream of the weir for approximately 750m upstream. In terms of the whole water body this represents 3% of the total water body length. Therefore the impact is assessed as permanent and negative, but **low magnitude at the water body scale.** As a result this modification should not affect the current 'good' status of this supporting element**.**	Hydraulic modelling shows that the hydrological regime downstream of the new weir will not change from existing conditions. Therefore there is expected to be no change within this quality element. **No impact.**	The existing structure will be retained and a new lock built to one side to enable navigation. Currently the proposal is to widen the channel adjacent to the Melksham Gate to create the lock. It is understood that the channel widening will be undertaken offline so as not to increase the existing channel width. The impact is therefore assessed as permanent but **negligible at the water body scale.** Operation of the new 'narrow lock' will cause a rapid but small (20mm) increase in water depth through the modified channel in Melksham. This change is likely to be offset by back-pumping effect which isn't taken into account in the model results and therefore the actual rise in depth is likely to be less. Downstream of Challymead weir within the more natural section of the River Avon the operation of the upstream locks increases water depth by 80mm, but this is a much more gradual process in comparison to upstream and is considerably less than natural variation. **No impact.**	Dredging will increase channel depth along the navigable route which is approximately 12m wide and 400m in length. This will not affect the whole width of the channel, except for a turning area which is proposed just downstream of Town Bridge. Dredging will locally increase the channel depth in the vacinity of the navigable route. The dredging work will be undertaken along approximately 400m length of the channel which is approximately 2% of the total water body length. Therefore the impact is assessed as permanent and **negative but low magnitude at the water body scale.** As a result this modification should not affect the current 'good' status of this supporting element.	The works will not result in any significant reduction in water quantity which could impact on any of these hydromorphological quality elements. **No impact.**	The works will not result in any significant reduction in water quantity which could impact on any of these hydromorphological quality elements. **No impact.**	The channel is 50% wider than its natural width through Melksham. The addition of the 225m long training bank will narrow the low flow channel to a more natural cross-sectional width. The channel will however be 'fixed' in place by the training bank on the right-hand side and the existing left bank. There will therefore be no lateral movement of the low flow channel. The training bank will be overtopped at high flows and therefore will have no impact on flood conveyance. The impact on width/depth variation is assessed as **permanent but negligible at the water body scale** and this modification should not affect the current 'good' status of this supporting element.	No - For all the works proposed there is no risk to deterioration at the water body scale. There are however, some localised negative impacts identified which could have a combined (cumulative) negative effect on the water body. These are associated with (2) the new canal junction (3) Berryfield Brook works; (5) the new weir, (7) the dredging works. Further enhancement works could be undertaken to help minimise the local impacts and mitigate for any potential cumulative negative effects but this is not required for compliance.	**No mitigation required for compliance.** **Opportunities for consideration / environmental enhancement (but not required for compliance):** Canal junction - permanent vegetation (i.e. reeds) should be encouraged to establish on any silt deposits that form within the overwide canal junction, only where they do not negatively impact on navigation. Berryfield Brook - the works should look to retain as much bank side vegetation as possible during the design development to reduce any impact on flow velocities (and loss of channel roughness). Soft-engineering solutions should be used where feasible to protect and retain the riparian margin of the channel. New weir - the operation of the sluice needs to be formalised to ensure that the sluice at the side of the weir is kept open during the winter months to help improve free flowing condition upstream Dredge - compliance is based on a 400m dredged section which is approximately 12m wide (not across the whole channel width). A full topographic survey of the bed should ideally be undertaken prior to dredging to ensure that only material to create the navigable depth is removed. The material derived from the dredging should be used locally i.e. in the creation of the training bank, soft embankments, and in the willow plantation.
