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River Thames Scheme Lake Surveys: Macrophytes

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River Thames Scheme Lake Surveys Macrophytes

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1. Introduction

1.1. Background

The proposed River Thames Scheme (RTS) is a major hydro-engineering scheme which aims to divert water from the River Thames at high flows through a number of the gravel pit lakes located either side of the river between Datchet (in the north) and Shepperton (in the south). There are 28 lakes of interest to the RTS and data is required to inform Habitats Directive risk assessments, WFD assessments and environmental impact assessments. Information collected through this contract will supplement a large body of water quality and biological data already held by the Environment Agency and is required as a data gap filling exercise.

The lakes range in size from approximately 40 ha to less than 1 ha. Some are SPA and WFD lakes, others are “SPA relevant” and some are neither. The information requirements associated with a given lake are therefore not the same. For some lakes HRA and/or WFD assessments are required, for others it is simply necessary to understand the implications in terms of species movement of increased connectivity as they become part of the flood channel or are more frequently inundated. For the lakes which are SPA or SPA relevant the Environment Agency also hopes to get information on the overall extent of aquatic macrophyte beds, i.e. whether the plants are confined to a small area of the lake, or are extensive throughout the lake. The location and extent of macrophyte beds are important in terms of providing habitat for the SPA features as well as understanding potential impacts related construction of the flood scheme channels, bunds and other associated infrastructure.

The list of lakes included with this project is detailed in Table 1 along with an approximate size in hectares and the requirement of each in terms of survey type. A map is also provided indicating the locations of the lakes (Figure 1).

1.2. Overall Objective

To carry out lake macrophyte surveys on lakes likely to be affected by the proposed River Thames Scheme (RTS) and to fulfil the requirements outlined above.

1.3. Specific Objectives

Undertake WFD compliant lake macrophyte surveys (WFD surveys) on the lakes listed in Table 1.

Carry out an assessment of the extent of macrophyte bed cover on the lakes where WFD-compliant macrophyte surveys are carried out. Details of the specific methods have been agreed with the EA project Manager and are given below.

Carry out a “basic” macrophyte survey on the remaining lakes to provide a general indication of extent of plant cover and species present, particularly in regard to INNS. Details of the specific methods have been agreed with the EA project Manager and are given below.

Data are to be provided to the EA in WFD-compliant spreadsheets as published on the UKTAG website, one spreadsheet per lake (<http://www.wfduk.org/resources/lakes-macrophytes>, using “LEAFPACS2 Lake metric calculator.xls”).

Maps of extent of macrophyte cover to be provided for each lake and all data to be in an appropriate electronic format, (e.g. excel spreadsheet).

