M25 junction 10/A3 Wisley interchange TR010030
5.4 Water framework directive compliance assessment report

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The M25 junction 10/A3 Wisley interchange Development Consent Order 202[x]

5.4 WATER FRAMEWORK DIRECTIVE ASSESSMENT REPORT

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1. Introduction

1.1.1 Highways England is proposing a scheme to improve traffic flow through the M25 junction 10/A3 Wisley interchange (the Scheme) and to make the junction safer for drivers. The proposed scheme comprises replacing the interchange between the M25 and A3 with an elongated roundabout, improving slip roads between the M25 and A3, widening the A3 and reconfiguring the local road network to make access to and from the A3 safer. These proposed works include modifications to the water environment.

1.1.2 This report is a Water Framework Directive (WFD) compliance assessment for a preliminary design of the Scheme. The WFD is a European directive that imposes legal requirements to protect and improve the water environment. A compliance assessment is undertaken to determine whether works that potentially affect the water environment meet the requirements of the directive.

1.1.3 The purpose of undertaking this WFD compliance assessment is to establish the nature and anticipated magnitude of the effects of scheme components on the WFD quality elements of the water bodies affected by the Scheme.

1.1.4 At the time of writing this assessment, the design of the Scheme had been developed to preliminary design stage. An updated WFD assessment will need to accompany subsequent stages of design.

2. Scheme background

2.1 Scheme process

2.1.1 In 2014, the Government published its Road Investment Strategy (RIS) for 2015-2020. This set-out a long-term programme for improvements to England's strategic road network. One scheme covered by the strategy is to improve traffic flow through the M25 junction 10/A3 Wisley interchange and to make the junction safer for drivers.

2.1.2 Highways England is the strategic highway authority charged with modernising, maintaining and operating England's strategic road network. It is the 'overseeing organisation' for improvements to the M25 junction 10/A3 Wisley interchange. This Scheme is being managed under the Project Control Framework (PCF), a phased approach to developing and delivering major road Schemes (Highways Agency, 2013). The Scheme is currently at stage 3 in the PCF lifecycle. In this phase, the various aspects of the Scheme (including environmental assessment) are developed sufficiently to complete the preliminary design.

2.2 Scheme location

2.2.1 The Scheme lies in the south west quadrant of the M25 London Orbital Motorway in Surrey. At junction 10 the A3, a key radial route from London to Portsmouth, crosses the M25 motorway. The M25 junction 10/A3 Wisley interchange forms the confluence of radial routes between Surrey, Hampshire and Greater London with orbital routes between Kent, East and West Sussex, Surrey, Berkshire and beyond. An overview of the study area together with the general location of Scheme components is set out in Figure 2.1. The Scheme is located in a very sensitive natural environment, and this context is explained in section 2.3 below. Because of this sensitive environmental context, environmental objectives warrant a particularly high status.

2.3 Environmental context of the Scheme

2.3.1 The Scheme is located within a very sensitive natural environment: a large tract of heath, bog, open water, secondary woodland and scrub. This area is protected by national and international designations: Ockham and Wisley Commons Site of Special Scientific Interest (SSSI) and the Thames Basin Heaths Special Protection Area (SPA).

2.3.2 Evolution of the Scheme design has recognised the importance of these environmental designations. The current configuration of the Scheme was selected in preference to other more expansive options to minimise encroachment of road works into these designated areas. Further detail on consideration of alternative solutions can be found in section 2.5.

2.3.3 Developing a design that balances functionality with positive environmental outcomes remains a key objective of the Scheme.

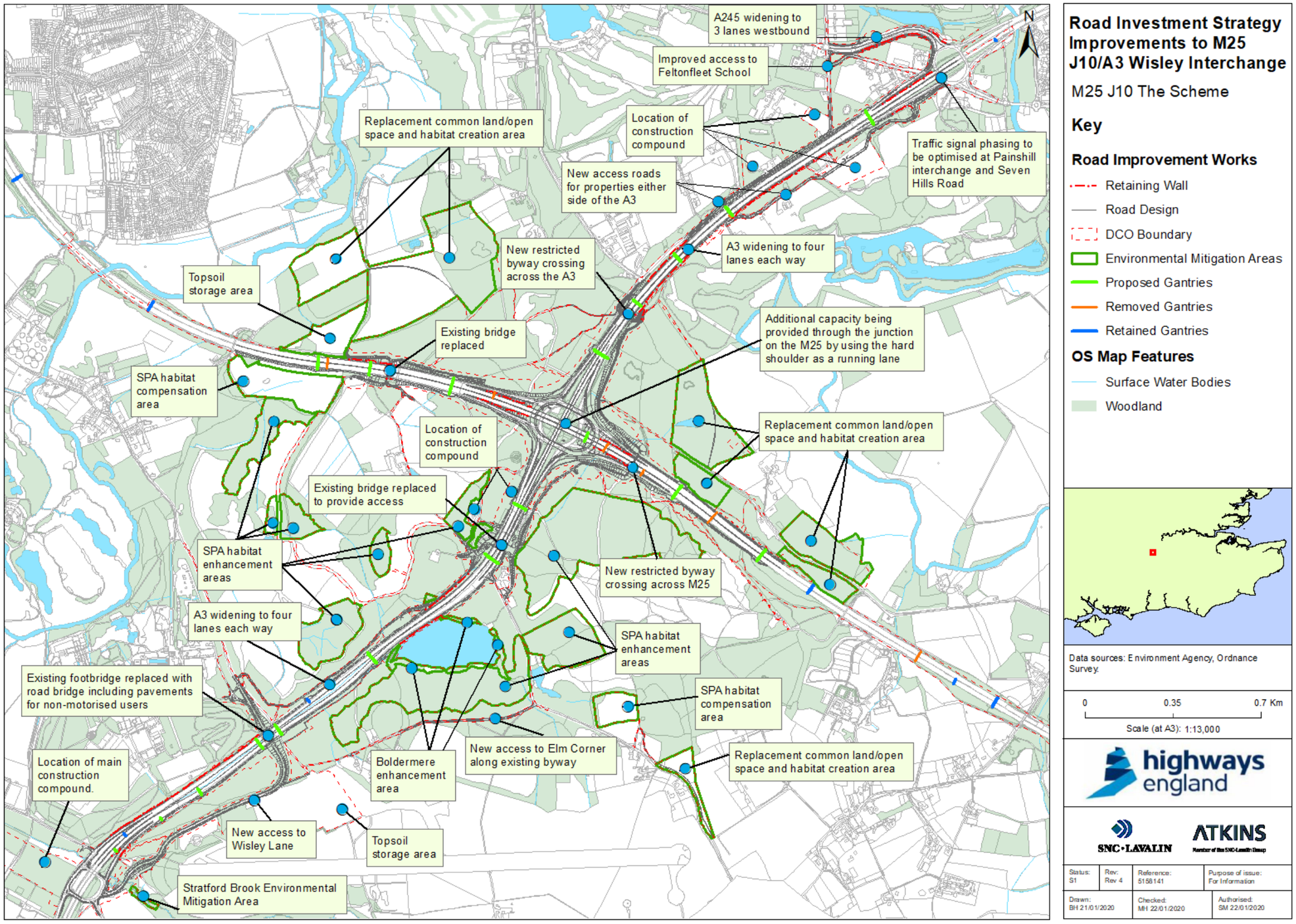


Figure 2.1: The Scheme

2.4 The Scheme

2.4.1 An explanation of the Scheme objectives and a detailed description of the Scheme proposals can be found in the 'Introduction to the Application' (application document TR010030/APP/1.2). In summary, the Scheme is needed to reduce congestion, improve safety, support planned housing and economic growth and improve walking and cycling provision. The key features of the Scheme include:

- Alteration and upgrading of the existing M25 junction 10 roundabout, including: elongation and widening of the circulatory carriageway to increase capacity for right-turning traffic; realignment, lengthening and widening of the junction entry and exit slip roads; and demolition of redundant bridge structures.
- Provision of four new dedicated free-flow slip lanes at M25 junction 10, to enable all left-turning traffic to pass through the junction unimpeded by traffic signals.
- Conversion of the existing hard shoulders on the M25 through junction 10 to provide an additional running lane for traffic in both directions, including emergency refuge areas and associated modifications to M25 gantries, signage and road markings.
- Widening of the A3 to dual four lanes between the Ockham Park junction and the Painshill junction, except where the A3 crosses over M25 junction 10, which will remain as two lanes in each direction.
- New sign gantries on the A3 to provide variable speed limits and lane control between Ockham Park and Painshill junctions.
- Widening of the A245 Byfleet Road to dual three lanes westbound between the Painshill junction and Seven Hills Road to the west and widening to dual three lanes eastbound on the approach to the Painshill junction.
- Provision of a~~two~~ new dedicated slip lane~~s~~ at the Painshill junction, to enable traffic leaving the northbound A3 to join the westbound A245.
- Improvement of the Ockham Park junction, including installation of traffic signals at the entries to the roundabout and for new crossing facilities for pedestrians and cyclists.
- Modification of A3 side road junctions, including: improvement of the Old Lane junction; closure of the Wisley Lane junction and construction of a new road bridging over the A3 to connect Wisley Lane with the A3 at Ockham Park junction; and closure of the Elm Lane junction and provision of an alternative access to Elm Corner via Old Lane and an improved section of Byway Open to All Traffic.

- Closure of private accesses from the A3 carriageways and the provision of substitute local access arrangements, including: a substitute access for properties between Redhill Road and Seven Hills Road (South) via a new road running alongside the A3 northbound carriageway; a substitute access for properties on the edge of Painshill Park via the A3 southbound on-slip; and a substitute access for properties at Wisley Common from Old Lane and crossing the A3 via the replacement Cockcrow Overbridge.
- Provision of new and improved facilities for pedestrians, cyclists and horse riders, including: a new 5.8 km long route along the A3 corridor between Ockham Park and Painshill junctions; new and replacement bridges for the benefit of non-motorised users to cross both the M25 and the A3; and new and upgraded public rights of way in the area around M25 junction 10.
- Provision of replacement common land and open space in exchange for that needing to be acquired for the Scheme.
- Extensive areas of habitat creation and enhancement and other environmental mitigation works, including: measures to compensate for the impacts of the Scheme on the Thames Basin Heaths SPA and on Bolder Mere; the provision of a new wildlife crossing over the A3 as part of a replacement Cockcrow overbridge; new amphibian crossings on Old Lane; and the reinstatement of landscape and habitats on land used temporarily for Scheme construction.

2.5 Scheme alternatives

2.5.1 During development of the Scheme a very wide range of alternative solutions for resolving the traffic problems at junction 10 have been identified, developed and assessed. This process is set out in Chapter 3 (Assessment of Alternatives) of the Environmental Statement (application document TR010030/APP/6.3), and with specific reference to minimising effect on the Thames Basin Heaths SPA in Habitat Regulations Assessment Stage 3 record (application document TR010030/APP/5.3). This section draws on and summarises key elements from these texts that demonstrate no feasible, less-damaging alternatives have been identified that would result in a lesser effect on the environment in general and, specifically, the integrity of WFD water bodies. Since the WFD water body most affected by the Scheme is Bolder Mere, attention focuses on this lake.

2.5.2 The Habitat Regulations Assessment Stage 3 record sets out a review of strategic options (for instance increase to rail capacity) that demonstrated junction improvement would be the most appropriate strategic solution. It also assesses a long list of 21 road options using a multi-criteria assessment framework based loosely around the Department for Transport's Early Appraisal and Sifting Tool (EAST). Effect on natural environment (of which Bolder Mere forms a part) was a key criteria used in the assessment.

2.5.3 Three options fell out of the long list (options 9, 14 and 16). Although these three options are very different in terms of their configuration, land take and effect on the natural environment, from the perspective of effect on WFD water bodies, and particularly Bolder Mere, the effect of the Scheme is very similar. Most differences between the three options are around the M25 junction 10/A3 Wisley interchange. The effect adjacent to Bolder Mere are limited to widening of the

A3 from D3AP (dual three-lane all-purpose road) to D4AP (dual four-lane all-purpose road) – a common feature of all three options required because traffic figures highlighted that an extra lane would be required for weaving and merging on approaches to the junction. From the perspective of effect on Bolder Mere there is nothing to differentiate between the three options. Option 14 was preferred because of traffic/safety benefit and because these could be achieved at lower cost and environmental impact.

2.5.4 Since its selection Option 14 has been refined to reduce its effect on the environment – in particular the SPA and WFD water bodies. A key refinement from the perspective of Bolder Mere has been the relocation of the Wisley Common Restricted Byway from immediately adjacent to Bolder Mere to the northern side of A3. This move reduces encroachment of the Scheme into Bolder Mere by an estimated 10 m.

3. WFD background and approach to M25 junction 10/A3 Wisley interchange assessment

3.1 WFD background

3.1.1 The WFD (Council Directive 2000/60/EC) aims to protect and enhance the quality of the water environment across all European Union member states. The WFD requires member states to classify the current condition or 'status or potential' of surface water and groundwater bodies and set a series of objectives for maintaining or improving condition.

3.1.2 The WFD requires all natural surface water bodies to achieve both Good Chemical Status (GCS) and Good Ecological Status (GES). Artificial and Heavily Modified Water Bodies (A/HMWBs) may be prevented from reaching GES due to the modifications necessary to maintain their 'use', e.g. navigation. They are, however, required to achieve Good Ecological Potential (GEP), through the implementation of a series of mitigation measures.

3.1.3 The WFD also requires good status (both qualitative and quantitative) to be achieved for all groundwater bodies, the prevention of the deterioration in groundwater status and the reversal of significant and sustained upward trends in pollutant concentrations in groundwater.

3.1.4 In addition, the WFD requires compliance with objectives and standards for protected areas specifically listed in the River Basin Management Plan (RBMP) for the protection of surface water and groundwater or for the conservation of habitats and species directly depending on water.

3.1.5 Status is reported at the water body scale, with individual water bodies forming part of larger River Basin Districts (RBD), for which RBMPs have been developed. The process of river basin management planning includes the preparation of programmes of measures for achieving the environmental objectives of the WFD and these act as the main reporting mechanism to the European Commission and the public.

3.1.6 Each RBMP documents the analysis, monitoring, objective-setting and consideration of measures required to maintain or improve status at a water body scale for both surface water and groundwater bodies. The first RBMPs were published in 2009 followed by a Cycle 2 update published in 2016.

3.2 WFD compliance assessments

3.2.1 A WFD compliance assessment is required for new developments and schemes to demonstrate that proposals will not result in a deterioration in status (or potential) of any water body (defined in this report as Test A), or prevent the water body from meeting good status (or potential) in the future (2021 or 2027) (defined in this report as Test B).

3.2.2 Compliance with the directive can only be fully demonstrated once detailed designs of a scheme have been prepared. However, design is an evolutionary process, and the earlier within that process the WFD can be considered, the more readily the legal requirements of the directive can be integrated into the design. The compliance assessment presented in this document accompanies a preliminary design prepared at Stage 3 of the PCF Process. The assessment is

made based on this preliminary design using a parameters based, reasonable worst case scenario approach, assuming:

- the mitigation already 'embedded' in this preliminary design (as presented in the Scheme Layout Plans (application document TR010030/APP/2.8), secured in section 5 of the draft DCO (application document TR010030/APP/3.1) and summarised in section 5.2) is implemented;
- additional specific mitigation (as summarised in section 5.3 and Table 5.1) is implemented as developed and agreed with the Environment Agency (EA) and Natural England (NE); and
- generic guidance on the principles of WFD compliant design (as summarised in section 5.4) is adhered to in subsequent detailed design of scheme components affecting the water environment.

3.3 WFD compliance assessment method, screening criteria and scope for the M25 junction 10/A3 Wisley interchange

Introduction

3.3.1 The Planning Inspectorate Advice Note 18 (The Planning Inspectorate, 2017) recommends that applicants seek the views early in the application process to agree a) the need for a WFD assessment; and b) method, scope and screening criteria. Further consultation is recommended as the potential impact of the development is better understood to develop mitigation that achieves compliance, and, if needed, to agree matters relating to Article 4.7 derogation.

3.3.2 Highways England and their representatives have consulted with the Environment Agency on matters relating to the WFD through the options appraisal stage (PCF2) for this scheme, and early in the preliminary design (PCF3). This consultation included face to face meetings on 8,19 and 29 March 2018, 13 April 2018, 18 August 2018, 2 November 2018, 22 January 2019, 21 February 2019, 19 March 2019 and 7 May 2019; and submission of draft WFD assessments for comment (dated 8 May 2018 and 21 February 2019). Consultation with NE has also taken place because of the close interaction between WFD status of Bolder Mere and the status of the Ockham and Wisley Commons SSSI. This includes face to face meetings on 17 December 2018 and 29 April 2019. Surrey Wildlife Trust and the British Dragonfly Society have also been consulted, including a face to face meeting on 22 January 2019. These discussions have played a key role in developing a proportionate mitigation package for the Scheme.

WFD assessment method

3.3.3 Very early in the application process representatives of Highways England discussed methods of WFD assessment with members of the Environment Agency's national Geomorphology Team (who have particular responsibility for the WFD assessment). The focus of discussion was largely Highways England RIS schemes in south east England that were expected to affect multiple water bodies. The Environment Agency suggested an assessment carried out for HS2 (HS2, 2016) as a useful template of best practice. Its thorough matrix-based approach allows analysis and recording of the effect of each scheme component on all WFD quality elements. It captures the core outcomes of a compliance

assessment whilst being transparent and simple to interpret. Assessments can be readily updated, creating a clear audit trail of WFD compliance as a scheme progresses through its lifecycle from options assessment to design, environmental permitting and implementation. This approach was used as a template for the WFD assessment carried out in this study (see below and Appendix C).

3.3.4 A precautionary risk-based approach, based on HS2 (2016), was taken to the assessment. The Scheme was assessed for its effect on achieving the two key environmental objectives set out in paragraph 3.2.1 (tests A and B), conservatively accounting for uncertainty of potential impacts (often determined by the level of information available at preliminary design stage).

3.3.5 The matrix approach used allows the effect of individual scheme components on individual WFD quality elements to be assessed and recorded. The matrix also allows aggregated effects to be recorded – so the effects of multiple scheme components in a single water body, and the overall effect of the Scheme on water body status (in accordance with the “one out, all out” philosophy of the WFD).

3.3.6 A colour coding “Red, Amber, Green” (RAG) system was used in a risk-based approach. Definitions for the colour coding were assigned to indicate the level of risk of objective non-compliance within each water body, accounting for a) mitigation already “embedded” into the preliminary design (as summarised in section 5.2) and b) additional mitigation to be integrated into later phases of the design (as set out in sections 5.3 and 5.4). The definitions were as follows:

- **Dark Blue**: beneficial effect of a scale sufficient to increase status class for the water body (certain)
- **Light Blue**: beneficial effect resulting in a localised improvement, but insufficient to increase status class at water body scale (certain)
- **Green**: no measurable change to (or effect on) water body (certain)
- **Yellow**: minor localised and/or temporary effect when balanced against mitigation – insufficient to affect an element at a water body scale (certain)
- **Amber**: an adverse effect is possible when balanced against mitigation – the extent of effect is uncertain, and there remains a potential to affect water body status
- **Red**: adverse effect of sufficient scale to impact on a quality element at a water body scale (certain)

Screening

3.3.7 A precautionary approach to screening scheme components for inclusion into the assessment has been taken. The approach has been as follows.

- **Surface water –** to screen in all scheme components intersecting with surface water features presented on OS VectorMap® District (Ordnance Survey, 2017). This is a very precautionary screen because this layer contains surface water features at a high resolution (i.e. it includes minor drainage ditches).

- **Ground water –** to screen in all scheme components with elements protruding below ground level or designed to pass flow to ground.
- **Lake** – to screen in all scheme components affecting surface and ground water features in the vicinity of Bolder Mere.

3.3.8 This screening approach has been agreed with the Environment Agency (Statement of Common Ground with Environment Agency, application document TR010030/APP/8.3).

Scoping

3.3.9 Highways England have also taken a very precautionary approach to scoping in the receptors (primarily WFD quality elements) that are potentially at risk from the Scheme, and therefore need to be included in this assessment. The approach is summarised below.

Surface quality elements

3.3.10 All surface water WFD biological, physico-chemical and hydromorphological quality elements assessed for each of the water bodies in the second cycle of the Thames RBMP (Environment Agency, 2018) are scoped into the WFD compliance assessment.

3.3.11 This WFD compliance assessment relies on output from the Highways Agency Water Resource Assessment Tool (HAWRAT, Highways Agency, 2009) to assess impacts of Specific Pollutants, Priority Substances and Priority Hazardous Substances WFD quality elements in road runoff on the water environment of receiving water bodies. Collaborative research between the Environment Agency (EA) and Highways Agency (HA) agreed on a group of 'significant pollutants' routinely found in road runoff to form the basis of the HAWRAT assessment (see table 3.1 and paragraph 5.9 of Highways Agency, 2009).

Groundwater status elements

3.3.12 All groundwater WFD quantitative status elements are scoped into the WFD compliance assessment.

3.3.13 WFD groundwater chemical status elements are addressed through a HAWRAT assessment in the same manner as per surface water (see paragraph 3.3.11).

WFD protected areas

3.3.14 The only WFD protected areas affected by the Scheme are Nitrate Vulnerable Zones and Surface Water Safeguard Zones (section 4.4). These zones have been set up to protect surface water and groundwater against pollution from nutrients, herbicides and pesticides.

3.3.15 Since the Scheme is a modification to an existing road scheme Highways England do not consider it to be a source or a pathway to nutrients, herbicides and pesticides. For this reason, WFD protected areas are scoped out of this compliance assessment.

This scoping approach has been agreed with the Environment Agency (Environment Agency, 2019).

4. M25 junction 10/A3 Wisley interchange compliance assessment

4.1 Introduction

4.1.1 This section, together with assessment matrices in Appendix C, sets out the WFD compliance assessment for the Scheme.

4.2 Information sources for WFD compliance assessment

General data sources

4.2.1 Information on the status and objectives of water bodies was taken from the Environment Agency Data Explorer (Environment Agency, 2018).

4.2.2 The Thames RBMP (Environment Agency, 2015) was referenced for details on programmes of measures and protected areas. The Environment Agency also supplied a list of Mitigation Measures assigned to Heavily Modified Water Bodies affected by the Scheme (Environment Agency, 2018a).

Surface water bodies

Biological and supporting elements

4.2.3 Assessment of the impact of scheme components on biological and supporting quality elements was undertaken based on information gathered by:

- Several surveys undertaken on the potentially impacted water bodies:
  - Walkover surveys were carried out by ecologists and geomorphologists on Stratford Brook on 30 May 2018, 4 October 2018 and 29 March 2019; on Bolder Mere on 9 January 2018 and 4 April 2018; and on smaller watercourses on 6 September and 15 November 2018.
  - River corridor surveys were done on Stratford Brook on 21 September 2017 and 7 September 2018, and on the Mole and the Wey on the 7 September 2018.
- Consultation meetings / telephone conferences with:
  - the Environment Agency on 8,19 and 29 March 2018, 13 April 2018, 18 August 2018 and 2 November 2018 (Statement of Common Ground with Environment Agency, application document TR010030/APP/8.3); and
  - NE on 18 December 2017 and 2 March 2018 (Statement of Common Ground with NE, application document TR010030/APP/8.2).
- Desk study using high resolution aerial photographs, topographic survey and environmental spatial data sets (e.g. Ordnance Survey river networks, environmental designations).

Specific pollutants and chemical elements

4.2.4 The impact of WFD specific pollutants, priority substances and priority hazardous substances, generated by road surfaces, on surface waters have been assessed using the Highways Agency's Water Risk Assessment Tool (HAWRAT). This tool has been specifically developed to determine a) whether road runoff generates an environmental risk and b) if measures are needed to mitigate that risk.

4.2.5 The toxicity thresholds used in HAWRAT were developed through a collaborative research programme between the Highways Agency and the Environment Agency to prevent adverse ecological effects in the receiving water bodies. The thresholds are consistent with those adopted for the derivation of Environmental Quality Standards (EQSs) under the WFD. Additional Runoff Specific Thresholds (RSTs) are also used in the assessment to investigate the potential for short term peaks in pollutants to impact aquatic ecology. Copper and zinc standards are key indicators to assess the range of likely pollutants within runoff.

4.2.6 This WFD compliance assessment uses the results from HAWRAT to assess potential for the Scheme to comply with substances from the range of specific pollutants, hazardous substances and priority hazardous substances set under the WFD – copper and zinc are both specific pollutants. A full description of the water quality assessment (for both surface and groundwater) is included in Chapter 8: Road Drainage and Water Environment (application reference TR010030/APP/6,3). The assessment has been based on the preliminary drainage design for the Scheme which can be seen in the Scheme Layout Plans (application document TR010030/APP/2.8).

Groundwater bodies

4.2.7 Assessment of the impact of scheme components on groundwater bodies was undertaken based on information from:

- British Geological Survey (BGS) 1:50,000 bedrock and superficial geology mapping (BGS, 2017)
- Environment Agency Catchment Explorer (Environment Agency, 2018)
- Limited groundwater level data from HAGDMS (Highways England, 2018) and a factual report by WSP at Wisley airfield (WSP, 2014)
- Information on preliminary design of piling and retaining walls (Appendix A)

4.2.8 WFD groundwater chemical status elements are addressed through a HAWRAT assessment as per surface water quality elements (see paragraphs 4.2.4 to 4.2.6 above).

4.3 WFD water bodies potentially affected by M25 junction 10/A3 Wisley interchange

4.3.1 The location of the water bodies potentially affected by the Scheme are shown in Figure 4.1.

River water bodies

4.3.2 The Scheme lies in the Thames Basin WFD District (RBD 6) within two operational catchments. These are the Lower Mole and Rythe Operational Catchment (OPCAT ID 3277) and the Wey Operational Catchment (OPCAT ID 3110). Within these catchments there are three WFD assessed water bodies that are potentially influenced by the Scheme.

4.3.3 The Stratford Brook (GB106039017890) WFD assessed water body is crossed directly by one of the components that comprise the Scheme. Neither the Wey (Shalford to River Thames confluence at Weybridge – GB106039017630) nor the Mole (Horley to Hersham – GB106039017621) are crossed by any of the scheme components; however, ditches and surface water flow paths that drain to these water bodies are potentially affected.

Lakes water bodies (and other open water surface water features)

4.3.4 There is one WFD designated lake affected by the Scheme. This is Bolder Mere (GB30643218). Note this lake is also specifically referenced in the designation for the Ockham and Wisley Commons SSSI. It is located south-east of the A3, with its western shoreline immediately adjacent to the carriageway. There are also two ponds affected by the Scheme: Manor Pond and an unnamed extremely ephemeral pond in the grounds of the Hilton Hotel at Cobham. However, neither of these water features are WFD water bodies in their own right.

Groundwater

4.3.5 There is one WFD groundwater body underlying the whole of the Scheme area. This is the Chobham Bagshot Beds groundwater body (GB40602G601400).

4.3.6 Based on geological open data (1:50,000 scale), most of the Scheme area is underlain by the Bagshot Formation (BGS, 2017). However, a small section under and beside Stratford Brook is underlain by the London Clay Formation. A 1:625k scale overview of the geology underlying the Scheme can be seen in Figure 4.2.

4.3.7 There are no Source Protection Zones (SPZ) in the area covered by the Scheme.

4.3.8 The Bagshot Formation is designated a Secondary Aquifer – by the Environment Agency, which means the formation consists of “permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.” (Environment Agency, 2018b).

4.3.9 There is limited groundwater level data available within the study area and no long-term groundwater monitoring data is available. Groundwater strike data has been collated from two existing historical ground investigation reports: WSP (2014) and Highways England (2018). Further information on groundwater strikes has also been collected from publicly available exploratory hole records (BGS, 2017) the locations of which are shown in Figure 4.3. In summary, the available data suggests groundwater strikes between 0.2 and 16 metres below ground level (mbgl) and are recorded in the Bagshot Formation, the London Clay and the superficial deposits. Groundwater levels are discussed in more detail in

Appendix 8.2 of the Environmental Statement (application document TR010030/APP/6.5).

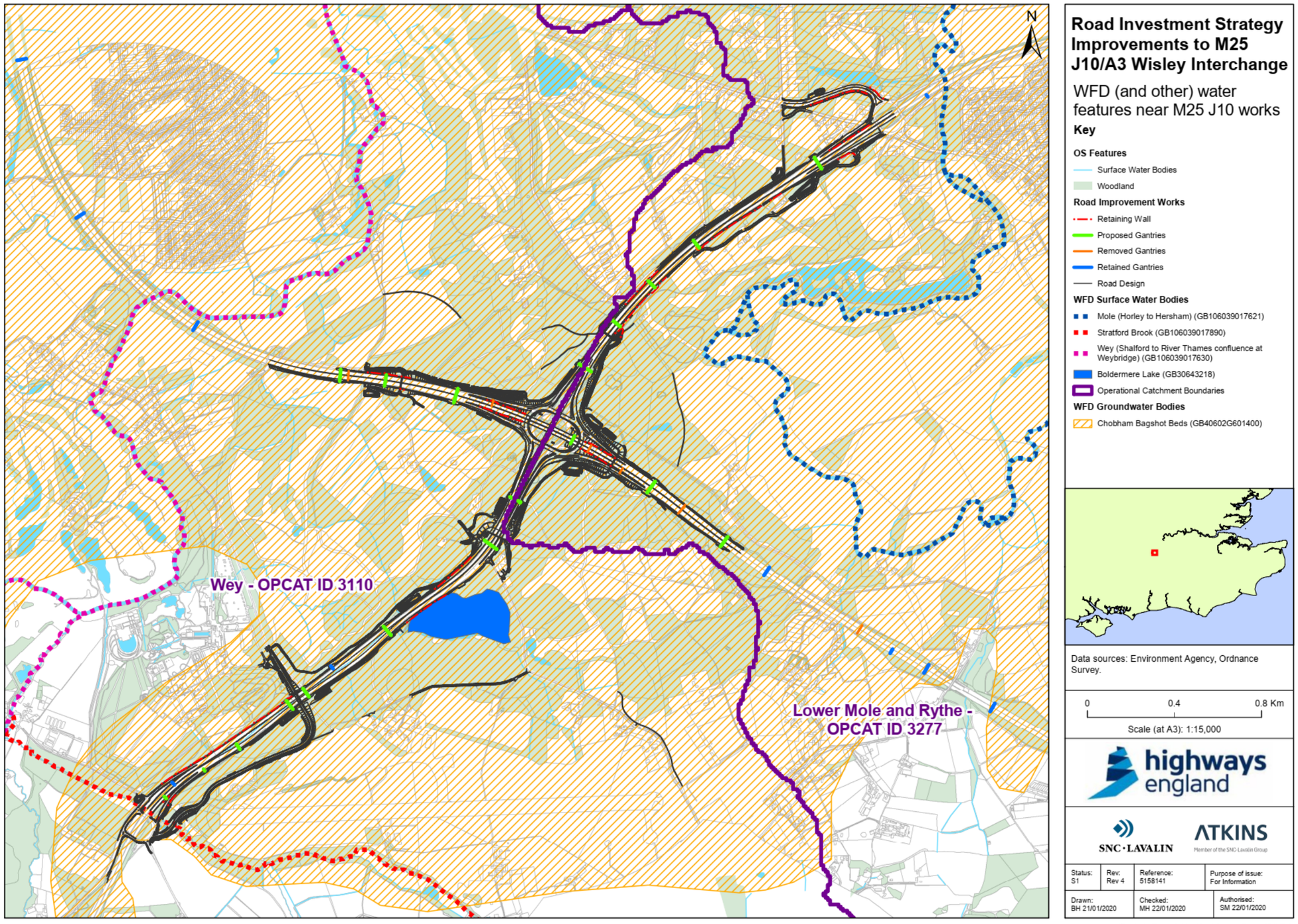


Figure 4.1: WFD (and other) water features near the M25 junction 10/A3 Wisley interchange

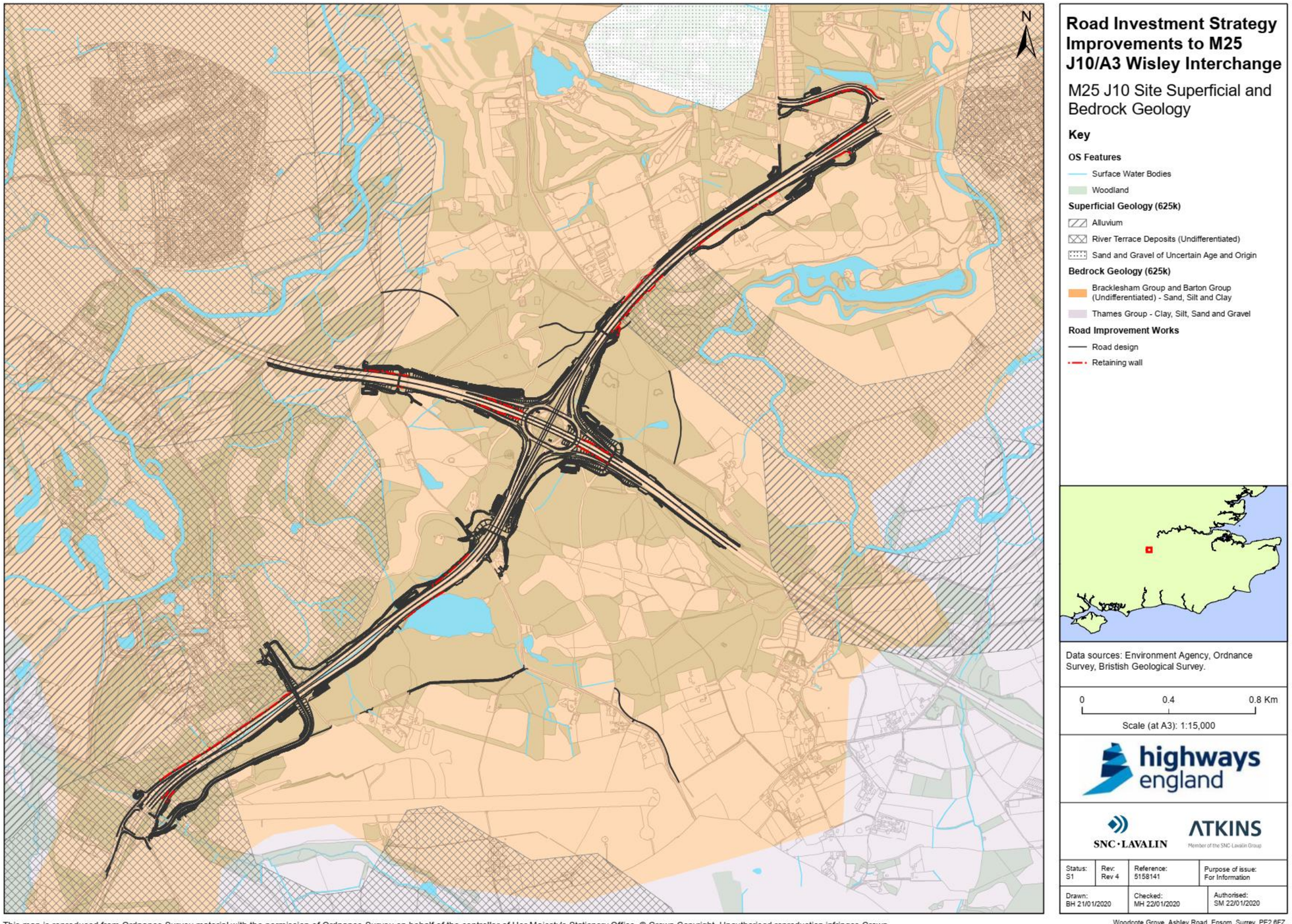


Figure 4.2: Overview of study area geology

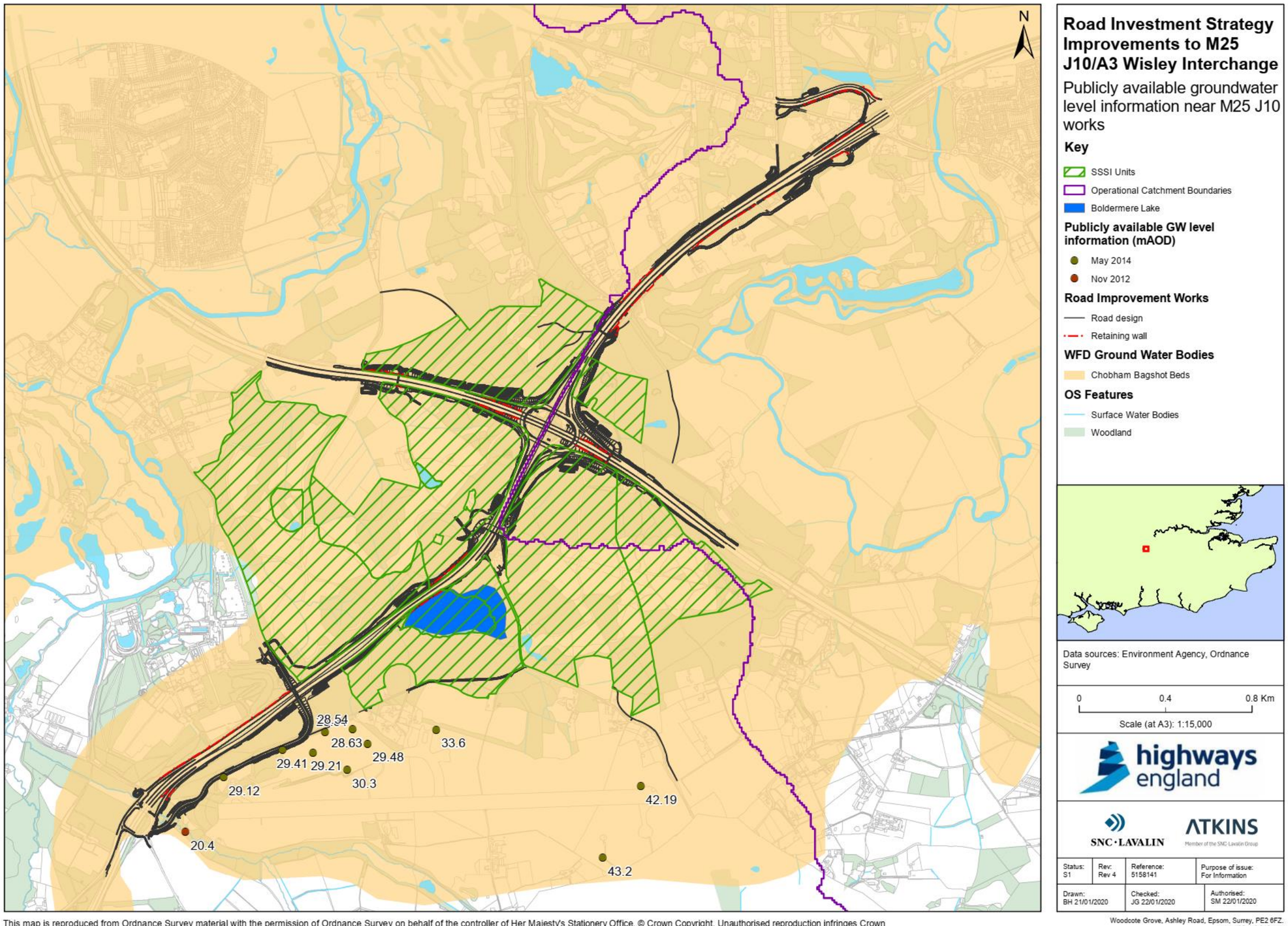


Figure 4.3: Publicly available groundwater level information

4.4 Protected areas potentially affected by the M25 junction 10/A3 Wisley interchange

4.4.1 The part of the Scheme that lies to the east of the M25 and south of the A3 overlies a Nitrate Vulnerable Zone.

4.4.2 The Scheme also overlies a Surface Water Safeguard Zone identified at risk from pesticides and herbicides (Propyzamide, Carbetamide and Metaldehyde). Metazachlor, MCPA, Mecoprop, Carbendazim and Chlorthalare are being considered for addition to this 'at risk' list.

4.4.3 The Scheme is located within a very sensitive natural environment protected under national and international designations as Ockham and Wisley Commons SSSI and the Thames Basin Heaths SPA. Although the evolution of the Scheme design has recognised these designations by reducing the footprint of works, it is of note that neither the SSSI or SPA are recognised as a Protected Area under the WFD[1].

4.5 Baseline WFD status (and objectives)

Surface water bodies

Stratford Brook

4.5.1 Stratford Brook (GB106039017890), a river water body, is **not designated as artificial or heavily modified**. Table 4.1 shows the status of the water body in cycle 2 from 2016 and the objectives that have been set by the Environment Agency for the water body to work towards.

4.5.2 The **ecological status** of Stratford Brook water body for 2016 (cycle 2) is moderate. The status is driven by the moderate status of invertebrates and therefore biological quality elements.

4.5.3 The 2016 (cycle 2) status for **chemical elements** of the water body is good. This is driven by priority hazardous substances as for both priority substances and other pollutants it was decided by the Environment Agency that they do not require assessment.

4.5.4 The **cycle 2 (2016) overall status** of the water body is moderate, driven by the moderate status of the biological quality elements. The reasons for not achieving good status were given as drought due to natural causes and physical modification due to land drainage.

4.5.5 The **objective** set by the Environment Agency for this water body is good by 2027. Achievement of good status prior to this date is considered to be technically infeasible for a biological quality element (invertebrates).

[1] The SSSI is designated under National (rather than European) law. The SPA is not recognised as an area requiring conservation of habitats and species directly depending on water.

Table 4.1: Stratford Brook WFD water body classification

Water body name	Stratford Brook	
Water body ID	GB106039017890	
National Grid Reference	TQ0661957267	
River Basin District	Thames (6)	
Management Catchment	Wey and tributaries (3114)	
Operational Catchment	Wey (3536)	
Artificial or HMWB	Not designated artificial or heavily modified	
Classification	**2016 Cycle 2**	**Objectives**
Overall water body	Moderate	Good by 2027
Ecological	Moderate	Good by 2027
Biological quality elements	Moderate	Good by 2027
Fish	Not assessed	Not assessed
Invertebrates	Moderate	Good by 2027
Macrophytes and Phytobenthos combined	Good	Not stated
Hydromorphological supporting elements	Supports Good	Supports Good by 2015
Hydrological regime	Supports Good	Supports Good by 2015
Morphology	Supports Good	Not stated
Physico-chemical quality elements	Good	Good by 2015
Ammonia (Phys-Chem)	High	Good by 2015
Dissolved Oxygen	Good	Good by 2015
pH	High	Good by 2015
Phosphate	Good	Good by 2015
Temperature	High	Good by 2015
Specific pollutants	High	High by 2015
Ammonia (Annex B)	Not assessed	Not assessed
Copper	Not assessed	Not assessed
Triclosan	High	High by 2015
Zinc	Not assessed	Not assessed
Chemical	Good	Good by 2015
Other pollutants	Does not require assessment	Does not require assessment
Priority hazardous substances	Good	Good by 2015

	Cadmium and its compounds	Not assessed	Not assessed
	Di(2-ethylhexyl) phthalate (Priority hazardous)	Good	Good by 2015
	Nonylphenol	Good	Not stated
	Tributyltin Compounds	Not assessed	Not assessed
	Priority substances	Does not require assessment	Does not require assessment

The Mole (Horley to Hersham)

4.5.6 The Mole (Horley to Hersham) is a river water body that is **not designated artificial or heavily modified**. The status of this water body in cycle 2 (2016) is shown in Table 4.2. The same table also shows the WFD objectives set for the water body by the Environment Agency.

4.5.7 The **cycle 2 (2016) ecological status** of the water body is moderate. This status is driven by a) moderate status for both invertebrate and macrophytes & phytobenthos combined biological quality elements and b) a moderate status for supporting physico-chemical elements (triggered by poor BOD and phosphate[2]).

4.5.8 The **cycle 2 (2016) chemical status** of the water body is good, driven by good status for both priority hazardous substances and priority substances. Other pollutants were considered not to require assessment.

4.5.9 The **cycle 2 overall status** of the water body was moderate, driven by the moderate status of both biological and supporting physico-chemical quality elements. Point source and diffuse source pollution from sewage discharge, poor soil management, poor nutrient management and livestock are the major reasons for many of the elements not achieving good. The presence of the invasive non-native species north American signal crayfish is also a reason for invertebrates not achieving good status.

4.5.10 The **objective** set by the Environment Agency for this water body is moderate by 2015. Achievement of good status is considered to be disproportionately expensive and technically infeasible for a biological quality element (macrophytes and phytobenthos combined) and a physico-chemical supporting element (phosphate).

[2] Supporting elements can only draw status down to moderate.

Table 4.2: Mole (Horley to Hersham) WFD water body classification

Water body name	Mole (Horley to Hersham)	
Water body ID	GB106039017621	
National Grid Reference	TQ0962359793	
River Basin District	Thames (6)	
Management Catchment	Mole (3058)	
Operational Catchment	Lower Mole and Rythe (3277)	
Artificial or HMWB	Not designated artificial or heavily modified	
Classification	**2016 Cycle 2**	**Objectives**
Overall water body	Moderate	Moderate by 2015
Ecological	Moderate	Moderate to 2015
Biological quality elements	Moderate	Moderate by 2015
Fish	Good	Good by 2015
Invertebrates	Moderate	Good by 2021
Macrophytes and Phytobenthos combined	Moderate	Moderate by 2015
Hydromorphological supporting elements	Supports Good	Supports Good by 2015
Hydrological regime	Supports Good	Supports Good by 2015
Morphology	Supports Good	Not stated
Physico-chemical quality elements	Moderate	Moderate by 2015
Acid Neutralising Capacity	High	Good by 2015
Ammonia (Phys-Chem)	Good	Good by 2015
Biochemical Oxygen Demand (BOD)	Poor	Not stated
Dissolved Oxygen	High	Good by 2015
pH	High	Good by 2015
Phosphate	Poor	Poor by 2015
Temperature	High	Good by 2015
Specific pollutants	High	High by 2015
Ammonia (Annex B)	Not assessed	Not assessed
Arsenic	Not assessed	Not assessed
Copper	High	High by 2015
Iron	High	High by 2015

	Manganese	High	Not stated
	Triclosan	High	High by 2015
	Zinc	High	High by 2015
Chemical		Good	Good by 2015
	Other pollutants	Does not require assessment	Does not require assessment
	Priority hazardous substances	Good	Good by 2015
	Benzo (b) and (k) fluoranthene	Good	Good by 2015
	Benzo(a)pyrene	Good	Good by 2015
	Cadmium and its compounds	Good	Good by 2015
	Di(2-ethylhexyl)phthalate (Priority hazardous)	Good	Good by 2015
	Mercury and its compounds	Good	Good by 2015
	Nonylphenol	Good	Good by 2015
	Priority substances	Good	Good by 2015
	Lead and its compounds	Good	Good by 2015
	Nickel and its compounds	Good	Good by 2015

Wey (Shalford to River Thames confluence at Weybridge)

4.5.11 The Wey (Shalford to River Thames confluence at Weybridge) is a river water body **designated as heavily modified** to satisfy the requirements of a navigation 'use' (Environment Agency, 2009). The status of this water body in cycle 2 (2016) is shown in Table 4.3. The same table also shows the WFD objectives set for the water body by the Environment Agency.

4.5.12 The **cycle 2 (2016) ecological potential** of the water body is moderate. This grade comes about because a) the physico-chemical quality element phosphate (considered insensitive to the modifications associated with the 'use' of the water body) is graded at moderate and b) not all mitigation measured are 'in place' (Table 4.4). Reasons for not achieving good status were given as physical modification for navigation, recreation, agriculture and rural land use (reservoir impoundment), barriers for ecological continuity (fish), urbanisation and "other" from local and central government; and point source for sewage discharge (continuous) from the water industry.

4.5.13 The water body is assigned a **good chemical status in cycle 2 (2016)**, however, note that all three of the chemical groups (other pollutants, priority hazardous substances and priority substances) are considered not to require assessment by the Environment Agency.

4.5.14 The **cycle 2 overall potential** of the water body is moderate, driven by not all required mitigation measures being 'in place' and the moderate status of a

supporting physico-chemical quality element (phosphate) that is insensitive to the 'use' of the water body.

4.5.15 The **objective** set by the Environment Agency for this water body is moderate by 2015. Although an extended deadline to 2027 would allow all mitigation measures to be implemented, it remains technically infeasible to achieve good status for phosphate.

Table 4.3: Wey (Shalford to R. Thames confl. at Weybridge) WFD water body classification

Water body name	Wey (Shalford to River Thames confluence at Weybridge)	
Water body ID	GB106039017630	
National Grid Reference	SU9962449076	
River Basin District	Thames (6)	
Management Catchment	Wey and tributaries (3114)	
Operational Catchment	Wey (3536)	
Artificial or HMWB	HMWB	
Classification	**2016 Cycle 2**	**Objectives**
Overall water body	Moderate	Moderate by 2015
Ecological	Moderate	Moderate by 2015
Biological quality elements	Moderate	Moderate by 2015
Fish	Moderate	Good by 2027
Invertebrates	High	Good by 2015
Macrophytes and Phytobenthos combined	Moderate	Moderate by 2015
Hydromorphological supporting elements	Supports Good	Supports Good by 2015
Hydrological regime	Supports Good	Supports Good by 2015
Physico-chemical quality elements	Moderate	Moderate by 2015
Acid Neutralising Capacity	High	Good by 2015
Ammonia (Phys-Chem)	High	Good by 2015
Biochemical Oxygen Demand (BOD)	High	Not stated
Dissolved Oxygen	High	Good by 2015
pH	High	Good by 2015
Phosphate	Moderate	Moderate by 2015
Temperature	High	Good by 2015

Specific pollutants	High	Not assessed
Ammonia (Annex B)	Not assessed	Not assessed
Arsenic	Not assessed	Not assessed
Copper	Not assessed	Not assessed
Iron	High	Not stated
Permethrin	Not assessed	Not assessed
Triclosan	Not assessed	Not assessed
Zinc	Not assessed	Not assessed
Supporting elements	Moderate	Good by 2027
Mitigation measures assessment	Moderate or less	Good by 2027
Chemical	Good	Good by 2015
Other pollutants	Does not require assessment	Does not require assessment
Priority hazardous substances	Does not require assessment	Does not require assessment
Priority substances	Does not require assessment	Does not require assessment

Table 4.4: Mitigation measures not 'in place' on Wey HMWB

Mitigation measures not 'in place'	
4.Remove or soften hard bank	33.Selective vegetation control
5.Preserve or restore habitats	34.Vegetation control
6.In-channel morph diversity	35.Vegetation control timing
7.Bank rehabilitation	36.Invasive species techniques
16.Fish passes	49. Modify vessel design.
19.Enhance ecology	50.Vessel Management
20.Changes to locks etc	51.Boats in central track
21.Avoid the need to dredge	52.Invasive species awareness
22.Dredging disposal strategy	53.Boat wash awareness
23.Reduce impact of dredging	56.Enhance ecology (recreation)
24.Reduce sediment resuspension	
25.Retime dredging or disposal	
26.Sediment management	
27.Dredge disposal site selection	
28.Manage disturbance	

Table Source: Environment Agency data request : THM79990, 28/03/2018

Bolder Mere

4.5.16 Bolder Mere is a lake water body designated as heavily modified to satisfy the requirements of a wider environment 'use' (Environment Agency, 2009). The modifications to the water body resulting in the heavily modified designation are taken to be a) a retaining wall separating the present day A3 and lake, b) the

embankment extending from the retaining wall to the south west and c) the structure controlling outflows from the lake during low flows (Figure 4.4). Some of these modifications are apparent in mid C19th Ordnance Survey maps (NLS, 2018). The most recent evolutions of the modifications are most probably associated with mid C20th improvements to the A3. Discussions with representatives from the Environment Agency concluded that the wider environment 'use' probably represented the value of Bolder Mere to species directly dependent on water for which the Ockham and Wisley Commons SSSI is designated (e.g. damsel and dragon flies). The status of this water body in cycle 2 (2016) is shown in Table 4.5. The same table also shows the WFD objectives set for the water body by the Environment Agency.

4.5.17 The **cycle 2 (2016) ecological potential** of the water body is moderate. This grade comes about despite mitigation measures being in place (i.e. the mitigation measure assessment is graded as good) because two quality elements considered insensitive to the modifications associated with the 'use' of the water body are graded at moderate. These moderate quality elements are a) the biological quality element phytoplankton and b) the physico-chemical supporting element total phosphorus. The reasons for not achieving good status were given as diffuse source pollution due to poor nutrient management from the agricultural and rural land management sector.

4.5.18 The water body is assigned a **good chemical status in cycle 2 (2016)**, though note that all three of the chemical groups (other pollutants, priority hazardous substances and priority substances) are considered not to require assessment by the Environment Agency.

4.5.19 The **cycle 2 overall potential** of the water body is moderate, driven by the moderate status of both biological and supporting physico-chemical quality elements that are insensitive to the 'use' of the water body (and the need to use expert judgement in the grading of some quality elements).

4.5.20 The **objective** set by the Environment Agency for this water body is good by the extended deadline of 2027, on the grounds that it would be technically infeasible to achieve good status for either total phosphorus or phytoplankton sooner.

Table 4.5: Bolder Mere WFD water body classification

Water body name	Bolder Mere[3]	
Water body ID	GB30643218	
National Grid Reference	TQ0766758404	
River Basin District	Thames (6)	
Management Catchment	Wey and tributaries (3114)	
Operational Catchment	Wey (3536)	
Artificial or HMWB	HMWB	
Classification	**2016 Cycle 2**	**Objectives**
Overall water body	Moderate	Good by 2027
Ecological	Moderate	Good by 2027
Biological quality elements	Moderate	Good by 2015
Phytoplankton	Moderate	Good by 2015
Hydromorphological supporting elements	Supports Good	Supports Good by 2015
Hydrological regime	High	Supports Good by 2015
Physico-chemical quality elements	Moderate	Good by 2027
Salinity	High	Good by 2015
Total Phosphorus	Moderate	Good by 2027
Specific pollutants	Not assessed	Not assessed
Supporting elements	Moderate	Good by 2015
Expert Judgement	Moderate	Not stated
Mitigation measures assessment	Good	Good by 2015
Chemical	Good	Good by 2015
Other pollutants	Does not require assessment	Does not require assessment
Priority hazardous substances	Does not require assessment	Does not require assessment
Priority substances	Does not require assessment	Does not require assessment

Groundwater bodies

4.5.21 The status of Chobham Bagshot Beds in cycle 2 (2016) is shown in Table 4.6. The same table also shows the WFD objectives set for the water body by the Environment Agency.

4.5.22 For the Chobham Bagshot Beds WFD groundwater body (GB40602G601400) the Overall Water body status for 2015 Cycle 2 was Good, with both the

[3] We understand that this water body is named Boldermere in the River Basin Management Plan but for consistency with the ES it is being referred to as Bolder Mere in this document

Quantitative and Chemical Elements reaching Good status. The objective is Good status by 2015.

4.5.23 The quantitative element of the groundwater WFD status takes into account dependent surface water features and groundwater dependent terrestrial ecosystems connected to the groundwater body. This includes Bolder Mere and the Ockham and Wisley Commons SSSI in the vicinity of the study area.

Table 4.6: Chobham Bagshot Beds WFD water body classification

Water body name	Chobham Bagshot Beds	
Water body ID	GB40602G601400	
National Grid Reference	TQ0269661581	
River Basin District	Thames (6)	
Management Catchment	Thames GW (1019)	
Operational Catchment	Chobham Bagshot Beds (1039)	
Artificial or HMWB	Not applicable	
Classification	**2016 Cycle 2**	**Objectives**
Overall water body	Good	Good by 2015
Quantitative	Good	Good by 2015
Quantitative Status element	Good	Good by 2015
Quantitative Dependent Surface Water Body Status	Good	Good by 2015
Quantitative GWDTEs test	Good	Good by 2015
Quantitative Saline Intrusion	Good	Good by 2015
Quantitative Water Balance	Good	Good by 2015
Chemical (GW)	Good	Good by 2015
Chemical Status element	Good	Good by 2015
Chemical Dependent Surface Water Body Status	Good	Good by 2015
Chemical Drinking Water Protected Area	Good	Good by 2015
Chemical GWDTEs test	Good	Good by 2015
Chemical Saline Intrusion	Good	Good by 2015
General Chemical Test	Good	Good by 2015
Supporting elements (Groundwater)	Does not require assessment	Does not require assessment

4.6 Site and Desk Investigations

Introduction

4.6.1 This section summarises the baseline condition of water features in the vicinity of the Scheme using information gathered by site and desk investigations as described in 4.2.3.