Morphology - bed structure and substrate	The new junction will exacerbate the baseline depositional processes in this area, The works are local in scale, limited to less than 0.1% of the total water body length and therefore the impact is assessed as **permanent but negligible** and will not affect the existing 'good' status of this quality element.	The new 8m long culvert will be partly buried so that the channel will maintain a natural mobile bed substrate through the structure. The works are local in scale, limited to less than 0.1% of the total water body length and therefore the impact is assessed as **permanent but negligible** and will not affect the existing 'good' status of this quality element.	**No impact** on bed structure and substrate.	Construction of a new weir will create an additional barrier to sediment transfer, which could have an impact on the structure of the bed both upstream (within the impounded reach) and immediately downstream of the new structure. In terms of operation, the weir will also open up navigation by boats along the River through the town, this increase in boat transport could potentially stir up sediments and increase turbidity. These effects are likely to be localised and will be **negligible at the water body scale**. The proposals are to include a tilting sluice at the side of the fixed weir to enable free movement of sediment during the winter months (as it will be kept open), which will help to mobilise sediment. Currently the bed of the River through Melksham is a mix of silt and gravel, there are also some important spawning gravels that were identified downstream of Challeymead Bridge. It is likely that the impounded flow conditions caused by the proposed new weir would result in more fine sediment deposition on the bed, leading to some loss of spawning habitat. The proposed weir will increase deposition for approximately 750m upstream of the structure, which could negatively impact on this quality element, however, the impact is likely to be localised and in terms of the whole water body this change represents 3% of the total water body length. Therefore the impact is assessed as permanent and negative, but **low magnitude at the water body scale**. As a result this modification should not affect the current 'good' status of this supporting element.	Construction of a new upstream weir will create an additional barrier to sediment transfer, which could have an impact on the structure of the bed of this downstream water body. However, the impact on this downstream water body in terms of sediment supply is likely to be negligible due to the addition of sediment from other sources coming into the river from elsewhere downstream of the weir and the operation of gate opening in winter months. Therefore this modification is likely to have a **negligible effect on this quality element at the water body scale** and should therefore not affect the current 'good' status of this supporting element.	The existing 'Melksham Gate' structure is to be retained and a new hydropower turbine constructed adjacent to the weir. This will locally change flow dynamics immediately adjacent to the structure, which may locally affect the structure of the channel bed, however the impact is likely to be **negligible at the water body scale**. As a result this modification should not affect the current 'good' status of this supporting element. The operation of the new 'narrow lock' has negligible impact on velocities (0.01m/s) and is therefore unlikely to have any effect on sediment transfer processes or corresponding effect on the structure or substrate of the bed either within the modified Melksham channel or the more natural channel downstream of Challymead weir, **No impact.**	Dredging will directly remove bed sediment from a 12m wide section of the channel, which will locally impact on bed structure and substrate of the bed through Melksham. This will not affect the whole width of the channel, where variations in bed structure and substrate will be retained (except for a turning area which is proposed just downstream of Town Bridge). The dredging work will be undertaken along approximately 400m length of the channel which is approximately 2% of the total water body length. Therefore the impact is assessed as permanent and **negative but low magnitude at the water body scale.** As a result this modification should not affect the current 'good' status of this supporting element.			The training bank is to be constructed from bed material won during the dredging of the navigation channel. The retaining front edge of the 225m long bank will be an additional new material on the existing bed of the river. However, the bulk of the bank will be constructed from bed substrate won during the dredging of the navigation channel. The impact on bed structure and substrate is **permanent but negligible at the water body scale** and this modification should not affect the current 'good' status of this supporting element.	No - For all the works proposed there is no risk to deterioration at the water body scale. There are however, some localised negative impacts identified which could have a combined (cumulative) negative effect on the water body. These are associated with (1) the new weir, and (2) the dredging works. Further enhancement works could be undertaken to help minimise the local impacts and mitigate for any potential cumulative negative effects but this is not required for compliance.	**No mitigation required for compliance.** **Opportunities for consideration / environmental enhancement (but not required for compliance):** New weir - the operation of the sluice needs to be formalised to ensure that the sluice at the side of the weir is kept open during the winter months to help improve free flowing condition upstream Dredge - compliance is based on a 400m dredged section which is approximately 12m wide (not across the whole channel width). A full topographic survey of the bed should ideally be undertaken prior to dredging to ensure that only material to create the navigable depth is removed. The material derived from the dredging should be used locally i.e. in the creation of the training bank, soft embankments, and in the willow plantation.