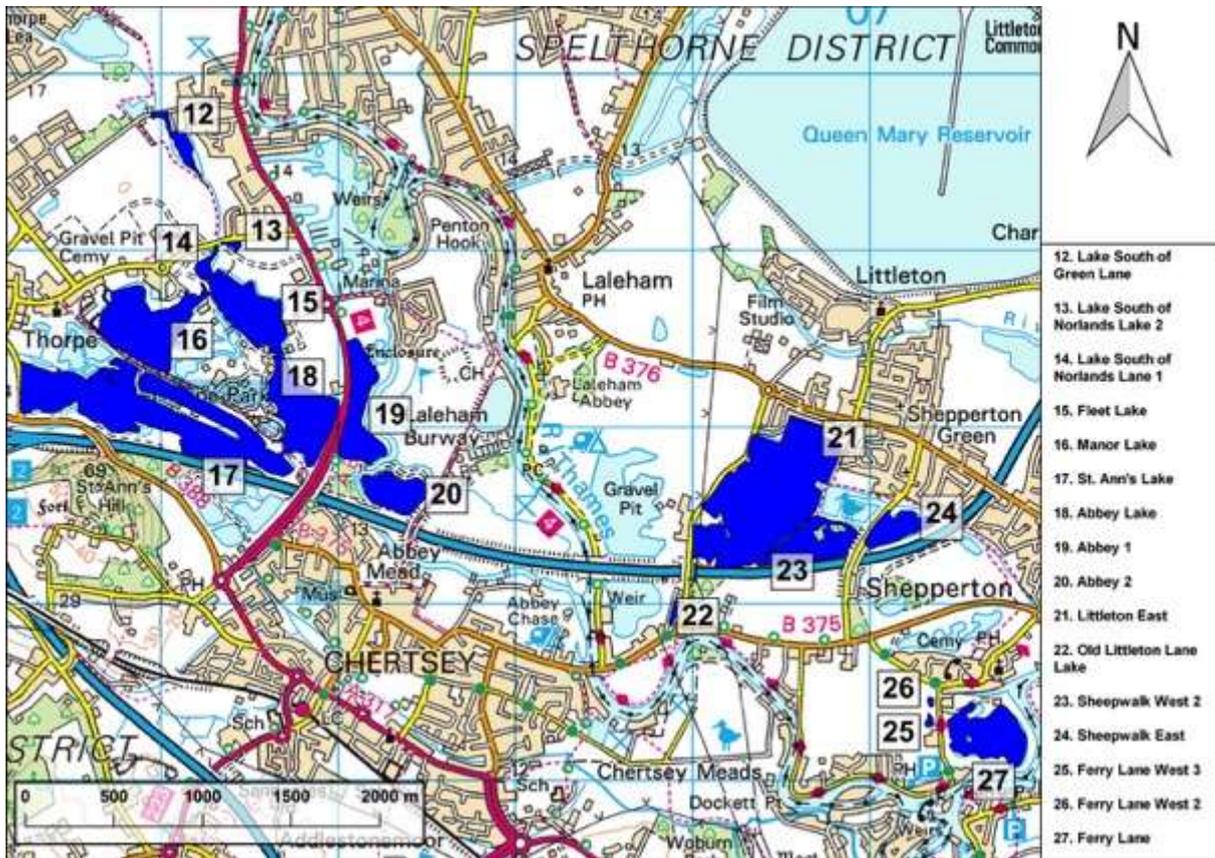


Figure 1 Map of the survey sites included in the RTS macrophyte project.

1.4. Instructions from the Environment Agency

The instructions provided by the Environment Agency were as follows:

“Macrophyte surveys to enable a lakes LEAFACs2 WFD classification. They must conform to the method outlined in the UKTAG method statement (see attached “Lake Macrophytes UKTAG Method Statement”). It may be appropriate to reduce the number of transects to less than 4 in the very small lakes (<5ha). Within this [report] these are referred to as “WFD surveys”.

““macrophyte extent maps” are envisaged as maps indicating the extent and location of the major macrophyte beds in each lake. There is some flexibility over the methods used and suppliers are invited to make recommendations as to what would be appropriate without being prohibitively expensive.”

“basic survey” is intended to provide an indication of the macrophytes present with a particular view to understanding the implications of increasing connectivity with the wider lake and river systems. This principally relates to the presence of INNS but on visiting these lakes other issues of relevance may be drawn to our attention. There is some flexibility over the methods used and suppliers are invited to make recommendations as to what would be appropriate without being prohibitively expensive.”

2. Methods

2.1. Survey sites

A total of 28 sites were identified for survey (Table 1). Of these, two sites were not surveyed due to access problems and St. Ann's Lake could only be partially surveyed. Full details are given in the individual site reports. The location of the sites are detailed in Table 1 and shown in the maps in Figure 1.

Table 1 List of sites surveyed

Name	Grid Ref	Area (ha)	Max. recorded depth (m)	Designation	Survey type	Survey Date
Datchet 3 North	TQ0011875986	3.9	6.6	SPA relevant	WFD/ Basic	10.08.16
Datchet 3 South	TQ0010575852	5.2	6.7	SPA relevant	WFD/ Basic	09.08.16
Kingsmead Island Lake	TQ0087475309	22.4	5.2	SPA relevant	WFD/ Basic	05.08.16
Sunnymeads 3	TQ0079174989	2.29	5.4	SPA relevant	WFD/ Basic	01.08.16
Horton 2	TQ0124874875	10.3	7.9	None	Basic	02.08.16
Wraysbury 2 North	TQ0104773844	37.5	5.5	SPA	WFD/ Basic	03.08.16
Wraysbury 2 South	TQ0087473294	20.6	5.7	SPA	WFD/ Basic	03.08.16
Lower Hythe Gravel Pit 1	TQ0110172947	1.3	4.8	None	Basic	14.07.16
Lower Hythe Gravel Pit 2	TQ0098172795	2.4	-	None	Basic	No Survey
Lower Hythe Gravel Pit 3	TQ0110572692	2.3	4.6	None	Basic	04.08.16
Lower Hythe Gravel Pit 4	TQ0125672817	0.7	-	None	Basic	No Survey
Lower Hythe Gravel Pit 5	TQ0126972727	0.4	3.8	None	Basic	04.08.16
Lake South of Green Lane	TQ0312269596	1.7	4.5	None	Basic	05.07.16
Lakes South of Norlands Lane (1)	TQ0325168903	1	5.0	None	Basic	04.07.16
Lakes South of Norlands Lane (2)	TQ0342369030	0.3	0.8	None	Basic	07.07.16
Manor Lake	TQ0288368552	15.9	5.7	SPA relevant	WFD/ Basic	04.07.16
Fleet Lake	TQ0350368661	10.5	5.5	SPA relevant	WFD/ Basic	06.07.16
Abbey Lake	TQ0379468075	13.2	7.1	SPA relevant	WFD/ Basic	08.07.16
St. Ann's Lake	TQ0287968108	40.4	No data	SPA	WFD/ Basic	09.08.16
Abbey 1	TQ0411768137	9.2	8.3	SPA relevant	WFD/ Basic	07.08.16
Abbey 2	TQ0431767620	6.3	6.6	SPA relevant	WFD/ Basic	08.07.16
Littleton East	TQ0645367617	39.4	7.2	SPA relevant	WFD/ Basic	10.08.16
Old Littleton Lane Lake	TQ0589666948	0.3	5.3	None	Basic	05.07.16

