

M25 junction 10/A3 Wisley interchange

TR010030

6.5 Environmental Statement: Appendix 7.6 Aquatic ecology

Regulation 5(2)(a)
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Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009



Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended)

M25 junction 10/A3 Wisley interchange

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

6.5 ENVIRONMENTAL STATEMENT: APPENDIX 7.6 AQUATIC ECOLOGY

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Appendix 7.6 Aquatic ecology

7.1 Aquatic Ecology surveys (2017 and 2018)

7.1.1 Introduction

- 7.1.1.1 This Appendix details the aquatic ecological baseline for the Scheme, including watercourses, standing water bodies and associated aquatic species, (namely, aquatic macroinvertebrates, aquatic macrophytes and fish).
- 7.1.1.2 This document is not a stand-alone assessment and should be read in conjunction with Chapter 7 (Ecology).

7.1.2 Objectives

- 7.1.2.1 This technical appendix defines the approaches applied in the screening of aquatic features for inclusion in the assessment and describes the methods used to collate the baseline (desk study and field survey data). These data are presented for both watercourses and standing water bodies in the following sections.

7.1.3 Methodology

Screening area

- 7.1.3.1 Screening for the presence of aquatic receptors (watercourses and standing water bodies) was undertaken within the proposed Scheme Area plus 50 metres (m) from the Scheme Boundary (the Screening Area).
- 7.1.3.2 This exercise allows for the identification of:
- aquatic habitats within the Scheme Area that may be affected by the proposed Scheme, for example a watercourse that is crossed or a standing water body that is located within the works area. Effects could arise through, for example, direct/indirect habitat loss, physical modification, disturbance and/or changes to water quality/quantity;
 - additional aquatic habitats located not more than 50 m from the Scheme Boundary that, whilst not within the works area, may still be at risk from disturbance due to their proximity to the proposed Scheme. This could be through, for example, overland pollution or mobilisation of fine sediment from the working area. A 50 m distance from the Scheme Boundary is conservative, in light of proposed Scheme requirements for standard pollution prevention and control measures affecting works within the wider water environment; and
 - with reference to hydrological connectivity, receiving watercourses and any dependant water bodies and designated sites potentially at risk due to propagation of effects from watercourses affected within the Screening Area.
- 7.1.3.3 In the absence of detailed published guidance for aquatic receptors and Ecological Impact Assessment (EclA), the extent of the Screening Area has been determined with reference to the design elements of the proposed Scheme, working practices required to construct it (in consultation with the design team), and the author's knowledge of similar schemes and working methods.

- 7.1.3.4 Watercourses and water bodies that are not in direct hydrological connectivity with an aquatic receptor within the Screening Area, are considered to be sufficiently isolated as to have negligible risk of impact from a construction or operation impact source.

Ecological Zone of Influence (EZol) and Study Area

- 7.1.3.5 The EZol for watercourses within the Screening Area (and by extension any hydrologically connected water bodies and designated sites) is defined based on the potential for impacts occurring within the Screening Area to be propagated within watercourses beyond its boundary (for example through hydrological transport of pollutants).
- 7.1.3.6 In the absence of published guidance that defines the EZol for watercourses, the EZol has been defined with reference to the design elements of the proposed Scheme, working practices required to construct it (in consultation with the design team) and the author's knowledge of similar schemes.
- 7.1.3.7 The proposed Scheme does not act to change hydromorphological processes, water quality or aquatic species movement relative to baseline conditions. Embedded design mitigation (including clear-span crossing of the Stratford Brook and attenuation/treatment of road drainage) maintains or improves the operational baseline.
- 7.1.3.8 Potential impacts may arise at the point of construction due to activities required to construct individual design elements. However, these are either localised (for example, riparian habitat loss/degradation) or subject to standard pollution prevention and control measures that serve to constrain the EZol.
- 7.1.3.9 In the unlikely event of an uncontrolled pollution or sediment mobilisation incident within a watercourse, effects are considered likely to be ameliorated (through deposition or dilution) and/or intercepted within 2 km of their origin. The EZol for watercourses is therefore considered to be not greater than 2 km (measured in linear watercourse extent¹) from the Scheme Boundary. This is considered to be an appropriate and conservative EZol within which the assessment assumes potential for effects.
- 7.1.3.10 The EZol for water bodies and aquatic designated sites that are not hydrologically connected to a watercourse located within the Screening Area is defined as the Screening Area itself (the proposed Scheme Area plus 50 m from the Scheme Boundary). This is the extent over which these receptors could be affected by the proposed Scheme, through mechanisms identified in G.1.3.2.
- 7.1.3.11 The Study Areas are defined on the basis of the EZol for aquatic receptors. For watercourses (located within the Screening Area) and hydrologically connected water bodies and designated sites is defined as 2 km (measured in linear watercourse extent) from the Scheme Boundary.
- 7.1.3.12 For standing water bodies and designated sites (falling within the Screening Area) and not hydrologically connected to a watercourse within the Screening Area is defined as the proposed Scheme Area plus 50 m from the Scheme Boundary.

¹ Inclusive of any dependant water body or designated site directly hydrologically connected to the watercourse within this defined extent.

7.1.3.13 When taken together these areas are referred to as the Combined Study Area.

Identification of aquatic features

7.1.3.14 All watercourses and standing water bodies within the Screening Area were identified from geospatial analysis and Ordnance Survey (OS) mapping. In addition, all watercourses and standing water bodies within the 2 km Study Area were assessed to ascertain their level of connectivity with those identified within the Screening Area, for consideration within the assessment.

7.1.3.15 The Centre for Ecology and Hydrology (CEH) Digital River Network (DRN; digitised from 1:50,000 OS mapping) and the OS MasterMap® Water Network Layer were used as the primary source for identifying potentially ecologically important watercourses that may be affected by the proposed Scheme.

7.1.3.16 Watercourses are defined as either:

- Main river:
 - A watercourse shown on the statutory Main River map dataset. These are typically larger streams and rivers but can also be smaller watercourses of specific interest or local significance.
 - The Environment Agency has permissive powers, but not a duty, to carry out maintenance, improvement or construction work on designated main rivers. The Environment Agency has powers to regulate the activities of others affecting rivers and their flood plains under the Environmental Permitting Regulations 2016, the Water Resources Act 1991 and land drainage byelaws.
- Ordinary watercourse:
 - All other watercourses are defined as ordinary watercourses. The Lead Local Flood Authority (LLFA) or, if within an Internal Drainage District, the Internal Drainage Board (IDB) have similar permissive powers to maintain and improve ordinary watercourses.
 - The LLFA or IDB have powers to regulate works under the provisions of the Land Drainage Act 1991 and local byelaws.
 - Ordinary watercourses include rivers, streams, land and roadside ditches, drains, cuts, culverts, dikes, sluices, sewers (other than public sewers within the meaning of the Water Industry Act 1991) and passages, through which water flows.

7.1.3.17 Where available, the name of the watercourse is provided as it appears on OS mapping. If the watercourse is unnamed, it has been named for the purpose of the ES according to its proximity to named locations on OS mapping, or to identified compensation or enhancement land parcels.

7.1.3.18 Standing water bodies are defined as ponds: man-made or natural standing water bodies less than 20,000 m² or 2 ha, or lakes: man-made or natural standing water bodies greater than 20,000 or m² 2 ha².

² Williams, P., Biggs, J., Thorne, A., Bryant, S., Fox, G. and Nicolet, P., 1999. *The Pond Book: a guide to the management and creation of ponds*. ds Conservation Trust, Oxford.

Desk study data records

- 7.1.3.19 Existing baseline records were collated for watercourses and water bodies within the Combined Study Area. This included the identification of designated sites (statutory and non-statutory) for which an aquatic receptor is noted specifically within the citation, or where a watercourse or standing water body is likely to be integral to the maintenance of the designated site's ecological integrity.
- 7.1.3.20 Several data sources were used to help inform the ecological baseline of identified aquatic receptors. These data sources are listed below.

Publicly available data

- 7.1.3.21 Several data sources were used to help inform the ecological baseline of identified aquatic receptors. These data sources are listed below:
- Environment Agency North West River Basin Management Plan (RBMP)
 - Environment Agency Data Catchment Explorer
 - Environment Agency Freshwater and Marine Biological Survey data for macroinvertebrates, fish, macrophytes and diatoms
 - Environment Agency River Habitat Surveys – Survey Details and Summary Results
 - Natural England Nature on the Map Interactive Map (MAGIC), which delineates statutory designated sites of importance for nature conservation and linked site citations
 - Surrey Biological Information Centre (SBIC)
 - Contemporary OS mapping.

Scheme data sources and supplementary data requests

- 7.1.3.22 No other data sources were used to inform this assessment.

Screening of data

- 7.1.3.23 All desk study data were screened for relevance to the Scheme in terms of location, date and period of record. The following criteria were applied to determine the suitability of individual records for inclusion in the baseline:
- Data records for watercourses and standing water bodies must have been collected within the past five years (10 years for Environment Agency River Habitat Survey (RHS) data)

Screening aquatic receptors for impact assessment and survey

- 7.1.3.24 CIEEM (2016)³ identifies the requirement for assessment to rationalise which ecological features should be subject to detailed assessment. It is not necessary for assessment to carry out detailed assessment of features that are sufficiently widespread, unthreatened and resilient to project impacts.

³ CIEEM (September 2018). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Chartered Institute of Ecology and Environmental Management, Winchester.

7.1.3.25 CIEEM (2016) also identifies that ecological features subject to detailed assessment will be those that are both considered to be important and potentially significantly affected by the project.

Watercourses and standing water bodies

7.1.3.26 In the absence of published guidance detailing rationale for screening of important aquatic receptors for assessment, those watercourses and standing water bodies within the 2 km Study Area were screened for inclusion in the assessment using the below criteria. Watercourses and standing water bodies were taken forward to assessment and screened for habitat and species survey requirements, where they are:

- Potentially lost (completely or partially), crossed or diverted
- Likely to experience changes to aquatic habitat structure or riparian character
- Likely to experience changes to water quality and/or quantity.

Screening aquatic receptors for field surveys

Survey screening approach

7.1.3.27 Aquatic habitat receptors taken forward to assessment were further screened to determine field survey requirements. Surveys were only undertaken in the absence of existing baseline data considered appropriate to inform the assessment. This ensured that survey effort was proportionate to the requirement for robust assessment.

7.1.3.28 Existing baseline data (for example, Environment Agency monitoring data and biological record centre data) were reviewed to identify the validity of its use (spatially and temporally) before determining a requirement for additional Scheme specific survey.

7.1.3.29 For each aquatic feature, watercourse or water body, a series of survey screening criteria were applied to determine the exact survey requirements to inform the assessment. These criteria are described in the following sections.

7.1.3.30 Furthermore, walkover surveys completed in 2017 and 2018 of aquatic habitats within the Study Area were undertaken (where access allowed) to broadly characterise habitat quality, the range of aquatic species likely to be supported and inform on their suitability for detailed habitat and species survey, alongside the broader criteria outlined below.

7.1.3.31 Walkover survey information is provided in Section 7.1.7.

Watercourse habitat survey screening

7.1.3.32 Watercourses taken forward to assessment were screened as requiring habitat surveys (e.g. River Corridor Survey (RCS)) based on the following criteria:

- The watercourse is main river, or is an ordinary watercourse for which a WFD status is reported, and is potentially affected by the Scheme, or
- The watercourse is an ordinary watercourse for which a WFD status is not reported, and

- it is not obviously heavily managed or modified (as inferred from mapping, and aerial imagery, WFD compliance assessment survey data, Phase 1 habitat survey information and walkover surveys, where available), and
- it will be lost/crossed/realigned or potentially experience a change in water quality/quantity or habitat quality, that could affect the flora and fauna within the watercourse and/or downstream receptors, or
- Despite being heavily modified, walkover surveys identified the presence of habitat complexity

Watercourse ecological survey screening

7.1.3.33 Watercourses were also screened as requiring detailed ecological survey (namely aquatic macroinvertebrate, aquatic macrophyte and fish survey) based on the following criteria:

- Watercourses that had been screened as requiring habitat survey (see above) and exhibited suitable habitat for the detailed species survey type, based on the habitat survey and/or walkover survey findings, where:
- There were no suitable existing baseline or proxy ecological data on the watercourse, within 2 km of the Scheme Boundary, or
- Despite being heavily modified, the walkover surveys identified the watercourse as likely to contain valuable species communities that will be sensitive to the Scheme works.

Standing water bodies survey screening

7.1.3.34 Standing water bodies taken forward to assessment were screened as requiring habitat and species survey based on the following criteria:

- The water body is likely to be lost or affected by the Scheme, for example, through habitat loss (complete or partial)
- The water body will experience a change in local hydrology that could affect flora and fauna; and
- Walkover surveys identified the water body as likely to contain valuable species communities that will be sensitive to the Scheme works.

Survey methods

Watercourse habitat surveys

7.1.3.35 Walkover surveys were undertaken of aquatic features within the Study Area to inform of broad character and habitat and species survey requirements. Walkover survey summaries for aquatic features are provided in Section 7.1.7.

Watercourse River Corridor Surveys

- 7.1.3.36 River Corridor Surveys (RCS) were undertaken using standard methods as described in the River Corridor Surveys: Methods and Procedures (Conservation Technical Handbook)⁴. The decision not to undertake River Habitat Surveys (RHS)⁵ was made in consultation with the Environment Agency. RCS was considered to provide appropriate detail to inform both in-channel and riparian habitat quality, since it also allows for both habitat mapping and detailing of in-channel aquatic macrophyte and bankside/riparian vegetation structure and species assemblages.
- 7.1.3.37 For each RCS the aquatic, marginal, bank and adjacent land zones were mapped for a 500 m reach of river (where access facilitated), with at least one representative cross-section drawn for each reach. A list of the dominant terrestrial and aquatic macrophytes was recorded and georeferenced photographs taken.
- 7.1.3.38 RCS survey data are provided in Section 7.1.7 of this Technical Appendix.

Aquatic macroinvertebrate surveys

- 7.1.3.39 Aquatic macroinvertebrate surveys were undertaken at a representative location within each watercourse reach screened as requiring survey. Typically, samples were collected downstream of the Scheme interface with the watercourse so that the location of the sampling site is in the direction in which most effects will propagate.
- 7.1.3.40 Macroinvertebrate samples were collected using a standard three-minute kick-sampling technique in accordance with River Invertebrate Prediction and Classification System⁶ (RIVPACS) standard sampling protocols.
- 7.1.3.41 Samples were preserved in the field in 99% IDA (Industrial Denatured Alcohol) and returned to the laboratory for analysis. Environmental variables required to generate RIVPACS2 community predictions were recorded, thus ensuring that should a full site WFD classification be required in future, the data collected was fit for purpose.
- 7.1.3.42 In the laboratory, species/mixed level identification of aquatic macroinvertebrates was undertaken in accordance with Environment Agency Operational Instruction 024_08⁷. For each sample, the following biological metrics were calculated:
- British Monitoring Working Party⁸ (BMWP) and associated scores, Number of Scoring Taxa (NTAXA) and Average Score Per Taxon (ASPT)
 - These indices were developed primarily as a means of assessing water quality and do not necessarily correlate intimately with conservation importance. They are underpinned by Pressure Sensitivity (PS) scores, based on tolerance to organic pollutants. These are assigned at a family level ranging from 1 (extremely tolerant) to 10 (extremely sensitive). Theoretically,

⁴ National Rivers Authority, 1992. River Corridor Surveys: Methods and Procedures. Conservation Technical Handbook.

