M25 junction 10/A3 Wisley interchange TR010030
6.5 Environmental Statement: Appendix 7.8 Bolder Mere ecological survey and condition assessment

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M25 junction 10/A3 Wisley interchange

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

6.5 ENVIRONMENTAL STATEMENT:

APPENDIX 7.8 BOLDER MERE ECOLOGICAL SURVEY

AND CONDITION ASSESSMENT

Regulation Number:	Regulation 5(2)(a)
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Author:	M25 junction 10/A3 Wisley interchange project team, Highways England

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7.1 Bolder Mere: Ecological survey and condition assessment

7.1.1 Introduction

Background

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

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

Aim of this report

7.1.1.3 Highways England are proposing to make improvements to the road network around the M25 – A3 junction 10 (hereafter referred to as 'the Scheme'). Proposed modifications include widening of the A3 and the addition of a new road and bridge across the A3 which interact with several watercourses and water bodies, including Bolder Mere.

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

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

Survey team

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

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

7.1.2 Methods

Macrophyte survey

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

7.1.2.2 CSM (as described in JNCC 2015[1]) is the standardised methodology for assessing the condition of designated standing water features in the UK. Macrophyte data area collected in a structured manner from four discrete "sections" of the lake, each consisting of a 100 m length of shoreline from which macrophytes are recorded at set water depths (25, 50, 75 and >75 cm) from 20 points along the section. An addition transect is surveyed from the centre of the section out into open water, with 20 points recorded between 100 cm depth at the shore end, out to the maximum depth of macrophyte growth. A full description of the field methods is given in JNCC (2015).

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

Habitat survey

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

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

Aquatic macro-invertebrate survey

7.1.2.6 A full description of sampling methods for aquatic macro-invertebrates is given in BSI Standards Publication (ISO 10870:2012[2]), with identification following the

[1] 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
[2] BSI Standards Publication. Water quality- guidelines for the selection of sampling methods and devices for benthic macroinvertebrates in fresh waters (ISO 10870:2012)

Environment Agency Operational Instruction 024_08 (2012[3]).

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

7.1.2.8 Samples were conducted using a standard Freshwater Biological Association (FBA) handnet (0.35 mm mesh), with a total of 60 seconds of vigorous disturbance and sweeping conducted for each separate habitat type. Any stony or rocky habitats were sampled with a 60 second 'kick and sweep' technique with a standard FBA handnet, with extra attention given to any larger rocks or woody debris which was examined and hand-picked where necessary (not included within the times period). Because the site was so shallow (< 1.0 m), fine sediments in the open water areas were easily reached and sampled using the 'kick and sweep' technique. All sample points were categorised by vegetation and substrate type. Sample locations were recorded with GPS and georeferenced digital photographs taken.

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

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

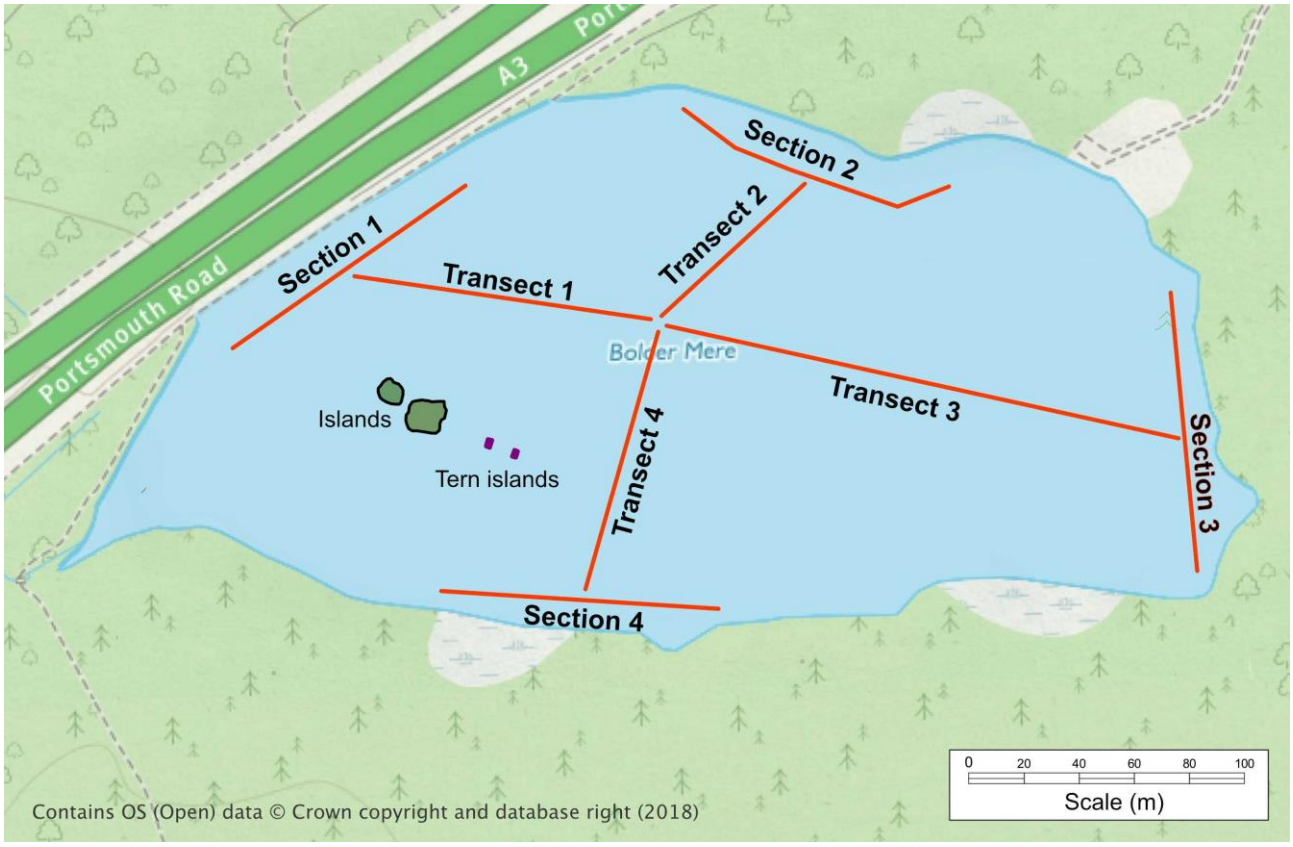
7.1.2.11 Taxomonic level follows that outlined in the EA Operational Instruction (2012) with each taxon assigned a Conservation Scores (CS) (after Chadd & Extence 2004[4]). BMWP (Armitage et al. 1983[5]) and WHPT (Walley & Hawkes 1996[6]) (including NTAXA and ASPT) were calculated for each site and the data combined with the assigned conservation scores to determine the Community Conservation Index (CCI, after Chadd & Extence 2004).