Name	Grid Ref	Area (ha)	Max. recorded depth (m)	Designation	Survey type	Survey Date
Sheepwalk West 2	TQ0666667334	8.2	8.9	SPA relevant	WFD/ Basic	07.07.16
Sheepwalk East	TQ0712567426	5.1	4.3	SPA relevant	WFD/ Basic	11.08.16
Ferry Lane West 2	TQ0731966459	0.2	3.2	None	Basic	11.07.16
Ferry Lane West 3	TQ0733966335	0.2	4.3	None	Basic	09.08.16
Ferry Lane	TQ0766766261	10.9	5.6	SPA relevant	WFD/ Basic	06.07.16

2.2. WFD Surveys

WFD macrophyte surveys were carried out using the methods detailed in the UKTAG method statement (UKTAG 2014) with the final number of transect being a function of lake area (less than four in lakes <5ha). These surveys are referred to as “WFD surveys” in the remainder of this document. Data were produced in a format compatible with the LEAFPACs2 metric calculator for WFD classification.

2.3. WFD Surveys

WFD macrophyte surveys were carried out using the methods detailed in the UKTAG method statement (UKTAG 2014) with the final number of transects being a function of lake area (less than four in lakes <5ha). These surveys are referred to as “WFD surveys” in the remainder of this document.

In brief, the plant surveys consisted of four components; a strandline survey of species uprooted and washed to the shore, a survey of the emergent and marginal species, a wader survey of the shallow littoral zone to approximately 1.0 m and a boat survey encompassing species in open water and extending to the point of maximum depth of colonisation. These were carried out at each site on up to four discrete 100 m sections of shoreline, which were considered representative of the lake and gave good geographical coverage.

Where possible, surveying was performed using a bathyscope, but a double-headed rake was used in deeper water, where material needed to be collected for identification, or where poor water clarity restricted visibility. The locations of all survey sections and boat transects were recorded using a Global Positioning System (GPS), backed up with digital photographs where necessary.

These methods were devised to provide quantitative species-abundance data that can be obtained in a pragmatic and repeatable manner. The technique optimises the chance of recording those species most typical of a lake site and detecting marked changes in their frequency. Although they do not aim to produce a complete species list for a lake, comparison with a more thorough mapping approach generally show that the transect method consistently detects more than 90% of the macrophyte species richness within a lake (e.g. Burgess *et al.* 2009). Additional efforts such as sampling drift line flora were made to record other species which did not occur in any of the survey sections.

All aquatic macrophyte surveys, upon which the data assessments in this report are based, were carried out between June and August 2016. *In-situ* macrophyte identifications were made by Ben Goldsmith or Stefania Goodrich. Voucher specimens were collected for taxonomically ambiguous species and identifications confirmed either from fresh materials

(usually in the evening of the survey) or at a later date from pressed specimens. Vouchers of charophytes were preserved in alcohol and sent to Nick Stewart (BSBI Charophyte Referee and expert on aquatic botany) for confirmation. Quality control was performed in-house with reference to previously collected herbaria specimens. Botanical nomenclature follows Stace (1997) for higher plants, Moore (1986) for Stoneworts (updated by N. Stewart, pers. comm.).

All field data were recorded onto standard forms printed onto waterproof paper and then transcribed into standard MS Excel spreadsheets designed to calculate values for the following metrics (see Willby *et al.* 2010 and WFD-UKTAG 2014):

- Lake Macrophyte Nutrient Index (LMNI)
- Number of Functional Groups (NFG)
- Number of Macrophyte Taxa (NTAXA)
- Mean per cent cover of hydrophytes (COV)
- Relative per cent cover of filamentous algae (ALG)

These gravel pit sites are often steep sided and therefore lack the wetland and marginal vegetation often seen in lowland lakes. Where present, marginal and emergent wetland plants were listed at WFD sites.

2.4. Extent of macrophyte cover and “basic” surveys

ENSIS has developed a pragmatic method for whole site assessment of lake macrophyte species. This has been successfully used to identify the extent and abundance of macrophyte species (including INNS and protected species) in sites ranging in size from <1 - 98 ha. Due to the dynamic nature of aquatic plants, particularly in these shallow lowland lakes, the extent of beds can be highly variable and therefore the agreed method was based on a geo-referenced, point survey method.

Data were collected using similar survey techniques (double-headed rake and bathyscope) as described above, but sample locations were chosen to ensure representative data were collected from the entire site. Using a small inflatable boat, points were surveyed at appropriately equally spaced locations throughout the lake. Each point is recorded using GPS, a water depth taken and a full list made of all species occurring at the point as well as proportion of exposed bare substrate. In addition, an abundance score is made for each species present at each point. Where present, the occurrence of non-native zebra mussels (and quagga mussels) was also noted.