Stratford Brook

4.6.2 Stratford Brook flows under the A3 at the western end of the Scheme, immediately adjacent to Ockham Park junction. The brook is affected by Scheme components SB1 & CB2, and SB2 & CB1 (Appendix B). Note that treated runoff from the Scheme will also discharge to the brook (SB3).

4.6.3 Stratford Brook is a tributary of the river Wey, joining the Mill Stream approximately 800m downstream of Ockham Park junction. Aquatic ecological surveys, including River Corridor Surveys (RCS), aquatic macrophyte, aquatic macroinvertebrates and fish surveys were undertaken between September 2017 and September 2018 as part of the wider ecological surveys. Full details are provided in the Environmental Statement Appendix 7.6 on Aquatic Ecology (application document TR010030/APP/6.5), with summarised information provided below. Figure B in Appendix E shows the two reaches surveyed, including survey locations and photos of key features.

4.6.4 River Corridor Surveys were undertaken on two 500 m reaches of the Stratford Brook: directly upstream of Stratford Brook Culvert (South) and downstream of Stratford Brook Culvert (North).

4.6.5 The upstream section was heavily shaded by mature woodland for the entire 500 m reach. The first 250 m of the upstream section consisted of natural planform, with meanders and gravel/fine sediment side bars. Water was clear, and a slow flow was observed. The second 250 m of the upstream section was turbid and impounded (with no visible flow), likely caused by the raised sill of Stratford Brook Culvert (South). Large stands of the invasive non-native species (INNS) Himalayan balsam (*Impatiens glandulifera*) was present throughout the reach.

4.6.6 The downstream section was straightened and heavily shaded from dense bankside scrub and tall herbs. Access to the watercourse was very difficult due to the dense scrub, with the channel being observed at only a couple of locations. Where it was visible, the water was observed to be clear and slow flowing, with bed substrate consisting of a mix of silt and gravels. Bankside vegetation was dominated by brambles (*Rubus fruticosus*), common nettle (*Urtica dioica*) and bracken (*Pteridium aquilinum*) with large stands of Himalayan balsam present where land has been previously cleared.

4.6.7 Aquatic macrophyte surveys were undertaken alongside the RCS surveys. Within the upstream reach the only aquatic macrophyte recorded was a small patch of common duckweed (*Lemna minor)* in one location. In the downstream reach only fool's water-cress (*Apium nodiflorum*) was present at the most upstream end.

4.6.8 Aquatic macroinvertebrate and electric fishing surveys were conducted at two locations on Stratford Brook: directly upstream of Stratford Brook Culvert (South) and downstream of Stratford Brook Culvert (North). Full details are provided in

the Environmental Statement Appendix 7.6 on Aquatic Ecology (Application document TR010030/APP/6.5), with summarised information provided below.

4.6.9 Based on the aquatic macroinvertebrate data gathered, the Biological Water Quality is 'good' upstream of Stratford Brook Culvert (South) and 'moderate' downstream of Stratford Brook Culvert (North). Both sites contain macroinvertebrate assemblages of low conservation value comprising predominantly common species. The assemblages indicate that conditions upstream and downstream of the culverts are 'moderately sedimented' and 'sedimented' respectively. Comparing sites, the upstream reach has the best habitat quality with highest flow velocities, more species recorded and lower fine sedimentation.

4.6.10 The majority of fish species recorded within Stratford Brook are typical of those found in small, silted watercourses, with the exception of bullhead, which can be found in a range of habitats. Six different fish species were caught during the survey. The most abundant species were bullhead (*Cottus gobio*, Habitats Directive Annex II species), minnow (*Phoxinus phoxinus*), three-spined stickleback (*Gasterosteus aculeatus*) and stoneloach (*Barbatula barbatula*). Bullhead is a Species of Principal Importance and is cited under Annex II of the EU Habitats Directive.

4.6.11 Fish population densities were low within the two reaches, which is likely to reflect habitat quality (including neighbouring land use identified as arable or pasture potentially contributing diffuse runoff or sediment). When compared, habitat was considerably more varied upstream with areas of glide interspersed with riffle, run and small pools. The in-stream habitat downstream comprised mainly of glide with silt evident throughout. Despite the variance in habitat between the two sites, no major difference in fish species composition was evident, indicating wider catchment pressures on fish populations, for example, barriers to movement/habitat quality.

Mole (Horley and Hersham)

4.6.12 The River Mole (Horley and Hersham) is not crossed directly by any component of the Scheme. However, there are four water features that drain into this water body in the vicinity of the Scheme, as shown in Appendix E. A walkover was conducted of each watercourse to record the general morphology and aquatic habitats present. Photographs were also taken and are presented in Appendix E.

Manor Pond

4.6.13 Manor Pond is at the eastern end of the Scheme, to the north of the A245, just off Painshill junction. Treated runoff from the Scheme will be discharging to the pond (ML4).

4.6.14 Manor Pond is a large fishing pond (approximately 1 ha in size), with a smaller overgrown pond upstream (west). A concrete outfall structure is present on the eastern edge of the pond, which allows water to flow down into a ditch/wet woodland area and towards the River Mole approximately 280 m to the east. At the time of survey (September 2018) aquatic vegetation was limited in the main pond to small areas of bulrush (*Typha latifolia*) at the margins, with mature trees overhanging the banks for the entire perimeter. Large stands of bamboo and rhododendron were also present on the banks.

4.6.15 The smaller pond and wet area to the west was dominated by a mix of bulrush and pendulous sedge (*Carex pendula)* surrounded by bamboo and rhododendron. The more complex vegetation in this area and lack of fish affords better habitat for a range of aquatic invertebrates than the main pond and is therefore of moderate ecological potential.

4.6.16 At the time of the survey, the main pond level was approximately 1m below outfall level resulting in the ditch/wet woodland area to the west being relatively dry. A large stand of Himalayan balsam is present here among mature woodland.

Ockham Common ditch

4.6.17 Ockham Common ditch is immediately to the south-east of the M25 junction 10/A3 Wisley interchange. The very downstream reaches of the ditch will be affected by Scheme components ML1 (please refer to Appendix B).

4.6.18 The ditch (visited September and November 2018) is shallow, ephemeral (dry at time of survey) and approximately 0.5m wide. It travels through a dense woodland (a mix of broadleaf trees and conifers) with an understory of bracken and brambles. No wetland species were identified within the ditch. The ditch extends approximately 350m. An area of wet woodland and a pond were found adjacent to the ditch, towards the north eastern end. It is of limited ecological value due to heavy shading and its ephemeral nature.

Pointers Road Ditch

4.6.19 Pointers Road Ditch is immediately to the north-east of the M25 junction 10/A3 Wisley interchange, running for approximately 400m along Pointers Road north towards the A3. Its downstream reaches will be affected by Scheme component ML3 (as shown in Appendix B).

4.6.20 The ditch is ephemeral and between 1 - 1.5m wide. At the time of survey (November 2018) there was a small amount of water at the most downstream end. The channel is straightened and sits within mature woodland which has recently undergone extensive tree removal works and has resulted in large amounts of woody debris scattering the banks and in places blocking the channel. Vegetation is limited to occasional brambles on the banks and pendulous sedge at the channel margins. Due to its channel morphology, ephemeral nature and woodland shading, Pointers Road ditch is of limited ecological value.

Chatley Wood Ditch and Pond

4.6.21 Chatley Wood Ditch and Pond are to the north-east of the M25 junction 10/A3 Wisley interchange, in part within Replacement land at Chatley Wood. An area of disturbed land / potential wet woodland at the south west end of the ditch is affected by Scheme component ML2 (Appendix B). Also note that habitat improvement works to Chatley Wood Pond are proposed as additional specific mitigation for the effect of the Scheme on ephemeral headwater ditches in the Mole catchment (Appendix F).

4.6.22 Chatley Wood Pond is a large (approximately 2300m^2) ephemeral, heavily silted pond within mature woodland consisting predominately of conifers. It is noticeably embanked on the eastern and northern edges with occasional

overhanging silver birch (*Betula pendula*) and willow species. At the time of survey (September and November 2018) the pond was dry, with only a small amount of water present within a distinct channel within the pond extent, which contained a large amount of water-pepper (*Persicaria hydropiper*). Marsh pennywort (*Hydrocotyle vulgaris*) covered the entire area of the pond with occasional areas of gypsywort (*Lycopus europaeus*), sedges and rushes. Due to its ephemeral nature, Chatley Wood Pond is of limited ecological value.

4.6.23 An indistinct ditch runs from the pond in a south western direction. As the ditch flows south west, it becomes more distinct in places, however, the use of heavy machinery for recent extensive tree removal works have removed any trace of a distinct ditch at other points and created the potential for a wet woodland in the winter. A brick culvert runs beneath Pointers Road to another area of disturbed land/potential wet woodland.

4.6.24 An artificial embankment to the south of Pointers Road creates a divide, with water to the south of the embankment flowing north from an outfall adjacent to the M25. Here, a concrete retention structure holds back water before it flows north easterly towards the embankment. The ditches are of limited ecological value due to the ephemeral nature, channel morphology and heavy shading.

Wey (Shalford to River Thames confluence at Weybridge)

4.6.25 The River Wey (Shalford to River Thames confluence at Weybridge) is not crossed directly by any component of the Scheme. However, there are eight ditches or surface water flow paths that drain to this water body in the vicinity of the Scheme. Although not all of these are directly affected by the Scheme, most are impacted (or are the subject of works to mitigate the effect of the Scheme). Details of the general morphology and aquatic habitats within these water features is set out below. Photographs taken at the time of survey are presented in Appendix E.

A3 ditch (adjacent to roadside)

4.6.26 This ephemeral ditch runs adjacent to the A3 (immediately south of the road), between Bolder Mere and Elm Lane. It currently conveys both natural runoff generated by a small upstream catchment and runoff coming off the A3. It is affected by Scheme components WY2 & WY3 (please refer to Appendix B). Note that the ditch will also receive treated runoff from the Scheme (WY9).

4.6.27 When surveyed in September 2018, this ditch was completely dry and contained a large volume of litter along the entire stretch (from Bolder Mere to Elm Lane). The ditch contained water when surveyed in January and November 2018 (in January this ditch was also receiving water from the both Bolder Mere outfalls). No aquatic vegetation was present at any survey, only bankside brambles and bracken encroaching in places and it is heavily shaded along the entire stretch from broadleaf trees. It is approximately 1m wide and at the downstream end banks are up to 0.5m high. Upstream, while the right bank remains high (adjacent to the road), the left bank disappears as a number of small ditches run into a wide wet area.

4.6.28 An aquatic invertebrate survey was undertaken in May 2018. Based on the aquatic macroinvertebrate data gathered, the Biological Water Quality is ‘poor’, comprising invertebrate assemblages of low conservation value containing

predominantly common species. The species present also show the flow is slack or sluggish and there is a high amount of sedimentation. Further details can be found in the Environmental Statement Appendix 7.6 on Aquatic Ecology (application document TR010030/APP/6.5). Due to its ephemeral nature and limited habitat complexity this ditch is of limited ecological value.

Pond Farm south ditch

4.6.29 This ditch receives water from Bolder Mere and the A3 ditch (adjacent to roadside). It flows in a northerly direction under the A3 and the Wisely Common Restricted Byway and continues northwards through Wisely Common. The very upper reaches of the ditch are affected by Scheme components WY4 & WY5 (as shown in Appendix B). Note that ditch will also receive treated runoff from the Scheme (WY9).

4.6.30 The ditch flows through mature woodland (a mix of conifer and broadleaf) with occasional woody debris and tree roots creating natural dams. When surveyed in September 2018, no flow was visible although damp areas were present containing water mint (*Mentha aquatica*) and fool's watercress (*Apium nodiflorum*) further downstream. In November 2018, the channel contained water with visible flow, received from A3 ditch (adjacent to roadside) (no flow was emanating from Bolder Mere). This ditch has the potential to be of ecological value but is limited due to heavy shading and ephemeral nature. This ditch flows within the Proposed Thames Basin Heath Special Protection Area compensation and enhancement area south of Pond Farm, Wisley Common.

Pond Farm west ditches

4.6.31 This is a ditch network draining Wisley Common around Pond Farm (Appendix E, Figure A). Although not directly affected by the Scheme, water habitat improvement works are proposed on sections of this ditch network within the Proposed Thames Basin Heath Special Protection Area compensation and enhancement area west of Pond Farm. These works are additional specific mitigation for the effect of the scheme on ephemeral headwater ditches in the Wey catchment and are described in Appendix F.

4.6.32 The ditches flow north westerly through mature broadleaf woodland and rough pasture. The main ditch is approximately 1.5m wide with a trapezoidal shape with predominantly smooth flow type. Heavy shading from mature trees limit any in-channel vegetation and bankside vegetation is limited to occasional bracken and bramble. Bankside tree roots provide natural dams within a straightened channel, although fine sediment berms are forming. The ditch running from the north east through rough pasture was dry at time of survey (November 2018) and overgrown within hedgerows. These ditches are of limited ecological value due to channel morphology, heavy shading and ephemeral nature.

Hut Hill south ditches

4.6.33 OS mapping suggests a series of ditches were present to the south west of Hut Hill in the Proposed Thames Basin Heath Special Protection Area compensation and enhancement area south of Hut Hill (Appendix E, Figure A). This area is not directly affected by the Scheme.

4.6.34 The recent use of heavy machinery to clear conifer trees and the resulting brush left behind has made it impossible to determine the course of the ditch network

(visited in November 2018). While it is anticipated this may become a wet area in the winter, overall these ditches are of limited ecological value due to their ephemeral nature.

Cockcrow Hill ditches

4.6.35 These ephemeral ditches are located to the north of Cockcrow Hill and south of M25 westbound on-slip at the M25 junction 10/A3 Wisley interchange. One ditch is directly affected by Scheme components WY8 (as shown in Appendix B).

4.6.36 This is an ephemeral ditch system (dry at time of survey in November 2018) with no in-channel vegetation and within a mix of conifer and broadleaf woodland, and heathland. The ditches run in a westerly direction into an area of wet heath. These ditches are of limited ecological value due to their ephemeral nature and heavy shading.

Hut Hill ditch

4.6.37 This ditch is located between the A3 and Hut Hill. It is anticipated that it will be affected by Scheme components WY6 & CB12 (Appendix B).

4.6.38 The ditch is ephemeral and runs along the side of a hill within mixed conifer and broadleaf woodland. Running in a north easterly direction, the channel is very indistinct and is hidden beneath dense bramble and bracken scrub. This ditch is of limited ecological value due to its ephemeral nature.

Ditches in central reservation of A3

4.6.39 There are two ditches within the central reservation of the A3 adjacent to the RHS Garden at Wisley. These will be affected by Scheme component WY7 (Appendix B).

4.6.40 The ditches were not accessible for survey. It is anticipated they capture road run-off from the A3, are ephemeral and of limited ecological value.

Elm Lane ditch

4.6.41 A small ditch runs alongside Old Lane, crossing underneath Elm Lane at the junction between the two roads. The ditch drains to Bolder Mere. It will be affected by Scheme component WY1 (as shown in Appendix B).

4.6.42 When surveyed (November 2018) water was visible south of Elm Lane flowing north, but, did not seem to appear under Elm Lane; the northern ditch contained water but had no flow and was at a low level. This ditch flows through mature broadleaf woodland with little understory vegetation comprised mostly of bramble, bracken and occasionally pendulous sedge (*Carex pendula*). Due to heavy shading and its ephemeral nature, it is of limited ecological value.

Bolder Mere

Background

4.6.43 Bolder Mere is a small (8 ha), shallow (max. 1.1 m) lake situated within mixed woodland and bordered to the northwest by the A3 dual carriageway. There are significant alterations to the drainage and shoreline of the lake, made, at least in part, to accommodate the building and expansion of the road now called the A3

(Figure 4.4). The lake and surrounding areas are of significant conservation interest (see section headed 'Designations' below).

4.6.44 Results of macrophyte, aquatic macro-invertebrate and habitat surveys of the lake can be found in Goldsmith Ecology (2018) (Appendix D.1), an investigation commissioned for this study to assess the ecology and physical habitat of the lake, identify the value of the habitats therein and consider mitigation for the effects of the Scheme.

4.6.45 The lake has a small surface water catchment of just under 2 km^2. Overlying a solid geology of the Bagshot Formation, it is believed to be in continuity with groundwater, and hence water levels are likely to be controlled or influenced by groundwater levels. Outflow from the lake is via a formal structure (thought to control low flows) and a natural outlet (thought to operate during higher flows) (Figure 4.4).

4.6.46 Historically the lake was a Carp fishery.

Designations

4.6.47 Bolder Mere is designated as part of Ockham and Wisley Commons SSSI primarily for its extensive areas of lowland heath (Natural England, undated & 2016). The wetlands, including Bolder Mere are an important feature within the SSSI, with notable importance for plant species with records of local rarities including Shoreweed Littorella uniflora, Marsh St. John's wort *Hypericum elodes*, Lesser water-plantain *Baldellia ranunculoides*, Needle spike-rush *Eleocharis acicularis* and Pillwort *Pilularia globulifera*.

4.6.48 More specifically, Bolder Mere is identified within the SSSI citation as being of national importance for dragonflies and damselflies (Odonata). Over 20 species have been recorded at the site, including the rare White-faced dragonfly *Leucorrhinia dubia* and local species such as the Hairy dragonfly *Brachytron pratense* and the Ruddy darter *Sympetrum sanguineum*.

4.6.49 Bolder Mere also lies within the Thames Basin Heaths SPA, but the lake is not considered important to the bird species (Nightjar, Woodlark, Dartford warbler) for which the SPA was created.

4.6.50 Bolder Mere is classified by the WFD as a lake HMWB (section 4.5). It is an unusually small water body. It was specifically awarded protection under the WFD because of its SSSI status (pers comm, Environment Agency). The lake's HMWB designation is because of its 'use' to the wider environment, which could, in part, be interpreted as its contribution to the healthy functioning of the wider environment of the SSSI. Hence, although the WFD and SSSI designations of the lake are not directly linked, the intent of designating the lake as a WFD water body and the specified 'use' of the water body can be interpreted as providing further protection to the lake as a unit of the SSSI.

Pressures on WFD status

4.6.51 A principal reason for Bolder Mere failing to achieve GEP in 2016 is exceedance of Total Phosphorus standards, as demonstrated by quarterly water quality monitoring carried out since 2010[4] and occurrence of algal blooms within the lake (pers comm. NE). Sources of phosphorus and other nutrients in Bolder

[4] Recent sampling regime can be found on the Environment Agency's Water Quality Archive at http://environment.data.gov.uk/water-quality/view/sampling-point/TH-PGWL0188 [accessed 25th April 2016].

Mere are not fully understood, but, could include recycling by biological activity (e.g. bottom feeding fish), overwintering bird roosts and septic tanks within the catchment of the lake.

4.6.52 A literature review of common chemical components of road runoff (Appendix D.3) suggests that the A3 is unlikely to be a direct source of phosphorus to Bolder Mere. The same review shows that the road is an unlikely pathway for phosphorus to the lake from common sources such as arable land.

4.6.53 Although the A3 is probably not contributing to the failure of the Bolder Mere water body to comply with phosphorus standards, provisional drainage survey records collected for this study and file records at NE indicate that runoff (and potential associated pollutants) from the A3 discharges direct to Bolder Mere, without treatment. The NE records refer to “ponded water on the road and lake merged into one” suggesting that either the road drainage system becomes overwhelmed or that high lake levels flood the road.

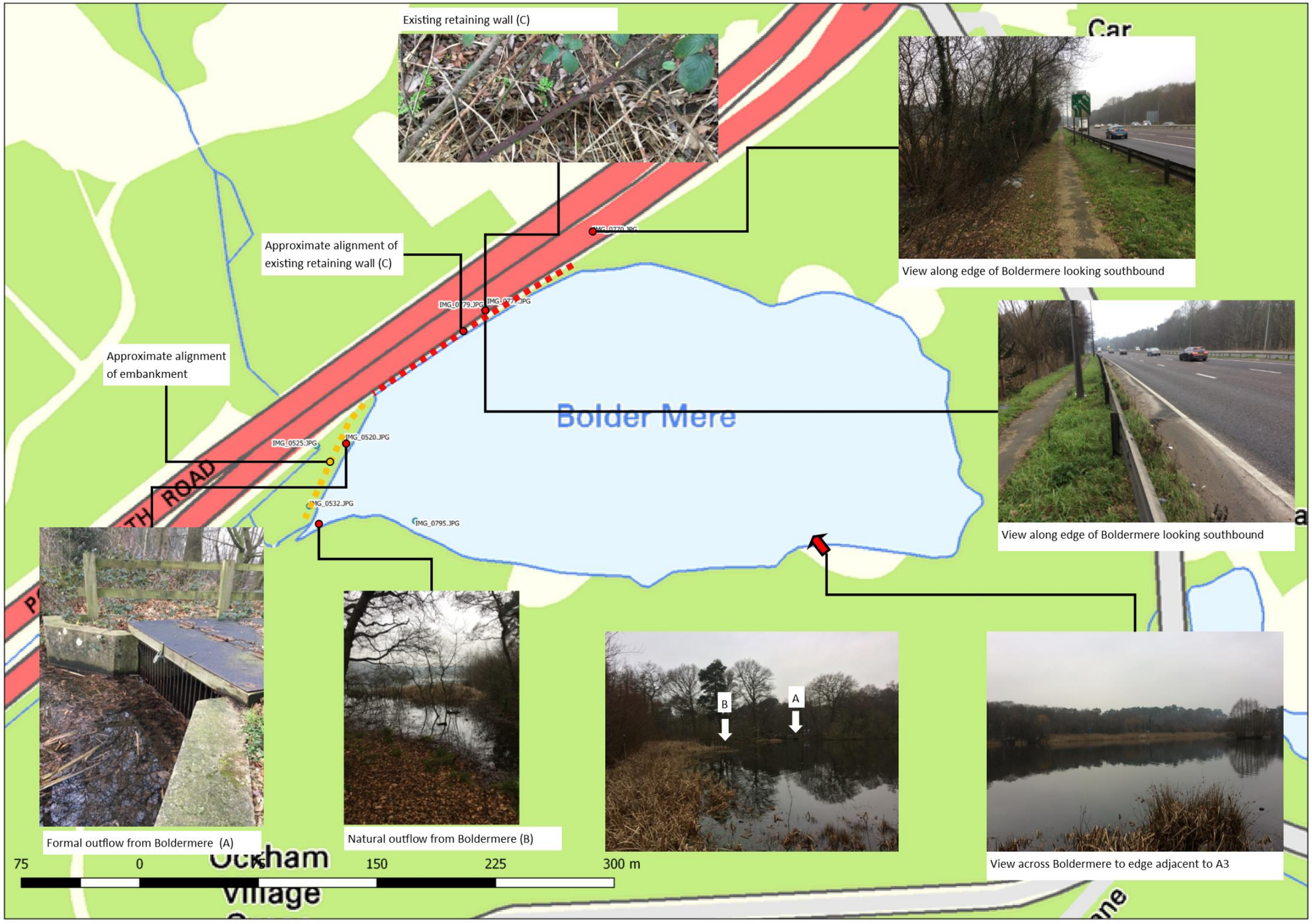


Figure 4.4: Bolder Mere: modifications resulting in HMWB status and photos of key features

Chobham Bagshot Beds

4.6.54 No site specific intrusive ground investigation has been undertaken in relation to this Scheme and therefore limited groundwater level information is available for the Chobham Bagshot Beds ground water body, and no long term monitoring data is available.

4.6.55 Information on groundwater strikes and rest levels have been collected from publicly available exploratory hole records[5] and other available sources, including HAGDMS24 and two previous ground investigations detailed in reports provided on the Guildford Borough Council planning applications website[6]. In summary, the available data suggests groundwater strikes between 0.2 and 16 mbgl and are recorded in the Bagshot Formation, the London Clay and the superficial deposits.

4.6.56 Environmental Statement Appendix 8.2 (application document TR010030/APP/6.5). contains a summary of the rest groundwater levels and a summary of the water strikes from these previous investigations recorded in the Bagshot Formation and the superficial deposits. The recent rest groundwater levels are single manual dips recorded in either May 2014 or November 2012. These manual dips are mapped in Figure 4.3. Older manual dips, while included in Appendix 8.2, are not considered by Highways England to be representative of present-day conditions and have therefore been excluded from Figure 4.3.

4.6.57 Due to the limited availability of groundwater level data, it is not possible to determine the groundwater flow direction or the depth to groundwater in the vicinity of the scheme. Intrusive site-specific ground investigation is scheduled for the detailed design phase of the Scheme and will allow the groundwater flow direction and the depth to groundwater to be determined. Assessment of the impacts of the Scheme on groundwater have therefore proceeded in the meantime on the basis of a reasonable worst-case scenario.

4.7 Effect of permanent works

Introduction

4.7.1 This section sets out an assessment of the compliance of each scheme component for the M25 junction 10 / A3 Wisley interchange with the requirements of the WFD. It is a summary of the full assessments set out in the matrices in Appendix C. General arrangements of the Scheme can be found in the Scheme Layout Plans (application document TR010030/APP/2.8). Scheme components affecting the water environment are marked on georeferenced general arrangements in Appendix B.

4.7.2 The assessments cover both Test A (no deterioration) and Test B (protecting future attainment of GES). They summarise the effect of scheme components on WFD quality elements using the colour coding described below paragraph 3.3.6.

[5] British Geological Survey (2017) Onshore GeoIndex (Online) Accessed on 21/03/2018 from http://mapapps2.bgs.ac.uk/geoindex/home.html

[6] Guildford Borough Council (2018) Planning applications, Accessed on 21/03/2019 from http://www2.guildford.gov.uk/publicaccess/applicationDetails.do?activeTab=documents&keyVal=_GUILD_DCAPR_157858

Assessments are aggregated based on the WFD principle of “one out, all out” to eventually determine the effect of the Scheme at a water body scale.

WFD assessment of the scheme

Stratford Brook

Overview

4.7.3 Scheme components affecting the Stratford Brook water body are considered compliant with the requirements of the WFD. This assumes a) mitigation already ‘embedded’ in the preliminary design (as summarised in section 5.2) and b) additional mitigations (as set out in sections 5.3 and 5.4) are implemented to ensure **no adverse effect on the water body**. On this basis, **the scheme components affecting Stratford Brook are not considered by Highways England to cause deterioration (thus passing Test A) and should not prevent future attainment of GES (Test B)**.

4.7.4 Figure 4.5 is a visual summary of our WFD assessment of the effect of each scheme component on the Stratford Brook WFD elements. A full assessment can be found in the matrix in Appendix C.

Test A Potential to cause deterioration of current WFD Ecological Status

4.7.5 Key points on the effects of scheme components on the water body and mitigation of those effects are set out in the in paragraphs 4.7.6 to 4.7.10 below.

4.7.6 Embedded mitigation associated with the proposed **new river crossing (Stratford Brook underbridge) (SB1)** is insufficient to fully mitigate the localised adverse effects the structure has on the brook. Effects are as follows: a) the macrophyte and phytobenthos quality element (shading reducing photosynthetic activity); b) the macroinvertebrate quality element (loss of habitat resulting from reduction in / loss of aquatic and riparian vegetation) and c) the hydromorphological quality element (simplification of riparian zone associated with shading and footprint of structure). Additional mitigation is required.

4.7.7 Consultation with the Environment Agency identified that mitigation effort would most effectively be targeted at improving fish and mammal passage through the existing Stratford Brook Culverts (North and South) and / or lowering the invert of Stratford Brook Culvert (South) to reduce the extent of backwater generated by the structure. However, insufficient information on the form and condition of these two structures is currently available to determine whether such works could be implemented at reasonable cost. To work around this uncertainty a simple strategy has been agreed between the Environment Agency and Highways England that keeps ‘in play’ the measures at Stratford Brook Culverts (North and South) that would deliver most environmental benefit whilst not committing the Scheme to a disproportionate cost. The strategy is set out below (with more detail provided in Appendix F):

- Commit the Scheme to delivering mitigations that carry a) reasonable and certain costs, and b) allow measures at Stratford Brook Culverts (North and South) to be explored further (measures SBa-SBd).

- Agree to implement a mix of measures at one or both of Stratford Brook Culvert (North) and Stratford Brook Culvert (South), if this can be done at reasonable cost.
- In the unlikely circumstance that a mix of measures at one or both of Stratford Brook Culvert (North) and Stratford Brook Culvert (South) cannot be delivered as part of the Scheme at reasonable cost, a commuted sum will be paid to the Environment Agency for delivery of environmental improvement in the Wey catchment (Statement of Common Ground with Environment Agency, application document TR010030/APP/8.3).

4.7.8 An appropriate set of measures to mitigate the localised adverse effects of the Stratford Brook underbridge (SB1) is secured by inclusion in the REAC for the Scheme (part of the Outline CEMP (application document TR010030/APP/7.2). Agreement of the details of this element of the Scheme is secured under Requirement 12 of the Development Consent Order for the Scheme (Application document TR010030/APP/3.1).

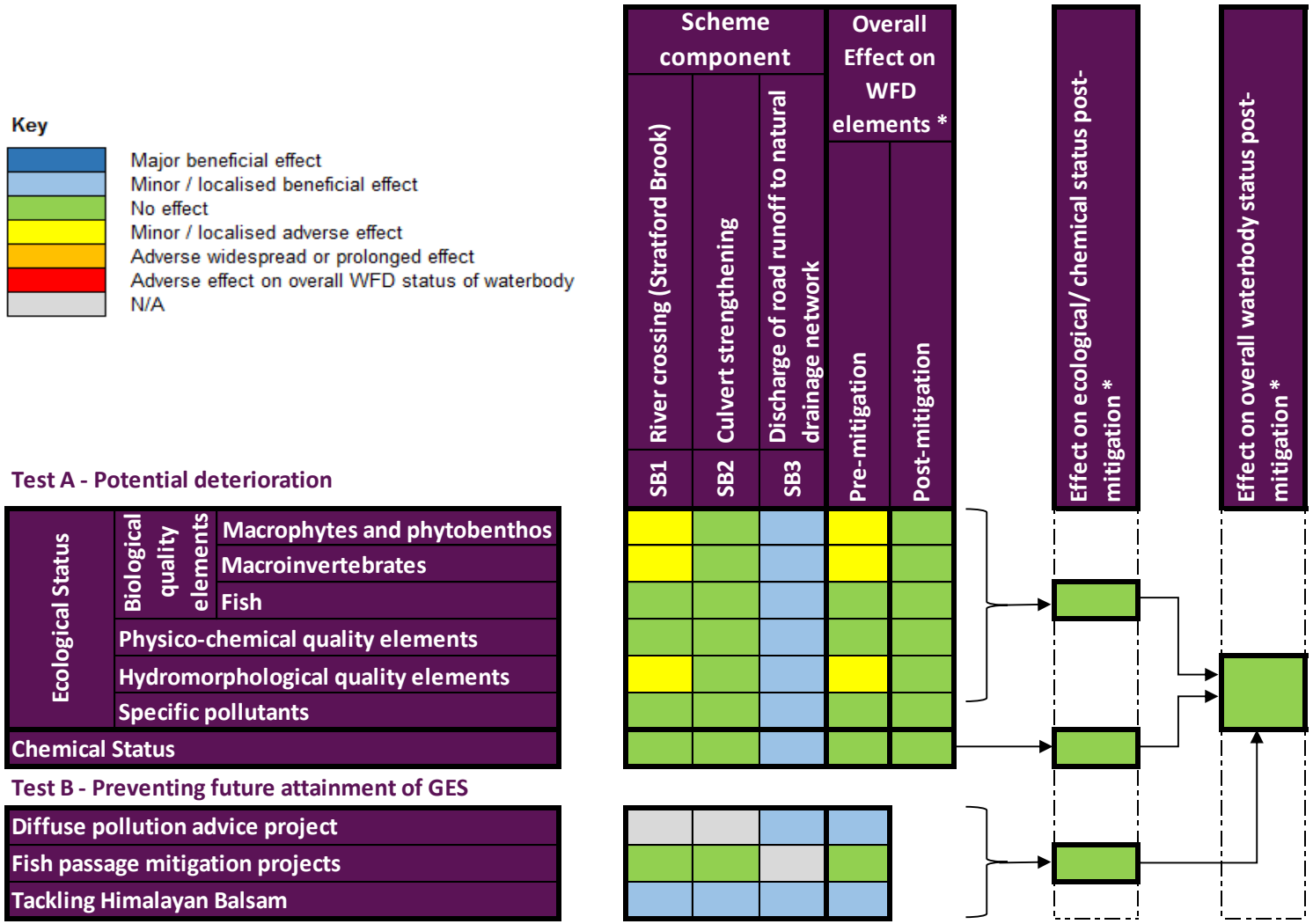
4.7.9 The strengthening of an existing **Stratford Brook Culvert (South) (SB2)** is assessed as having no effect on all WFD quality elements. Works will be undertaken in a way that allows the existing culvert to remain in situ.

4.7.10 **Improved management road runoff before discharge to the natural drainage network (SB3)** will generate localised beneficial effects on all WFD quality elements. Based on currently available information, a design for road drainage has been developed to achieve compliance with relevant EQS and RST toxicity standards as tested with HAWRAT - included in Chapter 8: Road Drainage and Water Environment in the Environmental Statement (Application document TR010030/APP/6.3). Attenuation areas are used to treat road runoff in this water body. Runoff generated by non-highway surfaces, such as embankments, is collected and conveyed to natural waters by pre-embankment drains.

Test B Potential to prevent future attainment of Good Ecological Status

4.7.11 Although there are no measures assigned to this water body in the RBMP or associated data sets, the local Catchment Partnerships do set out some aims in the RBMP (Environment Agency, 2015). The design does contribute to the reduction of diffuse pollution from the region’s road network and may contribute to the removal of barriers to fish passage. It could also be considered to contribute to the management of Himalayan Balsam.

4.7.12 Hence the Scheme is not considered by Highways England to prevent future attainment of Good Ecological Status.



* Each of these assessments takes the category with the worst effect recorded on the scheme components contained within their assessment

Figure 4.5: Summary of WFD assessments for the scheme in the Stratford Brook WFD water body

Mole (Horley to Hersham)

Overview

4.7.13 Scheme components affecting the Mole (Horley to Hersham) water body are considered compliant with the requirements of the WFD. This assumes a) mitigation already 'embedded' in the preliminary design (as summarised in section 5.2) and b) additional mitigations (as set out in sections 5.3 and 5.4) are implemented to ensure **no adverse effect on the water body**. On this basis, **the scheme components affecting this water body are not considered by Highways England to cause deterioration (thus passing Test A) and should not prevent future attainment of GES (Test B)**.

4.7.14 Figure 4.6 is a visual summary of our WFD assessment of the effect of each scheme component on the Mole (Horley to Hersham) WFD elements. A full assessment can be found in the matrix in Appendix C.

Test A Potential to cause deterioration of current WFD Ecological Status

4.7.15 Key points on the effects of scheme components on the water body and mitigation of those effects are set out in the in paragraphs 4.7.16 to 4.7.17 below.

4.7.16 **Works affecting channels and ditches (ML1, ML2 and ML3)** The loss of around 420 m of ephemeral headwater ditch, of which approximately 120 m is next to the road and is therefore likely to collect road drainage is assessed as having no effect on WFD quality elements for two reasons. Firstly, the new road drainage scheme consists of 720 m of open ditch of which, at this stage in the design, it is estimated that all 720 m will be reserved for water coming from embankments and natural catchments rather than road runoff. As 720 m is approximately 170% of the lost ephemeral channel length, the habitat will be more than replaced by the new open ditches once they have been given time to establish. It is recognised that the replacement ditch is formal in nature, with the design of the pre-embankment drains constrained by space and their primary function as efficient drainage of 'clean' water. However, a generic design has been agreed with the drainage team to make the ditches as environmentally sensitive as possible (see paragraphs headed 'Construction of new open ditches (pre-earthworks ditches)' in section 5.4). Finally, additional specific mitigation is proposed in the form of the enhancement of water features on Replacement Land (ML_a, see section 5.3 and Appendix F.4.2 for further details). The combined impact of the open ditches from the road drainage scheme and the enhancement of the water features on the Replacement Land will mitigate for the loss of habitat by providing an overall increase in ephemeral water habitat.

4.7.17 Improved management of road runoff before discharge to the natural drainage network (ML4) will generate localised beneficial effects on all WFD quality elements. Based on currently available information, a design for road drainage has been developed to achieve compliance with relevant EQS and RST toxicity standards as tested with HAWRAT - included in Chapter 8: Road Drainage and Water Environment in the Environmental Statement (Application document TR010030/APP/6.3). Attenuation areas are used to treat road runoff in this water body. Runoff generated by non-highway surfaces, such as embankments, is predominantly collected and conveyed to natural waters by pre-earthworks drains.

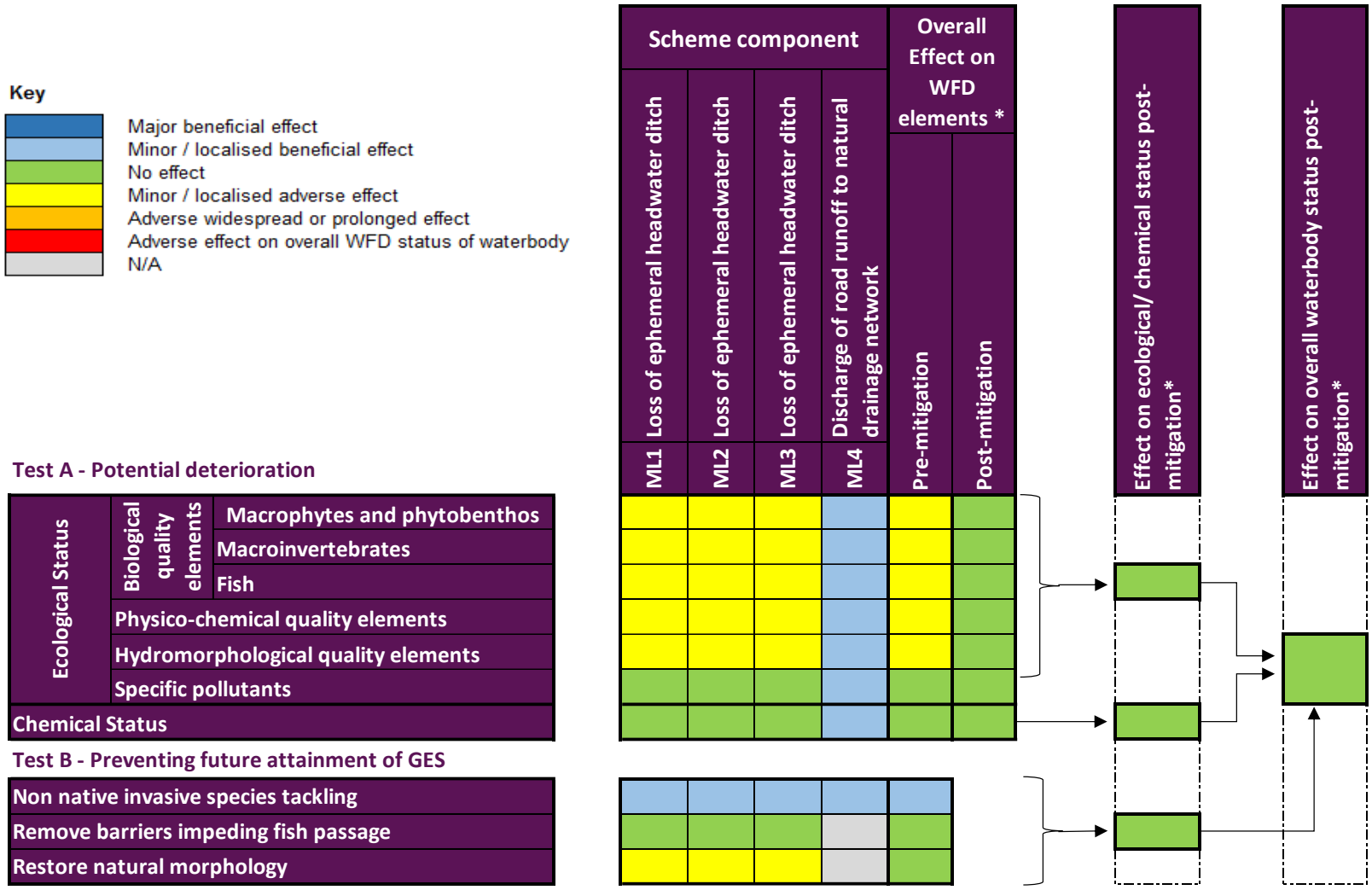
~~4.7.17 Although impacting riparian zone, a **retaining wall at Manor Pond (ML4)** is expected to have no effect on WFD water quality elements. The pond is artificial and stocked for fishing. It has a limited ecosystem value so does not notably contribute to the functioning of the Mole (Horley to Hersham) WFD water body~~

~~4.7.18 **Improved management of road runoff before discharge to the natural drainage network (ML5)** will generate localised beneficial effects on all WFD quality elements. Based on currently available information, a design for road drainage has been developed to achieve compliance with relevant EQS and RST toxicity standards as tested with HAWRAT - included in Chapter 8: Road Drainage and Water Environment in the Environmental Statement (Application document TR010030/APP/6.3). Attenuation areas are used to treat road runoff in this water body. Runoff generated by non-highway surfaces, such as embankments, is predominantly collected and conveyed to natural waters by pre-earthworks drains.~~

Test B Potential to prevent future attainment of Good Ecological Status

~~4.7.19~~4.7.18 Although there are no measures assigned to this water body in the RBMP or associated data sets, the local Catchment Partnerships do set out some aims in the RBMP (Environment Agency, 2015). The Scheme components affecting the Mole (Horley to Hersham) water body could be considered a) to contribute to the management of Non Native Invasive Species (NNIS); and b) restore natural channel morphology, through proposed additional mitigation work on Replacement Land. There are no opportunities within the Scheme boundary to remove barriers to fish passage.

~~4.7.20~~4.7.19 Hence the Scheme is not considered by Highways England to prevent future attainment of Good Ecological Status.



* Each of these assessments takes the category with the worst effect recorded on the scheme components contained within their assessment

Figure 4.6: Summary of WFD assessments for the Scheme on the Mole (Horley to Hersham) WFD water body

Wey (Shalford to River Thames confluence at Weybridge)

Overview

~~4.7.21~~4.7.20 Scheme components affecting the Wey (Shalford to River Thames confluence at Weybridge) water body are considered compliant with the requirements of the WFD. This assumes a) mitigation already 'embedded' in the preliminary design (as summarised in section 5.2) and b) additional mitigations (as set out in sections 5.3 and 5.4) are implemented to ensure **no adverse effect on the water body**. On this basis, **the scheme components affecting the water body are not considered by Highways England to cause deterioration (thus passing Test A) and should not prevent future attainment of GES (Test B)**.

~~4.7.22~~4.7.21 Figure 4.7 is a visual summary of our WFD assessment of the effect of each scheme component on the Wey (Shalford to River Thames confluence at Weybridge) WFD elements. A full assessment can be found in the matrix in Appendix C.

Test A Potential to cause deterioration of current WFD Ecological Potential

~~4.7.23~~4.7.22 Key points on the effects of scheme components on the water body and mitigation of those effects are set out in the in paragraphs 4.7.23 to 4.7.25 below.

~~4.7.24~~4.7.23 **Culverts works (WY1, WY3, WY4, WY5 & WY7 – part of) are assessed as having no effect on WFD quality elements.** Culvert works proposed on minor Ordinary Watercourses in the Wey catchment comprise one new culvert, one replacement, and three extensions. The preliminary design contains no detail on the form of these works beyond the General Arrangements in the Scheme Layout Plans (application document TR010030/APP/2.8). To secure WFD compliance, it is recommended that the principles of WFD compliant design outlined in the guidance in Section 5.4 should be observed when developing detailed designs for these structures and any associated channel realignments. Guidance under the headings 'Culverts', 'Channel widening, deepening, straightening or realigning' and 'Bank and Bed reinforcement' in 5.4 are particularly relevant. Additional mitigation measures local to the culvert works, or as part of the enhancement of water features on Replacement Land and in Enhancement Areas (Wy_a) may also be required - see section 5.3 and Appendix F.5.2 for further details). Note that scheme component WY1 is on an Elm Lane Ditch, a watercourse that drains to Bolder Mere – mitigation developed as part of detailed design should ensure no adverse effect on this sensitive lake habitat.

~~4.7.25~~4.7.24 **Works affecting channels and ditches (WY2, WY6, WY 7 – part of & WY8)** The loss of around 820 m of ephemeral headwater ditch, of which approximately all of the length is next to the road and is therefore likely to collect road drainage, is assessed as having no effect on WFD quality elements for two reasons. First, the new road drainage scheme consists of 2265 m of open ditch within the Wey catchment of which, at this stage in the design, 1440 m is estimated as reserved for water coming from embankments and natural catchments rather than road runoff. As 1440 m is approximately 175% of the lost ephemeral channel length, the habitat will be more than replaced by the new open ditches once they have been given time to establish. It is recognised that the replacement ditch is formal in nature, with the design of the pre-earthworks drains constrained by space and their primary function as efficient drainage of 'clean' water. However, a generic

design has been agreed with the drainage team to make the ditches as environmentally sensitive as possible (see paragraphs headed 'Construction of new open ditches (pre-earthworks ditches)' in section 5.4). Finally, additional specific mitigation is proposed in the form of the enhancement of water features on Replacement Land (WY_a, see section 5.3 and Appendix F.5.2 for further details). The combined impact of the open ditches from the road drainage scheme and the enhancement of the water features on the Replacement Land will mitigate for the loss of habitat by providing an overall increase in ephemeral water habitat.

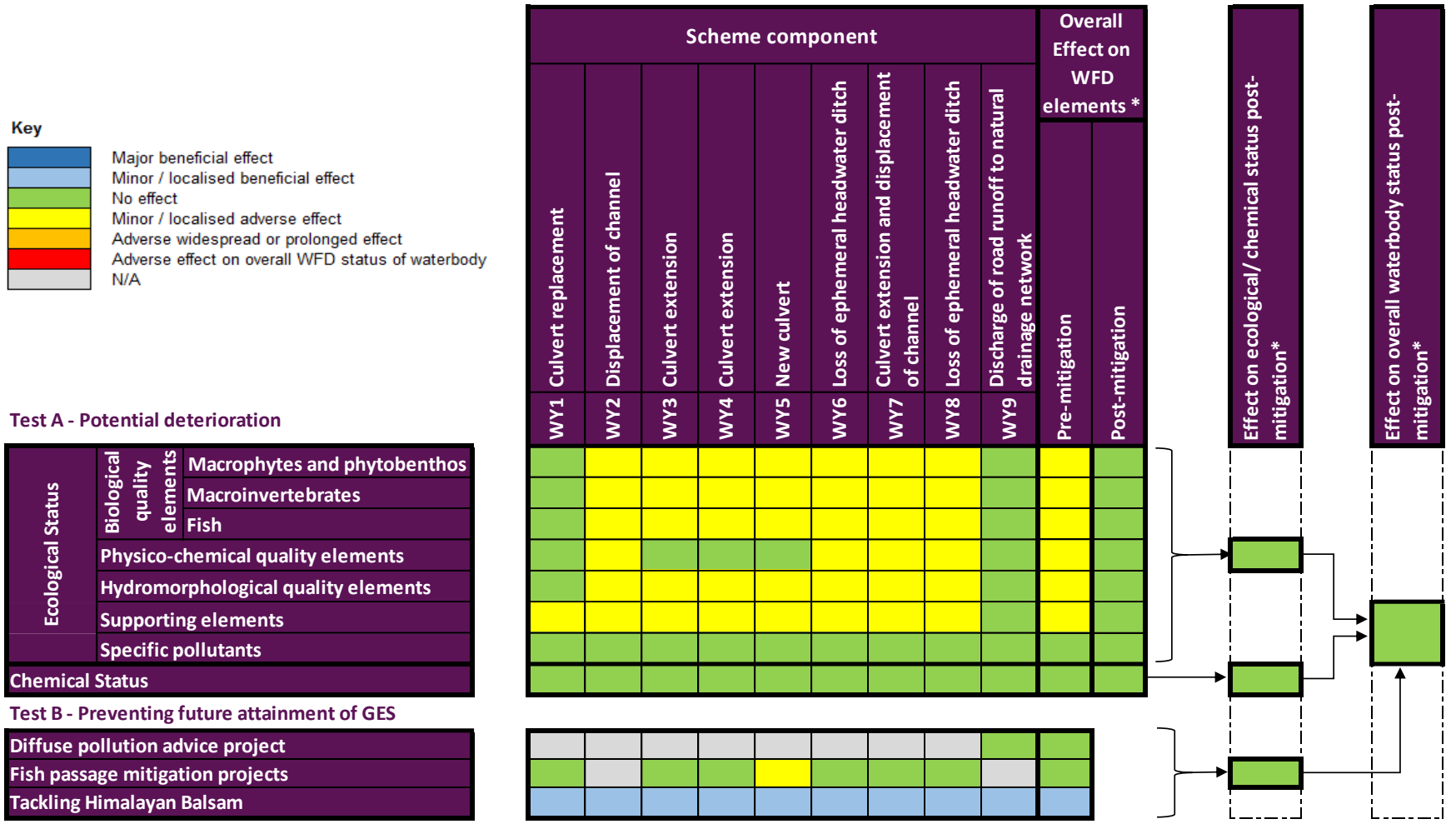
4.7.264.7.25 **Improved management of road runoff before discharge to the natural drainage network (WY9)** will generate localised beneficial effects. Based on currently available information, a design for road drainage has been developed to achieve compliance with relevant EQS and RST toxicity standards as tested with HAWRAT at the confluence of watercourses receiving runoff from the Scheme with the arterial River Wey. Additionally, the HAWRAT method for assessing the effect of road runoff on groundwaters (Method C, Highways England, 2009) was applied to points of discharge from the A3 to ditch tributaries of the Wey, using available groundwater data. No adverse effect was found on the water environment, but this will be confirmed following the receipt of more comprehensive information from intrusive site-specific ground investigation scheduled for the detailed design phase of the Scheme. Further detail on these assessments can be found in Chapter 8: Road Drainage and Water Environment in the Environmental Statement (application document TR010030/APP/6.3). Treatments of road runoff incorporated into the design comprise attenuation areas, soakaways and soakaway infiltration trenches. Runoff generated by non-highway surfaces, such as embankments, is predominantly collected and conveyed to natural waters by pre-earthworks drains.

Test B Potential to prevent future attainment of Good Ecological Potential

4.7.274.7.26 HMWB mitigation measures assigned to the Wey water body are listed in Table 4.4. Of these numbers 4 (remove or soften hard bank), 5 (preserve or restore habitats), 6 (in-channel morphological diversity), 7 (bank rehabilitation) and 19 (enhance ecology) are potentially compromised by the minor, localised culvert works and works affecting channels and ditches described in 4.7.23 above. Mitigation measures also set out in 4.7.23 are proposed to address this potential compromise.

4.7.284.7.27 The local Catchment Partnerships set out some aims in the RBMP (Environment Agency, 2015). Scheme components affecting the Wey water body could be considered to contribute to those on a) the management of Himalayan Balsam and b) the reduction of diffuse pollution from the region's road network. However, the Scheme does counter an aim to remove barriers to fish passage.

4.7.294.7.28 Overall, the Scheme is not considered by Highways England to prevent future attainment of Good Ecological Potential.



* Each of these assessments takes the category with the worst effect recorded on the scheme components contained within their assessment

Figure 4.7: Summary of WFD assessments for the Scheme on the Wey (Shalford to R. Thames confl. at Weybridge) WFD water body

Bolder Mere

Overview

~~4.7.30~~4.7.29 This WFD assessment indicates that scheme components affecting the Bolder Mere water body would be compliant with the requirements of the WFD. This assumes a) the mitigation already 'embedded' in the preliminary design (as summarised in section 5.2) is implemented and b) additional mitigations (as set out in sections 5.3 and 5.4) **will limit the overall effect of the scheme to minor and localised**. On this basis, **the scheme components affecting Bolder Mere are not considered by Highways England to cause deterioration at the water body scale (thus passing Test A) and should not prevent future attainment of GES (Test B)**.

~~4.7.31~~4.7.30 Figure 4.8 is a visual summary of our WFD assessment of the effect of each scheme component on the Bolder Mere WFD elements. A full assessment can be found in the matrix in Appendix C.

~~4.7.32~~4.7.31 To reduce the effect of the Scheme on Bolder Mere substantial embedded mitigation has been built into the scheme. The Wisley Common Restricted Byway is located away from Bolder Mere on the northern side. This reduces the encroachment of the Scheme into Bolder Mere by an estimated 10 m.

Test A Potential to cause deterioration of current WFD Ecological Potential

~~4.7.33~~4.7.32 It is the new retaining wall to be constructed along the north-western edge of the lake (BL1) **that drives the minor localised assessment**. This wall is required to accommodate the widening of the A3 into Bolder Mere. The new wall (length about 228 m) will be constructed c.4-8 m into the lake margins and replaces an existing wall. The effect of this new wall is to reduce lake volume slightly (by an estimated 2%) and to reduce the area of marginal habitat. It is the loss of marginal habitat that is of primary concern because of its potential adverse effect on the environmental 'use' of the lake margins by designated species of the Ockham and Wisley Common SSSI). As presented in the preliminary design, the wall could have a prolonged adverse effects on a) the macrophyte and phytobenthos quality element (direct loss of reedbeds, potential disruption of lake nutrient balance); b) the phytoplankton quality element (increase nutrient concentration in lake, in turn simplifying the phytoplankton assemblage) and c) the hydro-morphological quality element (loss of riparian zone and potential disruption of groundwater inflow to the lake). The preliminary design of the structure is also expected to have minor adverse localised effects on macroinvertebrate and physico-chemical quality elements, but are not predicated to cause deterioration or prevent Good Potential in the P WFD quality element (see Appendix D.2 for analysis demonstrating the estimated 2% reduction in lake volume does not adversely affect the WFD P status of the lake).

~~4.7.34~~4.7.33 The magnitude of these effects are substantially reduced by the **embedded mitigation** described in paragraph 4.7.31.

~~4.7.35~~4.7.34 Highways England are committed to implementation of additional mitigations to limit the effect of the retaining wall on marginal habitat and associated lake functions to minor localised. These mitigations are described in Appendix F and summarised in section 5.3. They comprise reinstatement of lake shore habitat along northwest edge of Bolder Mere (BL_a); habitat improvements on the shores of Bolder Mere (BL_b); invasive species management - carp and bream

(BL_c); feasibility studies into invasive species management (BL_d) and detailed design of new retaining wall along north-western edge of Bolder Mere (BL_e). Works BL_b will also be maintained and monitored for a period of 15 years in accordance with the specification set out in the Thames Basin Heath SPA Management and Monitoring Plan (application document TR010030/APP/6.5).

~~4.7.36~~4.7.35 The other component of the Scheme affecting Bolder Mere (drainage of road runoff, BL2) is expected to benefit the water environment. Current drainage records indicate that runoff from the A3 drains directly to Bolder Mere. The Scheme intends to close this pathway by redirecting runoff via mechanical treatment to a nearby ordinary watercourse. The reduced pollutant load to Bolder Mere is expected to improve lake water quality. In particular, from a WFD perspective, this will help ensure that the salinity quality element remains 'High' after construction. Agreement of the details of this element of the Scheme is secured under Requirement 10 of the Development Consent Order for the Scheme (application document TR010030/APP/3.1).