⁵ Environment Agency, 2003. River Habitat Survey in Britain and Ireland. Field Survey Guidance Manual.

⁶ EU Star UK, 2006. *RIVPACS Macroinvertebrate Sampling Protocol*. [pdf] Available at: <<http://www.eu-star.at/pdf/RivpacsMacroinvertebrateSamplingProtocol.pdf>> [Accessed 20 October 2018].

⁷ Environment Agency Operational Instruction 024_08- Freshwater macro-invertebrate analysis of riverine samples (issued 02/10/2012).

⁸ Biological Monitoring Working Party, 1978. Final report: assessment and presentation of the quality of rivers in Great Britain. Unpublished report, Department of the Environment, Water Data Unit.

a site with good water quality should result in a higher BMWP than a site with poor water quality.

- The Number of Scoring Macroinvertebrate Taxa (NTAXA) is simply the number of scoring taxa (families) recorded in the site sample and the ASPT is the BMWP divided by NTAXA. ASPT tends to be less influenced by seasonal community changes and the most appropriate index of the three by which to monitor a site over time. In general, ASPT scores above 5 represent macroinvertebrate communities living in good water quality. Lower scores are indicative of macroinvertebrate communities suffering from stress due to reduced water quality.
- In combination, the scores can also be used to infer watercourse condition in terms of habitat complexity.
- Lotic invertebrate Index for Flow Evaluation⁹ (LIFE)
- This metric was developed as a means of assessing flow as a stressor on the aquatic macroinvertebrate community. Macroinvertebrate taxa are assigned to a flow group depending on their documented flow preferences (current velocity) ranging from I (Rapid) to VI (Drought Resistant). This has been undertaken at a family level (LIFE(F)).
- The calculation of a community LIFE score is underpinned by Flow Scores (fs). These are derived with reference to an abundance/flow group matrix such that both the abundance and flow preference of recorded taxa is taken into account. Abundance categories are defined by standard Environment Agency categories.
- LIFE score categories identify the community as having a low, moderate or high sensitivity to flow reduction. With a lower score indicating a community made up of proportionally more taxa with a preference for low flows.
- Community Conservation Index¹⁰ (CCI)
- The CCI is used to assess community conservation value and highlights specific species of conservation importance based on the Joint Nature Conservation Committee (JNCC) threat categories (after Wallace, 1991¹¹).
- Community score categories range from low (i.e. a site that supports only common species and/or a community of low taxon richness) to very high (a community potentially of national significance and may merit statutory protection) conservation value. It should be noted that the CCI does not directly align with assessment valuation categories.
- Proportion of Sediment-sensitive Invertebrates¹² (PSI)
- The PSI is based on the known ecological responses of different macroinvertebrate species or family groups to the accumulation of sediment

⁹ Extence, C.A., Balbi, D.M. and Chadd, R.P., 1999. River flow indexing using British benthic macroinvertebrates: A framework for setting hydroecological objectives. *Regulated Rivers: Research and Management* 15, pp. 543-574.

¹⁰ Chadd, R.P. and Extence, C.A., 2004. The conservation of freshwater macroinvertebrate populations: a community-based classification Project. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 14, pp. 597-624.

¹¹ Wallace, I.D., 1991. A review of the Trichoptera of Great Britain. *Research and Survey in Nature Conservation* No. 32. Nature Conservancy Council: Peterborough.

¹² Extence, C.A., Chadd, R.P., England, J., Dunbar, M.J., Wood, P.J. and Taylor, E.D., 2013. The assessment of fine sediment accumulation in rivers using macro-invertebrate community response. *River Research and Applications*, 29, pp. 17-55.

on riverine substrata. This has been undertaken at a family level (PSI(F)) or species level (PSI(S)).

- Those taxa that are known to benefit from, or that are largely unaffected by sedimentation, are given a high score, known as a Sediment Sensitivity Rating (SSR). Those taxa that are known to suffer from the accumulation of sediment are given a low SSR. The metric also depends on the relative abundance of different taxa and so is not just dependent on “presence-absence”, but also on the numbers of different taxa recorded.
- The PSI score describes the percentage of sediment-sensitive taxa present in a sample with high values indicating a greater proportion (percentage) of silt intolerant macroinvertebrate species present within the macroinvertebrate community sampled i.e. the less a site is affected by silt the greater the PSI score. Scores range from 0 to 100 with categories from naturally sedimented/unsedimented to heavily sedimented.

7.1.3.43 Macroinvertebrate survey data are provided in Section 7.1.5 of this Technical Appendix.

Electric fishing surveys

7.1.3.44 Electric fishing surveys were undertaken along reaches screened as requiring survey in accordance with current industry standards:

- BS EN 14962:2006 / BS 6068-5.40:2006 Water quality – Guidance on the scope and selection of fish sampling methods
- BS EN 14011:2003 / BS 6068-5.32:2003 Water quality – Sampling of fish with electricity
- Environment Agency (2010) Electric fishing in rivers. Operational Instruction 144_03
- CEH (2002) Guidelines for Electric Fishing Best Practice R&D Technical Report W2-054/TR

7.1.3.45 The upstream and downstream extent of each survey reach (typically 50 m to 100 m) was defined and isolated using stop-nets. Three electric fishing runs, working in an upstream direction were undertaken at each survey reach, thus aligning the survey with the requirements for determining WFD fish status using the Fisheries Classification Scheme 2¹³ (FCS2) model.

7.1.3.46 Fish captured were identified to species, counted and either fork length or total length measured to the nearest mm (depending on species caught). Where multi-run catch returns facilitated, standardised population estimates based on Carle and Strub (1978¹⁴) were calculated, with the number of individual species expressed per 100 m² of watercourse channel. Otherwise, density estimates were produced from actual catch return data, again as number per 100 m².

¹³ WFD-UKTAG, 2008. UKTAG Rivers Assessment Methods. Fish Fauna (Fisheries Classification Scheme 2 (FCS2)). [pdf] Available at: <<https://www.wfduk.org/sites/default/files/Media/Characterisation%20of%20the%20water%20environment/Biological%20Method%20Statements/river%20fish.pdf>> [Accessed 6 June 2018].

¹⁴ Carle, F.L. and Strub, M.R., 1978. A new method for estimating population size from removal data. *Biometrics*, 34, pp. 621-830.

7.1.3.47 Minor¹⁵ species have been defined as small bodied fish that often occur in high abundance, including stone loach (*Barbatula barbatula*), bullhead (*Cottus gobio*), minnow (*Phoxinus phoxinus*) and three-spined stickleback (*Gasterosteus aculeatus*).

7.1.3.48 Summary fish survey data including species number and density estimates are provided in Section 7.1.5 of this Technical Appendix.

Water body habitat and species surveys - Common Standards Monitoring - Lakes

Macrophyte survey

7.1.3.49 Common Standards Monitoring (CSM) was undertaken following the JNCC Common Standards Monitoring Guidance for Freshwater Lakes¹⁶ and habitat survey.

7.1.3.50 CSM is the standardised methodology for assessing the condition of designated standing water features in the UK. Macrophyte data were 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 additional 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.

7.1.3.51 Sections are chosen to be representative of the site and are georeferenced and photographed to enable future surveys to be conducted using the same locations. 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 effort is made, outside of the sections, to identify the locations and extent to which they occur in a site.

Habitat survey

7.1.3.52 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.

Macroinvertebrate Survey

7.1.3.53 Sampling methods used complied with BS EN ISO 10870: 2012¹⁷, with mixed level identification (in accordance with Environment Agency Operational Instruction 024_08).

¹⁵ Environment Agency, 2014. Flow and Level Criteria for Coarse Fish and Conservation Species. Science Report SC020112/SR.

¹⁶ Joint Nature Conservation Committee (JNCC), (2015) Common Standards Monitoring Guidance for Freshwater Lakes Version March 2015. JNCC Report, JNCC, Peterborough [Online] Available from: http://jncc.defra.gov.uk/pdf/0315_CSM_Freshwater_lakes.pdf

¹⁷ BSI Standards Publication. Water quality- guidelines for the selection of sampling methods and devices for benthic macroinvertebrates in fresh waters (ISO 10870:2012)

- 7.1.3.54 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 as being dominant within the lake: a total of five separate habitats were sampled.
- 7.1.3.55 Samples were collected using 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 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 60 second 'kick and sweep' time period). All samples were categorised by meso-habitat (vegetation and substrate type). Sample locations were recorded with GPS and georeferenced digital photographs taken.
- 7.1.3.56 Samples were analysed separately, and a full taxon record and count made from each meso-habitat.
- 7.1.3.57 The following metrics were calculated for each meso-habitat as well as combined to provide metrics for the site as a whole: BMWP, NTAXA, ASPT, CCI (these metrics are described above) and WHPT.
- 7.1.3.58 The Whalley, Hawkes, Paisley & Trigg (WHPT)¹⁸ classification method enables the assessment of macroinvertebrates in rivers (in relation to general degradation, including organic pollution) according to the requirements of the WFD).

7.1.4 Limitations

- 7.1.4.1 The aim of the aquatic ecology surveys was to determine the baseline condition of the watercourses and standing water bodies identified as potentially being affected by the Scheme. Based on the information available at the time, we have only surveyed those watercourses that are directly impacted by Scheme components, including those watercourses and standing water bodies within/adjacent to replacement land or enhancement areas.
- 7.1.4.2 A number of watercourses were considered to be ephemeral ditches which have the potential to support aquatic features (macrophytes, macroinvertebrates and fish) under certain conditions. Most of the ephemeral ditches surveyed were done so in conditions not favourable to aquatic organisms, i.e. dry or at low flow.
- 7.1.4.3 Two ditches were identified as being potentially impacted by the Scheme within the central reservation of the A3. Due to the health and safety issues connected with trying to survey these ditches, along with the anticipation that these ditches will be ephemeral, relying on run-off from the A3, no surveys of these ditches were undertaken.
- 7.1.4.4 The RCS undertaken on the downstream reach of Stratford Brook was limited by dense bracken/bramble scrub preventing access to the majority of the watercourse. Therefore, assessment of this reach for the RCS was based on this limited access.

¹⁸ Walley, W.J. & H.A. Hawkes (1996) A computer - based reappraisal of the Biological Monitoring Working Party scores using data from the 1990 river quality survey of England and Wales. *Water Research*, 30: 2086 - 2094.

7.1.4.5 Whilst there is no clearly defined season for electric fishing surveys, their timing can be constrained by factors such as fish spawning/migration periods (primarily in relation to salmonid fisheries). Electric fishing surveys were undertaken to prescribed mythologies and guidance under consent from the Environment Agency.

7.1.4.6 Macrophyte and macroinvertebrate surveys undertaken on Bolder Mere did not set out to record all species present within Bolder Mere, merely to attempt to capture the species that are typical of the site and are representative of the site as a whole.

7.1.5 Results

Desk study

Watercourse habitat

- 7.1.5.1 Screening has identified the following watercourses within the Scheme Area. Grid references provided relate to either the crossing point (where applicable) or a central point along the watercourse within the Scheme Area:
- Stratford Brook – crossed by existing A3 alignment and new road bridge at TQ 06309 57456
 - Ditch system within A3 central reservation – central point TQ 06780 57920
 - Ditch adjacent to A3 – potentially affected by A3 widening works, central point TQ 07293 58266
 - Elm Lane ditch – crossed at TQ 07968 58145
 - Old Lane ditches – within Old Lane SPA compensation area, central point TQ 08292 58073
 - Hut Hill south ditches – located within Hut Hill South SPA enhancement area, central point TQ 07075 58414
 - Pond Farm south ditch – within Pond Farm south SPA enhancement area and affected by A3 widening, crossed at TQ 07374 58420
 - Hut Hill ditch – affected by A3 widening, central point TQ 07661 58632
 - Pond Farm west ditches – within Pond Farm west enhancement area and Wisley SPA compensation land, central point TQ 06821 59377
 - Cockrow Hill ditches – within M25 works area, crossed at TQ 07589 59396
 - Ockham common ditch – within M25 works area and within Ockham common/Sandpit Hill SPA enhancement area, crossed at TQ 08203 59124
 - Chatley Wood ditch – within M25 works area and within Chatley Wood replacement land, crossed at TQ 08340 59183
 - Pointers Road ditch – within A3 works area, crossed at TQ 08201 59388
 - Buxton Wood ditches – within Park Barn Farm replacement land, central point TQ 07025 59835
 - Park Barn Farm ditches – within Park Barn Farm replacement land, central point TQ 07649 60068

- Pointer Road north ditch – within Pointers Road North replacement land, central point TQ 09192 58796
- Seven Hill Hotel ditch – on the boundary of A3 compound area, central point TQ 08831 60382

7.1.5.2 The following watercourses are identified as occurring within 50 m of the Scheme Boundary. The grid references provided are for the point on the watercourse closest to the Scheme Boundary:

- Guilehill Brook – to the south of the Scheme Area, tributary of the River Wey, TQ 05648 57617
- Wisley Gardens ditch – isolated ditch close to A3, TQ 06499 57789
- Wisley north ditch – tributary of River Wey, close to M25, TQ 06657 59596
- River Wey at M25 – hydrologically connected to watercourses that interact with the Scheme, TQ 06239 59856
- River Mole at A3 – hydrologically connected to watercourses that interact with the Scheme, TQ 09892 60800
- River Mole at Chatley Wood replacement land – also hydrologically connected to watercourses that interact with the Scheme, TQ 08790 59595
- Pointers Cottage ditch – tributary of the River Mole, close to M25, TQ 09415 58419
- Pointers Farm ditch – tributary of River Mole, close to M25, TQ 09985 58028
- New barn farm ditch – tributary of River Mole, close to M25 TQ 11392 57589

Watercourses taken forward to impact assessment

7.1.5.3 As described in Section 7.1.3 not all watercourses are potentially affected by the Scheme. Therefore, the watercourses identified above were reviewed against details of the Scheme to identify those for which a potential impact pathway exists.

7.1.5.4 Only watercourses for which an impact pathway has been identified are detailed in Table 7.1.1, all other watercourses have been excluded from the impact assessment. This ensures only baseline data relevant to the Scheme and its likely significant effects are reported. When determining those watercourses requiring further assessment the embedded environmental design measures as detailed in Chapter 7 have been assumed.

7.1.5.5 In total, 12 of the 25 watercourses identified through the screening process have been taken forward for impact assessment (see Figure 7.9 for location). These are detailed in Table 7.1.1 together with the rationale for their inclusion within the impact assessment.