[3] Environment Agency Operational Instruction 024_08- Freshwater macro-invertebrate analysis of riverine samples (issued 02/10/2012).
[4] 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.
[5] Armitage, P.D., Moss, D., Wright, J.F. & Furse M.T. (1883) The performance of a new biological score system based on macro-invertebrates over a wide range of unpolluted running-water sites. Water Research, 17: 333-347.
[6] 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.

7.1.3 Summary results

CSM survey and condition assessment

Figure 7.1.1 Map of Bolder Mere showing CSM transect locations



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

7.1.3.2 Four sections were surveyed at Bolder Mere using the CSM methodology. The sections were chosen to focus on areas of different habitat types within the lake, as well as giving good geographical coverage (Figure 7.1.1). The lake is very shallow (maximum recorded depth of 1.0 m) and had aquatic plants growing throughout the entire expanse of open water. Boat transects were therefore conducted approximately perpendicular to each section to a point in the centre of the lake (TQ0761358414).

7.1.3.3 A total of 13 aquatic macrophyte species were recorded (Table 7.1.1) during the CSM survey. None of the species recorded are considered to be “characteristic” of favourable condition in shallow mesotrophic lakes and the site was dominated throughout the open water by the invasive non-native species (INNS) Nuttall’s waterweed *Elodea nuttallii* and had significant cover of the INNS, New Zealand Pigmyweed *Crassula helmsii*, in the shallow water in Section 4 and was abundant in the marginal zone around the south of the lake and into the wetter woodland area on the north shore (TQ0772558480).

Table 7.1.1: Aquatic macrophyte CSM data from Bolder Mere 26/06/2018

Submerged and floating vegetation	Species present (X)				26/07/2018 % Frequency (n=104)*
	S1	S2	S3	S4	
Ceratophyllum demersum	X	X	X	X	18.3
Chara globularis	X	X		X	15.4
Crassula helmsii		X		X	10.6
Elodea nuttallii	X	X	X	X	95.2
Lemna minor	X	X			5.8
Lemna trisulca	X	X			5.8
Myriophyllum alterniflorum	X	X	X	X	57.7
Nymphaea spp. "cultivar"	X				1.9
Persicaria amphibia				X	2.9
Potamogeton berchtoldii			X		1.9
Potamogeton crispus				X	1.0
Potamogeton obtusifolius				X	1.0
Potamogeton pusillus	X	X	X	X	42.3
Zannichellia palustris	X				2.9
Filamentous Algae	X				0.14

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

Bolder Mere condition assessment

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

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

7.1.3.6 For the purposes of reporting Bolder Mere is assumed to have been a natural Mesotrophic lake in its natural, undisturbed state. It is classified as being a high alkalinity, very shallow, low-altitude lake under UK Lakes WFD typology (Source CEH 2018[7]).

7.1.3.7 For a mesotrophic open water feature for be considered as being in favourable condition, it should normally be expected to have at least eight "characteristic" (i.e. typical of good condition) species present, and these should occur at more than 60% of the vegetated sample locations within the lake (see JNCC 2015). At Bolder Mere, the geographical location and small, shallow nature of the site would suggest less than eight would still be favourable, but there should be at least three characteristic shallow-water species present.

7.1.3.8 The following table (Table 7.1.2)) summarises the main features used to assess condition as detailed in the Common Standards Monitoring guidance for freshwater lakes (JNCC 2015). Each of the desired targets is summarised in the table and assessed as being "favourable" (✓) if it meets the target, or "unfavourable" (X) if it fails to meet the expected target. Where there is insufficient data a "?" is used

Table 7.1.2: Favourable condition assessment of Bolder Mere - 2018

Attribute	Target	Status	Comment
Extent	*No loss of extent of standing water*	*X*	*The site is modified along its border with the A3, where an artificial shoreline has been built into the lake.*
Macrophyte community composition	*Mesotrophic target ≥ 8 characteristic Litorelletea species*	*X*	*None recorded. Species including L. uniflora, Baldellia ranunculoides, P globulifera have been recorded locally and would be expected to grow here.*
	≥ 6/10 sample sports (boat & wader survey) have ≥ 1 characteristic species	*X*	*None*
	No loss of characteristic species	*?*	*No previous CSM data, but the SSSI citation refers to L. uniflora, Baldellia ranunculoides, P globulifera have been recorded locally.*
Negative indicator species	*Non-native species absent or present at low frequency*	*X*	*Elodea nuttallii is dominant in the lake (95%) and Crassula helmsii is abundant in the margins and frequent in the shallows on the south side. Despite removal efforts in 2012, large carp remain present. Turkish crayfish Astacus leptodactylus present.*

[7] CEH (2018) UK Lakes Portal; A GIS-based inventory of lakes for Great Britain. On line at https://eip.ceh.ac.uk/apps/lakes/ [Accessed Sept. 2018]

Attribute	Target	Status	Comment
	Benthic and epiphytic filamentous algal cover <20% of plots with high abundance.	✓	*Filamentous algal cover was very low.*
Macrophyte community structure	*Characteristic vegetation zones should be present and no deterioration from baseline conditions*	✓?	*Zonation is less typical in very shallow lakes. The vegetation occurred throughout the open water, and although dominated by E. nuttallii, did form a mosaic of species, grading into a range of marginal habitats. See text.*
	Maximum depth distribution should be maintained	✓	*Z_{max} (recorded) = 1.15 m, Z_s > 1.15 m. Z_v = 1.15 m (relative to TWL).*
	At least the present structure should be maintained	X	*No previous CSM data, but the dominance by non-native species is indicative of significant negative change.*
Water quality	*Mesotrophic target: Stable nutrient levels: TP target/limit = 20 µg P l^{-1}*	X?	*TP = 43 µg P l^{-1} (2003 ? quarterly mean[8]).*
	Stable pH / ANC values: pH ~ 5.5 – 7.0 and ANC > 40 µequl^{-1}	?	*No data*
	Mean annual total nitrogen TN < 1.5 mgl^{-1}	?	*No data*
	Adequate dissolved O_2 for health of characteristic fauna (> 6 mgl^{-1})	✓?	*Waters were well oxygenated at the time of survey (9.06 mgl^{-1}). High water temperatures (27° C) increase the risk of anoxia at night.*
	No excessive growth of cyanobacteria or green algae	?	*None during survey.*
Hydrology	*Natural hydrological regime*	X	*Site is partially / wholly artificial in origin and much of the north and north-west shore is artificial and of varying age, the newest dating to the building of the A3 in the 1970's onwards. The inflow to the southeast appears natural. The outflow is culverted to the NW.*

[8] Historic data from Carvalho, L, Maberly, S, May, L, Reynolds, C, Hughes, M, Brazier, R, Heathwaite, AL, Shuming, L, Hilton, J, Hornby, D, Bennion, H, Elliott, A, Willby, N, Dils, R, Phillips, G, Pope, L & Fozzard, I (2005) Risk assessment methodology for determining nutrient impacts in surface freshwater bodies. Science Report SC020029/SR, Environment Agency, Bristol – no current data available