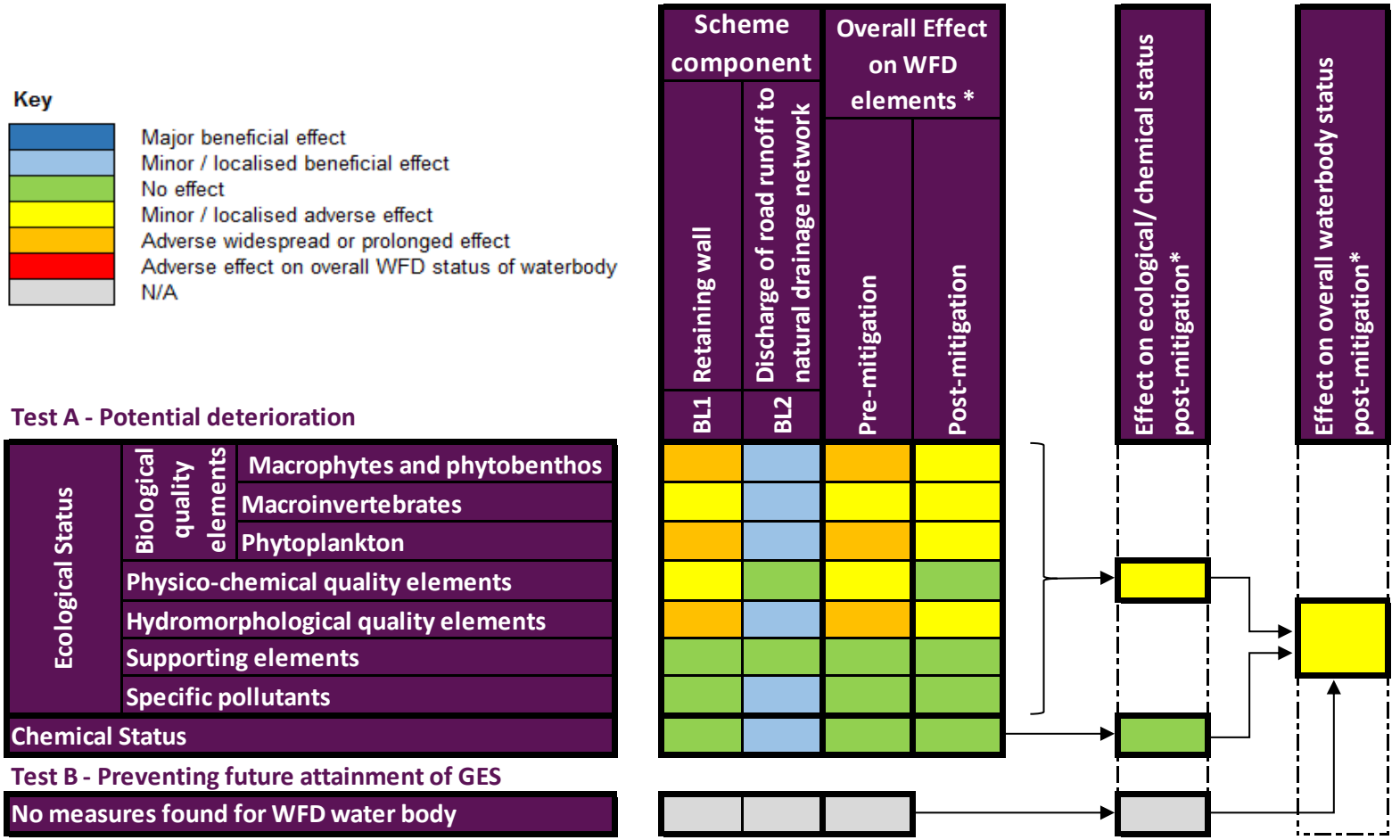
~~4.7.37~~4.7.36 The potential effects on Bolder Mere of culvert works on Elm Lane Ditch, a minor watercourse draining to the lake, are assessed in paragraph 4.7.23.

Test B Potential to prevent future attainment of Good Ecological Potential

~~4.7.38~~4.7.37 There are no measures assigned to this water body in the RBMP, in associated data sets, or by local Catchment Partnerships.

~~4.7.39~~4.7.38 However, the wider environment 'use' of this HMWB can be linked to the lake contributing to the health of the surrounding Ockham and Wisley Commons SSSI (paragraph 4.6.50). The package of embedded and additional specific measures outlined above have been agreed in principle as a) proportionate to the risk of adverse effect of the Scheme on the Bolder Mere SSSI unit and b) having potential to deliver additional biodiversity benefit (Statement of Common Ground with NE, application document TR010030/APP/8.2).

~~4.7.40~~4.7.39 Note also that additional mitigation (specific) measures to address NNIS (BL_c and BL_d) and embedded mitigation to redirect road runoff currently discharging to the lake via mechanical treatment to a nearby Ordinary Watercourse both align with the aims of the Wey Catchment Partnership.



* Each of these assessments takes the category with the worst effect recorded on the scheme components contained within their assessment

Figure 4.8: Summary of WFD assessment for the Scheme on Bolder Mere WFD water body

Chobham Bagshot Beds groundwater body

Overview

4.7.414.7.40 This WFD assessment indicates that scheme components affecting the Chobham Bagshot Beds groundwater body would be compliant with the requirements of the WFD. This assumes a) the mitigation already 'embedded' in the preliminary design (as summarised in section 5.2) is implemented and b) additional mitigations (as set out in sections 5.3 and 5.4) **will limit the overall effect of the scheme to minor and localised**. On this basis, **the scheme components affecting the Chobham Bagshot Beds groundwater body are not considered by Highways England to cause deterioration at the water body scale (thus passing Test A) and should not prevent future attainment of GES (Test B)**.

4.7.424.7.41 Figure 4.9 is a visual summary of our WFD assessment, of the effect of each scheme component on the Chobham Bagshot Beds WFD elements. A full assessment can be found in the matrix in Appendix C.

4.7.434.7.42 Scheme components whose potential impact on the WFD groundwater body have been assessed are:

- Deep foundations (piling) associated with new structures;
- Sheet piling retaining walls;
- Pre-cast concrete retaining walls;
- Crib-segmental retaining walls; and
- Road runoff drainage to groundwater via soakaways.

4.7.444.7.43 As no appropriate groundwater level information is currently available for the groundwater body (see section 4.6.54), a reasonable worst case approach to this assessment has been taken of assuming a fully saturated aquifer.

4.7.454.7.44 In the vicinity of Bolder Mere, where the groundwater flow direction is critical to understanding the potential effect of the scheme on the groundwater body and the lake, reasonable worst-case scenarios of groundwater flow have been used to determine the potential effect, as bulleted below. These represent two extremes of flow direction (one in which the retaining wall acts as a barrier to flow reaching the lake, the other in which the wall acts to prevent flow leaving the lake).

- Groundwater flow from north west to south east perpendicular to the existing retaining wall; and
- Groundwater flow direction from east to west, thereby the existing retaining wall may be retaining water in Bolder Mere.

4.7.464.7.45 Below ground structures, including deep foundations and retaining walls can form a barrier to groundwater flow, depending on the groundwater flow direction. This can potentially reduce groundwater contributions to groundwater dependant water features (e.g. water courses and any groundwater abstractions in the water body).

Sheet piling retaining walls

~~4.7.47~~4.7.46 Sheet piling along the western boundary of Bolder Mere (scheme component BL01), may affect groundwater contributions to Bolder Mere (a groundwater dependent terrestrial ecosystem, GWDTE). This effect is different depending on the groundwater flow direction, which will be confirmed following site-specific intrusive ground investigation:

- Under reasonable worst-case scenario a) (see section 4.7.44), the sheet piling would impede groundwater flow, reducing groundwater contribution to Bolder Mere.
- Reasonable worst-case scenario b) (see section 4.7.44) would mean that the existing retaining wall may be retaining water in the lake, and removal of this wall would impact Bolder Mere.

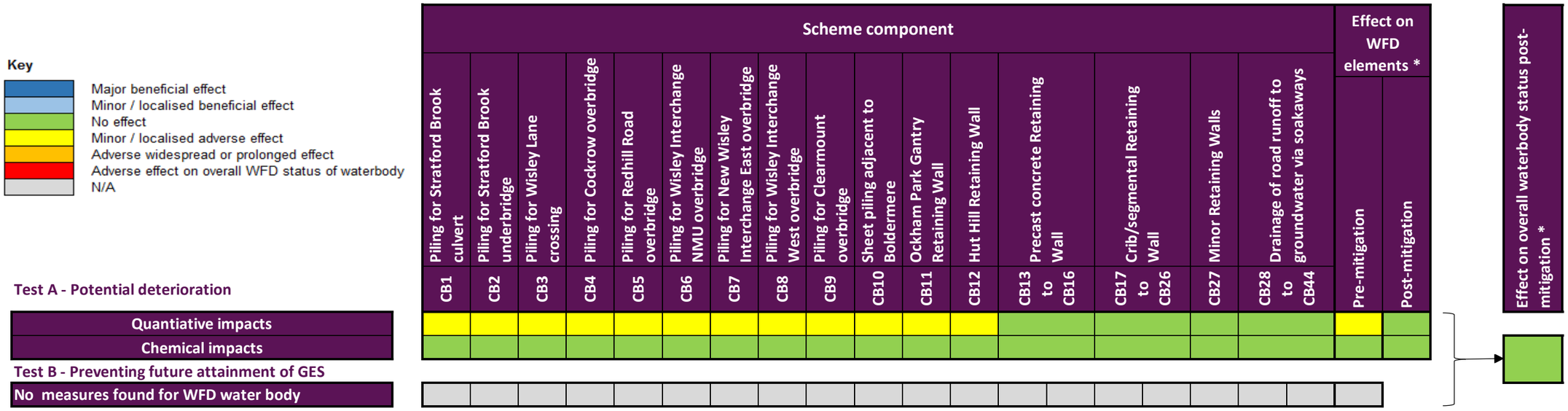
~~4.7.48~~4.7.47 Under both these scenarios, a minor/localised effect on the quantitative element may occur at this location. Additional mitigation (BL_e), as described in Section 5.3, in the form of a permeable retaining wall design, would mitigate the minor/localised effect on Bolder Mere under scenario a), and an impermeable retaining wall would mitigate the effect under scenario b).

Deep foundations

~~4.7.49~~4.7.48 Assuming the foundations will extend below the water table, there is potential for the piling to form a barrier to groundwater flow, potentially reducing groundwater contributions to adjacent watercourses and groundwater abstractions in the water body. A minor/localised effect on the quantitative element may occur at each piling location. The deep foundations may also introduce a rapid vertical flow pathway into the groundwater body for potentially contaminated runoff. Mitigation in the form of substantial clear spacing between piles and appropriate piling installation method will address these potential effects.

Road runoff drainage to groundwater

~~4.7.50~~4.7.49 There is potential for increased surface runoff from the scheme to cause deterioration to water quality of the groundwater body if runoff routed to soakaways is contaminated. There is also potential for indirect effects to groundwater dependant surface water bodies. The assessment of the effects of routine runoff on groundwater has indicated a medium risk to groundwater from the Scheme. The HAWRAT assessment (designed for surface water road runoff discharges) was undertaken to provide a conservative estimate and gauge the potential for pollution from road runoff to ground. No quantitative impacts are identified by this method. The design of road drainage systems in accordance with relevant toxicity standards is likely to prevent any potential effects.



* Each of these assessments takes the category with the worst effect recorded on the scheme components contained within their assessment

Figure 4.9: Summary of WFD assessment for the Scheme on Chobham Bagshot Beds WFD water body

4.8 Effect of temporary works

4.8.1 Temporary activities during construction potentially affecting WFD water bodies include the following:

- **Runoff from construction sites to surface water bodies** – Management of runoff from construction sites prior to discharge to surface water body.
- **Disturbance of non-native invasive species (NNIS)** – Construction activities can result in the spread of NNIS along surface water bodies and their riparian zone.
- **Vegetation management** – Clearance of riparian and in channel vegetation during construction.
- **De-watering** – Local changes to groundwater levels associated with pumping out of subterranean works areas (e.g. deep foundations) and disposal of pumped water to surface water bodies.
- **Runoff from construction sites to groundwater bodies** – Untreated runoff from construction sites discharges through permeable surface geology direct to an aquifer.

4.8.2 The Construction Environmental Management Plan (CEMP) is the principal mechanism for ensuring temporary activities such as those listed above do not adversely affect the water environment during construction of the Scheme. The plan sets out measures to avoid, minimise or mitigate adverse construction effects on the environment.

4.8.3 An Outline CEMP (application document TR010030/APP/7.2) has been prepared as part of the preliminary design process. This will be updated to a full CEMP by the Principal Contractor once in post.

4.8.4 The Outline CEMP records environmental risks and identifies how they will be managed during the construction of the Scheme; demonstrates how compliance with relevant environmental legislation, policy and good practice will be achieved and records objectives, commitments and mitigation measures to be implemented and set their programme and dates of achievement.

4.8.5 Potential risks to the water environment have been recorded within the Outline CEMP, together with a framework for their management during the construction process. This framework includes securing of environmental permits, development of appropriate methods of work and monitoring the state of environmental receptors. As an example the sensitivity of Bolder Mere to construction activity – and the need to develop a construction approach that protects WFD status and SSSI Favourable Condition – are recorded.

4.8.6 The outline CEMP includes advice on pollution prevention, management of non-native invasive species and vegetation management in accordance with the generic guidance set out in section 5.4 under the heading ‘Temporary activities during construction’.

4.9 Cumulative effects

4.9.1 Cumulative effects of multiple scheme components within the same water body have been accounted for within the assessment process, described in Section 4.7.

4.9.2 Since the water features affected by the Scheme are all headwaters, cumulative effect can only transfer to downstream water bodies.

4.9.3 The total area of land within the scheme red line boundary is 1.68 km^2.This comprises 0.63% of the combined area of the three WFD water bodies directly affected by the scheme (25.66 km^2). The dilution effect of the directly affected water bodies alone makes adverse cumulative effects on downstream water bodies extremely unlikely.

4.9.4 The effects of the scheme most likely to pass downstream are a) adverse water quality; b) barriers to biological continuity and c) loss of habitat essential to operation of the wider catchment ecosystem. It is very unlikely that adverse effects in these matters will be experienced in downstream water bodies for the following reasons:

- **Water Quality** – The Scheme is served by a drainage scheme designed to higher toxicity standards than the drainage system serving the existing road network. Improved standard of discharge will eliminate any risk of a reduction in water quality in downstream water bodies.
- **Barriers to biological continuity** – Both embedded and additional mitigation set out in this document requires scheme components to be designed to allow biological continuity.
- **Loss of habitat essential to operation of the wider catchment ecosystem** (e.g. fish spawning grounds) – Ecological surveys carried out to inform scheme design have not identified any such habitats.

4.9.5 In conclusion, the Scheme will not exert any adverse cumulative effects on WFD quality elements in other water bodies.

4.10 Article 4.7

4.10.1 Highways England does not need to apply for a derogation under Article 4.7 of the WFD because, as demonstrated in sections 4.7 to 4.9 above, the Scheme does not prevent achievement of the WFD environmental objectives in affected surface, lake or ground water bodies.

4.11 Biodiversity benefits

4.11.1 The package of mitigation proposed to address the effect of the Scheme on the water environment is considered to have potential to deliver biodiversity benefits to water features, in particular:

- The package of embedded and additional specific measures developed for Bolder Mere have been agreed in principle as a) proportionate to the risk of adverse effect of the Scheme on the Bolder Mere SSSI unit and b) with potential to deliver additional biodiversity benefit (Statement of Common Ground with NE, application document TR010030/APP/8.2).

- The Scheme is served by a significantly improved drainage scheme designed to higher toxicity standards than the drainage system serving the existing road network.
- The mitigation strategy proposed to address the effect of the Scheme on Stratford Brook sets out a pathway to developing a mitigation package that will deliver mitigation for the direct effects of the Scheme on the brook together with additional measures to deliver further biodiversity benefits. The extent of these further benefits will be determined during detailed design.

5. Mitigation

5.1 Introduction

5.1.1 This section summarises measures proposed to mitigate the effects of the Scheme on the water environment. Because the Scheme design is preliminary, the term mitigation is used in its broadest sense, to include not only direct mitigation for the effects of the Scheme, but also compensation and potential enhancement.

5.1.2 The preliminary design sets out the form of the Scheme as a set of General Arrangements along with concept or outline designs for some key scheme components. The preliminary design rarely provides detail on scheme components affecting the water environment. Therefore, three categories to describe mitigation measures have been used:

- **Embedded mitigation**: mitigation already explicitly represented in the preliminary design of the Scheme
- Additional mitigation:
  - **Specific** – measures that have been developed as far as concept sketches and brief descriptions
  - **Generic guidance** – for detailed design of scheme components in a way that should ensure WFD compliance

5.1.3 Additional mitigations in the form of both specific measures and generic guidance are recorded in the **Register of Environmental Actions and Commitments for the Scheme**, which in turn forms part of the Outline Construction and Environmental Management Plan (application document TR010030/APP/7.2). These documents are the mechanisms that secure mitigation being a) progressively embedded into the Scheme as it evolves through detailed design, and b) implemented during construction.

5.1.4 As the Scheme evolves Highways England remain in discussion with the Environment Agency and NE to develop a package of mitigation that provides direct mitigation or compensation for the effect of the Scheme on the water environment and, where opportunity and financial constraints allow, delivers enhancements to the natural environment.

5.2 Embedded mitigation

5.2.1 The evolution of the Scheme design through options assessment and preliminary design has recognised its sensitive environmental setting. The current configuration of the Scheme was selected in preference to other more expansive options to minimise encroachment of road works into designated and sensitive areas. This geographically constrained form of the Scheme is itself an embedded mitigation that limits the number and extent of water features affected.

5.2.2 Three substantial mitigation measures are already embedded within the preliminary design.

- Wisley Common Restricted Byway located away from Bolder Mere on the northern side of A3 – this location reduces encroachment of the Scheme into Bolder Mere by an estimated 10 m.

- Stratford Brook Underbridge – a single span structure extending across the floodplain in order to retain existing plan and cross-sectional channel form (application document TR010030/APP/2.9)
- A drainage system designed to meet WFD toxicity standards at points of discharge to natural waters, including soakaways (Chapter 8: Road Drainage and Water Environment (application document TR010030/APP/6.3))

5.3 Additional mitigation (specific)

5.3.1 Additional mitigation (specific) comprises measures that have been developed as far as concept sketches and brief descriptions. A summary of these measures can be found in Table 5.1. Further details can be found in Appendix F.

5.3.2 Additional mitigation (specific) has been developed in close consultation with both the Environment Agency and NE. The status of agreements on measures are recorded in the Statements of Common Ground with these organisations, (application document TR010030/APP/8.2 and 8.3).

5.3.3 These measures are recorded in the Register of Environmental Actions and Commitments for the Scheme, which in turn forms part of the Construction and Environmental Management Plan (application document TR010030/APP/7.2). They also form an integral part of the SPA Management and Monitoring Plan (application document TR010030/APP/7.19). Agreement on the details of the drainage or road runoff at Bolder Mere (BL2) and Stratford Brook Underbridge (SB1) are further secured under Requirements 10 and 12 of the Development Consent Order for the Scheme (application document TR010030/APP/3.1). Highways England is therefore satisfied that the additional mitigation (specific) proposed is sufficient to address the adverse effects of the Scheme on WFD quality elements.

5.3.4 Development of additional mitigation (specific) will continue in later phases of design in continued close consultation with the Environment Agency and NE.

Table 5.1: Summary of additional mitigation (specific)

Code	Title
BL_a	Reinstatement of lake shore habitat along northwest edge of Bolder Mere (adjacent to A3)
BL_b	Habitat improvements on the shores of Bolder Mere.
BL_c	Invasive species management - carp and bream
BL_d	Feasibility studies into invasive species management
BL_e	Detailed design of new retaining wall along north-western edge of Bolder Mere
SB_a	Habitat improvements along the Stratford Brook upstream of the A3.
SB_b	Reinstatement of riparian trees.
SB_c	Mammal shelf on Stratford Brook Underbridge.
SB_d	Investigation into feasibility of additional measures.
WY_a	Enhancement of water features on Replacement Land and in Enhancement Areas within Wey catchment.
ML_a	Enhancement of water features on Replacement Land within Mole catchment.
CB_a	Ground investigation, piling risk assessment, hydrogeological risk assessments and design alteration of piling and retaining walls.

5.4 Additional mitigation (generic guidance)

Introduction

5.4.1 This section contains generic guidance on minimising the impact of scheme components of WFD quality elements with a view to securing compliance of the Scheme with the WFD. The guidance covers components common to the Scheme and will be used to inform the detailed design process.

Components of the permanent Scheme

Single Span bridges

5.4.2 Single span structures are the preferred type of crossing because they minimise impact on the water environment if designed appropriately (Environment Agency, 2013; SEPA, 2010).

5.4.3 They should be designed and constructed in such a way as to minimise disruption to the river and riparian zone. Abutments should be set well back from the bank edge to allow the river to function naturally and to maintain a wildlife corridor along the banks. Where practically possible the bridge deck should run perpendicular to the watercourse (again to reduce shading). Bed and bank protection should only be used where a real risk to life or critical infrastructure is apparent. A single span structure should not create a barrier to fish and other wildlife, or disrupt navigation or recreation (SEPA, 2010).

5.4.4 Single span structures are not always technically feasible, particularly on wide rivers (where it may be necessary to place additional abutments in the

watercourses). They can take longer to construct. They may also be more expensive than other crossing types as specialist construction techniques may be required.

5.4.5 Further guidance on the engineering of river crossings is available in SEPA (2010).

Culverts

5.4.6 Culverts present a higher risk (than single span structures) of a) disrupting natural hydraulic and sediment transport processes, b) acting as a barrier to fish passage and movement of other wildlife and c) damaging the bed and banks of a river during construction. They are therefore not a preferred method of watercourse crossing from the perspective of protecting and improving the water environment.

5.4.7 Culverts are, however, generally cheaper and easier to build than single span structures because their construction process tends to be less complex. In some instances, they may be the only feasible technical solution. Hence, they can be consented by regulators (such as the Environment Agency) for crossing smaller, low sensitivity watercourses if their adverse impact on the water environment is minimised.

5.4.8 A culvert designed solely for hydraulic performance will not be consented by regulators. Guidance must be sought on how to reduce their adverse impact on the water environment. Useful references include:

- Chapter 8 of Fluvial Design Guide (Environment Agency, 2010);
- Chapter 4 of Culvert design and operation guide (C689) (Ciria, 2010);
- Water Framework Directive Mitigation Measures Manual (Environment Agency, 2013);
- Advice on minimising impact on fish passage in the Fish Pass Manual (Environment Agency, 2010a);
- SEPA's advice on river crossings and position statement on culverting (SEPA 2010, 2015);

5.4.9 Key considerations in environmentally sensitive culvert design are:

- Minimise length, for instance by incorporating wingwalls into the design;
- Minimise impact of the structure on natural flow and sediment process during construction and operation. For instance, an open arc structure that avoids disturbing the natural bed of the river is preferred to a box culvert;
- Do not size on hydraulic (flood) requirements alone. Additional capacity will be required for environmental uses (e.g. mammal shelves and ensuring natural flow / sediment process). Flow rates and depths during normal and low flows will need to be conducive to wildlife requirements such as fish passage; and
- Natural bed substrate will be required, so the invert of the culvert will need to be set well below natural bed level at both ends. Embedment depths will depend on local geomorphological processes but are commonly around 300 mm.

5.4.10 The Environment Agency have provided the following advice on culverts during consultation for this Scheme:

- Opportunities to improve an existing culvert should be sought where culverts are being extended/replaced
- Mammal fencing should be used to guide mammals into culverts where mammal ledges are being provided
- Re-aligning a watercourse should take preference over culverting.
- Where bed and bank reinforcement is required, compensation should be provided by enhancing an equivalent (or greater) length of riparian habitat.

Channel widening, deepening, straightening or realigning

5.4.11 The Environment Agency's preference is that loss of open channel should be compensated for by providing an equivalent length (or greater) of new open channel habitat or a significant reach of enhanced open channel habitat.

5.4.12 Widening, deepening, straightening or realigning of naturally functioning channels will be opposed by regulators (e.g. the Environment Agency) because it will result in loss of a range of river habitats and, by disrupting natural processes, may result in degradation of further downstream (or upstream) habitat.

5.4.13 However, watercourse channels adjacent to roads have often been modified by previous road building or drainage schemes. Hence, in some instances, the realignment of a channel can present an opportunity to restore channels to a more natural state of ecological function in line with WFD objectives.

5.4.14 Where widening, deepening, straightening or realigning of naturally functioning channels cannot be avoided, modification will need to be carried out in a manner that minimises long term impact. The regulator will need to consent the work and is likely to insist on environmental enhancements elsewhere to mitigate or offset adverse effects on the water environment.

5.4.15 Guidance should be sought on any works that result in the modification of a river channel. The guidance section of the River Restoration Centre website (RRC, 2014) is an excellent starting point for developing effective river restoration designs.

5.4.16 Key considerations in environmentally sensitive modifications to river channels are:

- Avoid modifying a channel that is already functioning naturally;
- Where channel modification is required, develop a design that works with natural processes, and hence allows the river to function naturally in the long term;
- Be aware that a natural river is likely to require space to function properly (e.g. to allow for re-meandering or backwaters). Allow for this space requirement in the design of other components of the Scheme and land purchases / agreements;
- As a general principle, the length of a realigned channel should exceed or match the length of channel prior to modification; and

- There are designers and contractors who specialise in river restoration. Designs developed by such specialists are more likely to be consented by the regulator.

Construction of new open ditches (pre-earthworks ditches)

5.4.17 To replace habitat removed by the Scheme the new open ditches created as part of the new road drainage system should be created in as environmentally sensitive a way as possible. It would be vital that vegetation would be allowed to establish on both the bed and banks of the ditches.

5.4.18 Discussions are ongoing with both the Drainage Team and the Geotechnical Team as to the precise nature of the lining of the ditches. The final decisions cannot be made until the dimensions of the drains have been designed and the results from intrusive site-specific ground investigation are returned which is scheduled for the detailed design phase of the Scheme.

5.4.19 It is recommended that the designs of the ditch lining is done in consultation with specialists in bioengineering solutions.

Bank and Bed reinforcement

5.4.20 Hard bed and bank reinforcement will be opposed by the regulator, except at locations where it can be demonstrated that it prevents potential loss of life or is necessary to protect critical infrastructure. Designs that work with natural processes (and hence avoid the need for protection) are preferred. Softer, bioengineered solutions will in many cases afford appropriate protection and be a cheaper/more sustainable design.

5.4.21 Bank and bed erosion is part of the natural functioning of a river.

5.4.22 Further guidance on the environmental aspects of bank protection is available in Environment Agency (2013) and SEPA (2008).

Drainage of road runoff (to surface water)

5.4.23 Collaborative research between the Environment Agency and the former HA developed a risk-based tool (HAWRAT) for a) assessing the effect on the water environment of relevant WFD specific pollutants, priority substances and priority hazardous substances, generated by road surfaces b) testing the effectiveness of mitigation (Highways Agency, 2009). This tool should be used as the basis for the design of road drainage.

5.4.24 Sustainable Drainage Systems (SuDS) are the preferred approach to managing pollution risk associated with road runoff and should be implemented where technically feasible. All drainage systems should be designed in accordance with industry standards, with particular emphasis on appropriate pollution prevention and control measures (CIRIA, 2015).

Deep foundation protruding into aquifers

5.4.25 Where deep foundations extending beneath the groundwater table are designed to be part of the Scheme (piling), these should be designed in accordance with industry standards - taking into account the site-specific water level and flow monitoring data obtained from intrusive ground investigation for the Scheme. A piling risk assessment should be carried out to ensure the selected piling method does not introduce contamination pathways into the aquifer. Where sheet piling

is replacing existing retaining walls, the design should not exceed the existing extent and depth of the retaining wall.

Drainage of road runoff (to groundwater)

5.4.26 See section titled “Drainage of road runoff (to surface water)” above.

5.4.27 The potential consequences of unplanned catastrophic incidents should be dealt with via the environmental management and contingency planning process.

Temporary activities during construction

Runoff from construction sites to surface and ground water bodies

5.4.28 Construction generates significant risks of pollution to surface and ground water bodies. These need to be fully mitigated by suitable control of construction practices such as adherence to the Pollution Prevention Guidance (PPG) Notes, specifically PPG 5: Works and Maintenance in or near Water and PPG 6: Construction and Demolition Sites (Environment Agency, 2014 & 2014a, withdrawn).

5.4.29 All PPGs that were previously maintained by the Environment Agency are currently under review and a new set of guidance notes are presently being issued as Guidance for Pollution Prevention (GPP) documents. These include GPP5 for works and maintenance in or near water (which replaces PPG5).

Disturbance of invasive non-native species

5.4.30 Construction activities in, over and adjacent to water bodies significantly increase the risk of the spread of NNIS associated with aquatic and riparian habitats. Risks will need to be managed effectively during the construction period through the implementation of biosecurity control, such as check-clean-dry procedures for plant, equipment and the workforce. The GB non-native species secretariat website (http://www.nonnativespecies.org) provides a key source of information for the identification of risks, appropriate control and management systems and disposal.

5.4.31 The Environment Agency should also be consulted to ascertain the status and distribution of invasive species in surface water bodies. Consideration needs to be given to the potential to create pathways for invasive species movement within/between water bodies, through for example, the removal of existing barriers e.g. artificial structures such as weirs and culverts.

Vegetation management

5.4.32 There is often the requirement to manage vegetation (both riparian and aquatic) during construction activities in, over and adjacent to water bodies. Vegetation clearance should only be undertaken following an ecological constraints assessment of the potential for vegetated habitats to support protected species (e.g. nesting birds, reptiles) and to determine the intrinsic ecological value of the habitat, plus the risk posed by NNIS.

5.4.33 Consideration should be given within the construction programme and design to translocate vegetation to an appropriate receptor site and/or improve conditions for target communities in line with regulatory drivers such as the WFD and the NERC Act’s (2006) proposed list of species/habitat of principle importance.

6. Conclusion and recommendations

6.1 Conclusions

6.1.1 This WFD assessment concludes that the Scheme is compliant with the requirements of the WFD. None of the components that make up the Scheme are considered by Highways England to cause deterioration at the water body scale (thus passing Test A). All should not prevent future attainment of GES or GEP (Test B).

6.1.2 The assessment is based on the preliminary design for the Scheme as presented in the Scheme Layout Plans (application document TR010030/APP/2.8). Critically it also assumes the following:

- The mitigation already 'embedded' in this preliminary design (as presented in the Scheme Layout Plans (application document TR010030/APP/2.8), secured in section 5 of the draft DCO (application document TR010030/APP/3.1) and summarised in section 5.2) is implemented.
- Additional specific mitigation (as set out in Appendix F and summarised in 5.3) is implemented as developed and agreed with the Environment Agency (and NE).
- Generic guidance on the principles of WFD compliant design (as summarised in section 5.4) is adhered to in subsequent detailed design of scheme components affecting the water environment.

6.1.3 Implementation of mitigation on the ground is secured through four mechanisms. Embedded mitigation is safe-guarded because it is explicitly represented in the preliminary design. Additional mitigation (in the form of both specific mitigation and generic guidance) is secured by inclusion in the Register of Environmental Actions and Commitments for the Scheme (part of the Outline CEMP (application document TR010030/APP/7.2). Where mitigation requires ongoing maintenance (habitat improvement measure BL_b), this maintenance work has been included in the SPA Management and Monitoring Plan (application document TR010030/APP/6.5).

6.1.4 The details of the drainage design to divert road drainage away from Bolder Mere (scheme component BL2) will be confirmed with the Environment Agency at detailed design. Agreement of the details of this design is included as a Requirements 10 of the Development Consent Order for the Scheme (application document TR010030/APP/3.1).

6.1.5 The details of the package of measures to mitigate for the effect of Stratford Brook underbridge (scheme component SB1) will be confirmed with the Environment Agency at detailed design. Agreement of the details of this design is included as a Requirements 12 of the Development Consent Order for the Scheme (application document TR010030/APP/3.1).

6.1.6 The measures summarised in 6.1.2 are considered not only to ensure compliance of the Scheme with the requirements of the WFD, but also implement enhancements within affected water bodies that will make a positive contribution towards the future attainment of GES or GEP.

6.1.7 The Scheme is not expected to exert any adverse cumulative effects on WFD quality elements in water bodies beyond those affected directly by the Scheme.

6.1.8 It is not necessary for Highways England to apply for a derogation under Article 4.7 of the WFD because the Scheme is not considered by Highways England to prevent achievement of the WFD environmental objectives in affected surface, lake or ground water bodies.

6.1.9 The package of mitigation proposed to address the effect of the Scheme on the water environment is considered to have potential to deliver biodiversity benefits to specific water features.

6.1.10 This WFD assessment has been undertaken using an approach recommended by the Environment Agency for its transparency, thoroughness and auditability. A very precautionary approach, using a reasonable worst case scenario has been adopted to scoping and screening scheme components and WFD quality elements for the assessment.

6.2 Recommendations

6.2.1 The following key recommendations are made:

- Consultation with regulators (principally the Environment Agency) continues regularly throughout the design process to ensure that the Scheme is designed to be compliant with the objectives of the WFD and that feasible opportunities for improvements to the water environment are integrated into the Scheme.
- The design principles set out in Section 5 are shared widely with all members of the design team involved in the development of Scheme components affecting the water environment.
- Specialists in sustainable design of river crossings, realignments, outfalls, management of bed/bank erosion and groundwater specialists continue to be consulted during the evolution of the design of Scheme components that have potential to modify the water environment.
- This WFD assessment is to be updated as more detailed information about the Scheme becomes available.

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Appendices

Appendix A. Information on preliminary design of piling and retaining walls

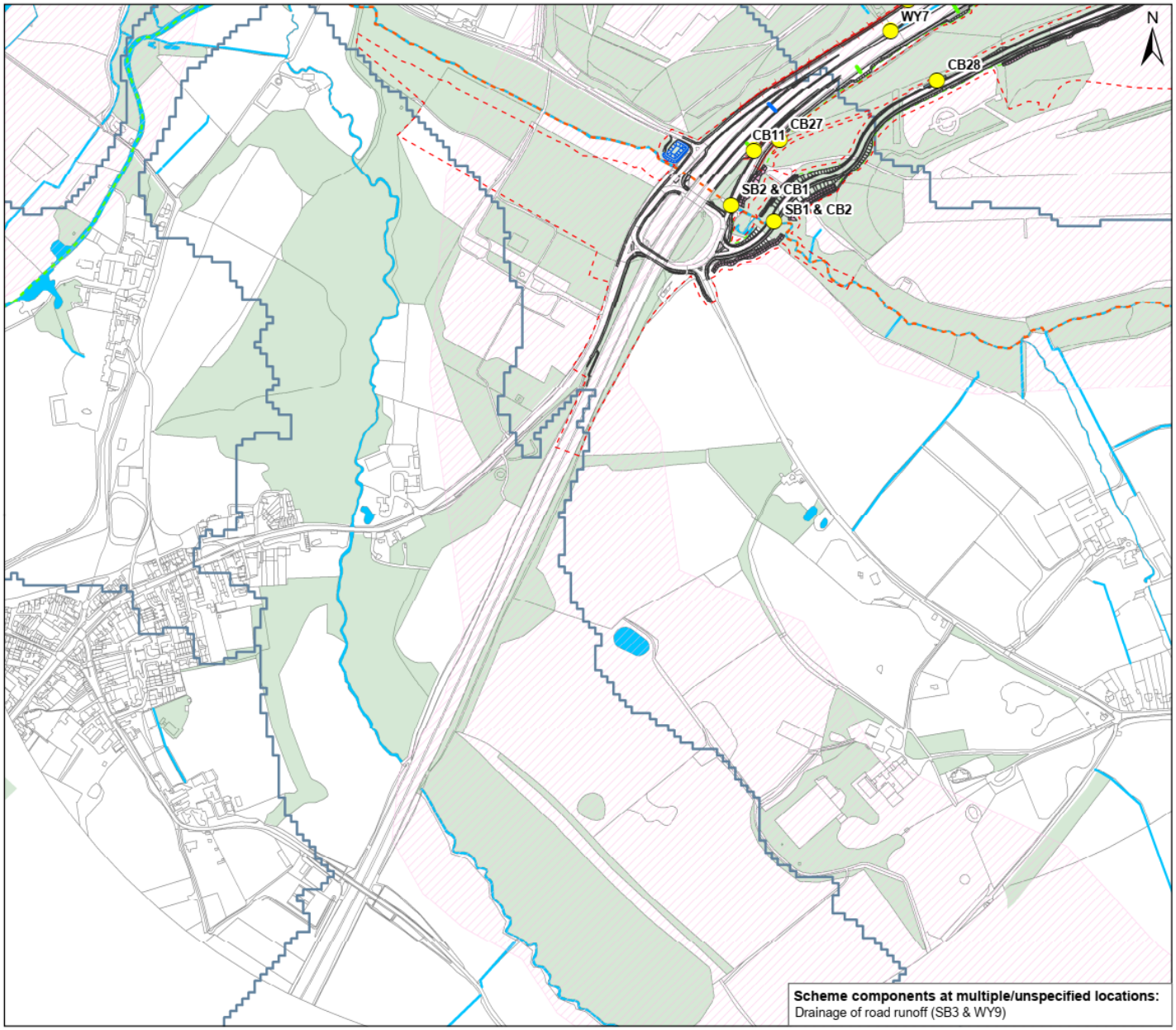
Table A-1 Preliminary design pilings summary (details are subject to detailed design)

Structure name	Pile group	Width of structure (m)	Approx. No. of piles*
Stratford Brook Culvert South	North Abutment	13	7
	South Abutment	13	7
Stratford Brook Underbridge	North Abutment	19	7
	South Abutment	19	7
Wisley Lane Overbridge	North Abutment	16	6
	Central Pier	16	6
	South Abutment	16	6
Cockcrow Overbridge	West Abutment	16	6
	Central Pier	16	6
	East Abutment	16	6
Redhill Overbridge	West Abutment	5 (7 foundation)	3
	East Abutment	5 (7 foundation)	3
Sandpit Hill Overbridge	North Abutment	5 (7 foundation)	3
	North Pier	5 (7 foundation)	3
	South Pier	5 (7 foundation)	3
	South Abutment	5 (7 foundation)	3
Junction 10 East Bridge	North Abutment	34	12
	South Abutment	34	12
Junction 10 West Bridge	North Abutment	34	12
	South Abutment	34	12
Clearmount Overbridge	North Abutment	7	3
	South Abutment	7	3

Table A-2: Preliminary design retaining wall summary (details are subject to detailed design)

Retaining Wall name*	Approx. length (m)	Maximum retained height (m)	Type of retaining wall	Approx. depth below ground (m)
Ockham Park Gantry Retaining Wall	50	3	Sheet piling	6
Wisley Retaining Wall	108	0.8	Crib/segmental wall	1
	620	1.6	Crib/segmental wall	1
Bolder Mere Retaining Wall	228	0.5 (average)	Sheet piling	6
Hut Hill Retaining Wall	231	6.5	Sheet piling	13
Wisley Interchange Retaining Wall A	176	2.4	Precast concrete walls	1
Wisley Interchange Retaining Wall B	210	2.9	Precast concrete walls	1
Wisley Interchange Retaining Wall C	195	4.3	Crib/segmental wall	1
Wisley Interchange Retaining Wall D	162	2.5	Precast concrete walls	1
Redhill NMU Retaining Wall A	355	3.8	Crib/segmental wall	1
Redhill NMU Retaining Wall B	48	1.5	Crib/segmental wall	1
New Redhill Retaining Wall	233	3.8	Crib/segmental wall	1
Painshill Retaining Wall A	235	3.9	Crib/segmental wall	1
Painshill Retaining Wall B	292	1.9	Crib/segmental wall	1
Painshill Retaining Wall C	93	2.4	Crib/segmental wall	1
Clearmount Retaining Wall A	23	4.7	Crib/segmental wall	1
Clearmount Retaining Wall B	32	4	Crib/segmental wall	1
Clearmount Retaining Wall C	155	2	Crib/segmental wall	1

Appendix B. Location of scheme components affecting the water environment



Road Investment Strategy Improvements to M25 J10/A3 Wisley Interchange

Figure B.1 - Plan 1 with scheme components

Key

- Scheme Components

Road Improvement Works

- Road design
- Retaining wall
- DCO Boundary
- Proposed gantries
- Retained gantries
- Filter drain
- Drainage attentuation pond
- Pre-earthwork ditch
- Soakaways

WFD Surface Water Bodies

- Stratford Brook
- Wey (Shalford to River Thames confluence at Weybridge)
- Operational Catchments
- River Water Body Catchments

WFD Groundwater Bodies

- Chobham Bagshot Beds

OS Features

- OS Surface Water Bodies
- Woodland

Data sources: Environment Agency and Ordnance Survey

0 0.175 0.35 Km

Scale (at A3): 1:6,000

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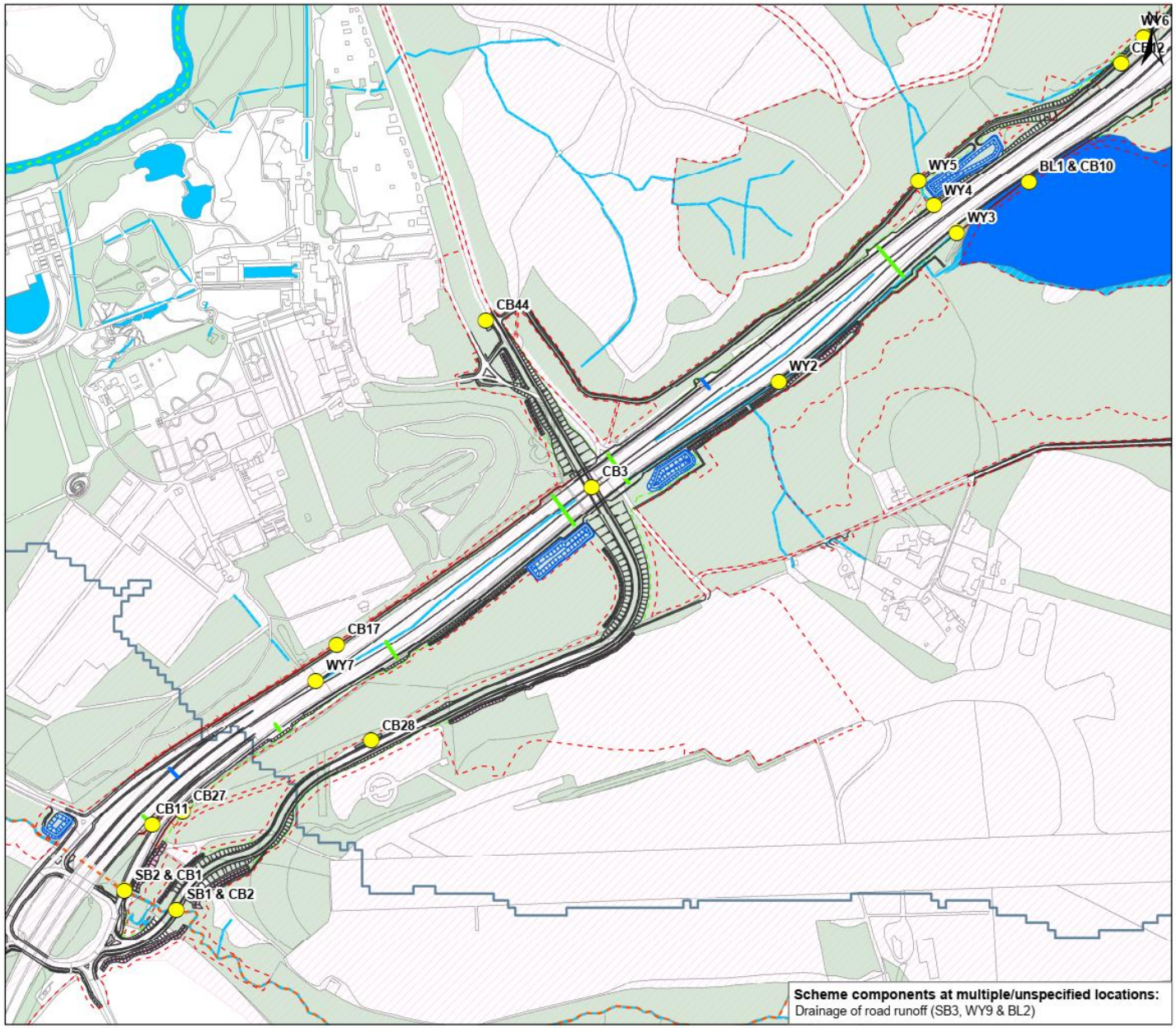

Road Investment Strategy Improvements to M25 J10/A3 Wisley Interchange

Figure B.2 - Plan 2 with scheme components

Key

- Scheme Components

Road Improvement Works

- Road design
- Retaining wall
- DCO Boundary
- Proposed gantries
- Retained gantries
- Filter drain
- Drainage attentuation pond
- Pre-earthwork ditch
- Soakaways

WFD Surface Water Bodies

- Stratford Brook
- Wey (Shalford to River Thames confluence at Weybridge)
- Boldermere Lake
- Operational Catchments
- River Water Body Catchments

WFD Groundwater Bodies

- Chobham Bagshot Beds

OS Features

- OS Surface Water Bodies
- Woodland

Data sources: Environment Agency and Ordnance Survey

0 — 0.15 — 0.3 Km

Scale (at A3): 1:5,000

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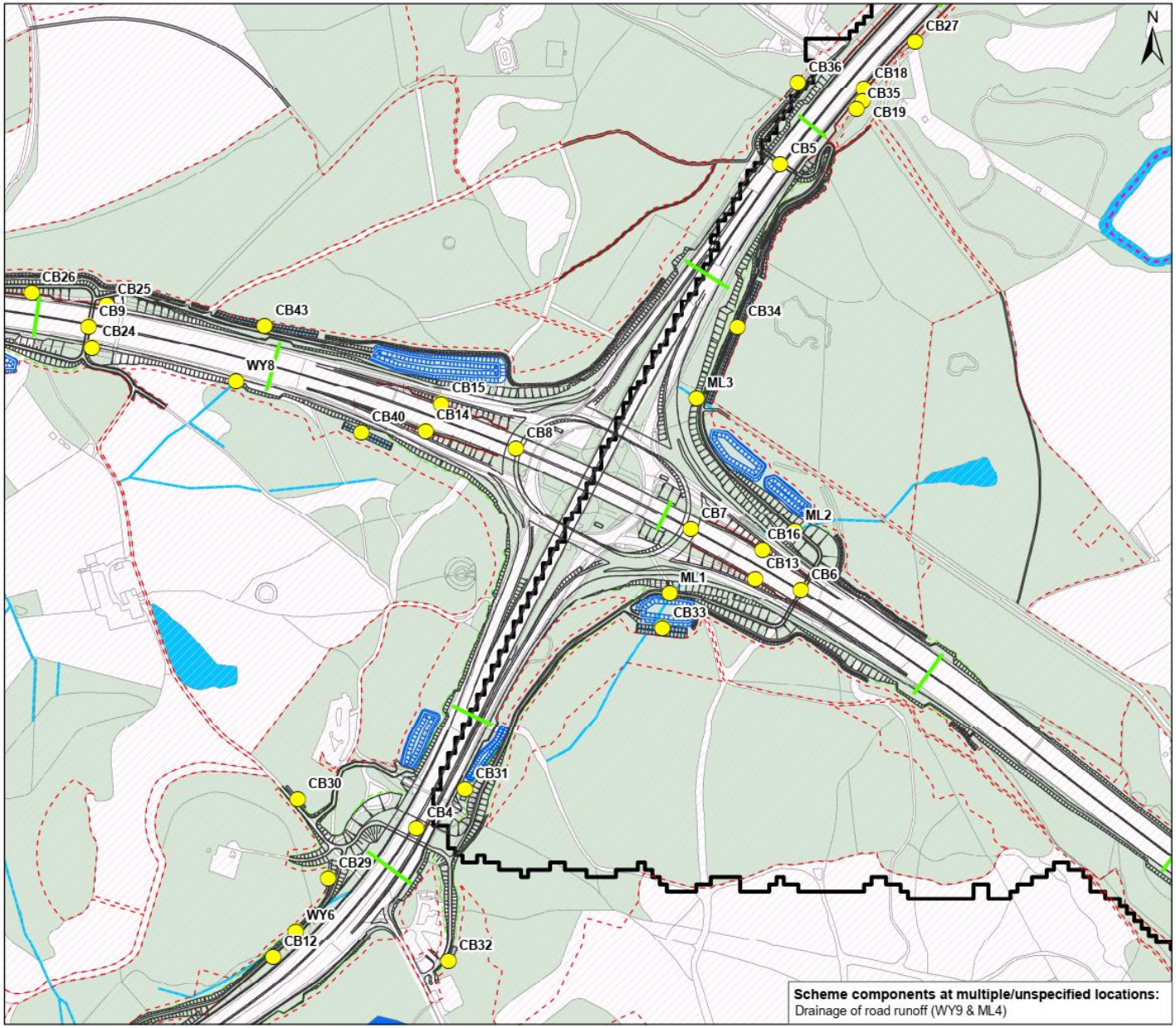

Road Investment Strategy Improvements to M25 J10/A3 Wisley Interchange

Figure B.3 - Plan 3 with scheme components

Key

- Scheme Components

Road Improvement Works

- Road design
- Retaining wall
- DCO Boundary
- Proposed gantries
- Filter drain
- Drainage attentuation pond
- Pre-earthwork ditch
- Soakaways

WFD Surface Water Bodies

- Mole (Horley to Hersham)
- Boldermere Lake
- Operational Catchments
- River Water Body Catchments

WFD Groundwater Bodies

- Chobham Bagshot Beds

OS Features

- OS Surface Water Bodies
- Woodland

Data sources: Environment Agency and Ordnance Survey

0 0.15 0.3 Km

Scale (at A3): 1:5,000

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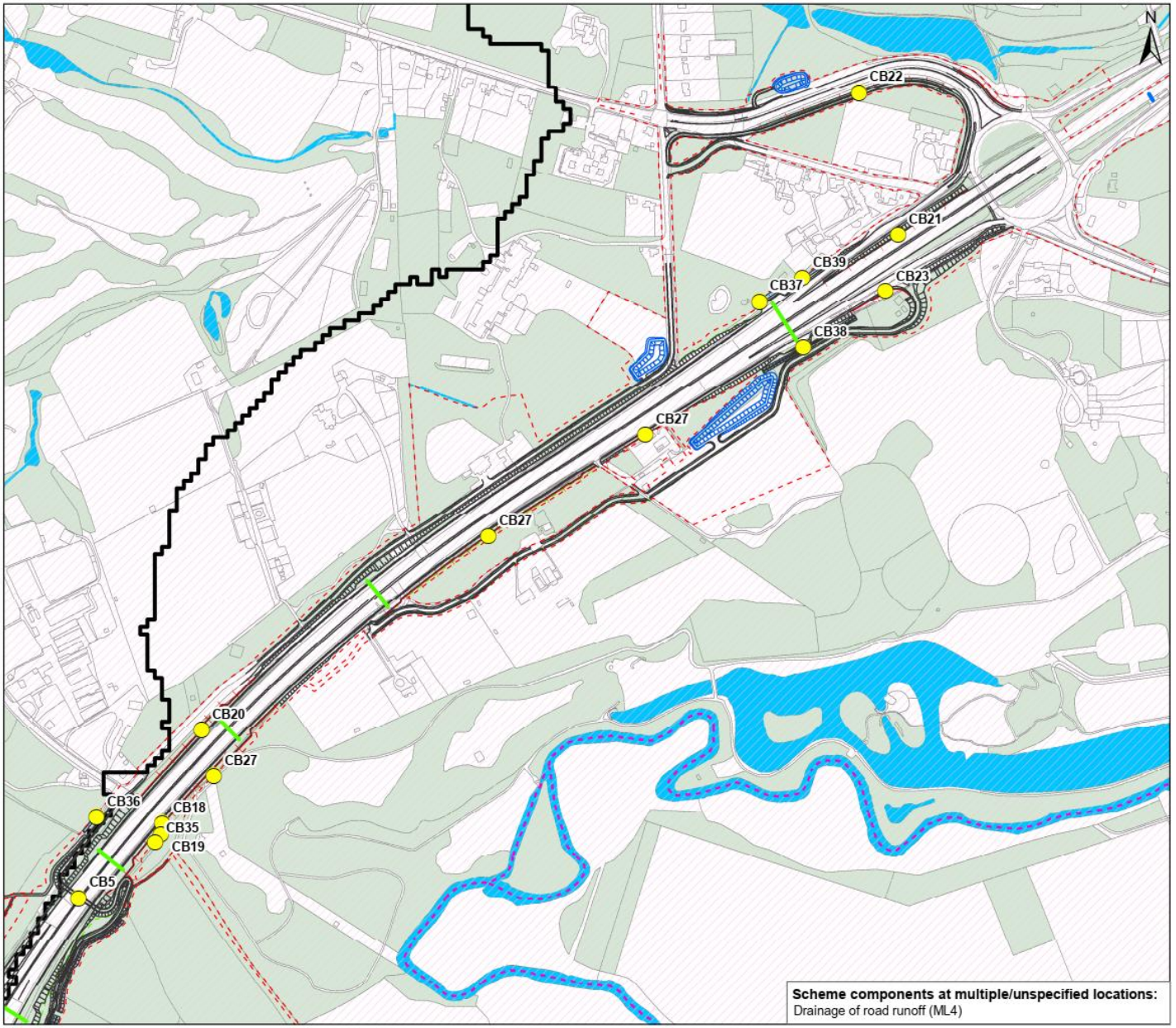

Road Investment Strategy Improvements to M25 J10/A3 Wisley Interchange

Figure B.4 - Plan 4 with scheme components

Key

- Scheme Components

Road Improvement Works

- Road design
- Retaining wall
- DCO Boundary
- Proposed gantries
- Retained gantries
- Filter drain
- Drainage attentuation pond
- Pre-earthwork ditch
- Soakaways

WFD Surface Water Bodies

- Mole (Horley to Hersham)
- Operational Catchments
- River Water Body Catchments

WFD Groundwater Bodies

- Chobham Bagshot Beds

OS Features

- OS Surface Water Bodies
- Woodland

Data sources: Environment Agency and Ordnance Survey

0 0.15 0.3 Km

Scale (at A3): 1:5,000

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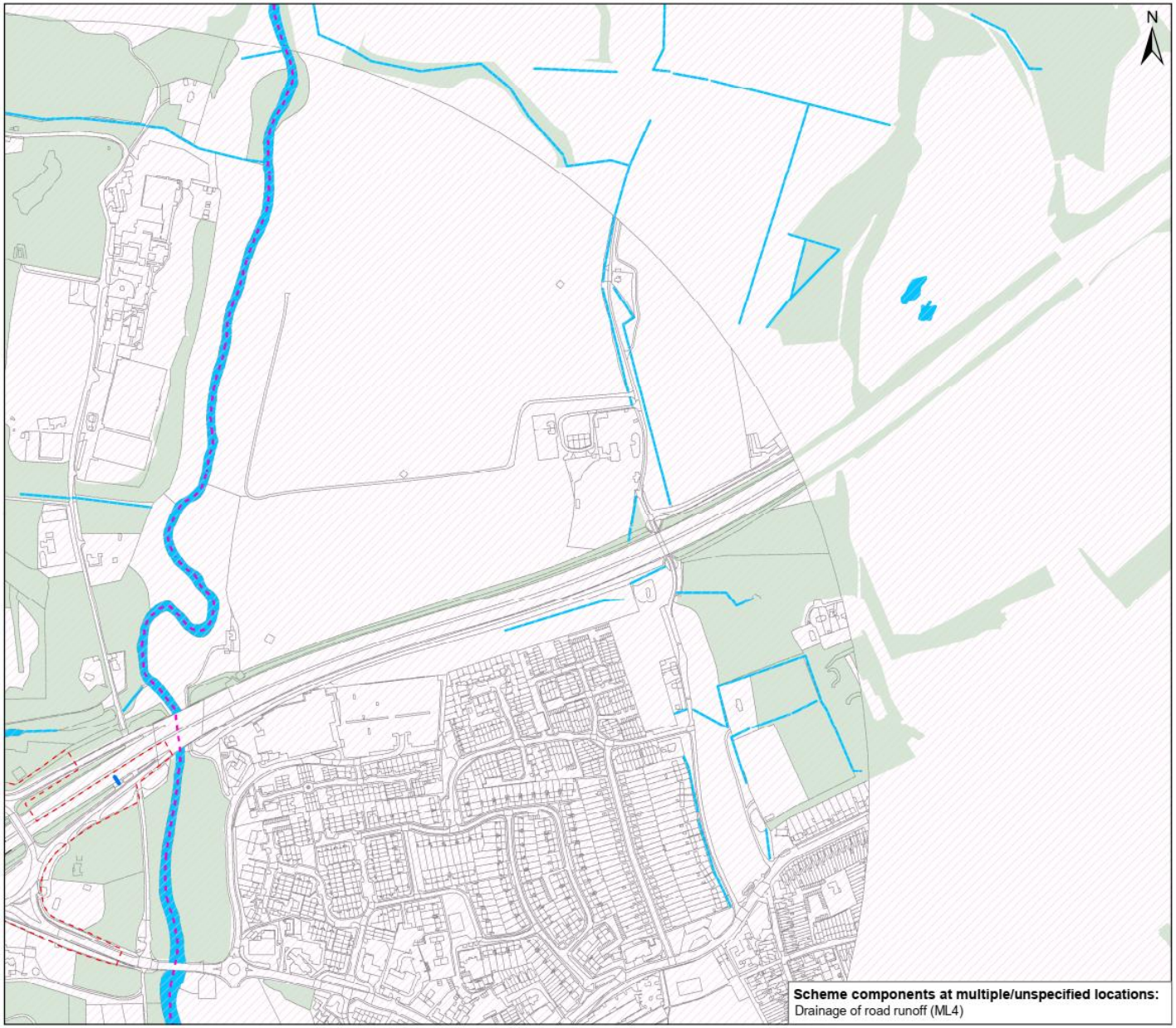

