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6.4 Environmental Statement Appendix 13.2 WFD Compliance Assessment

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6.4 Environmental Statement
Appendix 13.2 WFD Compliance Assessment

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1 Introduction

1.1 Background

1.1.1 The Water Environment (Water Framework Directive) (WFD) (England and Wales) Regulations 2017 are described in ES Appendix 13.1 Water Legislative and Policy Framework (Document Reference 6.4). The regulations set out a number of key objectives including:

- preventing deterioration of the WFD status of waters
- protecting, enhancing and restoring all bodies of surface water and groundwater
- progressively reducing discharges of priority substances and ceasing, or phasing discharges, of priority hazardous substances for surface waters
- ensuring progressive reduction of groundwater pollution
- mitigating the effects of floods and droughts
- ensuring sufficient supply of water

1.1.2 Regulation 5(2) (l) (iii) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended) requires Nationally Significant Infrastructure Projects to provide an assessment of effects upon water bodies in a River Basin Management Plan (RBMP) alongside their application.

1.2 Purpose

1.2.1 The purpose of this report is to:

- identify water bodies in a RBMP that are of relevance to the scheme
- assess the potential for effects
  highlight any mitigation measures required to ensure compliance

2 Methodology

2.1 Guidance

2.1.1 This report has followed guidance[1,2] produced by The Planning Inspectorate (PINS), the Environment Agency (EA) and the Department for Environment, Food and Rural Affairs (DEFRA) to:

- document the baseline condition of the water environment that may be impacted by the proposed works and identify potential receptors.
- screen the proposed activities for impact pathways to WFD quality elements.
- scope out potential risks to WFD quality elements from the activities screened into the assessment.
- carry out a detailed assessment where activities have been identified as posing a risk to the current status or future potential of WFD quality elements.

2.1.2 Unlike in estuarine or coastal environments, there is no specific or prescribed format or process to follow for fluvial or groundwater WFD compliance assessments. This absence of prescribed approach promotes flexibility to applicants and enables them to undertake a proportionate approach.

2.1.3 The WFD assessment comprises the following stages:

- Stage 1: Screening

- Stage 2: Scoping
- Stage 3: Impact assessment
- Stage 4: Identification and evaluation of measures (if required)
- Stage 5: Article 4.7 considerations (if required)

2.1.4 The approach adopted is intended to ensure there is no deterioration of a waterbody regardless of its WFD baseline classification.

2.2 Stage 1: screening

2.2.1 Initial screening identifies relevant water bodies in the study area. Water bodies are selected for inclusion in the early stages of the compliance assessment with reference to the River Basin Management Plans (RBMP).

2.2.2 This stage has considered whether the scheme has impact pathways to WFD waterbodies. Where impact pathways have been considered possible, the proposed zone of influence has been established based on the scheme baseline.

Scheme baseline

2.2.3 Scheme components and activities that have the potential to permanently affect surface water and/or groundwater bodies, and that therefore have the potential to impact on WFD status, have been identified. This has included the identification of all relevant embedded mitigation measures within the scheme construction strategy and design.

2.2.4 Potential impacts may result from the activities required to construct the scheme (e.g. temporary dewatering), or as a result of the scheme's design (e.g. watercourse crossings / realignments) and operation (e.g. road drainage).

2.2.5 The components of a road scheme are typically repeatable along its length and have therefore been categorised into generic component types (e.g. culverts, outfalls, cuttings, watercourse realignments) with regards to their likely impacts on surface waterbodies and/or groundwater bodies.

2.3 Stage 2: scoping

2.3.1 Scoping comprises a more detailed assessment to identify risks from the scheme to receptors (within the zone of influence) based on the relevant waterbodies and their quality elements. The aim of this assessment is to identify whether there is potential for deterioration in water body status or failure to comply with WFD objectives for any of the water bodies identified in Stage 1, and establish if further detailed assessment is required. At this stage, the scope of further assessment work at Stage 3 should be defined and agreed with the Environment Agency.

2.4 Stage 3: impact assessment

2.4.1 Stage 3 (impact assessment) is a detailed assessment of waterbodies and activities carried forward from the screening stage. It includes identification of waterbodies, description of the proposed development, methods used to determine impacts, risk of deterioration, and mitigation required.

2.4.2 The objective of the impact assessment is to establish the nature and anticipated magnitude of the effects of relevant scheme components on the WFD quality elements of the surface water and groundwater bodies affected by the scheme.

These effects are to be considered in terms of the potential for deterioration of current status and/or the prevention of status objectives.

2.4.3 The EA provides guidance on the definition of no deterioration[3]. Necessary measures must be taken to prevent deterioration from one waterbody status class to a lower one. Furthermore, according to a recent EU Court of Justice ruling[4], within-class deterioration should also be considered as an overall deterioration of the waterbody status.

2.4.4 The approach to the impact assessment suggested by the PINS guidance[1] has been used. The approach includes the following steps:

- A description of the scheme and the aspects of the development considered within the scope of the WFD assessment.
- Identification of waterbodies that are potentially affected (directly or indirectly) or could be at risk as a result of the scheme (the zone of influence).
- Collation of the baseline characteristics of the waterbodies concerned.
- Description of the methods used to determine and quantify the scale of WFD impacts (described in each topic specific appendix).
- An assessment of the risk of deterioration, as an Article 4.7 derogation may be required where is a there is a risk the scheme will prevent the achievement of good status or result in deterioration in status (further details in Annex A, section 3.6).
- An explanation of any mitigation required and how its delivery is secured.
- An explanation of any enhancements and/or positive contributions to the RBMP objectives proposed and how their delivery would be secured.

Waterbody baseline

2.4.5 This has been established by identifying the WFD surface water and groundwater bodies potentially affected by the scheme and identifying their baseline condition, using a combination of desktop assessment and, where possible, field surveys.

2.4.6 The desktop assessment has collated and reviewed the waterbody status and status objectives information for the relevant WFD waterbodies based on EA data (2016 Cycle 2 Waterbody Status Classification data). This data is considered to provide the current best estimate of status and the formal baseline against which the EA will assess compliance with the ‘no deterioration’ objective in 2017.