Attribute	Target	Status	Comment
Lake substrate	*Natural shoreline maintained*	*X*	*As above*
	Natural and characteristic substrate maintained	*✓*	*A range of peat and natural stony substrates occur around the southern margin, the northwest shore being of artificially placed rock. Open water areas comprise of silt and fine organic sediments.*
Sediment load	*Natural sediment load maintained*	*?*	*No evidence of any adverse sediment loading seen.*
Connectivity	*Maintain good connectivity with ground and surface waters and marginal habitats*	*✓(?)*	*Connectivity compromised by the dam and outflow. Well-connected along south margin.*
Attribute	**Target**	**Status**	**Comment**
Indicators of local distinctiveness	*Distinctive elements maintained*	*?*	*Additional Odonata required to fulfil the main criteria for designation. Recent records for L. uniflora could not be confirmed suggesting this species is either lost, or now very rare at the site.*

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

Habitat survey

7.1.3.10 The open water habitat is relatively uniform in both structure and species composition with *Elodea nuttallii* dominant, and Alternate water-milfoil *Myriophyllum alterniflorum* and Lesser pondweed *Potamogeton pusillus* rare at depths greater than 80 cm, increasing in abundance towards the littoral zone (10-50 cm), particularly in the northeast, east and south of the lake. Rigid hornwort *Ceratophyllum demersum* occurs with a patchy distribution and mainly at low abundance (< 10% cover) in the littoral zone. The most botanically rich area for submerged plant species was on the more consolidated stony substrates around the southern shore, where Curled pondweed *P. crispus*, Blunt-leaved pondweed *P. obtusifolius* and Stonewort *Chara globularis* were recorded (at low abundance) in addition to the species listed above.

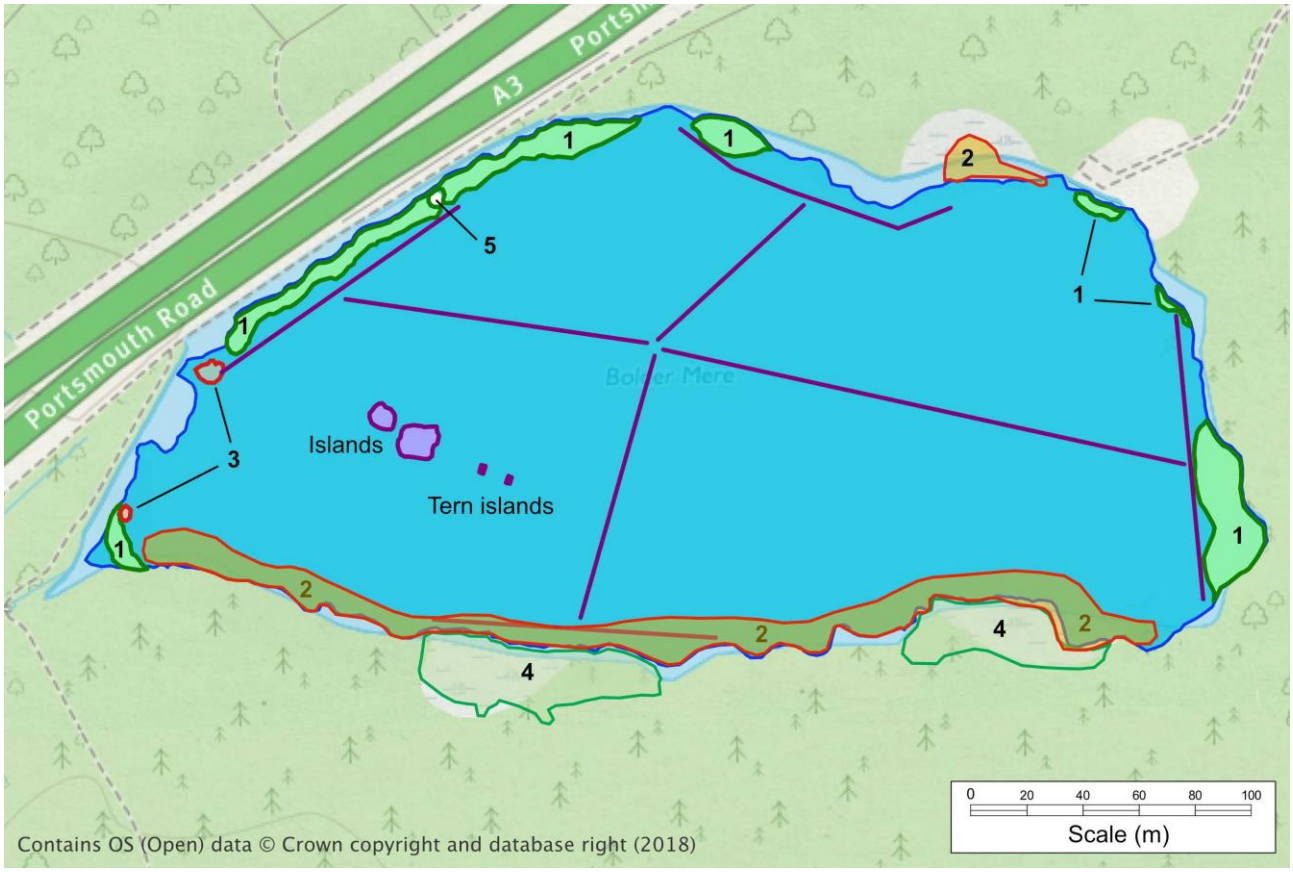
7.1.3.11 Whereas much of the open water is relatively uniform in structure and species composition, the marginal wetland habitats show considerable variation, and some maintain areas of significant floristic interest.

7.1.3.12 The most abundant emergent and marginal species is Common reed *Phragmites australis*. This forms relatively extensive stands around the eastern margin and along the north and north-west shore. Pertinent to this project it is the main

component of the emergent flora forming the narrow emergent zone against the A3, growing on the rocky artificial substrate bordering the A3 (see areas marked 1 on Figure 7.1.2).