Road Investment Strategy Improvements to M25 J10/A3 Wisley Interchange

Figure B.5 - Plan 5 with scheme components

Key

Road Improvement Works
- Road design
- DCO Boundary
- Retained gantries

WFD Surface Water Bodies
- Mole (Horley to Hersham)
- Operational Catchments
- River Water Body Catchments

WFD Groundwater Bodies
- Chobham Bagshot Beds

OS Features
- OS Surface Water Bodies
- Woodland

Data sources: Environment Agency and Ordnance Survey

0 0.15 0.3 Km

Scale (at A3): 1:5,000

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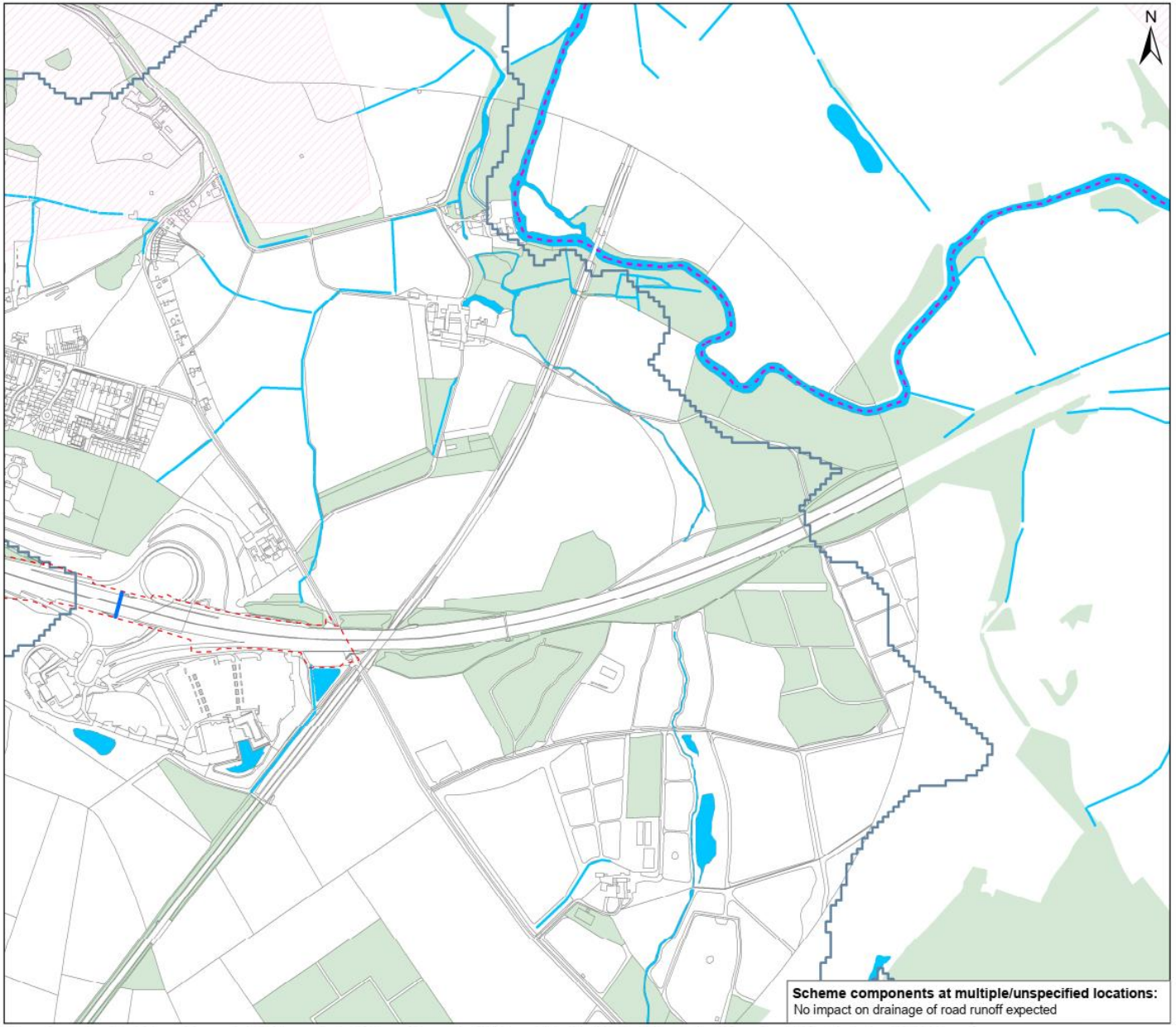

Road Investment Strategy
Improvements to M25
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Figure B.6 - Plan 6 with scheme components

Key

- DCO Boundary
- Retained gantries

WFD Surface Water Bodies

- Mole (Horley to Hersham)
- Operational Catchments
- River Water Body Catchments

WFD Groundwater Bodies

- Chobham Bagshot Beds

OS Features

- OS Surface Water Bodies
- Woodland

Data sources: Environment Agency and Ordnance Survey

0 0.2 0.4 Km

Scale (at A3): 1:7,000

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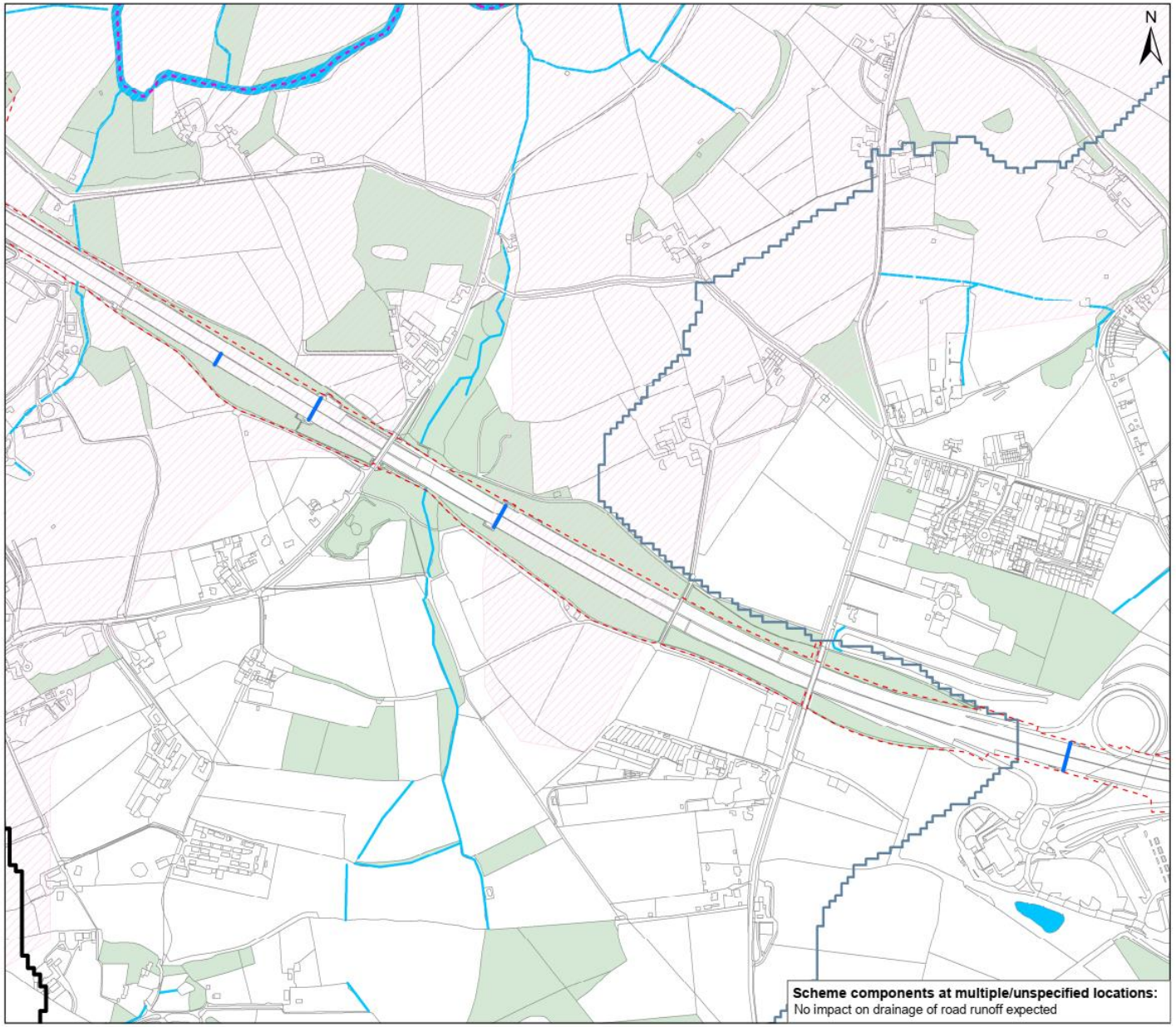

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Figure B.7 - Plan 7 with scheme components

Key

- DCO Boundary
- Retained gantries

WFD Surface Water Bodies

- Mole (Horley to Hersham)
- Operational Catchments
- River Water Body Catchments

WFD Groundwater Bodies

- Chobham Bagshot Beds

OS Features

- OS Surface Water Bodies
- Woodland

Data sources: Environment Agency and Ordnance Survey

0 0.175 0.35 Km

Scale (at A3): 1:6,000

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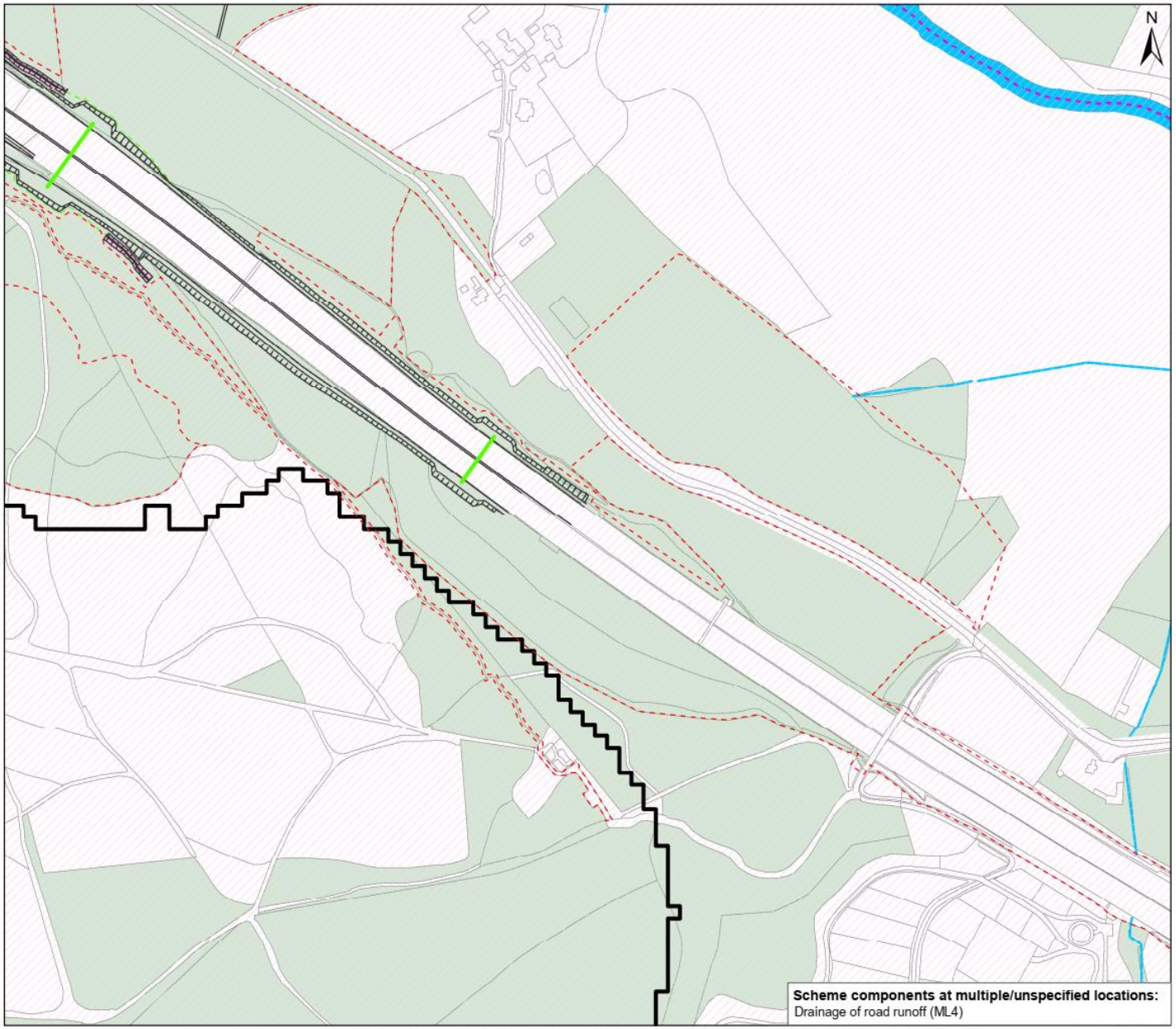

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Figure B.8 - Plan 8 with scheme components

Key

Road Improvement Works
- Road design
- DCO Boundary
- Proposed gantries
- Filter drain
- Pre-earthwork ditch

WFD Surface Water Bodies
- Mole (Horley to Hersham)
- Operational Catchments
- River Water Body Catchments

WFD Groundwater Bodies
- Chobham Bagshot Beds

OS Features
- OS Surface Water Bodies
- Woodland

Data sources: Environment Agency and Ordnance Survey

0 0.075 0.15 Km

Scale (at A3): 1:3,000

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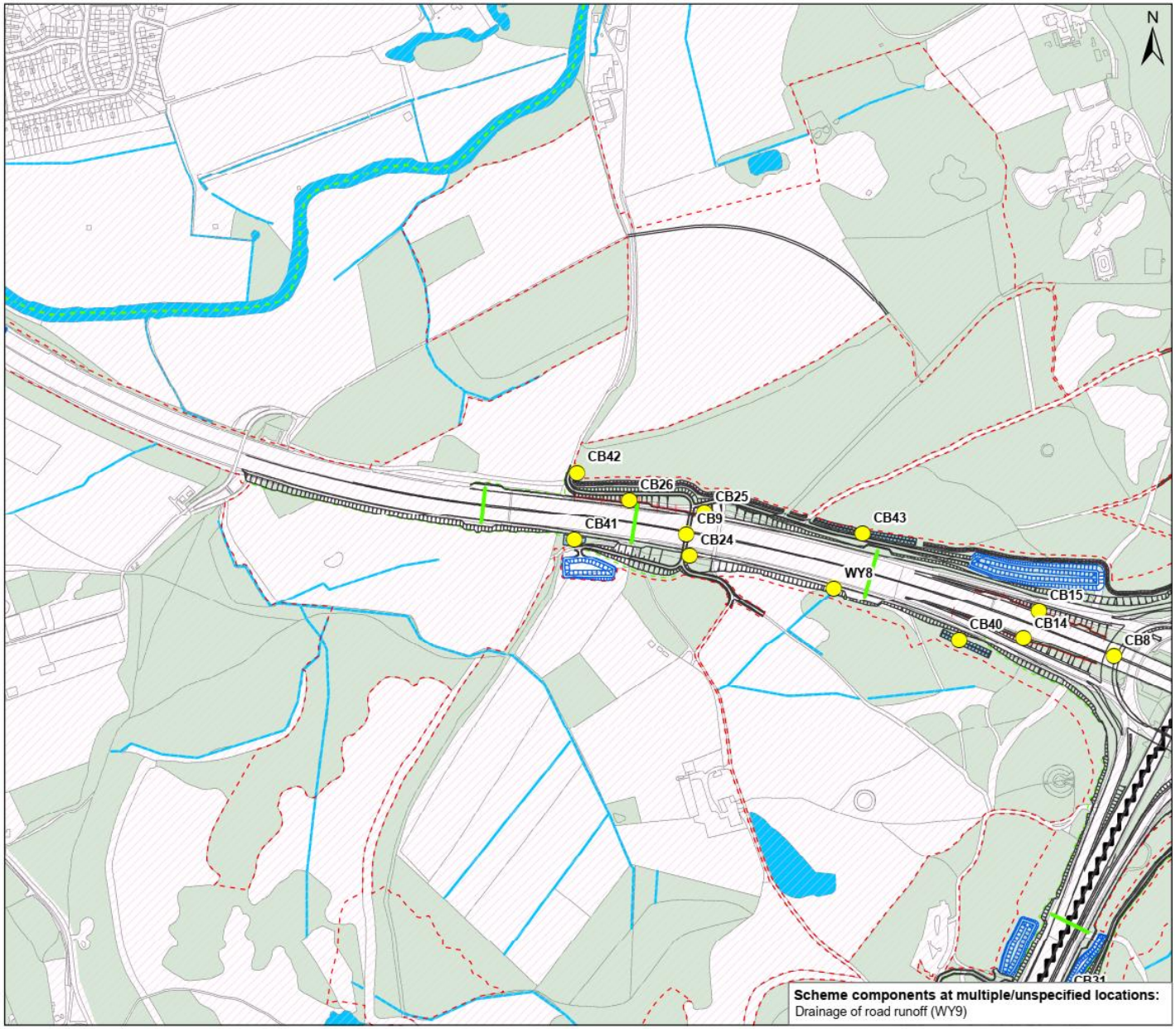

Road Investment Strategy Improvements to M25 J10/A3 Wisley Interchange

Figure B.9 - Plan 9 with scheme components

Key

- Scheme Components

Road Improvement Works

- Road design
- Retaining wall
- DCO Boundary
- Proposed gantries
- Retained gantries
- Filter drain
- Drainage attentuation pond
- Pre-earthwork ditch
- Soakaways

WFD Surface Water Bodies

- Wey (Shalford to River Thames confluence at Weybridge)
- Operational Catchments
- River Water Body Catchments

WFD Groundwater Bodies

- Chobham Bagshot Beds

OS Features

- OS Surface Water Bodies
- Woodland

Data sources: Environment Agency and Ordnance Survey

0 0.15 0.3 Km

Scale (at A3): 1:5,000

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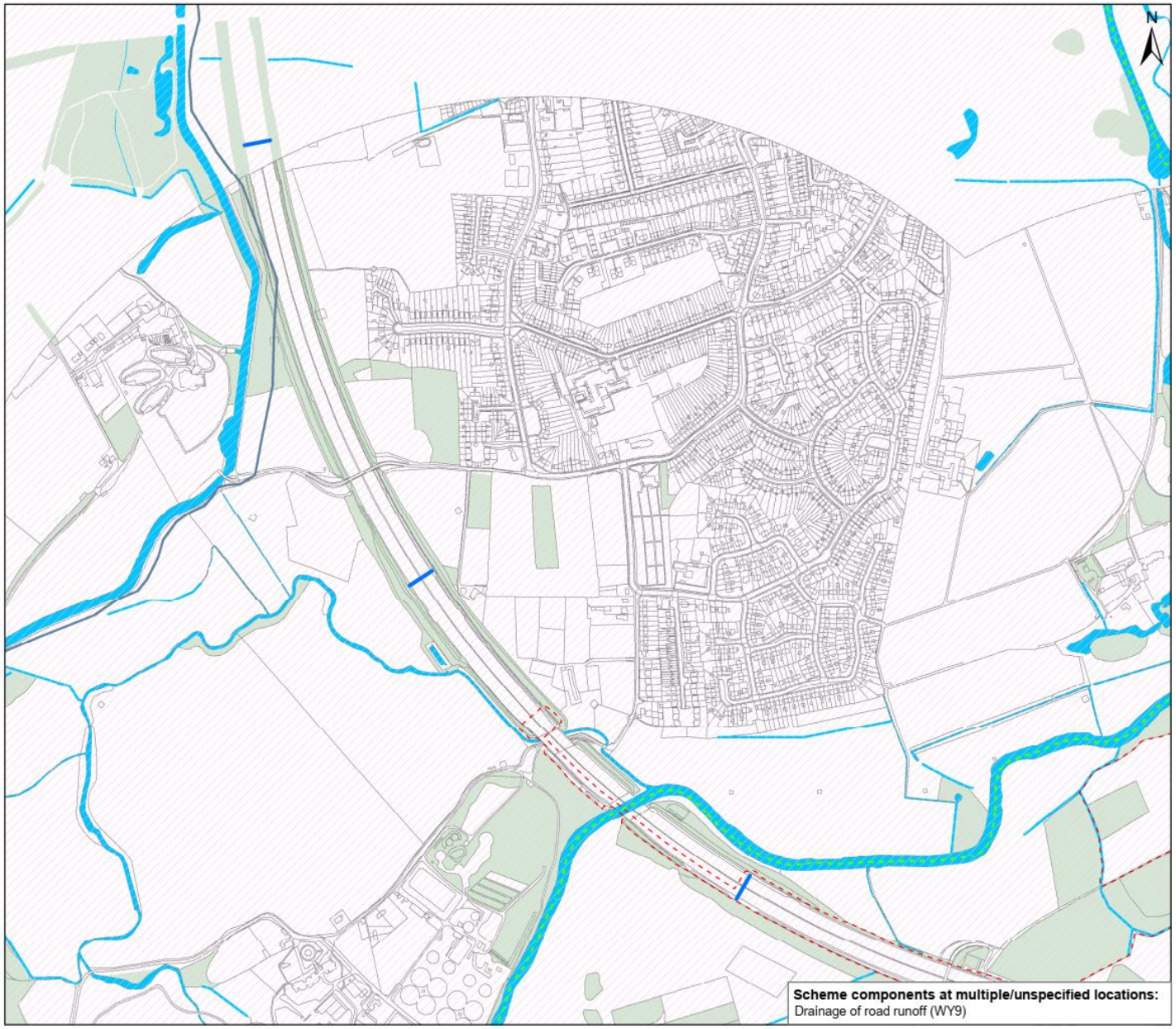

Road Investment Strategy Improvements to M25 J10/A3 Wisley Interchange

Figure B.10 - Plan 10 with scheme components

Key

Road Improvement Works

- Road design
- DCO Boundary
- Proposed gantries
- Retained gantries
- Filter drain

WFD Surface Water Bodies

- Wey (Shalford to River Thames confluence at Weybridge)
- Operational Catchments
- River Water Body Catchments

WFD Groundwater Bodies

- Chobham Bagshot Beds

OS Features

- OS Surface Water Bodies
- Woodland

Data sources: Environment Agency and Ordnance Survey

0 0.175 0.35 Km

Scale (at A3): 1:6,000

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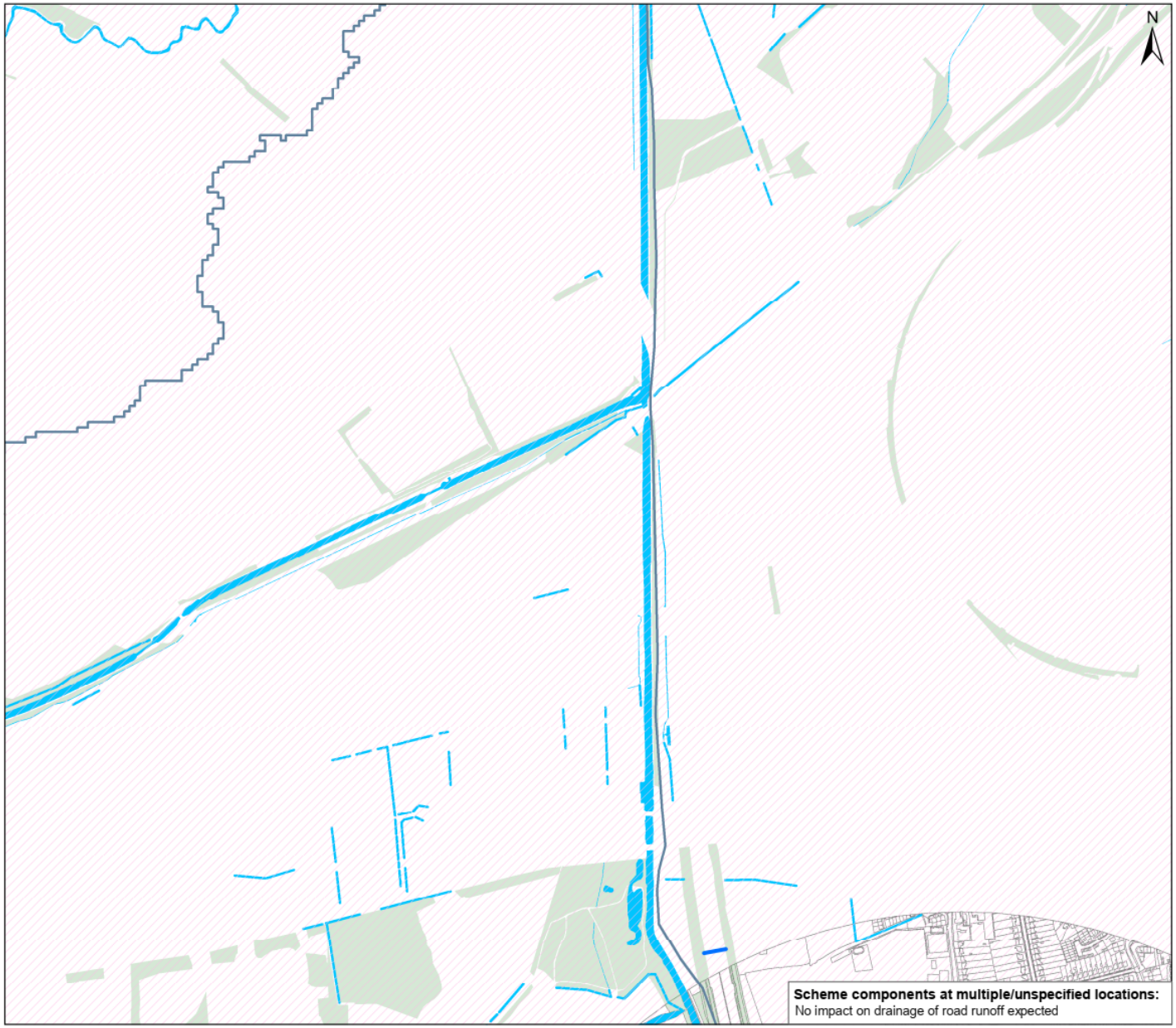

Road Investment Strategy Improvements to M25 J10/A3 Wisley Interchange

Figure B.11 - Plan 11 with scheme components

Key

- Retained gantries
- Operational Catchments
- River Water Body Catchments

WFD Groundwater Bodies

- Chobham Bagshot Beds

OS Features

- OS Surface Water Bodies
- Woodland

Data sources: Environment Agency and Ordnance Survey

0 0.2 0.4 Km

Scale (at A3): 1:7,000

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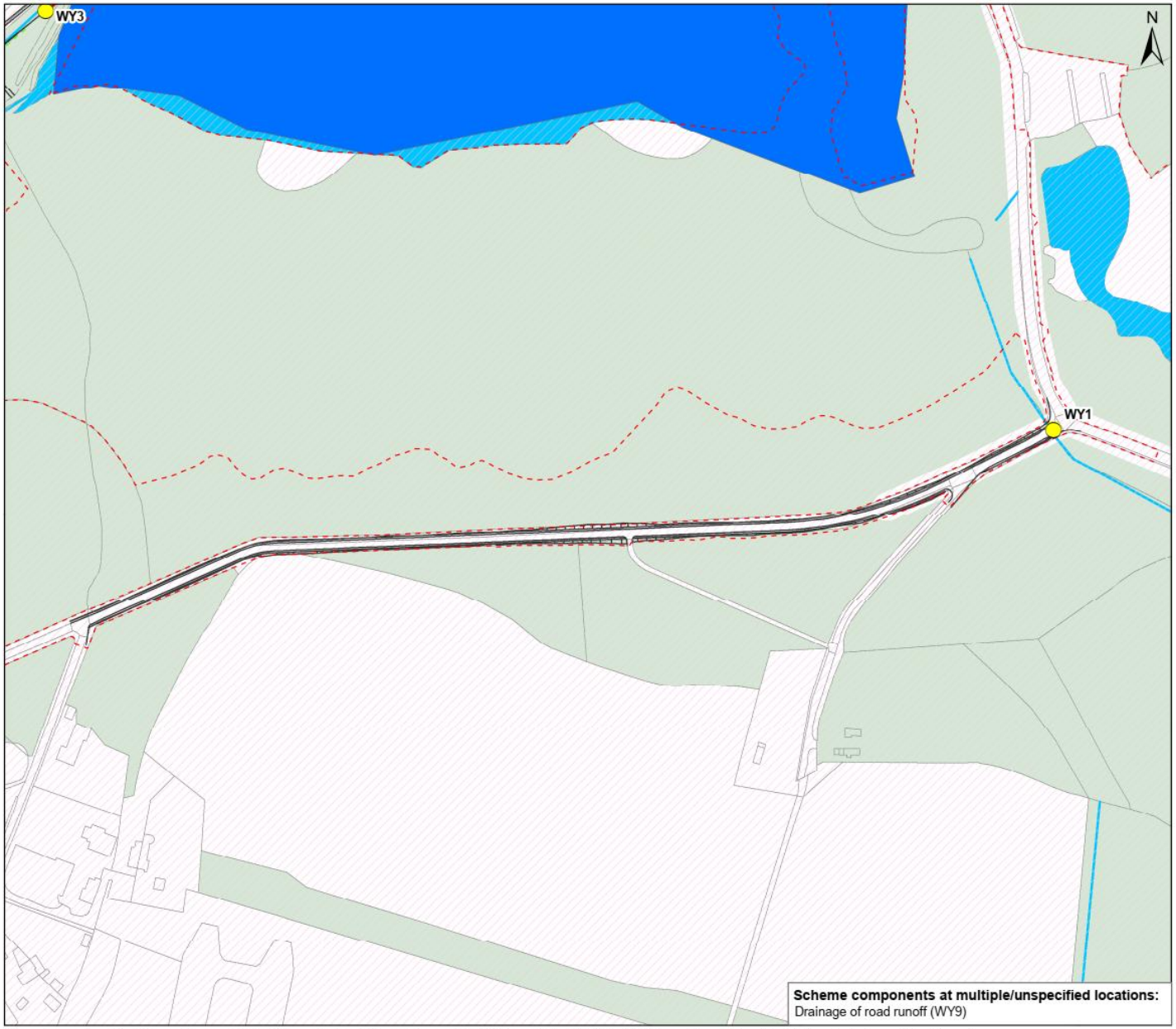

Road Investment Strategy
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Figure B.12 - Elm road with scheme components

Key

- Scheme Components

Road Improvement Works

- Road design
- Retaining wall
- DCO Boundary
- Filter drain
- Boldermere Lake
- Operational Catchments
- River Water Body Catchments

WFD Groundwater Bodies

- Chobham Bagshot Beds

OS Features

- OS Surface Water Bodies
- Woodland

Data sources: Environment Agency and Ordnance Survey

0 0.05 0.1 Km

Scale (at A3): 1:2,000

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Appendix C. WFD Assessment Matrices

Surface water body	Code	SB1	SB2	SB3
GB106039017890	**Scheme component**	River crossing (Stratford Brook)	Culvert strengthening	Discharge of road runoff to natural drainage network
	Water feature type	WFD assessed water body	WFD assessed water body	WFD assessed water body and land drainage ditches / ponds
Stratford Brook	**Location**	A3 Ockham Park Junction - Wisley Lane Diversion	A3 southbound off-slip at Ockham Park Junction	Multiple locations
	Description	c. 27.5m wide, c. 5m high new Stratford Brook underbridge to accommodate new access to Wisley Lane. Bridge spans across existing natural planform of river.	Strengthening of existing Stratford Brook Culvert (South) under the A3 southbound off-slip. Traffic load taken off existing culvert by placing new concrete beam deck above its soffit. New beam supported by reinforced concrete piles set-back from existing culvert. Existing culvert remains in-situ.	Treatment of runoff from road surfaces discharging into Stratford Brook and its tributaries to achieve compliance with EQS and RST toxicity standards.

Key
- major beneficial effect
- minor / localised beneficial effect
- no effect
- minor / localised adverse effect
- adverse widespread or prolonged effect
- adverse effect on overall WFD status of water body

Test A Potential to cause deterioration of current WFD Ecological Status

			Current Status	Status objective	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*
ECOLOGICAL STATUS	Biological quality elements	Macrophytes and phytobenthos	Good	Not assessed	The use of a single-span bridge (c. 27.5m wide and c. 5m high) as opposed to a culvert will minimise the impacts of this Scheme component on macrophytes and phytobenthos. However, permanent shading of the channel and riparian zone will result in a localised adverse effects due to a reduction in photosynthetic activity. These effects are not anticipated to a measurable effect on watercourse nutrient status. Minor localised effect.	Since existing culvert remains in-situ, no deterioration at water body scale.	Based on currently available information a design for road drainage has been developed to achieve compliance with relevant EQS and RST toxicity standards as tested with HAWRAT. Attenuation areas are used to treat road runoff in this water body. Runoff generated by non-highway surfaces, such as embankments, is collected and conveyed to natural waters by pre-embankment drains. Compliance with these toxicity standards will contribute to safeguarding the number and diversity of a) macrophytes and phytobenthos b) habitats available for macroinvertebrates and c) fish populations, particularly at early stages of life when they are vulnerable to suffocation. Minor / localised improvements to these WFD quality elements are expected to result from a more effective road drainage system.
		Macroinvertebrates	Moderate	Good by 2027	The use of a single-span bridge (c. 27.5m wide and c. 5m high) as opposed to a culvert will minimise the impacts of this Scheme component on macroinvertebrates. However, permanent shading of the channel and riparian zone will result in a localised adverse effects due to a reduction in / loss of aquatic and riparian vegetation. Minor localised effect.		
		Fish	Not assessed	Not assessed	As a single-span bridge is being used instead of a culvert there is not anticipated to be an effect on the status of fish in Stratford Brook water body. The bridge will not create a further barrier to the migration of fish through the water body. The bridge height (c. 5m) and width (c .27.5m) will allow sufficient light under the structure to not discourage fish movement. No deterioration at water body scale.		
	Physico-chemical quality elements	Physico-chemical quality elements comprise: Ammonia, Dissolved Oxygen, pH, Phosphate and Temperature.	Good	Good by 2015	Single-span bridge will not adversely affect the physico-chemical condition of Stratford Brook. No deterioration at water body scale.	Since existing culvert remains in-situ, no deterioration at water body scale.	See background information in first paragraph of biological quality elements. Compliance with toxicity standards will generate physico-chemical conditions more conducive to supporting healthy biological quality elements. More effective treatment of road runoff reduces silt and pollutant inputs to the water body, generating minor localised improvements to the background physical and chemical environment of the water body.
	Hydro-morphological quality elements	Hydro-morphological quality elements: Hydrological Regime (e.g. quantity and dynamics of water flow and connection to groundwater) and Morphology (e.g. river continuity, river depth and width variation, structure and substrate of river bed and structure of the riparian zone)	Supports Good	Supports Good by 2015	The use of a c. 27.5m wide single-span bridge over Stratford Brook instead of a culvert allows the present semi-natural sinuous channel to remain. Channel morphology and hydrological regime (including flow diversity, sediment continuity and diversity of planform) should not be impacted by the crossing. Realignment and restriction of the channel will not be necessary. At present bank protection to prevent under-cutting of the bridge structure is not anticipated (channel gradient is natural and the channel is formed in clays). However, construction and operation of bridge will simplify the riparian zone through shading and footprint of the structure, hence minor localised effect reported.	Since existing culvert remains in-situ, no deterioration at water body scale.	See background information in first paragraph of biological quality elements. Compliance with toxicity standards will generate hydro-morphological conditions more conducive to supporting healthy biological quality elements. Lower silt inputs from the road will reduce the dominance of fines in the aquatic sediment system. This is likely to lead to more diverse flow patterns, channel dimensions and improved substrate character (i.e. minor localised improvements to the hydro-morphological quality element).
	Specific pollutants	As listed in Annex VIII of the Water Framework Directive.	High	High by 2015	Physical modification of water feature will not cause deterioration to the Specific Pollutant quality elements.		See background information in first paragraph of biological quality elements. Compliance with toxicity standards is likely to generate minor / localised improvements to this quality element.
CHEMICAL STATUS	Priority substances and /or priority hazardous substances	As listed in the Environmental Quality Standards Directive, (2008/105/EC).	Good	Good by 2015	Physical modification of water feature will not cause deterioration to Chemical Status.		See background information in first paragraph of biological quality elements. Compliance with toxicity standards is likely to generate minor / localised improvements to this quality element.

Contains *sensitive* information

Surface water body	Scheme component	River crossing (Stratford Brook)	Culvert strengthening	Discharge of road runoff to natural drainage network
GB106039017890	Water feature type	WFD assessed water body	WFD assessed water body	WFD assessed water body and land drainage ditches / ponds
	Location	A3 Ockham Park Junction - Wisley Lane Diversion	A3 southbound off-slip at Ockham Park Junction	Multiple locations
Stratford Brook	Description	c. 27.5m wide, c. 5m high new Stratford Brook underbridge to accommodate new access to Wisley Lane. Bridge spans across existing natural planform of river.	Strengthening of existing Stratford Brook Culvert (South) under the A3 southbound off-slip. Traffic load taken off existing culvert by placing new concrete beam deck above its soffit. New beam supported by reinforced concrete piles set-back from existing culvert. Existing culvert remains in-situ.	Treatment of runoff from road surfaces discharging into Stratford Brook and its tributaries to achieve compliance with EQS and RST toxicity standards.

Key

- major beneficial effect
- minor / localised beneficial effect
- no effect
- minor / localised adverse effect
- adverse widespread or prolonged effect
- adverse effect on overall WFD status of water body

Test B Potential to prevent future attainment of Good Ecological Status

Current Status	Status objective	RBMP measures to achieve objective	Where RBMP measure will happen	When RBMP measure will happen	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*
		No measures assigned to this water body listed in RBMP or supporting data sets	NA	NA	NA	NA	NA
		At operational catchment scale (Wey catchment) the following measures relevant to these works are advocated by the local Catchment Partnership (Environment Agency, 2015)					
		Wey Diffuse Advice Project throughout the catchment. This would greatly extend a proven mechanism of reducing the impacts of rural and urban diffuse pollution, thus helping resolve catchment-wide problems with high levels of pesticides, phosphates and sediments impacting on river life and public drinking water abstractions.	catchment wide	unspecified	NA	NA	See text under 'overall effect'
		Fish passage mitigation projects on all key identified migratory barriers throughout the catchment, contributing directly to the local recovery of populations of threatened priority fish species, such as brown trout, Atlantic salmon and European eel, with associated recreational and fisheries provisioning benefits.	catchment wide	unspecified	The use of a single-span bridge instead of a culvert should reduce the impact to fish migration and therefore passage should not be affected, so aligning with this strategy.	Since existing culvert remains in-situ, no deterioration at water body scale.	NA
		A Strategy has been developed to tackle Himalayan Balsam in the catchment targeting high risk areas and to containment points. Project officer time for the development of strategies for other invasive non-native species (INNS) such as floating pennywort, water fern (Azolla) and mink is needed.	catchment wide	unspecified	See text under 'overall effect'		

*assumes that mitigations embedded in the Scheme are implemented.
** assumes additional mitigation measures are also implemented.

Surface water body

GB106039017890

Stratford Brook

WFD Assessment made on preliminary design presented in Scheme Layout Plans (application document TR010030/APP/2.8), assuming:
1) the mitigation already 'embedded' in this preliminary design is implemented;
2) additional specific mitigation (as summarised in section 5 of main body of this report) is implemented as developed and agreed with the Environment Agency (and Natural England); and
3) generic guidance on the principles of WFD compliant design (also summarised in section 5) is adhered to in subsequent detailed design of scheme components affecting the water environment.

Key

- major beneficial effect
- minor / localised beneficial effect
- no effect
- minor / localised adverse effect
- adverse widespread or prolonged effect
- adverse effect on overall WFD status of water body

Test A Potential to cause deterioration of current WFD Ecological Status

			Overall effect of Scheme on WFD element*	Additional Proposed Mitigation Measures	Residual effect of Scheme on WFD element**	Effect of Scheme on ecological / chemical status	Overall effect of Scheme on water body status
ECOLOGICAL STATUS	Biological quality elements	Macrophytes and phytobenthos	Although one Scheme component generates minor or localised improvements to quality elements, others are recorded as having no effect (i.e. causing no deterioration) or minor localised effect. The worst case (minor localised effect) is carried through.	The following additional mitigations are proposed for Stratford Brook: SB_a Habitat improvements along the Stratford Brook upstream of the A3, SB_b Reinstatement of riparian trees, SB_c Mammal shelf under Stratford Brook Underbridge. Additionally, feasibility assessments for the following additional mitigations will be undertaken at detailed design (SB_d): 1. Removal/modification of sill in Stratford Brook South Culvert 2. Retrofit mammal pass solution in Stratford Brook South Culvert 3. Modification to culvert under A3 and northbound slip road to improve fish and animal passage 4. Management of INNS Himalayan balsam A mix of measures identified in the feasibility study will be implemented if this can be done at reasonable cost. If not, an alternative solution will be implemented, as set out in Appendix F.	With the combination of mitigation to be put in place, the biological elements of Stratford Brook impacted by shading should be replaced within the catchment. Therefore, the Scheme should not have an effect on the status of the WFD water body.	With the mitigation in place the biological, physico-chemical and hydromorphological quality elements of Stratford Brook impacted by the shading should be replaced within the catchment. No effect anticipated at a water body scale.	**With the mitigation in place the biological, physico-chemical and hydromorphological quality elements of Stratford Brook impacted by the shading should be replaced within the catchment. No effect anticipated at a water body scale.**
		Macroinvertebrates					
		Fish	Although one Scheme component generates minor or localised improvements to quality elements, others are recorded as having no effect (i.e. causing no deterioration). The worst case (no deterioration) is carried through.		n/a		
	Physico-chemical quality elements	Physico-chemical quality elements comprise: Ammonia, Dissolved Oxygen, pH, Phosphate and Temperature.	Although one Scheme component generates minor or localised improvements to quality elements, others are recorded as having no effect (i.e. causing no deterioration). The worst case (no effect) is carried through.				
	Hydro-morphological quality elements	Hydro-morphological quality elements: Hydrological Regime (e.g. quantity and dynamics of water flow and connection to groundwater) and Morphology (e.g. river continuity, river depth and width variation, structure and substrate of river bed and structure of the riparian zone)	Although one Scheme component generates minor or localised improvements to quality elements, others are recorded as having no effect (i.e. causing no deterioration) or minor localised effect. The worst case (minor localised effect) is carried through.		With the combination of mitigation to be put in place, the riparian zone of Stratford Brook impacted by shading should be replaced within the catchment. Therefore, the Scheme should not have an effect on the status of the WFD water body.		
	Specific pollutants	As listed in Annex VIII of the Water Framework Directive.	Although one Scheme component generates minor or localised improvements to quality elements, others are recorded as having no effect (i.e. causing no deterioration). The worst case (no effect) is carried through.	No additional mitigation necessary	n/a		
CHEMICAL STATUS	Priority substances and/or priority hazardous substances	As listed in the Environmental Quality Standards Directive, (2008/105/EC).	Although one Scheme component generates minor or localised improvements to quality elements, others are recorded as having no effect (i.e. causing no deterioration). The worst case (no effect) is carried through.	No additional mitigation necessary	n/a	No deterioration at water body scale anticipated.	

Contains *sensitive* information

Surface water body

GB106039017890

Stratford Brook

WFD Assessment made on preliminary design presented in Scheme Layout Plans (application document TR010030/APP/2.8), assuming:
1) the mitigation already 'embedded' in this preliminary design is implemented;
2) additional specific mitigation (as summarised in section 5 of main body of this report) is implemented as developed and agreed with the Environment Agency (and Natural England); and
3) generic guidance on the principles of WFD compliant design (also summarised in section 5) is adhered to in subsequent detailed design of scheme components affecting the water environment.

Key

- major beneficial effect
- minor / localised beneficial effect
- no effect
- minor / localised adverse effect
- adverse widespread or prolonged effect
- adverse effect on overall WFD status of water body

Test B Potential to prevent future attainment of Good Ecological Status

	RBMP measures to achieve objective	Overall effect of Scheme on proposed measure	Overall effect of Scheme on WFD element*	Additional Proposed Mitigation Measures	Residual effect of Scheme on WFD element**	Effect of Scheme on ecological / chemical status	Overall effect of Scheme on water body status
	No measures assigned to this water body listed in RBMP or supporting data sets	NA					
	At operational catchment scale						
	Wey Diffuse Advice Project throughout the catchment. This would greatly extend a proven mechanism of reducing the impacts of rural and urban diffuse pollution, thus helping resolve catchment-wide problems with high levels of pesticides, phosphates and sediments impacting on river life and public drinking water abstractions.	By complying with current EQS and RST toxicity standards, as tested with HAWRAT, the Scheme is expected to reduce diffuse pollution of sediment from road runoff in this catchment, therefore aligning with this Scheme.					
	Fish passage mitigation projects on all key identified migratory barriers throughout the catchment, contributing directly to the local recovery of populations of threatened priority fish species, such as brown trout, Atlantic salmon and European eel, with associated recreational and fisheries provisioning benefits.	Proposed additional mitigation measure 'SB_b Feasibility study into river habitat and fish passage improvement along the Stratford Brook, within the red line boundary of the Scheme' has the potential to improve fish passage. See Section 5 of main report for more details. However, until feasibility of this measure is confirmed we assume there will be no effect on fish passage in Stratford Brook.					
	A Strategy has been developed to tackle Himalayan Balsam in the catchment targeting high risk areas and to containment points. Project officer time for the development of strategies for other invasive non-native species (INNS) such as floating pennywort, water fern (Azolla) and mink is needed.	By adoption of good practice in INNS management and biosecurity (see section 5), the works can contribute to this objective within the geographical confines of the Scheme.					

*assumes that mitigations embedded in the Scheme are imple
** assumes additional mitigation measures are also implement

Surface water body	Code	ML1	ML2	ML3	ML4
GB105039017621	Scheme component	Loss of ephemeral headwater ditch	Loss of ephemeral headwater ditch	Loss of ephemeral headwater ditch	Discharge of road runoff to natural drainage network
Mole (Horley to Hersham)	Watercourse type	Ordinary watercourse	Ordinary watercourse	Ordinary watercourse	WFD water body and ordinary watercourses
	Location	New Sandpit Hill overbridge embankment south of M25	New Sandpit Hill overbridge embankment north of M25	Between A3 (north of M25 J10) and New Red Hill restricted byway between new Redhill overbridge and new Sandpit Hill overbridge	Multiple locations
	Description	New Sandpit Hill overbridge embankments to the south west of the M25 will cross current watercourse. Part of channel will be lost and the rest diverted into the new drainage system	New Sandpit Hill overbridge embankments to the north east of the M25 will cross current watercourse. Part of channel will be lost and the rest diverted into the new drainage system	Widening of A3 southbound off slip at Wisley Junction and New Red Hill restricted byway between new Redhill overbridge and new Sandpit Hill overbridge crossing the channel loss of channel length	Treatment of runoff from road surfaces discharging into the Mole and its tributaries to achieve compliance with EQS and RST toxicity standards

Key

Test A: Potential to cause deterioration of current WFD Ecological Status

			Current Status	Status objective	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*
ECOLOGICAL STATUS	Biological quality elements	Macrophytes and phytobenthos	Moderate	Moderate by 2015	loss of an estimated 420m length of ephemeral headwater ditch (of low ecological value) could be offset by the creation of an estimated 720 m length of open ditch that will drain natural catchments or embankments At preliminary design a precautionary assessment is made that loss of ephemeral headwater ditches could cause a minor local reduction in habitat quality for macrophytes and phytobenthos macroinvertebrates and fish in channels that potentially contribute to habitat value at a water body scale			Based on currently available information a design for road drainage has been developed to achieve compliance with relevant EQS and RST toxicity standards as tested with HAWRAT. Attenuation areas, soakaways and soakaway infiltration trenches are used to treat road runoff in this water body. Runoff generated by non-highway surfaces such as embankments is collected and conveyed to natural waters by pre-embankment drains. Compliance with these toxicity standards will contribute to safeguarding the number and diversity of a) macrophytes and phytobenthos b) habitats available for macroinvertebrates and c) fish populations particularly at early stages of life when they are vulnerable to suffocation. Minor / localised improvements to these WFD quality elements are expected to result from a more effective road drainage system than is currently in place
		Macroinvertebrates	Moderate	Moderate by 2015				
		Fish	Good	Good by 2015				
	Physico-chemical quality elements	Physico-chemical quality elements comprise: Acid Neutralising Capacity, Ammonia, Biochemical Oxygen Demand, Dissolved Oxygen, pH, Phosphate and Temperature	Moderate	Moderate by 2015	See background information in first paragraph of biological quality elements At preliminary design a precautionary assessment is made that loss of ephemeral headwater ditches could cause a minor localised detriment to physico-chemical quality elements in channels that potentially contribute to habitat value at a water body scale			See background information in first paragraph of biological quality elements. Compliance with toxicity standards will generate physico-chemical conditions more conducive to supporting healthy biological quality elements. More effective treatment of road runoff reduces silt and pollutant inputs to the water body, generating minor localised improvements to the background physical and chemical environment of the water body
	Hydromorphological quality elements	Hydro-morphological quality elements: Hydrological Regime (e.g. quantity and dynamics of flow and connection to groundwater) and Morphology (e.g. river continuity, river depth and width variation, structure and substrate of river bed, and structure of riparian zone)	Supports Good	Supports Good by 2015	The current drainage system is naturally ephemeral. The channel network has a degraded planform with shallow cross section and is devoid of a distinct riparian zone (further details on baseline in the main body of the report). To accommodate the Scheme a more formal drainage system is being established. Highway drainage will be separated from natural runoff. Natural runoff will be collected in pre-embankment drains (of uniform plan - and cross-sectional form) and discharged either to soakaways or the existing river system. Approximately 420m of existing ditch will be replaced by c. 720m of open ditch that will drain natural catchments or embankments At preliminary design a precautionary assessment is made that loss of ephemeral headwater ditches could cause a minor localised detriment to hydromorphological quality elements in channels that potentially contributes to habitat value at a water body scale			See background information in first paragraph of biological quality elements. Compliance with toxicity standards will generate hydro-morphological conditions more conducive to supporting healthy biological quality elements. Lower silt inputs from the road will reduce the dominance of fines in the aquatic sediment system. This is likely to lead to more diverse flow patterns, channel dimensions and improved substrate character (i.e. minor localised improvements to the hydro-morphological quality element)
	Specific pollutants	As listed in Annex VIII of the Water Framework Directive	High	High by 2015	Physical modification of water feature will not cause deterioration to the Specific Pollutant quality elements			See background information in first paragraph of biological quality elements. Compliance with toxicity standards is likely to generate minor / localised improvements to this quality element
CHEMICAL STATUS	Priority substances and / or priority hazardous substances	As listed in the Environmental Quality Standards Directive (2008/105/EC)	Good	Good by 2015	Physical modification of water feature will not cause deterioration to Chemical Status			See background information in first paragraph of biological quality elements. Compliance with toxicity standards is likely to generate minor / localised improvements to this quality element

Contains sensitive information

Surface water body	Code	ML1	ML2	ML3	ML4
GB105039017621	Scheme component	Loss of ephemeral headwater ditch	Loss of ephemeral headwater ditch	Loss of ephemeral headwater ditch	Discharge of road runoff to natural drainage network
	Watercourse type	Ordinary watercourse	Ordinary watercourse	Ordinary watercourse	WFD water body and ordinary watercourses
	Location	New Sandpit Hill overbridge embankment south of M25	New Sandpit Hill overbridge embankment north of M25	Between A3 (north of M25 J10) and New Red Hill restricted byway between new Redhill overbridge and new Sandpit Hill overbridge	Multiple locations
Mole (Horley to Hersham)	Description	New Sandpit Hill overbridge embankments to the south west of the M25 will cross current watercourse. Part of channel will be lost and the rest diverted into the new drainage system	New Sandpit Hill overbridge embankments to the north east of the M25 will cross current watercourse. Part of channel will be lost and the rest diverted into the new drainage system	Widening of A3 southbound off slip at Wisley Junction and New Red Hill restricted byway between new Redhill overbridge and new Sandpit Hill overbridge crossing the channel loss of channel length	Treatment of runoff from road surfaces discharging into the Mole and its tributaries to achieve compliance with EQS and RST toxicity standards

Key

Current Status	Status objective	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*
Test B Potential to prevent future attainment of Good Ecological Status					
	RBMP measures to achieve objective	Where RBMP measure will happen	When RBMP measure will happen	Effect of Scheme component on WFD element	Effect of Scheme component on WFD element	Effect of Scheme component on WFD element	Effect of Scheme component on WFD element
	No measures assigned to this water body/issue in RBMP or supporting data sets	NA	NA	NA	NA	NA	NA
		At operational catchment scale (Wey catchment) the following measures relevant to these works are advocated by the local Catchment Partnership (Environment Agency, 2015)					
	Develop a comprehensive strategy for tackling invasive non native species	catchment wide	unspecified	See text under 'overall effect'			
	Remove barriers that are impeding fish passage and contributing directly to the local recovery of populations of threatened priority fish species such as brown trout Atlantic salmon and European eel with associated recreational and fisheries benefits	catchment wide	unspecified	See text under 'overal leffect'			NA
	Restore natural morphology where man made modifications exist with channel habitat creation gravel reintroduction tree works and back waters allowing naturalised flow regimes and sediment transport and associated flood management benefits	catchment wide	unspecified	Ephemeral ditches being removed along with their natural morphology therefore going against his objective			NA

*assumes that mitigations embedded in the Scheme are implemented
**assumes additional mitigation measures are also implemented

Surface water body

GB105030017621

Mole (Horley to Hersham)

WFD Assessment made on preliminary design presented in Scheme Layout Plans (application document TR010030/APP/2.8), assuming:
1) the mitigation already embedded in this preliminary design is implemented,
2) additional specific mitigation (as summarised in section 5 of main body of this report) is implemented as developed and agreed with the Environment Agency (and Natural England), and
3) general guidance on the principles of WFD compliant design (also summarised in section 5) is adhered to in subsequent detailed design of scheme components affecting the water environment

Key

High ecological status
Good ecological status / potential
Moderate ecological status / potential
Poor ecological status
Moderate / widespread or prolonged effect
Major deterioration / serious WFD failure of water body

			Overall effect of Scheme on WFD element	Additional Proposed Mitigation Measures	Residual effect of Scheme on WFD element**	Effect of Scheme on ecological / chemical status	Overall effect of Scheme on water body status
ECOLOGICAL STATUS	Biological quality elements	Macrophytes and phytobenthos					
		Macroinvertebrates					
		Fish		The following additional mitigations are proposed for the Mole catchment: ML_a Habitat improvements at Chatley Wood Pond. See Section 5 of main report for more details	With the mitigation in place the biological elements of the ephemeral channel potentially contributing to the habitat at a water body scale should be replaced within the catchment. Therefore the Scheme should not have an effect on the status of the WFD water body	With the mitigation in place the biological, physico-chemical and hydromorphological quality elements of the ephemeral channel potentially contributing to the habitat at a water body scale should be replaced within the catchment. No effect anticipated at a water body scale	With the mitigation in place the biological, physico-chemical and hydromorphological quality elements of the ephemeral channel potentially contributing to the habitat at a water body scale should be replaced within the catchment. No effect anticipated at a water body scale.
	Physico-chemical quality elements	Physico-chemical quality elements comprise: Acid Neutralising Capacity, Ammonia, Biochemical Oxygen Demand, Dissolved Oxygen, pH, Phosphate and Temperature	Although one scheme component has a minor localised beneficial effect, the other three are recorded as having minor or localised adverse effects due to local loss of channel that potentially contributes to habitat value at a water body scale. The worst case (minor / localised adverse effect) is carried through	The following additional mitigations are proposed for the Mole Catchment: ML_a Enhancement of water features on Replacement Land. See Section 5 of main report for more details	With the mitigation in place the physico-chemical elements of the ephemeral channel potentially contributing to the habitat at a water body scale should be replaced within the catchment. Therefore the Scheme should not have an effect on the status of the WFD water body		
	Hydromorphological quality elements	Hydro-morphological quality elements: Hydrological Regime (e.g. quantity and dynamics of flow and connection to groundwater) and Morphology (e.g. river continuity, river depth and width variation, structure and substrate of river bed, and structure of riparian zone)	Although one scheme component has a minor localised beneficial effect, the other three are recorded as having minor or localised adverse effects due to local loss of channel that potentially contributes to habitat value at a water body scale. The worst case (minor / localised adverse effect) is carried through	The following additional mitigations are proposed for the Mole Catchment: ML_a Enhancement of water features on Replacement Land. See Section 5 of main report for more details	With the mitigation in place the hydromorphological elements of the ephemeral channel potentially contributing to the habitat at a water body scale should be replaced within the catchment. Therefore the Scheme should not have an effect on the status of the WFD water body		
	Specific pollutants	As listed in Annex VIII of the Water Framework Directive	Although one Scheme component generates minor or localised improvements to quality elements, the three others are recorded as having no effect (i.e. causing no deterioration). The worst case (no effect) is carried through	No additional mitigation necessary	n/a		
CHEMICAL STATUS	Priority substances and / or priority hazardous substances	As listed in the Environmental Quality Standards Directive (2008/105/EC)	Although one Scheme component generates minor or localised improvements to quality elements, the three others are recorded as having no effect (i.e. causing no deterioration). The worst case (no effect) is carried through	No additional mitigation necessary	n/a	No deterioration at water body scale anticipated	

Contains sensitive information

Surface water body

GB 105030617621

Mole (Horley to Hersham)

WFD Assessment made on preliminary design presented in Scheme Layout Plans (application document TR010030/APP/2.8), assuming:
1) the mitigation already 'embedded' in the preliminary design is implemented,
2) additional specific mitigation (as summarised in section 5 of main body of this report) is implemented as developed and agreed with the Environment Agency (and Natural England), and
3) general guidance on the principles of WFD compliant design (also summarised in section 5) is adhered to in subsequent detailed design of scheme components affecting the water environment

Key

	Overall effect of Scheme on WFD element	Additional Proposed Mitigation Measures	Residual effect of Scheme on WFD element**	Effect of Scheme on ecological / chemical status	Overall effect of Scheme on water body status
RBMP measures to achieve objective	Overall effect of Scheme on proposed measure				
No measures assigned to this water body (ised in RBMP or supporting data ses	NA				
Develop a comprehensive strategy for tackling invasive non native species	By adopton of good practice in INNS management and biosecurity (see section 5) the works can contribute to this objective within the geographical confines of the Scheme				
Remove barriers that are impeding fish passage and contributing directly to the local recovery of populations of threatened priority fish species such as brown trout Atlantic salmon and European eel with associated recreational and fisheries benefits	No culverts are to be added to the water body as part of this Scheme nor are any going to be removed Therefore the Scheme will not contribute to the objective				
Restore natural morphology where man made modifications exist with channel habitat creation gravel reintroduction tree works and back waters allowing naturalised flow regimes and sediment transport and associated flood management benefits	Proposed additional measure 'WL_a Enhancement of water features on Replacement Land' has the potential restore areas of natural morphology See Section 5 of main report for more details This will mitigate against the loss of natural morphology so overall there is no effect on this objective				

*assumes that mitigations embedded in the Scheme are impl
** assumes additional mitigation measures are also implemen

Commercial in confidence

Surface water body

GB30643218

Bolder Mere

Code	BL1	BL2
Scheme component	Retaining wall	Discharge of road runoff to natural drainage network
Type	WFD lake water body	WFD lake water body
Location	A3 south of Junction 10	A3 south of Junction 10
Description	A3 being widened along north-western edge of Bolder Mere to accommodate additional lane. New retaining wall (length about 180m) to be constructed c. 4-8m into the lake margins to replace current wall. **Note encroachment of Scheme into Bolder Mere has been minimised by moving the restricted byway from the southern (Bolder Mere) side of the A3 to the northern side.**	Natural England records indicate that water from the A3 runs off directly to Bolder Mere. DF3 design intends highway runoff to be captured in pipe, mechanically treated and discharged to minor watercourse downstream of Bolder Mere.