Macrophyte species abundance was recorded using a 1-5 scale where: 1 = <2.5% cover (or one or two small individual), 2 = 2.5-10% cover (a few isolated individuals or small patch), 3 = 10-25% cover (several larger individuals, or a few patches), 4 = 25-50% cover (very obvious with many small individuals or substantial larger plans, but not dominant) and 5 = >50% cover (dominant). Consistency of scoring was maximised by Ben Goldsmith and Stefania Goodrich working together on some sites to agree scoring. The scores were in most parts decided by a combination of visual assessment (bathyscope) and rake sampling.

The total number of survey points ranged from approximately 50 to over 300 depending on the total area and complexity of the vegetation at each site. The output from this method is a series of geo-referenced maps for a site, each showing the extent and abundance for a species. These data have been recorded as simple MS Excel spreadsheets and can also be made available as GIS layers. Maps were produced using QGIS (QGIS 2.16 2016) and exported as graphics in jpeg format.

The patchy nature of aquatic plant distributions within a site means that no assumption should be made that any one species is growing between two or more other points where it is recorded. The use of single-species layers is not therefore appropriate and data are instead presented as geo-referenced abundance points for each species within a lake outline map. Native species are plotted as dots and non-native taxa as triangles.

Vegetation mapping and WFD data (where relevant) were combined to produce an overall percentage frequency for each species at a site.

2.5. Ordnance survey data

All maps presenting in this report are derived from Ordnance Survey data.

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3. Survey Results

3.1. Datchet 3 North

Survey Date	10 August 2016
Grid reference:	TQ0011875986
OS Grid reference (X,Y):	500118, 175986
Approx. surface area (ha.):	3.9
Maximum recorded depth (m):	6.6

Overview

Datchet 3 North is connected to Datchet 3 South, divided only by a long, narrow island through the centre of the two sites. Both sites are owned by Liquid Leisure, a company which focuses on water sport activities such as wakeboarding, water-skiing and water-surfing. Datchet 3 North features Europe's largest inflatable aqua park extending along approximately one third of the northern shore (Figure 2); for logistical and permission reasons we were unable to survey beneath the inflatable items.



Figure 2 Inflatable “aqua park” at Datchet 3 North.

Very few submerged plants were growing throughout the lake at the time of survey. The margins shelved steeply away from shore to deep water and perhaps more significantly, regular water sports activities generated a sizeable wake which had considerably eroded the lake margins, and in turn severely limited any growth within the littoral zone.

Macrophyte growth was further inhibited by the addition of blue dye aimed at suppressing ‘weed’ and algal growth. The overall extent of vegetation was therefore limited throughout

the majority of the lake with vegetation present primarily at the very eastern end of the site, where the erosional impact of the ski boats is likely to be lower (Figure 4).

Extent of macrophyte cover

The most abundant species recorded were *E. nuttallii* and *P. pectinatus*, the former of which was concentrated at the eastern end of the site, growing up to a maximum depth of 4.3 m. The latter species appeared to be more tolerant to the erosion and wake, since it was recorded more frequently, particularly along the southern edge of the site. However, abundance of these plants was generally low and very localised, each with average DAFOR values of “2” (occasional).