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

Figure 7.1.2 Bolder Mere habitats map



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

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

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

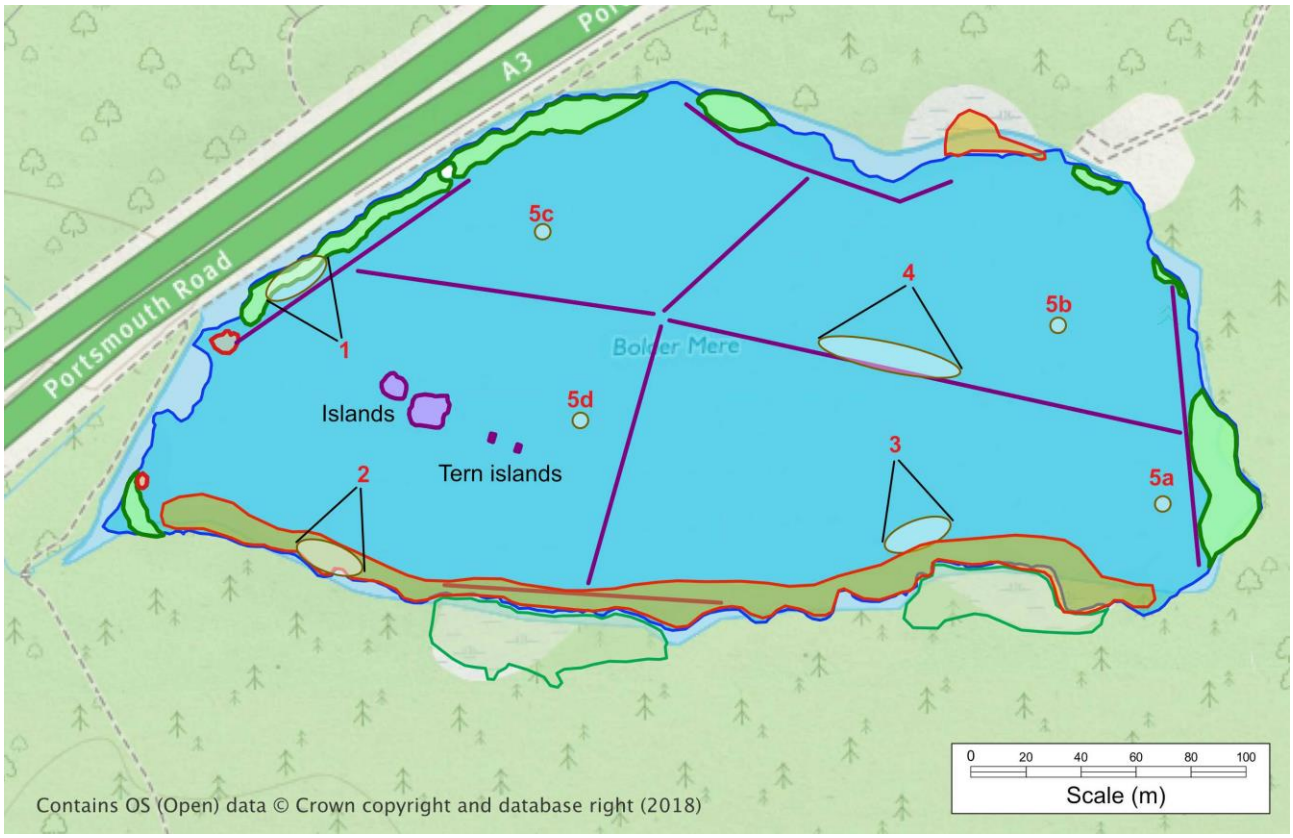
7.1.3.17 Previous management works around the south side of the lake have focussed on the of trees and scrub (birch, willow, alder and pine), to open up areas of the hydrosere and allowing the development of a more natural acid bog flora (4 in Figure 2). Here, the wetlands grade up to stands of Purple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

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

Aquatic macro-invertebrate survey

7.1.3.19 Five distinct habitats were identified within Bolder Mere and sampled for aquatic macro-invertebrates. These are described below, and the locations shown on Figure 7.1.3.

Figure 7.1.3 Map of Bolder Mere showing aquatic macro-invertebrate sampling locations (red)



- Sample 1 - Northwest shore (TQ0748358430)

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

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

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

- Sample 2 - Southwest shore (TQ0749158328)

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

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

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

- Sample 3 - South shore (TQ0771758330)

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

Substrate consisted of fine silt overlying consolidated gravel.

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

- Sample 4 - Open Water (TQ0770358379

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

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

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

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

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

Table 7.1.3: Aquatic macro-invertebrates, Bolder Mere June 2018

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

Taxon	CS	Common Name	Family	Site 1	Site 2	Site 3	Site 4	Site 5	Combined
Aeshna sp. (released)	*2*	*Hawker dragonfly larvae*	*Aeshnidae*		*2*				*2*
Baetidae (damaged)	*1*	*Mayfly*	*Baetidae*		*1*	*6*			*7*
Cloeon dipterum	*1*	*Pond olive mayfly*	*Baetidae*				*2*		*2*
Caenis horaria	*1*	*Anglers' curse mayfly*	*Caenidae*			*2*			*2*
Ceratopogonidae	*?*	*Biting midge*	*Ceratopogonidae*				*1*		*1*
Ceratopogonidae – Bezzia sp.?	*?*	*Biting midge*	*Ceratopogonidae*	*1*		*6*			*7*
Chaoborus spp.	*-*	*Phantom midge*	*Chaoboridae*	*4*					*4*
Chironomidae - Chironomini	*-*	*Non-biting midge*	*Chironomidae*	*327*	*432*	*135*	*61*	*411*	*1366*
Chironomidae - others	*-*	*Non-biting midge*	*Chironomidae*	*5*	*3*	*18*	*8*	*7*	*41*
Chironomidae - Tanypodinae	*-*	*Non-biting midge*	*Chironomidae*	*3*	*28*	*3*	*83*	*154*	*271*
Chironomidae - Tanytarsii	*-*	*Non-biting midge*	*Chironomidae*				*2*		*2*
Ischnura elegans	*1*	*Blue-tailed damselfly*	*Coenagrionidae*	*2*	*5*	*11*	`		*18*
Erythromma najas	*4*	*Red-eyed damselfly*	*Coenagrionidae*	*1*					*1*
Sigara spp.	*?*	*Water boatman*	*Corixidae*		*1*				*1*
Crangonyx pseudogracilis	*1*	*Non-native shrimp*	*Crangonyctidae*	*8*	*6*	*6*			*20*
Argyroneta aquatica	*3*	*Water spider*	*Dictynidae*		*2*				*2*
Gerris gibbifer	*4*	*Pond Skater*	*Gerridae*		*2*				*2*

Taxon	CS	Common Name	Family	Site 1	Site 2	Site 3	Site 4	Site 5	Combined
Hemiclepis marginata	4	Jawless Leech	Glossiphoniidae			1			1
Haliplus flavicollis	4	Crawling water beetle	Haliplidae	1					1
Hydracarina	-	Water mite	Hydrachnidiae		1	9			10
Oecetis lacustris	3	Caddisfly larvae	Leptoceridae			1	2		3
Mystacides longicornis	1	Long-horned caddisfly	Leptoceridae			4			4
Triaenodes bicolor	2	Long-horned caddisfly	Leptoceridae		1				1
Limnephilus sp. [rhombicus]	1	Caddisfly larvae	Limnephilidae	2					2
Lymnaea stagnalis	1	Great pond snail	Lymnaeidae	1	39	24			64
Lymnaea (Radix) peregra	1	Pond snail	Lymnaeidae		1	1	1		3
Ilyocoris cimicoides	4	Saucer bug	Naucoridae		10	21			31
Ranatra linearis	5	Water stick insect	Nepidae	2	5	1			8
Noterus clavicornis	2	Water beetle	Noteridae	1					1
Notonecta glauca	1	Backswimmer	Notonectidae			2			2
Ostracoda	-	Ostrocod	Ostracoda	7	11	113	46	17	194
Pedicia	?	Cranefly larvae	Pediciidae	1					1
Physa fontinalis	1	Common bladder snail	Physidae	5	22	43	2	1	73
Planorbarius corneus	4	Great ramshorn snail	Planorbidae		3				3
Planorbis planorbis	1	Ramshorn snail	Planorbidae	8	8	31			47
Gyraulus albus	1	White Ramshorn	Planorbidae	1					1

