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OXFORDSHIRE
STRATEGIC RAIL FREIGHT INTERCHANGE

DCO Submission

Environmental Statement

Chapter 9: Water Environment
Appendix 9.5: Water Framework Directive Assessment

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On behalf of
Oxfordshire Railfreight Limited

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BWB Consulting Limited

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Water Framework Directive (WFD) Assessment

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Contents

1. Introduction 5

1.1 Background 5

1.2 Legislative Context 5

1.3 Report structure 6

1.4 Project overview 6

2. WFD Waterbody Screening 8

3. Waterbody status 10

3.1 Definition of surface waterbody status 10

3.2 Relevant waterbody status 12

4. WFD assessment methodology 16

4.1 Introduction 16

4.2 No Deterioration Assessment 16

4.3 Future Status Objectives 17

5. Water Framework Directive Assessment 18

5.1 General Approach 18

5.2 Project Characteristics 18

5.3 No Deterioration Assessment 19

5.4 Future Good Status 27

6. Conclusions 29

7. References 30

Appendix 1 Landscape Masterplan 31

1. Introduction

1.1 Background

BWB Consulting have commissioned APEM to undertake a Water Framework Directive (WFD) assessment to assess any potential impacts the Oxfordshire Strategic Rail Freight Interchange (OxSRFI) project may have on the WFD waterbodies with potential connectivity to the Site. The development comprises a Strategic Rail Freight Interchange together with landscaping, access and other supporting infrastructure works.

1.2 Legislative Context

The EU Water Framework Directive (Directive 2000/60/EC) establishes a framework for the protection of inland surface waters, transitional waters, coastal waters, and groundwater. It aims to prevent and reduce pollution, promote sustainable water use, protect and improve the aquatic environment and mitigate the effects of floods and droughts. The overall objective is to achieve good environmental status for all waters.

The WFD is fully transposed into UK law via several mechanisms, principally:

- The Water Environment (WFD) (England and Wales) Regulations, (2003, 2015 & 2017); and
- The Environmental Permitting (England and Wales) (Amendment) Regulations, 2010 onwards.

The WFD thus remains in place post Brexit.

Under the WFD, 'water bodies' are the basic management units and are defined as all or part of a river system or aquifer, as part of the following framework (with examples relevant to this study):

- 'Water bodies' e.g. Langford Brook (Bicester to Ray including Gagle Brook) Water Body;
- 'Operational Catchments' e.g. Oxon Ray Operational Catchment;
- 'Management Catchment' e.g. Cherwell and Ray Management Catchment;
- 'River Basin Districts' (RBD) e.g. Thames River Basin District.

'River Basin Management Plans' (RBMPs) are developed at the RBD scale and environmental objectives are set. RBMPs are produced every six years, in accordance with the river basin management planning cycle. Summary documents for the second cycle of plans (including the Humber RBMP) were published by the Environment Agency in December 2015 (https://www.gov.uk/government/collections/river-basin-management-plans-2015), whilst the latest interim water body classification was published in 2019 via the Catchment Data Explorer website (https://environment.data.gov.uk/catchment-planning/) (Environment Agency, 2022a).

The UK classifies the current condition as 'status or potential' of surface and groundwater bodies and sets a series of objectives for maintaining or improving conditions so that water bodies maintain or reach 'good status or potential' during the next river basin management planning cycle. The Environment Agency is the competent authority for implementing the WFD in England. As part of its role, the Environment Agency must consider whether proposals for new schemes/developments have the potential to:

- Cause a deterioration of a water body from its current status or potential; and/ or
- Prevent future attainment of good status or potential where not already achieved.

As a result, new developments that have the potential to impact on current or predicted WFD status are required to assess their compliance against the WFD objectives of the potentially affected water bodies. Schemes designed by, linked to, or funded by the Environment Agency themselves are assessed against the same framework i.e. are not exempt from WFD assessment.

1.3 Report structure

This WFD compliance assessment report is laid out as follows:

- Section 1.4 of this report provides a high-level overview of the Project;
- Section 2 provides a summary of the WFD screening process;
- Section 3 provides information on the current WFD status of water bodies that have the potential to be impacted by the Project
- Section 4 describes the no deterioration assessment methodology;
- Section 5 presents the WFD compliance assessment discussions (supported by tables in the Appendices); and
- Section 6 sets out the assessment conclusions.

1.4 Project overview

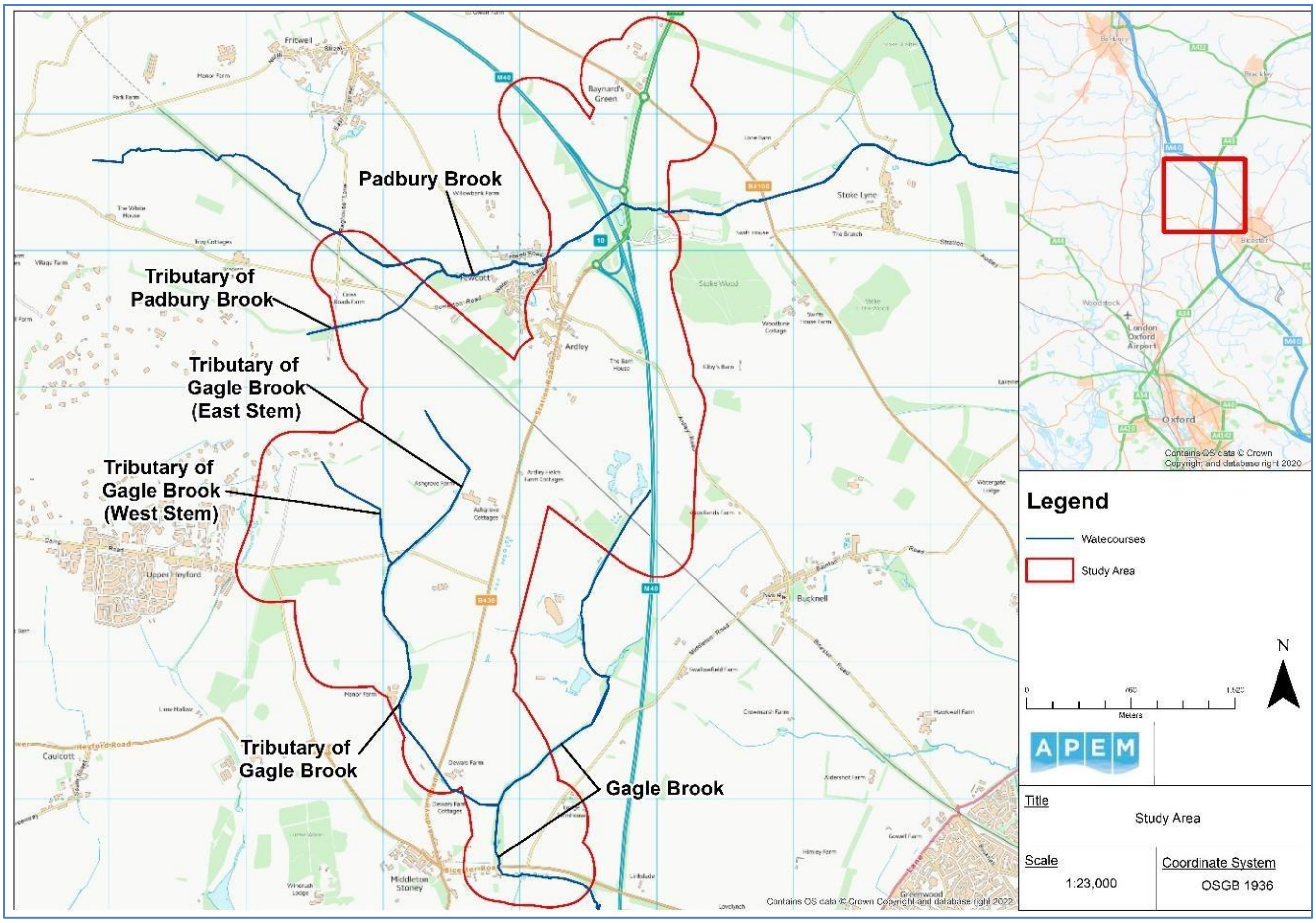
Oxfordshire Railfreight Limited is proposing a Strategic Rail Freight Interchange (SRFI) on land east of the former Upper Heyford Air Base, south of the Chiltern railway line, and southwest of Junction 10 of the M40 motorway. The emerging proposals respond to the recognised need to create a network of Strategic Rail Freight Interchanges throughout the country.

The development comprises a Strategic Rail Freight Interchange together with landscaping, access and other supporting infrastructure works. Given its strategic importance, the proposals meet the criteria to be considered a Nationally Significant Infrastructure Project (NSIP). As such, the proposals will be subject to an application for a Development Consent Order (DCO) which will be submitted for examination by the Planning Inspectorate who will process the application.

The study area consists of a 250m buffer from the development red line boundary. This is considered an appropriate distance to capture the potential impacts of the scheme on the physical properties of the water environment. The study area and name of watercourses referred to in this note are provided in Figure 1a below.

A WFD assessment is required to understand if the projects proposals will have any impacts on the WFD status of the water bodies within and surrounding the site.

Figure 1a Study area and watercourse names



2. WFD Waterbody Screening

Review of the Environment Agency's Catchment Data Explorer website identified two WFD surface water bodies in proximity to the Project site i.e. within a 1 km buffer set around the Project Site, as shown in Table 1.