Morphology - riparian zone structure	A new riparian zone approximately 300m long will be created at the junction with the new canal and River Avon. The banks are to be constructed from sheet piles and a canoe landing will be constructed. A reed bed will be established behind the piling on the upstream side of the new channel. The modification and its spatial effect represent less than 0.1% of the length of the WFD water body and should therefore not cause deterioration of the current 'good' status of this supporting element, therefore the impact is assessed as **permanent but negligible at the water body scale.** The impact is however assessed as **permanent and negative at the local scale.**	The construction of a new 8m long culvert and hard-lined banks of 160m length of bank will lead to some loss of bank side marginal vegetation along the Berryfield Brook. The works are limited in extent (160m length of channel), which represents less than 0.1% of the total water body length. However, the Berryfield Brook is approximately 3km in length so these works represent approximately 12.5% of the total brook length. The modification and its spatial effect represent less than 0.1% of the length of the WFD water body and should therefore not cause deterioration of the current 'good' status of this supporting element, therefore the impact is assessed as permanent but **negligible at the water body scale**. The impact is however assessed as **permanent and negative at the local scale.**	**No impact** on the condition of the riparian zone at Town Bridge.	The construction of a new 20m long weir will lead to some loss of bank side marginal vegetation immediately adjacent to the structure. Due to the potential length of hard bank adjacent to the structure the impact is assessed as **permanent and negative at the local scale**. Marginal habitat will be reinstated following construction therefore the impact at **the water body scale is assessed as short-term and negligible** and will not affect the existing 'good' status of this quality element. In terms of operation, the weir will also open up navigation by boats along the River through the town, this increase in boat transport could potentially lead to boat wash and some erosion of bankside vegetation. These effects are likely to be localised and will be **negligible at the water body scale**.	No direct works are proposed within this water body which could impact on this quality element. **No impact.**	The construction of a new lock adjacent to the existing Melksham Gate will result in some loss of bank side marginal vegetation immediately adjacent to the structure. Marginal habitat will be reinstated following construction therefore the impact at the water body scale is assessed as **short-term and negligible** and will not affect the existing 'good' status of this quality element. Operation of the new 'narrow lock' will cause a small (20mm) increase in water depth through the modified channel in Melksham and a 80mm increase in water depth within the natural channel downstream of Challymead weir. This change in depth is considerably less than would happen due to natural variation (i.e. response to rainfall runoff) and therefore the impact on riparian zone is negligible. **No impact.**	The proposed dredging work is to be focused on removal of bed sediment and the banks will not be touched. **No impact.**			The training bank will formalise extensive silt and sand deposits that already occurs within the overwide stretch of the River Avon within Melksham. It will create a stable planform within the river which is likely (without management) to become vegetated. This will create a new 'stable' riparian zone within the channel. On the other side of the training bank, between it and the existing right-hand bank, would be a shallow marginal channel which will not be accessible and is likely to support permanent vegetation (i.e. reed beds). The impact on the riparian zone is therefore likely to be **permanent and positive** at the local scale, but **negligible at the water body scale** and this modification should not affect the current 'good' status of this supporting element.	No - For all the works proposed there is no risk to deterioration at the water body scale. There are however, some localised negative impacts identified which could have a combined (cumulative) negative effect on the water body. These are associated with (2) the new canal junction (3) Berryfield Brook works; (5) the new weir, Further enhancement works could be undertaken to help minimise the local impacts and mitigate for any potential cumulative negative effects but this is not required for compliance.	**No mitigation required for compliance.** **Opportunities for consideration / environmental enhancement (but not required for compliance):** Canal junction - permanent vegetation (i.e. reeds) should be encouraged to establish on any silt deposits that form within the overwide canal junction, only where they do not negatively impact on navigation. Berryfield Brook - the works should look to retain as much bank side vegetation as possible during the design development to reduce any impact on flow velocities (and loss of channel roughness). Soft-engineering solutions should be used where feasible to protect and retain the riparian margin of the channel. New weir - the operation of the sluice needs to be formalised to ensure that the sluice at the side of the weir is kept open during the winter months to help improve free flowing condition upstream.
Physico-chemical Supporting Elements												
Thermal conditions	Locally there may be some increase in river temperature due to water being impounded within this area just upstream of the proposed weir. Currently flow is slow through Melksham due to the over-wide planform of the channel and existing impoundment upstream of Melksham Gate, therefore the impact locally is likely to be negligible. No predicted change to thermal condition at water body scale and of permanent nature, and no knock-on effect on biological elements. **No impact.**	There is no baseline data from which to assess potential impacts on thermal condition. Locally river temperatures may increase along the 160m length of lined channel due to removal of bankside vegetation. The impact is assessed as permanent but **negligible at the water body scale**.	There are no significant permanent effects on any hydromorphological supporting elements, therefore there is not expected to be any impact on physico-chemical elements at the water body scale. **No impact.**	**No predicted changes at the water body scale.** Locally there may be some increase in river temperature due to water being impounded upstream of the proposed weir. Currently flow is slow through Melksham due to the over-wide planform of the channel and existing impoundment upstream of Melksham Gate, therefore the **impact locally is also likely to be negligible.**	There are no significant permanent effects on any hydromorphological supporting elements, therefore there is not expected to be any impact on physico-chemical elements at the water body scale. **No impact.**	There are no significant permanent effects on any hydromorphological supporting elements, therefore there is not expected to be any impact on physico-chemical elements at the water body scale. **No impact.**	During dredging, the entrainment of sediment into the water column may result in increased turbidity leading to a reduction in light penetration. The River Avon appears to have quite high turbidity background levels. Potential effects will be limited to temporary effects during the construction phase and therefore it is **unlikely that this quality element will be adversely affected in the long-term or at the water body scale.**	There are no significant permanent effects on any hydromorphological supporting elements, therefore there is not expected to be any impact on physico-chemical elements at the water body scale. **No impact.**	There are no significant permanent effects on any hydromorphological supporting elements, therefore there is not expected to be any impact on physico-chemical elements at the water body scale. **No impact.**	Potential, local, small scale positive effect caused by retaining a greater a depth of water within the low flow channel. No predicted change to dissolved oxygen levels at water body scale and of permanent nature, and no knock-on effect on biological elements. **No impact.**	No - For all the works proposed there is no risk to deterioration at the water body scale.	No mitigation required.