Table 7.1.1: Watercourses identified as requiring further assessment

Watercourse	Rationale for inclusion in impact assessment
Stratford Brook	<p>Main river in the Scheme Area and screened into assessment due to works associated with a new river crossing.</p> <p>WFD assessed and screened in for habitat and species surveys at the location of the new crossing to provide additional information on habitat character and species assemblages.</p>
River Wey	<p>Main river outside of Scheme Area. Not directly impacted but in hydrological connectivity with the Stratford Brook and other minor watercourses that interact with the Scheme Area.</p> <p>WFD assessed and screened in for habitat survey due to proximity to replacement land boundary.</p>
River Mole	<p>Main river outside of the Scheme Area. Not directly impacted but in hydrological connectivity with minor watercourses that interact with the Scheme and immediate adjacent to Chatley Wood replacement land.</p> <p>WFD assessed and screened in for habitat survey due to proximity to replacement land boundary.</p>
Pointers Road ditch	<p>Ordinary watercourse within the Scheme Area screened into assessment due to works connected with the widening of the A3 and Junction 10 improvements.</p> <p>Not WFD assessed and screened out of habitat and species surveys based on it not meeting survey screening criteria and walkover surveys confirming habitat is limited (ephemeral ditch, dry at survey).</p>
Chatley Wood ditch	<p>Ordinary watercourse within the Scheme Area screened into the assessment due to works associated with M25 and Junction 10 improvements.</p> <p>Not WFD assessed and screened out of habitat and species surveys based on it not meeting survey screening criteria and walkover surveys confirming habitat is limited (ephemeral ditch, dry at survey).</p>
Ockham Common ditch	<p>Ordinary watercourse within the Scheme Area screened into the assessment due to works associated with M25 and Junction 10 improvements.</p> <p>Not WFD assessed and screened out of habitat and species surveys based on it not meeting survey screening criteria and walkover surveys confirming habitat is limited (ephemeral ditch, dry at survey).</p>
Cockrow Hill ditches	<p>Ordinary watercourse network within the Scheme Area screened into the assessment due to works associated with the A3 widening and Junction 10 improvements.</p> <p>Not WFD assessed and screened out of habitat and species surveys based on it not meeting survey screening criteria and walkover surveys confirming habitat is limited (ephemeral ditch, dry at survey).</p>
Pond Farm south ditch	<p>Ordinary watercourse within the Scheme Area screened into the assessment due to works associated with the A3 widening and within Pond Farm south SPA enhancement area.</p> <p>Not WFD assessed and screened out of habitat and species surveys based on it not meeting survey screening criteria and</p>

Watercourse	Rationale for inclusion in impact assessment
	walkover surveys confirming habitat is limited (ephemeral ditch, dry at survey).
Hut Hill ditch	Ordinary watercourse within the Scheme Area screened into the assessment due to works associated with the A3 widening. Not WFD assessed and screened out of habitat and species surveys based on it not meeting survey screening criteria and walkover surveys confirming habitat is limited (ephemeral ditch, dry at survey).
Ditch adjacent to A3	Ordinary watercourse within the Scheme Area screened into the assessment due to works associated with the A3 widening. Not WFD assessed but screened in for species surveys based on walkover surveys confirming suitable conditions to support aquatic macroinvertebrates and due to its proximity to Bolder Mere, the potential to support notable taxa.
Ditch system within A3 central reservation	Ordinary watercourse within the Scheme Area screened into the assessment due to works associated with the A3 widening. Not WFD assessed and screened out of habitat and species surveys based on it not meeting survey screening criteria and walkover surveys confirming habitat is limited (ephemeral ditch, dry at survey).
Elm Lane ditch	Ordinary watercourse within the Scheme Area screened into the assessment due to works associated with Elm Lane improvements. Not WFD assessed and screened out of habitat and species surveys based on it not meeting survey screening criteria and walkover surveys confirming habitat is limited (ephemeral ditch, dry at survey).
All other watercourses identified in the Study Area	Screened out as do not meet screening criteria and have no impact pathway as not hydrologically connected to the Scheme.

Notes: Please see Section 7.1.7 for walkover survey details that were undertaken to inform the screening process.

Watercourse habitat data

- 7.1.5.6 No statutory or non-statutory designated watercourses occur within the Study Area. Review of designated site data has identified the following designated sites as being associated with watercourses being taken forward for assessment:
- Ockham and Wisley commons Site of Special Scientific Interest (SSSI)¹⁹
 - Ockham and Wisley Local Nature Reserve (LNR)
- 7.1.5.7 Citations for Ockham and Wisley commons SSSI and LNR, identify associated watercourses as important features likely to be of significance in maintaining the ecological communities supported through hydrological interaction with the designated site.
- 7.1.5.8 Three watercourses are assessed as WFD water bodies within the Thames River Basin District. Full information on the status of WFD assessed water bodies is provided in the WFD compliance assessment (TR010030 5.4 Water Framework Directive Assessment Report).

¹⁹ SSSI citation available at <<https://designatedsites.naturalengland.org.uk/PDFsForWeb/Citation/1001052.pdf>> [Accessed 21 December 2018].

Table 7.1.2: WFD 2016 Cycle 2 water body classification (rivers)

Watercourse	WFD water body name	WFD water body ID	Morphological designation	Ecological element assessed and status/potential
Stratford Brook	Stratford Brook	GB106039017890	Not designated as artificial or heavily modified	Overall status: Moderate Ecological status: Moderate Invertebrates: Moderate Macrophytes and phytobenthos combined: Good Hydromorphological elements: Supports Good
River Wey	River Wey (Shalford to River Thames confluence at Weybridg)	GB106039017630	Designated as heavily modified	Overall status: Moderate Ecological status: Moderate Invertebrates: High Macrophytes and phytobenthos combined: Moderate Hydromorphological elements: Supports Good
River Mole	River Mole (Horley to Hershams)	GB106039017621	Not designated as artificial or heavily modified	Overall status: Moderate Ecological status: Moderate Invertebrates: Moderate Macrophytes and phytobenthos combined: Moderate Hydromorphological elements: Supports Good

7.1.5.9 The WFD classification provides an assessment of the watercourse habitat at the water body scale. The Stratford Brook is not designated as artificial or heavily modified and is assessed as being at moderate status. The ecological status, including invertebrates is assessed as moderate with macrophytes and phytobenthos combined assessed as good. The Stratford Brook’s hydromorphological elements are assessed as supporting good (flow regime and physical habitat).

7.1.5.10 The River Wey is designated as heavily modified and is assessed as being at moderate status. The ecological status, including macrophytes and phytobenthos is assessed as moderate with invertebrates assessed as high. The River Wey (Shalford to River Thames confluence at Weybridge) hydromorphological elements are assessed as supporting good (flow regime and physical habitat).

7.1.5.11 The River Mole is not designated as artificial or heavily modified and is assessed as being at moderate status. The ecological status, including macrophytes and phytobenthos combined and invertebrates are assessed as moderate. The River Mole (Horley to Hersham) hydromorphological elements are assessed as supporting good (flow regime and physical habitat).

7.1.5.12 Environment Agency watercourse habitat data is limited to an RHS on the River Mole surveyed in 2008 in Table 7.1.3.

Table 7.1.3: Environment Agency RHS data

Watercourse	RHS site ID and NGR	Date of Record	Survey details
River Mole	22693 TQ 09169 59151 (central)	06/05/2008	Site located 700 m upstream of Chatley Wood replacement land. HMS: 2760 HMC: 5 (severely modified) Wetted width: 12 m Water depth: not provided

Notes: HMS = Habitat Modification Score, HMC = Habitat Modification Class

7.1.5.13 The RHS on the section of the River Mole surveyed identified the watercourse as being severely modified. The modification score is driven by artificial structures and channel re-sectioning. The site was noted as having been realigned or over-deepened for more than 33% of its length. The substrate was recorded as unconsolidated and predominated flow types recorded as run or glide.

Aquatic macroinvertebrate data – watercourses

7.1.5.14 Environment Agency aquatic macroinvertebrate data are available for the Stratford Brook and River Wey.

Table 7.1.4: Environment Agency macroinvertebrate data

Watercourse/ site name	Location (NGR)	Sample date	Survey results
Stratford Brook U/S footbridge Hollybush Lane	TQ 05738 57744 Site located approximately 550 m downstream of current A3 culvert.	26/04/2016	Biotic metric scores are as follows: NTAXA: 16 BMWP: 87 ASPT: 5.44 LIFE (family): 7.00 PSI (family): 43.33
		30/09/2016	Biotic metric scores are as follows: NTAXA: 13 BMWP: 74 ASPT: 5.69 LIFE (family): 6.73 PSI (family): 27.78
River Wey at Plough Bridge, Byfleet	TQ 06995 61334 Site located approximately	11/04/2014	Biotic metric scores are as follows: NTAXA: 28 BMWP: 171

Watercourse/ site name	Location (NGR)	Sample date	Survey results
	1.3 km downstream of Park Barn Farm replacement land.		ASPT: 6.11 LIFE (family): 7.33 PSI (family): 48.33
		18/09/2014	Biotic metric scores are as follows: NTAXA: 25 BMWP: 155 ASPT: 6.2 LIFE (family): 7.67 PSI (family): 60.71

Notes: NTAXA = Number of BMWP scoring taxa, BMWP = Biological Monitoring Working Party, ASPT = Average Score Per Taxon, LIFE = Lotic-invertebrate Index for Flow Evaluation, PSI = Proportion of Sediment-sensitive Invertebrates.

7.1.5.15 Aquatic macroinvertebrate sampling of Stratford Brook indicates moderate to good biological quality for autumn and spring respectively (as inferred from BMWP and ASPT scores). LIFE scores indicate moderate flows and PSI scores indicate the river bed is moderately sedimented (spring) to sedimented (autumn).

7.1.5.16 Aquatic macroinvertebrate sampling of the River Wey indicates very good biological water quality for spring and autumn surveys (as inferred from BMWP and ASPT scores). LIFE scores indicate predominantly fast flows, with PSI scores indicating the river bed is moderately sedimented.

Aquatic macrophyte data – watercourses

7.1.5.17 Environment Agency aquatic macrophyte data are available for the Stratford Brook and River Wey.

Table 7.1.5: Environment Agency macrophyte data

Watercourse/ site name	Location (NGR)	Sample date	Survey results
Stratford Brook U/S footbridge Hollybush Lane	TQ 05738 57744 Site located approximately 550 m downstream of current A3 culvert.	14/08/2015	Biotic metric scores are as follows: RMNI: 7 NTAXA: 8 ALG: 0.05
River Wey at Plough Bridge, Byfleet	TQ 06995 61334 Site located approximately 1.3 km downstream of Park Barn Farm replacement land.	12/08/2014	Biotic metric scores are as follows: RMNI: 7.99 NTAXA: 13 ALG: 0.5

Notes: RMNI = River Macrophyte Nutrient Index, NTAXA = Number of aquatic taxa, ALG = percentage cover of green filamentous algae.

- 7.1.5.18 The macrophyte surveys on the Stratford Brook recorded eight species of truly aquatic macrophyte (NTAXA), which are as an assemblage are indicative of high nutrient conditions (RMNI = 7).
- 7.1.5.19 Macrophyte surveys on the River Wey indicate a species rich assemblage (NTAXA = 13), which are as an assemblage indicative of high nutrient conditions (RMNI = 7.99).
- 7.1.5.20 For both watercourse surveys the percentage cover of filamentous algae was low.

Fish data – watercourses

- 7.1.5.21 Environment Agency fish data are available for the River Wey.

Table 7.1.6: Environment Agency fish data

Watercourse/ site name Location (NGR)	Survey details	Sample date	Survey results
River Wey at Byfleet at Brooklands TQ0700061338	Electric fishing - catch depletion sample over 95 m stretch. Site located 1.3 km downstream of Park Barn Farm replacement land.	06/12/2015	Number of species = 7 Chub – 30No. Roach – 27No. Pike – 3No. Dace – 28No. Bleak – 6No. Perch – 4No. Gudgeon – 6No.

- 7.1.5.22 A total of 104 fish were caught representing seven different species. The most common species caught were chub (*Leuciscus cephalus*) (30 individuals), dace (*Leuciscus leuciscus*) (28 individuals) and roach (*Rutilus rutilus*) (27 individuals). Pike (*Esox Lucius*) were the least caught species with only three caught.

Standing water body habitat

- 7.1.5.23 Screening has identified the following standing water bodies within or partially within the Scheme Area (see Figure 7.9 for location). Bolder Mere is classified as lake (>2 ha in size), the others as ponds. Grid references relate to the centre point of the standing water body:
- Bolder Mere – potentially affected by the A3 widening works, TQ 07622 58400
 - Chatley Wood pond – within Chatley Wood replacement land, TQ 08590 59269
- 7.1.5.24 The following standing water bodies (all classified as ponds since <2 ha in area) are identified as occurring within 50 m of the Scheme Boundary. The grid references relate to the centre point of the standing water body:
- Manor Pond – potentially affected by work on the A245, TQ 09499 60903
 - Ockham Common south car park pond – within Ockham and Wisley common SSSI, within 150 m of Bolder Mere, TQ 07990 58233

- Wisley Common pond – pond close to northern extent of Pond Farm south ditch, TQ 06916 58804
- Pond Farm pond – pond on main track towards Surrey Wildlife Trust offices, TQ 07518 59025
- Park Barn Farm pond – pond just outside Park Barn Farm replacement land, TQ 07496 59981
- Cobham services pond – close to services at Cobham, TQ 11441 57447

Standing water bodies taken forward to impact assessment

7.1.5.25 As described in Section 7.1.3, not all standing water bodies are potentially affected by the Scheme. Therefore, the standing water bodies identified above were reviewed against details of the Scheme to identify those standing water bodies for which an impact pathway exists.

7.1.5.26 Only standing water bodies for which an impact pathway exists are detailed in Table 7.1.7, all other standing water bodies have been excluded from the impact assessment. This ensures only baseline data relevant to the Scheme and its likely significant effects are reported. When determining those standing water bodies requiring further assessment the embedded environmental design measures as detailed in Chapter 7 have been assumed.

7.1.5.27 In total, three of the eight standing water bodies in the Study Area have been taken forward for impact assessment. These are detailed in Table 7.1.7 and a rationale provided for their inclusion within the impact assessment.

Table 7.1.7: Standing water bodies identified as requiring further assessment

Waterbody	Rationale for inclusion in impact assessment
Bolder Mere	Lake (8.06 ha) within the Scheme Area and screened into assessment due to works associated with the A3 widening. WFD assessed and screened in for habitat and species surveys due to the potential loss of marginal and open water habitat.
Chatley Wood pond	Pond 0.23 ha in size within the Scheme Area and screened into assessment as a precaution since within Chatley Wood replacement land. Not WFD assessed and screened out of habitat and species surveys based on not meeting survey screening criteria and walkover surveys confirming habitat is limited (ephemeral pond, dry at survey).
Manor Pond	<u>Pond 0.99 ha in size within 500m of the Scheme boundary and screened into assessment due to potential run-off from the A245 and changes to local drainage discharge.</u> <u>Not WFD assessed and screened out of habitat and species surveys as identified as amenity fishing lake with limited habitat quality due to presence of large number of carp and associated high water turbidity.</u>

Notes: Please see Section 7.1.7 for walkover survey details that were undertaken to inform the screening process.