2.4.7 The following datasets have also been used to further establish the nature and existing condition of those watercourses located within WFD waterbodies that are affected by the scheme:

- Observations from site walkovers
- Observations from water features survey (March 2018 to April 2019) within ES Appendix 13.11 Water Features Survey (Document Reference 6.4)
- EA Catchment Data Explorer, including relevant information from the Severn and Thames River Basin Management Plans 2015[5]
- EA Water Quality Archive[6]
- Natural England MAGIC[7]
- Ordnance Survey (OS) mapping (including topography)
- British Geological Survey (BGS) mapping[8]
- A417 Missing Link Preliminary Groundwater Report 2019[9]

- ES Appendix 8.22 Aquatic Invertebrate Survey Report (Document Reference 6.4)
- ES Appendix 8.23 Fish Habitat Assessment Report (Document Reference 6.4)
- ES Appendix 8.24 Assessment of Tufaceous Vegetation (Document Reference 6.4)
- ES Appendix 13.4 Water Quality Assessment (Document Reference 6.4)
- ES Appendix 13.5 Hydromorphological assessment (Document Reference 6.4)
- ES Appendix 13.6 Spillage risk assessment (Document Reference 6.4)
- ES Appendix 13.7 Hydrogeological Impact Assessment (Document Reference 6.4)
- ES Appendix 13.10 Drainage Strategy Report (Document Reference 6.4)
- ES Appendix 13.12 Water Environment Monitoring Data (Document Reference 6.4)

2.4.8 Potential groundwater dependent terrestrial ecosystems (GWDTEs) will be identified from statutory environmental designations in the study area and spring features will be identified from issues labelled on the OS maps. Licensed and unlicensed groundwater abstraction details will be sought from the EA or the relevant local authority.

2.4.9 The geomorphology baseline conditions were identified during a site walkover and details are outlined in ES Appendix 13.5 Hydromorphology Assessment (Document Reference 6.4). A visual inspection during a site visit is an appropriate method for undertaking a geomorphology survey to inform this level of assessment.

2.4.10 To establish a baseline condition, aquatic invertebrate surveys and fish habitat mapping has been conducted for watercourses that are considered to potentially be modified by the scheme.

2.4.11 Groundwater monitoring is ongoing across the scheme and has informed current reporting. Details are presented in ES Appendix 13.7 Hydrogeological Impact Assessment (Document Reference 6.4).

3 Screening

3.1 Scheme components

3.1.1 This report has considered all ‘scheme components’ that have the potential to permanently affect surface waterbodies and groundwater bodies, and therefore have the potential to impact on WFD status. All scheme components have been assessed individually before the combined effect on quality element status is considered.

3.1.2 Linear infrastructure projects, such as roads, typically have generic scheme components that are repeated across the length of the scheme. A total of six such scheme components have been identified that may directly or indirectly affect surface waterbodies along the scheme alignment. These include:

- culverts (detailed in Table 3-1)
- watercourse realignments (detailed in Table 3-1)
- road drainage basins (detailed in Table 3-1)
- road drainage outfalls (detailed in Table 3-1)

- embankments
- cuttings

Table 3-1 Design features of relevance to the water environment

Watercourse	Approximate chainage (m)	WFD Waterbodies (SW: surface water, GW: groundwater)	Description
Tributary of Norman's Brook	0+100	SW: Horsbere Bk – source to conf with R Severn GW: Severn Vale – Secondary Combined	Piped outfall to stream culvert
Tributary of Norman's Brook	0+500	SW: Horsbere Bk – source to conf with R Severn GW: Severn Vale – Secondary Combined and Severn Vale and Severn Vale – Jurassic Limestone Cotswold Edge South	Piped outfall to stream culvert via Dog Lane
Tributary of Norman's Brook	0+550	SW: Horsbere Bk – source to conf with R Severn GW: Severn Vale – Secondary Combined	Replacement and realignment of stream culvert
N/a	1+300 to 2+055	SW: Horsbere Bk – source to conf with R Severn River Churn GW: Severn Vale – Jurassic Limestone Cotswold Edge South	Cold Slad Link Retaining Wall/Realignment/loss of watercourse
Tributary of Norman's Brook	1+550	SW: River Churn GW: Severn Vale – Jurassic Limestone Cotswold Edge South	Stepped basins between A417 and private access with outfall to stream
N/a	1+650 to 2+900	SW: River Churn GW: Severn Vale – Jurassic Limestone Cotswold Edge South Burford Jurassic	Air Balloon Cutting
N/a	2+100 to 2+300	SW: River Churn GW: Burford Jurassic	Stepped basins
Dry valley – flowing to unnamed tributary of River Churn 1	2+150	SW: River Churn GW: Burford Jurassic	Drainage basins with overflow to dry valley
Unnamed land drainage ditch	3+100	SW: River Churn GW: Burford Jurassic	Land drainage culvert
N/a	3+200	SW: River Churn GW: Burford Jurassic	Drainage basin
N/a	3+200	SW: River Churn GW: Burford Jurassic	B4070 Cutting
N/a	3+200 to 4+700	SW: River Churn River Frome GW: Burford Jurassic	Stockton to Nettleton Cuttings

Watercourse	Approximate chainage (m)	WFD Waterbodies (SW: surface water, GW: groundwater)	Description
Dry valley – flowing to unnamed tributary of River Churn 2	3+900	SW: River Churn GW: Burford Jurassic	Drainage basin with overflow to dry valley
Dry valley – flowing to unnamed tributary of River Frome	4+600	SW: River Frome GW: Severn Vale – Jurassic Limestone Cotswold Edge South	Drainage basin with overflow to dry valley via culvert under farm access
Unnamed land drainage ditch	4+750	SW: River Frome GW: Severn Vale – Jurassic Limestone Cotswold Edge South	Land drainage culvert
N/a	5+250	SW: River Frome GW: Severn Vale – Jurassic Limestone Cotswold Edge South	Cowley Junction East Cutting
Unnamed land drainage ditch	5+300	SW: River Frome GW: Severn Vale – Jurassic Limestone Cotswold Edge South	Land drainage culvert
Tributary of the River Frome	5+500	SW: River Frome GW: Severn Vale – Jurassic Limestone Cotswold Edge South	Re-use of replacement of existing outfall