Oxygenation conditions (DO)	Local, small scale effects only through changes in flow and recognising existing slow flow conditions. No predicted change to dissolved oxygen levels at water body scale and of permanent nature, and no knock-on effect on biological elements. **No impact.**	Local, small scale effects only through changes in bank shading and vegetation cover. No predicted change to dissolved oxygen levels at water body scale and of permanent nature, and no knock-on effect on biological elements. **No impact.**		Local, small scale effects only through changes in flow and recognising existing impoundment/ slow flow. **No predicted change to dissolved oxygen levels at water body scale** and of permanent nature, and no knock-on effect on biological elements.			Dredging may result in a dip in DO levels due to increased turbidity and possibly lower DO in lower flows due to the increased capacity of the channel (though this is likely to be minimal due to the existing overwide planform of the channel). These impacts are all likely to be temporary during the construction phase and therefore it is **unlikely that this quality element will be adversely affected in the long-term or at the water body scale.**			Potential, local, small scale positive effect caused by retaining a greater a depth of water within the low flow channel. No predicted change to dissolved oxygen levels at water body scale and of permanent nature, and no knock-on effect on biological elements. **No impact.**		
Acidification status (pH)	No predicted change to pH levels at water body scale and of permanent nature, and no knock-on effect on biological elements. **No impact.**	No predicted change to pH levels at water body scale and of permanent nature, and no knock-on effect on biological elements. **No impact.**		Local, small scale effects only through changes in shading and vegetation. **No predicted change to pH levels at water body scale** and of permanent nature, and no knock-on effect on biological elements.			No predicted changes to pH levels at the water body scale.			No predicted change to pH levels at water body scale and of permanent nature, and no knock-on effect on biological elements. **No impact.**		
Nutrient conditions (Phosphates)	Currently supports 'moderate' status. No predicted change to nutrient levels as a result of the proposed works at the water body scale.**No impact.**	Currently supports 'moderate' status. No predicted change to nutrient levels as a result of the proposed works at the water body scale.**No impact.**		Local, small scale effects only through changes in flow and sediment retention behind the new structure. However, **no predicted change at water body scale** and of permanent nature, and no knock-on effect on biological elements.			No predicted change to nutrient levels at water body scale.			Currently supports 'moderate' status. No predicted change to nutrient levels as a result of the proposed works at the water body scale.**No impact.**		
Specific Pollutants	No predicted changes to specific pollutants. **No impact.**	No predicted changes to specific pollutants. **No impact.**		In terms of operation, the weir will open up the channel to navigation by boats through the town, this increase in boat transport could potentially increase the risk of pollution (i.e. waste water and grey water from boats and leakage of engine oil and fuel). These effects are likely to be localised and will be **negligible at the water body scal**e.			Mobilisation of silt during dredging can flourish bacteria numbers, particularly in higher water temperatures, and therefore impact on water quality. Potential effects will be limited to temporary effects during the construction phase and therefore it is **unlikely that this quality element will be adversely affected in the long-term or at the water body scale.**			No predicted changes to specific pollutants. **No impact.**		
Biological Quality Elements												
Phytoplankton	There is no baseline data from which to assess potential impacts on phytoplankton. Phytoplankton are free-floating and will be less impacted by physical changes to the channel planform than compared to other biota. There are no predicted changes to supporting conditions such as nutrient levels, temperature, or shading that would affect phytoplankton at water body scale. The impact is therefore assessed as **short-term and negligible at the water body scale.**	There is no baseline data from which to assess potential impacts on phytoplankton. Phytoplankton are free-floating, and will be less impacted by physical changes to the channel than compared to other biota. There are no predicted changes to supporting conditions such as nutrient levels, temperature, or shading that would affect phytoplankton at water body scale.The impact is therefore assessed as **short-term and negligible** at the water body scale.	There are no significant permanent effects on any hydromorphological supporting elements and physico-chemical elements predicted from the proposed works. Therefore it is unlikely that there will be any subsequent knock-on effects to any biological quality elements. **No impact.**	There is no baseline data from which to assess potential impacts on phytoplankton. Phytoplankton are free-floating and will be less impacted by physical changes to the channel planform than compared to other biota. There are no predicted changes to supporting conditions such as nutrient levels, temperature, or shading that would affect phytoplankton at water body scale.The impact is therefore assessed as **short-term and negligible** at the water body scale.	There are no significant permanent effects on any hydromorphological supporting elements and physico-chemical elements predicted from the proposed works. Therefore it is unlikely that there will be any subsequent knock-on effects to any biological quality elements. **No impact.**	There are no significant permanent effects on any hydromorphological supporting elements and physico-chemical elements predicted from the proposed works. Therefore it is unlikely that there will be any subsequent knock-on effects to any biological quality elements. **No impact.**	There is no baseline data from which to assess potential impacts on phytoplankton. Dredging, however, may mobilise nutrients present within the sediment, which could lead to increased phytoplankton growth. Phytoplankton are free-floating, and so will be less impacted by direct removal compared to other biota, but may be affected by changes in oxygenation and suspended solids during works. The river will need to be dredged to maintain navigable depth along the 400m length of channel through Melksham, this represents a permanent change; affecting 2% of the total water body length. The impact on phytoplanton is however likely to be **short-term and temporary**, affected only during the works and there will be **no significant long-term affect on phytoplankton at the water body scale**. However, **due to lack of baseline data it is recomended that the proposed work should follow the precautionary principle to minimise sediment mobilisation during construction and that appropriate mitigation should be in place.