Key

- major beneficial effect
- minor / localised beneficial effect
- no effect
- minor / localised adverse effect
- adverse widespread or prolonged effect
- adverse effect on overall WFD status of water body

Test A Potential to cause deterioration of current WFD Ecological Status

			Current Status	Status objective	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*
ECOLOGICAL STATUS	Biological quality elements	Macrophytes and phytobenthos	Not assessed	Not assessed	Construction of a replacement retaining wall further into the lake will result in direct loss of established macrophyte communities dominated by common reed. Common reed are very effective at extracting nutrients including Phosphorus from the lake. Hence direct loss of common reed has the potential to disrupt the nutrient balance of lake and so the structure of the macrophyte and phytobenthos assemblage. Potential for adverse effect at water body scale.	The existing drainage system discharges road runoff direct to Bolder Mere. The Scheme intends to close this pathway by redirecting runoff via mechanical treatment to a nearby Ordinary Watercourse. Reduced pollutant load expected to improve lake water quality which in turn improves biological quality element. Minor beneficial effect.
		Macroinvertebrates	Not assessed	Not assessed	Construction of a replacement retaining wall further into the lake will reduce habitat available to macroinvertebrates including notable species (e.g. dragonflies and damselflies) for various stages of their lifecycle. Potential minor adverse localised effects.	
		Phytoplankton	Moderate	Good by 2015	Direct loss of macrophytes associated with construction of a replacement retaining wall further into the lake has potential to increase nutrient concentration in lake, in turn simplifying the phytoplankton assemblage. Potential for adverse effect at water body scale.	
	Physico-chemical quality elements	Physico-chemical quality elements comprise total phosphorus, salinity, dissolved oxygen, pH, acid neutralising capacity.	Moderate	Good by 2027	The retaining wall is most likely to affect physico-chemical quality elements through a) direct loss of macrophytes and b) reduction in lake volume. Direct loss of macrophytes has potential to increase nutrient (particularly Phosphorus) concentrations in lake (see text above). A conservative assessment (see Appendix D) estimated the loss of volume associated with the encroachment to be less than 2% of total lake volume (considered to be insufficient to cause deterioration). Overall, minor adverse localised effects.	**Salinity -** Treated road surface runoff may contain salts. Redirection of road runoff (potentially containing salts) should reduce salinity of lake (beneficial impact). **Phosphorus**: analysis presented in Appendix D demonstrates that the A3 is neither a source or pathway for Total P to Bolder Mere. Hence no deterioration expected in physico-chemical quality elements at water body scale.
	Hydro-morphological quality elements	Hydro-morphological quality elements: Hydrological Regime (e.g. quantity and dynamics of flow, level, residence time and connection to groundwater)and Morphology (e.g. lake depth variation, quantity and structure of the substrate and both the structure and condition of the lake shore zone). However, for a HMWB the assessment of this quality element needs to account for the designated use of the water body.	Supports Good	Supports Good by 2015	Natural functioning of the hydrological regime and a natural lake morphology are considered essential components of a healthy lake ecosystem. Constantly changing water levels and shallow sloping margins combine to create a variation of depth and substrate that in turn generates a complex mosaic of habitats. The replacement of the existing retaining wall supporting the A3, and its relocation to accommodate a wider carriageway, will result in loss of a) an established gradually sloping lake margin and b) open water habitat. As the lake is at least partially groundwater fed, changes to the connection to the groundwater, through the potential addition of deeper sheet piling in the retaining wall, could adversely impact the hydrological regime. Potential for adverse prolonged effects.	The existing drainage network discharges road runoff direct to Bolder Mere. The Scheme intends to close this pathway by redirecting runoff via mechanical treatment to a nearby Ordinary Watercourse. Expected effect is a) a slight reduction to inflows and b) a reduction in fine sediment input to lake. Potential for minor beneficial effects.
	Supporting Elements (Surface Water)	Supporting elements only occur in a heavily modified water body. For Lake Surface Water bodies they cover: mitigation measures assessment and expert judgement.	Moderate	Good by 2015	No Mitigation Measures associated with this HMWB listed in the RBMP.	
	Specific pollutants	As listed in Annex VIII of the Water Framework Directive.	Does not require assessment	Does not require assessment	Physical modification of water feature will not cause deterioration to the Specific Pollutant quality elements.	The existing Scheme discharges road runoff direct to Bolder Mere. The DF3 design intends to close this pathway by redirecting runoff via mechanical treatment to a nearby Ordinary Watercourse. Reduced pollutant load expected to improve lake water quality. Minor beneficial effect. [Note that the Catchment Data Explorer records Chemical Quality elements for Bolder Mere as "Does not require assessment"]

Surface water body	
GB30643218	
Bolder Mere	

Code	BL1	BL2
Scheme component	Retaining wall	Discharge of road runoff to natural drainage network
Type	WFD lake water body	WFD lake water body
Location	A3 south of Junction 10	A3 south of Junction 10
Description	A3 being widened along north-western edge of Bolder Mere to accommodate additional lane. New retaining wall (length about 180m) to be constructed c. 4-8m into the lake margins to replace current wall. **Note encroachment of Scheme into Bolder Mere has been minimised by moving the restricted byway from the southern (Bolder Mere) side of the A3 to the northern side.**	Natural England records indicate that water from the A3 runs off directly to Bolder Mere. DF3 design intends highway runoff to be captured in pipe, mechanically treated and discharged to minor watercourse downstream of Bolder Mere.

Key

- major beneficial effect
- minor / localised beneficial effect
- no effect
- minor / localised adverse effect
- adverse widespread or prolonged effect
- adverse effect on overall WFD status of water body

			Current Status	Status objective	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*
CHEMICAL STATUS	Priority substances and/or priority hazardous substances	As listed in the Environmental Quality Standards Directive, (2008/105/EC).	Does not require assessment	Does not require assessment	Physical modification of water feature will not cause deterioration to Chemical Status.	See text under 'Specific Pollutants'

Test B Potential to prevent future attainment of Good Ecological Status

	RBMP measures to achieve objective	Where RBMP measure will happen	When RBMP measure will happen	Effect of Scheme component on WFD element	Effect of Scheme component on WFD element
	No measures were found for this Lake water body. The data catchment explorer, the South East RBMP (Environment Agency, 2015) and the River Wey Catchment vision (2014) were all referenced as with the surface water measures.				

*assumes that mitigations embedded in the Scheme are implemented.
** assumes additional mitigation measures are also implemented.

Surface water body

GB30643218

Bolder Mere

WFD Assessment made on preliminary design presented in Scheme Layout Plans (application document TR010030/APP/2.8), assuming:
1) the mitigation already 'embedded' in this preliminary design is implemented;
2) additional specific mitigation (as summarised in section 5 of main body of this report) is implemented as developed and agreed with the Environment Agency (and Natural England); and
3) generic guidance on the principles of WFD compliant design (also summarised in section 5) is adhered to in subsequent detailed design of scheme components affecting the water environment.

Key
- major beneficial effect
- minor / localised beneficial effect
- no effect
- minor / localised adverse effect
- adverse widespread or prolonged effect
- adverse effect on overall WFD status of water body

			Overall effect of Scheme on WFD element	Additional Proposed Mitigation Measures	Residual effect of Scheme on WFD element**	Effect of Scheme on ecological / chemical status	Overall effect of Scheme on water body status
Test A Potential to cause deterioration of current WFD Ecological Status							
ECOLOGICAL STATUS	Biological quality elements	Macrophytes and phytobenthos	Although Scheme component BL2 (discharge of road runoff) has potential to generate localised improvements to quality element, Scheme component BL1 (retaining wall) is recorded as having an adverse effect. The worst case (adverse effect) is carried through.	The following additional mitigations are proposed for Bolder Mere: BL_a Reinstatement of habitat along northwest shore (adjacent to A3) BL_b Habitat Improvements on the shores of Bolder Mere BL_c Invasive species management carp and bream Bl_d Feasibility studies into invasive species management BL_e Detailed design of new retaining wall along north-western edge of Bolder Mere See Section 5 of main report for more details.	Additional proposed mitigation measures expected to prevent deterioration at water body scale in long term. Minor temporary effects.	It is anticipated that adequate mitigation can be undertaken to avoid deterioration at water body scale. Only minor temporary effects are expected.	**It is anticipated that adequate mitigation can be undertaken to avoid deterioration at water body scale. Only minor temporary effects are expected.**
		Macroinvertebrates	Although Scheme component BL2 (discharge of road runoff) has potential to generate localised improvements to quality element, Scheme component BL1 (retaining wall) is recorded as having a minor adverse localised effect. The worst case is carried through.				
		Phytoplankton	Although Scheme component BL2 (discharge of road runoff) has potential to generate localised improvements to quality element, Scheme component BL1 (retaining wall) is recorded as having an adverse effect. The worst case (adverse effect) is carried through.				
	Physico-chemical quality elements	Physico-chemical quality elements comprise total phosphorus, salinity, dissolved oxygen, pH, acid neutralising capacity.	Although Scheme component BL2 (discharge of road runoff) is not expected to cause deterioration to quality element, Scheme component BL1 (retaining wall) is recorded as having a minor adverse localised effect. The worst case is carried through.		Additional proposed mitigation measure BL_a will re-establish macrophyte community along NW shore, mitigating potential increase in P concentrations in the lake. This mitigation allow effect of Scheme to be re-assessed as 'no deterioration' at water body scale.		
	Hydro-morphological quality elements	Hydro-morphological quality elements: Hydrological Regime (e.g. quantity and dynamics of flow, level, residence time and connection to groundwater)and Morphology (e.g. lake depth variation, quantity and structure of the substrate and both the structure and condition of the lake shore zone). However, for a HMWB the assessment of this quality element needs to account for the designated use of the water body.	Loss of lake marginal habitat will affect lake hydro-morphology. Risk of a prolonged adverse effect at the water body scale.		Additional proposed mitigation measures expected to prevent deterioration at water body scale in long term. Minor temporary effect.		
	Supporting Elements (Surface Water)	Supporting elements only occur in a heavily modified water body. For Lake Surface Water bodies they cover: mitigation measures assessment and expert judgement.	No Mitigation Measures associated with this HMWB listed in the RBMP.	No additional mitigation necessary	n/a		
	Specific pollutants	As listed in Annex VIII of the Water Framework Directive.	Although some Scheme components generate minor or localised improvements to quality elements, others are recorded as having no effect (i.e. causing no deterioration). The worst case (no effect) is carried through.				

Surface water body

GB30643218

Bolder Mere

WFD Assessment made on preliminary design presented in Scheme Layout Plans (application document TR010030/APP/2.8), assuming:
1) the mitigation already 'embedded' in this preliminary design is implemented;
2) additional specific mitigation (as summarised in section 5 of main body of this report) is implemented as developed and agreed with the Environment Agency (and Natural England); and
3) generic guidance on the principles of WFD compliant design (also summarised in section 5) is adhered to in subsequent detailed design of scheme components affecting the water environment.

Key

- major beneficial effect
- minor / localised beneficial effect
- no effect
- minor / localised adverse effect
- adverse widespread or prolonged effect
- adverse effect on overall WFD status of water body

			Overall effect of Scheme on WFD element	Additional Proposed Mitigation Measures	Residual effect of Scheme on WFD element**	Effect of Scheme on ecological / chemical status	Overall effect of Scheme on water body status
CHEMICAL STATUS	Priority substances and/or priority hazardous substances	As listed in the Environmental Quality Standards Directive, (2008/105/EC).	Although some Scheme components generate minor or localised improvements to quality elements, others are recorded as having no effect (i.e. causing no deterioration). The worst case (no effect) is carried through.	No additional mitigation necessary	n/a	No deterioration at water body scale anticipated.	

Test B Potential to preven

Test B Potential to prevent future attainment of Good Ecological Status

	RBMP measures to achieve objective	Overall effect of Scheme on proposed measure				
	No measures were found for this	No measures were found for this Lake water body. The data catchment explorer, the South East RBMP (Environment Agency, 2015) and the River Wey Catchment vision (2014) were all referenced as with the surface water measures.				

*assumes that mitigations embedded in the Scheme are imple
** assumes additional mitigation measures are also implemen

Surface water body	Code	WY1	WY2	WY3	WY4
GB106039017630	Scheme component	Culvert replacement	Displacement of channel	Culvert extension	Culvert extension
Wey (Shalford to River Thames confluence at Weybridge)	Watercourse type	Ordinary watercourse	Ordinary watercourse	Ordinary watercourse	Ordinary watercourse
	Location	East end of Elm Lane	South of A3 - between Bolder Mere and Wisley Lane Diversion	South of A3 - outflow from Bolder Mere	North of A3 - outflow from Bolder Mere
	Description	Culvert replacement assumed to be necessary because of increased traffic on a minor road that provides access to local houses.	Widening of A3 is likely to displace 570m of existing channel (catchment area approximately 0.7km²). This will be replaced with an open ditch of similar length.	Approx. 10m culvert extension to the south of the A3 to allow for minor watercourse to continue under widened A3.	Approx. 10m culvert extension to the north of the A3 to allow for minor watercourse to continue under widened A3.

Key

- major beneficial effect
- minor / localised beneficial effect
- no effect
- minor / localised adverse effect
- adverse widespread or prolonged effect
- adverse effect on overall WFD status of water body

			Current Status	Status objective	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*
Test A Potential to cause deterioration of current WFD Ecological Potential								
ECOLOGICAL STATUS	Biological quality elements	Macrophytes and phytobenthos	Moderate	Moderate by 2015	Replacement of culvert in headwaters of catchment under an existing small road not considered to have an effect on biological quality elements at a water body scale.	In the Wey catchment the whole loss of an estimated 820 m length of ephemeral headwater ditch (of low ecological value) is likely to be offset by the creation of an estimated 1440 m length of open ditch that will drain natural catchments or embankments. However, at preliminary design a precautionary assessment is made that loss of ephemeral headwater ditches could cause a minor, local reduction in habitat quality for macrophytes and phytobenthos, macroinvertebrates and fish in channels that potentially contribute to habitat value at a water body scale.	A culvert extension is required under the A3 to convey a straightened section of a small, ephemeral, ordinary watercourse that potentially contributes to habitat value and ecological resilience at a water body scale. The extension of the culvert will also require channel realignments. The culvert extension is likely to cause minor, local reduction in habitat quality for macrophytes and phytobenthos, macroinvertebrates and fish due to the loss of semi-natural habitat and increased shading. Minor, localised adverse effect.	A culvert extension is required under the A3 to convey a straightened section of a small, ephemeral, ordinary watercourse that potentially contributes to habitat value and ecological resilience at a water body scale. The extension of the culvert will also require channel realignments. The culvert extension is likely to cause minor, local reduction in habitat quality for macrophytes and phytobenthos, macroinvertebrates and fish due to the loss of semi-natural habitat and increased shading. Minor, localised adverse effect.
		Macroinvertebrates	High	Good by 2015				
		Fish	Moderate	Good by 2027				
	Physico-chemical quality elements	Physico-chemical quality elements comprise: Acid Neutralising Capacity, Ammonia, Biochemical Oxygen Demand, Dissolved Oxygen, pH, Phosphate and Temperature.	Moderate	Moderate by 2015	Not considered to have an effect on physico-chemical condition at a water body scale.	See background information in first paragraph of biological quality elements. At preliminary design a precautionary assessment is made that loss of ephemeral headwater ditches could cause a minor localised detriment to physico-chemical quality elements in channels that potentially contribute to habitat value at a water body scale.	A culvert extension is not considered to adversely effect physico-chemical condition at the water body scale.	A culvert extension is not considered to adversely effect physico-chemical condition at the water body scale.
	Hydromorphological quality elements	Hydro-morphological quality elements: Hydrological Regime (e.g. quantity and dynamics of flow and connection to groundwater) and Morphology (e.g. river continuity, river depth and width variation, structure and substrate of river bed, and structure of riparian zone). However, for a HMWB the assessment of this quality element needs to account for the designated use of the water body.	Supports Good	Supports Good by 2015	Replacement of culvert in headwaters of catchment under an existing small road not considered to have an effect on hydro-morphological quality elements at a water body scale.	See background information in first paragraph of biological quality elements. At preliminary design a precautionary assessment is made that loss of ephemeral headwater ditches could cause a minor localised detriment to hydromorphological quality elements in channels that potentially contribute to habitat value at a water body scale.	A culvert extension under A3 and associated channel realignments will further reduce the morphological and hydrological complexity (less dynamic flow, more uniform river morphology, loss of sediment continuity and loss of riparian zone) of a channel potentially contributing to habitat at a water body scale. Minor, localised adverse effect.	A culvert extension under A3 and associated channel realignments will further reduce the morphological and hydrological complexity (less dynamic flow, more uniform river morphology, loss of sediment continuity and loss of riparian zone) of a channel potentially contributing to habitat at a water body scale. Minor, localised adverse effect.
	Supporting Elements (Surface Water)	Supporting elements only occur in a heavily modified water body. For River Surface Water bodies they cover: mitigation measures assessment.	Moderate or less	Good by 2027	The proposed works have a minor adverse effect on the following Mitigation Measures assigned to this HMWB: Remove or soften hard bank; Preserve or restore habitats; In-channel morph diversity; Bank rehabilitation; and Enhance ecology. Minor adverse effect.	The proposed works could have a minor adverse effect on the following Mitigation Measures assigned to this HMWB: Preserve or restore habitats; In-channel morph diversity and Enhance ecology. Minor adverse effect.	The proposed works have a minor adverse effect on the following Mitigation Measures assigned to this HMWB: Remove or soften hard bank; Preserve or restore habitats; In-channel morph diversity; Bank rehabilitation; and Enhance ecology. Minor adverse effect.	
	Specific pollutants	As listed in Annex VIII of the Water Framework Directive.	High	High by 2015	Physical modification of water feature will not cause deterioration to the Specific Pollutant quality elements.			
CHEMICAL STATUS	Priority substances and / or priority hazardous substances	As listed in the Environmental Quality Standards Directive, (2008/105/EC).	Good	Good by 2015	Physical modification of water feature will not cause deterioration to Chemical Status.			

Contains sensitive information

Surface water body	Code	WY1	WY2	WY3	WY4
GB106039017630	Scheme component	Culvert replacement	Displacement of channel	Culvert extension	Culvert extension
Wey (Shalford to River Thames confluence at Weybridge)	Watercourse type	Ordinary watercourse	Ordinary watercourse	Ordinary watercourse	Ordinary watercourse
	Location	East end of Elm Lane	South of A3 - between Bolder Mere and Wisley Lane Diversion	South of A3 - outflow from Bolder Mere	North of A3 - outflow from Bolder Mere
	Description	Culvert replacement assumed to be necessary because of increased traffic on a minor road that provides access to local houses.	Widening of A3 is likely to displace 570m of existing channel (catchment area approximately 0.7km²). This will be replaced with an open ditch of similar length.	Approx. 10m culvert extension to the south of the A3 to allow for minor watercourse to continue under widened A3.	Approx. 10m culvert extension to the north of the A3 to allow for minor watercourse to continue under widened A3.

Key

major beneficial effect
minor / localised beneficial effect
no effect
minor / localised adverse effect
adverse widespread or prolonged effect
adverse effect on overall WFD status of water body

Current Status	Status objective	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*
Test B Potential to prevent future attainment of Good Ecological Potential					
RBMP measures to achieve objective	**Where RBMP measure will happen**	**When RBMP measure will happen**	**Effect of Scheme component on WFD element**	**Effect of Scheme component on WFD element**	**Effect of Scheme component on WFD element**	**Effect of Scheme component on WFD element**
No measures assigned to this water body listed in RBMP or supporting data sets	NA	NA	NA	NA	NA	NA
At operational catchment scale (Wey catchment) the following measures relevant to these works are advocated by the local Catchment Partnership (Environment Agency, 2015)						
Wey Diffuse Advice Project throughout the catchment. This would greatly extend a proven mechanism of reducing the impacts of rural and urban diffuse pollution, thus helping resolve catchment-wide problems with high levels of pesticides, phosphates and sediments impacting on river life and public drinking water abstractions.	catchment wide	unspecified	NA	NA	NA	NA
Fish passage mitigation projects on all key identified migratory barriers throughout the catchment, contributing directly to the local recovery of populations of threatened priority fish species, such as brown trout, Atlantic salmon and European eel, with associated recreational and fisheries provisioning benefits.	catchment wide	unspecified	Replacement of culvert in headwaters of catchment under an existing small road unlikely to have a material impact on fish passage.	NA	Extension of culvert under an existing carriageway therefore not causing further barrier to fish passage but extending and increasing a current barrier.	Extension of culvert under an existing carriageway therefore not causing further barrier to fish passage but extending and increasing a current barrier.
A Strategy has been developed to tackle Himalayan Balsam in the catchment targeting high risk areas and to containment points. Project officer time for the development of strategies for other invasive non-native species (INNS) such as floating pennywort, water fern (Azolla) and mink is needed.	catchment wide	unspecified	See text under 'overall effect'			

*assumes that mitigations embedded in the Scheme are implemented.
** assumes additional mitigation measures are also implemented.

Contains sensitive information

Surface water body		WY5	WY6	WY7	WY8
GB106039017630		New culvert	Loss of ephemeral headwater ditch	Culvert extension and displacement of channel	Loss of ephemeral headwater ditch
Wey (Shalford to River Thames confluence at Weybridge)		Ordinary watercourse	Ordinary watercourse	Ordinary watercourse	Ordinary watercourse
		New Wisley Common restricted byway - outflow from Bolder Mere	New Wisley Common restricted byway - Hut Hill	North of A3 and between A3 carriageways - RHS Garden Wisley	South of M25 westbound on-slip at Wisley Junction
		New Wisley Common restricted byway requires a new approx. 10m culvert to be put in on the outflow from Bolder Mere.	The new Wisley Common restricted byway route traverses along approximately 170m of ephemeral ditch which will therefore be lost.	A ditch flows between the two carriageways of the A3. Embankments from road widening will displace c. 25m of channel and require a c.5m culvert extension. Widening on west side of northbound carriageway (RHS Garden Wisley) will also require a short culvert extension.	The widening of the M25 footprint to accommodate the new position of the westbound on-slip will cause a loss of channel (length 15m) as the channel will need to start further south than currently.

Key

major beneficial effect
minor / localised beneficial effect
no effect
minor / localised adverse effect
adverse widespread or prolonged effect
adverse effect on overall WFD status of water body

			Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*
Test A Potential to cause deterioration of current WFD Ecological Potential						
ECOLOGICAL STATUS	Biological quality elements	Macrophytes and phytobenthos	A new culvert (c. 10 m) is required on a section of small, ephemeral, ordinary watercourse that potentially contributes to habitat value and ecological resilience at a water body scale. The culvert is likely to cause minor, local reduction in habitat quality for macrophytes and phytobenthos, macroinvertebrates and fish. It will also interrupt ecological connectivity. Minor, localised adverse effect.	In the Wey catchment the whole loss of an estimated 820 m length of ephemeral headwater ditch (of low ecological value) is likely to be offset by the creation of an estimated 1440 m length of open ditch that will drain natural catchments or embankments. However, at preliminary design a precautionary assessment is made that loss of ephemeral headwater ditches could cause a minor, local reduction in habitat quality for macrophytes and phytobenthos, macroinvertebrates and fish in channels that potentially contribute to habitat value at a water body scale.	The culvert extension and channel displacement is likely to cause minor, local reduction in habitat quality for macrophytes and phytobenthos, macroinvertebrates and fish due to the loss of semi-natural habitat and increased shading in a channel that potentially contributes to habitat value and ecological resilience at a water body scale. Minor, localised adverse effect.	In the Wey catchment the whole loss of an estimated 820 m length of ephemeral headwater ditch (of low ecological value) is likely to be offset by the creation of an estimated 1440 m length of open ditch that will drain natural catchments or embankments. However, at preliminary design a precautionary assessment is made that loss of ephemeral headwater ditches could cause a minor, local reduction in habitat quality for macrophytes and phytobenthos, macroinvertebrates and fish in channels that potentially contribute to habitat value at a water body scale.
		Macroinvertebrates				
		Fish				
	Physico-chemical quality elements	Physico-chemical quality elements comprise: Acid Neutralising Capacity, Ammonia, Biochemical Oxygen Demand, Dissolved Oxygen, pH, Phosphate and Temperature.	A new culvert is not considered to have an effect on the physico-chemical condition of the channel.	See background information in first paragraph of biological quality elements. At preliminary design a precautionary assessment is made that loss of ephemeral headwater ditches could cause a minor localised detriment to physico-chemical quality elements in channels that potentially contribute to habitat value at a water body scale.	A more uniform channel shape is likely to cause minor localised detriment to physico-chemical quality elements in a channel potentially contributing to habitat at a water body scale.	See background information in first paragraph of biological quality elements. At preliminary design a precautionary assessment is made that loss of ephemeral headwater ditches could cause a minor localised detriment to physico-chemical quality elements in channels that potentially contribute to habitat value at a water body scale.
	Hydromorphological quality elements	Hydro-morphological quality elements: Hydrological Regime (e.g. quantity and dynamics of flow and connection to groundwater) and Morphology (e.g. river continuity, river depth and width variation, structure and substrate of river bed, and structure of riparian zone). However, for a HMWB the assessment of this quality element needs to account for the designated use of the water body.	A new culvert on the outflow from Bolder Mere is likely to locally reduce the morphological and hydrological complexity (less dynamic flow, more uniform river morphology, loss of sediment continuity and loss of riparian zone) of approx. 10 m of channel potentially contributing to habitat at a water body scale. Minor, localised adverse effect.	See background information in first paragraph of biological quality elements. At preliminary design a precautionary assessment is made that loss of ephemeral headwater ditches could cause a minor localised detriment to hydromorphological quality elements in channels that potentially contribute to habitat value at a water body scale.	A culvert extension under the A3 and associated channel displacement will reduce the morphological and hydrological complexity (less dynamic flow, more uniform river morphology, loss of sediment continuity and loss of riparian zone) of a channel potentially contributing to habitat at a water body scale at this location. Minor, localised adverse effect.	See background information in first paragraph of biological quality elements. At preliminary design a precautionary assessment is made that loss of ephemeral headwater ditches could cause a minor localised detriment to hydromorphological quality elements in channels that potentially contribute to habitat value at a water body scale.
	Supporting Elements (Surface Water)	Supporting elements only occur in a heavily modified water body. For River Surface Water bodies they cover: mitigation measures assessment.	The proposed works have a minor adverse effect on the following Mitigation Measures assigned to this HMWB: Remove or soften hard bank; Preserve or restore habitats; In-channel morph diversity; Bank rehabilitation; and Enhance ecology. Minor adverse effect.	The proposed works have a minor adverse effect on the following Mitigation Measures assigned to this HMWB: Preserve or restore habitats; In-channel morph diversity and Enhance ecology. Minor adverse effect.	The proposed works have a minor adverse effect on the following Mitigation Measures assigned to this HMWB: Remove or soften hard bank; Preserve or restore habitats; In-channel morph diversity; Bank rehabilitation; and Enhance ecology. Minor adverse effect.	The proposed works have a minor adverse effect on the following Mitigation Measures assigned to this HMWB: Preserve or restore habitats; In-channel morph diversity and Enhance ecology. Minor adverse effect.
	Specific pollutants	As listed in Annex VIII of the Water Framework Directive.	Physical modification of water feature will not cause deterioration to the Specific Pollutant quality elements.			
CHEMICAL STATUS	Priority substances and / or priority hazardous substances	As listed in the Environmental Quality Standards Directive, (2008/105/EC).	Physical modification of water feature will not cause deterioration to Chemical Status.			

Contains sensitive information

Surface water body		WY5	WY6	WY7	WY8
GB106039017630		New culvert	Loss of ephemeral headwater ditch	Culvert extension and displacement of channel	Loss of ephemeral headwater ditch
Wey (Shalford to River Thames confluence at Weybridge)		Ordinary watercourse	Ordinary watercourse	Ordinary watercourse	Ordinary watercourse
		New Wisley Common restricted byway - outflow from Bolder Mere	New Wisley Common restricted byway - Hut Hill	North of A3 and between A3 carriageways - RHS Garden Wisley	South of M25 westbound on-slip at Wisley Junction
		New Wisley Common restricted byway requires a new approx. 10m culvert to be put in on the outflow from Bolder Mere.	The new Wisley Common restricted byway route traverses along approximately 170m of ephemeral ditch which will therefore be lost.	A ditch flows between the two carriageways of the A3. Embankments from road widening will displace c. 25m of channel and require a c.5m culvert extension. Widening on west side of northbound carriageway (RHS Garden Wisley) will also require a short culvert extension.	The widening of the M25 footprint to accommodate the new position of the westbound on-slip will cause a loss of channel (length 15m) as the channel will need to start further south than currently.

Key

major beneficial effect
minor / localised beneficial effect
no effect
minor / localised adverse effect
adverse widespread or prolonged effect
adverse effect on overall WFD status of water body

		Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*
Test B Potential to prevent future attainment of Good Ecological Potential					
	RBMP measures to achieve objective	**Effect of Scheme component on WFD element**	**Effect of Scheme component on WFD element**	**Effect of Scheme component on WFD element**	**Effect of Scheme component on WFD element**
	No measures assigned to this water body listed in RBMP or supporting data sets	NA	NA	NA	NA
		At operational catchment scale (Wey catchment) the following measures relevant to these works are advocated by the local Catchment Partnership (Environment Agency, 2015)			
	Wey Diffuse Advice Project throughout the catchment. This would greatly extend a proven mechanism of reducing the impacts of rural and urban diffuse pollution, thus helping resolve catchment-wide problems with high levels of pesticides, phosphates and sediments impacting on river life and public drinking water abstractions.	NA	NA	NA	NA
	Fish passage mitigation projects on all key identified migratory barriers throughout the catchment, contributing directly to the local recovery of populations of threatened priority fish species, such as brown trout, Atlantic salmon and European eel, with associated recreational and fisheries provisioning benefits.	A new culvert will have a minor impact on this quality element as it will cause an additional barrier to fish passage. However, there are already barriers on the channel and there is very limited fish habitat in the channel.	The loss of a section of the upstream part of an ephemeral channel will not cause a further barrier to fish passage.	Extension of culvert under an existing carriageway therefore not causing further barrier to fish passage but extending and increasing a current barrier.	The loss of a small section of the most upstream part of the channel will not cause a further barrier to fish passage.
	A Strategy has been developed to tackle Himalayan Balsam in the catchment targeting high risk areas and to containment points. Project officer time for the development of strategies for other invasive non-native species (INNS) such as floating pennywort, water fern (Azolla) and mink is needed.	See text under 'overall effect'			See text under 'overall effect'

*assumes that mitigations embedded in the Scheme are imple
** assumes additional mitigation measures are also implement

Contains sensitive information

Surface water body	WY9
GB106039017630	Discharge of road runoff to natural drainage network
Wey (Shalford to River Thames confluence at Weybridge)	WFD water body and ordinary watercourses
	Multiple locations
	Treatment of runoff from road surfaces discharging into the Wey and its tributaries to achieve compliance with EQS and RST toxicity standards.

WFD Assessment made on preliminary design presented in Scheme Layout Plans (application document TR010030/APP/2.8), assuming:
1) the mitigation already 'embedded' in this preliminary design is implemented;
2) additional specific mitigation (as summarised in section 5 of main body of this report) is implemented as developed and agreed with the Environment Agency (and Natural England); and
3) generic guidance on the principles of WFD compliant design (also summarised in section 5) is adhered to in subsequent detailed design of scheme components affecting the water environment.

Key
- major beneficial effect
- minor / localised beneficial effect
- no effect
- minor / localised adverse effect
- adverse widespread or prolonged effect
- adverse effect on overall WFD status of water body

			Effect of Scheme component on WFD element*	Overall effect of Scheme on WFD element	Additional Proposed Mitigation Measures	Residual effect of Scheme on WFD element**	Effect of Scheme on ecological / chemical status	Overall effect of Scheme on water body status
Test A Potential to cause deterioration of current WFD Ecological Potential								
ECOLOGICAL STATUS	Biological quality elements	Macrophytes and phytobenthos	Based on currently available information a design for road drainage has been developed to achieve compliance with relevant EQS and RST toxicity standards as tested with HAWRAT. The changes to the road drainage on the A3 were assessed as having no adverse effect on the water environment at the confluence of the Wey and the tributaries flowing from the A3 when tested by the HAWRAT assessment. Additionally, Method C was applied to points of discharge from the A3 to ditch tributaries of the Wey, using available groundwater data. No adverse effect was found on the water environment, but this will be confirmed following the receipt of results from the ground investigation. Treatments of road runoff incorporated into the design comprise attenuation areas, soakaways and soakaway infiltration trenches. Runoff generated by non-Highway surfaces, such as embankments, is collected and conveyed to natural waters by pre-embankment drains. Compliance with these toxicity standards will contribute to safeguarding a) the number and diversity of macrophytes and phytobenthos b) the habitats available for macroinvertebrates and c) fish populations, particularly at early stages of life when they are most vulnerable. No effect is therefore expected on the WFD quality elements from the new road drainage system.	All but two Scheme components generate minor / localised adverse effect on quality elements due to localised loss of channel, habitat and connectivity that potentially contribute to habitat value at a water body scale. The worst case (minor / localised adverse effect) is carried through.	The following additional mitigations are proposed for the Wey (Shalford to River Thames confluence at Weybridge): WY_a Enhancement of water features on Replacement Land and in Enhancement Areas Observation of principles of WFD compliant design for culverts and associated channel realignments. See Section 5 of main report for more details.	With the mitigation in place a) the biological elements of the ephemeral channel potentially contributing to the habitat at a water body scale should be replaced within the catchment and b) appropriate culvert design should minimise effect of culvert works on biological elements. The combined effect of these mitigations is considered to achieve no effect on the status of the WFD water body.	With the mitigation in place the biological, physico-chemical and hydromorphological quality elements of the ephemeral channel potentially contributing to the habitat at a water body scale should be replaced within the catchment. No effect anticipated at a water body scale.	With the mitigation in place the biological, physico-chemical and hydromorphological quality elements of the ephemeral channel potentially contributing to the habitat at a water body scale should be replaced within the catchment. No effect anticipated at a water body scale.
		Macroinvertebrates						
		Fish						
	Physico-chemical quality elements	Physico-chemical quality elements comprise: Acid Neutralising Capacity, Ammonia, Biochemical Oxygen Demand, Dissolved Oxygen, pH, Phosphate and Temperature.	See background information reported above on biological quality elements. Compliance with toxicity standards will generate physico-chemical conditions more conducive to supporting healthy biological quality elements. No effect is therefore expected on the WFD quality elements from the new road drainage system.	Half of the Scheme components generate minor / localised adverse effect on quality elements due to localised loss of channel, habitat and connectivity that potentially contribute to habitat value at a water body scale. The worst case (minor / localised adverse effect) is carried through.	The following additional mitigations are proposed for the Wey (Shalford to River Thames confluence at Weybridge): WY_a Enhancement of water features on Replacement Land and in Enhancement Areas Observation of principles of WFD compliant design for culverts and associated channel realignments. See Section 5 of main report for more details.	With the mitigation in place a) the physico-chemical elements of the ephemeral channel potentially contributing to the habitat at a water body scale should be replaced within the catchment and b) appropriate culvert design should minimise effect of culvert works on physico-chemical elements. The combined effect of these mitigations is considered to achieve no effect on the status of the WFD water body.		
	Hydro-morphological quality elements	Hydro-morphological quality elements: Hydrological Regime (e.g. quantity and dynamics of flow and connection to groundwater) and Morphology (e.g. river continuity, river depth and width variation, structure and substrate of river bed, and structure of riparian zone). However, for a HMWB the assessment of this quality element needs to account for the designated use of the water body.	See background information reported in the first paragraph of the biological quality elements above. Compliance with toxicity standards will generate hydro-morphological conditions more conducive to supporting healthy biological quality elements. Treatment will stop an increase in silt inputs from the road which would increase fines in the aquatic sediment system leading to impacts on flow patterns, channel dimensions and substrate character. No effect is therefore expected on the WFD quality elements from the new road drainage system.	All but two Scheme component generate minor / localised adverse effect on quality elements due to localised loss of channel, habitat and connectivity that potentially contribute to habitat value at a water body scale. The worst case (minor / localised adverse effect) is carried through.	The following additional mitigations are proposed for the Wey (Shalford to River Thames confluence at Weybridge): WY_a Enhancement of water features on Replacement Land and in Enhancement Areas Observation of principles of WFD compliant design, where practicable, for culverts and associated channel realignments. See Section 5 of main report for more details.	With the mitigation in place the hydromorphological elements of the ephemeral channel potentially contributing to the habitat at a water body scale should be replaced within the catchment. Therefore, the Scheme should not have an effect on the status of the WFD water body.		
	Supporting Elements (Surface Water)	Supporting elements only occur in a heavily modified water body. For River Surface Water bodies they cover: mitigation measures assessment.	See background information reported above on biological quality elements. The proposed changes to the road drainage system do not directly contribute to HMWB mitigation measures. No effect.	All but one Scheme component generate minor / localised adverse effect on quality elements due to localised loss of channel, habitat and connectivity that potentially contribute to habitat value at a water body scale. The worst case (minor / localised adverse effect) is carried through.	The following additional mitigations are proposed for the Wey (Shalford to River Thames confluence at Weybridge): WY_a Enhancement of water features on Replacement Land and in Enhancement Areas WFD compliant culvert design ('Additional Mitigation - generic guidance' part of Section 5) See Section 5 of main report for more details.	With the mitigation in place the Scheme should not have an effect on the status of the WFD water body.		
	Specific pollutants	As listed in Annex VIII of the Water Framework Directive.	See background information reported in the first paragraph of biological quality elements. Compliance with toxicity standards will allow levels of specific pollutants to be more conducive to supporting healthy biological quality elements. No increase in specific pollutants are expected and therefore no effect is expected on this WFD quality element.	All scheme components are assessed as having no effect on quality element. Therefore, no effect is anticipated.	No additional mitigation necessary.	n/a		
CHEMICAL STATUS	Priority substances and / or priority hazardous substances	As listed in the Environmental Quality Standards Directive, (2008/105/EC).	See background information reported above on biological quality elements. Compliance with toxicity standards will allow for chemical levels more conducive to supporting healthy biological quality elements. No effect is expected on the Chemical Status from changes to the road drainage network.	All scheme components are assessed as having no effect on quality element. Therefore, no effect is anticipated.	No additional mitigation necessary.	n/a	No deterioration at water body scale anticipated.	

Contains sensitive information

Surface water body	WY9
GB106039017630	Discharge of road runoff to natural drainage network
Wey (Shalford to River Thames confluence at Weybridge)	WFD water body and ordinary watercourses
	Multiple locations
	Treatment of runoff from road surfaces discharging into the Wey and its tributaries to achieve compliance with EQS and RST toxicity standards.

WFD Assessment made on preliminary design presented in Scheme Layout Plans (application document TR010030/APP/2.8), assuming:
1) the mitigation already 'embedded' in this preliminary design is implemented;
2) additional specific mitigation (as summarised in section 5 of main body of this report) is implemented as developed and agreed with the Environment Agency (and Natural England); and
3) generic guidance on the principles of WFD compliant design (also summarised in section 5) is adhered to in subsequent detailed design of scheme components affecting the water environment.

Key
major beneficial effect
minor / localised beneficial effect
no effect
minor / localised adverse effect
adverse widespread or prolonged effect
adverse effect on overall WFD status of water body

	RBMP measures to achieve objective	Effect of Scheme component on WFD element*	Overall effect of Scheme on WFD element	Additional Proposed Mitigation Measures	Residual effect of Scheme on WFD element**	Effect of Scheme on ecological / chemical status	Overall effect of Scheme on water body status
Test B Potential to prevent future attainment of Good Ecological Potential							
	No measures assigned to this water body listed in RBMP or supporting data sets	NA	NA				
		At operational catchment scale (Wey catchment) the following measures relevant to these works are advocated by the local Catchment Partnership (Environment Agency, 2015)					
	Wey Diffuse Advice Project throughout the catchment. This would greatly extend a proven mechanism of reducing the impacts of rural and urban diffuse pollution, thus helping resolve catchment-wide problems with high levels of pesticides, phosphates and sediments impacting on river life and public drinking water abstractions.	See text under 'overall effect'	Design of road drainage systems in accordance with modern toxicity standards derived through application of HAWRAT will allow for no effect to be caused by this scheme.				
	Fish passage mitigation projects on all key identified migratory barriers throughout the catchment, contributing directly to the local recovery of populations of threatened priority fish species, such as brown trout, Atlantic salmon and European eel, with associated recreational and fisheries provisioning benefits.	NA	The extension and replacement of culverts are unlikely to have a material impact on fish passage. Nor is the loss of upstream sections of ephemeral channels. The construction of a new culvert could have an impact on fish passage, however, proposed additional mitigation measure 'WFD compliant culvert design' ('Additional Mitigation - generic guidance' in Section 5) will allow for continued movement of fish due to it being oversized with a natural bed.				
	A Strategy has been developed to tackle Himalayan Balsam in the catchment targeting high risk areas and to containment points. Project officer time for the development of strategies for other invasive non-native species (INNS) such as floating pennywort, water fern (Azolla) and mink is needed.		By adoption of good practice in INNS management and biosecurity (see section 5), the works can contribute to this objective within the geographical confines of the Scheme.				

*assumes that mitigations embedded in the Scheme are imple
** assumes additional mitigation measures are also implement

Groundwater body	Code	CB1	CB2	CB3	CB4	CB5	CB6	CB7	CB8	CB9
	Scheme component	Piling for Stratford Brook Culvert South	Piling for Stratford Brook Underbridge	Piling for Wisley Lane Overbridge	Piling for Cockcrow Overbridge	Piling for Redhill Overbridge	Piling for Sandpit Hill Overbridge	Piling for New Junction 10 East Bridge	Piling for New Junction 10 West Bridge	Piling for Replacement Clearmount Overbridge
GB40602G601400	Location	Stratford Brook Culvert	Stratford Brook Underbridge	Wisley Lane Overbridge	Cockcrow Overbridge	Redhill Overbridge	Wisley Interchange NMU Overbridge	New Wisley Interchange East Overbridge	New Wisley Interchange West Overbridge	Replacement Clearmount Overbridge
	Description	Foundation piling - 14 piles, up to 25 m deep, 36 m wide, clear pile spacings of 2 x diameter	Foundation piling - 14 piles, up to 25 m deep, clear pile spacings of 2 x diameter	Foundation piling - 18 piles in 3 groups, up to 25 m deep, clear pile spacings of 2 x diameter	Foundation piling - 18 piles in 3 groups, up to 25 m deep, clear pile spacings of 2 x diameter	Foundation piling - 6 piles in 2 groups, up to 25 m deep, clear pile spacings of 2 x diameter	Foundation piling - 12 piles in 4 groups, up to 25 m deep, clear pile spacings of 2 x diameter	Foundation piling - 24 piles in 2 groups, up to 25 m deep, clear pile spacings of 2 x diameter	Foundation piling - 24 piles in 2 groups, up to 25 m deep, clear pile spacings of 2 x diameter	Foundation piling - 6 piles in 2 groups, up to 25 m deep, clear pile spacings of 2 x diameter
Chobham Bagshot Beds	Summary of local geology & water table (Geology at 1 in 50 scale)	Bagshot Formation bedrock overlying London Clay; no mapped superficial deposits. Water bearing strata. No Water level information.	Bagshot Formation bedrock overlying London Clay; no mapped superficial deposits. Water bearing strata. No Water level information.	Bagshot Formation bedrock overlying London Clay; no mapped superficial deposits. Water bearing strata. No Water level information.	Bagshot Formation bedrock overlying London Clay; no mapped superficial deposits. Water bearing strata. No water level information.	Bagshot Formation bedrock overlying London Clay; no mapped superficial deposits. Water bearing strata. No water level information.	Bagshot Formation bedrock overlying London Clay; no mapped superficial deposits. Water bearing strata. No water level information.	Bagshot Formation bedrock overlying London Clay; no mapped superficial deposits. Water bearing strata. No water level information.	Bagshot Formation bedrock overlying London Clay; no mapped superficial deposits. Water bearing strata. No water level information.	Bagshot Formation bedrock overlying London Clay; no mapped superficial deposits. Water bearing strata. No water level information.

Key

major beneficial effect
minor / localised beneficial effect
no effect
minor / localised adverse effect
adverse widespread or prolonged effect
adverse effect on overall WFD status of water body

	Current Status	Status objective	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*
Test A Potential to cause deterioration of current WFD Ecological Status											
QUANTITATIVE IMPACTS	Quantitative impacts cover: Saline or other intrusions of poor quality water due to groundwater abstraction, the impact on the ecological status of surface water bodies, the impact on the condition of groundwater dependent terrestrial ecosystems, and the impact on the groundwater body water balance.	Good	Good by 2015	Groundwater body is at outcrop at this location. Assuming piling will extend below the water table, foundations may form a barrier to groundwater flow, potentially reducing groundwater contributions to adjacent water courses and any groundwater abstractions in the water body.								
CHEMICAL IMPACTS	Chemical impacts cover: pollution concentrations, quality impact on groundwater abstractions, impact on the chemical & ecological status of surface water bodies, nutrient concentration impact on GWDTEs, Drinking Water Protected Areas and a General quality assessment.	Good	Good by 2015	Groundwater body is at outcrop at this location with no low permeability geology protecting the groundwater body. Assuming piling will extend below the water table, deep foundations may create rapid vertical flow pathways into the groundwater body for potentially contaminated runoff. Assuming piling design & construction is to industry standards, this risk to the groundwater body should be mitigated.								

Test B Potential to prevent future attainment of Good Ecological Status

	RBMP measures to achieve objective	Where RBMP measure will happen	When RBMP measure will happen	Effect of Scheme component on WFD element	Effect of Scheme component on WFD element	Effect of Scheme component on WFD element	Effect of Scheme component on WFD element	Effect of Scheme component on WFD element	Effect of Scheme component on WFD element	Effect of Scheme component on WFD element	Effect of Scheme component on WFD element	Effect of Scheme component on WFD element
	No measures were found for this Ground water body. The data catchment explorer, the South East RBMP (Environment Agency, 2015) and the River Wey Catchment vision (2014) were all referenced as with the surface water measures.											

Test C Potential to prevent attainment of Protected Area Objectives

Addressed elsewhere in Environmental Scoping Report

*assumes that mitigations embedded in the Scheme are implemented.
** assumes additional mitigation measures are also implemented.
WFD GW assessment:

Quantitative Status

1.1.1 Quantitative status is defined[1] by the quantity of groundwater available as base flow to watercourses and water-dependent ecosystems and as 'resource' available for use as drinking water and other consumptive purposes. Quantitative status is assigned on a scale of good or poor, and on the basis of four 'tests' as follows:
1.1.2 **Saline or other intrusions** - to identify groundwater bodies where the intrusion of poor quality water, such as saline water or water of different chemical composition, as a result of groundwater abstraction is leading to sustained upward trends in pollutant concentrations or significant impact on one or more groundwater abstractions.
1.1.3 **Surface water** - to identify groundwater bodies where groundwater abstraction is leading to a significant diminution of the ecological status of associated surface water bodies.
1.1.4 **Groundwater dependent terrestrial ecosystems (GWDTE)** - to identify groundwater bodies where groundwater abstraction is leading to significant damage to associated GWDTE.
1.1.5 **Water balance** - to identify groundwater bodies where groundwater abstraction exceeds the 'available groundwater resource', defined as the rate of overall recharge to the groundwater body itself less the rate of flow required to meet the ecological needs of associated surface water bodies and GWDTE.

Chemical Status

1.1.6 Chemical status is defined[2] by the concentrations of a range of key pollutants, by the quality of groundwater feeding into watercourses and water-dependent ecosystems and by the quality of groundwater available for drinking water purposes. This is assigned on a scale of good or poor, and on the basis of five 'tests':
1.1.7 **Saline or other intrusions** - to identify groundwater bodies where the intrusion of poor quality water, such as saline water or water of different chemical composition, as a result of groundwater abstraction is leading to sustained upward trends in pollutant concentrations or significant impact on one or more groundwater abstractions.
1.1.8 **Surface water** - to identify groundwater bodies where groundwater is leading to a significant diminution of the chemical status of associated surface water bodies.
1.1.9 **GWDTE** - to identify groundwater bodies where groundwater is leading to significant damage to associated GWDTE.
1.1.10 **Drinking Water Protected Areas (DrWPA)** - to identify groundwater bodies failing to meet the DrWPA objectives defined in Article 7 of the WFD or at risk of failing in the future. The aim is no deterioration in quality of waters for human consumption.
1.1.11 **General quality assessment** - to identify groundwater bodies where widespread deterioration in quality has or will compromise the strategic use of groundwater. The aim is no significant impairment of human use of groundwater and no significant environmental risk from pollutants across a groundwater body.

[1] As described in Environment Agency Method Statement for Groundwater Quantitative Status Assessment (Classification).
[2] As described in Environment Agency Method Statement for Groundwater Chemical Status Assessment (Classification).