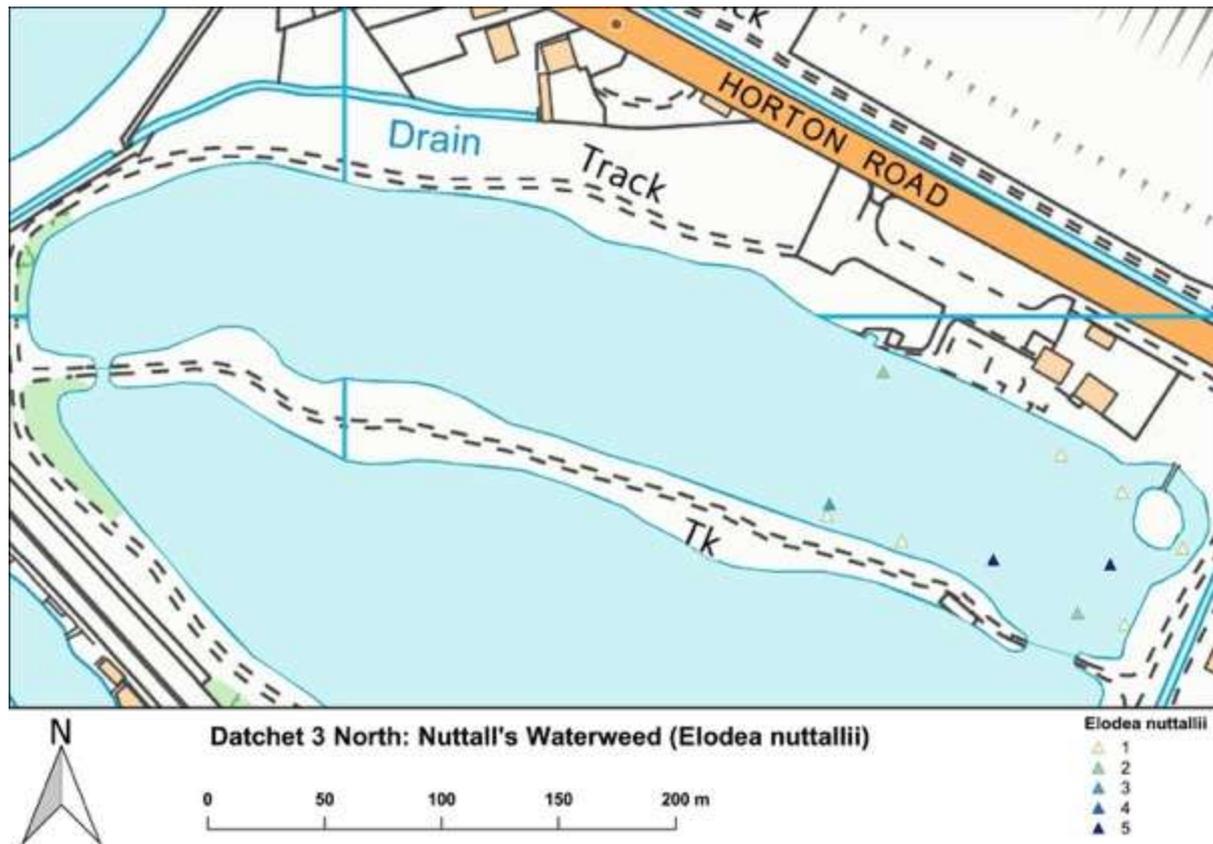


Figure 3 Extent and abundance of *Elodea nuttallii* at Datchet 3 North.

Notably, *Chara* sp. was recorded at 10 survey points, as can be seen in Figure 6. Based on field identification, this is most likely to be *Chara contraria*; which was confirmed from the adjoining site from similar habitats. A voucher specimen was not collected.

Zebra mussels were recorded frequently along the margins of the site. They were mainly concentrated on larger solid substrates (brick and concrete) and ranged from scattered individuals (“1”) to areas with dense, but isolated growths (“3”) (Figure 8).

A full species list is given in Table 2, and the extent of macrophyte cover in Figure 4.