**	There are no significant permanent effects on any hydromorphological supporting elements and physico-chemical elements predicted from the proposed works. Therefore it is unlikely that there will be any subsequent knock-on effects to any biological quality elements. **No impact.**	There are no significant permanent effects on any hydromorphological supporting elements and physico-chemical elements predicted from the proposed works. Therefore it is unlikely that there will be any subsequent knock-on effects to any biological quality elements. **No impact.**	There is no baseline data from which to assess potential impacts on phytoplankton. Phytoplankton are free-floating and will be less impacted by physical changes to the channel planform than compared to other biota. There are no predicted changes to supporting conditions such as nutrient levels, temperature, or shading that would affect phytoplankton at water body scale. The impact is therefore assessed as **short-term and negligible at the water body scale.**	No - For all the works proposed there is no risk to deterioration at the water body scale. There are however, some localised negative impacts associated with the dredging works. Further enhancement works could be undertaken to help minimise the local impacts but this is not required for compliance.	**No mitigation required for compliance.** **Opportunities for consideration / environmental enhancement (but not required for compliance):** Dredge - compliance is based on a 400m dredged section which is approximately 12m wide (not across the whole channel width). A full topographic survey of the bed should ideally be undertaken prior to dredging to ensure that only material to create the navigable depth is removed. The material derived from the dredging should be used locally i.e. in the creation of the training bank, soft embankments, and in the willow plantation. The dredging works should follow good working practice to reduce fine sediment input during works, which will minimise nutrient mobilisation in the watercourse. Phytoplankton blooms should be monitored during and post dredging.
Macrophytes and phytobenthos	The construction of the junction has the potential to impact on the substrate of the bed by increasing the proportion of fine sediment accumulated on the bed. However, this impact will be localised, deposition is likely to be slow and is not likely to be significant at the water body scale. In terms of operation, the junction will be navigable by boats, which could potentially lead to damage of existing aquatic vegetation (i.e. the reed bed along the River Avon at the junction location). These effects are likely to be localised and will be negligible at the water body scale. The impact is therefore assessed as **permanent and negative, but low magnitude at the water body scale**. As a result this modification should not affect the current 'moderate' status of this supporting element.	This quality element is currently assessed as 'moderate' status. The construction of the culvert has the potential to impact on the substrate of the bed, however the culvert will be partly buried so that the channel will maintain a natural mobile bed substrate. Shade may be reduced due to the lining of 180m length of channel upstream and downstream of the culvert crossing, this could have a positive impact on macrophyte growth within the Berryfield Brook, however the impact will be localised and not at the water body scale. The impact is therefore assessed as **short-term and negligible at the water body scale**.and it is envisaged that the proposed works will not affect the existing 'moderate' status of this quality element.		The construction of the weir has the potential to impact on the substrate of the bed by increasing the proportion of fine sediment on the bed and covering up clean gravel beds. However, this impact will be relatively localised (impact on 750m of channel) and therefore is less signficant at the water body scale (3% of the water body length). In terms of operation, the weir will also open up navigation by boats along the River through the town, this increase in boat transport could potentially lead to damage of existing aquatic vegetation. These effects are likely to be localised and will be negligible at the water body scale. The impact is therefore assessed as permanent and negative, but **low magnitude at the water body scale**. As a result this modification should not affect the current 'moderate' status of this supporting element.			Dredging will not impact on the entire width of channel, leaving some sand and gravel deposits unaffected. This quality element is currently assessed as 'moderate' status. Some emergent vegetation is present on the gravel/sand bars and therefore will be impacted if removed during dredging and construction of the new river canal junction.The work will however impact on less than 2% of the overall water body length. The impact is therefore assessed as **permanent and negative, but low magnitude** at the water body scale**,** largely caused by removal of biota and habitat during dredging. It is therefore envisaged that the proposed works will not affect the existing 'moderate' status of this quality element.			The construction of the training bank has the potential to permanently impact on the substrate of the bed through the creation of a permanent 'island'. There are existing large sediment deposits within the overwide channel through Melksham so this is not a significant change from what naturally occurs. As the bank is to be constructed from sediment dug from the main channel the seed bank will be maintained. The training bank will help retain a greater depth within the low flow channel during normal to low flow conditions. This may have a positive local effect on macrophyte growth. The impact on macrophytes is therefore likely to be **permanent and positive at the local scale**, becoming **negligible at the water body scale**. As a result this modification should not affect the current 'moderate' status of this supporting element and may slightly help contribute towards it achieving 'good' status.	No - For all the works proposed there is no risk to deterioration at the water body scale. There are however, some localised negative impacts identified which could have a combined (cumulative) negative effect on the water body. These are associated with (2) the new canal junction (5) the new weir, and (2) the dredging works. Further enhancement works could be undertaken to help minimise the local impacts and mitigate for any potential cumulative negative effects but this is not required for compliance.	