3.2 Construction activities

Table 3-2 Screening of construction activities for risks to WFD quality elements

Proposed activity	Screen in/out	Justification
Temporary dewatering to enable construction (e.g. for cuttings)	In	The construction of cuttings has the potential to temporarily lower groundwater levels which may impact on nearby receptors that are reliant upon groundwater. The activity therefore has the potential to impact upon WFD quality elements and all WFD water and groundwater bodies have been screened into assessment for this activity.
Temporary loss of a section of the tributary of Norman's Brook to enable embankment widening	In	The widening of the A417 up Crickley Hill and the new access to Grove Farm are anticipated to require the watercourse to be re-routed between Ch 0+500m and Ch 1+600m during construction of these scheme elements. Following construction, the watercourse will flow along a new alignment around the southern edge of the earth bunding. The impact of this permanent modification is considered under Operational Activities (Table 3-3). The loss of approximately 1.1km of watercourse may result in impacts to WFD quality elements of the Norman's Brook - source to confluence Hatherley Brook waterbody. This activity is screened into the assessment.

Proposed activity	Screen in/out	Justification
Works in or near to watercourses (e.g. construction of culverts and drainage outfalls)	Out	In-channel works would be undertaken to install new culverts, drainage outfalls and to realign Crickley Stream. The temporary nature of these works and the construction mitigations described in ES Appendix 2.1 Environmental Management Plan (EMP) (Document Reference 6.4) minimises the potential for permanent impacts upon WFD quality elements. All WFD waterbodies have been screened out of the assessment for this activity.
Temporary discharge of site runoff to surface waters and groundwaters	Out	Measures considered to be standard industry practice will be adopted during construction to ensure that runoff discharged from the site is of acceptable quality and is discharged in a manner that does not impact upon geomorphology or hydrology of local watercourse. Above standard construction practices to be implemented are detailed in ES Appendix 2.1 EMP (Document Reference 6.4). With these measures in place no permanent impacts on the current status or status objectives of WFD quality elements are expected as a result of this activity. All WFD waterbodies have been screened out of the assessment for this activity.
Sediment mobilisation from site run-off	Out	Construction activities increase the risk of pollutants entering the wider water environment from spillages from vehicles/plant, concrete wash-waters and sediment mobilisation. These risks would be present over the length of the construction sequence, with high-risk periods during topsoil stripping and works in or near to watercourses. The risk of sediment mobilisation remains until vegetation is established (at least one growing season). ES Appendix 2.1 EMP (Document Reference 6.4) details how water and sediment would be managed across the scheme and include provisions to minimise the likelihood of runoff, provide containment of spillage and capture or treat wastewaters where necessary. These mitigation measures are intended to prevent permanent impacts upon WFD surface water or groundwater quality elements as a result of this activity. All WFD waterbodies have been screened out of the assessment for this activity.
Accidental spillage of pollutants (e.g. fuel leakage from storage or plant)	Out	Measures considered to be standard practice, which are detailed in ES Appendix 2.1 EMP (Document Reference 6.4), will be adopted during construction to ensure that if an accidental spillage occurs it will be contained and disposed of appropriately. With these measures in place no permanent impacts on the current status or status objectives of WFD quality elements are expected as a result of this activity. All the WFD waterbodies have been screened out of the assessment for this activity.

3.3 Operational activities

Table 3-3 Screening of operational activities for risks to WFD quality elements

Proposed activity	Screen in/out	Explanation
Permanent changes to groundwater levels or flows as a result of new cuttings, embankments or road drainage	In	The cuttings included in the scheme design (listed in Table 3-1) may cause local changes to groundwater levels. The significant areas of cuttings for the scheme extend across all WFD groundwaters bodies including 'Severn Vale – Secondary Combined', 'Severn Vale – Jurassic Limestone Cotswold Edge South' and Burford Jurassic. There is a potential for this activity to result in impacts to WFD quality elements. All WFD groundwater bodies have been screened into assessment for this activity.
Permanent changes to surface water flow regimes as a result of new cuttings, embankments or road drainage	In	The new cuttings included in the scheme design (listed in Table 3-1) may cause local changes to groundwater drainage which is likely to result in changes to the flow regimes of minor watercourses in the scheme study area. The significant areas of cuttings for the scheme are in 'River Frome – source to Ebley Mill', and 'River Churn – source to Perrots Brook' and 'Norman's Brook – source to confluence Hatherley Brook' catchment. There is a potential for this activity to result in impacts to WFD quality elements. 'River Frome – source to Ebley Mill', 'River Churn – source to Perrots Brook' and 'Norman's Brook – source to confluence Hatherley Brook' WFD waterbodies have been screened into assessment for this activity. The 'Horsbere Bk – source to confluence with the River Severn' WFD waterbody is screened out of assessment for this activity.
Discharge of routine runoff to surface waters or groundwater from the road drainage system	In	Runoff from the carriageway will pass through the road drainage system prior to its discharge to local watercourses and land ditches at greenfield runoff rates. There is potential for this runoff to degrade water quality in waters that receive runoff from the scheme. There is potential for this runoff to impact water quality in the following waterbodies, which are all screened into the assessment: Surface waters: - 'River Frome – source to Ebley Mill', - 'River Churn – source to Perrots Brook' and - 'Norman's Brook – source to confluence Hatherley Brook' Groundwaters: - 'Severn Vale – Secondary Combined', - 'Severn Vale – Jurassic Limestone Cotswold Edge South' - 'Burford Jurassic'
Accidental spillage of pollutants (e.g. fuel spills)	In	The road drainage system would provide a level of buffering and an opportunity for containment between impermeable areas (where a spillage is most likely to occur) and the wider water environment. Despite this there is potential for accidental spillage to result in a degradation in the quality of waters receiving runoff from the Scheme. There is potential for spillage to impact water quality in the following waterbodies, which are all screened into the assessment: Surface waters: - 'River Frome – source to Ebley Mill', - 'River Churn – source to Perrots Brook' and - 'Norman's Brook – source to confluence Hatherley Brook' Groundwaters:

Proposed activity	Screen in/out	Explanation
		- 'Severn Vale – Secondary Combined', - 'Severn Vale – Jurassic Limestone Cotswold Edge South' 'Burford Jurassic'
New in-channel structures (e.g. culverts or drainage outfalls)	In	The new in-channel structures would consist of new culverts and drainage outfalls as listed in Table 3-1. New structures within a watercourse can alter local channel cross section and induce local bank or bed erosion, as well as reduce the available natural habitat area. There is potential for impacts to hydromorphology and subsequent effects upon biological quality elements in the following waterbodies, which are all screened into the assessment: Surface waters: - 'River Frome – source to Ebley Mill', - 'River Churn – source to Perrots Brook' and - 'Norman's Brook – source to confluence Hatherley Brook'
Realignment of tributary of Norman's Brook	In	The realignment of the tributary of Norman's Brook (within the 'Norman's Brook – source to confluence Hatherley Brook' WFD waterbody as identified by the tracer test) has the potential to impact sediment regime, channel morphology and natural fluvial processes. The realignment has result in a change to sediment supply, rate of sediment transfer downstream and depositional zones. The new channel could also lack morphological diversity. Natural fluvial processes could be impacted causing an increase in erosion and/or deposition which can have feedback effects including reduction in channel stability. There is a potential for this activity to impact WFD quality elements and therefore the tributary of Norman's Brook within the WFD waterbody 'Norman's Brook – source to confluence Hatherley Brook' has been screened into assessment for this activity.

3.4 Zone of influence

3.4.1 The screening of the scheme components has noted activities that have the potential to impact upon quality elements of WFD surface water and groundwater bodies. The following WFD waterbodies are deemed to be within the potential zone of influence of the scheme:

Surface waterbodies (ES Figure 13.3 WFD Surface Waterbodies (Document Reference 6.3)):

- Horsbere Brook – source to confluence with the River Severn
- Norman's Brook – source to confluence Hatherley Brook
- River Churn – source to Perrots Brook
- River Frome – source to Ebley Mill

Groundwater bodies (ES Figure 13.4 WFD Groundwater Bodies (Document Reference 6.3)):

- Severn Vale – Secondary Combined
- Severn Vale – Jurassic Limestone Cotswold Edge South
- Burford Jurassic

4 Scoping

4.1.1 The scope of the detailed assessment is based upon the activities identified as potentially posing a risk to WFD quality elements in the screening assessment. The study area extends to the waterbodies within the zone of influence.

4.1.2 An EIA scoping opinion was provided by PINS (ES Appendix 4.1 The Planning Inspectorate Scoping Opinion (Document Reference 6.4)) which included a response relating to WFD assessment from the EA. This response has been considered in this assessment.

4.1.3 The EA was consulted on the scope of the monitoring being undertaken, as well as key effects of the scheme and mitigation. The record of consultation with the EA is recorded in the respective Statement of Common Ground, see Statement of Commonality (Document Reference 7.3).

5 Baseline

5.1 WFD surface waterbodies

5.1.1 The Cotswold Escarpment forms a surface water divide between the River Severn catchment and the River Thames catchment (to the east and south-east of the divide). To the west of the divide, the land within the scheme drains to the River Severn and its tributaries, including Norman's Brook, Horsbere Brook and the River Frome. To the east and south-east, the land within the scheme drains to the River Churn, a tributary of the Thames.

5.1.2 Horsbere Brook, Norman's Brook, the River Frome and the River Churn are ordinary watercourses within the study area.

5.1.3 The scheme is predominantly situated in the wider Severn River Basin District (RBD), with a small area to the east located with the Thames RBD.

5.1.4 The following WFD waterbodies shown in Table 5-1 are relevant to the scheme or hydrologically connected.

5.1.5 The status, failing elements and designations of these watercourses are summarised in Table 5-1.

Horsbere Brook - source to confluence with the River Severn[10]

5.1.6 Horsbere Brook (GB109054032760) is classified as a 'river' located within the Severn RBD. This river is formally designated as a 'heavily modified waterbody' (HMWB).

5.1.7 The waterbody achieved 'Moderate' overall waterbody status in 2019 and has no future objective.

5.1.8 The waterbody received an 'Moderate' overall status due to 'Moderate' ecological status as a result of 'Poor' biological quality elements, specifically fish, and a 'Fail' chemical status as a result of Priority hazardous substances, specifically Polybrominated diphenyl ethers and mercury and its compounds.

5.1.9 The reasons for not achieving 'Good' status are a result of physical modifications including barriers causing ecological discontinuity.

5.1.10 The EA Catchment Data Explorer depicts the 'Horsbere Brook source to confluence with the River Severn' catchment boundary as extending to the north of the A417. The EA also depicts the catchment as encompassing a tributary of Horsbere Brook that borders a stretch of the scheme to the north. However, tracer testing has indicated that the tributary flows to the north and extends out of the 'Horsbere Brook source to confluence with the River Severn' catchment, as shown in ES Figure 13.1 Surface Water Features (Document Reference 6.3). Therefore, this tributary should be considered part of the Norman's Brook source to confluence Hatherley Brook catchment. The Horsbere Brook catchment would only be connected to the scheme during period of extreme flow, when flow in the tributary of Norman's Brook exceeds the capacity of the culvert beneath the A417 and backs up to a level where it flows via overland flow westwards along the southern edge of the A417 into Horsbere Brook.

Norman's Brook – source to confluence Hatherley Brook[11]

5.1.11 Norman's Brook (GB109054032780) is formally designated as a 'river' located within the Severn RBD. Norman's Brook has not been designated as an artificial or heavily modified river.

5.1.12 The waterbody achieved 'Moderate' overall waterbody status in 2019 and has no future objective.

5.1.13 The waterbody received an overall 'Moderate' status due to 'Moderate' ecological status as a result of 'Moderate' biological quality elements and physico-chemical quality elements, specifically due to 'Moderate' results for macrophytes and phytobenthos combined and 'Poor' phosphate results, respectively. It also achieved a 'Fail' chemical status as a result of Priority hazardous substances, specifically Polybrominated diphenyl ethers and mercury and its compounds.