Table 1 WFD Waterbodies Within c.1 km of the Project Site

Waterbody type	Waterbody Name (ID)	Location	Included in subsequent assessment	Justification
Surface waterbodies				
HMWB River	Padbury Brook (GB105033038210)	Flows through the northern boundary of the site.	Yes	Tributaries of this water body intersect the site to the north
River	Langford Brook (Bicester to Ray including Gagle Brook) (GB106039030140)	Intersects the site at its southern boundary	Yes	Water body intersects the site directly.

Table notes: HMWB = 'Heavily Modified Water Bodies' (artificial and man-made water bodies, such as canals, or natural water bodies that have undergone significant modification are termed Heavily Modified Water Bodies).

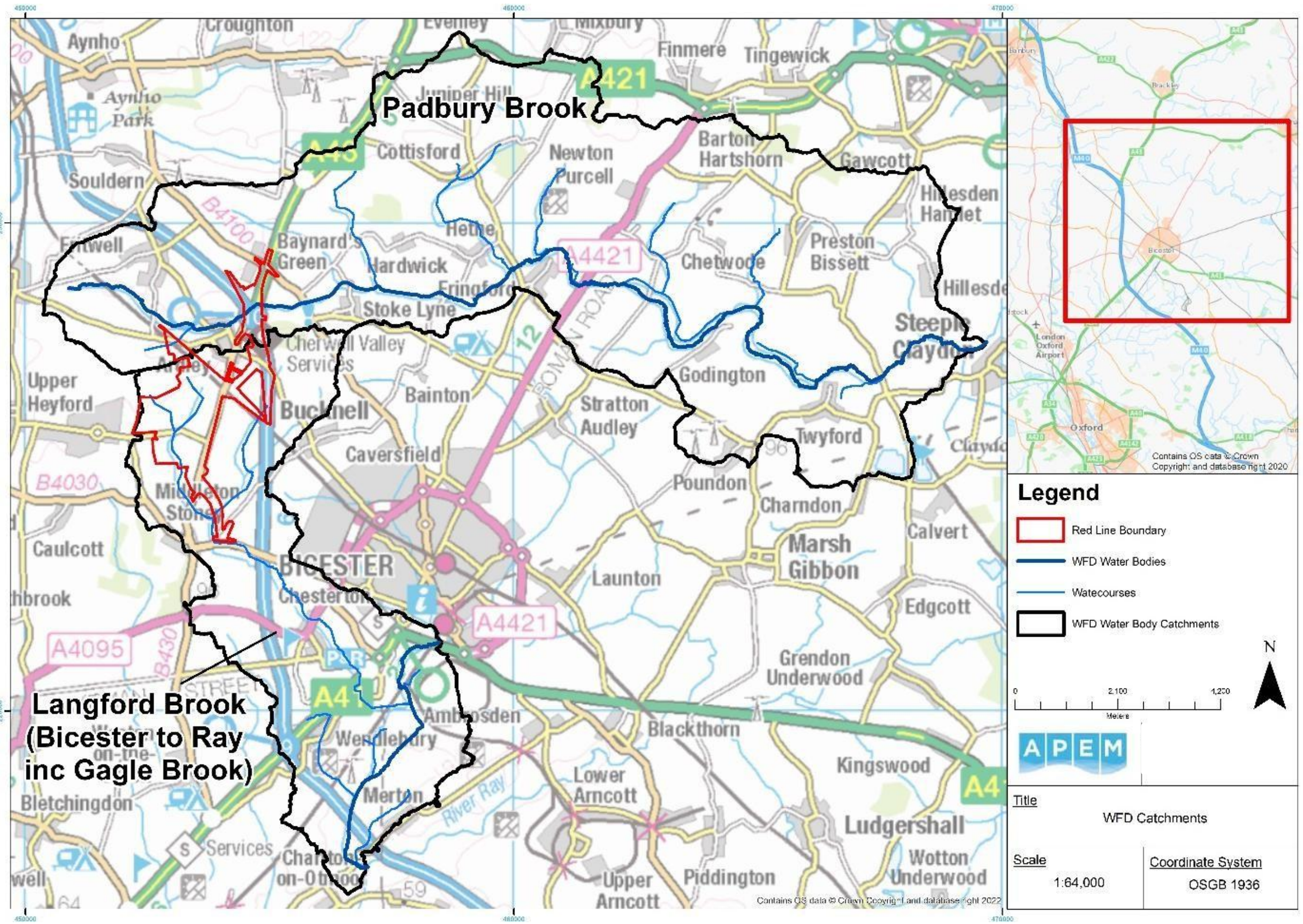


Figure 1b WFD waterbodies in vicinity of the Project site

3. Waterbody status

3.1 Definition of surface waterbody status

Under the WFD, surface water body status is classified on the basis of ecological and chemical status or potential. Ecological status is assigned to surface water bodies that are natural and considered by the Environment Agency not to have been significantly modified for anthropogenic purposes. Ecological potential is assigned to artificial and man-made water bodies (such as canals), or natural water bodies that have undergone significant modification; these are termed Heavily Modified Water Bodies (HMWBs). The term 'ecological potential' is used as it may be impossible to achieve good ecological status because of modification for a specific use, such as navigation or flood protection. The ecological potential represents the degree to which the quality of the water body approaches the maximum it could achieve. The worst-case classification is assigned as the overall surface water body status, in a 'one-out all-out' system. This system is summarised below in Figure 2.

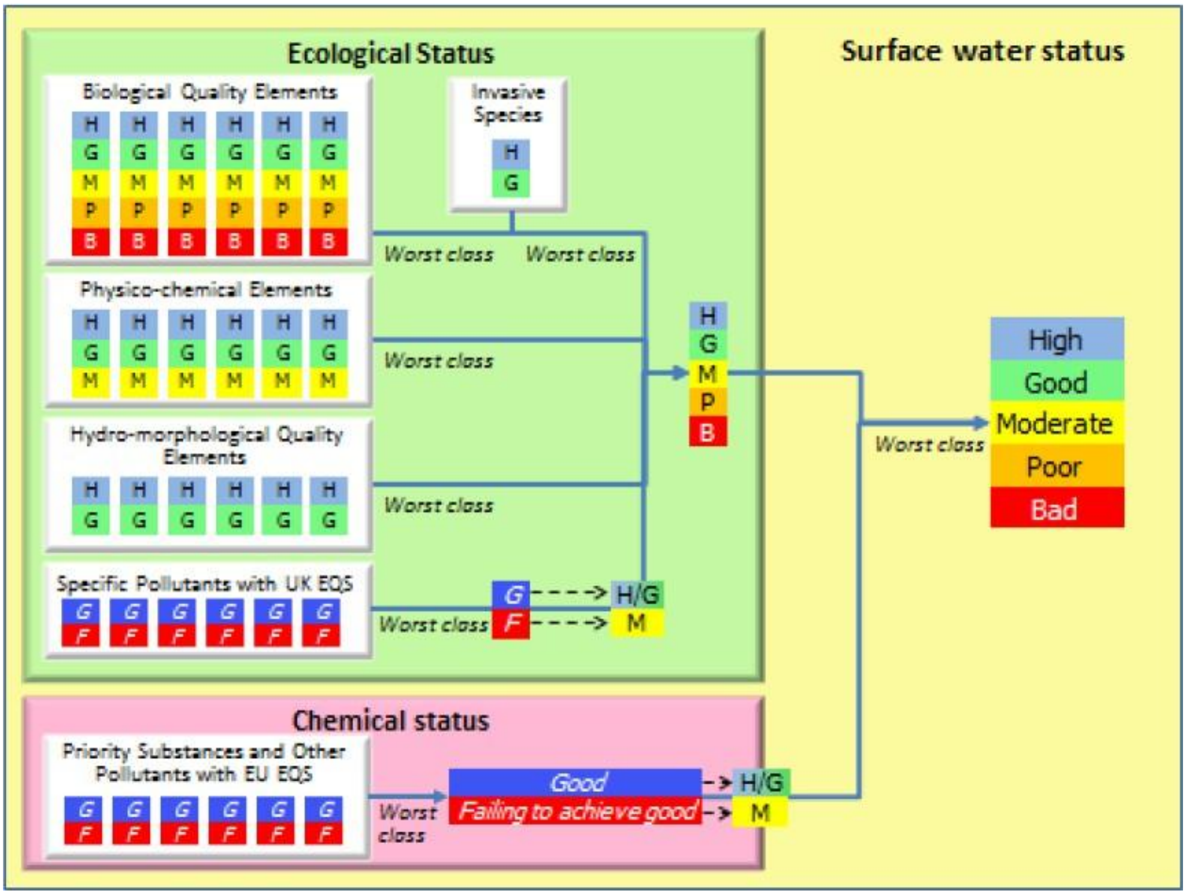


Figure 2 WFD classification elements – Bringing all of the strands of evidence together (Environment Agency, 2015)

3.1.1 Ecological status or potential

Ecological status or potential is defined by the overall health or condition of the water body. This is assigned on a scale of High, Good, Moderate, Poor, or Bad, and based on four ecological classification components (e.g. Environment Agency, 2022a), as follows:

- Biological: This test is designed to assess the status indicated by biological quality elements such as the abundance of fish, invertebrates, or algae and by the presence of invasive species. The biological quality elements can influence an overall water body status from Bad through to High.
- Physico-chemical: This test is designed to assess compliance with environmental standards for supporting physicochemical conditions, such as dissolved oxygen (DO), phosphorus, and ammonia. The physicochemical elements can only influence an overall water body status from Moderate through to High.
- Specific pollutants: This test is designed to assess compliance with environmental standards for concentrations of specific pollutants, such as zinc, cypermethrin or arsenic. As with the physico-chemical test, the specific pollutant assessment can only influence an overall water body status from Moderate through to High.
- Hydromorphology: For natural, non-HMWBs, this test is undertaken when the biological and physico- chemical tests indicate that a water body may be of High status. It specifically assesses elements such as water flow, sediment composition and movement, continuity, and structure of the habitat against reference or 'largely undisturbed' conditions. If the hydromorphological elements do not support High status, then the status of the water body is limited to Good overall status. For artificial or HMWBs, hydromorphological elements are assessed initially to determine which of the biological and physico-chemical elements should be used in the classification of ecological potential. In all cases, assessment of baseline hydromorphological conditions are an important factor in determining possible reasons for classifying biological and physico-chemical elements of a water body as less than Good, and hence in determining what mitigation measures may be required to address these failing water bodies. Section 3.1.1.1 below provides further discussion of Artificial and Heavily Modified Water Bodies

3.1.1.1 Additional AWB and HMWB hydromorphology considerations

Artificial Water Body (AWB) and Heavily Modified Water Body (HMWB) hydromorphological elements are assessed using a three-stage process, firstly looking at flow, then mitigation measures and biological quality elements.