**No mitigation required for compliance.** **Opportunities for consideration / environmental enhancement (but not required for compliance):** Canal junction - permanent vegetation (i.e. reeds) should be encouraged to establish on any silt deposits that form within the overwide canal junction, only where they do not negatively impact on navigation. New weir - the operation of the sluice needs to be formalised to ensure that the sluice at the side of the weir is kept open during the winter months to help reduce silt accumulation upstream Dredge - ccompliance is based on a 400m dredged section which is approximately 12m wide (not across the whole channel width). A full topographic survey of the bed should ideally be undertaken prior to dredging to ensure that only material to create the navigable depth is removed. The material derived from the dredging should be used locally i.e. in the creation of the training bank, soft embankments, and in the willow plantation.
Benthic invertebrate fauna	Area of new channel habitat for benthic invertebrates created from the 150m length of channel (stretching from the junction to the lock gate). Potential negative impact due to disturbance due to wash from boat traffic resulting in disturbance of bottom sediment and benthos living within, along with marginal and in-channel vegetation. There could also be an increase in specific pollutants due to waste water and grey water from boats and leakage of engine oil and fuel. Overall it is envisaged that the proposed works will have **negligible impact** on benthic invertebrate population within the water body and the works should not affect the existing 'high' status of this quality element.	The new culvert and lined channel banks will locally alter the shape of the channel, thus altering the quantity and dynamics of the flow and the width and depth of the channel; this could affect the species assemblage of benthic macroinvertebrates. This quality element is currently assessed as 'high' status. Macroinvertebrates are concentrated along the margins and edge of the wetted channel. There is potential for direct impact on benthic macroinvertebrates as the banks and channel margin will be affected by the work. The modification represents less than 0.1% of the length of the water body and should therefore not affect the current 'good' status of this supporting element, therefore the impact is assessed as permanent but **negligible at the water body scale**. The impact is however assessed as permanent and **negative at the local scale.**		The main impacts are likely to be created during the operation of the weir, due to the impact on the substrate of the bed by increasing the proportion of fine sediment on the bed and covering up clean gravels. In addition, changes in the flow dynamics and depth of the waterbody and potential impacts on invertebrate species through wash and sediment disturbance due to boat traffic. Operation of the weir will result in elevated water levels upstream which will reduce flow and channel depth prohibitive to many riparian macroinvertebrates. In addition there will be some increase in disturbance due to wash from boat traffic resulting in disturbance of bottom sediment and benthos living within, along with marginal and in-channel vegetation. There could also be an increase in specific pollutants due to waste water and grey water from boats and leakage of engine oil and fuel . All these impacts could negatively impact on the existing 'high status' of this quality element, however, the impact is likely to be localised and in terms of the whole water body this change represents 3% of the total water body length. Therefore the impact is assessed as **permanent and negative, but low magnitude at the water body scale**. It is therefore envisaged that the proposed works will not affect the existing 'high' status of this quality element.			Macroinvertebrates are concentrated along the margins and edge of the wetted channel, in particular the majority of notable species were recorded in the Conigre Mead LNR adjacent to the River Avon. There will be no direct impact on benthic macroinvertebrates as the banks and channel margins will not be affected by the work. There may, however, be indirect effects on the marginal zone depending on where dredged material is disposed. **At the water body scale, the impact is assessed as temporary and negligible**			The training bank will locally alter the shape of the channel, thus altering the quantity and dynamics of the flow and the width and depth of the channel; this could affect the species assemblage of benthic macroinvertebrates. This quality element is currently assessed as 'high' status. Macroinvertebrates are concentrated along the margins and edge of the wetted channel. There is potential for direct impact on benthic macroinvertebrates as the training bank will formalise extensive silt and sand deposits that already occurs within the overwide stretch of the River Avon within Melksham. The bank will create a new 'stable' riparian zone within the channel. On the other side of the training bank, between it and the existing right-hand bank, would be a shallow marginal channel which will not be accessible and is likely to support permanent vegetation (i.e. reed beds). This area would be permanently undisturbed. The impact on the benthic macroinvertebrates is therefore likely to be **permanent and positive at the local scale**, but **negligible at the water body scale** and this modification should not affect the current 'good' status of this supporting element.	No - For all the works proposed there is no risk to deterioration at the water body scale. There are however, some localised negative impacts on benthic inverts which are associated with the new weir.	**No mitigation required for compliance.** **Opportunities for consideration / environmental enhancement (but not required for compliance):** Due consideration will need to be given to the exact location for the disposal of dredged material within the marginal zone, so as not to negatively impact on the assemblage composition and abundance of benthic macroinvertebrates. Look to protect where feasible the marginal zone (provision of inaccessible habitat zones) adjacent to the navigable channel. Measures may include an elevated or floating tow path. Such a walkway should be designed to allow the movement of water beneath, whilst attenuating excessive wash from waterway traffic. Also strict measures to regulate boat speed should also be instigated. Possible creation of new habitat including reinstatement and subsequent management of floodplain wetland features including ditches, scrapes and reedbeds adjacent to the river and beyond should be considered.