5.1.14 The reasons for not achieving 'Good' status have been attributed to diffuse and point pollution related to poor livestock management and sewage discharge, respectively.

5.1.15 As detailed above, a tributary of Norman's Brook is located within the site boundary and adjacent to the scheme, the watercourse flows along the northern section of the scheme. This tributary is incorrectly shown as being part of the Horsbere Brook catchment on EA Catchment Data Explorer mapping. A second tributary is located to the north of the Crickley Hill and Barrow Wake SSSI, approximately 650m from the scheme, as shown in ES Figure 13.1 Surface Water Features (Document Reference 6.3) and ES Figure 13.3 WFD Surface Waterbodies (Document Reference 6.3).

5.1.16 The tributary of Norman's Brook is a distinguishable feature and is a continuously flowing watercourse fed by land drainage systems and springs on the south and east of Grove Farm and the A417 highway drainage system to the north. Between its source and Crickley Hill stream culvert the existing watercourse has an irregular and steep course interrupted by short culverts and other features such as informal dams, weirs and cascades.

5.1.17 The watercourse enters a culvert just east of the Crickley Hill Farm. This culvert crosses diagonally under the existing A417 Mainline and then continues along Dog Lane and Bentham Lane before discharging to an open ditch just north of Bentham County Club on the western side of Bentham Lane. The total length of the existing culverts is over 1000 metres including Crickley Hill stream culvert.

River Churn - source to Perrots Brook[12]

5.1.18 The River Churn (GB106039029810) is classified as a 'river' and is located within the Thames Severn RBD. The River Churn has not been designated as an artificial or heavily modified river.

5.1.19 The waterbody achieved 'Moderate' overall waterbody status in 2019 and has an objective of 'Good' by 2027.

5.1.20 The waterbody received an overall 'Moderate' status due to 'Moderate' ecological status as a result of 'Moderate' biological quality elements, specifically due to macrophytes and phytobenthos combined and fish and a 'Fail' chemical status as a result of Priority hazardous substances, specifically Polybrominated diphenyl ethers and mercury and its compounds..

5.1.21 The reasons for not achieving 'Good' status in relation to macrophytes and phytobenthos combined have been attributed to suspect data and groundwater abstractions. Reasons for not achieving 'Good' status in relation to fish have been attributed to poor livestock management.

5.1.22 The nearest tributary of the River Churn to the scheme is located approximately 50m from the scheme, as shown in ES Figure 13.1 Surface Water Features (Document Reference 6.3) and ES Figure 13.3 WFD Surface Waterbodies (Document Reference 6.3).

River Frome – source to Ebley Mill[13]

5.1.23 The River Frome (GB109054032470) is formally designated as 'river' and is located within the Severn RBD. The River Frome has not been designated as an artificial or heavily modified river.

5.1.24 The waterbody achieved 'Moderate' overall waterbody status in 2019 and has no future objective set. The 'Moderate' status is as a result of 'Moderate' biological quality elements, specifically due to fish, and a 'Fail' chemical status as a result of Priority hazardous substances, specifically Polybrominated diphenyl ethers and mercury and its compounds.

5.1.25 The nearest tributary of the River Frome is located approximately 260m from the scheme, as shown in ES Figure 13.1 Surface Water Features (Document Reference 6.3) and ES Figure 13.3 WFD Surface Waterbodies (Document Reference 6.3).

5.2 WFD groundwater bodies

5.2.1 The scheme is located across three WFD groundwater bodies: Severn Vale – Secondary Combine; Severn Vale – Jurassic Limestone Cotswold Edge South; and Burford Jurassic.

Severn Vale – Secondary Combined[14]

5.2.2 The Severn Vale – Secondary Combined groundwater body (GB40902G204900) has a groundwater area of 120,678 Ha. The groundwater area extends across Wales and England from the east of Chepstow up to Great Malvern, encompassing Gloucester and most of Cheltenham. The groundwater body is located to the far most western extent of the scheme, as shown in ES Figure 13.4 WFD Groundwater Bodies (Document Reference 6.3).

5.2.3 The groundwater body received a 'Good' status in 2019 and has no future objective set.

Severn Vale – Jurassic Limestone Cotswold Edge South[15]

5.2.4 Severn Vale - Jurassic Limestone Cotswold Edge South groundwater body (GB40901G305700) has a groundwater area of 23,910Ha. The groundwater area extends up through Nailsworth, Stroud and Whiteway. The groundwater body is located to the east of the Severn Vale – Secondary Combined groundwater body, as shown in ES Figure 13.4 WFD Groundwater Bodies (Document Reference 6.3).

5.2.5 The groundwater body received a 'Good' status in 2019 and has no future objective set.

Burford Jurassic[16]

5.2.6 Burford Jurassic groundwater body (GB40601G600400) has a groundwater area of 90,062 Ha. The groundwater area extends from Cirencester up through the Cotswolds to Snowshill. The groundwater body is located to the far most eastern extent of the scheme and to the east of the Severn Vale – Jurassic Limestone Cotswold Edge South groundwater body, as shown in ES Figure 13.4 WFD Groundwater Bodies (Document Reference 6.3).

5.2.7 The groundwater body received a 'Poor' status in 2019 and has an objective of 'Good' by 2027.

5.3 Hydrogeology

5.3.1 The hydrogeological baseline is described in ES Appendix 13.7 Hydrogeological Impact Assessment (Document Reference 6.4).

5.4 Hydromorphology

5.5 The hydromorphological baseline is described in ES Appendix 13.5 Hydromorphology Assessment (Document Reference 6.4).

5.6 Aquatic ecology

5.6.1 The aquatic invertebrate baseline is described in ES Appendix 8.22 Aquatic Invertebrate Survey Report (Document Reference 6.4).

5.6.2 The fish habitat baseline is described in ES Appendix 8.23 River Habitat Survey and Fish Habitat Assessment Report (Document Reference 6.4).