	CB10	CB11	CB12	CB13	CB14	CB15	CB16	CB17	CB18	CB19	CB20	CB21
Groundwater body	Bolder mere Retaining Wall (BL1)	Ockham Park Gantry Retaining Wall	Hut Hill Retaining Wall	Wesley Interchange Retaining Wall A	Wesley Interchange Retaining Wall B	Wesley Interchange Retaining Wall C	Wesley Interchange Retaining Wall D	Wesley Retaining Wall	Redhill Retaining Wall A	Redhill Retaining Wall B	New Redhill Retaining Wall	Fairshill Retaining Wall A
GB40602G601400	North west boundary of Bolder Mere	Gantry on A3 southbound after A3 Southbound Cliff slip at Ockham Park Junction	South side of New Wisley Common restricted byway	M25 westbound east of Wesley Interchange	M25 westbound west of Wesley Interchange	M25 eastbound west of Wesley Interchange	M25 eastbound east of Wesley Interchange	A3 Northbound Cliff slip at Ockham Park Junction	Southbound A3 prior to New Redhill Overbridge	New Redhill Overbridge	North west of A3 at Silvermere Lodge	Northbound A3 after A3 Northbound Cliff slip at Fairshill Junction
Chobham Bagshot Beds	Sheet piling for up to 230m length Orientation NE to SW Up to a max of 6 m deep (Average retained height of 0.5m)	Sheet piling of 50m length Unknown orientation Up to a max of 6m deep (2 x above ground height)	Sheet piling for up to 230m length Unknown orientation Up to a max of 13m deep (2 x above ground height)	Precast concrete walls for up to 170m length Unknown orientation Up to a max of 1m deep	Precast concrete walls for up to 210m length Unknown orientation Up to a max of 1m deep	Precast concrete walls for up to 195m length Unknown orientation Up to a max of 1m deep	Precast concrete walls for up to 162m length Unknown orientation Up to a max of 1m deep	Crib/segmental wall for up to 728m length Unknown orientation Depth up to 1m	Crib/segmental wall for up to 355m length Unknown orientation Depth up to 1m	Crib/segmental wall for up to 165m length Unknown orientation Depth up to 1m	Crib/segmental wall for up to 233m length Unknown orientation Depth up to 1m	Crib/segmental wall for up to 235m length Unknown orientation Depth up to 1m
	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information Assumed significant groundwater contribution to Bolder Mere Lake	Bagshot Formation bedrock overlying London Clay some isolated areas of superficial deposits (Kempton Park Gravel) Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay some isolated areas of superficial deposits (Lynch Hill Gravel) Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay some isolated areas of superficial deposits (Lynch Hill Gravel) Water bearing strata No Water level information
	Effect of Scheme containment on WFD element*	Effect of Scheme containment on WFD element*	Effect of Scheme containment on WFD element*	Effect of Scheme containment on WFD element*	Effect of Scheme containment on WFD element*	Effect of Scheme containment on WFD element*	Effect of Scheme containment on WFD element*	Effect of Scheme containment on WFD element*	Effect of Scheme containment on WFD element*	Effect of Scheme containment on WFD element*	Effect of Scheme containment on WFD element*	Effect of Scheme containment on WFD element*

Key
- major beneficial effect
- minor localised beneficial effect
- no effect
- minor localised adverse effect
- adverse widespread prolonged effect
- adverse effect on overall WFD status of water body

Test A Potential to cause deterioration of current WFD Ecological Status

Test A Potential to cau

QUANTITATIVE IMPACTS	Quantitative impacts cover Saline or other intrusions of poor quality water due to groundwater abstraction the impact on the ecological status of surface water bodies the impact on the condition of groundwater dependent terrestrial ecosystems and the impact on the groundwater body water balance	Groundwater body is at outcrop at this location Assuming the sheet piling will extend below the water table this may form a barrier to groundwater flow potentially reducing groundwater contributions to Bolder Mere lake and any other adjacent water courses	Groundwater body is at outcrop at this location Assuming the sheet piling will extend below the water table this may form a barrier to groundwater flow potentially reducing groundwater contributions to adjacent water courses and wetlands and any groundwater abstractions in the water body	Groundwater body is at outcrop at this location However as the precast concrete wall will protrude to a maximum of 1 m into the ground it is not expected to extend below the normal level of the water table so a barrier to groundwater flow should not be created				Groundwater body is at outcrop at this location However as the crib / segmental wall is anticipated to protrude less than 1 m below ground it is not expected to extend below the water table in normal conditions so a barrier to groundwater flow should not be created				Groundwater body is at outcr
CHEMICAL IMPACTS	Chemical impacts cover pollution concentrations quality impact on groundwater abstractions impact on the chemical & ecological status of surface water bodies nutrient concentration impact on GWDTEs Drinking Water Protected Areas and a General quality assessment	Groundwater body is at outcrop at this location with no low permeability geology protecting the groundwater body As the sheet piling is likely to extend below the water table deep foundations may create rapid vertical flow pathways into the groundwater body for potentially contaminated runoff However it is expected that the sheet piling design & construction will be to industry standards so this risk to the groundwater body should be mitigated		Groundwater body is at outcrop at this location with no low permeability geology protecting the groundwater body However as the precast concrete wall does not extend below the water table rapid vertical flow pathways for potentially contaminated runoff should not be created				Groundwater body is at outcrop at this location with no low permeability geology protecting the groundwater body However as the crib / segmental wall is not expected to extend below the normal levels of the water table rapid vertical flow pathways for potentially contaminated runoff should not be created				Groundwater body is at outc bel

Test B Potential to prevent future attainment of Good Ecological Status

Test B Potential to prev

	RBMP measures to achieve objective	Effect of Scheme containment on WFD element	Effect of Scheme containment on WFD element	Effect of Scheme containment on WFD element	Effect of Scheme containment on WFD element	Effect of Scheme containment on WFD element	Effect of Scheme containment on WFD element	Effect of Scheme containment on WFD element	Effect of Scheme containment on WFD element	Effect of Scheme containment on WFD element	Effect of Scheme containment on WFD element	Effect of Scheme containment on WFD element	Effect of Scheme containment on WFD element
		No measures were found for this Ground water body The data catchment explorer the South East RBMP (Environment Agency 2015) and the River Wey Catchment vision (2014) were all referenced as with the surface water measures											

Test C Potential to prevent attainment of Protected Area Objectives

Test C Potential to pre

	Addressed elsewhere in Environmental Scoping Report

	CB22	CB23	CB24	CB25	CB26	CB27	CB28	CB29	CB30	CB31	CB32	CB33
Groundwater body	Fairshill Retaining Wall B	Fairshill Retaining Wall C	Clearmount Retaining Wall A	Clearmount Retaining Wall B	Clearmount Retaining Wall C	Minor retaining walls	Drainage of road runoff to groundwater via Soakaway 1	Drainage of road runoff to groundwater via Soakaway 2	Drainage of road runoff to groundwater via Soakaway 3	Drainage of road runoff to groundwater via Soakaway 4	Drainage of road runoff to groundwater via Soakaway 5	Drainage of road runoff to groundwater via Soakaway 6
GB40602G601400	Westbound A245	A3 Southbound On slip at Fairshill Junction	East of Replacement Clearmount overbridge at edge of northbound M25	East of Replacement Clearmount overbridge at edge of southbound M25	West of Replacement Clearmount overbridge at edge of southbound M25	Multiple (4) locations	Adjacent to New Wisley Lane Diversion	Junction between New Wisley Common restricted byway and New Ockham Common restricted byway	Adjacent to Footpath 10 New Ockham Common restricted byway	Existing Cockcrow footbridge	Adjacent to New Curne's Clump restricted byway	Adjacent to drainage attenuation area at Sandpit Hill
Chobham Bagshot Beds	Cntb/segmental wall for up to 292m length Unknown orientation Depth up to 1m	Cntb/segmental wall for up to 93m length Unknown orientation Depth up to 1m	Cntb/segmental wall for up to 23m length Unknown orientation Depth up to 1m	Cntb/segmental wall for up to 32m length Unknown orientation Depth up to 1m	Cntb/segmental wall for up to 195m length Unknown orientation Depth up to 1m	Precast concrete walls for up to 352m length Unknown orientation Up to a max of 1m deep	Drainage of potentially contaminated surface water runoff direct to groundwater	Drainage of potentially contaminated surface water runoff direct to groundwater	Drainage of potentially contaminated surface water runoff direct to groundwater	Drainage of potentially contaminated surface water runoff direct to groundwater	Drainage of potentially contaminated surface water runoff direct to groundwater	Drainage of potentially contaminated surface water runoff direct to groundwater
	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay some isolated areas of superficial deposits (Lynch Hill Gravel) Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay some isolated areas of superficial deposits (Kempton Park Gravel) Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay some isolated areas of superficial deposits (Kempton Park Gravel and Lynch Hill Gravel) Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information
Key: major beneficial effect; minor localised beneficial effect to effect; minor localised adverse effect; adverse widespread prolonged effect; adverse effect on overall WFD class of water body	Effect of Scheme containment on WFD element*	Effect of Scheme containment on WFD element*	Effect of Scheme containment on WFD element*	Effect of Scheme containment on WFD element*	Effect of Scheme containment on WFD element*	Effect of Scheme containment on WFD element*	Effect of Scheme containment on WFD element*	Effect of Scheme containment on WFD element*	Effect of Scheme containment on WFD element*	Effect of Scheme containment on WFD element*	Effect of Scheme containment on WFD element*	Effect of Scheme containment on WFD element*

se deterioration of current WFD Ecological Status — Test A Potential to cau

QUANTITATIVE IMPACTS	Quantitative impacts cover Saline or other intrusions of poor quality water due to groundwater abstraction the impact on the ecological status of surface water bodies the impact on the condition of groundwater dependent terrestrial ecosystems and the impact on the groundwater body water balance	op at this location However as the cntb / segmental wall is anticipated to protrude less than 1 m below ground it is not expected to extend below the water table in normal conditions so a barrier to groundwater flow should not be created	Groundwater body is at outcrop at this location However as the precast concrete walls of less than 1m deep are not expected to extend below the normal levels of the water table a barrier to groundwater flow should not be created	No impacts identified as a result of Scheme element
CHEMICAL IMPACTS	Chemical impacts cover pollution concentrations quality impact on groundwater abstractions impact on the chemical & ecological status of surface water bodies nutrient concentration impact on GWDTEs Drinking Water Protected Areas and a General quality assessment	op at this location with no low permeability geology protecting the groundwater body However as the cntb / segmental wall is not expected to extend w the normal levels of the water table rapid vertical flow pathways for potentially contaminated runoff should not be created	Groundwater body is at outcrop at this location with no low permeability geology protecting the groundwater body However as the precast concrete walls should not extend below the normal level of the water table rapid vertical flow pathways for potentially contaminated runoff should not be created	Groundwater body is at outcrop at the Scheme location with no low permeability geology protecting the groundwater body Potential for increased surface runoff from Scheme to cause deterioration to water quality of groundwater body if runoff is contaminated Potential secondary effects to groundwater dependant surface water bodies Pollution control measures will be applied to soakaways subject to the requirement of the HAWRAT assessment Therefore the risk to groundwater quality will be mitigated

vent future attainment of Good Ecological Status — Test B Potential to prev

	RBMP measures to achieve objective	Effect of Scheme containment on WFD element	Effect of Scheme containment on WFD element	Effect of Scheme containment on WFD element	Effect of Scheme containment on WFD element	Effect of Scheme containment on WFD element	Effect of Scheme containment on WFD element	Effect of Scheme containment on WFD element	Effect of Scheme containment on WFD element	Effect of Scheme containment on WFD element	Effect of Scheme containment on WFD element	Effect of Scheme containment on WFD element
	No measures were found for this Ground water body The data catchment explorer the South East RBMP (Environment Agency 2015) and the River Wey Catchment vision (2014) were all referenced as with the surface water measures											

vent attainment of Protected Area Objectives — Test C Potential to prev

Addressed elsewhere in Environmental Scoping Report

		CB34	CB35	CB36	CB37	CB38	CB39	CB40	CB41	CB42	CB43	CB44	
		Drainage of road runoff to groundwater via Soakaway 7	Drainage of road runoff to groundwater via Soakaway 8	Drainage of road runoff to groundwater via Soakaway 9	Drainage of road runoff to groundwater via Soakaway 10	Drainage of road runoff to groundwater via Soakaway 11	Drainage of road runoff to groundwater via Soakaway 12	Drainage of road runoff to groundwater via Soakaway 13	Drainage of road runoff to groundwater via Soakaway 14	Drainage of road runoff to groundwater via Soakaway 15	Drainage of road runoff to groundwater via Soakaway 16	Drainage of road runoff to groundwater via Soakaway 17	
Groundwater body		New Red Hill restricted byway	Gothic Tower	Redhill Road	Painshill LAR gantry - eastbound A3	Painshill LAR gantry - westbound A3	A3 Northbound Off slip at Painshill Junction	M25 Westbound On slip	Drainage attenuation at Replacement Clearmount overbridge	Adjacent to end of north-western Replacement Clearmount Overbridge embankment	North of M25 - Adjacent to Footpath 11 and maintenance access track	Wisley Lane work northerly extent	
GB40602G601400		Drainage of potentially contaminated surface water runoff direct to groundwater	Drainage of potentially contaminated surface water runoff direct to groundwater	Drainage of potentially contaminated surface water runoff direct to groundwater	Drainage of potentially contaminated surface water runoff direct to groundwater	Drainage of potentially contaminated surface water runoff direct to groundwater	Drainage of potentially contaminated surface water runoff direct to groundwater	Drainage of potentially contaminated surface water runoff direct to groundwater	Drainage of potentially contaminated surface water runoff direct to groundwater	Drainage of potentially contaminated surface water runoff direct to groundwater	Drainage of potentially contaminated surface water runoff direct to groundwater	Drainage of potentially contaminated surface water runoff direct to groundwater	
Chobham Bagshot Beds		Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	Bagshot Formation bedrock overlying London Clay no mapped superficial deposits Water bearing strata No Water level information	WFD Assessment made on pr TR010030/APP/2.8), assuming 1) the mitigation already 'emb 2) additional specific mitigatio as developed and agreed with 3) generic guidance on the pr to in subsequent detailed desig

Key
- major beneficial effect
- minor localised beneficial effect
- no effect
- minor localised adverse effect
- adverse widespread or prolonged effect
- adverse effect on overall WFD status of water body

		Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Effect of Scheme component on WFD element*	Overall effect of Scheme on WFD element

se deterioration of current WFD Ecological Status

Test A Potential to cause de

QUANTITATIVE IMPACTS	Quantitative impacts cover Saline or other intrusions of poor quality water due to groundwater abstraction the impact on the ecological status of surface water bodies the impact on the condition of groundwater dependent terrestrial ecosystems and the impact on the groundwater body water balance	No impacts identified as a result of Scheme element											No deterioration of the quantitative elements of this groundwater body at the water body scale However introduction of deep foundations may lead to a deterioration in local habitats if appropriate local mitigation cannot be identified
CHEMICAL IMPACTS	Chemical impacts cover pollution concentrations quality impact on groundwater abstractions impact on the chemical & ecological status of surface water bodies nutrient concentration impact on GWDTEs Drinking Water Protected Areas and a General quality assessment	crop at the Scheme location with no low permeability geology protecting the groundwater body Potential for increased surface runoff from Scheme to cause deterioration to water quality of groundwater body if runoff is contaminated Potential secondary effects to groundwater dependant surface water bodies Pollution control measures will be applied to soakaways subject to the requirement of the HAWRAT assessment Therefore the risk to groundwater quality will be mitigated											No effect on the chemical status of this groundwater body is expected from the Scheme

vent future attainment of Good Ecological Status

Test B Potential to prevent

	RBMP measures to achieve objective	Effect of Scheme component on WFD element	Effect of Scheme component on WFD element	Effect of Scheme component on WFD element	Effect of Scheme component on WFD element	Effect of Scheme component on WFD element	Effect of Scheme component on WFD element	Effect of Scheme component on WFD element	Effect of Scheme component on WFD element	Effect of Scheme component on WFD element	Effect of Scheme component on WFD element	Effect of Scheme component on WFD element	Overall effect of Scheme on proposed measure
	No measures were found for this Groundwater body The data catchment explorer the South East RBMP (Environment Agency 2015) and the River Wey Catchment vision (2014) were all referenced as with the surface water measures												No measures were found for thi

vent attainment of Protected Area Objectives

Test C Potential to prevent

Addressed elsewhere in Environmental Scoping Report	Addres

Groundwater body	
GB40602G601400	
Chobham Bagshot Beds	

		Additional Proposed Mitigation Measures	Residual effect of Scheme on WFD element**	Overall effect of Scheme on water body status
Deterioration of current WFD Ecological Status				
QUANTITATIVE IMPACTS	Quantitative impacts cover Saline or other intrusions of poor quality water due to groundwater abstraction the impact on the ecological status of surface water bodies the impact on the condition of groundwater dependent terrestrial ecosystems and the impact on the groundwater body water balance	The following additional mitigations are proposed CB_a Ground investigations and design alteration of piling and retaining walls BL_e Detailed design of CB10 retaining wall alongside Bolder Mere following groundwater risk assessment See Section 5 of main report for more details	No deterioration at water body scale Additional proposed mitigations for piling and retaining walls wil mitigate potential effect on groundwater flows and Bolder Mere	It is anticipated that adequate mitigation can be undertaken to avoid deterioration at water body scale. Only minor temporary effects are expected.
CHEMICAL IMPACTS	Chemical impacts cover pollution concentrations quality impact on groundwater abstractions impact on the chemical & ecological status of surface water bodies nutrient concentration impact on GWDTEs Drinking Water Protected Areas and a General quality assessment	No additional mitigation necessary	n/a	
future attainment of Good Ecological Status				
	RBMP measures to achieve objective			
	s Ground water body The data catchment explorer the South East RBMP			
attainment of Protected Area Objectives				
	sed elsewhere in Environmental Scoping Report			

ninary design presented in Scheme Layout Plans (application document
.
added in the preliminary design is implemented,
n (as summarised in section 5 of main body of this report) is implemented
the Environment Agency (and Natural England), and
nciples of WFD compliant design (also summarised in section 5) is adhered
gn of scheme components affecting the water environment.

Key

major beneficial effect
minor / localised beneficial effect
no effect
minor / localised adverse effect
adverse widespread or prolonged effect
adverse effect on overall WFD status of water body

Appendix D. Further information on Bolder Mere

D.1 Bolder Mere Ecological Survey and Condition Assessment

Goldsmith Ecology

Specialist Services in Aquatic Science

Boldermere: Ecological Survey and Condition Assessment

Summary Report

Ben Goldsmith

November 2018

Boldermere:
Ecological Survey and Condition Assessment

Summary Report
November 2018

To:
Atkins Ltd.

Ben Goldsmith & Katrin Layer-Dobra

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Cover photo: Boldermere © Goldsmith Ecology

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1. Introduction

1.1. Background

Boldermere, Surrey (TQ077584) is a small (8 ha), shallow (max. 1.1 m) lake situated within mixed woodland and bordered to the northwest by the A3 dual carriageway. The lake is classified by the Water Framework Directive (WFD) as being a heavily modified waterbody (ID GB30643218) with significant alterations to the drainage and shoreline having been made to accommodate the building and expansion of the A3. Despite this, the site, and surrounding areas are of significant conservation interest and are encompassed by the Ockham and Wisley Commons Site of Special Scientific Interest (SSSI), designated primarily for its extensive areas of lowland heath. The wetlands, including Boldermere are an important feature within the SSSI, with notable importance for plant species with records of local rarities including Shoreweed *Littorella uniflora*, Marsh St. John's wort *Hypericum elodes,* Lesser water-plantain *Baldellia ranunculoides*, Needle spike-rush *Eleocharis acicularis* and Pillwort *Pilularia globulifera.*

More specifically, Boldermere is identified within the SSSI citation as being of national importance for dragonflies and damselflies (Odonata), with over 20 species have been recorded from the site, including the rare White-faced dragonfly *Leucorrhinia dubia* and local species such as the Hairy dragonfly *Brachytron pratense* and the Ruddy darter *Sympetrum sanguineum*.

1.2. Aim of this report

Highways England are proposing to make improvements to the road network around the M25 – A3 Junction 10. Proposed modifications include widening of the A3 and the addition of a new road and bridge across the A3 which interact with several watercourses and water bodies, including Boldermere.

Atkins therefore requires specialist aquatic ecological surveys to support the production of environmental assessments to determine the current ecological baseline of the aquatic species and habitats at Boldermere and to determine where works may be required to off-set any changes made to the site.

The primary aim of this report is to provide aquatic macrophyte and aquatic macro-invertebrate data from Boldermere with a view to assessing the ecology and physical habitat of the lake and identifying the value of the habitats therein.

1.3. Survey team

The survey work was undertaken by Goldsmith Ecology. Dr Ben Goldsmith was responsible for macrophyte surveys and Dr Katrin Layer-Dobra for macro-invertebrate survey and identification.

All field surveys were conducted between 26th – 27th June 2018. Conditions were calm, sunny and clear, with only very light wind.

2. Methods

2.1. Macrophyte Survey

The surveys incorporated two different methods in an effort to maximise ecological information. The methods are described here as Common Standards Monitoring (CSM) and habitat survey.

CSM (as described in JNCC 2015) is the standardised methodology for assessing the condition of designated standing water features in the UK. Macrophyte data area collected in a structured manner from four discrete “sections” of the lake, each consisting of a 100 m length of shoreline from which macrophytes are recorded at set water depths (25, 50, 75 and >75 cm) from 20 points along the section. An addition transect is surveyed from the centre of the section out into open water, with 20 points recorded between 100 cm depth at the shore end, out to the maximum depth of macrophyte growth. A full description of the field methods is given in JNCC (2015).

The macrophyte data from these surveys are collected in a structured and repeatable manner. Sections are chosen to be representative of the site and are recorded using GPS, backed up by photographs, to enable future surveys to be conducted using the same locations. The surveys attempt to capture the species that are typical of the site and therefore representative of the site as a whole. The CSM surveys do not set out to record all species present in a site. Rare taxa, may occur outside of the survey sections and therefore be overlooked. Where species of conservation interest are known to occur in a site, additional survey effect may be made to find these outside of the sections, and identify the locations and extent to which they occur in a site.

2.2. Habitat survey

While the CSM survey delivers excellent data to feed into site condition assessments, it does not assess the full extent of species and habitats within a lake, and therefore a more comprehensive method of survey is required where specific ecological information is required. A full site survey was therefore undertaken at Boldermere whereby the areas between each CSM section were walked, waded and rowed (using a small inflatable boat). Species and habitats therein were recorded using GPS and digital photography, accompanied by descriptive accounts of marginal and open water habitats.

The main habitats, and those of high ecological quality, were recorded relative to their location and additional comment made on the ecological value of each habitat type to the site. Data are presented in graphical format (as georeferenced maps), and as part of the descriptive report.

2.3. Aquatic macro-invertebrate survey

A full description of sampling methods for aquatic macro-invertebrates is given in BSI Standards Publication (ISO 10870:2012), with identification following the Environment Agency Operational Instruction 024_08 (2012).

With the key requirements being to establish baseline data, infer water quality and potentially seek rare or notable species, separate samples were collected from those habitats identified as being dominant within the lake; a total of five separate habitats were sampled.

Samples were conducted using a standard Freshwater Biological Association (FBA) handnet (0.35 mm mesh), with a total of 60 seconds of vigorous disturbance and sweeping

conducted for each separate habitat type. Any stony or rocky habitats were sampled with a 60 second 'kick and sweep' technique with a standard FBA handnet, with extra attention given to any larger rocks or woody debris which was examined and hand-picked where necessary (not included within the times period). Because the site was so shallow (< 1.0 m), fine sediments in the open water areas were easily reached and sampled using the 'kick and sweep' technique. All sample points were categorised by vegetation and substrate type. Sample locations were recorded with GPS and georeferenced digital photographs taken.

Samples were examined in the net, with any larger species removed, identified and released back to the water. The remaining sample was transferred to suitable containers and preserved with denatured alcohol within one hour of collection.

Samples were analysed separately, and a full taxon record and count made from each meso-habitat. Where an individual taxon occurs at very high abundance, a subsample (e.g. 10%) was be taken from the well-mixed sample and the final count estimated.

Taxomonic level follows that outlined in the EA Operational Instruction (2102) with each taxon assigned a Conservation Scores (CS) (after Chadd & Extence 2004). BMWP (Armitage *et al.* 1983) and WHPT (Walley & Hawkes 1996) (including NTAXA and ASPT) were calculated for each site and the data combined with the assigned conservation scores to determine the Community Conservation Index (CCI, after Chadd & Extence 2004).

3. Summary Results

3.1. CSM survey and condition assessment

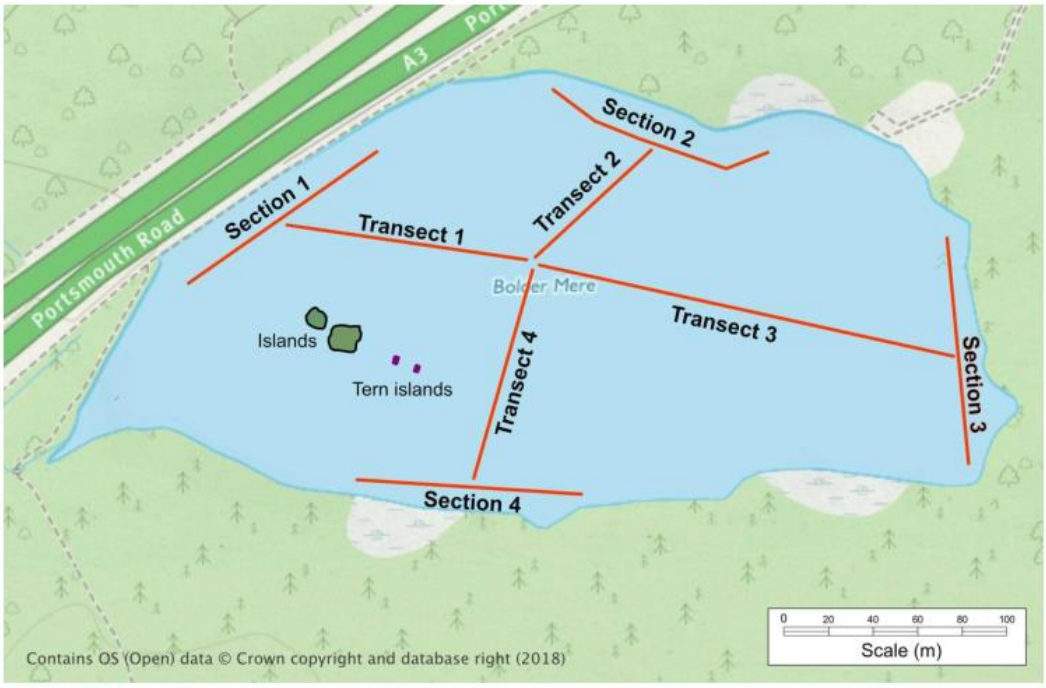

Figure 1 Map of Boldermere showing CSM transect locations

Water levels on 26th June were estimated to be 15 cm below normal top water level. This was based on the vertical drop below the lip of the outflow grill at the north-western side (TQ0744158397).

Four sections were surveyed at Boldermere using the CSM methodology. The sections were chosen to focus on areas of different habitat types within the lake, as well as giving good geographical coverage (Figure 1). The lake is very shallow (maximum recorded depth of 1.0 m) and had aquatic plants growing throughout the entire expanse of open water. Boat transects were therefore conducted approximately perpendicular to each section to a point in the centre of the lake (TQ0761358414).

A total of 13 aquatic macrophyte species were recorded (Table 1) during the CSM survey. None of the species recorded are considered to be "characteristic" of favourable condition in shallow mesotrophic lakes and the site was dominated throughout the open water by the invasive non-native species (INNS) Nuttall's waterweed *Elodea nuttallii* and had significant cover of the INNS, New Zealand Pigmyweed *Crassula helmsii*, in the shallow water in Section 4 and was abundant in the marginal zone around the south of the lake and into the wetter woodland area on the north shore (TQ0772558480).

Table 1 Aquatic macrophyte CSM data from Boldermere 26/06/2018

Submerged and floating vegetation	Species present				26/06/2018 % Frequency (n=104)*
	S1	S2	S3	S4	
Ceratophyllum demersum					18.3
Chara globularis					15.4
Crassula helmsii					10.6
Elodea nuttallii					95.2
Lemna minor					5.8
Lemna trisulca					5.8
Myriophyllum alterniflorum					57.7
Nymphaea spp. "cultivar"					1.9
Persicaria amphibia					2.9
Potamogeton berchtoldii					1.9
Potamogeton crispus					1.0
Potamogeton obtusifolius					1.0
Potamogeton pusillus					42.3
Zannichellia palustris					2.9
Filamentous Algae					**0.14**

* Based on data from all **vegetated** sample plots in the CSM survey. Red text indicates INNS.

3.2. Boldermere condition assessment

Boldermere lies within the wider Ockham and Wisley Commons SSSI, a site primarily notified (in 1975) for its significance for areas of lowland heath, bog, open water, secondary woodland and scrub. These habitats support a rich community of heathland plants and animals, including a large number of rare and local insects. Boldermere is not included within the original SSSI designation (1975) as a qualifying standing water feature, but is recognised within the favourable condition tables (NE 2015) as being an important habitat which supports a diverse Odonata assemblage, including a number of rare species. Preservation of this habitat is therefore important within the wider SSSI management.

The SSSI citation and favourable condition tables do not assign Boldermere to a lake type (as defined in JNCC 2015). The site lies within an area of moderately acid surface geology (mainly Bagshot bed formations) and it is therefore reasonable to assume the site would naturally have been of low to moderate alkalinity and nutrient poor, as is typical of lowland heath areas. This is ratified by some of the plant species listed for the area, with include typically oligo-mesotrophic species such as *Littorella uniflora,* Pillwort *Pilularia globulifera* and *Hypericum elodes.*

For the purposes of reporting Boldermere is assumed to have been a natural Mesotrophic lake in its natural, undisturbed state. It is classified as being a high alkalinity, very shallow, low-altitude lake under UK Lakes WFD typology (Source CEH 2018).

For a mesotrophic open water feature for be considered as being in favourable condition, it should normally be expected to have at least eight “characteristic” (i.e. typical of good condition) species present, and these should occur at more than 60% of the vegetated

sample locations within the lake (see JNCC 2015). At Boldermere, the geographical location and small, shallow nature of the site would suggest less than eight would still be favourable, but there should be at least three characteristic shallow-water species present.

The following table (Table 2) summarises the main features used to assess condition as detailed in the Common Standards Monitoring guidance for freshwater lakes (JNCC 2015). Each of the desired targets is summarised in the table and assessed as being "favourable" (✔) if it meets the target, or "unfavourable" (**X**) if it fails to meet the expected target. Where there is insufficient data a "**?**" is used.

Table 2 Favourable condition assessment of Boldermere - 2018.

Attribute	Target	Status	Comment
Extent	No loss of extent of standing water	**X**	The site is modified along its border with the A3, where an artificial shoreline has been built into the lake.
Macrophyte community composition	***Mesootrophic target***: ≥ 8 characteristic *Littorelletea* species	**X**	None recorded. Species including *L. uniflora, Baldellia ranunculoides, P. globulifera* have been recorded locally and would be expected to grow here.
	≥ 6/10 sample spots (boat & wader survey) have ≥ 1 characteristic species	**X**	None.
	No loss of characteristic species	**?**	No previous CSM data, but the SSSI citation refers to *L. uniflora, Baldellia ranunculoides, P. globulifera* have been recorded locally.
Negative indicator species	Non-native species absent or present at low frequency	**X**	*Elodea nuttallii* is dominant in the lake (95%) and *Crassula helmsii* is abundant in the margins and frequent in the shallows on the south side. Despite removal efforts in 2012, large carp remain present. Turkish crayfish *Astacus leptodactylus* present.
	Benthic and epiphytic filamentous algal cover <20% of plots with high abundance.	✔	Filamentous algal cover was very low.
Macrophyte community structure	Characteristic vegetation zones should be present and no deterioration from baseline conditions	✔**(?)**	Zonation is less typical in very shallow lakes. The vegetation occurred throughout the open water, and although dominated by *E. nuttallii,* did form a mosaic of species, grading into a range of marginal habitats. See text.
	Maximum depth distribution should be maintained	✔	Z_{max} (recorded) = 1.15 m, Z_s > 1.15 m. Z_v = 1.15 m (relative to TWL).
	At least the present structure should be maintained	**X**	No previous CSM data, but the dominance by non-native species is indicative of significant negative change.

Attribute	Target	Status	Comment
Water quality	***Mesotrophic target***: Stable nutrient levels: TP target / limit = 20 µg P l^{-1}	**X?**	TP = 43 µg P l^{-1} (2003 ? quarterly mean[1]).
	Stable pH / ANC values: pH ~ 5.5 – 7.0 and ANC > 40 µequl^{-1}	**?**	No data.
	Mean annual total nitrogen TN < 1.5 mgl^{-1}	**?**	No data.
	Adequate dissolved O_2 for health of characteristic fauna (> 6 mgl^{-1})	**✓?**	Waters were well oxygenated at the time of survey (9.06 mgl^{-1}). High water temperatures (27° C) increase the risk of anoxia at night.
	No excessive growth of cyanobacteria or green algae	**?**	None during survey.
Hydrology	Natural hydrological regime	**X**	Site is partially / wholly artificial in origin and much of the north and north-west shore is artificial and of varying age, the newest dating to the building of the A3 in the 1970's onwards. The inflow to the southeast appears natural. The outflow is culverted to the NW.
Lake substrate	Natural shoreline maintained	**X**	As above.
	Natural and characteristic substrate maintained	**✓**	A range of peat and natural stony substrates occur around the southern margin, the northwest shore being of artificially placed rock. Open water areas comprise of silt and fine organic sediments.
Sediment load	Natural sediment load maintained	**?**	No evidence of any adverse sediment loading seen.
Connectivity	Maintain good connectivity with ground and surface waters and marginal habitats	**✓(?)**	Connectivity compromised by the dam and artificial outflow. Well-connected along south margin.
Indicators of local distinctiveness	Distinctive elements maintained	**?**	Additional Odonata required to fulfil the main criteria for designation. Recent records for *L. uniflora* could not be confirmed suggesting this species is either lost, or now very rare at the site.

In summary, Boldermere fails to meet the majority of qualifying targets required for favourable condition for this (or any) lake type. Despite being assessed as unfavourable, many of the aquatic habitats in and around the lake remain important, particularly for invertebrates and birds. Pertinent to this report, it is necessary to identify which habitats are of the highest value and where there is potential for habitat improvement.

3.3. Habitat survey

The open water habitat is relatively uniform in both structure and species composition with *Elodea nuttallii* dominant, and Alternate water-milfoil *Myriophyllum alterniflorum* and Lesser pondweed *Potamogeton pusillus* rare at depths greater than 80 cm, increasing in

[1] Historic data from Carvalho *et al.* (2005) – no current data available

abundance towards the littoral zone (10-50 cm), particularly in the northeast, east and south of the lake. Rigid hornwort *Ceratophyllum demersum* occurs with a patchy distribution and mainly at low abundance (< 10% cover) in the littoral zone. The most botanically rich area for submerged plant species was on the more consolidated stony substrates around the southern shore, where Curled pondweed *P. crispus,* Blunt-leaved pondweed *P. obtusifolius* and Stonewort *Chara globularis* were recorded (at low abundance) in addition to the species listed above.

Whereas much of the open water is relatively uniform in structure and species composition, the marginal wetland habitats show considerable variation, and some maintain areas of significant floristic interest.

The most abundant emergent and marginal species is Common reed *Phragmites australis*. This forms relatively extensive stands around the eastern margin and along the north and north-west shore. Pertinent to this project it is the main component of the emergent flora forming the narrow emergent zone against the A3, growing on the rocky artificial substrate bordering the A3 (see areas marked 1 on Figure 2).

This habitat is of moderate conservation interest. It provides important shelter and nesting habitat for water fowl and dragon / damselflies. There is a well-used mute swan nest site within the A3 reed margin (5 on Figure 2). *Phragmites* reed is a common habitat in this area and at Boldermere is relatively species poor in terms of other wetland plants due to the reed out-competing most other plant species. Very few aquatic macrophytes grow beneath the *P. australis* stands.

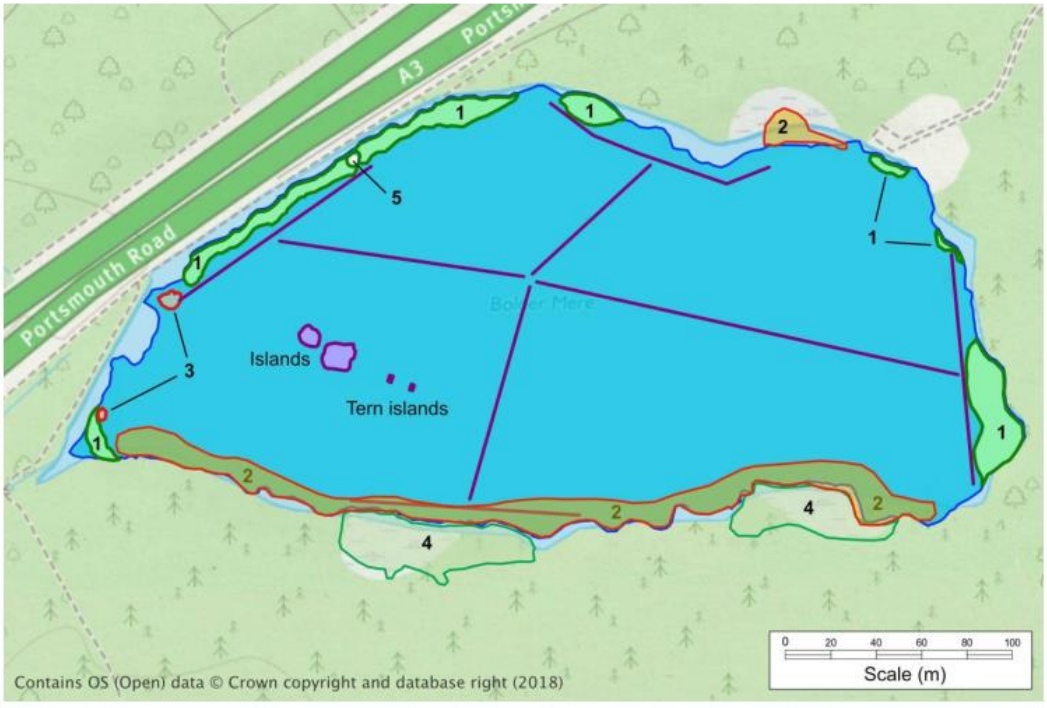

Figure 2 Boldermere habitats map

To the west, south-west and north-east of the lake, the margins have extensive areas of dense overhanging trees, mainly comprising willow and alder at the lake edge, with a mix of coniferous and deciduous species behind, including mature oak and birch with understory of Bracken *Pteridium aquilinum.* Where the wetter areas extend into the woodland to the west and southeast of the site, there are stands of sedges (Lesser pond-sedge *Carex acutiformis* and Bottle sedge *C. rostrata* and occasional Cyperus sedge *C. pseudocyperus*).

The most species rich and botanically interesting areas are along the southern margin of the lake (areas 2 grading into 4 on Figure 2). Here the substrates are mainly gravels and pebbled, bound by organic silts. Mixed stands of emergent vegetation include Common spike-rush *Eleocharis palustris,* Water horsetail *Equisetum fuviatile,* Amphibious bistort *Persicaria amphibia,* Branched bur-reed *Sparganium erectum,* Great reedmace *Typha latifolia* and Marsh pennywort *Hydrocotyle vulgaris.*

Unfortunantly, *Crassula helmsii* is abundant in area 2*,* growing in dense mats within the draw-down zone.

Previous management works around the south side of the lake have focussed on the of trees and scrub (birch, willow, alder and pine), to open up areas of the hydrosere and allowing the development of a more natural acid bog flora (4 in Figure 2). Here, the wetlands grade up to stands of Purple moor-grass *Molinia caerula* and *Sphagnum* spp.*,* with Common sedge *Carex nigra* and Lesser spearwort *Ranunculus flammula* common and include two species less common in the south-east of England, *Hypericum elodes* and Common cottongrass *Eriophorum angustifolium*.

Despite the presence of *Crassula helmsii,* these managed areas probably represent the best botanical habitats at the site and their management and preservation should be a key component for any long-term vision for the site. Active and regular to prevent scrub and tree encroachment along the wetland areas of the south shore will help to maintain the site and achieve the diverse array of habitats required to support priority species groups such as Odonata at the site.

3.4. Aquatic macro-invertebrate survey

Five distinct habitats were identified within Boldermere and sampled for aquatic macro-invertebrates. These are described below, and the locations shown on Figure 3.

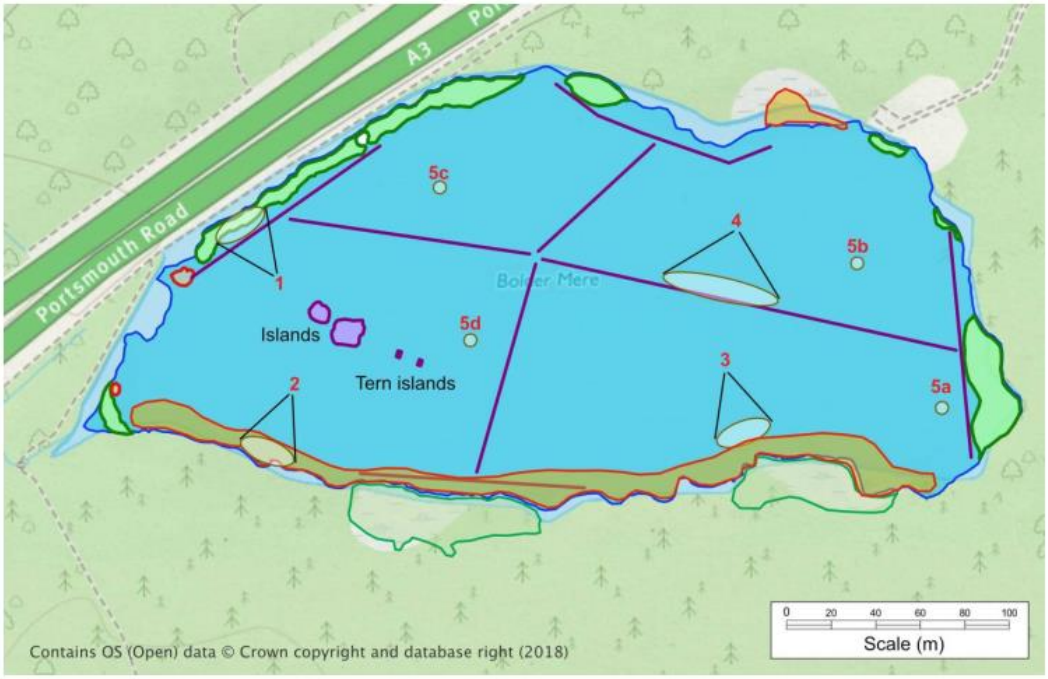

Figure 3 Map of Boldermere showing aquatic macro-invertebrate sampling locations (red)

Sample 1 - Northwest shore (TQ0748358430)

Sample taken within the submerged stems of dense Common reed *Phragmites australis*.

Substrate was mainly organic silts and leaf-litter overlying hard "rocky" material, the latter assumed to be part of the artificial shore that orders the A3.

A series of short kick and sweep samples were made at a number of points in approximately 15 m of similar habitat. Total time of one minute.

Sample 2 - Southwest shore (TQ0749158328)

Sample taken within the shallow littoral zone amongst emergent stands of Common spike-rush *Eleocharis palustris* and Branched bur-reed *Sparganium erectum*. Submerged plants included shallow-growing *Myriophyllum alterniflorum, Elodea nuttallii* and *Crassula helmsii.*

Substrate was a mix of loosely consolidated pebbles and gravel mixed with fine organic silt and leaf litter.

A continuous kick and sweep sample was made through approximately 10 m of similar habitat. Total time of one minute.

Sample 3 - South shore (TQ0771758330)

Sample taken in 30 – 50 cm water depth within beds of submerged aquatic vegetation dominated by *Myriophyllum alterniflorum* and *Potamogeton pusillus. Elodea nuttallii* and *Crassula helmsii* were also present, but rare. This area had no emergent vegetation and was typical of the shallow littoral around the south shore

Substrate consisted of fine silt overlying consolidated gravel.

A continuous kick and sweep sample was made through approximately 10 m of similar habitat. Total time of one minute.

Sample 4 - Open Water (TQ0770358379

Sample taken in 85 – 95 cm water depth within beds of dense submerged aquatic vegetation dominated by *Elodea nuttallii*. This area was typical of the majority of the open water away from the lake edges (No photo due to poor visibility in the deeper water).

Substrate consisted of fine silt with occasional areas of harder consolidated gavels.

A continuous sweep sample was made with the net from the boat while rowing slowly forwards through approximately 20 m of similar habitat. Total time of one minute.

Sample 4 - Open Water sediments (5a - TQ0779958345, 5b - TQ0775758414, 5c - TQ0757558438, 5a - TQ0758258368)

Samples taken in 75 – 90 cm water depth in areas where the submerged vegetation was less dense. Samples were not timed, but instead taken at four separate locations, using the invert net to scoop and sieve soft sediments at each location (No photo due to poor visibility in the deeper water).

Table 3 Aquatic macro-invertebrates, Boldermere June 2018.

Conservation scores (CS) follow Chadd & Extence (2004) – a "?" is assigned to poorly identified taxa and a "-" to taxa with no CS score

Taxon	CS	Common Name	Family	Site 1	Site 2	Site 3	Site 4	Site 5	Combined
Aeshna sp. (released)	2	Hawker dragonfly larvae	Aeshnidae		2				2
Baetidae (damaged)	1	Mayfly	Baetidae		1	6			7
Cloeon dipterum	1	Pond olive mayfly	Baetidae				2		2
Caenis horaria	1	Anglers' curse mayfly	Caenidae			2			2
Ceratopogonidae	?	Biting midge	Ceratopogonidae				1		1
Ceratopogonidae – Bezzia sp.?	?	Biting midge	Ceratopogonidae	1		6			7
Chaoborus spp.	-	Phantom midge	Chaoboridae	4					4
Chironomidae - Chironomini	-	Non-biting midge	Chironomidae	327	432	135	61	411	1366
Chironomidae - others	-	Non-biting midge	Chironomidae	5	3	18	8	7	41
Chironomidae - Tanypodinae	-	Non-biting midge	Chironomidae	3	28	3	83	154	271
Chironomidae - Tanytarsii	-	Non-biting midge	Chironomidae				2		2
Ischnura elegans	1	Blue-tailed damselfly	Coenagrionidae	2	5	11	`		18
Erythromma najas	4	Red-eyed damselfly	Coenagrionidae	1					1
Sigara spp.	?	Water boatman	Corixidae		1				1
Crangonyx pseudogracilis	1	Non-native shrimp	Crangonyctidae	8	6	6			20
Argyroneta aquatica	3	Water spider	Dictynidae		2				2
Stenelmis canaliculata	9	Riffle beetle	Elmidae		3				3
Gerris gibbifer	4	Pond Skater	Gerridae		2				2
Hemiclepis marginata	4	Jawless Leech	Glossiphoniidae			1			1
Haliplus flavicollis	4	Crawling water beetle	Haliplidae	1					1
Hydracarina	-	Water mite	Hydrachnidiae		1	9			10
Oecetis lacustris	3	Caddisfly larvae	Leptoceridae			1	2		3
Mystacides longicornis	1	Long-horned caddisfly	Leptoceridae			4			4
Triaenodes bicolor	2	Long-horned caddisfly	Leptoceridae		1				1
Limnephilus sp. [rhombicus]	1	Caddisfly larvae	Limnephilidae	2					2
Lymnaea stagnalis	1	Great pond snail	Lymnaeidae	1	39	24			64

Taxon	CS	Common Name	Family	Site 1	Site 2	Site 3	Site 4	Site 5	Combined
Lymnaea (Radix) peregra	1	Pond snail	Lymnaeidae		1	1	1		3
Ilyocoris cimicoides	4	Saucer bug	Naucoridae		10	21			31
Ranatra linearis	5	Water stick insect	Nepidae	2	5	1			8
Noterus clavicornis	2	Water beetle	Noteridae	1					1
Notonecta glauca	1	Backswimmer	Notonectidae			2			2
Ostracoda	-	Ostrocod	Ostracoda	7	11	113	46	17	194
Pedicia	?	Cranefly larvae	Pediciidae	1					1
Physa fontinalis	1	Common bladder snail	Physidae	5	22	43	2	1	73
Planorbarius corneus	4	Great ramshorn snail	Planorbidae		3				3
Planorbis planorbis	1	Ramshorn snail	Planorbidae	8	8	31			47
Gyraulus albus	1	White Ramshorn	Planorbidae	1					1
Anisus leucostoma	5	White-lipped ramshorn snail	Planorbidae	1		4			5
Plea minutissima	4	Pygmy backswimmer	Pleidae		9	15			24
Sialis lutaria	1	Alderfly larvae	Sialidae		5			2	7
Sphaerium spp.	1	Freshwater clam	Sphaeriidae	1	5	8	7	3	24
Potamopyrgus antipodarum	1	New Zealand mud snail	Tateidae		1	92	15	1	109
Tipulidae	?	Cranefly larvae	Tipulidae	1					1
Number of taxa				21	25	25	13	8	43
Numbers of Families				16	21	20	9	6	31
Number of BMWP Families				11	15	14	6	4	23
BMWP score				**47**	**76**	**64**	**25**	**12**	**113**
Average score per taxon ASPT				4.27	5.07	4.57	4.17	3.00	4.91
Number of WHPT Families				15	17	16	7	4	27
WHPT score				**54.8**	**61.5**	**57.5**	**25.5**	**10.4**	**106.4**
Average score per taxon ASPT				3.65	3.62	3.59	3.64	2.60	3.94

A total of 43 aquatic macro-invertebrate taxa were identified from the samples from 31 families (Table 3). Where possible, individuals were identified to species level, but those that were damaged or more taxonomically challenging or numerous (e.g. *Chironomidae*) were identified only to family or genus level. Two dragonfly larvae were removed from the Site 2 net sample and released back to the lake. In the field it was only possible to identify them as *Aeshna* species.

In terms of community composition, the two marginal sites (1 and 2) and the littoral zone on the south shore (Site 3) had the highest number of taxa, with the open water (Site 4) and sediments (sites 5a-d) supporting much lower numbers (Figure 4). Using the macro-invertebrate data to infer ecological quality, the BMWP and WHPT metrics suggest the more species rich marginal and littoral sites to be of higher ecological quality than the open water sites.

Of the three marginal / littoral meso-habitats (sites 1-3), the *Phragmites* reed (Site 1) achieves slightly lower BMWP and WHPT scores than the habitats on the south side of the site. Although not sampled, the habitat immediately in front of the reed face was dominated by *Elodea nuttallii* on fine silts with only sparse *P. pusillus,* and *M. alterniflorum*; a habitat most similar to that throughout the open water (Site 4).

When the data from the different habitats are combined, the BWMP score is 113, which classifies the site as “very good” in terms of its macro-invertebrate fauna.

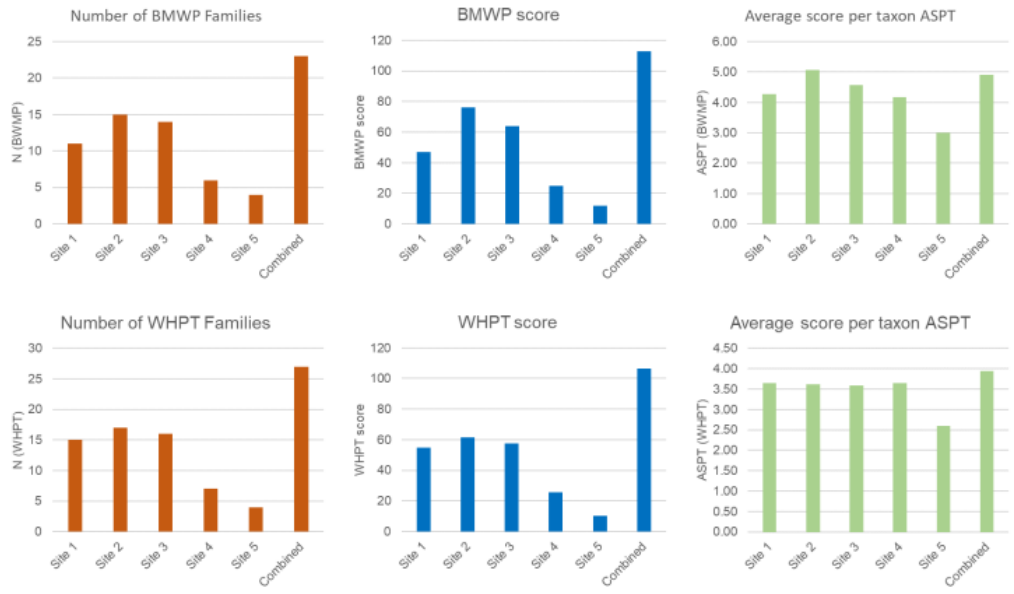

Figure 4 Aquatic macro-invertebrate BWMP and WHPT metrics from Boldermere

In terms of the particular conservation interest from each meso-habitat, only one species recorded here is of high conservation status. A single individual of the Riffle beetle *Stenelmis canaliculata* was found in Site 2. This species is nationally rare and recorded in the UK Red data book for insects (Shirt 1987) and is listed as “Vulnerable” within the IUCN classification.

The conservation scores for each species were used to calculate a community conservation index (CCI, Chadd & Extence 2004). This metric can be expressed relative to

either the highest conservation value (CSmax) of any one species, or to the BMWP score; these are shown in Figure 5. The CSmax derived CCI score for site 2 is skewed heavily by the single occurrence of ***Stenelmis canaliculata***, but nonetheless, both metrics show the conservation value of marginal habitats to be higher than the open water areas.

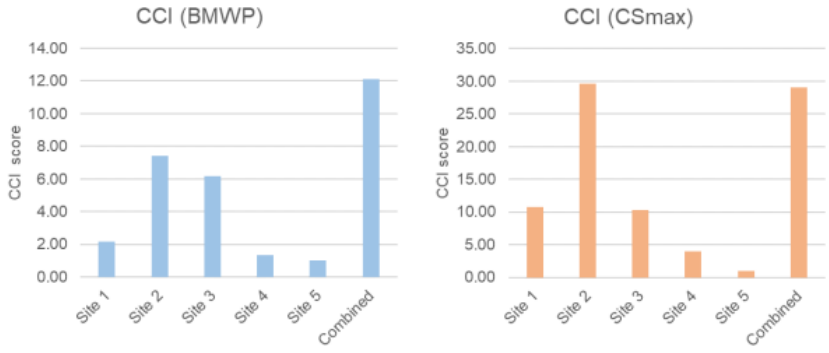

Figure 5 Community Conservation Index scores for the Boldermere meso-habitats

Although Boldermere is noted for its rare Odonata, none of the larvae recorded here were rare species. The warm, sunny conditions during the field survey were excellent for adult dragonflies and damselflies and a number of species were noted on the wing at the site (Table 4); again, these did not include any of the rarities recorded previously from the site.

Table 4 Adult dragonflies and damselflies recorded at Boldermere June 26th 2018

Species	Common name
Anax imperator	Emperor dragonfly
Libellula quadrimaculata	Four-spotted chaser
Enallagma cyathigerum	Common blue damselfly
Ischnura elegans	Blue-tailed damselfly
Coenagrion puella	Azure damselfly
Erythromma najas	Red-eyed damselfly
Calopteryx splendens	Banded demoiselle
Sympetrum striolatum	Common darter
Aeshna grandis	Brown hawker
Libellula depressa	Broad-bodied chaser

4. Appraisal of the Evidence

4.1. Aquatic flora

The current assemblage is in the most part typical of shallow eutrophic lowland lakes in the south-east of England. The one exception to this is the presence of *Myriophyllum alterniflorum.* This species is ecologically confined to lower alkalinity sites and is normally replaced by Spiked water-milfoil in more eutrophic and higher alkalinity sites. Its presence here, at high frequency, reflects the local geology and suggests that eutrophication has not yet become a major problem at the site. The maintenance of good water quality data will help to establish the extent of any enrichment and should certainly form part of any future management and monitoring plan.

Other macrophyte species recorded are more generalist in their habit, occurring across a wide range of ecological and trophic gradients. The occurrence of the Stonewort *Chara globularis* (Figure 6) suggests nitrogen concentrations are not excessive. Stoneworts are particularly sensitive to nitrates, and rarely persist in sites where nitrate is high.

The open water was dominated by extensive beds of *Elodea nuttallii.* While this species undoubtedly provides suitable habitat for aquatic invertebrate species and forage for water fowl, it occurs at a density that leaves little space for native species to colonise and grow.

Species of conservation interest, listed in the SSSI citation such as *Littorella uniflora, Baldellia ranunculoides* and *Pilularia globulifera* were not recorded and the site lacks any of the more any of the typically mesotrophic *Potamogeton* species normally associated with high quality waterbodies of medium alkalinity.

Figure 6 *Chara globularis* (x10) from Boldermere

4.2. Aquatic macro-invertebrates

Boldermere has a rich aquatic macro-invertebrate fauna, with BMWP and CCI scores indicating relatively high ecological quality. Sampling from the different meso-habitats shows the highest quality habitats to be within the marginal and littoral zone, with the more uniform, open water habitats being of lower quality.

Odonata are identified in the SSSI favourable condition tables as being the key species group for the site and the wider SSSI. Odonata larvae were recorded only from the marginal and littoral habitats and although total numbers were relatively low, the majority of individuals were found in Site 2 within mixed stands of emergent and shallow, submerged vegetation.

Figure 7 *Ranatra linearis,* Boldermere

The importance of the lake habitats for Odonata necessitates that areas of both sheltered open habitat as well as overhanging trees, reeds and shaded areas are maintained around the lake to provide feeding, resting and courting areas. The Oakham and Wisley SSSI Favourable Condition Table (FCT) states: "Ideally, a structurally diverse mixture of heath, grassland and mire should be maintained surrounding the ponds with scattered scrub to provide shelter". Notable species such as the Downy emerald *Cordulea aenea* and the nationally scarce Brilliant emerald *Somatochlora metallica* require favoured water bodies to have partly shaded margins (ideally 30-60% of margin shaded), as well as open areas of shallow, vegetated water for egg-laying (BDS 2004).

In terms of aquatic macro-invertebrate habitat, the maintenance of a diverse array of marginal habitats that favours many of the dragonflies and damselflies listed for the site is of importance.

4.3. Invasive species

Of primary concern at the site is not only the lack of typical aquatic macrophyte species associated with medium-alkalinity shallow lakes, but also the dominance of non-native, invasive species, particularly *Elodea nuttallii* and *Crassula helmsii*, the latter forming very dense mats and having a significant impact on the low-growing marginal vegetation which would otherwise be good potential habitat for *Pilularia globulifera* and *Littorella* uniflora (Figure 8). These species are exceptionally difficult to control once established and therefore their presence seriously compromises the future conservation value of the site if left unmanaged.

Figure 8 *Crassula helmsii* growing in the exposed littoral zone on the south shore.

Two other INNS were recorded during the survey; carp and Turkish (long-clawed) crayfish *Astacus leptodactylus*. It is understood that a significant effort was made to remove carp from Boldermere in 2012, and angling is now prohibited at the site.

Figure 9 Large (dead) carp and Turkish crayfish recorded at Boldermere

As with any fish removal, success is rarely 100%, and the presence of large carp in such a shallow site will be damaging due to their foraging behaviour. 6 -10 individuals were observed during the survey, including one dead fish measuring over 80 cm long and 45 cm deep (Figure 9). The shallow, warm water, provides potential conditions for recruitment and thus further management and control should be a priority.

Several mature adult Turkish (long-clawed) crayfish *Astacus leptodactylus* were seen during the survey (Figure 9). This species is not considered to be as environmentally destructive as the Signal Crayfish in terms of burrowing, but it is a very generalist omnivore, and as such can pose a threat to a wide range of plant and macro-invertebrate species, including larval stages of Odonata. Control and eradication should feature in the management plan for the site.