Standing water body habitat data

7.1.5.28 One statutory and one non-statutory designated sites are within the Study Area:

- Ockham and Wisley Commons Site of Special Scientific Interest (SSSI)²⁰
- Ockham and Wisley Local Nature Reserve (LNR)

7.1.5.29 Bolder Mere is noted within the citations of both the SSSI and LNR as an open water habitat that is an integral component of the designated site in terms of the range of flora and fauna that are supported. This includes over 20 species of Odonata and a number of notable aquatic plants.

7.1.5.30 Of the three water bodies, Bolder Mere is assessed under the WFD. Details for which are provided in Table 7.1.8 Full information on the status of WFD assessed water bodies is provided in the WFD compliance assessment (TR010030 5.4 Water Framework Directive Assessment Report).

Table 7.1.8: WFD 2016 Cycle 2 water body classification (lakes)

Watercourse / WFD waterbody name	WFD water body ID	Morphological designation	Ecological element assessed and status/potential
Bolder Mere	GB30643218	Designated as heavily modified	Overall status: Moderate Ecological status: Moderate Phytoplankton: Moderate Hydromorphological elements: Supports Good

7.1.5.31 The WFD classification provides an assessment of the water body habitat at the water body scale. Bolder Mere is designated as heavily modified and is assessed as being at moderate potential. The ecological status is moderate, with phytoplankton assessed as moderate. Bolder Mere’s hydromorphological elements are assessed as supporting good (flow regime and physical habitat).

7.1.5.32 There are no Environment Agency desk study data available for the water bodies that report specific aquatic survey information obtained from aquatic macroinvertebrate, macrophyte or fish sampling.

²⁰ SSSI citation available at <<https://designatedsites.naturalengland.org.uk/PDFsForWeb/Citation/1001052.pdf>> [Accessed 21 December 2018].

Field surveys

Watercourses habitat survey data

7.1.5.33 The following watercourses have been screened as requiring RCS:

- Stratford Brook upstream and downstream of current A3 culverts
- River Wey
- River Mole

7.1.5.34 It should be noted that the River Wey and River Mole are located adjacent to Park Barn Farm and Chatley Wood replacement land respectively. The RCS were undertaken in these areas to characterise habitat immediately adjacent to the replacement lands which could also be used to inform potential enhancement opportunities.

7.1.5.35 Summary results for sites at which surveys have been completed are provided in Table 7.1.10.

Table 7.1.9: RCS survey details

Watercourse	Feature type	Survey date	Survey location
Stratford Brook upstream	Main river	21/09/2017	Full survey (500 m) upstream of the current A3 south bound slip road culvert. u/s: TQ 06372 57417 d/s: TQ 06278 57475
Stratford Brook downstream	Main river	07/09/2018	Partial survey (channel viewed from limited number of locations along 500 m survey reach) undertaken downstream of current A3 culvert due to site access constraints. u/s: TQ 06182 57537 d/s: TQ 05745 57740
River Wey	Main river	07/09/2018	Full survey (500 m) centred on river adjacent to the Park Barn Farm compensation land. u/s: TQ 06870 59856 d/s: TQ 07236 60099
River Mole	Main river	07/09/2018	Full survey (500 m) centred on river adjacent to the Chatley Wood compensation land. u/s: TQ 09083 59560 d/s: TQ 08849 59705

Table 7.1.10: Summary of RCS results

Watercourse	Survey results
Stratford Brook upstream	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 the box culvert beneath the A3 south bound slip road. Large stands of the invasive non-native species (INNS) Himalayan balsam (<i>Impatiens glandulifera</i>) was present throughout the reach.
Stratford Brook downstream	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 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 (<i>Rubus fruticosus</i>), common nettle (<i>Urtica dioica</i>) and bracken (<i>Pteridium aquilinum</i>) with large stands of Himalayan balsam present where land has been previously cleared.
River Wey	The 500 m of the River Wey surveyed was wide and slow flowing, with an open bank structure, comprised of tall herbs/grass and occasional mature trees (with a small area of woodland) shading the water's edge. Marginal vegetation was extensive and consisted predominantly of reed canary grass (<i>Phalaris arundinacea</i>) and reed sweet grass (<i>Glyceria maxima</i>) with large amounts of the invasive non-native species floating pennywort (<i>Hydrocotyle ranunculoides</i>) present throughout alongside occasional other in-channel vegetation. The channel was wide with a smooth flow and little variation in morphology and flowed through low lying fields providing a flood plain in times of high flow. Substrate was not visible with the water clarity low.
River Mole	The watercourse meanders through rough pasture, mature woodland and into the semi-formal gardens of Painshill Park. Upstream, hedgerows dominate the right bank (predominantly blackthorn, <i>Prunus spinose</i>) with tall herbs and grasses on the left bank. Flowing downstream, the bank height increases, significantly on the left with mature woodland stretching down to the banks of the river, limiting marginal vegetation in this area. Mature trees lining the left bank consists mostly of ash (<i>Fraxinus excelsior</i>), alder (<i>Alnus glutinosa</i>) and willow (<i>Salix fragilis</i>). Marginal vegetation includes branched bur-reed (<i>Sparganium erectum</i>), nettle (<i>Urtica dioica</i>) and willowherb (<i>Epilobium hirsutum</i>). Downstream the river flows through semi-formal gardens, where sweet chestnut (<i>Castanea sativa</i>) dominates.

Aquatic macroinvertebrate survey data – watercourses

7.1.5.36 The following watercourses have been screened as requiring aquatic macroinvertebrate survey:

- Stratford Brook
- Ditch adjacent to A3

7.1.5.37 Summary results for sites at which surveys have been completed are provided in Table 7.1.11.

Table 7.1.11: Aquatic macroinvertebrate survey details

Watercourse	Feature type	Survey date	Survey location
Stratford Brook Upstream	Main river	30/05/2018	Upstream of existing A3 culverts TQ 06462 57344
Stratford Brook Downstream	Main river	30/05/2018	Downstream of existing A3 culverts TQ 05970 57625
Ditch adjacent to A3	Ordinary watercourse	30/05/2018	Close to Bolder Mere outfall – downstream of Bolder Mere. TQ 07376 58344

Table 7.1.12: Summary of aquatic macroinvertebrate survey results

Watercourse	Survey results
Stratford Brook upstream	Biotic metric scores are as follows: NTAXA: 19; BMWP: 93; ASPT: 5.17; LIFE: 7.02; CCI: 2.15 (Low); PSI: 59.38 (Moderately sedimented) Regionally notable or rarer taxa: None
Stratford Brook downstream	Biotic metric scores are as follows: NTAXA: 11; BMWP: 45; ASPT: 4.09; LIFE: 6.8; CCI: 2.25 (Low); PSI: 37.5 (Sedimented) Regionally notable or rarer taxa: None
Ditch adjacent to A3	Biotic metric scores are as follows: NTAXA: 11; BMWP: 35; ASPT: 3.89; LIFE: 6.4; CCI: 2.33 (Low); PSI: 17.65 (Heavily sedimented) Regionally notable or rarer taxa: None

Notes: NTAXA = Number of BMWP scoring taxa, BMWP = Biological Monitoring Working Party, ASPT = Average Score Per Taxon, LIFE = Lotic-invertebrate Index for Flow Evaluation, CCI = Community Conservation Index, PSI = Proportion of Sediment-sensitive Invertebrates.

- 7.1.5.38 Based on the aquatic macroinvertebrate data gathered from the Stratford Brook upstream, specifically the BMWP and ASPT scores, the biological water quality is assessed as 'good'. The macroinvertebrate assemblage is assessed as being of low conservation value (CCI score) comprising of only commonly occurring species. The community metric data indicates that the bed is 'moderately sedimented' (PSI score) and that the community has a moderate sensitivity to flow reduction (LIFE score).
- 7.1.5.39 Aquatic macroinvertebrate data from the Stratford Brook site sampled downstream of the A3 culverts indicates that the biological water quality is 'moderate' based on BMWP and ASPT scores. It contains macroinvertebrate assemblages of low conservation value comprising of commonly occurring species (CCI score). The community metric data indicates that the bed is 'sedimented' (PSI score) and that the community has a moderate sensitivity to flow reduction (LIFE score).

7.1.5.40 Aquatic macroinvertebrate data from the ditch adjacent to the A3 show that the biological water quality is 'poor' based on BMWP and APST scores. Although it is likely that scores are influenced by the limited range of habitats supported by the ditch. CCI scores show that the macroinvertebrate assemblage is of low conservation value containing commonly occurring species. The species present also show the flow is slack or sluggish (LIFE score) and is highly sedimented (PSI score) as anticipated for a ditch habitat of this typology.

7.1.5.41 Full details are presented in the Stratford Brook report in Appendix 7.7.

Fish survey data – watercourses

7.1.5.42 The Stratford Brook was screened as requiring fish survey. Summary of results are provided in Table 7.1.14

Table 7.1.13: Fish survey details

Watercourse	Feature type	Survey date	Survey location
Stratford Brook Upstream	Main river	30/05/2018	Upstream of existing A3 culverts u/s: TQ 06472 57351 d/s: TQ 06408 57381
Stratford Brook Downstream	Main river	30/05/2018	Downstream of existing A3 culverts u/s: TQ 06039 57600 d/s: TQ 05962 57627

Table 7.1.14: Summary of fish survey results

Watercourse	Survey details	Species recorded
Stratford Brook upstream	100 m survey reach starts approx. 200 m upstream of current culvert. Electric fishing by wading.	Number of species = 5 Total number caught: Minnow – 7No. Bullhead – 16No. Three-spined stickleback – 13No. Stoneloach - 9No. Gudgeon – 1No. Population estimates as follows expressed as number per 100 m ² of channel: Minnow - 5 Bullhead – 1.1 Three-spined stickleback - 9 Stoneloach - 7 Gudgeon - 1 No salmonid species recorded
Stratford Brook downstream	80 m survey reach starts approx. 150 m downstream of current culverts. Electric fishing by wading.	Number of species = 6 Total number caught: Minnow – 22No.; Bullhead – 22No. Three-spined stickleback – 12No. Stoneloach – 9No. Gudgeon – 2No.

Watercourse	Survey details	Species recorded
		Tench – 1No. Population estimates as follows expressed as number per 100 m ² of channel: Minnow - 25 Bullhead - 23 Three-spined stickleback - 18 Stoneloach - 8 Gudgeon - 2 Tench - 1 No salmonid species recorded

- 7.1.5.43 For the site upstream of the current culverts, a total of 46 individual fish representing five different species were caught during the surveys. Bullhead (*Cottus gobio* cited under Annex II of the EU Habitats Directive) was the most abundant fish species comprising 35% of the total catch. Gudgeon (*Gobio gobio*) was the least abundant fish species with only a single individual caught. Density estimates were very low for all species indicating a limited fishery dominated by minor species.
- 7.1.5.44 The site downstream of the current culverts yielded 68 individual fish representing six different species. Minnow (*Phoxinus phoxinus*) and bullhead were the most abundant species each comprising 32% of the total catch. Tench (*Tinca tinca*) was the least abundant species with only a single individual caught. Density estimates were higher than those recorded in the upstream site, but still very low, indicating a limited fishery composed of minor species only.
- 7.1.5.45 Due to the lack of suitable habitat in Stratford Brook for tench and gudgeon, it is likely that these species records are a result of washout from a stocked pond located upstream of the survey areas.
- 7.1.5.46 No salmonid species were recorded at survey.
- 7.1.5.47 Full details are presented in the Stratford Brook report in Appendix 7.7.

Standing waterbody survey data

- 7.1.5.48 Detailed surveys were undertaken within Bolder Mere due to its WFD status and importance within Ockham and Wisley Common SSSI. Surveys were undertaken on 26th and 27th June 2018.

Bolder Mere aquatic macrophyte, habitat and macroinvertebrate surveys

Macrophyte surveys

- 7.1.5.49 Four sections were surveyed at Bolder Mere using Common Standards Monitoring (CSM) methodology (as described in Survey section above). These sections were chosen to focus on areas of different habitat types within the lake as well as giving good geographical coverage.

7.1.5.50 A total of 13 aquatic macrophyte species were recorded during the survey. The site was dominated throughout the open water by the invasive non-native species Nuttall's waterweed (*Elodea nuttallii*) along with a significant cover of New Zealand pigmyweed (*Crassula helmsii*) around the lake margins. Other dominant species included alternate water-milfoil (*Myriophyllum alterniflorum*) and lesser pondweed (*Potamogeton pusillus*).

7.1.5.51 A list of aquatic macrophytes identified during the CSM survey, along with frequency of occurrence at sample points are shown in Table 7.1.15.

Table 7.1.15: Bolder Mere CSM macrophyte survey results

Submerged and floating vegetation	Frequency (%) (n=104)*
Rigid hornwort <i>Ceratophyllum demersum</i>	18.3
Stonewort <i>Chara globularis</i>	15.4
New Zealand pigmyweed <i>Crassula helmsii</i>	10.6
Nuttall's waterweed <i>Elodea nuttallii</i>	95.2
Common duckweed <i>Lemna minor</i>	5.8
Ivy-leaved duckweed <i>Lemna trisulca</i>	5.8
Alternate water-milfoil <i>Myriophyllum alterniflorum</i>	57.7
Water lily <i>Nymphaea</i> spp. "cultivar"	1.9
Amphibious bistort <i>Persicaria amphibia</i>	2.9
Small pondweed <i>Potamogeton berchtoldii</i>	1.9
Curled pondweed <i>Potamogeton crispus</i>	1.0
Blunt-leaved pondweed <i>Potamogeton obtusifolius</i>	1.0
Lesser pondweed <i>Potamogeton pusillus</i>	42.3
Horned pondweed <i>Zannichellia palustris</i>	2.9

*Based on data from all vegetated sample plots in the survey. Red text indicates invasive non-native species (INNS).

Habitat surveys

7.1.5.52 The surveys have identified the following dominant meso-habitats:

- Common reed dominated emergent vegetation, relatively species poor in terms of other wetland plants due to the reed out-competing most other plant species.
- Mixed emergent vegetation including 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*). *Crassula helmsii* is abundant in these areas.
- Wetland acid bog flora, including stands of purple moor-grass (*Molinia caerulea*) and Sphagnum spp., with common sedge (*Carex nigra*) and lesser spearwort (*Ranunculus flammula*). Other species less common in the south-east of England, include marsh St John's-wort (*Hypericum elodes*) and common cottongrass (*Eriophorum angustifolium*).