Fish fauna	The new junction will have an impact on longitudinal connectivity along the River Avon by allowing fish to access the canal up to the first lock. This is likely to be a positive impact, as it will create a new area of habitat along the River Avon, extending upstream to the lock (approx. 150m in length). The overall impact is assessed as **permanent and negligible at the water body scale**. The impact is however assessed as **permanent and positive at the local scale**.	The River Avon currently supports 'High' status for fish and the river supports a good mixed coarse fishery as well as the potential for migratory brown trout and eel. Smaller streams feeding the River Avon are likely to support brown trout, however, the Berryfield Brook is not known to support habitat for migratory fish species due to poor water quality resulting from discharge entering the brook from the Bowerhill Sewage Treatment Works. This however, should not preclude it's potential for providing spawning habitat in the future. Longitudinal connectivity will be impacted by the construction of a new culvert along the Berryfield Brook. The bed substrate will be maintained through the culvert, however the addition of a 6m long culvert will reduce light penetration along the channel, which has the potential to impact on fish migration upstream. It is also proposed to line a length of the banks of the Berryfield Brook for approximately 160m. This work will reduce bank roughness and may therefore change flow dynamics along the downstream end of the brook which may impact on flow attraction for fish. These works could therefore restrict or cut off 3km of 'potential' spawning or fry nursery habitat upstream along the Berryfield Brook. This represents approximately 12.5% of the Bristol water body length built is less than 0.1% of the total water body length. The overall impact is therefore assessed as **permanent but negligible** at the water body scale. The impact is however assessed as **permanent and negative at the local scale.**	Longitudinal connectivity will be negatively impacted by the construction of a new weir along the River Avon, which has the potential to impact on fish passage. The proposal includes a (carriner type) fish pass to help enable fish passage upstream, however it is not clear if this will enable passage for all species and therefore the overall effect is currently negative. The bed substrate will also be affected by the impoundment resulting in a more homogenised bed substrate. This will reduce the potential habitat available for feeding and spawning within the reach immediately upstream of the proposed weir. The River Avon currently supports 'High' status for fish. The overall impact on river continuity is considered to be **negative and permanent (moderate magnitude)** as the works will create an additional barrier along the water body. There is therefore an associated **risk of deterioration in this biological quality element unless suitable mitigation can be applied.**	River connectivity will be slightly impacted by the construction of the upstream weir as it will form a barrier to fish passage/connectivity throughout the River Avon system. A fish pass is to be constructed on the new weir which will help to improve river connectivity for fish movement upstream and downstream of the new structure. In addition, there are other downstream barriers along the River Avon (within the water body). As a result, this modification is likely to have a **negligible effect at the water body scale** and should therefore not affect the current 'good' status of this supporting element.	The existing 'Melksham Gate' structure is to be retained and a new fish pass is to be constructed. Provision of a Larinser fish pass, or other type if preferred, along with an eel/elver pass will improve fish passage from that possible through the existing weir pool and trowerse fish pass at the Melksham weir. The need for an elver pass will need to be determined during design as it depends on the gradient of Larinier pass and the size of eel that are present.The impact is therefore likely to be **positive at the local scale but negligible at the water body scale.** As a result this modification should not affect the current 'high' status of this supporting element.	Dredging will entail the physical removal of habitat and reduce the amount of available spawning habitat. The length of river to be dredged is approximately 400m. Most of the existing spawning habitat is found at the margins of the channel, which will be largely unaffected by the area to be dredged. Some spawning habitat along the left bank will be lost where the dredged channel connects with the new canal. This amounts to a length of approximately 100m which is less than 1% of the total waterbody length. Therefore while some loss of spawning habitat is likely to occur the impact is likely to be short-term and minimal. Eels have been recorded along the River Avon. Eels have a preference for habitat which includes the interface between marginal zone (reedbeds-sleafs) and