Flow conditions are assessed initially on a pass or fail basis to determine which of the biological and physico-chemical quality elements should be used in the classification of ecological potential.

Where the flow conditions are unaffected by the physical modification (flow conditions pass), the water body potential is determined by the worst of either the mitigation measures assessment, or any element that is not sensitive to the modified nature of the water body.

Where the flow conditions are significantly impacted by the physical modification (flow conditions fail), the water body potential is determined by the worst of any of the Mitigation Measures assessments or the assessment of biological quality elements, physico-chemical quality elements or specific pollutants.

Note that dissolved oxygen assessments are made for canal water (monitoring and reporting against status thresholds), however, the results are not used as part of the water body classification (one-out-all-out).

3.1.2 Chemical status

Chemical status is a further classification component defined by compliance with environmental standards for chemicals that are priority substances and/or priority hazardous substances, in accordance with e.g. the Environmental Quality Standards Directive (2008/105/EC). This is assigned on a scale of Good or Fail only. Surface water bodies were historically only monitored for priority substances where there were known discharges of these pollutants; otherwise surface water bodies were reported as being at good chemical status. In recent years the expansion of the number of chemicals assessed, to include parameters such as Polybrominated diphenyl ethers (PBDE) has resulted in an increased number of water bodies failing to meet Good Chemical status.

3.2 Relevant waterbody status

There are two waterbodies to be considered in this WFD assessment (remaining following initial screening): Langford Brook (Bicester to Ray including Gagle Brook) (GB106039030140) and Padbury Brook (GB105033038210).

3.2.1 Padbury Brook (GB105033038210)

To the north of the site, a tributary of the Padbury Brook flows eastwards. A number of drainage ditches and small ponds are also present within the Site and across the Study Area as a whole. These discharge to the Gagle Brook.

Beyond the limits of the Site, the area crossed by the J10 Highway Improvements comprises the Padbury Brook catchment. The Padbury Brook ultimately discharges to the River Great Ouse, downstream of the Proposed Development and lies within the Anglian River Basin District.

The latest Padbury Brook waterbody characterisation information was taken from the Environment Agency’s Catchment Data Explorer website (Environment Agency, 2022a). The Cycle 2 and 3 classification data are provided in Table 2.

A hydro morphological survey was undertaken in December 2022 of Padbury Brook within the Red Line Boundary to capture the hydromorphological characteristics of the watercourse in more detail (Appendix 2).

Table 2 Padbury Brook Cycle 2 classifications

Parameter		2019	2022
Waterbody ID	GB105033038210		
Waterbody length	26.285 km		
Waterbody type	HMWB		
Overall Waterbody		**Moderate**	**Moderate**
Ecological, chemical or quantitative status	**Ecological**	**Moderate**	**Moderate**
Ecological, chemical or quantitative status	**Chemical**	**Fail**	**Does not require assessment**
Component	**Priority substances**	**Good**	**Does not require assessment**
Component	**Priority hazardous substances**	**Fail**	**Does not require assessment**
Ecological supporting elements	Mitigation Measures Assessment	**Good**	**Good**
Biological quality elements	Fish	**/**	**/**
	Invertebrates	**Good**	**Good**
Physico-chemical quality elements	Ammonia (Phys-Chem)	**High**	**High**
	Dissolved oxygen	**High**	**High**
	pH	**High**	**High**
	Phosphate	**Moderate**	**Moderate**
	Temperature	**High**	**High**
Hydromorphological Supporting Elements	Hydrological Regime	**Supports good**	**Supports good**
Priority Hazardous Substances (subset of)	Polybrominated diphenyl ethers (PBDE)	**Fail**	**Fail**
	Benzo(a)pyrene	**Good**	**/**
	Dioxins and dioxin-like compounds	**Good**	**/**
	Heptachlor and cis-Heptachlor epoxide	**Good**	**/**
	Hexachlorobenzene	**Good**	**/**
	Hexachlorobutadiene	**Good**	**/**
	Mercury and Its Compounds	**Good**	**/**

3.2.2 Langford Brook (Bicester to Ray including Gagle Brook) (GB106039030140)

The Site comprises a tributary of the Gagle Brook, (known for the purposes of this assessment as the Ashgrove Brook) formed of two channels in the north-western portion of the Site close to the boundary with the Upper Heyford Airfield.

The majority of the Site, the Middleton Stoney Relief Road, the Ardley Bypass, and the Heyford Park Link are located within the Gagle Brook catchment. The Ashgrove Brook flows in a generally southerly direction through the Site and discharges to the Gagle Brook to the north-east of Middleton Stoney. Drainage from the Upper Heyford Airfield outfalls into the upper reaches of the Ashgrove Brook, on the Site.

The latest Langford Brook (Bicester to Ray including Gagle Brook waterbody characterisation information was taken from the Environment Agency's Catchment Data Explorer website (Environment Agency, 2022a). The Cycle 2 and 3 classification data are provided in Table 3.

A hydro morphological survey was undertaken in December 2022 of Langford Brook (Bicester to Ray including Gagle Brook) within the Red Line Boundary to capture the hydromorphological characteristics of the watercourse in more detail (Appendix 2).

Table 3 Langford Brook (Bicester to Ray including Gagle Brook) classifications

Parameter		2019	2022
Waterbody ID	GB106039030140		
Waterbody length	6.585 km		
Waterbody type	River (not designated artificial or heavily modified)		
Overall Waterbody Status		**Poor**	**Poor**
Ecological, chemical or quantitative status	**Ecological**	**Poor**	**Poor**
Ecological, chemical or quantitative status	**Chemical**	**Fail**	**Does not require assessment**
Component	**Priority substances**	**Good**	**Does not require assessment**
Component	**Priority hazardous substances**	**Fail**	**Does not require assessment**
Ecological supporting elements	Mitigation Measures Assessment	**NA**	**NA**
Biological quality elements	Fish	**High**	**High**
	Invertebrates	**Good**	**Good**
Physico-chemical quality elements	Ammonia (Phys-Chem)	**High**	**High**
	Dissolved oxygen	**Moderate**	**Moderate**
	pH	**High**	**High**
	Phosphate	**Poor**	**Poor**
	Temperature	**High**	**High**
Hydromorphological Supporting Elements	Hydrological Regime	**Supports good**	**Supports good**
Priority Hazardous Substances (subset of)	Polybrominated diphenyl ethers (PBDE)	**Fail**	**/**
	Benzo(a)pyrene	**Good**	**/**
	Dioxins and dioxin-like compounds	**Good**	**/**
	Heptachlor and cis-Heptachlor epoxide	**Good**	**/**
	Hexachlorobenzene	**Good**	**/**

Parameter		2019	2022
	Hexachlorobutadiene	Good	/
	Mercury and Its Compounds	Fail	/

4. WFD assessment methodology

4.1 Introduction

Proposed developments and schemes that have the potential to affect a WFD water body should undertake a WFD assessment to demonstrate that proposals will not result in a deterioration in status (or potential) or prevent the water body from meeting Good status (or potential) in the future (2027). Specifically, the Environment Agency (as the statutory regulator) must consider whether proposals for new developments and schemes have the potential to:

- Cause a deterioration of a water body from its current status or potential (see Section 4.2 No Deterioration Assessment); and/ or
- Prevent future attainment of Good status, or potential where not already achieved (Section 4.3 Future Status Objectives).

Environment Agency led schemes are subject to the same level of scrutiny as other schemes. If the tests above cannot be satisfied, Article 4.7 of the Directive sets out conditions and specific situations that permit derogations.

4.2 No Deterioration Assessment

The definition of WFD Deterioration was clarified following a ruling by the Court of Justice of the European Union (CJEU) in July 2015 (C-461/13):

- "deterioration of the status" of the relevant water body includes a fall by one class of any element of the "quality elements" even if the fall does not result in a fall of the classification of the water body as a whole;
- 'Any deterioration' in quality elements in the lowest class constitutes deterioration; and
- Certainty regarding a project's compliance with the Directive is required at the planning consent stage; hence, where deterioration 'may' be caused, derogations under Article 4.7 of the WFD are required at this stage.

While deterioration within a status class does not contravene the requirements of the WFD, (except for Drinking Water Directive parameters in drinking water protected areas), the WFD requires that action should be taken to limit within-class deterioration as far as practicable. The no deterioration baseline for each water body assessment is taken to be the 2019 status as reported in Section 3.2.