Taxon	CS	Common Name	Family	Site 1	Site 2	Site 3	Site 4	Site 5	Combined
Anisus leucostoma	*5*	*White-lipped ramshorn snail*	*Planorbidae*	*1*		*4*			*5*
Plea minutissima	*4*	*Pygmy backswimmer*	*Pleidae*		*9*	*15*			*24*
Sialis lutaria	*1*	*Alderfly larvae*	*Sialidae*		*5*			*2*	*7*
Sphaerium spp.	*1*	*Freshwater clam*	*Sphaeriidae*	*1*	*5*	*8*	*7*	*3*	*24*
Potamopyrgus antipodarum	*1*	*New Zealand mud snail*	*Tateidae*		*1*	*92*	*15*	*1*	*109*
Tipulidae	*?*	*Cranefly larvae*	*Tipulidae*	*1*					*1*
Number of taxa				*21*	*25*	*25*	*13*	*8*	*42*
Number of families				*16*	*21*	*20*	*9*	*6*	*30*
Number of BWMP families				*11*	*16*	*14*	*6*	*4*	*22*
BMWP 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*

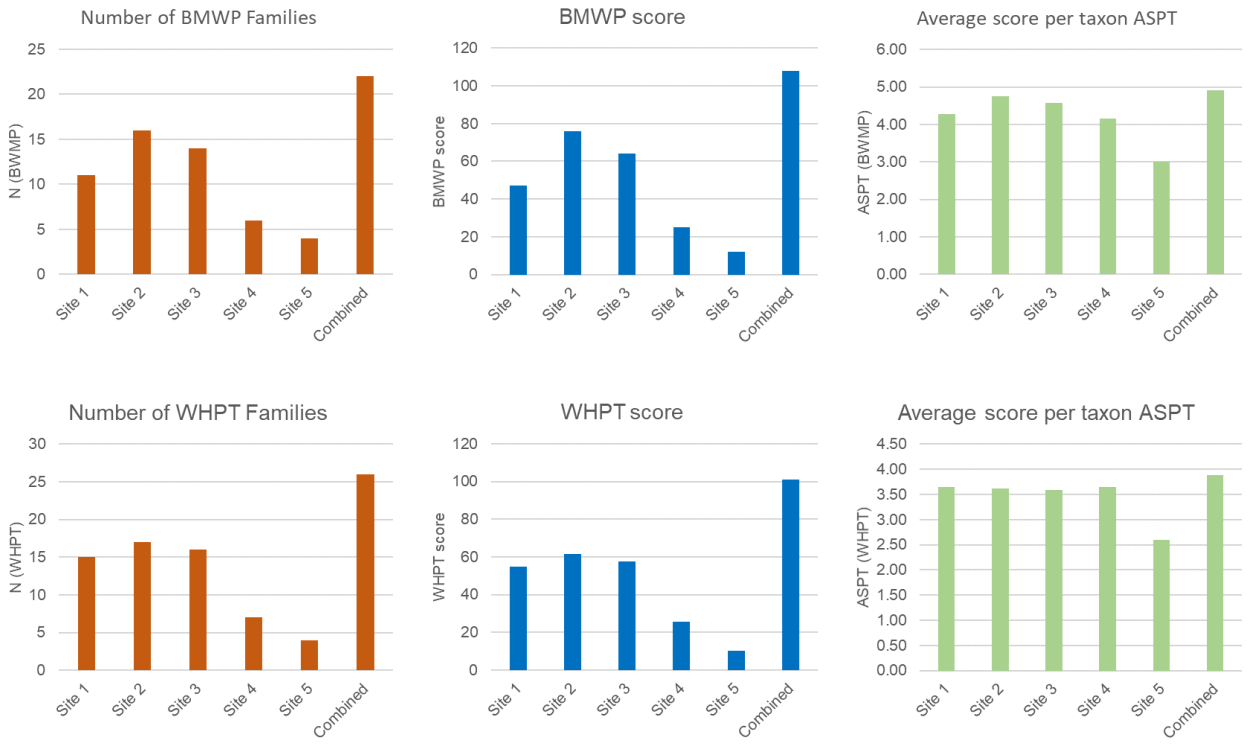
7.1.3.21 A total of 42 aquatic macro-invertebrate taxa were identified from the samples from 30 families (Table 7.1.3). Where possible, individuals were identified to species level, but those that were damaged or more taxonomically challenging or numerous (e.g. *Chironomidae*) were identified only to family or genus level. Two dragonfly larvae were removed from the Site 2 net sample and released back to the lake. In the field it was only possible to identify them as *Aeshna* species.

7.1.3.22 In terms of community composition, the two marginal sites (1 and 2) and the littoral zone on the south shore (Site 3) had the highest number of taxa, with the open water (Site 4) and sediments (sites 5a-d) supporting much lower numbers (Figure 7.1.4). Using the macro-invertebrate data to infer ecological quality, the BMWP and WHPT metrics suggest the more species rich marginal and littoral sites to be of higher ecological quality than the open water sites.

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

7.1.3.24 When the data from the different habitats are combined, the BWMP score is 108, which classifies the site as “very good” in terms of its macro-invertebrate fauna.

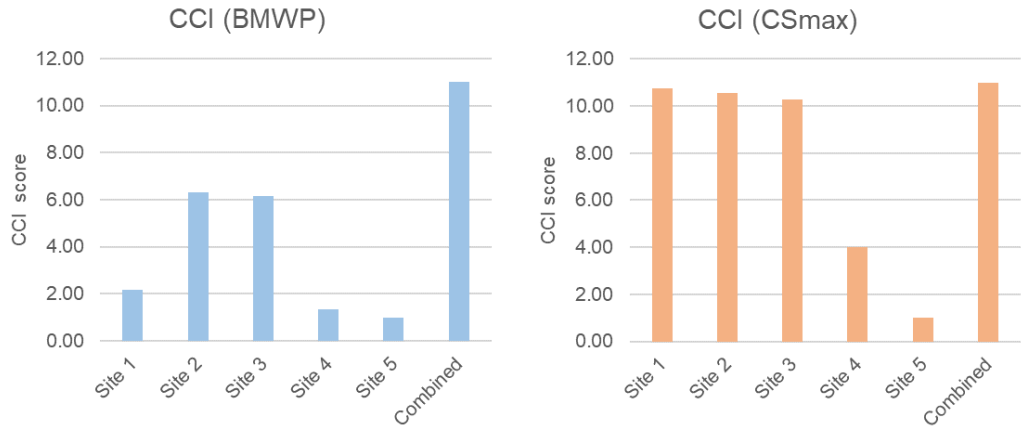
Figure 7.1.4 Aquatic macro-invertebrate BMWP and WHPT metrics from Bolder Mere



7.1.3.25 In terms of the particular conservation interest from each meso-habitat, during this survey, we found no species of high conservation status (e.g. those listed in the UK Red data book for insects (Shirt 1987)). There were however a number of taxa recorded that favour better quality aquatic environments (see below).