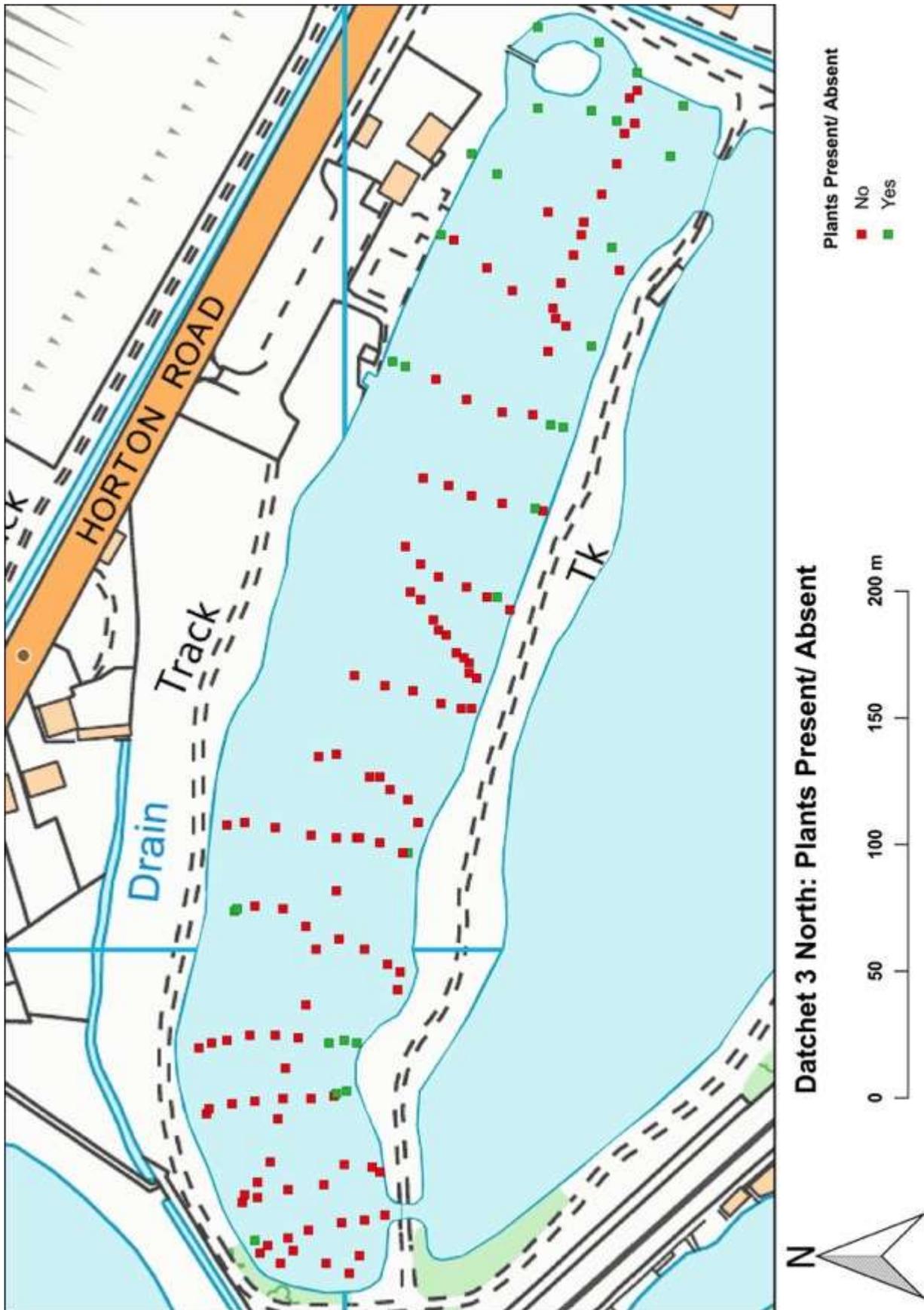


Figure 4 The extent of macrophyte cover at Datchet 3 North.

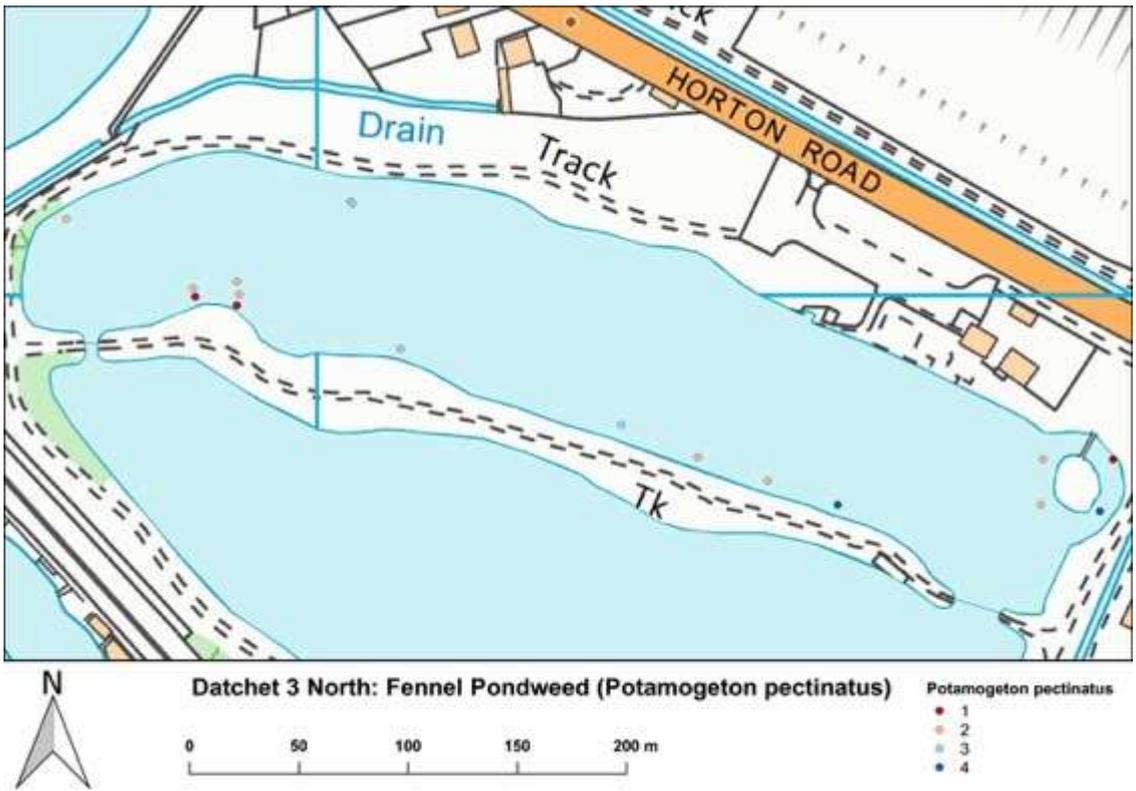


Figure 5 Extent and abundance of *Potamogeton pectinatus* at Datchet 3 North.