open water. This zone is not going to be affected by the proposed dredge and therefore the impact on eel habitat is assessed as low. A new area of reedbed is proposed at the junction with the new canal and this will help to provide additional habitat. There is a risk that some eels may be directly impacted by being removed with the dredged material, especially if the works correspond with the eel migratory season (Feb to May). The timing of works is therefore significant for all migratory species and dredging will need to avoid the spawning season. Turbidity may increase within the river during and following dredging, which may impact on fish, both directly or indirectly by smothering spawning habitat. Observations indicate that the River Avon carries a naturally high suspended sediment load, therefore the impact from dredging is likely to be **short-term and negligible** against the naturally high background turbidity of the channel. As a result this modification should not affect the current 'high' status of this supporting element.	The training bank will help retain a greater depth within the low flow channel during normal to low flow conditions. This is likely to have a localised positive effect on fish (i.e. passage and habitat availability). The impact on fish is therefore likely to be **permanent and positive at the local scale**, becoming **negligible at the water body scale**. As a result this modification should not affect the current 'high' status of this biological quality element.	**Risk - there is a risk of deterioration associated with the proposed new weir.** **Mitigation is required.** There are also some localised negative impacts associated with (i) the Berryfield Brook works, and (ii) the dredging works. Further enhancement works could be undertaken to help minimise the local impacts but this is not required for compliance.	**Actions required for WFD compliance:** New weir: The fish pass design needs to incorporate passage for as many species as possible. The scheme should look for opportunities to better connect the channel with the floodplain elsewhere along the River Avon water body to offset some of the negative effects of the new weir. Opportunities to remove impeding structures within any adjacent tributaries could be considered to help mitigate for some of the negative effects on river continuity resulting from the new weir. Discussion with the Bristol Avon Rivers Trust (BART) have identified a number of sites that could be considered as mitigation for the new weir on the River Avon. These structures are lauded along the Bybrook/ Brook, Wiltshire and are summarised in the table in Section 4 Mitigation. Undertake habitat improvement works upstream of the existing weir. Look to create additional areas of marginal reed growth and wetland areas around the channel. Soft banks should be retained as much as possible to help provide habitat and shelter for fish. **Opportunities for consideration / environmental enhancement (but not required for compliance):** Berryfield Brook - The new culvert along the Berryfield Brook should be designed to be as fish friendly as possible. Reduce the length of hard bank revetment required along the Berryfield Brook or replace with a soft engineering solution to maintain the vegetated riparian margin. This will also help to offset some of the local permanent effects. Dredging to be undertaken outside of the migratory fish season (Feb to May for Eels).

3B - Mitigation measures

Water body name, ID and current status	**Bristol Avon (Semington Bk to By Bk (River) ID GB109053027372 - 22km length Moderate Ecological Potential Objective - Good Potential by 2027**
Potential impact for achievement of HMWB Mitigation Measures	All the proposed mitigation measures for this water body are 'in place' and therefore the proposals are not considered to impact on them.

Key

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Appendix 2.6

Additional Mitigation

Mitigation required for WFD compliance:

Weirs identified by BART that could be investigated for removal as mitigation for the new weir along the River Avon.
Source: Harriet Alvis, Jan 2019

No feasible weir removal sites were identified along the River Avon, therefore the best option put forward are on the Bydemill Brook, which runs from Corsham to the confluence at Lacock by Lacock Abbey

The following structures that potentially inhibit fish passage have been identified:

Obstruction no.	Grid reference	Passable to salmonids?	Passable to coarse fish?	Description
1	ST 91997 68811	N	N	Weir (gauging)
2	ST 91803 68721	N	N	Weir
3	ST 91677 68653	N	N	Ford (including small weir in side channel)
4	ST 91312 68496	?	?	A350 culvert
5?	*~ ST 90999 68655*	*?*	*?*	*Possible sluice structure at Arnold's Mill (private land)*
6	~ ST 90807 68769	N	N	Weir
7	~ ST 90710 68899	N	N	Sluice
8	ST 90540 69067	?	?	Railway culvert
9	ST 89422 69100	N	N	Weir at Byde Mill
10	ST 89035 69267	Y	Y – not in low flows	Sill below Thingley Bridge
11	ST 87663 69780	?	?	Railway culvert
12	ST 87371 69862	?	?	Culvert under Corsham (including Railway)