5.6.3 Tufa deposits supporting Annex 1 species have been identified along the tributary of Norman's Brook between Ch 1+000m and Ch 1+150m. An assessment of the vegetation has been conducted and is presented in ES Appendix 8.24 Assessment of tufaceous vegetation (Document Reference 6.4).

5.7 Protected areas and designations

5.7.1 Under the WFD, 'Protected Areas' are defined as areas requiring special protection because of their sensitivity to pollution or due to their particular economic, social or environmental importance. These areas are waterbodies or parts of them:

- used for the abstraction of water intended for human consumption (Drinking Water Protected Area (DrWPA);
- supporting economically significant shellfish or freshwater fish stocks (Freshwater Fish Water; Shellfish Water);
- where a large number of people are expected to bathe (Bathing Water);
- supporting habitats or species of international biodiversity conservation importance (such as a Special Area of Conservation (SAC) or Special Protection Area (SPA)); and/or
- sensitive to nutrient enrichment (such as a Nitrate Vulnerable Zone (NVZ) or Urban Waste Water Treatment Directive (UWWTD) sensitive zone).

5.7.2 The specific environmental designations, measures and actions for these protected areas have been established under previous European Directives, which set out the requirements to ensure the protection of the area's water environment or protection of wildlife that is directly dependant on that water environment. Where a WFD waterbody falls within or forms all or part of one of these designated predicted areas, the waterbody is subject to additional environmental objectives (and associated monitoring regimes, risk assessments, and regulations) in accordance with the relevant, previous Directive(s).

DrWPA

5.7.3 The nearest DrWPA is the Shropshire, Herefordshire, Worcestershire and Gloucestershire (GB70910509) which is located approximately 9.2km from the scheme.

SAC

5.7.4 The Cotswold Beechwoods SAC is located 270m west and downslope of the B4070, includes areas of vegetation dependent on high groundwater levels that are associated with some nationally rare invertebrate species. These protected areas extend from the south-east of Birdlip to High Brotheridge, and includes springs supplying Horsbere Brook.

5.7.5 The Severn Estuary SAC is located 9km west of the scheme and is hydrologically connected to the scheme via Norman's Brook and Horsebere Brook and the River Frome.

SPA

5.7.6 There are no SPAs that are hydrologically connected to the scheme.

NVZ

5.7.7 The eastern extent of the scheme is located within 'Hatherley Bk – conf Norman's Bk to conf R Severn' Surface Water NVZ under the 2017 designation.

UWWTD

5.7.8 The scheme is not located within an UWWTD sensitive area.

Aquifers

Aquifer designation - bedrock

5.7.9 The majority of the scheme is located upon a Principal Aquifer, except the north western part of the scheme. The aquifer designations are shown on ES Figure 13.6 Aquifer Designations (Document Reference 6.3).

5.7.10 More comprehensive details on hydrogeology are included in ES Figure 13.4 WFD Groundwater Bodies (Document Reference 6.3).

Aquifer designation – superficial deposits

5.7.11 The north western extent of the scheme is located within the Secondary Aquifer. There are no other superficial deposits located along the scheme extent. The aquifer designations are shown on ES Figure 13.6 Aquifer Designations (Document Reference 6.3).

5.7.12 More comprehensive details on hydrogeology are included in ES Figure 13.4 WFD Groundwater Bodies (Document Reference 6.3).

5.8 Summary

5.8.1 The WFD surface waterbodies and groundwater bodies that are hydrologically connected to the scheme are shown in Table 5-1 and Table 5-2 of this report, respectively.

Table 5-1 Summary of WFD surface waterbodies in the study area

WFD waterbody	Horsbere Brook – source to confluence with the River Severn	Norman's Brook – source to confluence Hatherley Brook	River Churn – source to Perrots Brook	River Frome – source to Ebley Mill
ID	GB109054032760	GB109054032780	GB106039029810	GB109054032470
Type of Waterbody	River	River	River	River
Area (km^2)	13.04	3.91	16.94	27.73
HMWB/AWB	Heavily Modified	Not designated as HMWB/AWB	Not designated as HMWB/AWB	Not designated as HMWB/AWB
Overall Status	Moderate	Poor	Moderate	Moderate
Objective	No objective	No objective	Good by 2027	No objective
Chemical Status	Fail	Fail	Fail	Fail
Ecological Status	Moderate	Moderate	Moderate	Good
Driver of failure to achieve 'good' status	Fish	Macrophytes and Phytobenthos	Macrophytes and Phytobenthos Fish	Fish
Reasons for not achieving 'good' status	Physical modification of barriers causing ecological discontinuity	Poor livestock management (diffuse pollution) Sewage discharge (point source)	Poor livestock management (diffuse pollution) Groundwater abstraction	N/A

Table 5-2 Summary of WFD groundwater bodies in the study area

WFD groundwater body	Severn Vale – secondary combined	Severn Vale – Jurassic Limestone Cotswold Edge South	Burford Jurassic
ID	GB40902G204900	GB40901G305700	GB40601G600400
Type of Waterbody	Groundwater	Groundwater	Groundwater
Area (km^2)	1,206.78	239.10	900.62
Overall Status	Good	Good	Poor
Objective	No objective set	No objective set	Good by 2027
Chemical Status	Good	Good	Poor
Quantitative Status	Good	Good	Good
Driver of failure to achieve 'good' status	N/A	N/A	Chemical DrWPA General chemical test
Reasons for not achieving 'good' status	N/A	N/A	Poor nutrient management (diffuse source) Private sewage treatment (point source)

6 Impact assessment

6.1 Detailed assessment appendices

6.1.1 Potential impacts upon surface water and groundwater WFD quality elements have been identified in the screening assessment undertaken in Section 3.