The principle of this assessment is to assess the potential for impact on, and therefore deterioration to, each of the (relevant) WFD supporting elements. Where a potential for impact is identified, the scale of change is considered in the context of the relevant environmental standards for the baseline classification band i.e. if a baseline supporting element is at Good, any potential impact to that supporting element would be characterised in the context of the Good/Moderate classification boundary standard.

4.3 Future Status Objectives

RBMPs are used to outline water body pressures and the actions that are required to address them. The future status objective assessment considers the ability of the development to contribute to WFD objectives for the water body. Assessments in this project will be based on the mitigation measures assessments, future objectives, and programme of measures set out within the Environment Agency’s Catchment Data Explorer website for each water body.

The assessment considers whether the Project has the potential to further exacerbate known pressures (Tier 1 pressures e.g. Physical Modification due to Flood Protection) or the ability for the water body to achieve the current aspiration dates to achieve Good.

5. Water Framework Directive Assessment

5.1 General Approach

The WFD assessment assesses the effects of the Project (masterplan provided in Appendix 1) on each of the relevant WFD elements (Table 3). Although not all strictly relevant to this assessment location, to ensure full compliance with EA's risk assessment guidance, the following receptors are also used as assessment criteria:

- **"physical habitat** – the distribution and diversity of habitat including the physical processes that sustain and create new habitat. Physical habitat is essential for fish, macrophytes and invertebrates to live and thrive
- **water quality** – particularly physico-chemical aspects of water quality - such as levels of dissolved oxygen, phosphorus, and ammonia
- **fish and eels**
- **macrophytes** - water plants visible to the naked eye, growing in the river
- **invertebrates** - insects, worms, molluscs, crustacea etc living on the river bed
- **diatoms** - microscopic diatoms (algae) found on rocks and plants"

The WFD assessment reports on the following considerations:

- identification of the likely impacts of the Project on individual WFD receptors;
- estimate of the magnitude of those impacts;
- estimate of the probability of those impacts occurring;
- identification of the residual risk once any action has been undertaken to avoid the risk, minimise it, mitigate it or compensate for it within the waterbody (if required);
- evaluation of the significance of the risk (where relevant) with reference to the RBMP status thresholds and objectives.

5.2 Project Characteristics

Key Project characteristics and assumptions relevant to this assessment are as follows:

- **Ground works**: The scheme requires significant earthworks which will inevitably increase the risk of pollution to the surface water system.
- **Dewatering**: Not applicable to the Project.
- **Surface Water Run-Off**: Surface water run off may enter the surrounding water bodies during construction. Rainfall with unstable ground can also potentially run into the water courses.

- **Foul Drainage**: There will be increased pressure on the local foul water network due to the temporary presence of construction workers and associated welfare facilities[1].
- **Other discharges**: Assumed no operational phase discharges of any type (e.g. chemical discharges, temperature discharges).
- **Screening**: Not applicable to the Project.
- **Dredging**: Not applicable to the Project.

5.3 No Deterioration Assessment

5.3.1 Construction Phase

Padbury Brook

Impacts on surface water quality

There are a number of pathways in which the water quality of the Padbury Brook (see Table 2) could be impacted during the construction phase. The Project involves demolition of existing buildings and structures (including farmstead buildings and Severn Trent Green Power IVC facility), and new earthworks to create development plateau to accommodate new development, drainage attenuation features, and extensive perimeter earthworks bunding which will form part of the screening (landscape and visual mitigation) of the Proposed Development.

Construction activities can lead to the pollution of receiving waters, impacting the water quality supporting elements of the Padbury Brook (see Table 2). Activities that might generate effects include the demolition of existing structures, earth stripping, stockpiling, excavation, construction plant movements and hauls, refuelling, equipment maintenance, storage of materials and chemicals and the generation, storage and disposal of waste materials.

The uncontrolled release of substances such as solvents, cleaning agents, paints and other chemicals, liquids or solids could lead to further pollution of the receiving waterbodies. These could become a hazard if used in the construction process or stored on Site. These substances can be of high toxicity thereby have a negative effect on the Gagle and Padbury Brooks prior to mitigation.

The risk of sediment reaching the watercourses and of leakage or spillage of fuel, chemicals and other potentially polluting substances would be mitigated through good site practice and management, implemented in line with a Construction Environmental Management Plan

[1] The Project has established a foul water connection point at Middleton Stoney Road, Bicester and confirmed they will not undertake modelling to confirm what mitigation may be required until the DCO is granted.

(CEMP). The contractor would be required to plan and execute their work to ensure that hazardous or polluting substances do not cause harm to underlying aquifers, surface water systems, landscaping and associated ecology.

In addition, at the commencement of any component of earthworks, the necessary permanent drainage basins for that component would need to be constructed and outfalls into the existing watercourses provided, in accordance with the drainage strategy contained in the Environmental Statement. No works within an ordinary watercourse or within the by-law protected strip either side would commence until approval has been granted, by the lead local flood authority.

Environment Agency Guidance for Pollution Prevention (GPPs) should be adhered to at all times to reduce the chance of chemical spills and other pollution events impacting Padbury Brook. Relevant spill kits would be kept on Site for the rapid treatment of any spillages, with staff trained in their use present at all times when work is underway. Exclusion fencing will be established along the routes of watercourses and particular care taken in terms of movement of machinery and storage of materials in proximity to these features.

Thus, although there is potential minor impacts on water quality during construction, it is not anticipated that the Project will impact the water quality supporting elements of Padbury Brook (see Table 3) due to the mitigation measures set out in the CEMP that the Project will adopt.

Impacts on ecology

Impacts on ecology could come from a number of pathways, including allowing increased sediment load to enter the watercourse, pollution through spillages of oil or chemicals, the spread of invasive species and harm to local wildlife from construction noise of entrapment.

An increase in suspended sediments from construction activities can have a range of effects, e.g.:

- suspended sediment increases could adversely affect water quality which could indirectly impact fish and could (over time) result in shifts to turbidity-tolerant fish communities;
- If sediment were to be released it could smother out spawning grounds affecting preferred breeding habitat and impact on breeding;
- deposition of fine sediment is a key issue for aquatic vegetation due to reduced light availability for attached aquatic plants effecting photosynthesis and reducing biomass of algae communities and macrophytes through direct smothering of existing plants;
- Increases in suspended sediments can result in increased invertebrate drift, significantly altering the distribution of benthic invertebrates in streams and rivers which can have an overall impact on the food web and health of a river.

It is noted that the proposed construction activities are short duration (any effects would be temporary) and localised, and no significant impacts on the river's ecology are anticipated. Mitigation should nonetheless be adhered to (as above) to minimise the potential for any impact generation during the construction phase (and thus remove any potential for ecological impact on Padbury Brook and WFD supporting element deterioration).

Impacts on Hydromorphology

During construction, the primary risk to hydromorphology is sediment entering the watercourse. This can affect riverbed substrate at the point of entry and downstream, with impacts greatest near the source and diminishing with dilution and dispersion further downstream. These effects are likely temporary, as high flows typically "clean" accumulated sediment from the substrate; however, impacts could be significant before mitigation.

One pathway for sediment input is uncontrolled overland flow or sediment-laden water discharged from drainage networks and excavations. Mitigation should follow measures outlined for water quality impacts, including good site practice, silt management through the CEMP, creation of drainage basins and exclusion fencing, and adherence to EA GPPs.

Another pathway occurs where excavations, groundworks, or construction take place in or adjacent to the river, such as for bridges and culverts. In-stream silt management should be implemented to prevent downstream dispersion. These measures must be maintained and cleared of silt regularly and at the end of construction before removal, to avoid sediment release caused by poor maintenance or removal without prior cleaning.

Additional impacts may arise from discharging site water via outfalls, which can cause local erosion of the riverbed and banks. Outfalls from temporary drainage networks should, where feasible, be oriented downstream with appropriate protection, and discharge rates controlled to minimize erosion. Where flow control alone is insufficient, supplementary measures such as temporary aprons, flow dispersion techniques, or stilling areas should be used.

Langford Brook (Bicester to Ray including Gagle Brook)

Impacts on surface water quality

As discussed above for the Padbury Brook, there are a number of pathways in which the water quality and ecological supporting elements of the of the Langford Brook (see Table 3) could be impacted during the construction phase. These are discussed in detail above and relate to the Langford Brook also.

Realignment of two limbs of the upper reaches of the Ashgrove Brook are proposed as part of the Project; these two limbs receive flow from the airfield. By realigning the upper reaches around and within the Proposed Development, it will maintain this flow route whilst mitigating against flood risk as well as avoiding the need for culverting.

The realignment works could however result in sediment and pollution run off, potentially causing a deterioration in chemical status. Earthworks associated with the realignment works could increase sediment runoff, turbidity, and nutrient loading, especially if not well controlled.

Additionally, if the realignment disturbs previously undisturbed soils or sediment from the airfield, it could release contaminants into the watercourse.

To mitigate these potential impacts, measures within the CEMP and GPPs should be adhered to (as discussed above) to minimise sediment and pollutants entering the watercourse during the realignment works. Periods of high rainfall should be avoided to reduce the risk of sedimentation.

Thus, although there is potential minor impacts on water quality during construction, it is not anticipated that the Project will impact the water quality supporting elements of the Langford Brook (Bicester to Ray including Gagle Brook) (see Table 3) waterbody due to the mitigation measures that the Project should adopt (as discussed above).