7.1.3.26 The conservation scores for each species were used to calculate a community conservation index (CCI, Chadd & Extence 2004). This metric can be expressed relative to either the highest conservation value (CSmax) of any one species, or to the BMWP score; these are shown in Figure 7.1.5. Both metrics show the conservation value of marginal habitats to be higher than the open water areas.

Figure 7.1.5 Community Conservation Index scores for the Bolder Mere meso-habitats



7.1.3.27 Although Bolder Mere is noted for its rare Odonata, none of the larvae recorded here were rare species. The warm, sunny conditions during the field survey were excellent for adult dragonflies and damselflies and a number of species were noted on the wing at the site (Table 7.1.4**Error! Reference source not found.**); again, these did not include any of the rarities recorded previously from the site.

Table 7.1.4: Adult dragonflies and damselflies recorded at Bolder Mere June 26 2018

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

7.1.4 Appraisal of the evidence

Aquatic flora

7.1.4.1 The current assemblage is in the most part typical of shallow eutrophic lowland lakes in the south-east of England. The one exception to this is the presence of

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

7.1.4.2 Other macrophyte species recorded are more generalist in their habit, occurring across a wide range of ecological and trophic gradients. The occurrence of the Stonewort *Chara globularis* (Figure 7.1.6) suggests nitrogen concentrations are not excessive. Stoneworts are particularly sensitive to nitrates, and rarely persist in sites where nitrate is high.

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

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

Figure 7.1.6 *Chara globularis* (x10) from Bolder Mere

Aquatic macro-invertebrates

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

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

of emergent and shallow, submerged vegetation.

Figure 7.1.7 Ranatra linearis, Bolder Mere

7.1.4.7 The importance of the lake habitats for Odonata necessitates that areas of both sheltered open habitat as well as overhanging trees, reeds and shaded areas are maintained around the lake to provide feeding, resting and courting areas. The Oakham and Wisley SSSI Favourable Condition Table (FCT) states: "Ideally, a structurally diverse mixture of heath, grassland and mire should be maintained surrounding the ponds with scattered scrub to provide shelter". Notable species such as the Downy emerald *Cordulea aenea* and the nationally scarce Brilliant emerald *Somatochlora metallica* require favoured water bodies to have partly shaded margins (ideally 30-60% of margin shaded), as well as open areas of shallow, vegetated water for egg-laying (BDS 2004[9]).

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

Invasive species

7.1.4.9 Of primary concern at the site is not only the lack of typical aquatic macrophyte species associated with medium-alkalinity shallow lakes, but also the dominance of non-native, invasive species, particularly *Elodea nuttallii* and *Crassula helmsii*, the latter forming very dense mats and having a significant impact on the low-growing marginal vegetation which would otherwise be good potential habitat for *Pilularia globulifera* and *Littorella uniflora* (Figure 7.1.8). These species are exceptionally difficult to control once established and therefore their presence seriously compromises the future conservation value of the site if left unmanaged.

[9] British Dragonfly Society (2004) Habitat Management Fact File The Brilliant Emerald Somatochlora metallica (Vander Linden). On line at: https://british-dragonflies.org.uk/sites/british-dragonflies.org.uk/files/somatochlora%20metallica.pdf [Accessed Nov. 2018]

Figure 7.1.8 *Crassula helmsii* growing in the exposed littoral zone on the south shore

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

Figure 7.1.9 Large (dead) carp and Turkish crayfish recorded at Bolder Mere

7.1.4.11 As with any fish removal, success is rarely 100%, and the presence of large carp in such a shallow site will be damaging due to their foraging behaviour. 6 -10 individuals were observed during the survey, including one dead fish measuring over 80 cm long and 45 cm deep (Figure 7.1.7). The shallow, warm water, provides potential conditions for recruitment and thus further management and control should be a priority.

7.1.4.12 Several mature adult Turkish (long-clawed) crayfish *Astacus leptodactylus* were seen during the survey (Figure 7.1.9). This species is not considered to be as environmentally destructive as the Signal Crayfish in terms of burrowing, but it is a very generalist omnivore, and as such can pose a threat to a wide range of plant and macro-invertebrate species, including larval stages of Odonata. Control and eradication should feature in the management plan for the site.

7.1.5 A vision for Bolder Mere

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

Bolder Mere: The vision

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

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

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

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

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

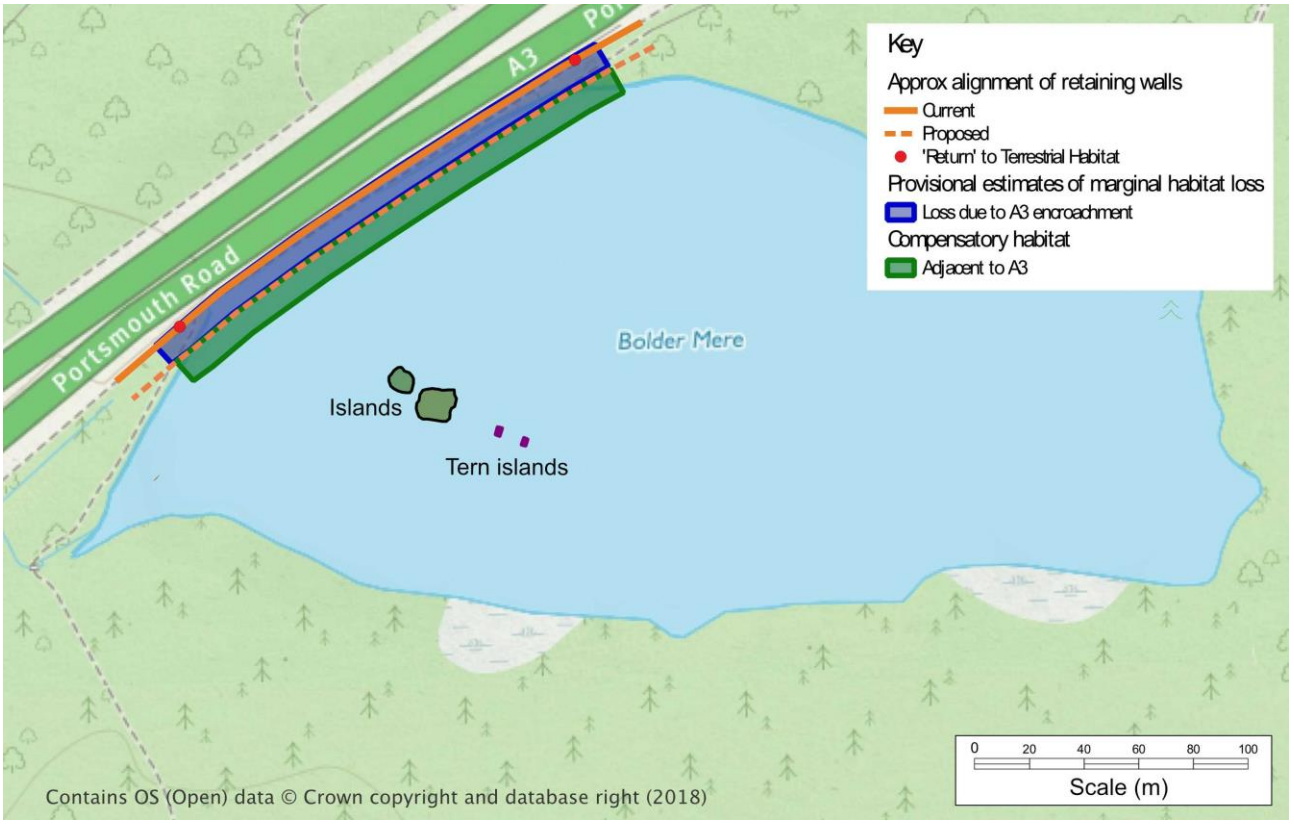
7.1.5.7 Water quality will be very good. Concentrations of plant nutrients such as nitrogen and phosphorus will be low (TN < 1.5 mgl^{-1} & TP < 30 μgl^{-1}), both in the lake, and in the feeder stream. Catchment management will ensure that sediment loads and run-off are minimised and controls will be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