- Open water habitat dominated by Nuttall’s water weed (*Elodea nuttalli*), alternate water-milfoil (*Myriophyllum alterniflorum*) and lesser pondweed (*Potamogeton pusillus*).

7.1.5.53 In total, 41 macrophyte species were identified during all surveys (habitat surveys and CSM survey). A full list is presented in the Bolder Mere report in Appendix 7.7.

Macroinvertebrate surveys

7.1.5.54 Aquatic macroinvertebrates were sampled within five distinct habitats were identified within Bolder Mere:

- Sample 1 – north west shore – within submerged common reed. Substrate was mainly organic silts and leaf litter overlying rocky material.
- Sample 2 – south west shore – within shallow littoral zone, amongst emergent stands of common spike rush and branched bur-reed. Substrate was mix of loosely consolidated pebbles and gravel mixed with fine silt and leaf litter.
- Sample 3 – south shore – sample taken within 30-50 cm water depth within beds of submerged aquatic vegetation dominated by alternative water-milfoil and lesser pondweed. Substrate consisted of fine silt overlying consolidated gravel.
- Sample 4 – open water – sample taken in 85-95 cm water depth within beds of dense submerged aquatic vegetation dominated by Nuttall’s pondweed. Substrate consisted of fine silt with occasional areas of harder consolidated gravels.
- Sample 5 – open water sediments – sample taken in 75-90 cm water depth in areas where the submerged vegetation was less dense.

7.1.5.55 A summary of the number of taxa identified during the survey, along with relevant metrics are shown in Table 7.1.16.

Table 7.1.16: Bolder Mere aquatic macroinvertebrate survey results

	Sample					
	1	2	3	4	5	Combined
Number of taxa	21	25	25	13	8	42
Number of families	16	21	20	9	6	30
Number of BMWP families	11	16	14	6	4	22
BWMP score	47	76	64	25	12	108
Average score per taxon ASPT	4.27	4.75	4.57	4.17	3.00	4.91
Number of WHPT families	15	17	16	7	4	26
WHPT score	54.8	61.6	57.5	25.5	10.4	101.1
Average score per taxon ASPT	3.65	3.62	3.59	3.64	2.60	3.89

Notes: BMWP = Biological Monitoring Working Party, ASPT = Average Score Per Taxon, WHPT = The Whalley, Hawkes, Paisley & Trigg classification method enables the assessment of invertebrates in rivers in relation to general degradation, including organic pollution.

- 7.1.5.56 A total of 42 aquatic macroinvertebrate species were recorded representing 30 families. The two marginal sites (sample 1 and 2) and the littoral zone on the south shore (sample 3) had the highest number of taxa, with the open water site and sediment site supporting much lower numbers.
- 7.1.5.57 In terms of the particular conservation interest from each meso-habit, we found no species of high conservation status (e.g. those listed in the UK Red data book for insects (Shirt 1987²¹)). There were however a number of taxa recorded that favour better quality aquatic environments.
- 7.1.5.58 Although Bolder Mere is noted for its Odonata, none of the nymphs recorded at survey were rare species. The warm sunny conditions during the survey were excellent for adult dragonflies and damselflies and a number of species were recorded on the wing at the site. Again, these did not include any of the rarities recorded previously from the site.

7.1.6 Discussion

Screening

- 7.1.6.1 Of the 25 watercourses and eight standing water bodies identified within the Screening Area 12 watercourses and three standing water bodies have been taken forward to assessment and screening for survey requirements. Desk study and walkover survey information resulted in the screening of four watercourses and one standing water body as requiring further habitat and/or species surveys.

Watercourses

- 7.1.6.2 Following screening, the following watercourses were taken forward for impact assessment:
- Stratford Brook
 - River Wey
 - River Mole
 - Ditch adjacent A3

Stratford Brook

- 7.1.6.3 RCS identified that both the upstream and downstream 500 m reaches of the Stratford Brook were heavily shaded, limiting aquatic vegetation present. The upstream 500 m displayed a much more natural planform with the downstream 500 m reach straightened with limited planform variability.
- 7.1.6.4 Desk study information and field survey data for macroinvertebrates indicate 'moderate' to 'good' biological water quality with species assemblages of low conservation value that are affected by siltation and slow flows. Desk study macrophyte data indicates assemblages tolerant of high nutrient conditions.

²¹ Shirt, D.B. (ed.) (1987). British Red Data Books: Insects, Joint Nature Conservation Committee. On line at: <http://www.nhm.ac.uk/our-science/data/uk-species/checklists/NBNSYS0000000025/index.html>

- 7.1.6.5 The majority of fish species recorded within the Stratford Brook are typical of those found in small, silted watercourses. Fish population densities were low, which is likely to reflect habitat quality (including neighbouring land use identified as arable or pasture potentially contributing diffuse runoff or sediment) and indicate wider catchment pressures on fish populations, for example barriers to movement/habitat quality.

River Wey

- 7.1.6.6 RCS identified the River Wey as a wide river with moderate flows, meandering through low lying rough pasture floodplain. Intermittent trees line the banks with large amounts of the invasive non-native floating pennywort and occasional Himalayan balsam.
- 7.1.6.7 Desk study information for macroinvertebrates indicates 'very good' biological water quality with species assemblages with a preference for fast flows and moderately tolerant to sedimentation. Desk study macrophyte data indicates assemblages tolerant of high nutrient conditions, and desk study fish data include coarse fish typical of lowland rivers.

River Mole

- 7.1.6.8 Desk study RHS and RCS field survey information identified the River Mole as a wide, modified river (over deepened for more than 33% of its length), with moderate flows through rough pasture farmland, mature woodland and semi-formal gardens.

Ditch adjacent A3

- 7.1.6.9 The ditch adjacent to the A3 was considered as having potential to support aquatic macroinvertebrates due to its location adjacent to Bolder Mere and that while ephemeral, contained water for more than half the year. Field survey data for macroinvertebrates indicate biological water quality is 'Poor' and of low ecological importance.

Standing water bodies

- 7.1.6.10 Following screening, all standing water bodies were taken forward for impact assessment.
- 7.1.6.11 Habitat and species surveys were undertaken on Bolder Mere, including macrophyte and aquatic macroinvertebrate surveys.
- 7.1.6.12 None of the macrophyte species recorded during survey were 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 Nuttall's waterweed along with a significant cover of New Zealand pigmyweed.
- 7.1.6.13 Distinct habitats were identified within the lake and at the margins, with the southern margins proving the most diverse in terms of macrophytes and macroinvertebrate assemblages. Field survey data classifies the site as "very good" in terms of its macroinvertebrate fauna. While the SSSI is noted for its rare Odonata species, no rarities were recorded during the survey.

7.1.7 Scheme aquatic ecology data

River Corridor Survey maps

Stratford Brook upstream

River Corridor Survey Stratford Brook, Ripley, Surrey – Section 1 – 21/09/17

Undertaken by: Atkins
Weather: overcast, mild, no recent rain
NGR u/s: TQ 06372 57417
NGR d/s: TQ 06278 57475

Summary

The 500m of the Stratford Brook surveyed was found to be heavily shaded by mature woodland, predominantly alder within the first 300m of the culvert, with a mixture of oak and other species along the banks of the most upstream 200m. This shading prevented the presence of any in-stream aquatic vegetation.

Upstream, the watercourse was characterised by a succession of meanders with unvegetated gravel bars and occasional pools, creating a variety of habitats for aquatic macro-invertebrates. Further downstream, the wetted width filled the whole channel with a mostly uniform depth. No flow was evident along the whole reach, with the water changing from clear upstream to becoming increasing turbid downstream towards the culvert.

Description of the watercourse

Broad nature

The reach surveyed can be split into two characteristic areas;

- The downstream section from the A3 culvert for approximately 200m upstream has increased water turbidity (bed substrate was not visible) with a narrower channel and lower banks.
- The upstream section from the start of the reach until approximately 200m from the A3 culvert is characterised by clear water, a wider channel with gravel bars and higher banks.

Throughout the whole 500m reach, there is heavy shading from mature broadleaf woodland and scrub. Alders (*Alnus glutinosa*) dominate the downstream section with an increase in oak upstream. Occasional holly, elder and willow trees are present on both banks. Tall grass and herbs are present on both banks throughout and large stands of the invasive non-native species Himalayan balsam are present in places with evidence of management (cutting). Ground cover species include ground ivy (*Glechoma hederacea*), nettles, enchanter's nightshade (*Circaea lutetiana*) and brambles (*Rubus fruticosus*).

Dimensions

The majority of the reach is between 2-2.6m wide. However, towards the downstream end, the channel narrows to approximately 1.5m wide. Upstream, the watercourse was characterised by a succession of meanders with unvegetated gravel bars. Further downstream, the wetted width filled the whole channel with a mostly uniform depth. No flow was evident along the whole reach, with the water changing from good clarity to becoming increasing turbid towards the culvert.

Substrate

At the time of survey, the bed was not visible at the downstream end due to increased turbidity, however further upstream the substrate consisted of gravels and sand, overlaid with silt and detritus.

Bank structure

The left and right bank face were near vertical throughout the reach with some areas of slump. Bank substrate consisted of earth with some clay. Upstream, bank heights were approximately 1.25m. Downstream the bank heights were 0.5m.

Side channels / structures

An old brick footbridge was present towards the upstream end and two dry side channels were identified. A cable also crossed the river close at bank top height (assumed to be an electricity supply cable).

Instream / marginal vegetation

There was very little marginal vegetation throughout the 500m reach, although there was some terrestrial grasses and liverworts on bank face. Pendulous sedge were recorded in places on the bank top along with terrestrial grasses and scrub species. The only instream vegetation found was one small patch of common duckweed (*Lemna minor*).

Adjacent land use

Adjacent land use consisted of semi-improved grassland (pasture) to the south of the river (left hand bank) and a mixture of unimproved grassland and arable to the north of the river (right hand bank).

Other notes

Large stands of the invasive non-native species Himalayan balsam, were present along the 500m reach. The largest stand had been cut in a recent management attempt. An American mink (*Neovison vison*) was also observed in the channel.

Management recommendations and enhancement opportunities

It is likely that heavy shading by the mature broadleaf woodland has limited the presence of any in-channel and marginal aquatic macrophytes. The removal of occasional trees and/or scrub to allow more light into the channel could encourage aquatic macrophytes to establish within this reach.

There was evidence of recent management of a large stand of Himalayan balsam for which continued management/removal is recommended.

Photo 1 – Looking upstream from close to A3 culvert. Water impounded and turbid.

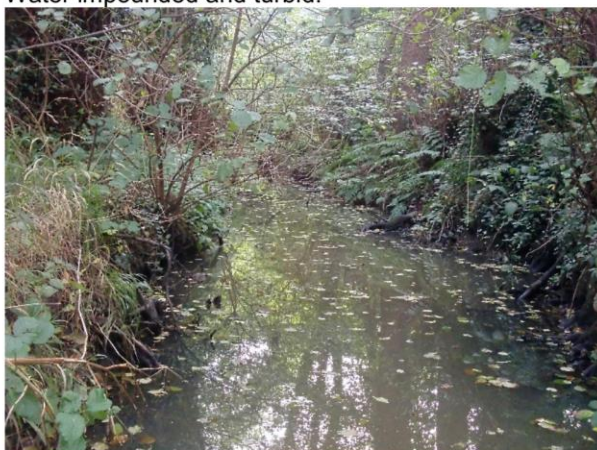


Photo 2 – One of two dry side channels marked on OS mapping



Photo 3 – Looking upstream mid-500m section. Gravel side and in-channel bars forming.



Photo 4 – Dry side channel

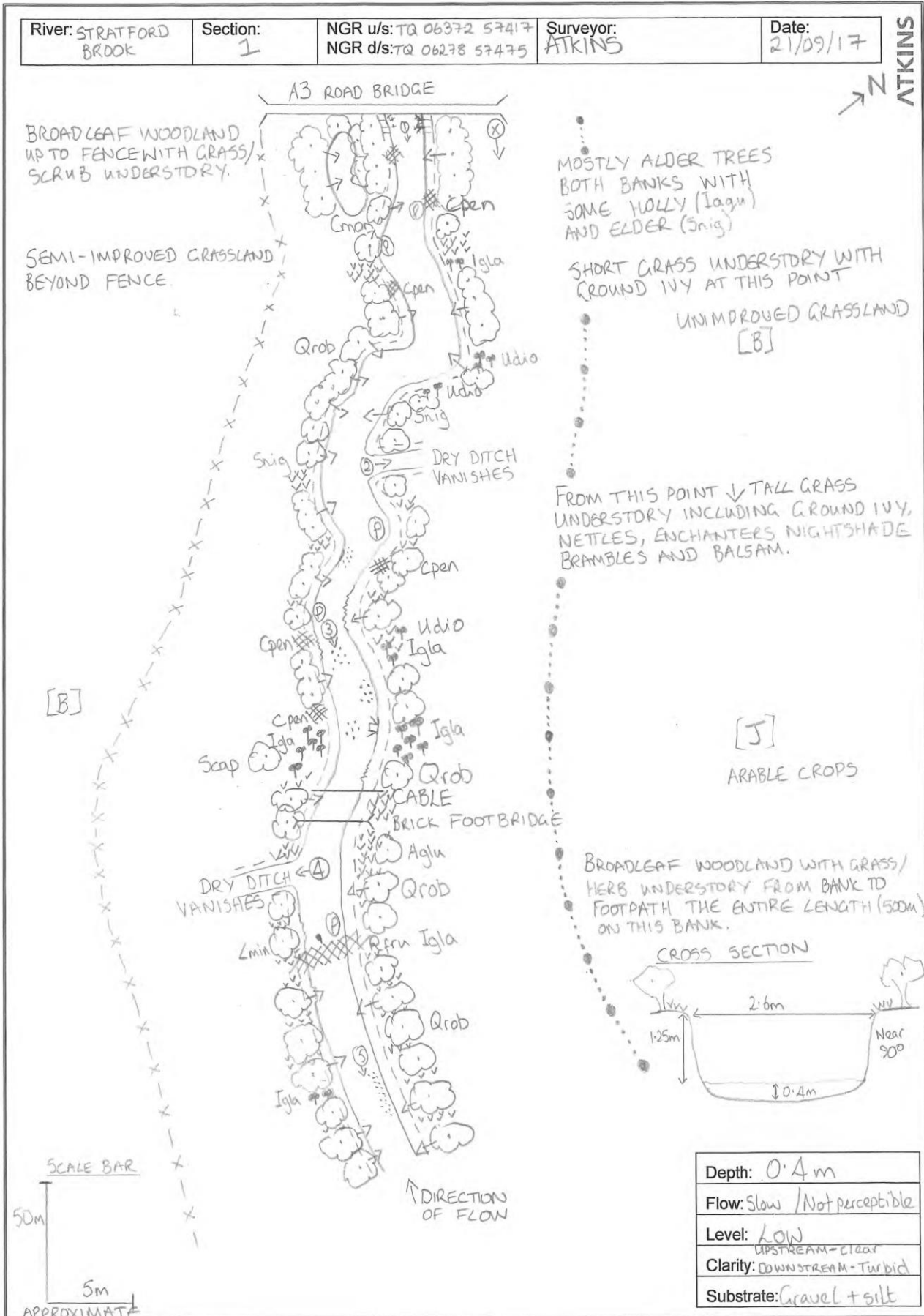


Photo 5 – Looking upstream towards end of 500m reach. Gravel/sediment side bar present.