Impacts on ecology

As discussed above for the Padbury Brook, there are a number of pathways in which the ecological supporting elements of the of the Langford Brook (see Table 3) could be impacted during the construction phase. These are discussed in detail above and relate to the Langford Brook also.

It is noted that the proposed construction activities are short duration (any effects would be temporary) and localised, and no significant impacts on the river's ecology are anticipated. Mitigation should nonetheless be adhered to (as above) to minimise the potential for any impact generation during the construction phase (and thus remove any potential for ecological impact on Langford Brook and WFD supporting element deterioration).

Impacts on Hydromorphology

As noted for Padbury Brook, several pathways could affect hydromorphology during construction, and these also apply to Langford Brook.

In addition, realignment works on both the east and west limbs of Ashgrove Brook may lead to sediment runoff from working adjacent to the river and direct sediment input from excavations. This could alter channel bed morphology, as described for Padbury Brook.

To mitigate these risks, measures set out in the CEMP and EA GPPs (as previously discussed) should be strictly followed to minimize sediment entering the watercourse during realignment works.

5.3.2 Operational Phase (both waterbodies)

The Project has the potential to introduce a significant area of impermeable surfaces onto a currently greenfield area. This has the potential to increase surface water runoff through reduced infiltration within the Site as well as increased discharge into receiving watercourses. However, the attenuation of flood water due to the Sustainable Drainage Systems (SuDS) measures included within the drainage design of the Site will reduce the volume of water entering the watercourses from the Site, Ardley Bypass, Heyford Park Link and the Middleton Stoney Relief Road during a flood event. The drainage design will also account for future increases in likely rainfall as a result of climate change.

Once in use, pollutants associated with run-off from the Site, Ardley Bypass, Heyford Park Link and the Middleton Stoney Relief Road have the potential to effect detrimentally upon the quality of water in the Gagle Brooks from direct runoff. Contamination in the operational phase is most likely to be caused by increased vehicle usage.

To mitigate this, the Proposed Development's facilities management team would be responsible for cleaning and maintenance of proposed oil interceptors which would mitigate against the potential effect of contaminated surface runoff entering the drainage system. A maintenance schedule for the proposed SuDS measures would also be prepared such that the effectiveness of the proposed stages of water quality treatment remains for the lifetime of the Proposed Development.

The creation of large impermeable areas will involve the following modifications to watercourses:

- Removal of approximately 600m of an artificial drainage channel forming the upper section of the eastern limb of Ashgrove Brook.
- Removal of approximately 30 m of an artificial drainage channel adjoining Ashgrove Brook about 35 m upstream of the confluence of its eastern and western limbs.
- Installation of four culverts/crossings along the eastern limb of Ashgrove Brook (approximately 9m, 32m, 52m, and 18m).
- Installation of two culverts/crossings on the newly realigned western limb of Ashgrove Brook (currently an artificial drainage channel), approximately 95m and 25m in length.
- A single carriageway crossing (approximately 75m) of Ashgrove Brook, located about 230m downstream of the confluence of its limbs.
- A single-track crossing (approximately 23m) of Ashgrove Brook, approximately 300m further downstream; and,
- A culvert crossing (approximately 12m) of Padbury Brook to accommodate a northbound slip road connecting the site to the M40.

The removal of the upper 600m of the eastern limb and the 300m artificial channel is expected to reduce flow and fine sediment delivery to Ashgrove Brook. However, as these channels are short, located at headwaters, convey minimal flow, contain mostly fine sediment, have limited transport capacity, and are heavily modified for agricultural drainage, the overall impact is unlikely to be significant.

Unmitigated, culvert and crossing structures could disrupt hydromorphological processes and habitat features by severing or impeding hydrological and geomorphological connectivity within affected reaches. To mitigate this, crossings should be designed in accordance with CIRIA and/or DMRB standards. Design features should include buried inverts, adequate channel width, and low-flow channels or baffles (where appropriate). Incorporating these measures will help maintain hydrological and geomorphological connectivity and enhance the morphological character of the watercourse through modified sections.

As discussed above, realignment of two limbs of the upper reaches of the Ashgrove Brook are proposed as part of the Project. By realigning the upper reaches around and within the Site, it will maintain this flow route whilst mitigating against flood risk.

However if the realignment simplifies the channel (e.g. straightening, loss of meanders), it could result in reduced habitat quality within these sections; though it is recognised that the eastern limb and sections of the western limb have been predominantly heavily modified or are artificial (for the purpose of drainage) and may be mostly of minor geomorphological or habitat value. Realignment design will require consideration of potential changes in flow velocity or direction which could impact sediment transport and deposition, potentially leading to erosion or siltation of the channels.

The design of the new realigned channels should, as far as possible, replicate the characteristics of the physical habitat in the present-day watercourses, i.e., prior to realignment. Where possible, habitat enhancement features should be considered for the realigned channels, which may include: comparable bed substrate and morphology (e.g., riffles and pools), channel dimensions and width/depth variation, sinuosity, vegetation within the riparian zone and, where permitting, inclusion of in-channel habitat features, e.g., large wood. Where possible, the realignment should aim to include features suited to the watercourse that may improve the physical habitat and enhance ecological connectivity when compared to the present day.

Hydraulic modelling was undertaken by BWB Consulting in partnership with the EA, to assess any potential effects of the scheme and inform the design of the Proposed Development to ensure the realignment of the upper reaches of Ashgrove Brook has no subsequent increase in risk both on Site and downstream.

There may be slight beneficial effects in the form of a reduced risk of flooding in more extreme events because of reduced rates of discharge from the Site into local watercourses and as a result of the drainage strategy; this will be later defined as the EIA process advances. There is also potential for a slight beneficial impact to water quality due to the change of use from agricultural which is currently a key issue preventing Padbury Brook catchment reaching Good WFD status.

Thus it is not anticipated that the Project will impact the overall WFD status of Padbury Brook (see Table 3) or Langford Brook (see Table 3) during the operation of the Project.

Table 6 Summary of mitigation measures to ensure WFD waterbody status does not deteriorate

Activity	Biological supporting elements				Hydro-morphological supporting elements		Physico-chemical supporting elements	Chemical		GW	
	Fish	Invertebrates	Macrophytes	Macrophytes and Phytobentos combined	Hydrological Regime	Morphology		Priority hazardous substances	Priority Substances	Quantitative status	Chemical Status
Potential Construction Phase Impact Pathways											
Generation of turbid or polluted runoff which could enter the water environment.	> All contractors would need to adopt water pollution prevention procedures in line with best practice, as set out in a project specific Construction Environmental Management Plan (CEMP). > Implementation of a drainage strategy. > Timing of works to avoid periods of heavy rain when the risk of fine sediment being transported from earth works and soil remediation is significantly increased. > Environment Agency Guidance for Pollution Prevention (GPPs) will be adhered to at all times in order to reduce the chance of chemical spills and other pollution events > Relevant spill kits will be kept on site for the rapid treatment of any spillages, with staff trained in their use present at all times when work is underway. > Exclusion fencing will be established along the routes of watercourses and particular care taken in terms of movement of machinery and storage of materials in proximity to these features. > Installation of in-stream sediment management techniques which are maintained > Best practice measures for the industry will be employed according to agreed standards to minimise adverse effects on the surrounding area through dust deposition. This will include wheel washes of construction vehicles and dust suppression techniques during periods of dry weather and/ or high winds						See measures for biological supporting elements which also apply here.			n/a	n/a
Earthworks including excavation, landforming, trenching and landscaping.	> All contractors would need to adopt water pollution prevention procedures in line with best practice, as set out in a project specific Construction Environmental Management Plan (CEMP). > Implementation of a drainage strategy. > Installation of in-stream sediment management techniques which are maintained > Timing of works to avoid periods of heavy rain when the risk of fine sediment being transported from earth works and soil remediation is significantly increased.										
Pollution or disruption of flow to groundwater through ground excavations or piling.	> Areas at risk of spillage, such as vehicle maintenance areas and hazardous substance stores (including fuel, oils and chemicals) will be bunded and carefully sited to minimise the risk of hazardous substances entering drainage systems or local watercourses. > Prior to construction a suitably qualified ECoW will be appointed by the contractor and will be responsible for overseeing enabling works and construction and the implementation of the CEMP. Once works are underway, the ECoW would work on Site providing ecological and pollution control advice and supervision for all relevant mitigation measures. > Application of best practice techniques of construction to ensure that drainage patterns and water quality within the study area are maintained. > Construction materials, fuels, and chemicals will be stored in impermeable containers on impermeable pads to prevent leaks and spills that could infiltrate into the groundwater. The CEMP also details the use of impermeable barriers and liners where necessary to prevent contaminated runoff from infiltrating the groundwater.										
Potential Operational Phase Impact Pathways											
Generation of turbid runoff associated with operational phase activities.	> SUDS measures will be implemented and adhered to in accordance with the principles of the SUDS Manual by CIRIA. Surface water will also be excluded from the foul drainage system to minimise the volume of drainage requiring treatment. > A drainage strategy would be developed that aims for post development runoff rates to replicate pre-development runoff rates so that there is no change in flood flows.						Operational practices will incorporate measures to prevent pollution including emergency spill response procedures.			n/a	n/a