5. A Vision for Boldermere

To ensure that Boldermere is effectively managed and where necessary, to help deliver improvements to the area, a "Vision" for the site is required to provide the goals to work towards. The Vision, presented here is based on the evidence collected from this study and the targets set out in the FCTs.

5.1. Boldermere: The Vision

The vision is focussed on both the open water and the array of wetland habitats that surround the pond; a site of rich historical, cultural and environmental interest, lying within the Oakham and Wisley SSSI.

The Vision is of a future in which the waters of Boldermere remain clear and are dominated throughout the summer months by a diverse community of submerged aquatic plants. Alternate water milfoil, pondweeds and stoneworts will be important components of the aquatic flora, creating areas of dense weed growth right up to the water's surface. Around the pond, there will be a mosaic of different wetland habitats grading back to mature stands of mixed woodland. The lake margin will include extensive areas of reed-bed, tall stands of willow and alder with low branched extending to overhang the water; stands of low-growing emergent vegetation, grading gently into areas of acid bod with Sphagnum mosses present in the wetter areas backed by Purple moor-grass. Local rarities such as Marsh St. John's wort, Pillwort and Shoreweed will flourish at the water's edge and non-native plant species will be absent or remain at low abundance with no new introductions occurring.

The diverse array aquatic and marginal habitats will play host to a rich and important invertebrate community. Dragonflies and damselflies will be seen throughout the summer months: the many different species, including national rarities, being indicative of the good habitat and water quality at Boldermere. The quality and diversity of habitats will support a host of other invertebrate species, and thus the pond will be an important feeding ground for water birds as well as insectivorous birds and bats feeding on insects on the wing.

The fish population will consist of native species, such as perch, eels, and roach. Non-native species, including common carp and alien crayfish species, will be absent and the lake will remain closed to anglers. The passage of eels to and from the pond will not be compromised by obstructions within the wider catchment.

The expanse of open water and extensive wetlands will attract a range of bird species, with Reed warblers, Mute swans, Coot, Moorhen, Great-crested grebe and Kingfishers among the resident breeders, while others will use the site as a feeding stop-off on migratory routes. The pond will attract many other species of waterfowl during the winter.

Water quality will be very good. Concentrations of plant nutrients such as nitrogen and phosphorus will be low (TN < 1.5 mgl-1 & TP < 30 µgl-1), both in the lake, and in the feeder stream. Catchment management will ensure that sediment loads and run-off are minimised and controls will be placed on domestic wastewater to ensure they do not pollute the pond.

Public access to Boldermere will be sufficient to provide a safe area for visitors to enjoy a vista of the lake and its wetland habitats and wildlife. The pond will be an area where people go to enjoy and learn about the natural environment and a place that promotes health and well-being through exercise and relaxation. The provision of well managed

public access and signage, will help to promote a wider understanding of the importance of freshwater habitats and thus safeguard the site into the future.

6. Recommendations

6.1. Re-alignment of the A3

It is understood from Atkins that the proposal to improve the M25 / A3 road network will include the re-alignment of the northwest shore of Boldermere. The proposal at Boldermere is to move the current retaining embankment that lies adjacent to the A3 approximately 10 m into the lake, thus losing a 10 m wide strip of the lake margin and associate habitats therein (Figure 10). This involves the potential disruption to approximately 180 m of shoreline along the northwest side of Boldermere. The proposal is to replace any loss of habitat within this region with a like-for-like replanting and / or translocation of the existing habitats.

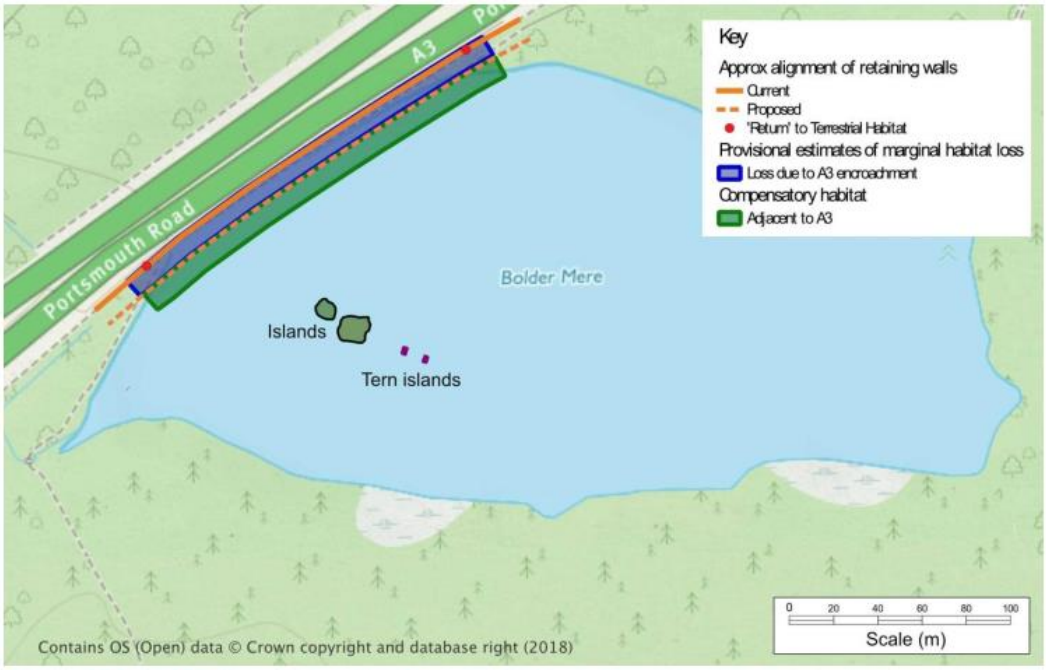

Figure 10 Map of Boldermere showing the proposed re-alignment.

With the possible exception of 10 - 20 m at the eastern, this stretch of shoreline is all artificial, much of it having been created during the original building of the A3 dual carriageway. The eastern end is terrestrial habitat comprising regenerated broadleaf woodland with a range of different age-class willow and alder trees overhanging the lake.

Similarly, approximately 30 - 40 m of the western end of the proposed re-alignment is also terrestrial broadleaf woodland and includes large alder and a mature oak tree on the lake bank. The impact relating to the loss of terrestrial habitats are not covered in this report.

With respect to the lake and wetland habitats the realignment will result in the loss of approximately 120 m of existing lake shore, equating to approximately 1,200 m^2 of the lake area. This area is currently dominated by emergent and marginal Common reed *Phragmites australis* growing in a dense and continuous stand ranging from 5 – 15 m in

width (see Figure 2) and backed by a narrow line of willow against the road verge. While not the highest quality wetland habitat in terms of invertebrate or botanical interest, this area is nonetheless of moderate ecological quality (based on aquatic macro-invertebrate BMWP and CCI scores) and provides nesting habitat for Mute swans (at TQ0750558438) and potentially for a range of other birds using the site (e.g. Reed warbler, Coot, Moorhen and Mallard). This marginal habitat also provides a valuable aesthetic component to Boldermere, shielding the A3 from view from the main areas of public access around the south and east margin. For this reason, it is recommended that this habitat is translocated or re-created on a like-for-like basis following the re-alignment work. This includes replanting willow between the new reedbeds and the re-aligned road verge to add height and shelter to the lake margin.

Phragmites australis is normally relatively easy to re-establish at a site and there is excellent advice on best practice within the conservation literature, e.g. RSPB (2014) and Sussex Wildlife Trust (2004).

6.2. Implications relating to the loss of open water habitat

The proposed re-alignment works and habitat re-creation will result in a loss of surface area of the open water habitat, assumed to be approximately 1200 m^2 (0.12 ha = c. 1.5% of lake area). This impacts on the SSSI condition assessment for the lake, whereby any loss of extent to the open water due to active management is deemed to be unfavourable.

In this case there are two factors that lessen the impact of this proposed reduction to surface area:

- First, because the open water habitat at Boldermere is not included within the original SSSI designation (1975) as a qualifying feature, it is not afforded the same protection as the listed SSSI features.
- Secondly, the quality of the open water habitat in front of the reeds has been demonstrated to be of lower ecological quality than the marginal habitat type than that planned to replace it (this area has low botanical quality and the open water macro-invertebrate samples were of low BMWP and CCI scores).

The primary wetland habitats identified in the SSSI FCTs (NE 2015) as important, are those which supports the diverse (including rare) Odonata assemblage. These are in the most part marginal habitats, particularly those around the south shore and suitable roosting sites in necessitating that management is best focussed on ensuring an array of suitable wetland habitats are available to maintain the Odonata.

Specifically, in Table 2a of the SSSI FCTs the open water features the targets are stated as:

- Sufficient area of suitable habitat to maintain assemblage.
- No net loss of area or edge of suitable habitat.
- 10 - 40% emergent vegetation in each water body.
- 30 - 50% submerged vegetation in shallower <30 cm parts of each water body.
- Parts of pond margins shaded by trees, parts unshaded.
- Shoreline predominantly natural and no significant loss of marginal vegetation.

Thus, while open water is necessary for larval stages, it is the shallow water areas that are best suited (e.g. those around the south shore) and management is best focused on

maintaining this habitat and areas of sheltered, sunny, open habitat that provide feeding, resting and courting areas for adult Odonata. This habitat needs to remain varied and structurally diverse and included good connectivity to areas of open heath, grassland and mire around the lake as well as scrub and woodland scattered scrub to provide shelter.

It is recommended that any loss of open water habitat would be best off-set by addressing the main conservation problems at the site (i.e. invasive species and water quality) and the effective management and preservation of the higher quality habitats around the southern margin of the lake.

6.3. Habitat improvement to off-set the re-alignment

The littoral zone and associated marginal habitat around the south shore have been shown to be the highest quality habitats at Boldermere in terms of both their botanical interest (submerged aquatic and wetland species) and aquatic macro-invertebrates. This area also contains the best examples of the habitat types identified in the SSSI FCTs as important for Odonata. The effective management of these habitats provides the best opportunity to maintain and potentially improve the conservation value of Boldermere and off-set the loss of open water habitat resulting from the re-alignment work.

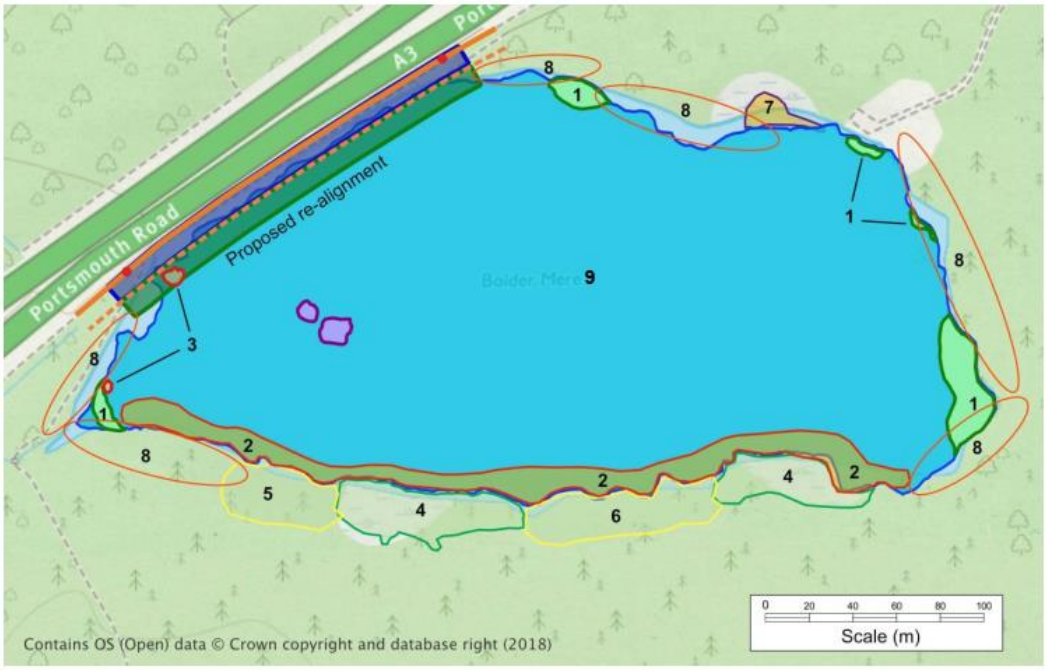

Figure 11 Potential habitat improvement areas at Boldermere

A number of key areas are identified in Figure 11 where the management recommendations are focussed.

1. Reed bed. Dominated by *Phragmites australis* with occasional Greater reedmace *Typha latifolia*. These areas, including the future development of the re-aligned shore, provide good habitat for birds and invertebrates and are important within the site. The current extent (to include the future re-aligned area) is considered suitable for the site. No additional management is required, but future control would be

necessary if there is any evidence of any significant spread into adjacent habitat types or open water.

2. This area represents an important shallow water (<30 cm) habitat with a diverse submerged macrophyte flora grading into a mixed emergent flora. This is excellent habitat for macro-invertebrates (including Odonata), but suffers from a high cover of the invasive, non-native species *Crassula helmsii.* Controlling the *C. helmsii* in this area and preventing spread within the site, and to other sites, represents a major management challenge. Chemical treatment is cited by Newman (2013) as the only realistic control method, but this risks also damaging desirable native species. Persistent physical control (hand pulling) risks spreading the plant unless done with extreme care by experienced practitioners; this is only feasible on small areas. It is recommended that further advice is sought from specialist in *Crassula helmsii* management.
3. The water lilies *Nymphaea* sp. are confined to two beds at the western end. These provide good habitat for some Odonata species during egg-laying and should be maintained within the site. One population is likely to be within the re-alignment areas and it is recommended that it is translocated to remain as close as possible to its current location.
4. Two areas of open acid bog with good connectivity to the lake and grading into drier *Molinia* heath and woodland. This habitat is already managed to prevent encroachment of the birch and willow. These areas provide excellent open habitat for Odonata, and benefit from partial enclosure from the adjacent woodland and encroaching birch. Best practice management will include regular clearance of any encroaching scrub from within the open areas and period removal of larger birch and willow (and any trees) from the edges to maintain a semi-open structure grading into the woodland behind.
5. An area of close growing birch and willow scrub with dense understory of *Sphagnum* spp.. An interesting habitat that would benefit from partial clearance of the birch and willow to towards the lake shore to provide more open areas of acid bog habitat. Long-term management will be required to prevent future encroachment of trees.
6. An area of drier marginal habitat mainly reverting to woodland. Thinning and removal of trees and scrub would help to encourage a low-growing heath / grassland community to develop and provide improved habitat for Odonata.
7. Wet woodland with sedge and rush understory, but also *C. helmsii* present. Refer to point 2 with respect to the need to control *C. helmsii.* No addition management required.
8. Areas of dense overhanging tree cover, mainly willow. This is important habitat for many Odonata species as well as birds. Management of this habitat should be considered on a long-term time scale, with larger trees occasionally being removed and natural regeneration allowed to occur. The current level of overhanging tree habitat is estimated at 40% of the perimeter and lies within the target stated in the FCT (30 - 60%).
9. Open water habitat remains important for the site and will be best maintained by ensuring catchment sources of nitrogen and phosphorous are below target values for this lake type (1.5 mgl^{-1} N and 30 μgl^{-1} P) and sediment loads are low. It is important that the lake does not receive run-off from the adjacent A3. A catchment

nutrient budget is recommended to identify any potential sources of nutrients reaching the lake and where possible, reduce nutrient inputs.

6.4. Invasive species

In addition to the *Crassula* (see above), two other non-native species are present in Boldermere and would benefit from the implementation of control measures.

Carp *Cyprinus carpio* are potentially damaging to the flora and fauna within the lake and significant numbers of large Carp remain in the lake. The shallow water warms quickly in the spring making this a potential site for successful recruitment and survival of Carp eggs and fry. A fish survey and removal of Carp (and bream if present) is therefore recommended. Annual monitoring of the fish population will be important to establish the success of fish removals.

Turkish (Narrow-clawed) crayfish *Astacus leptodactylus* appear to be well established in the site with a number of individual adults observed. Advice on control of this species is rather limited due to its relatively low impact on physical disturbance and susceptibility to crayfish “plague”. This species is omnivorous however and at Boldermere it may well present a threat to the aquatic macro-invertebrate population, which include a number of rare species. Control is therefore recommended and further advise should be sought on the most effective methods.

6.5. Biosecurity

Given the presence of a number of INNS an effective bio biosecurity plan should be in place at Boldermere before any work commences at the site. *Crassula helmsii* and *Elodea nuttallii* are both readily transported between sites on machinery and footwear.

While the accidental transfer of Turkish crayfish is unlikely, its presence means there is potential to transfer crayfish “plague” (an oomycete pathogen) between sites. This can be potentially devastating if introduced to waters where native White-clawed crayfish *Austropotamobius pallipes* are present.

Any potential work at the site should therefore be covered by a comprehensive bio-security plan which is communicated and adhered to by all site personnel and visitors. All tools, and machinery used at site should be checked, cleaned and disinfected or dried before being moved to another site. Footwear is best left at site, or removed at the vehicle and not worn elsewhere without undergoing thorough check-clean-dry procedures.

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Appendix 1 CSM Macrophyte data Boldermere (26/06/2018)

Lake Details

Lake Name	Bolder Mere
SSSI Name	Ockham & Wisley Commons
SAC Name	
Grid Ref (centre)	TQ076584
WBID / NI No.	43218 /

Survey Details

Survey Date	26/06/2018	
Surveyors	BG & Kat L-D	
Shore Surveys	4	out of
Wader Surveys	4	4
Boat Surveys	4	sections

Site Notes:
Crassula and Turkish Crayfish confirmed in 2018
cm.

Survey Notes:
Site very shallow (1 m max). Water level down by approx 15

Lots of crassula on south shore / littoral. Large carp present - apparently, some removed in 2012.

Section Locations

	Shore Survey GPS Co-ords start	Shore Survey GPS Co-ords end	Boat Survey GPS Co-ords start (shore)	Boat Survey GPS Co-ords end (lake)
Section 1	TQ0745458409	TQ0754058466	TQ0749458431	TQ0761358414
Section 2	TQ0762758494	TQ0772158474	TQ0767458485	TQ0761358414
Section 3	TQ0780458422	TQ0781158323	TQ0780358371	TQ0761358414
Section 4	TQ0753958315	TQ0763958311	TQ0759058318	TQ0761358414

Dissolved Oxygen Profile

GPS Location	TQ0761358414
Maximum Depth (m)	1 m
Secchi Depth (cm)	-

Notes: Secchi > depth

Depth (m)	DO (mg/l)	Temp (°C)
0	9.15	27
0.5	9.06	27

Site Condition Assessment: Bolder Mere (26/06/2018)

Plant List by Section - Boat Survey

Section 1
Chara globularis
Elodea nuttallii
Myriophyllum alterniflorum
Potamogeton pusillus
Zannichellia palustris

Section 2
Chara globularis
Elodea nuttallii
Myriophyllum alterniflorum
Potamogeton pusillus

Section 3
Ceratophyllum demersum
Elodea nuttallii
Myriophyllum alterniflorum
Potamogeton berchtoldii
Potamogeton pusillus

Section 4
Chara globularis
Elodea nuttallii
Myriophyllum alterniflorum
Potamogeton pusillus

Plant List by Section - Wader Survey

Section 1
Ceratophyllum demersum
Elodea nuttallii
Lemna minor
Lemna trisulca
Myriophyllum alterniflorum
Nymphaea spp. "cultivar"
Phragmites australis
Potamogeton pusillus
Typha latifolia

Section 2
Ceratophyllum demersum
Chara globularis
Elodea nuttallii
Lemna minor
Myriophyllum alterniflorum
Phragmites australis
Potamogeton pusillus
Sparganium erectum

Section 3
Elodea nuttallii
Myriophyllum alterniflorum
Phragmites australis
Potamogeton pusillus
Sparganium erectum
Typha latifolia

Section 4
Ceratophyllum demersum
Chara globularis
Crassula helmsii
Elodea nuttallii
Lemna trisulca
Myriophyllum alterniflorum
Persicaria amphibia
Potamogeton crispus
Potamogeton obtusifolius
Potamogeton pusillus

Plant List - Shore Survey (marginals and emergents)

Alisma plantago-aquatica
Carex acutiformis
Carex pseudocyperus
Crassula helmsii
Equisetum fluviatile
Hydrocotyle vulgaris
Iris pseudacorus
Juncus bulbosus
Lycopus europaeus
Molinia caerulea
Persicaria amphibia
Ranunculus flammula
Solanum dulcamara
Sphagnum sp.
Typha latifolia
Alnus glutinosa
Carex nigra
Carex rostrata
Eleocharis palustris
Eriophorum angustifolium
Hypericum elodes
Juncus articulatus
Juncus effusus
Mentha aquatica
Oenanthe crocata
Phragmites australis
Salix sp.
Sparganium erectum
Typha angustifolia

Plant List - Shore Survey (strand-line. i.e. not rooted)

Ceratophyllum demersum
Lemna minor
Potamogeton pusillus
Elodea nuttallii
Myriophyllum alterniflorum

Species Abundance - Boat Survey

Total number of sample plots	80
Total number of vegetated sample plots	40

Plant Species	Occurrence *n*	Occurrence %
Ceratophyllum demersum	1	2
Chara globularis	4	10
Elodea nuttallii	40	100
Myriophyllum alterniflorum	19	48
Potamogeton berchtoldii	2	5
Potamogeton pusillus	17	42
Zannichellia palustris	3	8

Species Abundance - Wader Survey

Total number of sample plots	80
Total number of vegetated sample plots	78

Plant Species	Occurrence *n*	Occurrence %
Ceratophyllum demersum	18	23
Chara globularis	12	15
Crassula helmsii	11	14
Elodea nuttallii	59	76
Lemna minor	6	8
Lemna trisulca	6	8
Myriophyllum alterniflorum	41	53
Nymphaea spp. "cultivar"	2	3
Persicaria amphibia	3	4
Phragmites australis	33	42
Potamogeton crispus	1	1
Potamogeton obtusifolius	1	1
Potamogeton pusillus	27	35
Sparganium erectum	3	4
Typha latifolia	4	5

Plant Scores

Total plant species 41 **Filamentous algae (%)** 0.5 % WADER / 0 % BOAT
Total plant cover (%) 117.85

SURVEY SCORES

PLANT SPECIES	PERIMETER	WADER	BOAT	COVER %	DAFOR	ABUNDANCE
Elodea nuttallii	0.025	0.128	0.5102	33.17	A	4
Myriophyllum alterniflorum	0.025	0.0995	0.1785	13.4	F	3
Potamogeton pusillus	0.025	0.0588	0.129	9.41	O	2
Phragmites australis	0.5625	0.0341	0	9.01	O	2
Alnus glutinosa	0.5	0	0	7.14	O	2
Salix sp.	0.5	0	0	7.14	O	2
Crassula helmsii	0.2125	0.0251	0	3.75	R	1
Typha latifolia	0.25	0.0024	0	3.64	R	1
Sparganium erectum	0.2125	0.002	0	3.09	R	1
Eleocharis palustris	0.1875	0	0	2.68	R	1
Mentha aquatica	0.1875	0	0	2.68	R	1
Chara globularis	0	0.0261	0.03	2.46	R	1
Juncus effusus	0.125	0	0	1.79	R	1
Ceratophyllum demersum	0.025	0.0368	0.0042	1.65	R	1
Potamogeton berchtoldii	0	0	0.025	1.43	R	1
Lycopus europaeus	0.0875	0	0	1.25	R	1
Hydrocotyle vulgaris	0.0875	0	0	1.25	R	1
Carex acutiformis	0.0875	0	0	1.25	R	1
Juncus articulatus	0.0625	0	0	0.89	R	1
Molinia caerulea	0.0625	0	0	0.89	R	1
Hypericum elodes	0.0625	0	0	0.89	R	1
Oenanthe crocata	0.0625	0	0	0.89	R	1
Carex rostrata	0.0625	0	0	0.89	R	1
Sphagnum sp.	0.0625	0	0	0.89	R	1
Zannichellia palustris	0	0	0.0142	0.81	R	1
Iris pseudacorus	0.05	0	0	0.71	R	1
Persicaria amphibia	0.025	0.0078	0	0.58	R	1
Lemna minor	0.025	0.0056	0	0.52	R	1
Juncus bulbosus	0.025	0	0	0.36	R	1
Eriophorum angustifolium	0.025	0	0	0.36	R	1
Equisetum fluviatile	0.025	0	0	0.36	R	1
Alisma plantago-aquatica	0.025	0	0	0.36	R	1
Ranunculus flammula	0.025	0	0	0.36	R	1
Carex pseudocyperus	0.025	0	0	0.36	R	1
Carex nigra	0.025	0	0	0.36	R	1
Solanum dulcamara	0.025	0	0	0.36	R	1
Typha angustifolia	0.025	0	0	0.36	R	1
Lemna trisulca	0	0.0079	0	0.23	R	1
Nymphaea spp. "cultivar"	0	0.003	0	0.09	R	1
Potamogeton crispus	0	0.0025	0	0.07	R	1
Potamogeton obtusifolius	0	0.0025	0	0.07	R	1

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D.2 Technical note on WFD Compliance for Bolder Mere

ATKINS
Member of the SNC-Lavalin Group

Technical note

Project:	RIS M25 Junction 10	**To:**	marcus.huband@atkinsglobal.com
Subject:	WFD compliance - Boldermere	**From:**	ian.morrissey@atkinsglobal.com
Date:	22 Aug 2018	**cc:**	

Background

Boldermere Lake (GB30643218) is classified as a heavily modified water body (HMWB) under the Water Framework Directive (WFD) and will be directly affected by the M25 Junction 10 scheme due to the proposals to encroach into the water body along the current alignment of the A3. For the purposes of this assessment, the reduction in surface area is assumed to be concomitant with a reduction in lake volume therein.

This technical note details the approach taken in assessing the implications of this reduction on the current Total Phosphorous (hereafter TP) physico-chemical quality element as assessed under the Water Framework Directive. The current 2016 Cycle 2 assessment for Boldermere is that the Overall Potential of the water body is at Moderate[1]. It is assessed as having Good Chemical Status and Moderate Ecological Status. The Moderate status being driven by TP, phytoplankton and expert judgement that Good Potential has not been achieved. The objective set for this water body in Cycle 2 is Good Overall Potential by 2027.

Any reduction in lake volume has the potential to affect the TP status element (and through trophic association the status of the phytoplankton element) which could potentially result in a measurable deterioration in the water body and non-compliance with Boldermere's WFD objectives.

Assessment methods

This quantitative assessment of the implication of lake volume reduction on Boldermere TP has been undertaken following the UKTAG's Lake Assessment Method for Phosphorus and using UKTAG's Lake Phosphorus Calculator (LPC)[2]. Boldermere chemistry data held by the Environment Agency (supplied by Sian Davies on 21 August 2018) which spans the period from July 2010 through to July 2018 has been used in the calculation summary data and outputs presented. The raw chemical data has not been included in this technical note but is available upon request.

The assessment involved a three-step calculation process:

1. **Calculation of TP reference conditions based on lake information and predictor variables**

In determining the current status (baseline) for TP in Boldermere, lake typology information and predictor variables were first inputted to LPC to calculate the reference TP and TP lower status boundary classes (High/Good/Moderate/Poor). These data were inputted to the *TP_Ref_and _Boundary_calculator* tab of the LPC and can be summarised as follows:

Lake information
Name: Boldermere

---

[1] Catchment Data Explorer. Boldermere Lake WFD water body Cycle 2 assessment. Available at: http://environment.data.gov.uk/catchment-planning/WaterBody/GB30643218 [Accessed 22 August 2018].

[2]UKTAG Lake Assessment Method. Phosphorus. Available at: https://www.wfduk.org/sites/default/files/Media/Environmental%20standards/Lake%20Phosphorus%20UKTAG%20Method%20Statement.pdf [Accessed 22 August 2018].

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Type: High alkalinity, Very Shallow (HAVS)
Humic conditions: 0 – clear water lake
Region: Central

Predictor variables
Mean observed alkalinity (from July 2010 to July 2018): 1359.38 uEq/L
Number of alkalinity measurements used to calculate mean: N=32
Mean depth[1]: 0.70m
Altitude[1]: 27m AOD

Table 1: TP and WFD status boundary reference condition outputs

Morpho-edaphic index (MEI)	**Category** of reference P value used, either site-specific "**S**" or type-specific "**T**"	**Reference total phosphorus** concentration (as geometric mean). Maximum 35ug/L	**High/Good** Minimum 0.7	**Good/Moderate** Minimum 0.46	**High** (minimum 5ug/L)	**Good** (minimum 8ug/L)	**Moderate** (minimum 16ug/L)	**Poor** (minimum 32ug/L)
		ug/L			ug/L	ug/L	ug/L	ug/L
1.359	S	28	0.77	0.54	37	53	106	212

Based on the available alkalinity data and lake typology information the reference TP value for Boldermere has been computed to be 28 ug/L. The lower boundary values for High, Good, Moderate and Poor status classifications are computed at 37, 53, 106 and 212 ug/L, respectively (Table 1). These reference values are used in context with observed values of TP to ascertain the status of the TP element (step 2) within the WFD classification hierarchy.

2. Calculation of Current TP Status and statistical confidence of the classification

This calculation of Current TP Status has been undertaken using the full range of available TP data and undertaken separately for the most recent 12-month sampling period (to provide an assessment based on the most recent full yearly data cycle). These data were inputted, alongside the reference condition values (obtained from step 1), into the *Confidence of Class calculator* tab of the LPC, as follows:

a. Full record of TP measurements from Boldermere (July 2010 to July 2018) where:
   i. Mean of Log10 TP = 1.836 ug/L
   ii. Standard Deviation of Log10 TP = 0.359
   iii. Count of Log10 TP, N=33
b. Last 12 months TP measurements from Boldermere (July 2017 to July 2018) where:
   i. Mean of Log10 TP = 1.733 ug/L
   ii. Standard Deviation of Log10 TP = 0.431
   iii. Count of Log10 TP, N=33

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Table 2: Current TP Status and statistical confidence of the classification

Calculation	Calculations to determine statistical confidence of the classification												
	Geometric mean and face value classification			Statistical confidence WB is classified ***worse than***:				Statistical confidence WB is classified within a given status class. The sum of these values must = 1				
	Geometric mean TP, ug/L	Face Value TP class	Face Value TP class (numeric) 6 = High, 4 = Good, 3 = Moderate, 2 = Poor, 1 = Bad, 0 = missing data	High status	Good status	Moderate status	Poor status	Confidence of High status	Confidence of Good status	Confidence of Moderate status	Confidence of Poor status	Confidence of Bad status
Boldermere (2.a. Full record)	69	Moderate	3	1.00	0.96	0.00	0.00	0.00	0.04	0.96	0.00	0.00
Boldermere (2.b. Last 12 months)	54	Moderate	3	0.88	0.52	0.02	0.00	0.12	0.35	0.50	0.02	0.00

Both the *Full record* and *Last 12 months record* LPC outputs class Boldermere as having Moderate status for TP, with the Geometric mean TP values being 69 ug/L and 54 ug/L respectively (Table 2). This assessment marries that reported for Boldermere by the Environment Agency in 2016[1] and forms the baseline against which changes in lake volume are assessed in step 3. It should be noted that the confidence of the classification being at Moderate is higher when using the *Full record* (0.98), due in part to the lower standard deviation within the TP data series, when compared to the *Last 12 months* record (0.50).

3. Calculation of Assumed TP Status and statistical confidence of the classification

These calculations are based on assumptions relating to the encroachment of the A3 alignment into the lake that are required to ascertain if under the projected lake volume change, there would be a deterioration in status as measured through the historical TP record. These assumptions are:

- Encroachment into the lake will result in a direct loss of lake volume that is equal to the surface area loss multiplied by the average depth of the lake i.e. there is a fixed water level within Boldermere that does not increase because of the volumetric loss.
- The calculations assume that the volume of the lake has remained static throughout the historical record and that the bed level is consistent throughout the lake profile. This assumption is likely to result in an over estimate of the volume loss since the marginal habitat affected by the encroachment is likely to be shallower than the mean reported depth of 0.7 m.
- The resulting change in historical mass balance of TP forms a linear relationship with the projected loss of lake volume i.e. the loss of volume does not assume a concomitant reduction in TP within the historical record and apportions this loss to the remaining volume (this is a conservative assumption as it assumes no TP is lost within the volume replaced by the encroachment).
- The calculations do not account for the influence of biological processing on the concentrations of TP recorded.
- Historical predictor variables used to calculate the reference conditions are unaltered.

Volumetric loss calculations

The current lake volume has been simply calculated by multiplying the WFD reported surface area and average depth values for the water body, where:

Surface area = 81,000 m^2
Average depth = 0.7 m
Current volume = **56,700 m^3**

The loss of volume has been calculated based on the current understanding of the encroachment extent, which is identified as being of 10 m along a 180 m length of lake shore. The resultant loss of volume is therefore:

1,260 m^3 = Surface area loss (180 m x 10 m) x average depth (0.7 m)

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The projected volume following the encroachment is therefore: **55,440 m^3** (56,700 – 1,260). This equates to a volumetric loss of **2%** of the lake volume over baseline condition.

Adjustment of historical TP data to calculate an assumed record

By apportioning the mass balance as a simple volumetric loss, the historical TP records can be adjusted to an assumed record, based on the assumptions made. The purpose being to feed these data back into the LPC to ascertain the magnitude of TP deviation from the baseline and any resultant changes in class or class confidence around TP status.

As with the Current TP Status calculations (step 2), this calculation of Assumed TP Status has been undertaken using the full range of available TP data and separately for the most recent 12-month sampling period. These data were again inputted, alongside the reference condition outputs (obtained from step 1), into the *Confidence of Class calculator* tab of the LPC, as follows:

a. Assumed full record of TP measurements from Boldermere (July 2010 to July 2018) where:
   i. Mean of Log10 TP = 1.846 ug/L
   ii. Standard Deviation of Log10 TP = 0.359
   iii. Count of Log10 TP, N=33
b. Assumed last 12 months TP measurements from Boldermere (July 2017 to July 2018) where:
   i. Mean of Log10 TP = 1.743 ug/L
   ii. Standard Deviation of Log10 TP = 0.431
   iii. Count of Log10 TP, N=33

Table 3: Assumed TP Status and statistical confidence of the classification

Calculation	Calculations to determine statistical confidence of the classification											
	Geometric mean and face value classification			Statistical confidence WB is classified ***worse than***:				Statistical confidence WB is classified within a given status class. The sum of these values must = 1				
	Geometric mean TP, ug/L	Face Value TP class	Face Value TP class (numeric) 6 = High, 4 = Good, 3 = Moderate, 2 = Poor, 1 = Bad, 0 = missing data	High status	Good status	Moderate status	Poor status	Confidence of High status	Confidence of Good status	Confidence of Moderate status	Confidence of Poor status	Confidence of Bad status
Boldermere (3.a. Assumed full record)	70	Moderate	3	1.00	0.97	0.00	0.00	0.00	0.03	0.97	0.00	0.00
Boldermere (3.b. Assumed last 12 months)	55	Moderate	3	0.89	0.55	0.02	0.00	0.11	0.34	0.53	0.02	0.00

In light of the predicted volumetric change of Boldermere, both the *Assumed full record* and *Assumed last 12 months record* LPC outputs still classify Boldermere as having Moderate status for TP, with the Geometric mean TP values calculated at 70 ug/L and 55 ug/L, respectively (Table 3). This equates to a slight increase in mean TP of just 1 ug/L when compared to the baseline situation. Nor is there any significant effect on the confidence of the classification at Moderate, which increase slightly to 0.97 (previously 0.95) and 0.53 (previously 0.50) for the calculations undertaken.

Summary

The proposal to encroach into Boldermere Lake along the current alignment of the A3 has been calculated as resulting in a minor loss of lake volume of around 1,260 m^3 (equates to a 2% loss in volume based on the conservative assumptions applied). The implications of this loss on the Boldermere TP status have been assessed through the adjustment of the historical data records by means of a simple mass balance apportionment of TP across the remaining lake volume. The assessment found a minor increase in the reported Geometric mean TP of 1 ug/L (when applied to both the full data record and last 12 months record). However, there is no change to the status of the TP WFD element as measured using the LPC, which

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remains at Moderate in both cases, with no material increase to the confidence that the assessment might be less than Moderate.

It is therefore concluded that the proposal will be compliant with the water body's WFD objectives for TP and would be unlikely to result in a deterioration of nutrient status related measures such as lake phytoplankton. The magnitude of change is also considered to be so slight, as to not act on its own to prevent the achievement of Good in the future.

D.3 A3 Source-Pathway Assessment for Bolder Mere

Technical Note

Project:	M25 Junction 10: Boldermere		
Subject:	Review of highway runoff characteristics		
Author:	P Cross	Atkins No.:	
Date:	13/11/2018	Icepac No.:	
		Project No.:	
Distribution:	M Huband	Representing:	Atkins

Introduction

A literature review into the characteristics of highway runoff has been conducted to support decision-making on the M25 Junction 10 Scheme in relation to Boldermere, a designated Water Framework Directive (WFD) lake waterbody currently failing to meet its environmental objective for phosphorous (P).

The Scheme is proposing works around Junction 10 and along the A3 to ease congestion. Boldermere is located adjacent to the A3 (south of Junction 10) (Figure 1). The aim of this literature review is to canvas scientific literature for a view on whether road networks are a likely significant source (or pathway) for P residing in water bodies.

To supplement the review, Atkins has mapped land use surrounding Boldermere and undertaken flow path analysis to assess whether the A3 may act as a pathway into Boldermere for potential sources of P.

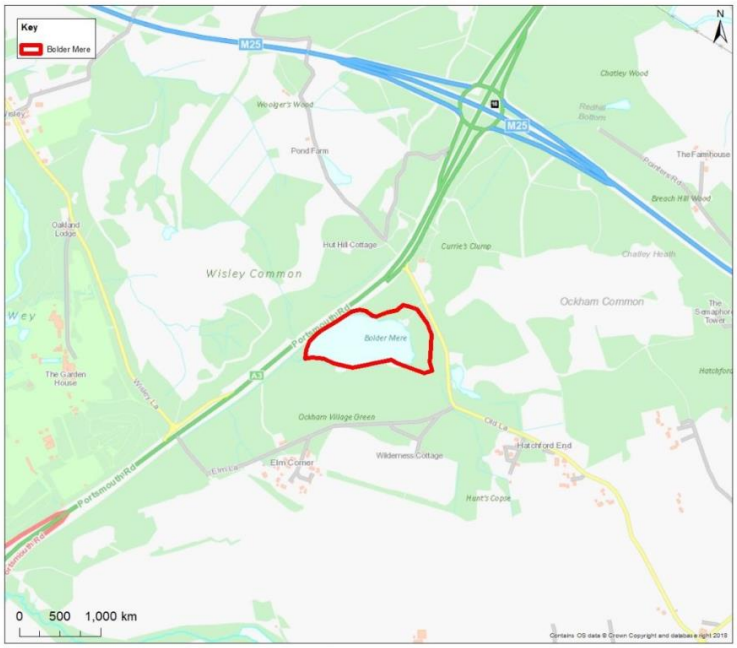

Figure 1 Location of Boldermere

The review has drawn on several sources, but particularly draws on a journal article written by Kayhanian *et al.* (2012) which presents a comprehensive literature analysis of highway runoff studies on an international level.

Chemical composition of highway runoff

Highway runoff contains pollutants such as suspended solids, fine particles, heavy metals, nutrients, organic chemicals (including herbicides and pesticides) and fecal indicator bacteria that can cause significant degradation of receiving water quality (Kayhanian *et al.*, 2012). For the purpose of this review, particular focus is given to nutrient constituents and their impacts on water quality.

Nutrients

Kayhanian *et al.* (2012) identify seven nutrient constituents in highway runoff:

- Nitrates
- Nitrites
- Ammonium
- Total Kjehldal nitrogen (TKN)
- Total nitrogen (total N)
- Phosphate
- Total phosphorus

An increase in P and/or N loads is the key pressure that may result in an enhanced risk of eutrophication in freshwater ecosystems (Heathwaite *et al.*, 2005). Eutrophication is defined as *'the enrichment of water by nutrients, stimulating an array of symptomatic changes including increased production of algae and/or higher plants, which can adversely affect the diversity of the biological system, the quality of the water and the uses to which the water may be put'* (Environment Agency, 1998, p.36).

The P and N constituents listed above can be transformed in the environment from dissolved to particulate forms or from one dissolved form to another, with an overall impact that can be substantial (Kayhanian *et al.*, 2012).

Possible sources of phosphorus

The sources of P and N species measured in highway runoff may be related to both traffic and non-traffic sources (Kayhanian *et al.*, 2012). However, the contribution of N and P from traffic-related sources in runoff appears to be **less significant** than that from natural sources such as soil and vegetation from surrounding land uses (Kayhanian and Paytan, 2011).

Heathwaite *et al.* (2005) modelled catchment total P loads (kg per acre) using the Great British Lakes (GBL) approach for 50 test lakes including Boldermere. The GBL approach was developed by Bennion *et al.* (2003) to identify lakes at risk of deterioration in water quality as a result of the presence of sources likely to generate a eutrophication hazard (Heathwaite *et al.*, 2005).

The total P loads ranged from 5 kg a^{-1} for Maes-Llyn in West Wales to over 19,000 kg a^{-1} for Loch Ness. On average, the GBL model predicted that approximately 37% of total P load originated from agricultural livestock, 33% from land cover and 30% from human population in the catchment. The combined figure of 70% from agricultural sources (land use plus livestock) reflects the predominately rural locations of the 50 test lakes (Heathwaite *et al.*, 2005).

In the case of Boldermere, the total P load totalled 20 kg a^{-1} from agricultural livestock, 48 kg a^{-1} from land cover and 98 kg a^{-1} from human population in the catchment (Table 1) (Heathwaite *et al.*, 2005).

Lake	Catchment total P load (kg a^{-1})			
	(a) Land cover	(b) Animals	(c) Population	Total
Bolder Mere	48	20	98	166

Table 1 Modelled catchment total P loads derived from (a) land cover, (b) animal stocking density, and (c) human population contributions for Boldermere catchment using the Tier 1 approach (adapted from Heathwaite et al., 2005)

Land Cover Map 2007

The primary land cover type to the east and south of Boldermere is principally arable (Figure 2) and land cover type to the north and west of the waterbody is primarily broadleaf woodland. This evidence supports the modelled catchment P loads from agricultural sources quoted by Heathwaite *et al.*, (2005) (Table 1). A large sewage treatment works is also located approximately 2km to the north-west of the waterbody which could account for the modelled catchment P load from population in the catchment (Table 1).

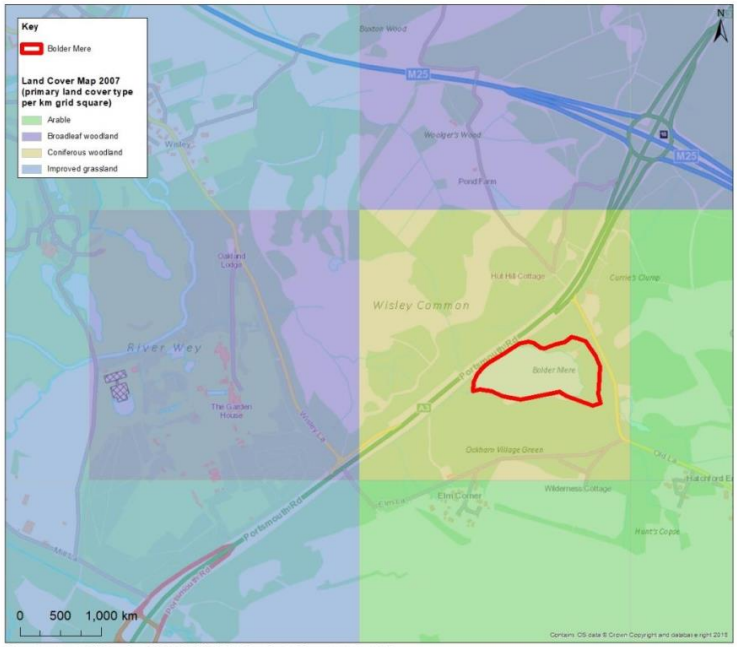

Figure 2 Primary land cover type per km grid square in the vicinity of Boldermere (source: Land Cover Map 2007)

Possible pathways for phosphorus

Atkins has undertaken flow path analysis in Geographical Information Systems to assess whether the A3 may act as a pathway into Boldermere for the potential sources of P identified above. Flow accumulation per 50m grid square indicates that the catchment within which Boldermere is located drains in a north-westerly direction towards the A3 (Figure 3). Water from the north-west primarily drains arable land (Figure 2) and reaches Boldermere before the A3 (Figure 3). It is therefore unlikely that the A3 acts as a pathway for potential sources of P.

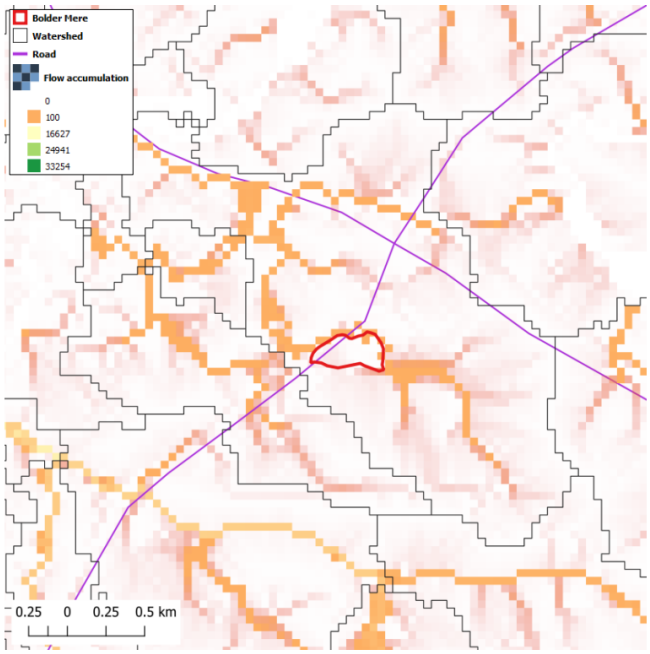

Figure 3 Flow accumulation per 50m grid square in the vicinity of Boldermere

Conclusion

In conclusion, the literature review findings indicate that the contribution of P in highway runoff from natural sources, such as soil and vegetation from surrounding land uses, appears to be **more significant** than that from traffic-related sources (Kayhanian and Paytan, 2011).

Flow path analysis indicates that water to the north-west primarily appears to drain arable land which reaches Boldermere before the A3. Therefore, the A3 is **unlikely** to act as a pathway for potential sources of P.

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Kayhanian, M., Fruchtman, B.D., Gulliver, J.S., Montanaro, C., Ranieri, E., Wuertz, S., 2012. Review of highway runoff characteristics: Comparative analysis and universal implications. Journal of Water Research 46, 6609–6624.

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Appendix E. Background on baseline

Figure E.1 Water features in the vicinity of the Scheme

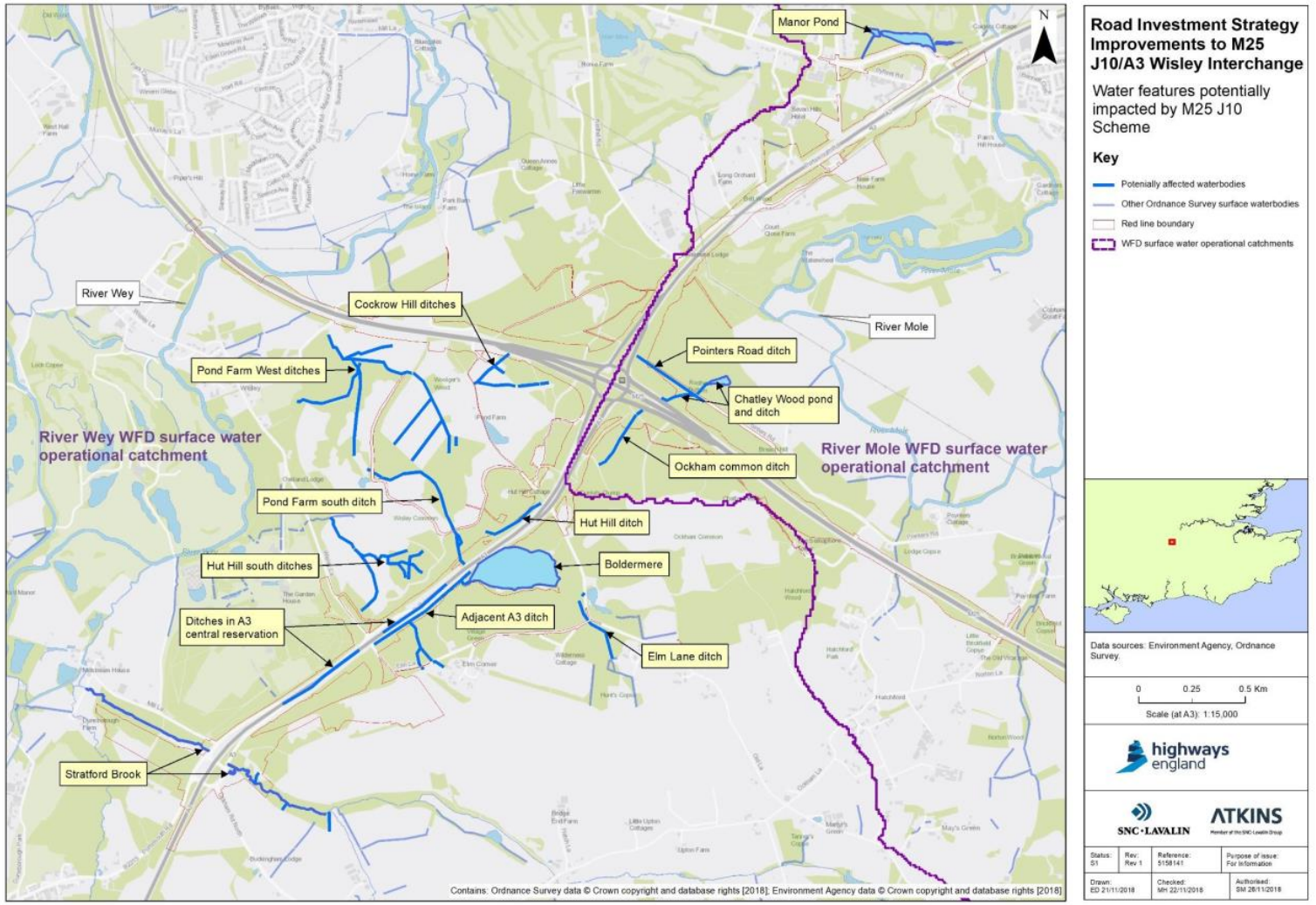


Figure E.2: Stratford Brook

Figure E.3: Manor Pond

Figure E.4: Ockham common ditch

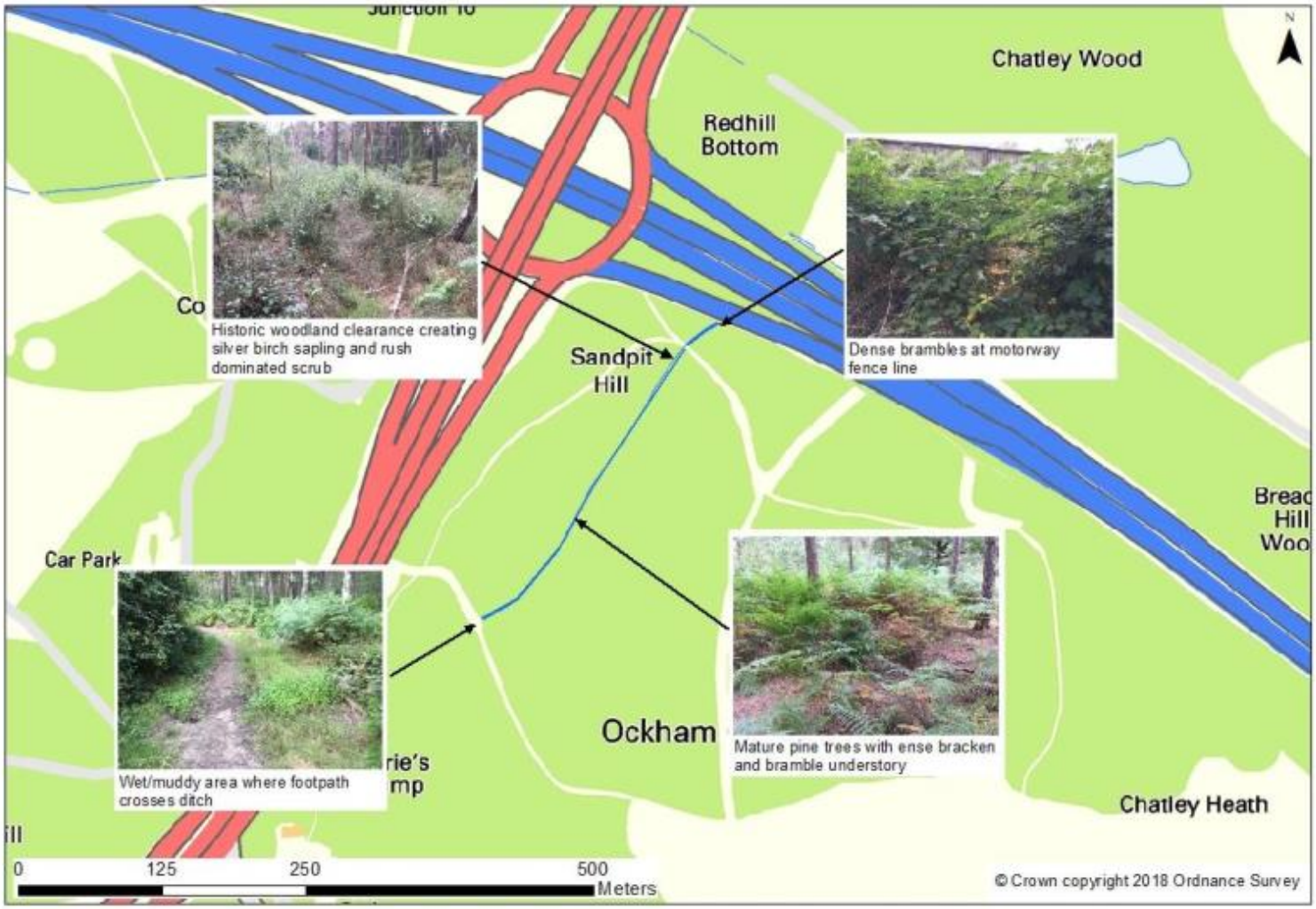


Figure E.5: Pointers Road ditch

Figure E.6: Chatley Wood pond and ditch

Figure E.7: A3 ditch (adjacent to road side)