Abbreviations within the Stratford Brook Section 1 River Corridor Survey sketch are:

Abbreviation	Scientific name	Common name
Aglu	<i>Alnus glutinosa</i>	Alder
Cmon	<i>Crataegus monogyna</i>	Hawthorn
Cpen	<i>Carex pendula</i>	Pendulous sedge
Iqua	<i>Ilex aquifolium</i>	Holly
Igla	<i>Impatiens glandulifera</i>	Himalayan balsam
Lmin	<i>Lemna minor</i>	Common duckweed
Scap	<i>Salix caprea</i>	Goat willow
Snig	<i>Sambucus nigra</i>	Elder
Qrob	<i>Quercus robur</i>	Pedunculate oak
Udio	<i>Urtica dioica</i>	Common nettle



Stratford Brook downstream

River Corridor Survey

Stratford Brook, Ripley, Surrey – Section 2 – 07/09/2018

Undertaken by: Atkins

Weather: Sunny with overcast spells, mild, no recent rain

NGR u/s: TQ 06182 57537

NGR d/s: TQ 05745 57740

Summary

A straightened channel, with a mix of dense scrub and woodland shading the entire reach, preventing access and aquatic macrophytes from establishing within the reach. A large amount of Himalayan balsam was present along the entire reach mixed with brambles and bracken with little else present.

Description of the watercourse

Broad nature

The reach surveyed was very overgrown with brambles (*Rubus fruticosus*), common nettle (*Urtica dioica*), bracken (*Pteridium aquilinum*) and Himalayan balsam (*Impatiens glandulifera*) making it very difficult to get to the channel which was only really accessible at the most upstream end close to the Stratford Brook culvert, and at a small access track/road crossing approximately 240m downstream of the culvert. When visible the channel was straightened and heavily shaded by the marginal and bankside vegetation, including occasional mature trees, saplings and shrubs.

Dimensions

The majority of the reach was not visible due to the dense scrub and trees. Where visible, the channel was between 1.5-2.5m wide, wider at the Stratford Brook culvert end. Water, when undisturbed was relatively clear.

Substrate

Where the channel was visible, the bed substrate consisted of a mix of gravels and sand, with areas of silt deposits and detritus/leaf litter.

Bank structure

Bank substrate consisted of earth with some clay and sand. Where visible, the banks were stable and heavily vegetated with terrestrial species. Both banks were approximately 1m high, with gentle embankments on both banks, the right embankment higher at approximately 2.5m compared to the left bank at approximately 1.75m.

Side channels / structures

No side channels were noted, however only a small section of the 500m reach was visible. The Stratford Brook Culvert at the most upstream end, is a large structure, approximately 90m long. There is a small access track/road crossing approximately 240m downstream of the culvert end.

Instream / marginal vegetation

Only a small part of the 500m reach was visible at survey. A large stand of fool's water-cress (*Apium nodiflorum*) was present at the most upstream end of the reach, at the culvert exit. No in-channel vegetation as present at the only other accessible point, at the small access track/road. Marginal vegetation was limited to terrestrial plants, which were very overgrown throughout the 500m reach.

Adjacent land use

Adjacent land use consisted of a dense mix of tall grasses and herbs with woodland scrub directly adjacent to the channel, with semi-improved grassland used as a car boot sale site behind, to the south of the river (left hand bank). North of the river (right hand bank) consisted of a mixture of woodland scrub and tall grasses and herbs. Along with the dense bramble/bracken/nettle/balsam mix, were occasional mature trees including crack willow (*Salix fragilis*), ash (*Fraxinus excelsior*) and sycamore (*Acer pseudoplatanus*). A large number of poplar (*Populus nigra*) were present close to the small access track/road.

Other notes

Large stands of the invasive non-native species Himalayan balsam, were present along the entire 500m reach.

Management recommendations and enhancement opportunities

It is likely that heavy shading by mix of trees and scrub has limited the presence of any in-channel and marginal aquatic macrophytes. The removal of occasional trees and/or scrub to allow more light into the channel could encourage aquatic macrophytes to establish within this reach. The removal of the large stands of Himalayan balsam is also recommended.

Photo 1 – Looking downstream from A3 culvert.



Photo 2 – Looking toward the stream from main road. Very overgrown, access to stream very difficult.



Photo 3 – Looking downstream towards minor road crossing.

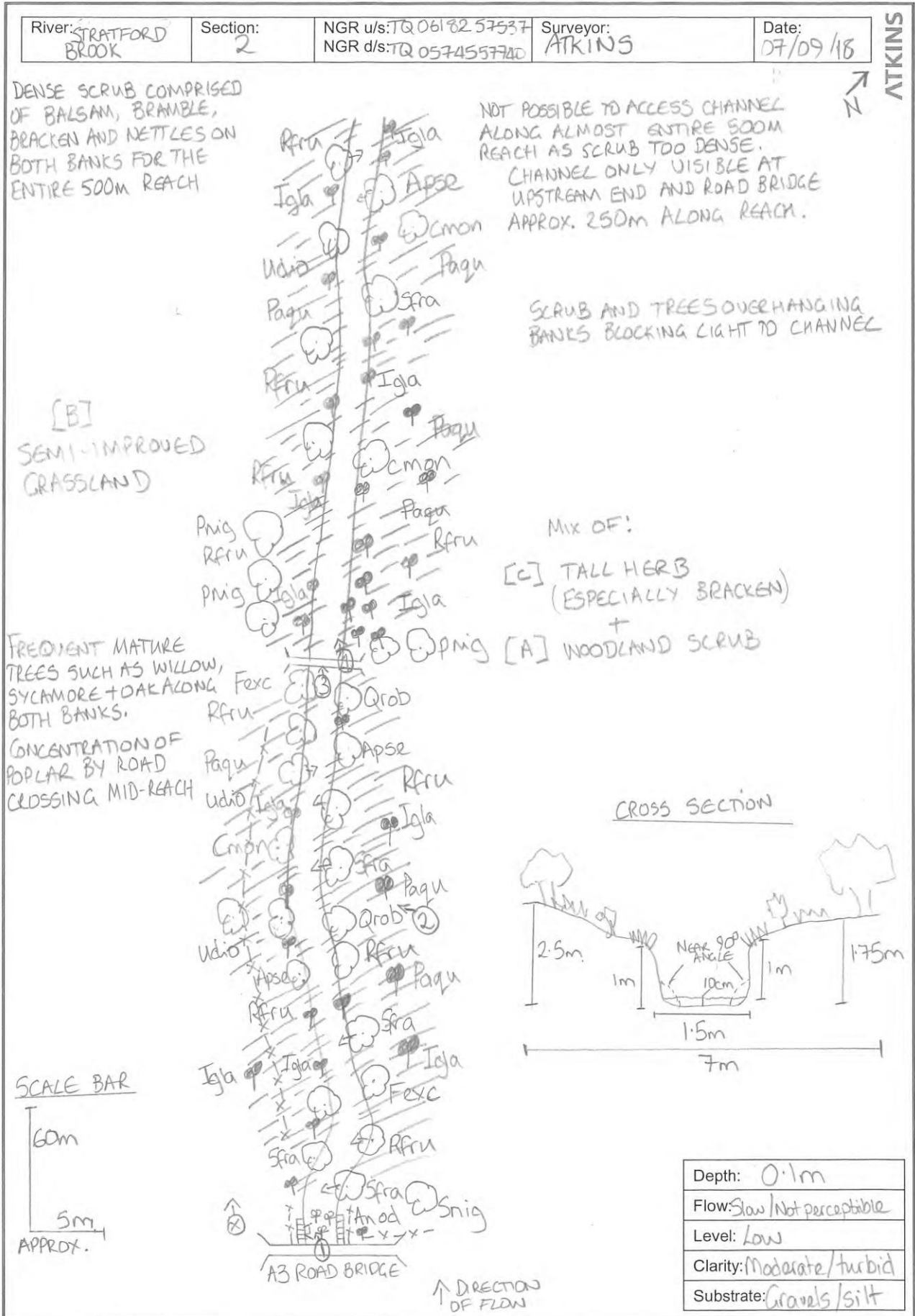


Photo 4 – Looking downstream from minor road crossing.



Abbreviations within the Stratford Brook Section 2 River Corridor Survey sketch are:

Abbreviation	Scientific name	Common name
Anod	<i>Apium nodiflorum</i>	Fool's-water-cress
Apse	<i>Acer pseudoplatanus</i>	Sycamore
Cmon	<i>Crataegus monogyna</i>	Hawthorn
Fexc	<i>Fraxinus excelsior</i>	Ash
Igla	<i>Impatiens glandulifera</i>	Himalayan balsam
Paqu	<i>Pteridium aquilinum</i>	Bracken
Pnig	<i>Populus nigra</i>	Black Poplar
Qrob	<i>Quercus robur</i>	Oak
Sfra	<i>Salix fragilis</i>	Crack Willow
Snig	<i>Sambucus nigra</i>	Elder
Udio	<i>Urtica dioica</i>	Common nettle



River Wey

River Corridor Survey River Wey, near Park Barn Farm, Surrey – 07/09/18

Undertaken by: Atkins
Weather: overcast, mild, no recent rain
NGR u/s: TQ 06870 59856
NGR d/s: TQ 07236 60099

Summary

The 500m of the River Wey surveyed was wide and slow flowing, with an open bank structure, comprised of tall herbs/grass and occasional mature trees (with a small area of woodland) shading the waters edge. Marginal vegetation was extensive with large amounts of the invasive non-native species floating pennywort (*Hydrocotyle ranunculoides*) present throughout with occasional other in-channel vegetation. The channel was wide with a smooth flow and little variation in morphology. Substrate was not visible with the water clarity low.

Description of the watercourse

Broad nature

There was little change in general morphology throughout the reach. The channel was wide and deep throughout with a smooth flow. The channel flows through low lying fields providing a flood plain in times of high flow. Both banks were similar heights with water close to bank top at time of survey. Marginal and in-channel vegetation consisted predominantly of reed canary grass (*Phalaris arundinacea*) and reed sweet grass (*Glyceria maxima*) which provided some habitat variability, although the presence of floating pennywort could impact the growth of other vegetation if not managed.

Dimensions

The channel was approximately 20m wide, with wide banks of marginal vegetation, particularly on the left bank. There was little variation in width along the 500m reach.

Substrate

The channel was deep and bed substrate not visible at the time of survey due to depth and turbidity of water.

Bank structure

Both banks were of equal height with water no more than 50cm from bank top. Both banks sloped steeply into the water (approx. 90°). Dense marginal vegetation was present on both banks throughout the 500m reach. Good connectivity to the flood plain was evident throughout, with wide flat fields adjacent to the channel. Occasional trees and a small woodland were present throughout, predominantly alders (*Alnus glutinosa*) with willow (*Salix fragilis*), sycamore (*Acer pseudoplatanus*) and oak (*Quercus robur*).

Side channels / structures

The map suggests several side channels flow into the river throughout the 500m reach. The bank was surveyed from the right with one indistinct side channel present, although this entered the main channel close to bank top. No side channels were observed entering the main channel from the left hand bank.

Instream / marginal vegetation

Dense marginal vegetation was present throughout, comprised mostly of reed canary grass, reed sweet grass, hairy willowherb (*Epilobium hirsutum*) and common nettle (*Urtica dioica*). Large amounts of floating pennywort was present throughout the reach, in places extending up to 1/3 of the channel width. Other vegetation present included bulrush (*Typha latifolia*), arrowhead (*Sagittaria sagittifolia*) and unbranched bur-reed (*Sparganium emersum*).

Adjacent land use

Fields adjacent to both banks consisted of rough pasture and were low lying.

Management recommendations and enhancement opportunities

The large amounts of floating pennywort present could potentially limit other native vegetation present in a short space of time. Himalayan balsam (*Impatiens glandulifera*) was also present, mostly within woodland adjacent to the river but on occasion at the waters edge also.

Photo 1 – Upstream end looking across channel. Overhanging trees and floating pennywort present.



Photo 2 – Looking across channel, mid reach. Floating pennywort present



Photo 3 – Looking upstream from mid 500m reach.

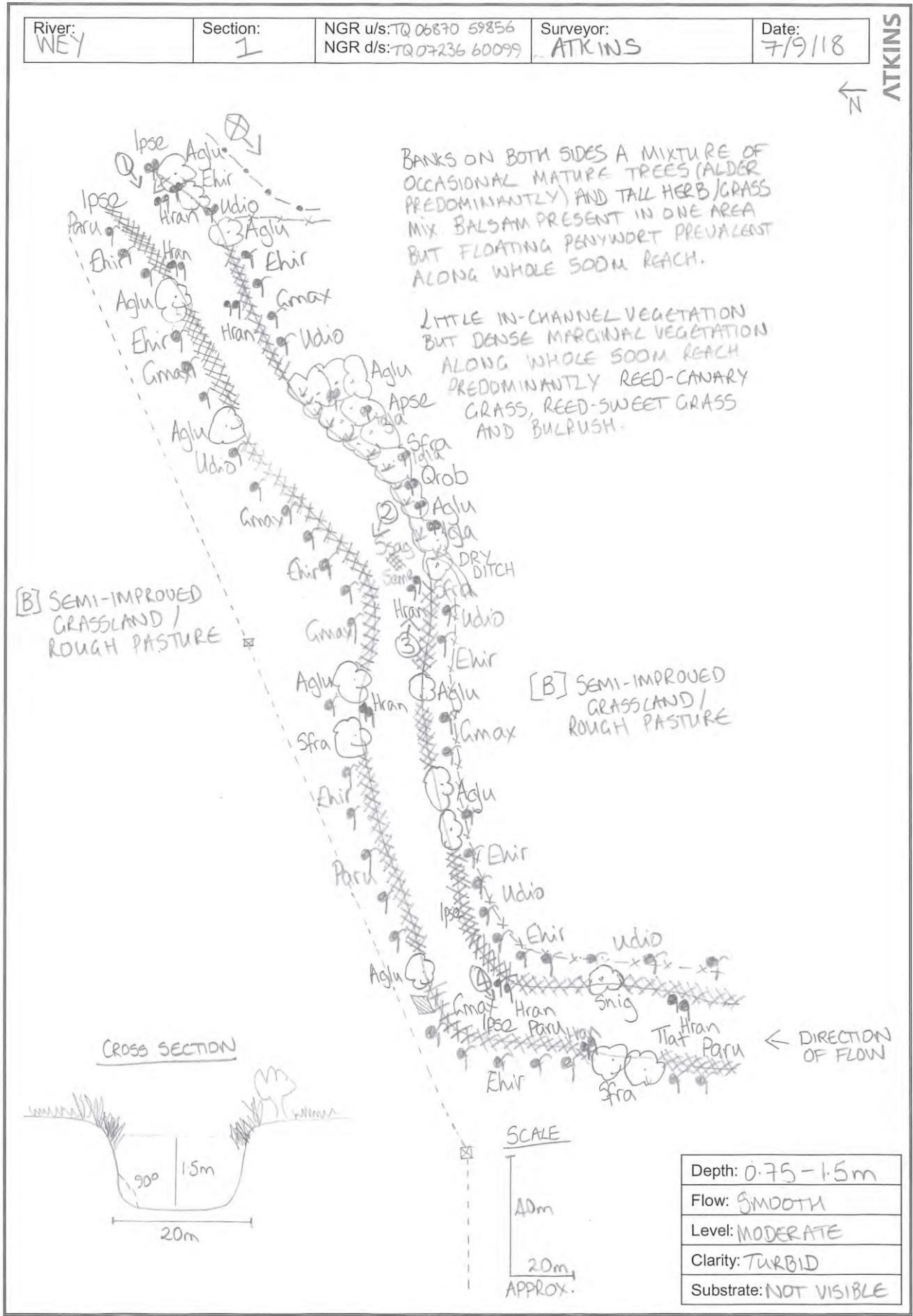


Photo 4 – Upstream end, looking across channel with floating pennywort



Abbreviations within the River Wey River Corridor Survey sketch are:

Abbreviation	Scientific Name	Common name
Aglu	<i>Alnus glutinosa</i>	Alder
Apse	<i>Acer pseudoplatanus</i>	Sycamore
Ehir	<i>Epilobium hirsutum</i>	Hairy willowherb
Gmax	<i>Glyceria maxima</i>	Reed-sweet grass
Hran	<i>Hydrocotyle ranunculoides</i>	Floating pennywort
Igla	<i>Impatiens glandulifera</i>	Himalayan balsam
Ipse	<i>Iris pseudacorus</i>	Yellow Iris
Paru	<i>Phalaris arundinacea</i>	Reed-canary grass
Qrob	<i>Quercus robur</i>	Oak
Seme	<i>Sparganium emersum</i>	Unbranched bur-reed
Sfra	<i>Salix fragilis</i>	Crack willow
Snig	<i>Sambucus nigra</i>	Elder
Ssag	<i>Sagittaria sagittifolia</i>	Arrowhead
Tlat	<i>Typha latifolia</i>	Bulrush
Udio	<i>Urtica dioica</i>	Common nettle



River Mole

River Corridor Survey

River Mole, Painshill Park Cobham, Surrey – 07/09/18

Undertaken by: Atkins
Weather: overcast, mild, no recent rain
NGR u/s: TQ 09083 59560
NGR d/s: TQ 08849 59705

Summary

Wide, slow flowing river surrounded by mature woodland and rough pasture. Upstream, the river runs through rough pasture on both banks, with the left bank becoming much higher and steeper mid-reach. The downstream end is marked by the bifurcation of the river through the semi-formal gardens of Painshill Park.

Description of the watercourse

Broad nature

The river meanders through rough pasture, mature woodland and into semi-formal gardens. Hedgerows dominate the right bank upstream with tall herbs and grasses on the left bank. Flowing downstream, the bank height increases, significantly on the left with mature woodland stretching down to the banks of the river, limiting marginal vegetation in this area. Mature trees lining the banks consists mostly of ash (*Fraxinus excelsior*), alder (*Alnus glutinosa*) and willow (*Salix fragilis*). Marginal vegetation includes branched bur-reed (*Sparganium erectum*), nettle (*Urtica dioica*) and willowherb (*Epilobium hirsutum*). Downstream the river flows through the semi-formal gardens of Painshill Park, where sweet chestnut dominates (*Castanea sativa*). Flow was smooth throughout, with turbid water preventing estimation of depth.

Dimensions

The width of the channel varies through the 500m reach. Upstream it is approximately 12m from bank top to bank top. Mid reach where the river bends from flowing west/south west to flowing north, is up to 20m wide with instable banks creating vegetated bars. Before the channel bifurcates at the downstream end it returns to approximately 12m wide.

Substrate

At the time of survey, the bed was not visible due to depth of water and turbidity.

Bank structure

Both banks were near vertical at the upstream and downstream sections, consisting of soil/clay/gravel mix. In these sections bank heights (from water to bank top) were between 1m – 1.5m high. Mid reach, the height of both banks increased, to approximately 2m on the right bank but up to 5m on the left. Here, the right bank was still vertical and susceptible to slump, with the left bank more gently angled. The mature woodland just downstream from here was on a steeply sloping hillside.

Side channels / structures

No side channels were identified at survey. Mid-reach a large willow tree had fallen into the channel with other large woody debris within the channel towards the downstream end. At the downstream end, where the channel bifurcates an old weir is present.

Instream / marginal vegetation

Little in-channel vegetation was identified and was limited to unbranched bur-reed (*Sparganium emersum*) present upstream. Marginal vegetation was present throughout on both banks, apart from mid-reach where the left bank was very steep and the mature woodland reached to the waters edge. Marginal vegetation was uniform throughout and consisted predominantly of branched bur-reed, reed canary grass (*Phalaris arundinacea*), nettle and willowherb.

Adjacent land use

Land adjacent to the river on the right bank was rough pasture throughout the 500m reach. For the right bank upstream, adjacent land use consisted of rough pasture. Mid-reach, mature woodland was present and downstream flowed through semi-formal gardens of Painshill Park.

Other notes

Occasional stands of Himalayan balsam, were present through the 500m reach.

Management recommendations and enhancement opportunities

Removal of Himalayan balsam is recommended.

Photo 1 – Looking upstream from most upstream end of reach. Marginal aquatics and willows present



Photo 2 – Woody debris within channel at meander section



Photo 3 – High, steep sided left hand bank mid 500m reach

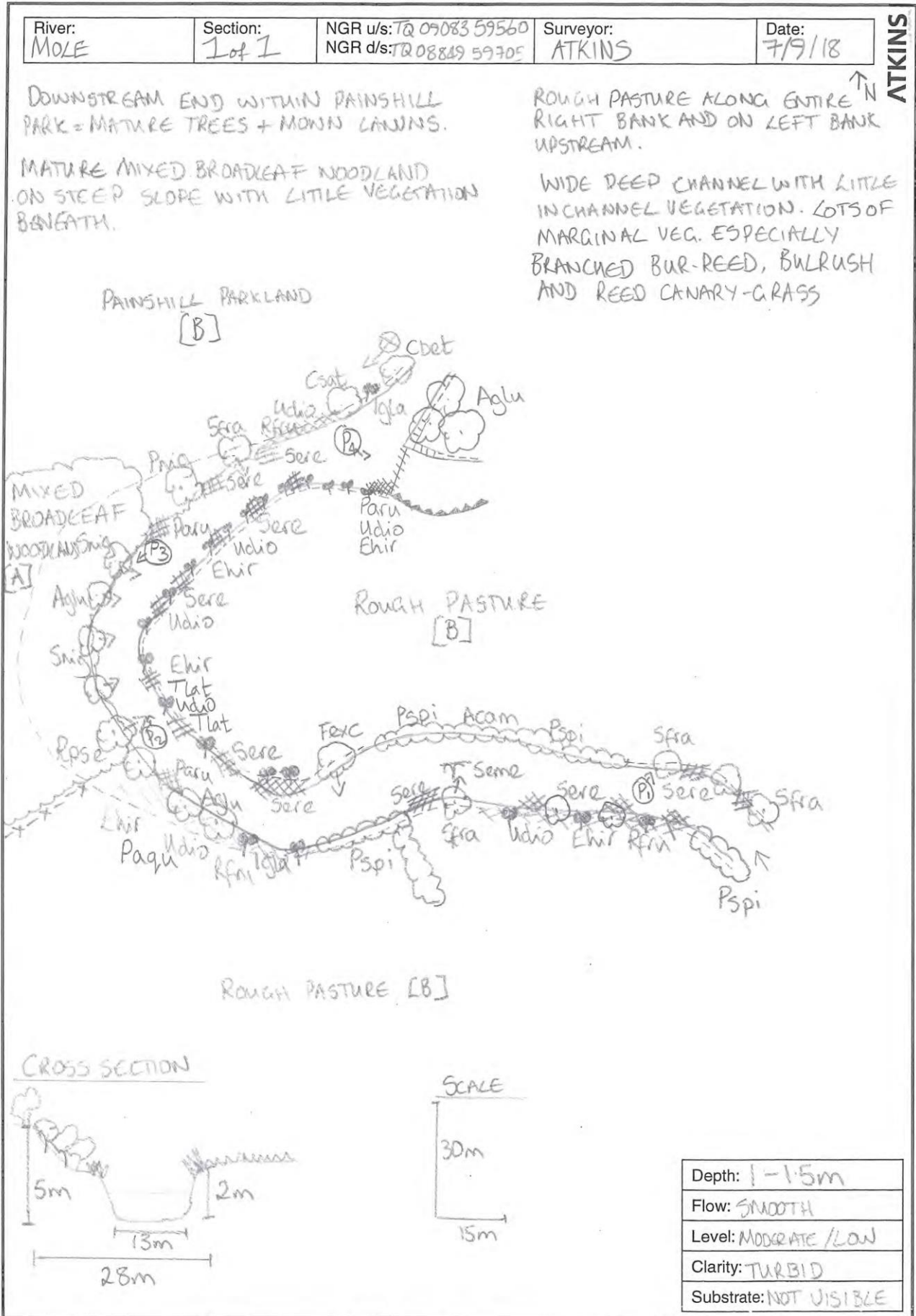


Photo 4 – Downstream end of reach with weir, where channel branches



Abbreviations within the River Mole River Corridor Survey sketch are:

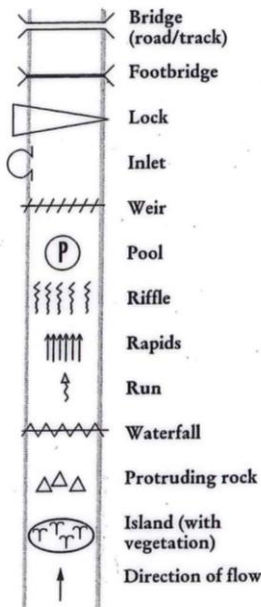
Abbreviation	Scientific name	Common name
Acam	<i>Acer campestre</i>	Field maple
Aglu	<i>Alnus glutinosa</i>	Alder
Cbet	<i>Carpinus betulus</i>	Hornbeam
Csat	<i>Castanea sativa</i>	Sweet chestnut
Ehir	<i>Epilobium hirsutum</i>	Hairy willowherb
Fexc	<i>Fraxinus excelsior</i>	Ash
Igla	<i>Impatiens glandulifera</i>	Himalayan balsam
Paru	<i>Phalaris arundinacea</i>	Reed-canary grass
Pauq	<i>Pteridium aquilinum</i>	Bracken
Pnig	<i>Populus nigra</i>	Black poplar
Pspi	<i>Prunus spinosa</i>	Blackthorn
Rfur	<i>Rubus fruticosus</i>	Bramble
Rpse	<i>Robinia pseudoacacia</i>	False acacia
Seme	<i>Sparganium emersum</i>	Unbranched bur-reed
Sere	<i>Sparganium erectum</i>	Branched bur-reed
Sfra	<i>Salix fragilis</i>	Crack willow
Snig	<i>Sambucus nigra</i>	Elder
Tlat	<i>Typha latifolia</i>	Bulrush
Udio	<i>Urtica dioica</i>	Common nettle



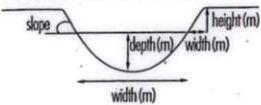
Key to symbols and abbreviations used in RCS