7.1.5.8 Public access to Bolder Mere will be sufficient to provide a safe area for visitors to enjoy a vista of the lake and its wetland habitats and wildlife. The pond will be an area where people go to enjoy and learn about the natural environment and a place that promotes health and well-being through exercise and relaxation. The provision of well managed public access and signage, will help to promote a wider understanding of the importance of freshwater habitats and thus safeguard the site into the future.

7.1.6 Recommendations

7.1.6.1 It is understood from Atkins that the proposal to improve the M25 / A3 road network will include the re-alignment of the northwest shore of Bolder Mere. The proposal at Bolder Mere is to move the current retaining embankment that lies adjacent to the A3 approximately 10 m into the lake, thus losing a 10 m wide strip of the lake margin and associate habitats therein (Figure 7.1.10). This involves the potential disruption to approximately 180 m of shoreline along the northwest side of Bolder Mere. The proposal is to replace any loss of habitat within this region with a like-for-like replanting and / or translocation of the existing habitats.

Figure 7.1.10 Map of Bolder Mere showing the proposed re-alignment



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

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

7.1.6.4 With respect to the lake and wetland habitats the realignment will result in the loss of approximately 120 m of existing lake shore, equating to approximately 1,200 m^2 of the lake area. This area is currently dominated by emergent and marginal Common reed *Phragmites australis* growing in a dense and continuous stand ranging from 5 – 15 m in width (see Figure 2) and backed by a narrow line of willow against the road verge. While not the highest quality wetland habitat in terms of invertebrate or botanical interest, this area is nonetheless of moderate ecological quality (based on aquatic macro-invertebrate BMWP and CCI scores) and provides nesting habitat for Mute swans (at TQ0750558438) and potentially for a range of other birds using the site (e.g. Reed warbler, Coot, Moorhen and Mallard). This marginal habitat also provides a valuable aesthetic component to Bolder Mere, shielding the A3 from view from the main areas of public access around the south and east margin. For this reason, it is recommended that this habitat is translocated or re-created on a like-for-like basis following the re-alignment work. This includes replanting willow between the new reedbeds and the re-aligned road verge to add height and shelter to the lake margin.

7.1.6.5 *Phragmites australis* is normally relatively easy to re-establish at a site and there is excellent advice on best practice within the conservation literature, e.g. RSPB (2014[10]) and Sussex Wildlife Trust (2004[11]).

Implications relating to the loss of open water habitat

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

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

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

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

[10] White, G., Self, M. & Blyth, S. (2014) Bringing Reedbeds to Life: creating and managing reedbeds for wildlife. RSPB. On line at: https://www.rspb.org.uk/globalassets/downloads/documents/conservation-projects/bringing-reedbeds-back-to-life/bringing-reed-beds-to-life-report.pdf [accessed Nov. 2018]
[11] Sussex Wildlife Trust (2003) How to Create & Manage Reedbeds. On line at: https://assets.sussexwildlifetrust.org.uk/create-and-manage-reedbeds-2.pdf [accessed Nov. 2018]

are available to maintain the Odonata.