6.1.2 The assessment of construction and operational effects has been informed by the findings of the following detailed assessments:

- ES Appendix 8.22 Aquatic Invertebrate Survey Report (Document Reference 6.4)
- ES Appendix 8.23 Fish Habitat Assessment Report (Document Reference 6.4)
- ES Appendix 8.24 Assessment of Tufaceous Vegetation (Document Reference 6.4)
- ES Appendix 13.4 Water Quality Assessment (Document Reference 6.4)
- ES Appendix 13.5 Hydromorphological Assessment (Document Reference 6.4)
- ES Appendix 13.6 Spillage Risk Assessment (Document Reference 6.4)
- ES Appendix 13.7 Hydrogeological Impact Assessment (Document Reference 6.4)
- ES Appendix 13.10 Drainage Strategy Report (Document Reference 6.4)

6.2 Construction activities

Temporary dewatering to enable construction

6.2.1 The screening identified the potential for impacts on WFD quality elements of surface water and groundwater bodies resulting from temporary dewatering to enable construction, particularly at cutting locations.

6.2.2 Where the hydrogeological impact assessment has indicated that temporary dewatering would be required, groundwater intercepted as part of the works would be retained within the catchment of the respective receiving water.

6.2.3 The initial hydrogeological impact assessment has identified that impacts relating to temporary dewatering would be localised to each cutting and hence not anticipated to have a significant impact on the quality elements of any WFD surface water or groundwater bodies.

6.2.4 No impacts upon GWDTEs are anticipated as a result of the temporary dewatering.

Temporary loss of a section of the tributary of Normans Brook

6.2.5 The screening identified the potential for impacts on WFD quality elements of the Normans Brook - source to confluence Hatherley Brook river waterbody resulting from temporary loss of the uppermost 1.1km of the tributary of Normans Brook. This section of watercourse would be realigned to enable widening of the A417 embankment.

6.2.6 A temporary impact upon all quality elements of the watercourse would result from this activity. However, the impact would be limited to this 1.1km section of watercourse. The duration of the impact would be for the length of the construction programme.

6.2.7 The fish habitat assessment within ES Appendix 8.23 River habitat survey and Fish habitat assessment (Document Reference 6.4), of the section of watercourse that would be impacted, concluded that whilst habitat for mixed juvenile fish (salmonid fry and parr) and salmonid spawning habitat was recorded, it is considered highly unlikely that this reach provides habitat for salmonids due to the high number of impassable weirs.

6.2.8 To ensure that effects upon WFD quality elements are localised and temporary, the detailed design of the realigned watercourse would provide aquatic habitat features of an equivalent or greater value to that of the existing watercourse.

6.2.9 Given the mitigation proposed and the short section of watercourse potentially effected, this activity is not anticipated to result in any significant effects upon the quality elements of the Normans Brook – source to confluence Hatherley Brook waterbody.

6.3 Operational activities

Permanent changes to groundwater flow regimes as a result of new cuttings, embankments or road drainage

6.3.1 The potential for changes to groundwater levels and flows has been assessed in ES Appendix 13.7 Hydrogeological Impact Assessment (Document Reference 6.4).

6.3.2 The proposed cuttings are expected to encounter groundwater. The permanent drainage would result in minor, localised changes to groundwater levels and flows. There are no recorded licensed abstractions within 1km of the scheme.

6.3.3 Analysis of the extent of anticipated drawdown indicates that localised changes in groundwater level are unlikely to impact upon any groundwater quality elements. Additionally, the drainage design would retain collected groundwater within the respective receiving water.

6.3.4 Therefore, this activity is not anticipated to result in any significant effects upon the quality elements of WFD groundwater bodies.

6.3.5 No impacts upon GWDTEs are anticipated as a result of this activity.

Permanent changes to surface water flow regimes as a result of new cuttings, embankments or road drainage

6.3.6 The potential for changes to surface water flows as a result of changes in groundwater level or flow changes has been considered in ES Appendix 13.7 Hydrogeological Impact Assessment (Document Reference 6.4).

6.3.7 Analysis has shown that localised changes in groundwater level or flow resulting from drainage for ground stabilisation along the tributary of Normans Brook would result in change in surface water flow in the realigned stream. The existing inputs from various springs between Ch 0+500m and Ch 1+600m would be collected by this drainage and directed back into the stream further downslope.

6.3.8 This would cause a reduction in baseflow for a short section of the realigned stream with the potential for subsequent impacts on ecological quality elements in this localised reach.

6.3.9 To mitigate for this impact, the detailed design of the realigned stream will account for the anticipated changes to flow regime to ensure that the channel form is optimised to maximise habitat potential.

6.3.10 Given the mitigation proposed and the short section of watercourse potentially effected, this activity is not anticipated to result in any significant effects upon the quality elements of the 'Normans Brook – source to confluence Hatherley Brook' waterbody.

Discharge of routine run-off to surface water from the road drainage

6.3.11 Impacts of routine run-off on surface waters has been assessed through a HEWRAT assessment undertaken in ES Appendix 13.4 Water Quality Assessment (Document Reference 6.4).

6.3.12 The assessment identified that all road drainage areas require some form of pollutant treatment to reduce loadings to receiving waters to an acceptable level. All networks on the scheme include a basin (pond) along with at least one other measure as a treatment train. Catchments 6, 7 and 8 require an additional pollution control measure to meet the required removal percentage. This additional treatment will be in the form of a forebay within the basins to effectively remove pollutants. The forebay design will be developed at the detailed design stage.

6.3.13 The exact type and configuration of the basins will depend heavily on the specific ground conditions (suitability for infiltration) at each location and the preferred maintenance regime of the adopting body (Highways England or Gloucestershire County Council).

6.3.14 This surface water quality assessment is based on a precautionary assumption that no infiltration will take place within the drainage systems and at the basins. Infiltration testing has been undertaken following ground investigations. During detailed design, there will be opportunities to introduce infiltration techniques and optimise the basin designs. Infiltration will also significantly improve the pollutant removal performance of the highway drainage systems.

6.3.15 Given the mitigation proposed, this activity is not anticipated to result in any significant effects upon the quality elements of any surface waterbodies that would receive discharge from the road drainage system.

Discharge of routine run-off to groundwater from the road drainage

6.3.16 Impacts of routine run-off on groundwater has been assessed in ES Appendix 13.4 Water Quality Assessment (Document Reference 6.4).