AQUATIC AND MARGINAL ZONES

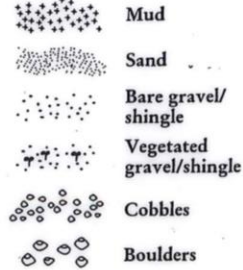
CHANNEL FEATURES



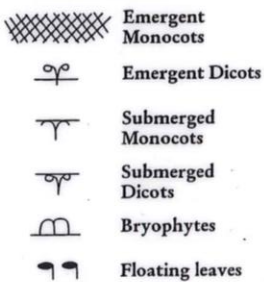
CHANNEL CROSS-SECTION



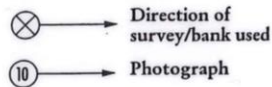
SUBSTRATE



CHANNEL VEGETATION

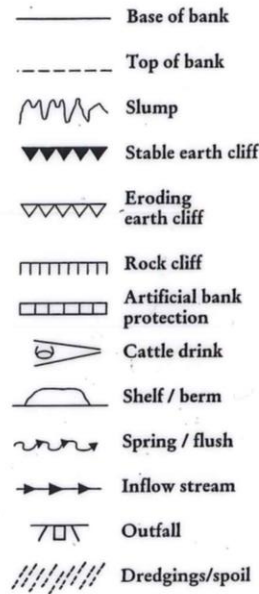


SURVEY INFORMATION

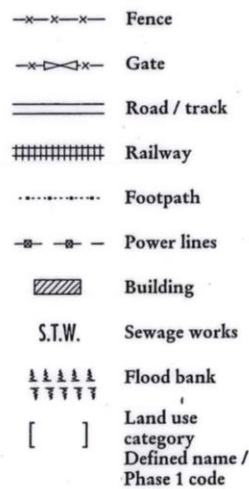


BANK AND ADJACENT LAND ZONES

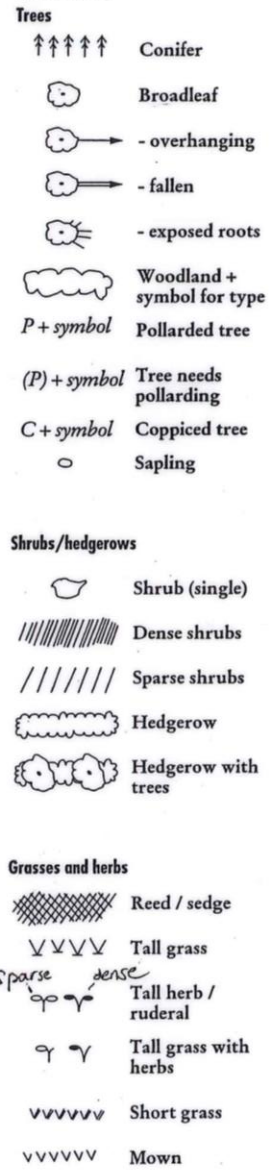
BANK FEATURES



ADJACENT LAND FEATURES



VEGETATION



Walkover survey maps

Manor Pond



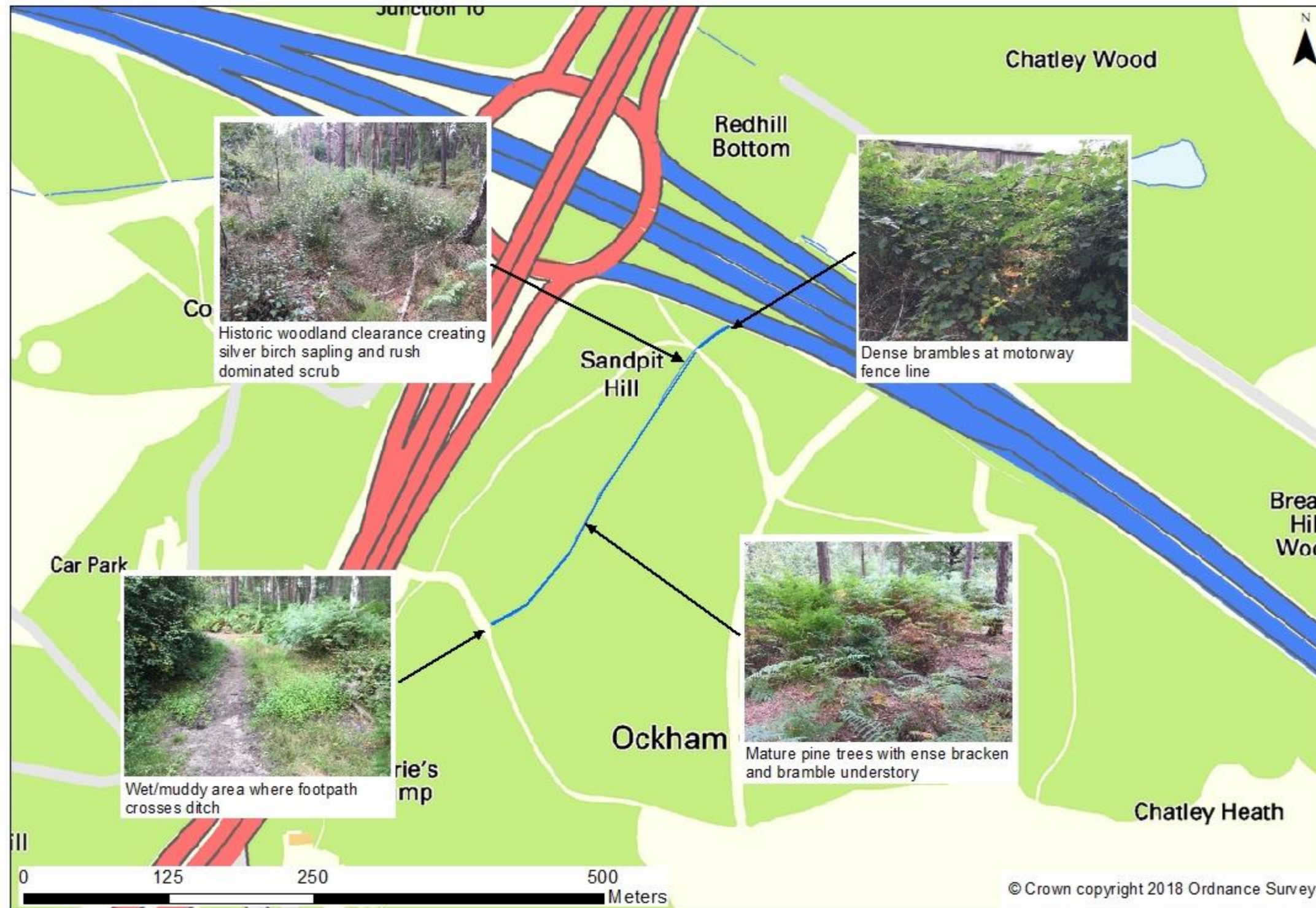
Large fishing pond with a smaller overgrown pond upstream (west). A concrete outfall structure is present on the eastern edge of the pond, which discharges to a ditch/wet woodland area and towards the River Mole approximately 280 m to the east. At the time of survey aquatic vegetation was limited in 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 invasive non-native species (INNS) bamboo and rhododendron were also present on the banks. At the time of the survey, the main pond level was approximately 1 m below outfall level resulting in the ditch/wet woodland area to the west being relatively dry. A large stand of INNS Himalayan balsam is present here among mature woodland. 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.

Bolder Mere



Small, shallow lake situated within mixed woodland and bordered to the northwest by the A3 dual carriageway. A large stand of common reed (*Phragmites australis*) runs adjacent to the A3, with smaller stands occurring along the eastern and northern shores. 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. Where the wetter areas extend into the woodland to the west and southeast of the site, there are stands of sedges and other emergent vegetation including common spike-rush (*Eleocharis palustris*), branched bur-reed and bulrush. New Zealand pigmyweed (*Crassula helmsii*) is present throughout, especially in the eastern shore where it grows in dense mats. Previous management works around the south side of the lake have focussed on removal of trees and scrub, to allow the development of a more natural acid bog flora, including purple moor-grass (*Molinia caerulea*) and *Sphagnum* spp.

Ockham Common ditch



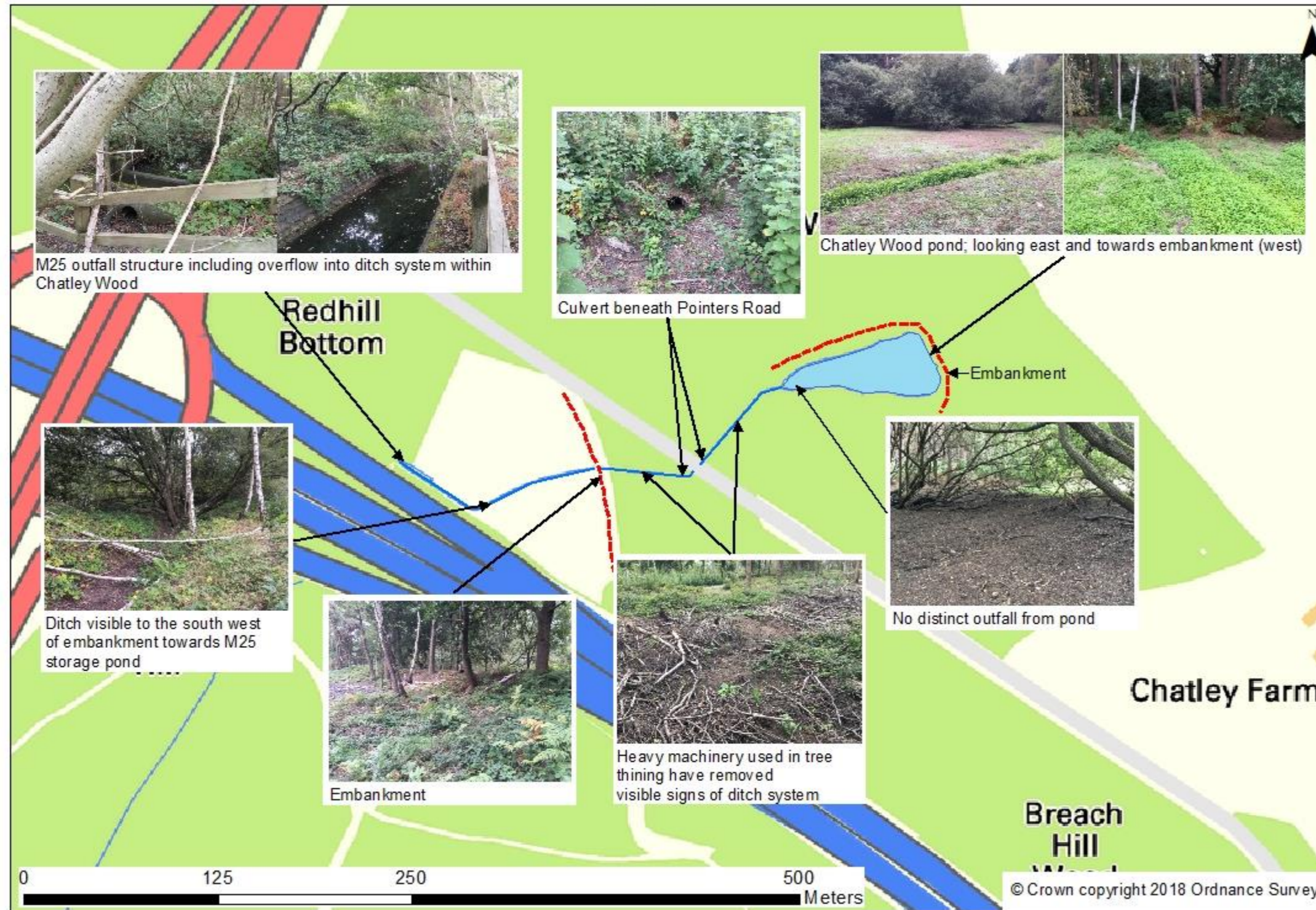
Shallow, ephemeral drainage ditch (dry at time of survey) and approximately 0.5 m wide. It flows through a dense woodland (a mix of broadleaf trees and conifers) with an understory of bracken and brambles. No wetland species were identified within the ditch. The ditch extends approximately 350 m north easterly towards hording adjacent to the M25. An area of wet woodland and a pond were found adjacent to the ditch, towards the north eastern end.

Pointers Road ditch



An ephemeral drainage ditch, between 1 - 1.5 m wide running for approximately 400 m along Pointers Road towards the A3. At the time of survey 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.

Chatley Wood pond and ditch



Large pond within mature woodland consisting predominately of Scots pine (*Pinus sylvestris*). The pond is noticeably embanked on the eastern and northern edges with occasional overhanging silver birch (*Betula pendula*) and willow species. At the time of survey, 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.

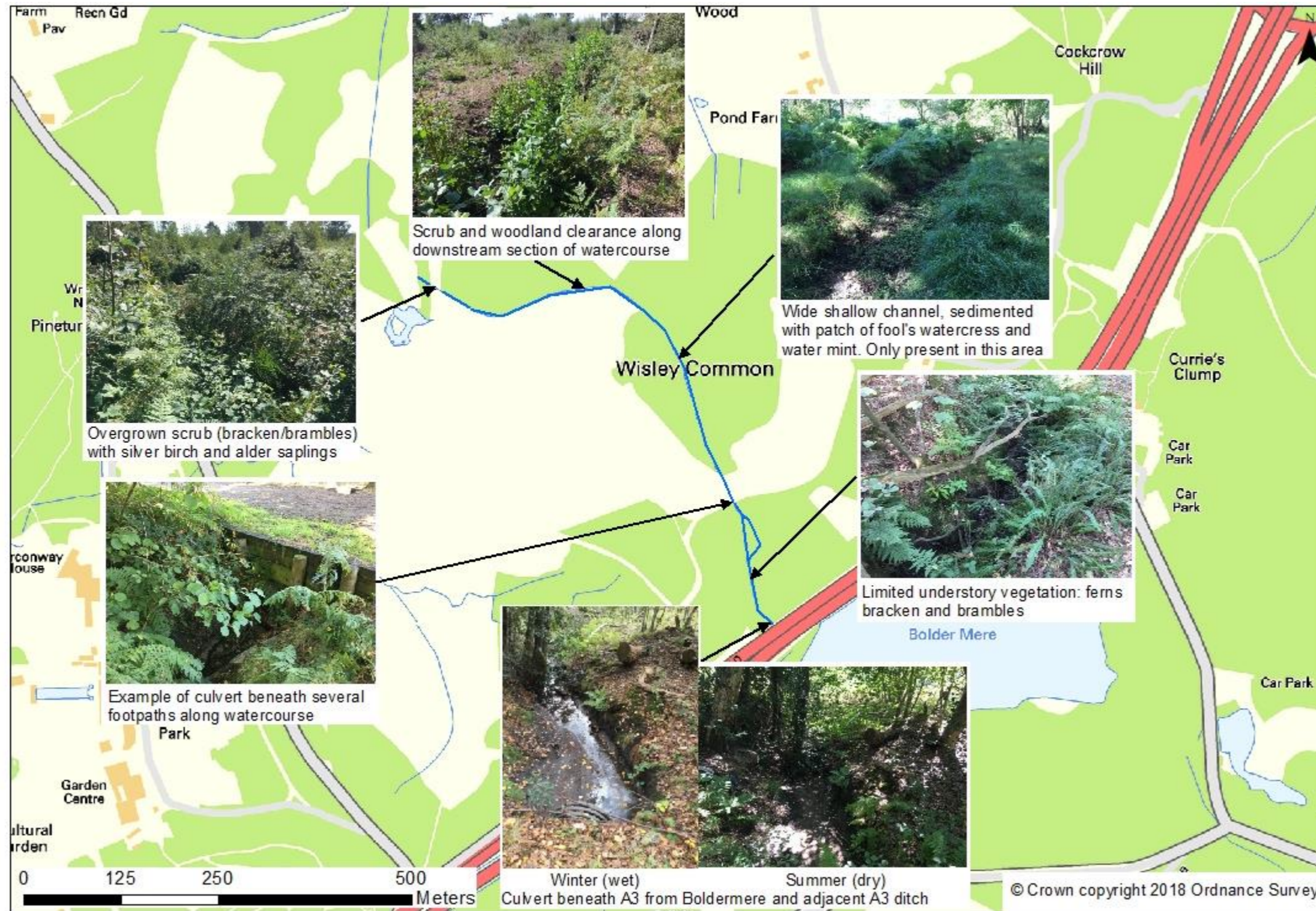
An indistinct ditch runs from Chatley Wood pond in a south western direction becoming more distinct in places, however, the use of heavy machinery for recent extensive tree removal works have removed any trace of a distinct ditch at other points and created the potential for a wet woodland in the winter.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

A3 ditch (adjacent to A3)



When surveyed in September 2018, the ditch adjacent to the A3 (southbound side) 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 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 1 m wide and at the downstream end banks are up to 0.5 m 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.

Pond Farm south ditch



This ditch receives water from Bolder Mere and from the ditch adjacent to the A3. It flows through mature woodland (a mix of conifer and broadleaf) with occasional woody debris and tree roots creating natural dams. When surveyed, 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, courtesy of flow from the ditch adjacent to the A3 (no flow was emanating from Bolder Mere).

Pond Farm west ditches & Hut Hill south ditches



Pond Farm west – A series of ditches flow north westerly through mature broadleaf woodland and rough pasture. The main ditch is approximately 1.5 m 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 and overgrown within hedgerows.

Hut Hill south – OS mapping suggests a series of ditches were present within an area of dense conifer trees. The recent use of heavy machinery to clear these trees and the resulting brush left behind has made it impossible to determine the route of these ditches. It is anticipated this may become a wet area in the winter.

Cockrow Hill ditches & Hut Hill ditch



Cockrow Hill – An ephemeral ditch system with no in-channel vegetation and within a mix of conifer and broadleaf woodland, and heathland. The ditch runs in a westerly direction into an area of wet heath.

Hut Hill – An ephemeral ditch running 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.

Elm Lane ditch



A small ditch flows alongside Old Lane, crossing Elm Lane. When surveyed flow 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.

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