Activity	Biological supporting elements				Hydro-morphological supporting elements		Physico-chemical supporting elements	Chemical		GW	
	Fish	Invertebrates	Macrophytes	Macrophytes and Phytobentos combined	Hydrological Regime	Morphology		Priority hazardous substances	Priority Substances	Quantitative status	Chemical Status
Changes to surface water drainage e.g. introduction/development of preferential flow pathways.	> An effective drainage strategy will be in place throughout operation to prevent adverse impacts from surface runoff on the WFD status of the waterbodies scoped into the assessment. > SUDS measures will be implemented and adhered to in accordance with the principles of the SUDS Manual by CIRIA. Surface water will also be excluded from the foul drainage system to minimise the volume of drainage requiring treatment. > Electrical, foul waste and servicing components will be integrated into a site wide infrastructure plan. > A drainage strategy would be developed that aims for post development runoff rates to replicate pre-development runoff rates so that there is no change in flood flows.									n/a	n/a
Changes to channel hydromorphology from realignments	> Realignment should replicate the characteristics of the physical habitat in the present-day watercourses, i.e., prior to realignment. > Where possible, habitat features should be considered for the realigned channels, which may include: comparable bed substrate and morphology (e.g., riffles and pools), channel dimensions and width/depth variation, sinuosity, vegetation within the riparian zone and, where permitting, inclusion of in-channel habitat features, e.g., large wood.							n/a		n/a	n/a
Changes to channel hydromorphology from culverting	> Culverts/Crossings to be designed according to relevant DMRB and CIRIA guidance – maintaining flow and sediment connectivity of the culverted watercourses, and allowing bed characteristics to reform across the culvert/crossing bed.							n/a		n/a	n/a

5.4 Future Good Status

5.4.1 Padbury Brook

The Reasons for Not Achieving Good (RNAG) for the Padbury Brook water body are the Moderate status of the Phosphate and Fail status of PBDE. The Moderate phosphate status has been put down to poor nutrient management and sewage discharge into the water body.

No process chemicals containing phosphate would be used during the Project however, runoff of silt and sediment into the watercourse may introduce additional phosphate load. As discussed, preventative measures would be important in ensuring that silt/sediment during construction works does not seep into the watercourse. If such an incident does occur, the water quality of Padbury Brook may be negatively impacted, which would have indirect impacts on biota. However, this is a short-term impact during the construction phase only, therefore long term impacts are not anticipated.

To prevent this, all contractors would need to adopt water pollution prevention procedures in line with good practice, as set out in the CEMP. The risk of sediment reaching the watercourses and of leakage or spillage of fuel, chemicals and other potentially polluting substances would be mitigated through good site practice and management, implemented in line with the CEMP. The contractor would be required to plan and execute their work to ensure that hazardous or polluting substances do not cause harm to the watercourses on site.

Based on the above information it is not considered that any of the aspects of the Project would prevent the WFD objectives from being achieved due to the preventative measures the Project will put in place.

5.4.2 Langford Brook (Bicester to Ray including Gagle Brook)

The RNAG for the Langford Brook (Bicester to Ray including Gagle Brook) is the Poor status of the Phosphate and Moderate status of DO and Mercury. The Poor phosphate status is due to poor nutrient management, while the Moderate DO status are down to sewage discharge into the water body.

No process chemicals containing phosphate or metals would be used during the Project however, runoff of silt and sediment into the watercourse may introduce additional phosphate load. The various construction activities may also result in sediments and pollutants entering the watercourses which can impact water quality, including DO.

As discussed above, measures (outlined in the CEMP) would be adhered to to ensure that hazardous or polluting substances do not cause harm to the water courses on site and Environment Agency GPPs would be followed to reduce the chance of chemical spills and other pollution events that may impact Langford Brook.

Based on the above information it is not considered that any of the aspects of the Project would prevent the WFD objectives from being achieved due to the preventative measures the Project will put in place.

6. Conclusions

The WFD assessment indicates that, based on the latest Project design, there is potential for only very minor localised effects on both Padbury Brook and Langford Brook (Bicester to Ray including Gagle Brook) water bodies. However, due to the mitigation measures to be put in place, during both the construction and operational phase of the Project, it has been assessed that it is unlikely that the Project will cause any WFD deterioration or change in water body status or prevent attainment, or potential to achieve, future good status.

The mitigation embedded within the design for the Proposed Development include but are not limited to, adherence to a Project specific CEMP, adherence to GPPs, implementation of a drainage strategy and realignment of the upper reaches of the Ashgrove Brook (the design of which incorporates natural features that support biodiversity).

No further assessment of WFD is recommended given that no significant deterioration or change in water body status is predicted.

7. References

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Appendix 1 Landscape Masterplan

Appendix 2 Geomorphology Desk Study and Site Walkover

1. Desk study

A high-level desk-based study has been carried out reviewing existing information for the study area. The following are key sources of data used for the desk study:

- Contemporary OS maps (DEFRA, 2023a);
- Current aerial photography (DEFRA, 2023a);
- Geology and soil maps (BGS, 2022; Cranfield Soils and Agrifood Institute, 2023); and,
- Historical maps (NLS, 2023).

1.1 Historical channel changes

Overall, there has been no significant change to the planform of all watercourses within the study area between earliest maps available (1888) and the present day (NLS, 2023). A concrete tank structure appears to have been constructed at the headwater of Tributrary of Gagle Brook (East Stem) at the same time as Upper Heyford Airbase. A large online pond was also created on the Tributary of Gagle Brook at Ashgrove Farm between 1965 and present day. The Tributary of Padbury Brook was culverted under the railway between 1888 and 1914 and the construction of the M40 and Junction 10 resulted in the straightening and culverting of Padbury Brook between in the late 80s/early 90's and the present day.

1.2 Soils and geology

Soils within the study area are generally described as freely draining, lime-rich loamy soils, creating herb-rich chalk and limestone pasture and lime-rich deciduous woodland habitat (Cranfield Soils and Agrifood Institute, 2023). These soils drain to the limestone groundwater and are described as being vulnerable to leaching of nitrate.

The Tributary of Gagle Brook (west stem) and Tributary of Padbury Brook has superficial head deposits, and the other watercourses (including the east stem, Tributary of Gagle Brook, Gagble Brook and Padbury Brook) have alluvial deposit, both consisting of clay, silt sand and gravel. Bedrock geology underlaying the Gagle Brook catchment and Padbury Brook is White Limestone Formation, while the Tributary of Padbury Brook runs over Mudstone (Rudland Formation) and Limestone (Forest Marble Formation) (BGS, 2023). The Gagle Brook and tributaries within the study area overlay part of the 'Tackley Jurassic' WFD groundwater body (EA, 2023).

2. Site survey

The geomorphological walkover of watercourses within the study area was undertaken on the 13th and 14th December 2022. Weather conditions during the survey were dry and cold, with snow which had fallen two days prior still present on the ground. The ground was predominantly frozen, making groundwater connectivity difficult to comment on.

The walkover characterised the current form and function of watercourses and identified key constraints (i.e. anthropogenic modifications) on natural functioning. The survey recorded:

- bed and bank erosion;
- in-channel and floodplain sediment deposits;
- extent and type of engineering modifications (e.g. bed and bank reinforcements, culverts, bridges, weirs, channel realignments);
- woody material;
- riparian vegetation structure and extent; and,
- macrophytes.

These features were recorded using a hand-held GPS and digitised using GIS. Photographs were taken of key features and at regular intervals throughout the survey to document channel characteristics. Key structures observed on site can be seen in Appendix A.

2.1 Tributary of Gagle Brook (west stem)

The upper extent of Gagle Brook (west stem) was dry at the time of survey. The channel here was straight, forming the border to arable agricultural fields, measuring approximately 1m side and 0.4m deep. The upper reaches of the channel were fenced on both banks and lined by a hedgerow on the right bank, however had limited vegetated riparian buffer on the left (Figure 2.1). Channel substrate here consisted of loam.

Longitudinal connectivity was impacted by a culvert under a farm access track and a grate crossing the channel which had resulted in an accumulation of organic material (largely leaf litter) and backing up of water upstream (Figure 2.2). An inlet structure with a timber headwall was also observed downstream of the grate (Figure 2.3), with all water in the channel diverted into the structure. The purpose of this inlet was not clear on site.

The watercourse re-emerges at SP 52963 26069 where the channel has a straight planform (Figure 2.4) which is predominantly overgrown with rush (*Juncus effusus*). The channel was fenced on the left bank, however both banks had no significant riparian vegetated buffer. A section of erosion was observed on the right bank at SP 52970 26029 and poaching was present along the majority of the left bank. Downstream of the road crossing, the channel continues in a highly modified, straightened planform with no riparian complexity and minimal habitat diversity (Figure 2.5).

Figure 2.1 Dry upper reaches (looking downstream at SP 52588 26391)

Figure 2.2 Grate crossing channel causing trapping of organic debris and backing up of water (looking from left bank to right at SP 52927 26132)

Figure 2.3 Inlet pipe (looking downstream at SP 52927 26132)

Figure 2.4 Straight channel, minimal riparian buffer (looking downstream at SP 52971 25962)

Figure 2.5 Straight channel, minimal riparian buffer (looking upstream at SP 53072 25707)

2.2 Tributary of Gagle Brook (east stem)

The source of the east steam tributary of Gagle Brook was at a concrete structure which appeared to be controlled by two sluice outlets (Figure 2.6). Analysis of historical mapping suggests that the structure could potentially be associated with discharge from Upper Heyford Airbase as it does not appear to be on mapping prior to construction of the site. From here, the channel appears to be culverted under a farm access track and discharges into an open, straight channel via a large concrete culvert headwall. The channel runs alongside a farm track in an incised channel measuring approximately 1m wide and 0.5m deep with gravel and loam substrate. A hedgerow runs along the left bank of the channel at this location.