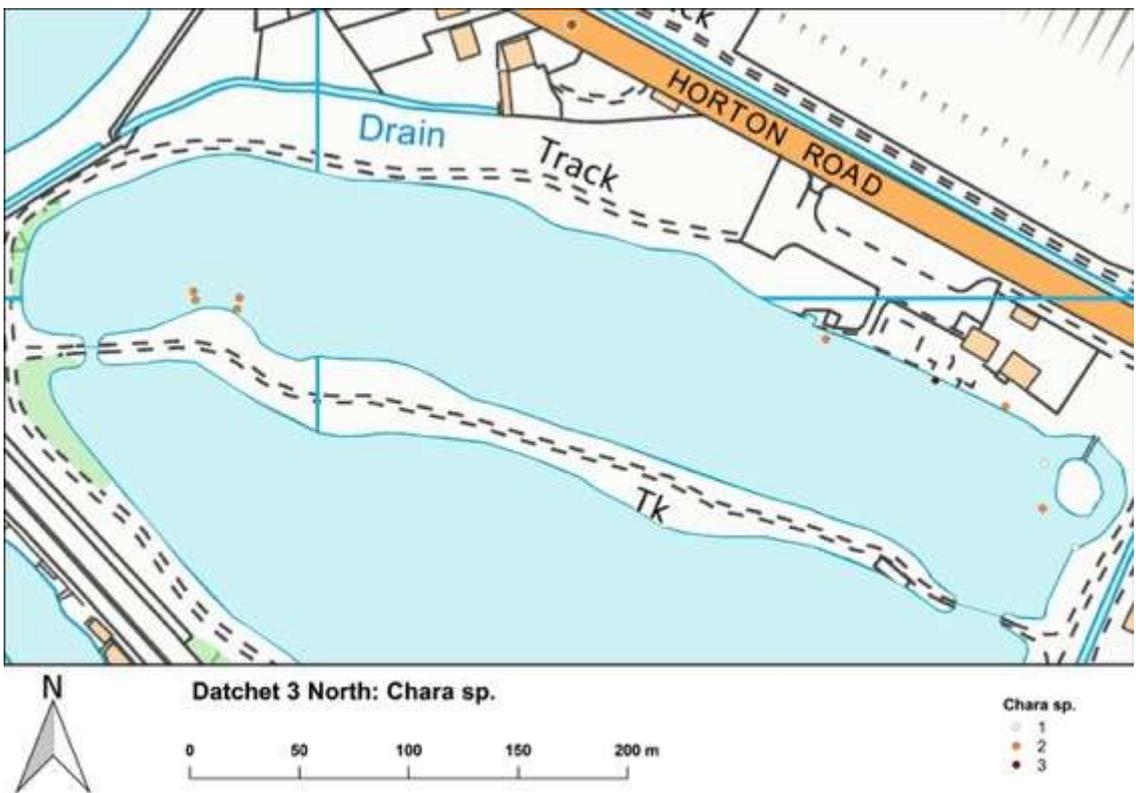


Figure 6 Extent and abundance of *Chara* sp. (*C. contraria*?) at Datchet 3 North.

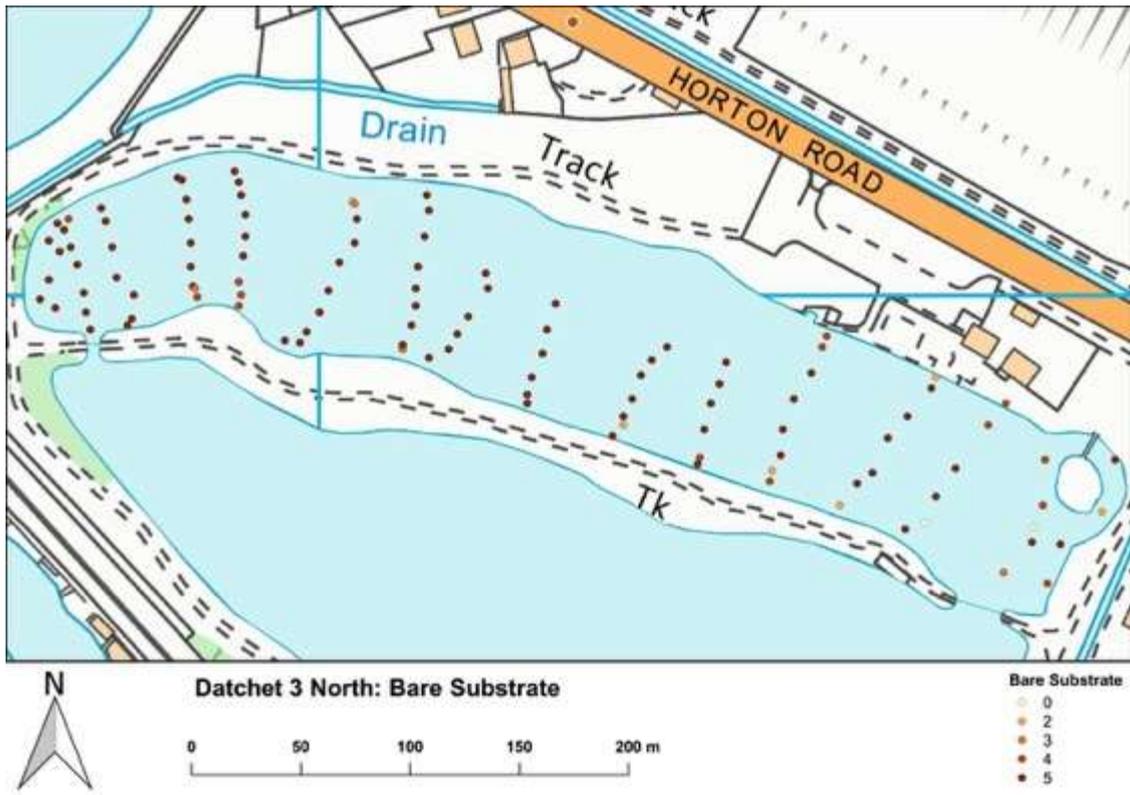


Figure 7 Extent of bare substrate at Datchet 3 North.