Figure E.8: Pond Farm south ditch

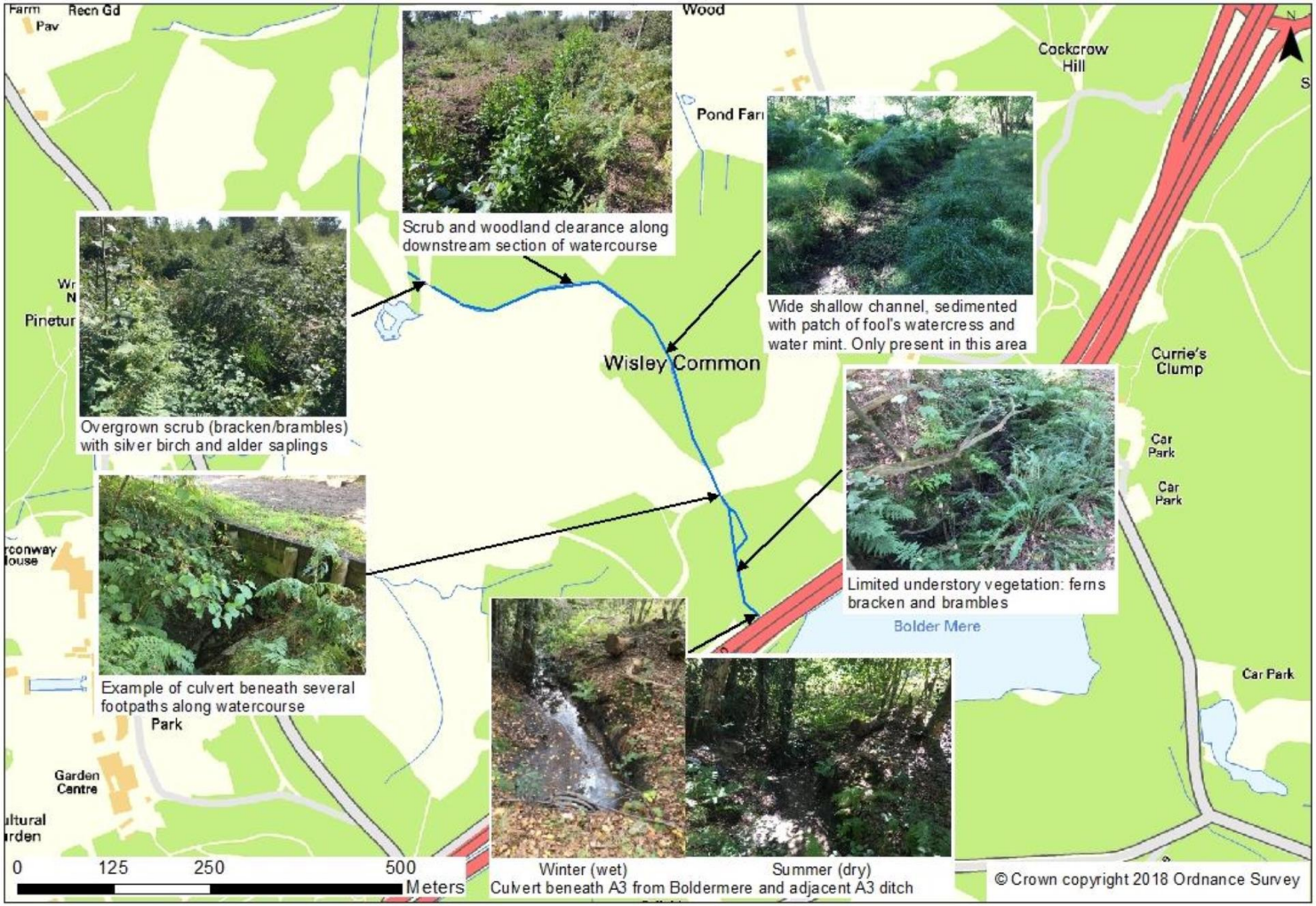


Figure E.9: Cockrow Hill & Hut Hill ditches

Figure E.10: Elm Lane ditch

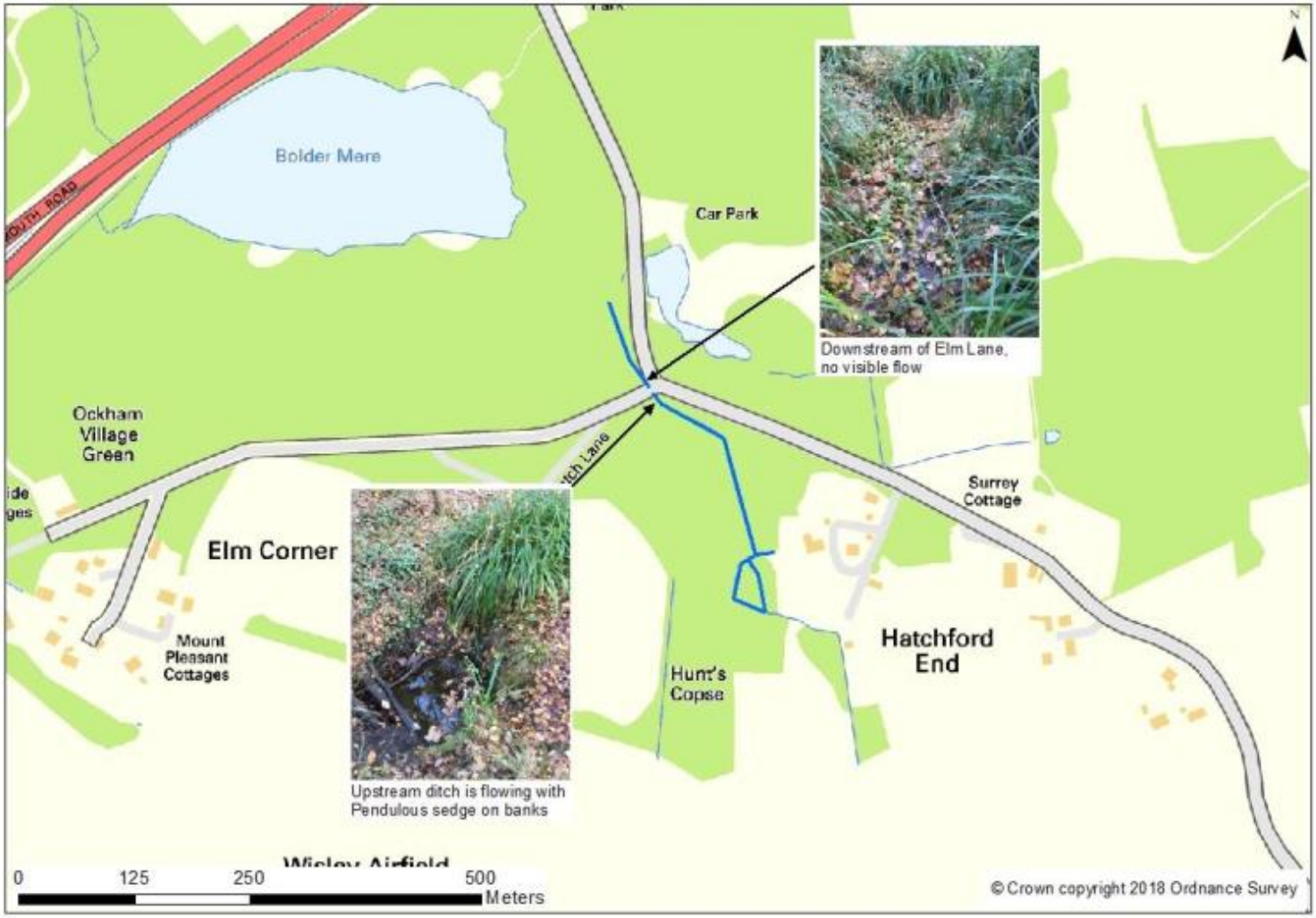
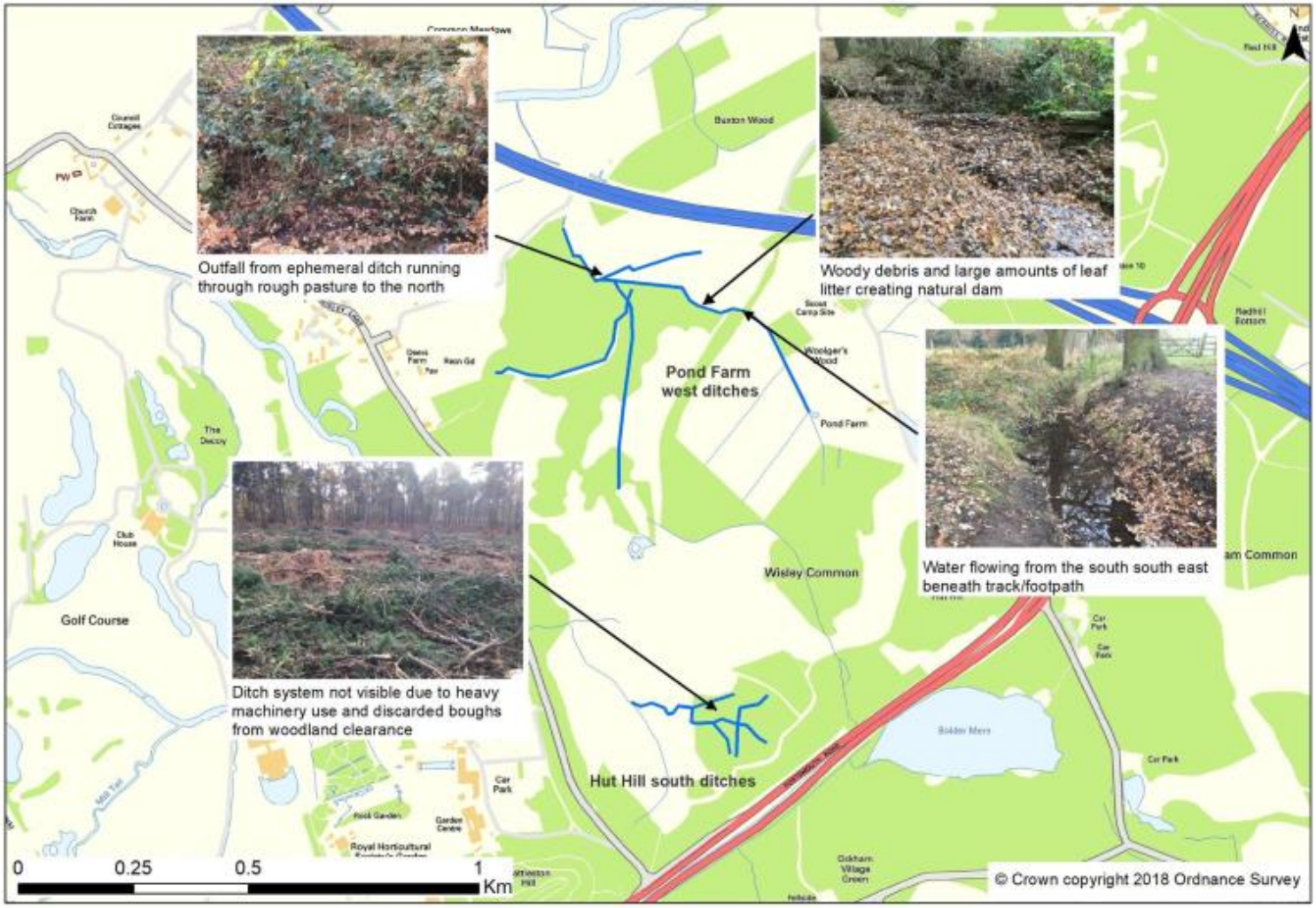


Figure E.11: Pond Farm west & Hut Hill south ditches



Appendix F. Brief descriptions and concept sketches for additional mitigation (specific)

F.1 Introduction

F.1.1 Purpose of Appendix

F.1.1 This appendix provides further information on what is termed additional mitigation (specific) in this WFD assessment. An explanation of the three categories of mitigation used in this WFD assessment (embedded mitigation, additional mitigation (specific) and additional mitigation (generic advice)) is presented in section 5.1 of the WFD assessment.

F.1.2 Additional mitigation (specific) comprises measures that have been developed as far as concept sketches and brief descriptions. Highways England (HE) are committed to the implementation of these measures, or measures generating equivalent environmental benefit. These measures are recorded in the Register of Environmental Actions and Commitments for the Scheme, which in turn forms part of the Construction and Environmental Management Plan (Application Ref: TR010030/APP/7.2). They also form an integral part of the SPA Management and Monitoring Plan (Application Ref: TR010030/APP/7.19). These documents are the mechanisms that secure mitigation being a) progressively embedded into the Scheme as it evolves through detailed design, b) implemented during construction and c) managed and monitored after construction.

F.1.2 Summary of Additional mitigation (specific) measures

F.1.3 A summary of the additional mitigation (specific) measures is presented in Table 1 below. The conceptual designs for these are described and presented in the text and figures that make up the rest of this appendix.

Table F-1: Summary of additional mitigation (specific) measures

Water body	Code	Title
Bolder Mere	BL_a	Reinstatement of lake shore habitat along northwest edge of Bolder Mere (adjacent to A3)
	BL_b	Habitat improvements on the shores of Bolder Mere.
	BL_c	Invasive species management - carp and bream
	BL_d	Feasibility studies into invasive species management
	BL_e	Detailed design of new retaining wall along north-western edge of Bolder Mere
Stratford Brook	SB_a	Habitat improvements along the Stratford Brook upstream of the A3.
	SB_b	Reinstatement of riparian trees.
	SB_c	Mammal shelf on Stratford Brook Underbridge.
	SB_d	Investigation into feasibility of additional measures.
Wey	WY_a	Enhancement of water features on Replacement Land and in Enhancement Areas within Wey catchment.
Mole	ML_a	Enhancement of water features on Replacement Land within Mole catchment.
Chobham Bagshot Beds	CB_a	Ground investigation, piling risk assessment, hydrogeological risk assessments and design alteration of piling and retaining walls.

F.2 Additional mitigation (specific) measures in the Bolder Mere water body

F.2.1 As part of the Scheme, the A3 is being widened along the north-western edge of Bolder Mere to accommodate an additional lane for traffic. A new retaining wall will be constructed (length about 180 m) c. 4-8 m into the lake margins to replace the current wall. This will result in the loss of c. 1200 m2 (0.12 ha = c. 1.5%) of lake area and loss of a c. 180 m length of lake shore habitat comprising emergent and marginal Common reed Phragmites australis backed by a narrow line of willow.

F.2.2 Mitigation embedded in the Scheme for these works are described in the main body of this report. They comprise a scheme configuration that minimises the encroachment of the road into Bolder Mere and a significant upgrade to road drainage that replaces a direct untreated discharge to Bolder Mere with a treated discharge to a ditch downstream of the lake. The remainder of this section describes additional mitigation (specific) measures to be incorporated in the Scheme to directly mitigate and compensate for its effects on Bolder Mere.

F.2.3 The additional mitigation (specific) measures related to Bolder Mere to be implemented as part of the Scheme are presented in Table 2 and Figure 1 below. These measures are being implemented with the objective of maintaining and potentially improving the conservation value of Bolder Mere, with a focus on providing for the needs of species identified within the citation for the wetland elements of Ockham and Wisley Commons SSSI, and in particular the Odonata order (dragonflies and damselflies). The measures are based on recommendations from Goldsmith Ecology (2018) and follow extensive consultation with the Environment Agency, Natural England and Surrey Wildlife Trust.

Table F-2: Additional mitigation (specific) measures for Bolder Mere

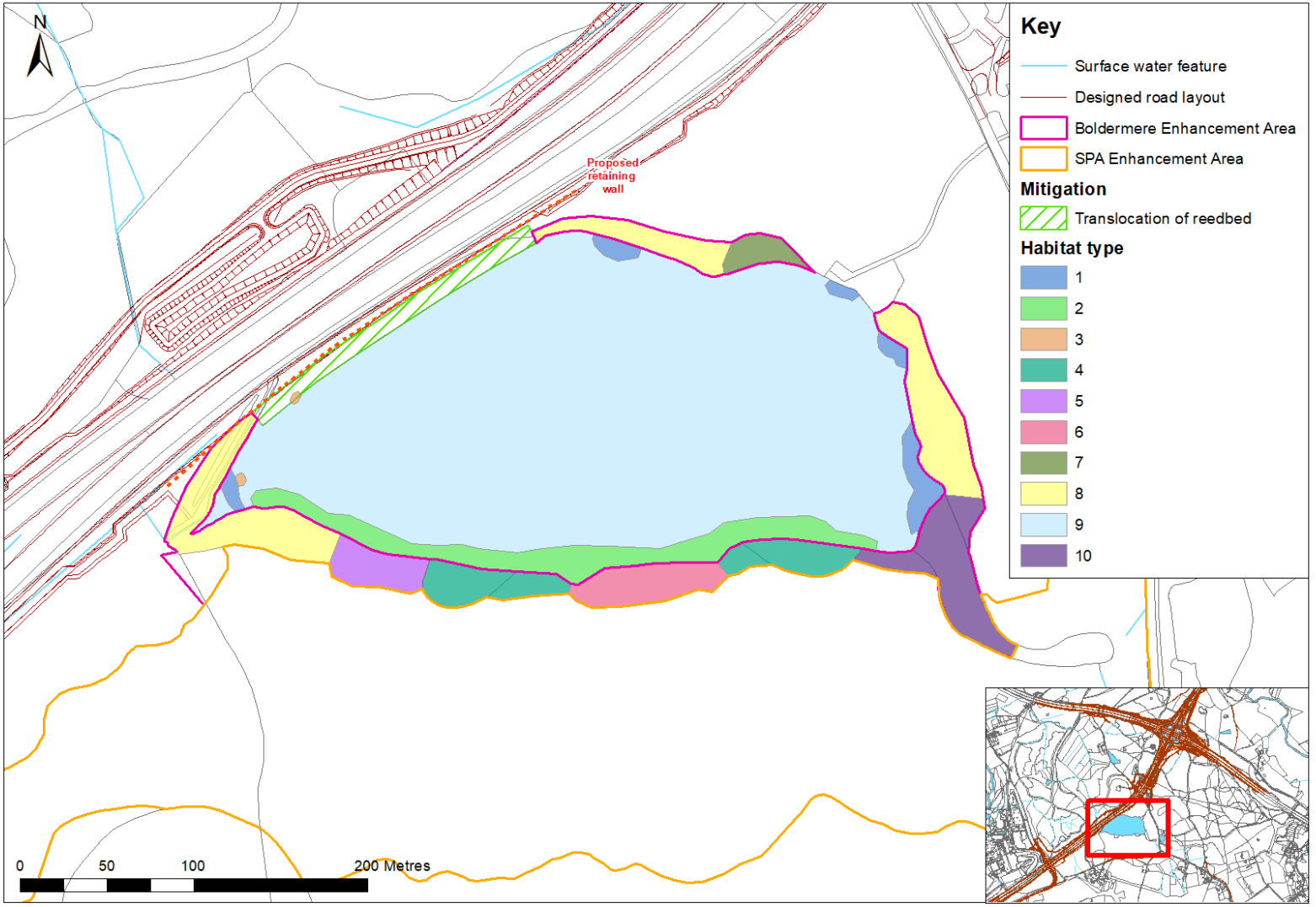
Additional mitigation (specific)	Code	Purpose	Description
Reinstatement of lake shore habitat along northwest edge of Bolder Mere (adjacent to A3)	BL_a	Direct mitigation for loss of lake shore habitat resulting from encroachment of A3 into Bolder Mere	Following recommendations in Goldsmith (2018) the Scheme will include the replacement of lake shore habitat comprising emergent and marginal Common reed *Phragmites australis* backed by a narrow line of willow either by like-for-like replanting or translocation of the existing habitats. Goldsmith (2018) also recommends the translocation of water lily beds to locations as close as possible to existing locations.
Habitat improvements on the shores of Bolder Mere.	BL_b	Compensation for loss of a) lake shore habitat and b) open water habitat resulting from encroachment of A3 into Bolder Mere	Following recommendations in Goldsmith (2018) and consultation with key stakeholders the following habitat management works will be delivered through the SPA Management and Monitoring Plan (Application Ref: TR010030/APP/7.19). The numbering of habitats follows that on pages 22-23 of Goldsmith (2018), with the exception of Habitat 10, which has been developed through consultation with Natural England. The location of each habitat type is shown on **Error! Reference source not found.**. • **Habitat 1** (reedbed) Removal of reed to avoid any significant spread into adjacent land or open water over the long term. • **Habitat 2** (shallow water with a diverse submerged macrophyte flora grading into a mixed emergent flora) – see row on feasibility studies below, specifically the reference to *Crassula helmsii*. • **Habitat 3** (water lilies) – see reference to water lilies in row above on reinstatement of lake shore habitat along northwest edge of Bolder Mere (adjacent to A3). • **Habitat 4** (two areas of acid bog) Regular clearance of any encroaching scrub from within the open areas and periodic removal of larger trees (most likely birch and willow) from the edges to maintain a semi-open structure grading into the woodland behind. • **Habitat 5** (close growing birch and willow scrub with dense understory of *Sphagnum spp.*). Regular thinning and removal of trees and scrub to encourage a low-growing heath / grassland community to develop. • **Habitat 6** (area of drier marginal habitat). Regular thinning and removal of trees and scrub to encourage a low-growing heath / grassland community to develop. Rhododendron should be removed / treated to avoid further spread. • **Habitat 7** (wet woodland with sedge and rush understory) see row on feasibility studies below, specifically the reference to *Crassula helmsii*.

			• **Habitat 8** (dense overhanging tree cover). Occasional removal of larger trees, allowing natural regeneration. On the northern shore in particular, dense over-hanging tree cover is very effective at discouraging people from visiting the lake shore. Hence a sensitive balance needs to be struck between a) not opening up the lake shore so much that people gain regular access and disturb lake wildlife and b) maintaining the prescribed % cover to achieve SSSI favourable condition. On the south and south eastern shore, tree works should be undertaken in such a way as to maintain the existing habitat structure and limit spread of reedbeds. • **Habitat 9** Open water habitat. • **Habitat 10** (Alder woodland adjacent to south east shore) rotational management of alder, birch and willow to maintain a transitional zone with a varied canopy structure. Excess shading of the lake shore should be targeted, with the aim of maintaining sufficient light to encourage development of marsh and mire habitat, but not to the significant detriment of other habitat types. Key will be reducing the height of the tree canopy along the lake shore.
Invasive species management - carp and bream	BL_c		A management programme to reduce/remove the existing carp (and bream, if present) population(s) in Bolder Mere. Carp are noted as a potential constraining factor on lake habitat function because they regularly disturb the bed (for instance when feeding), which mixes bed sediments and chemicals (e.g. nutrients) into the water column.
Feasibility studies into invasive species management	BL_d		Feasibility assessment into the most appropriate management strategies for eradicating, controlling or limiting the effect of the invasive non-native species bulleted below and known to be present in Bolder Mere. • *Crassula helmsii* (New Zealand pigmyweed) • *Astacus* leptodactylus (narrow-clawed (Turkish) crayfish) • *Elodea nuttallii* (Nuttall's waterweed). The assessment will provide an opinion on the likely effectiveness of each strategy. It will also advise on how best to increase the diversity of macrophytes in Bolder Mere.
Detailed design of new retaining wall along north-western edge of Bolder Mere	BL_e	To ensure the new wall does not form more of a barrier to groundwater flow into Bolder Mere than the existing retaining wall	A hydrogeological risk assessment will be undertaken following site-specific intrusive ground investigation. This will consider groundwater flow direction and groundwater contribution into Bolder Mere. This information will be used to develop the design of the sheet pile element. As the groundwater flow direction in this area is not currently known, two reasonable worst-case scenarios have been mitigated for:

			• Groundwater flow direction NW to SE across the retaining wall – in this scenario, the retaining wall will be designed so as not to impede groundwater flow. King Sheet Piling®[7] with its discontinuous below ground piling design means sheet piling would not impede groundwater flow. This piling technique has been used to address concerns about similar issues raised by the EA on the East West Rail Phase 1 project, and also by Highways England on other schemes. • Groundwater flow direction E to W across the retaining wall – in this scenario, the new retaining wall will be designed to replicate the existing wall, ensuring that the water in Bolder Mere is retained by the new wall. A continuous sheet piling design would be used in this scenario. A piling risk assessment will also be carried out to ensure the selected piling method does not introduce contamination pathways into the aquifer.

[7] The King Sheet Piling (KSP®) system is covered by one or more patents or patent applications, including GB2463079. Copyright Balfour Beatty plc 2008. Contractors building a KSP wall must first ensure a licence agreement is completed. More information is available at www.ksppiling.co.uk.

Figure F.1: Bolder Mere



F.3 Additional mitigation (specific) measures in Stratford Brook water body

F.3.1 There are two components of the Scheme that affect Stratford Brook: reinforcement of the existing Stratford Brook Culvert South and the proposed Stratford Brook underbridge.

F.3.2 Reinforcement of the Stratford Brook Culvert South will be achieved by works beneath the surface. However, vegetation clearance close to the Stratford Brook will be required to allow access to the works site. Works required to mitigate for the local effects of this vegetation clearance on the riparian zone of the Stratford Brook are set out in Table 3 and Figure 2 below as part of the measure coded SB_a.

F.3.3 The Stratford Brook Underbridge spans 27.5 m from one side of the floodplain to the other and 19 m upstream to downstream. The soffit of the bridge is c. 2 m above river bed level (drawing E551522 - ATK - SBR - A3_L1_BN_SBK - DR - CB – 000001, rev C-01).

F.3.4 The full span configuration of the underbridge delivers substantial embedded mitigation for its effect on the channel, floodplain and riparian zone of the Stratford Brook. Spanning the full width of river and floodplain maintains the river's natural plan- and cross- sectional form and allows channel and floodplain flow and sediment regimes to continue to function close to naturally.

F.3.5 However, the underbridge bridge will shade a 27.5 m by 19 m section of channel and floodplain, with consequent adverse effects on channel and particularly riparian ecology that are not fully addressed by embedded mitigation. The wide low bridge deck will result in a) direct loss of vegetation, b) reduction in the species range and c) a simplification of the structure of vegetation cover in the affected riparian zone. This degradation of the riparian zone will likely also lead to adverse effect on the flora and fauna living in the margins of the channel. Additional mitigation is required to address these residual local adverse effects.

F.3.6 Consultation with the Environment Agency has also highlighted the opportunities that the Scheme presents for mitigating the adverse effects of existing Highways England structures on the water environment: the existing Stratford Brook Culvert South (on which reinforcement works will be implemented as part of the Scheme) and the much longer Stratford Brook Culvert North that runs under the A3 and its northern slip road. A high invert on the former raises upstream water levels in the Stratford Brook, creating less natural habitat (deeper, slower flows) along a 100-200m reach. The latter is very likely to restrict biological continuity (passage of small mammals and fish).

F.3.7 The Environment Agency advises that the additional mitigation effort of the Scheme would be most effectively targeted at reducing the adverse effects of the existing Stratford Brook Culverts (North and South) on the brook. Initial site visits by specialists in fish easement concluded that it should be possible to implement some form of additional mitigation at one or both of these structures at reasonable cost. However, a firm opinion on the technical feasibility and cost of mitigation will not be possible until further information on the form and condition of the structures is collected during detailed design.

F.3.8 It is therefore not currently possible to settle on a single mitigation package that delivers both proportionate benefit for the environment and adequate cost certainty for the project. Instead a simple strategy has been agreed between the Environment Agency and HE that keeps ‘in play’ the measures at Stratford Brook Culverts (North and South) that would deliver most environmental benefit whilst not committing the project to a disproportionate cost. The strategy is as follows:

a. Commit the project to delivering mitigations that carry a) reasonable and certain costs, and b) allow measures at Stratford Brook Culverts (North and South) to be explored further. These measures are set out in Table 3 and Figure 2 below as measures SBa-SBd.

b. Agree to implement a mix of measures at one or both of Stratford Brook Culvert (North) and Stratford Brook Culvert (South), if this can be done at reasonable cost .

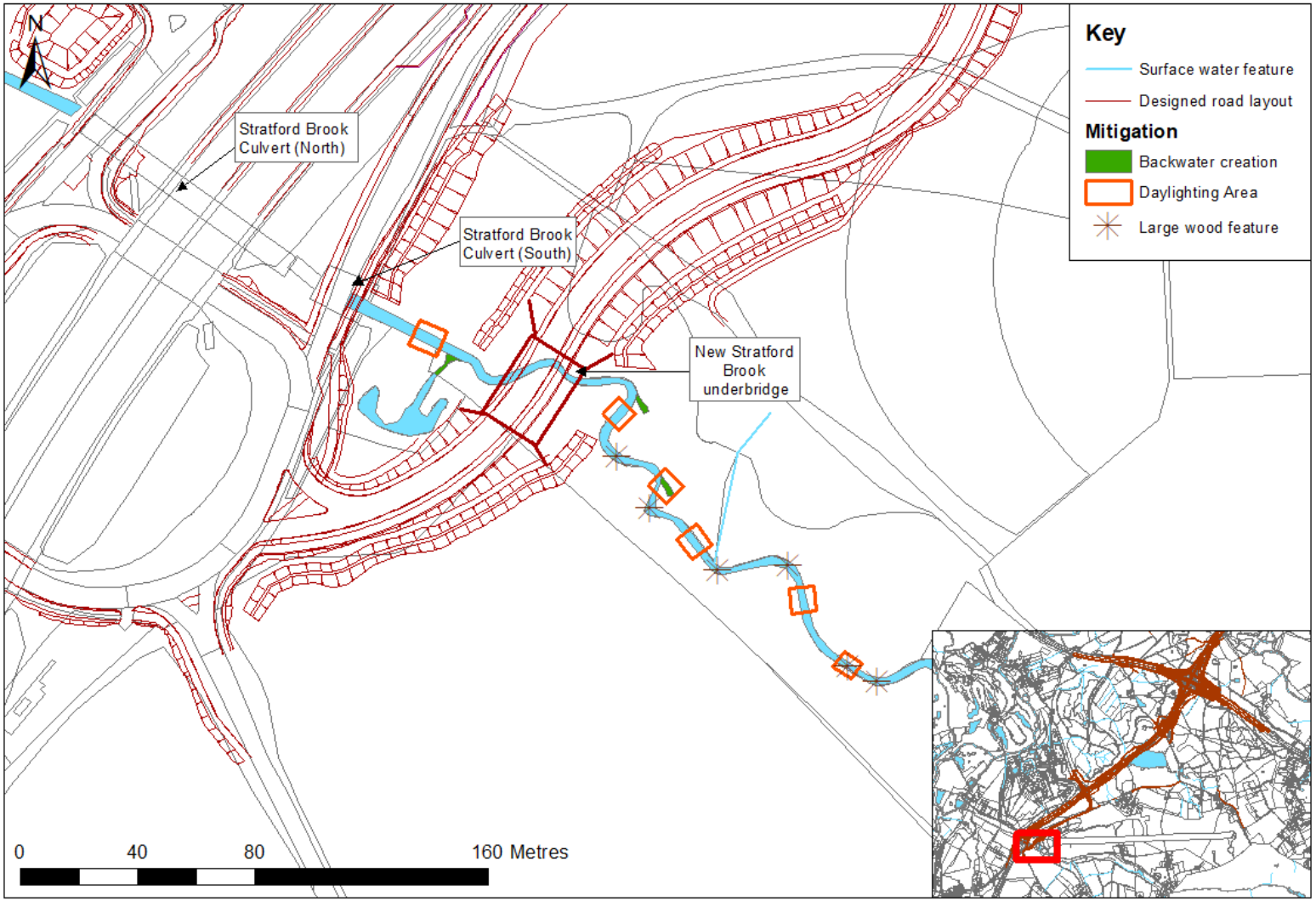
c. In the unlikely circumstance that a mix of measures at one or both of Stratford Brook Culvert (North) and Stratford Brook Culvert (South) cannot be delivered as part of the scheme at reasonable cost, payment of a commuted sum to the Environment Agency for delivery of environmental improvement in the Wey catchment. This commuted sum has been calculated using an Environment Agency costing tool that includes river restoration measures (Environment Agency, 2015a). It is the estimated cost of delivering 100 m of restored channel immediately downstream of the Stratford Brook Culvert (North) (Statement of Common Ground with Environment Agency, application document TR010030/APP/8.3).

Table F-3: Additional mitigation (specific) measures for Stratford Brook

Additional mitigation (specific)	Code	Purpose	Description
Habitat improvements along the Stratford Brook upstream of the A3.	SB_a	Compensation for vegetation clearance associated with reinforcement of Stratford South Culvert and residual shading effects of Stratford Brook Underbridge on Stratford Brook and its floodplain.	These works comprise: • **Backwater creation (3 No.)** Backwater habitats will be created through mechanical excavation of the banks, to increase watercourse habitat complexity and provide sites of refuge from high flow for aquatic species e.g. fish. Three backwaters will be excavated to provide additional wetted channel habitat connected to the main watercourse. Three backwaters will be excavated to provide additional wetted channel habitat connected to the main watercourse. The backwaters will be nominally 5m in length and 2m wide at the base (predominantly with 1:2 slopes to existing ground level, but more gradual slopes where technically feasible to generate variation in profile and facilitate mammal and amphibian access). The bed level of the backwaters will be approximately 300mm below the existing hard bed level of the Stratford Brook, to ensure connectivity is maintained during low flow. Details of the shape of the backwaters will be determined in detailed design, and will ensure fish are not trapped in the backwater during low flow. Any required tree works (at the site of the backwater and along chosen access routes to the backwater working area) will be undertaken outside of the bird nesting season, with vegetation reinstatement within the working area undertaken as described below. • **Daylighting Area (6No.)** Shading by riparian trees is noted as a current constraining factor acting to limit the distribution of aquatic macrophytes within the Stratford Brook and by association in-channel and riparian habitat complexity. Selective tree/shrub works that will include clearance (including root mass) and felling and/or coppicing (depending on species) will be undertaken to improve the watercourse habitat and generate a more varied age structure along the riparian zone. Six daylighting areas along the watercourse will be created, each nominally 100m^2 in area. At each daylighting area, nominally 10m of bank length, extending 5m into the riparian zone, will be daylighted along both the right and left bank. It is envisaged that works will be motor-manual (i.e. no need for access by plant) with tree arising being processed in situ and stored/secured locally to provide valuable “deadwood” habitat adjacent to the watercourse. An ecological assessment of trees/shrubs (e.g. bat roost potential/intrinsic ecological value) within each daylighting area will be undertaken prior to the works with trees marked for retention as required. Where individual tree species lend themselves to coppicing e.g. alder, this will be the preferred method of daylighting. All works will be undertaken outside of the bird nesting period.

			• **Large wood features (6No.)** Six large wood features will be installed in the watercourse to add habitat complexity and improve local hydromorphological condition in keeping with the character of the watercourse (wooded headwater). Appropriately sized large wood (typically 200mm to 300mm in diameter, 2m to 3m long) will be yielded from the local daylighting works and secured within the channel to prevent mobilisation during high flows. Due to the small size of the watercourse (nominally 1.5m wide) the lengths of wood required are considered to negate the need for the use of plant in the installation of large wood • **Gravel runs (nominally 3No.)** Three in-channel gravel runs will be installed, to create sections of shallower higher velocity flow, if this can be incorporated into the scheme in a way that avoids generation of additional backwater. Typically these will be 5 m in length and sufficiently raised to substantially generate shallower, higher velocity flow (a nominal raising of 500mm).
Reinstatement of riparian trees.	SB_b	To mitigate for riparian tree loses during construction	Vegetation clearance works required to a) construct the new Wisley Lane Realignment watercourse crossing, b) modify the existing Stratford Brook Culvert South crossing, and c) gain access to backwater creation areas, will be mitigated through reinstatement following construction. Reinstatement of trees will be undertaken at a minimum of a 1 to 1 replacement ratio (for whole tree loses only i.e. it is assumed that coppiced trees will not need to be replaced) and involve the planning of semi-mature native wetland tree species such as alder and willow at an appropriate time of year (nominally mid-November to March). Trees will be appropriately staked and protected with rabbit/deer guards as required.
Mammal shelf on Stratford Brook Underbridge.	SB_c	Compensate for the effect that the bridge has on mammal passage during high flows.	Provision of a mammal shelf under the Stratford Brook underbridge to accommodate movement of mammals underneath this new structure at high order events (if possible a 100-year climate change event).
Investigation into feasibility of additional measures.	SB_d	Compensation for the effect of Stratford Brook underbridge on the water environment. Additionally, to consider mitigation for the impacts of existing HE structures.	An investigation into the feasibility of implementing the measures bulleted below • Modifications to the Stratford Brook Culvert (North) to improve water depths for fish passage and improve mammal passage at high order events (if possible a 100-year climate change event). • Removal/modification of the sill within the Stratford Brook Culvert (South) to reduce flow impoundment and / or facilitate fish passage. • Improve fish passage by installation of features such as baffles on the sill within the Stratford Brook Culvert (South) • Retrofitting a mammal pass solution within the Stratford Brook Culvert (South). • Management of the invasive non-native species Himalayan balsam *(Impatiens glandulifera*) along the reach.

Figure F.2: Stratford Brook



F.4 Additional mitigation (specific) measures in Mole water body

F.4.1 Background

F.4.1 The Scheme is located on the watershed between the Mole and Wey catchments. As a result, some scheme components affect ephemeral headwater ditches. These ditches are most likely to have been constructed to drain wet land and facilitate agriculture, forestry or construction of roads. They are minor artificial drainage features that convey water infrequently.

F.4.2 Construction of embankments associated with the New Sandpit Hill restricted byway overbridge (scheme components ML1 and ML2), and the restricted byway between the Sandpit Hill overbridge and the New Redhill restricted byway overbridge (scheme component ML3) result in loss or displacement of an estimated 420 m length of ephemeral headwater ditch (parts of the Ockham Common ditch and Chatley Wood ditch system). Ecological surveys, as summarised in section 4.6 of the main body of this report, reveal these ditches to be of limited ecological value because of their ephemeral nature, artificial channel morphology and heavy shading.

F.4.3 Indicative photos of the Ockham Common ditch and Chatley Wood ditch systems are presented in Figure 3 and Figure 4 below.

F.4.4 An improved drainage system is to be implemented as part of the Scheme. Wherever possible, this keeps runoff from highway and non-highway surfaces separate. In the preliminary design for the part of the Scheme within the Mole catchment, there are 720m of pre-earthwork drain currently assigned to collecting runoff generated by non-highway surfaces, such as embankments or natural catchments, and conveying this ‘clean’ runoff to natural waters. These pre-earthworks drains will essentially perform the same function as the ephemeral headwater ditches being lost to or displaced by the Scheme – land drainage.

F.4.5 Like the ditches they replace, the pre-earthworks drains will have a land drainage function, and will have an artificial profile. To ensure bank-stability it is likely that the drain sides will need to be reinforced by geotextile permeable to vegetation. Initial discussions with drainage engineers confirm that there is flexibility within future stages of design to develop a ditch form that, although focused on its primary drainage function, will be sensitive to the water environment.

F.4.6 In summary around 420 m of ephemeral headwater will be lost or transposed by the Scheme. At the same time around 720 m of pre-earthwork drain conveying water solely from non highway surfaces are included in the preliminary design. Because both old and new drainage systems are artificial and ephemeral, both are of limited ecological value, but substantially more ditch / drain conveying ‘clean’ water is being provided by the Scheme than lost to it.

F.4.7 In order to ensure sufficient mitigation is secured for the effect of the Scheme on ephemeral headwater ditches in the Mole catchment, and potentially to generate ecological enhancement as part of the Scheme, habitat improvements at Chatley Wood Pond will be undertaken. These are set out below.

Figure F.3: Ephemeral headwater ditch adjacent to current M25 alignment on the northern side of the proposed Sandpit Hill overbridge (Chatley Wood Ditch System)

Figure F.4: Ephemeral headwater ditch adjacent to current M25 alignment on the southern side of the proposed Sandpit Hill overbridge (Ockham Common Ditch)

F.4.2 Additional specific mitigation - Chatley Wood Pond

F.4.8 In order to ensure sufficient mitigation is secured for the effect of the Scheme on ephemeral headwater ditches in the Mole catchment, and potentially to generate ecological enhancement as part of the Scheme, additional specific mitigation is proposed to Chatley Wood Pond in the Chatley Wood Replacement Land parcel.

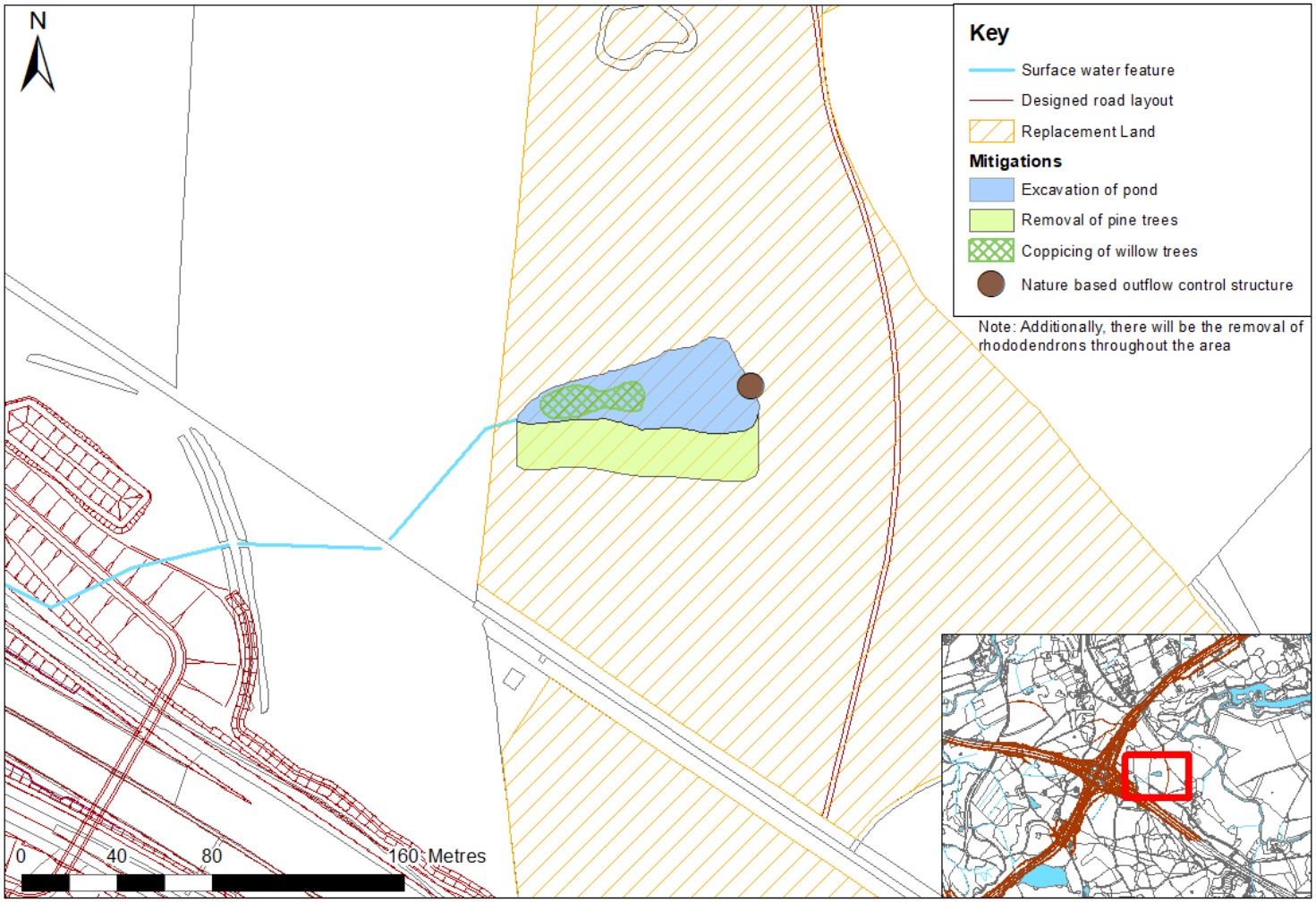
F.4.9 Chatley Wood pond is no longer an open water feature. It is almost entirely silted up. However, there is a distinct ditch running through the pond which is dense with water pepper (Persicaria hydropiper) becoming less distinct as it flows west through a group of willow trees. Much of the pond is unshaded and there is a continuous covering of marsh pennywort (Hydrocotyle vulgaris) with areas of rushes and sedges. An embankment/high ground runs along the northern and eastern perimeters. The pond sits within an area of mature woodland, predominantly Scotts pine (Pinus sylvestris) with occasional broadleaf deciduous trees such as silver birch (Betula pendula).

F.4.10 Proposals for enhancement of the pond, in particular creation of open water and wetland habitat, are set out in Table 4 and Figure 5 below.

Table F-4: Additional mitigation (specific) measures for ephemeral headwater ditches affected by the Scheme in the River Mole catchment

Additional mitigation (specific)	Code	Purpose	Description
Habitat improvements at Chatley Wood Pond	ML_a	Modify the existing heavily silted pond so that it becomes a more persistent wetland feature	The objective of the works is to modify the existing heavily silted pond so that it becomes a more persistent wetland feature. The pond is still likely to be ephemeral, but the works should generate open water for longer during wet periods. As such the works will compensate for loss of ephemeral ditches by creating habitat that evolves from wet to dry through the seasons. The intent is that the pond should persist wet for longer than the ephemeral headwater ditch environments affected by the scheme. Proposed works comprise:- • excavation of the pond to its original dimensions (c. 0.25 ha). The pond will be excavated deep enough to create continuity between shallow groundwater / soil water level during at least part of the year. Also, shallow margins will be created to encourage development of a gradual transition between open water and terrestrial habitat. • A nature-based control will be installed on the outflow of the pond (for instance a throttle to flow created from felled trees), to encourage retention of water in the pond during higher flows. • Coppicing of the large willows and the line of pines being taken back 10-20 metres on the south side to allow more sun onto the pond edges. • Removal of rhododendrons within a 20-metre radius of the pond.

Figure F.5Additional mitigation (specific) measures for ephemeral headwater ditches affected by the Scheme in the River Mole catchment



F.5 Additional mitigation (specific) measures in Wey water body

F.5.1 Background

F.5.1 The Scheme is located on the watershed between the Wey and Mole catchments. As a result, some scheme components affect ephemeral headwater ditches. These ditches are most likely to have been constructed to drain wet land and facilitate agriculture, forestry or construction of roads. They are minor artificial drainage features that convey water infrequently.

F.5.2 The scheme component that has the most substantial effect on ephemeral headwater ditches in the Wey catchment is the widening of the A3 between Bolder Mere and Elm Lane (WY2). This will result in the displacement c. 570 m of existing channel into a new pre-embankment drain. This drain is a heavily modified section of a natural drainage network (serving a catchment of c. 0.7 km2) that currently also receives runoff from the A3. An indicative photo is presented in Figure 6 below.

Figure F.6: Ephemeral headwater ditch to the south of A3 between Bolder Mere and Elm Lane

F.5.3 The other scheme components affecting ephemeral headwater ditches in the Wey catchment comprise displacement of c. 35 m of road drainage ditch between the carriageways of the A3 (WY7), loss of the very upper section of two ditches, total channel loss of 185 m (WY6 & WY8) and culvert works at WY1, 2, 3, 4, 5 & 7 (30 m).

F.5.4 An improved drainage system is to be implemented as part of the Scheme. Wherever possible, this keeps runoff from highway and non-highway surfaces separate. In the preliminary design for the part of the Scheme within the Mole catchment, there are 1440m of pre-earthwork drain currently assigned to collecting runoff generated solely by non-highway surfaces, such as embankments or natural catchments, and conveying this 'clean' runoff to natural waters. These pre-earthworks drains will essentially perform the same function as the ephemeral headwater ditches being lost to or displaced by the Scheme – land drainage.

F.5.5 Like the ditches they replace, the pre-earthworks drains will have a land drainage function, and will have an artificial profile. To ensure bank-stability it is likely that the drain sides will need to be reinforced by geotextile permeable to vegetation. Initial discussions with drainage engineers confirm that there is flexibility within future stages of design to develop a ditch form that, although focused on its primary drainage function, will be sensitive to the water environment.

F.5.6 In summary around 820 m of ephemeral headwater will be lost or transposed by the Scheme. At the same time around 1440 m of pre-earthwork drain conveying water solely from non highway surfaces are included in the preliminary design. Because both old and new drainage systems are artificial and ephemeral, both are of limited ecological value, but substantially more ditch / drain conveying 'clean' water is being provided by the Scheme than lost to it.

F.5.7 In order to ensure sufficient mitigation is secured for the effect of the Scheme on ephemeral headwater ditches in the Wey catchment, and potentially to generate ecological enhancement as part of the Scheme, enhancements to part of the Pond Farm south ditch and Pond Farm West ditches will be undertaken. These are set out below.

F.5.2 Additional specific mitigation

Pond Farm south ditch

F.5.8 This ditch, running north through Wisley Common, receives water from Bolder Mere and a ditch running adjacent to the A3 between Bolder Mere and Elm Lane. It is straightened and surrounded by mature broadleaf woodland with limited in-channel aquatic vegetation. Small patches of fool's watercress (Apium nodiflorum) and water mint (Mentha aquatica) are present downstream where the banks are shallow and light can enter the channel.

F.5.9 Enhancements to the ditch within the Pond Farm South SPA Enhancement Area will be included as part of the Scheme, as shown in Figure 7. These enhancements comprise selective daylighting and tree removal along the ditch and creation of up to 5 bank side scrapes, each with approximate dimensions of 20 m2, to increase the area of wet habitat adjacent to the channel.

Pond Farm West ditches

F.5.10 Several straightened, heavily shaded ditches flow through mature broadleaf woodland. Bankside, marginal and in-channel vegetation is very limited and at the time of survey (November 2018) a large amount of leaf litter covered the channel.

F.5.11 Enhancements to and creation of additional water features within the Pond Farm West SPA Enhancement Area will be included as part of the Scheme, as shown in Figure 8. These enhancements comprise creation of three pond features (nominally covering an area of 500 m2), selective daylighting and tree removal along the ditch network and creation of up to 16 bank side scrapes, each with approximate dimensions of 20 m2 to increase the area of wet habitat adjacent to the channel.

F.6 Additional mitigation (specific) measures in Chobham Bagshot Beds water body

F.6.1 Site-specific intrusive ground investigation is required to determine groundwater flow direction and the depth to groundwater. Once a hydrogeological risk assessment has been completed, this information shall be used to refine the pile design to ensure no detrimental impact on groundwater flow and hence abstractions and Groundwater Dependent Terrestrial Ecosystems (GWDTEs).

F.6.2 A piling risk assessment will also be carried out once information is available from ground investigation (during detailed design) to ensure selected piling methods do not introduce contamination pathways into the aquifer.

Figure F.7: Additional mitigation (specific) measures for ephemeral headwater ditches affected by the Scheme in the River Wey catchment (Ditch downstream of Bolder Mere)

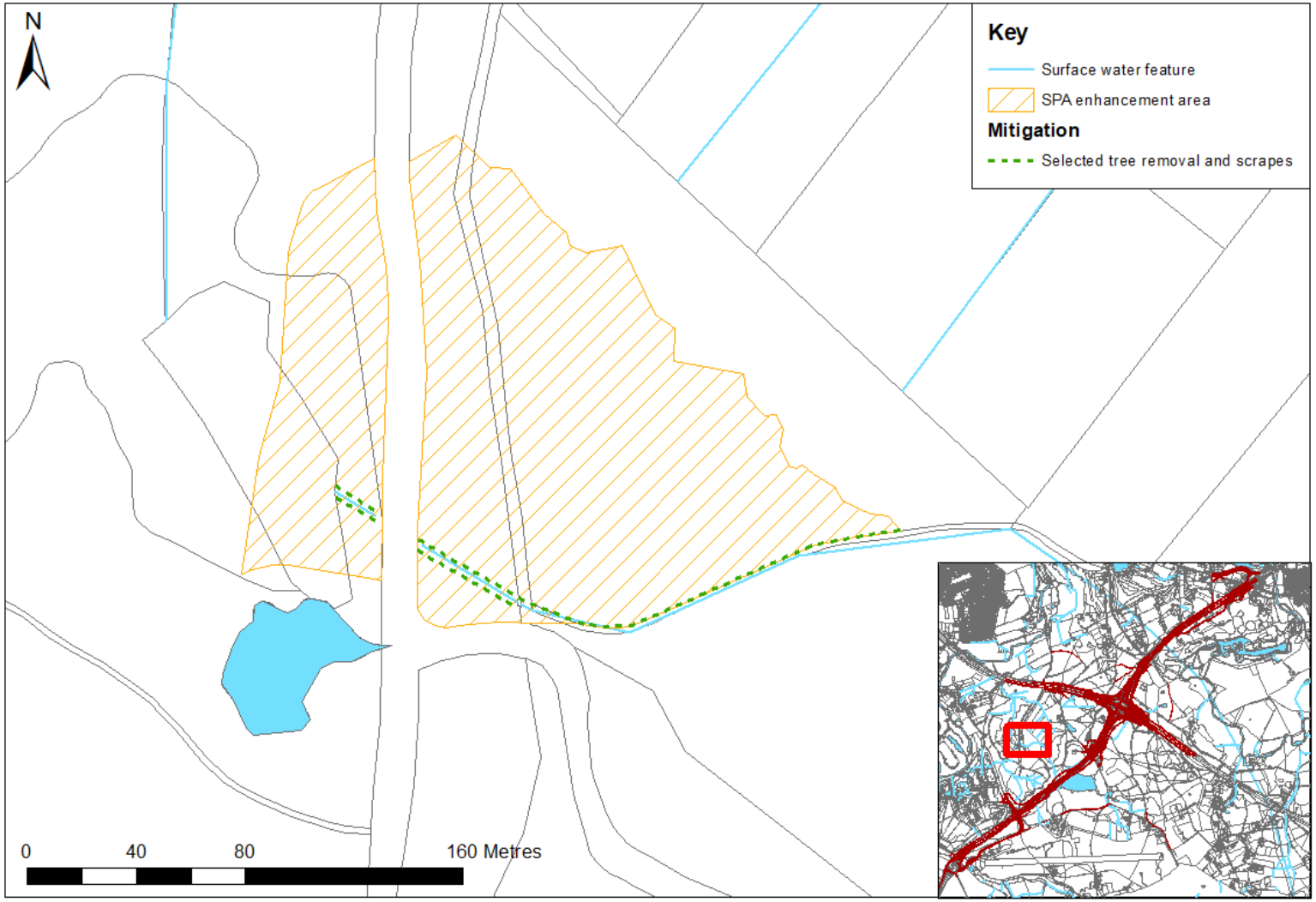
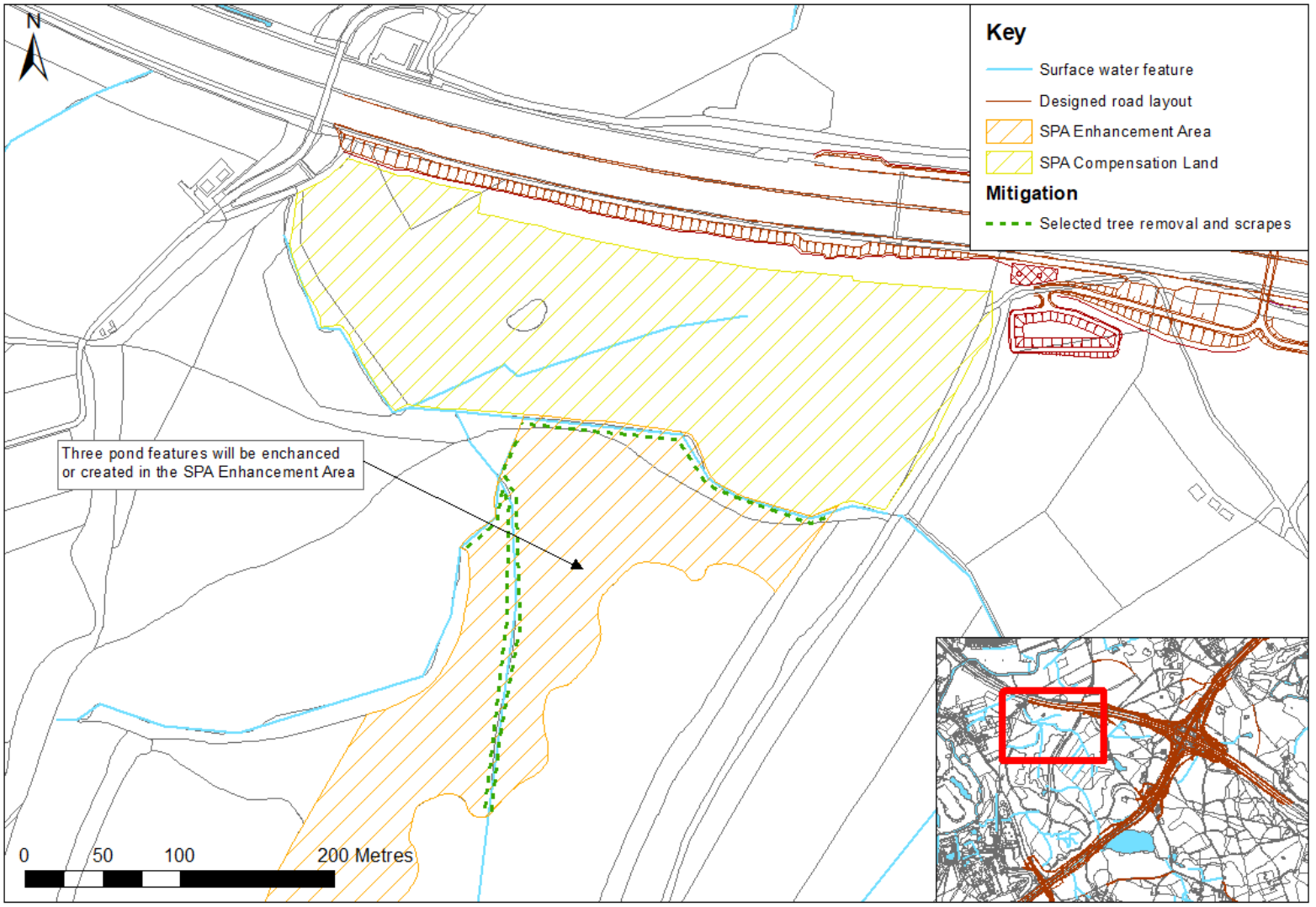


Figure F.8: Additional mitigation (specific) measures for ephemeral headwater ditches affected by the Scheme in the River Wey catchment (Wisley ditches north)



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