At SP 53607 26455 the channel flows over a concrete ford (Figure 2.7) before forming the boundary to a grazing field. Here the channel is bordered by a row of mature trees on the Left Bank and a fence on the left. The channel has a uniform trapezoidal cross section and straight planform with gravel and silt substrate. The channel continues past Ashgrove Farm and through an online pond where it enters a woodland area at SP 53462 26069 (Figure 2.8). Here the channel measured approximately 1.25m wide with bank approximately 0.25m high and has clean gravel substrate and run and riffle flow with wood dams creating some additional variability in flow types (Figure 2.9). Downstream of the road crossing, the channel has straight planform and limited riparian vegetation. The channel flows through a further culvert under a farm access track (Figure 2.10) before meeting the east stem at SP 53074 25706. The culvert here measured approximately 0.2m wide and constricted flow, limiting longitudinal connectivity.

Figure 2.6 Channel source – impounding dam and sluice structure (looking upstream at SP 53289 26850)

Figure 2.7 Concrete ford (looking from right to left bank at SP 53607 26455)

Figure 2.8 Gravel substrate, channel flowing through woodland (SP 53373 25982)

Figure 2.9 Gravel substrate (looking from left to right bank at SP 53373 25982)

Figure 2.10 Straight drainage channel, limited riparian vegetation (looking upstream at SP 53081 25709)

2.3 Tributary of Gagle Brook

The Tributary of Gagle Brook flows through woodland between SP 53074 25706 and SP 52994 25426. Here the channel has fine gravel and silt substrate with several large wood dams (Figure 2.11). The channel has a trapezoidal cross section measuring approximately 1.5m wide with 0.3m high banks. The predominant flow type at this location was glide. Some lengths of undercutting were noted along the left bank. A concrete outfall headwall is present on the left bank at SP 52998 25447, set back approximately 0.75m from the channel bank. No water was discharging from the outfall at the time of survey.

Downstream of the woodland, the channel flows alongside a grazing field. The channel is wider at this location, measuring approximately 2m wide with substrate consisting of sand and fine gravels over clay and glide and run flow types. The channel is fenced on the right bank (Figure 2.12) and a designated livestock drinking area located at SP 53157 25135 (Figure 2.13). The right bank borders an arable field which is unfenced and has no riparian buffer. The channel was crossed by two culverts for farm access vehicles.

The channel enters a large online pond adjacent to Manor Farm which is impounded by a weir outlet measuring approximately 0.75m high and 1m wide (Figure 2.14). Downstream of the pond, another designated livestock drinking point was observed. From here the channel flows through a modified straightened channel measuring approximately 1.5-2m wide with trapezoidal banks approximately 0.6m high (Figure 2.15). The channel was fenced with no tree lining or riparian buffer. The water within the channel at this section begins to stagnate with distance downstream and was dry upstream of Ardley Road (Figure 2.16). This suggests that subsurface flow occurs within this section. There was no indication that the flow was diverted to the pond at Dewars Farm (which also appeared to be at a higher gradient than the channel).

Downstream of Ardley Road, the channel was dry at the time of survey (Figure 2.17) with loam substrate. A small outfall was observed from the pond at Dewars Farm to the channel at SP 53457 24094. Immediately upstream of its confluence with Gagle Brook, the channel has gravel substrate.

Figure 2.11 Channel flowing through woodland (looking downstream at SP 53038 25637)

Figure 2.12 Straight channel flowing adjacent to grazing field (looking upstream at SP 53181 24875)

Figure 2.13 Designated drinking area (looking from right to left bank at SP 53157 25135)

Figure 2.14 Online pond and downstream weir (looking upstream at SP 53131 24639)

APEM

Figure 2.15 Straight, modified channel (looking upstream at SP 53318 24332)

Figure 2.16 Stagnant water and dry channel upstream of Ardley Road (looking upstream at SP 53413 24177)

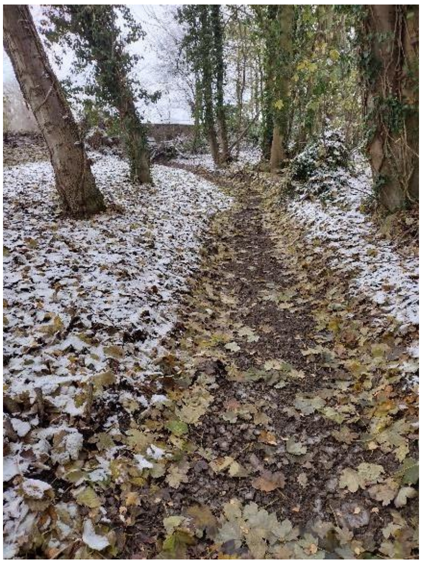

Figure 2.17 Straight, dry channel (looking upstream at SP 53417 24160)

2.4 Gagle Brook

Between the M40 motorway and the railway line, Gagle Brook has a straight planform lined by trees on the right bank and fenced on the left. The channel appeared to have no connection to the ponds to the west of the channel. The channel here measured approximately 1m wide and 0.6m deep and alternated between sections of dry channel and ponded, stagnant water at the time of survey with loam substrate.

Downstream of the railway, the channel continued in a straight planform with run flow and gravel substrate through a woodland corridor (Figure 2.18). Several large wood dams were noted through this section. Structures observed through this length included a footbridge, fence crossing the channel outfall and culvert under a farm access track. The Gagle Brook flows out of the study area where it passes the Ardley Energy Recovery Facility and the Ardley Quarry.

A large offline pond, referred to as Trow Pool is present at SP 54662 24931 (outside of the study area). Water is discharged from the pond to Gagle Brook at SP 54647 24893 (Figure 2.19). Downstream of the pond, the channel is much wider, measuring approximately 2.5m wide, flowing through a woodland corridor. The channel is crossed by a large farm access bridge at SP 54519 24542 measuring approximately 5m wide. From here to the B4030 road crossing, the channel has sand and gravel substrate overlying clay and glide (Figure 2.20), riffle and pool flow.

Downstream of the B4030 road crossing, the channel has a straight planform and shallow glide flow (water approximately 0.25m deep) with submerged fine leaved macrophytes (Figure 2.21).

Figure 2.18 Straight channel through woodland (looking downstream at SP 54754 25991)

Figure 2.19 Outfall from Trow Pool (looking downstream at SP 54647 24893)

Figure 2.20 Channel flowing through woodland (looking downstream at SP 53857 23994)

Figure 2.21 Submerged fine leaved macrophytes (looking downstream at SP 53837 23505)

2.5 Tributary of Padbury Brook

The Tributary of Padbury Brook emerges from Upper Heyford airbase in a small concrete culvert measuring approximately 0.2m wide (Figure 2.22). From here the channel flows through a wooded area with a sinuous planform, fine gravel, sand and silt substrate and glide and run flow (Figure 2.23). The channel here varies between 1.2-2m in width with shallow banks measuring approximately 0.3m high. Several large wood dams were noted here.

Downstream of Raghouse Lane road crossing, the channel has a straight planform with a modified and incised cross-section forming the boundary to an arable agricultural field (Figure 2.24). Channel substrate is dominated by fine gravel over clay. The channel flows under the railway line in a concrete culvert measuring approximately 0.75m wide with a brick headwall (Figure 2.25).

Figure 2.22 Culvert outlet from Upper Heyford airbase (looking upstream at SP 52457 27393)

Figure 2.23 Channel through woodland (looking downstream at SP 52582 27426)

Figure 2.24 Channel forming boundary to arable field (looking upstream at SP 53016 27531)

Figure 2.25 Culvert under railway (looking downstream at SP 53131 27573)

2.6 Padbury Brook

Padbury Brook between Fritwell Road and Ardley Sewage Works has a straight planform with substantial riparian buffer consisting of grasses and scrub (Figure 2.26), measuring approximately 7-10m wide. The channel itself measures 3.3-4m wide and banks are 0.5-1m high. Channel substrate consists of sand and gravels and flow is predominantly glide and run. Reed dieback dominated the channel at this location and a vehicle ford crosses the channel at SP 54287 28006 (with no associated bed reinforcement).

Downstream of the sweage works and upstream of the M40 motorway the channel forms the boundary to a large arable field. The channel is narrower at this location measuring approximately 2m wide and has an embankment measuring approximately 0.75m high on the right bank. Channel substrate alternated between silt at areas of glide or pooled water and gravels at lengths of faster run flow (Figure 2.27). The channel has submerged broadleaf macrophytes along much of its length, and floating duckweed where there is less tree cover. The brook passes under the M40 in a twin culvert, each measuring approximately 1m wide (Figure 2.28).

Downstream of the A43, the channel emerges from another set of twin culverts measuring approximately 1.25m wide. From here, the channel has a modified trapezoidal cross section measuring approximately 1.5-2m wide and with bank height of 0.8m (Figure 2.29). The channel has gravel substrate and gravely loam banks with glide flow within the upper section and run and riffle within the downstream section. Several macrophytes were noted here including submerged broadleaf and floating duckweed. The channel is crossed by three footbridges and two pipes.