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

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

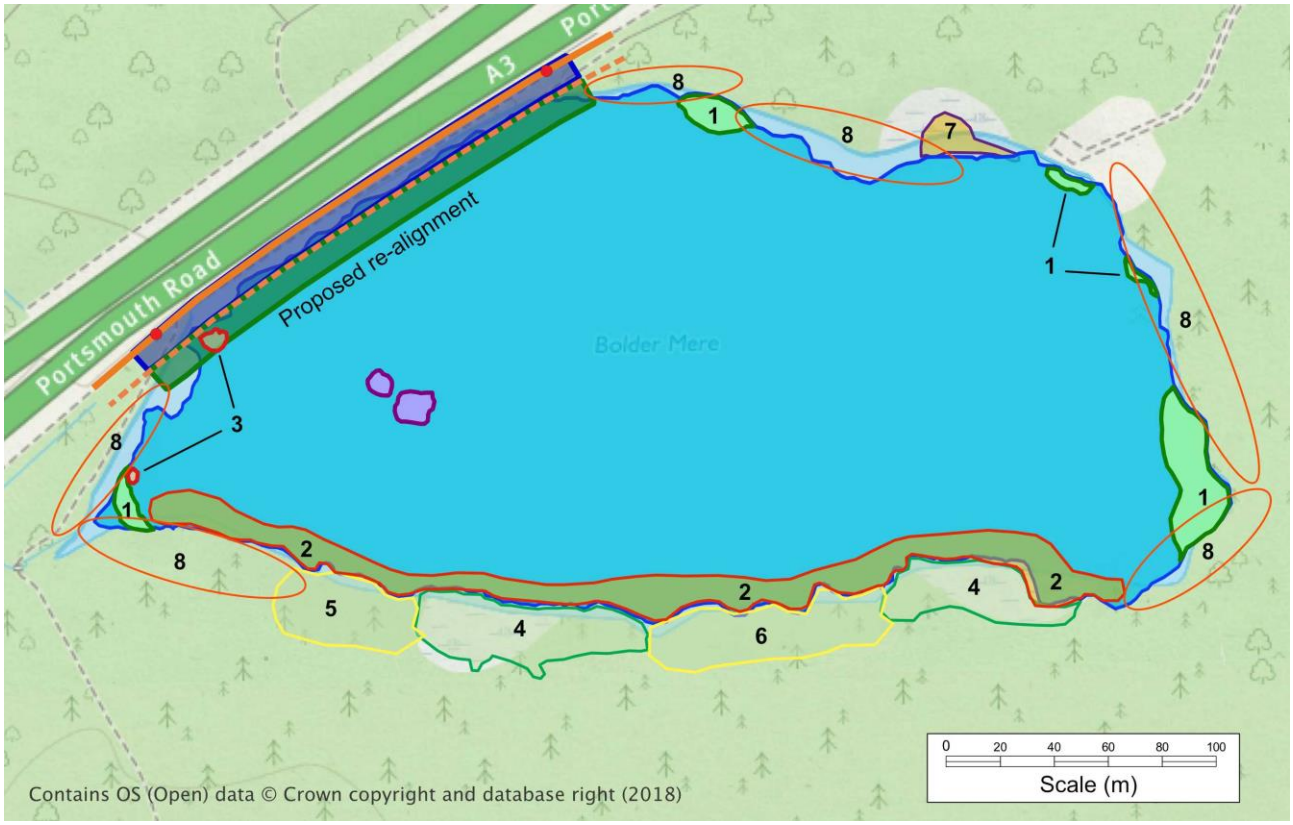
7.1.6.10 Thus, while open water is necessary for larval stages, it is the shallow water areas that are best suited (e.g. those around the south shore) and management is best focused on maintaining this habitat and areas of sheltered, sunny, open habitat that provide feeding, resting and courting areas for adult Odonata. This habitat needs to remain varied and structurally diverse and included good connectivity to areas of open heath, grassland and mire around the lake as well as scrub and woodland scattered scrub to provide shelter.

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

Habitat improvement to offset the re-alignment

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

Figure 7.1.11 Potential habitat improvement areas at Bolder Mere



7.1.6.13 A number of key areas are identified in Figure 7.1.11 where the management recommendations are focussed.

- 1. Reed bed. Dominated by *Phragmites australis* with occasional Greater reedmace *Typha latifolia*. These areas, including the future development of the re-aligned shore, provide good habitat for birds and invertebrates and are important within the site. The current extent (to include the future re-aligned area) is considered suitable for the site. No additional management is required, but future control would be necessary if there is any evidence of any significant spread into adjacent habitat types or open water.
- 2. This area represents an important shallow water (<30 cm) habitat with a diverse submerged macrophyte flora grading into a mixed emergent flora. This is excellent habitat for macro-invertebrates (including Odonata), but suffers from a high cover of the invasive, non-native species *Crassula helmsii*. Controlling the *C. helmsii* in this area and preventing spread within the site, and to other sites, represents a major management challenge. Chemical treatment is cited by Newman (2013[12]) as the only realistic control method, but this risks also damaging desirable native species. Persistent physical control (hand pulling) risks spreading the plant unless done with extreme care by experienced practitioners; this is only feasible on small areas. It is recommended that further advice is sought from specialist in *Crassula helmsii* management.

[12] Newman, J. (2013). CEH Information Sheet 12: Crassula helmsii, Australian Swamp Stonecrop. CEH information Sheet.

- 3. The water lilies *Nymphaea* sp. are confined to two beds at the western end. These provide good habitat for some Odonata species during egg-laying and should be maintained within the site. One population is likely to be within the re-alignment areas and it is recommended that it is translocated to remain as close as possible to its current location.
- 4. Two areas of open acid bog with good connectivity to the lake and grading into drier *Molinia* heath and woodland. This habitat is already managed to prevent encroachment of the birch and willow. These areas provide excellent open habitat for Odonata, and benefit from partial enclosure from the adjacent woodland and encroaching birch. Best practice management will include regular clearance of any encroaching scrub from within the open areas and period removal of larger birch and willow (and any trees) from the edges to maintain a semi-open structure grading into the woodland behind.
- 5. An area of close growing birch and willow scrub with dense understory of *Sphagnum* spp.. An interesting habitat that would benefit from partial clearance of the birch and willow to towards the lake shore to provide more open areas of acid bog habitat. Long-term management will be required to prevent future encroachment of trees.
- 6. An area of drier marginal habitat mainly reverting to woodland. Thinning and removal of trees and scrub would help to encourage a low-growing heath / grassland community to develop and provide improved habitat for Odonata.
- 7. Wet woodland with sedge and rush understory, but also *C. helmsii* present. Refer to point 2 with respect to the need to control *C. helmsii*. No addition management required.
- 8. Areas of dense overhanging tree cover, mainly willow. This is important habitat for many Odonata species as well as birds. Management of this habitat should be considered on a long-term time scale, with larger trees occasionally being removed and natural regeneration allowed to occur. The current level of overhanging tree habitat is estimated at 40% of the perimeter and lies within the target stated in the FCT (30 - 60%).
- 9. Open water habitat remains important for the site and will be best maintained by ensuring catchment sources of nitrogen and phosphorous are below target values for this lake type (1.5 mgl^{-1} N and 30 μgl^{-1} P) and sediment loads are low. It is important that the lake does not receive run-off from the adjacent A3. A catchment nutrient budget is recommended to identify any potential sources of nutrients reaching the lake and where possible, reduce nutrient inputs.

Invasive species

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

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

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

Biosecurity

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

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

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

7.1.7 Supporting data

CSM Macrophyte data Bolder Mere (26/06/2018)

Lake Details		**Survey Details**		
Lake Name	Bolder Mere	Survey Date	26/06/2018	
SSSI Name	Ockham & Wisley Commons	Surveyors	BG & Kat L-D	
SAC Name		Shore Surveys	4	out of
Grid Ref (centre)	TQ076584	Wader Surveys	4	4
WBID / NI No.	43218 /	Boat Surveys	4	sections

Site Notes:
Crassula and Turkish Crayfish confirmed in 2018

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

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

Section Locations

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

Dissolved Oxygen Profile

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

Notes: Secchi > depth

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

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

Plant List by Section - Boat Survey

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

Section 2
Chara globularis
Elodea nuttallii
Myriophyllum alterniflorum
Potamogeton pusillus

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

Section 4
Chara globularis
Elodea nuttallii
Myriophyllum alterniflorum
Potamogeton pusillus

Plant List by Section - Wader Survey

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

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

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

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

Plant List - Shore Survey (marginals and emergents)

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

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

Ceratophyllum demersum
Elodea nuttallii
Lemna minor
Myriophyllum alterniflorum
Potamogeton pusillus

Species Abundance - Boat Survey

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

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

Species Abundance - Wader Survey

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

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

Plant Scores

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

SURVEY SCORES

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

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