6.3.17 The assessment identified that all road drainage areas pose a medium risk of impact to groundwater. DMRB LA 113 states that where a medium risk of impact is indicated, detailed assessment should be undertaken by a competent expert.

6.3.18 This assessment would be undertaken upon completion of the ground investigation at the detailed design stage (following DCO). Where required, mitigation measures would be incorporated into the detailed design to reduce the risk to an acceptable level.

6.3.19 Following the additional assessment to be undertaken at detailed design and subsequent mitigation measures if required, this activity is not anticipated to result

in any significant effects upon the quality elements of any groundwater bodies that would receive discharge from the road drainage system.

6.3.20 No impacts upon GWDTEs are anticipated as a result of this activity.

Accidental spillage of pollutants

6.3.21 Impacts resulting from accidental spills have been assessed in ES Appendix 13.6 Spillage Risk Assessment (Document Reference 6.4).

6.3.22 The assessment identified that, without consideration of the drainage scheme, there would be no discharge with a serious spillage risk more frequent than 1% and 0.5% annual exceedance probability (AEP) (1 in 100 year and 1 in 200-year return period) thresholds. The spillage risk is therefore acceptable, and no mitigation is required.

6.3.23 This activity is not anticipated to result in any significant effects upon the quality elements of any WFD waterbodies.

New culverts to maintain land drainage pathways

6.3.24 Impacts resulting from new culverts have been assessed in ES Appendix 13.5 Hydromorphology Assessment (Document Reference 6.4).

6.3.25 Three land drainage culverts are proposed as part of the scheme. These structures would all be maintaining flow pathways at headwaters during periods of overland flow and would not span permanent watercourses. Despite this, culverts have the potential to reduce habitat availability and connectivity and alter sediment transport through scour or deposition.

6.3.26 To mitigate the potential impact of culverts, the detailed design would follow CD 529 Design of outfall and culvert details[17].

6.3.27 Given the mitigation proposed, this activity is not anticipated to result in any significant effects upon the quality elements of any of the WFD surface waterbodies where culverts are proposed as part of the scheme.

New outfalls from the road drainage system

6.3.28 Impacts resulting from new culverts have been assessed in ES Appendix 13.5 Hydromorphology Assessment (Document Reference 6.4).

6.3.29 Twelve road drainage outfalls are proposed as part of the scheme. Outfalls have the potential to alter local channel cross section and induce local bank or bed erosion, as well as reduce the available natural bank habitat area.

6.3.30 To mitigate the potential impact of outfalls, the detailed design would follow CD 529 Design of outfall and culvert details.

6.3.31 Given the mitigation proposed, this activity is not anticipated to result in any significant effects upon the quality elements of any of the WFD surface waterbodies where outfalls are proposed as part of the scheme.

Realignment of the tributary of Normans Brook

6.3.32 Impacts resulting from realignment of the tributary of Normans Brook have been assessed in ES Appendix 13.5 Hydromorphology Assessment (Document

Reference 6.4). Further information of the design of the realignment is presented in ES Appendix 13.10 Drainage Report (Document Reference 6.4)

6.3.33 The widening of the A417 and its embankment through Crickley Hill requires the watercourse to be realigned southwards along the toe of the widened embankment. The uppermost 320m of the watercourse would be culverted to accommodate a new access road and road drainage basin.

6.3.34 As the widened road embankment would take up a greater proportion of the valley, the bed of the realigned watercourse would be perched approximately 2m above the existing riverbed level.

6.3.35 The realignment of the watercourse would impact upon hydromorphological supporting elements, with subsequent effects upon biological quality elements (e.g. fish invertebrates, macrophytes), of the Normans Brook – source to confluence Hatherley Brook waterbody.

6.3.36 The following design principles would be implemented during the detailed design of the scheme to mitigate the effects of the realignment upon WFD quality elements:

- the detailed design of the realigned watercourse would provide naturalistic features of an equivalent or greater value to that of the existing watercourse
- the channel design would incorporate bioengineering techniques over traditional hard engineering where feasible
- the flow regime of the realigned watercourse would be as similar as the existing flow regime as practicable
- the detailed design should be overseen by an experienced fluvial geomorphologist

6.3.37 Tufa habitat surveys have been carried out to establish whether the deposits that would be lost support protected habitats or species. Potential tufa spring mitigation sites have been identified (ES Appendix 8.25 Tufa-forming springs: selection of potential compensation sites (Document Reference 6.4)) and will be developed further during detailed design.

6.3.38 Given the mitigation proposed, this activity is not anticipated to result in any significant effects upon the quality elements of any of the WFD surface waterbodies where outfalls are proposed as part of the scheme.

7 Identification and evaluation of measures

RMBP objectives

7.1.1 The study area is located across the Severn and Thames RBDs and therefore the objectives from both the Severn RBMP and Thames RBMP are relevant to the scheme.

7.1.2 The river basin districts seek to comply with the objectives of the WFD. Common measures, and standards to help achieve the WFD objectives detailed within the Severn and Thames RBMPs are listed.

7.1.3 To prevent deterioration of the status of surface waters and groundwater, measures to support include:

- controlling new physical modifications
- managing pollution from wastewater

- managing pollution from towns, cities and transport
- changes to natural flow and levels of water
- managing invasive non-native species
- managing pollution from rural areas
- managing pollution from mine waters

8 Conclusions

8.1.1 It is considered that the activities related to the scheme will not cause deterioration in the status of any WFD waterbodies or prevent them from achieving either 'Good Ecological Status' or 'Good Ecological Potential' by 2021 or 2027, provided that the mitigations measured described in Section 6 are implemented. The delivery of this mitigation is secured by its inclusion within the EMP (ES Appendix 2.1 EMP (Document Reference 6.4)).

8.1.2 This assessment has been based on currently available WFD baseline data and design information for the scheme. The assessment is considered a 'live' document and should be reviewed and updated at detailed design and construction, particularly if:

- the EA update or provide additional WFD baseline data for the relevant waterbodies; and/or
- significant changes to the nature, alignment, scale or construction methods of the scheme are made.

8.1.3 Any future updates to the assessment should be shared and agreed with the EA as the regulatory authority in England.

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