Figure 2.26 Straight channel with substantial riparian buffer (looking downstream at SP 54305 28022)

Figure 2.27 Gravel substrate (looking upstream at SP 54586 28225)

Figure 2.28 Twin culvert under M40 motorway (looking downstream at SP 54607 28232)

Figure 2.29 Straight, modified channel adjacent to Cherwell Valley Motorway Services (looking downstream at SP 54864 28314)

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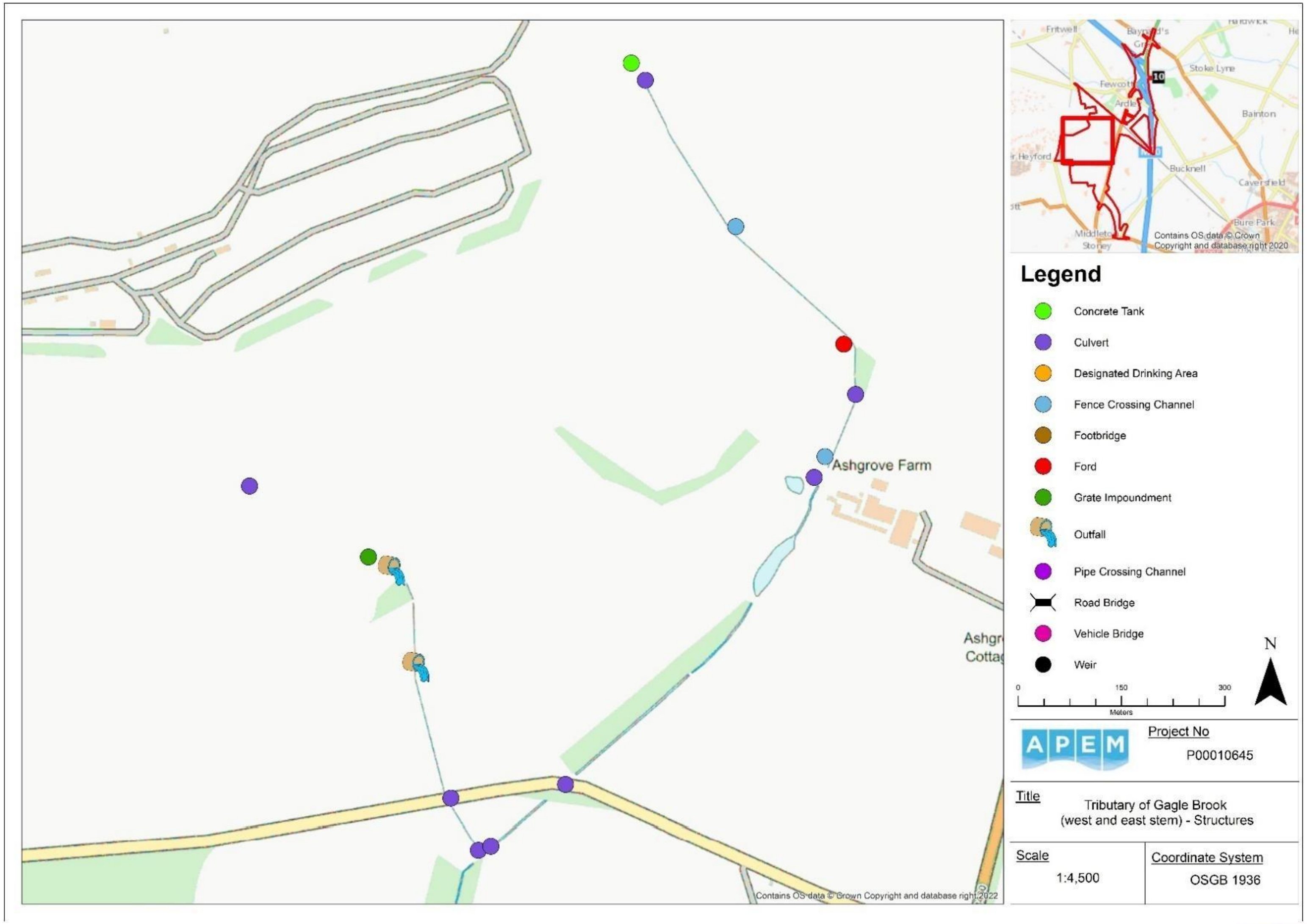
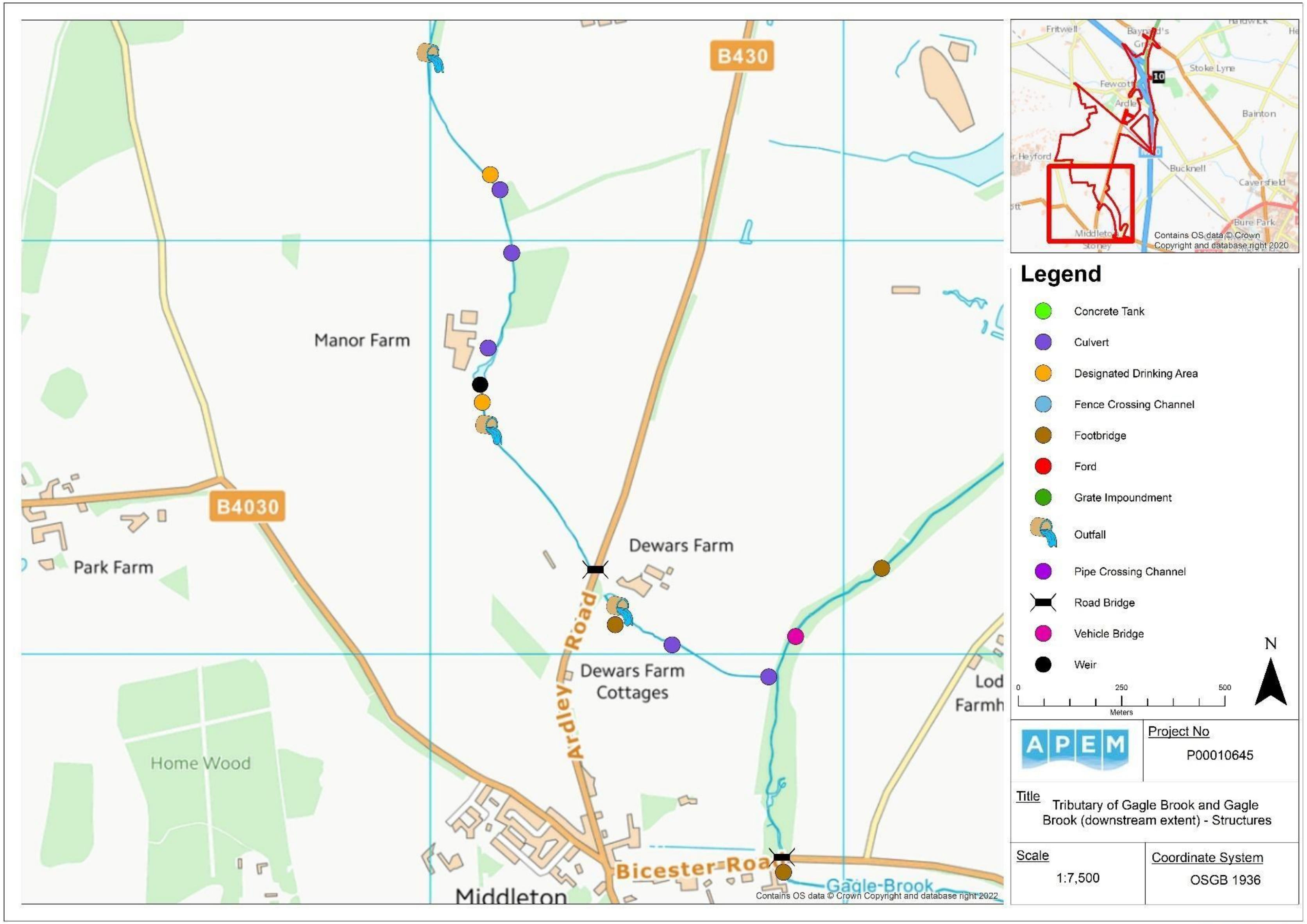
Appendix A: Structures




B430
B4030
Manor Farm
Park Farm
Dewars Farm
Dewars Farm Cottages
Ardley Road
Home Wood
Bicester Road
Gagle Brook
Middleton
Lod Farmh
Contains OS data © Crown Copyright and database right 2022
Fritwell
Stoke Lyne
Fewcott
Ardley
Bainton
Bucknell
Caversfield
Bure Park
Contains OS data © Crown Copyright and database right 2020
Legend
Concrete Tank
Culvert
Designated Drinking Area
Fence Crossing Channel
Footbridge
Ford
Grate Impoundment
Outfall
Pipe Crossing Channel
Road Bridge
Vehicle Bridge
Weir
N
0
250
500
Meters
Project No
P00010645
Title
Tributary of Gagle Brook and Gagle Brook (downstream extent) - Structures
Scale
1:7,500
Coordinate System
OSGB 1936

APEM

Project No
P00010645

Title
Gagle Brook (upstream extent) - Structures

Scale
1:8,000

Coordinate System
OSGB 1936

APEM

Green Farm
Street
East Street
Raghouse Lane
M40
Baynard's Green
Willowbank Farm
Fritwell Road
Lane
Water
10
Fewcott
Cross Roads Farm
Somerton Road
Ardley
The Barn House
Kilby's Barn
Contains OS data © Crown Copyright and database right 2022
Stoke Lyne
Bainton
Bucknell
Caversfield
Bure Park
Contains OS data © Crown Copyright and database right 2020
Legend
Concrete Tank
Culvert
Designated Drinking Area
Fence Crossing Channel
Footbridge
Ford
Grate Impoundment
Outfall
Pipe Crossing Channel
Road Bridge
Vehicle Bridge
Weir
N
0
330
660
Meters
Project No
P00010645
Title
Padbury Brook and Tributary of Padbury Brook - Structures
Scale
1:10,000
Coordinate System
OSGB 1936