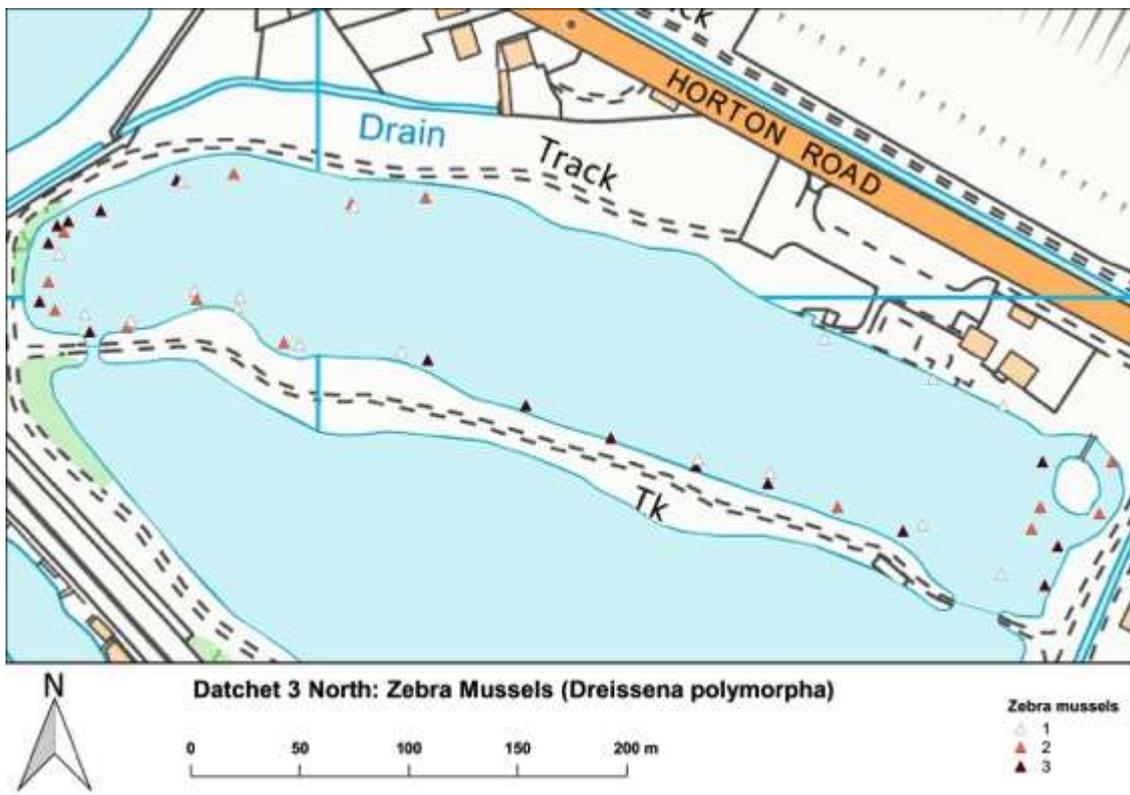


Figure 8 Extent and abundance of *Zebra mussels* at Datchet 3 North.

WFD survey

Only three aquatic species were recorded and the marginal vegetation was limited to mainly generalist taxa. A summary of the species is given in Table 2 and the LEAFPACS 2 metrics in Table 3.

Table 2 Macrophyte summary; Datchet 3 North

Species	Frequency (n= 192)	LEAFPACS 2 Cover (%)
Aquatic taxa		
<i>Ceratophyllum demersum</i>	0.5	-
<i>Chara</i> sp. (<i>C. contraria</i> ?)	6.8	0.46
<i>Elodea nuttallii</i>	6.3	0.25
<i>Potamogeton pectinatus</i>	13.0	1.1
<i>Potamogeton pusillus</i>	0.5	-
Marginal / emergent taxa		
<i>Carex acutiformis</i>		-
<i>Epilobium hirsutum</i>		-
<i>Iris pseudacorus</i>		-
<i>Lythrum salicaria</i>		-
<i>Mentha aquatica</i>		-
<i>Phalaris arundinacea</i>		-
<i>Lycopus europaeus</i>		-

Table 3 LEAFPACS 2 metrics applied to Datchet 3 North.

LEAFPACS metric report				
LMNI	NTAXA	NFG	COV	ALG
6.32	3.00	3.00	0.60	0.00

3.2. Datchet 3 South

Survey Date	9 August 2016
Grid reference:	TQ0010575852
OS Grid reference (X,Y):	500105, 175852
Approx. surface area (ha.):	5.2
Maximum recorded depth (m):	6.7
Secchi depth (m)	2.9

Overview

In comparison to Datchet 3 North, Datchet 3 South supports a more extensive plant community and greater species richness. This site is also used regularly for water sports, specifically for cable wakeboarding inclusive of a number of fixed jumps and rails anchors around the lake (Figure 9). As a result, there is some evidence of erosion in the margins from the wake, but without the heavy boat traffic, this is less extensive than in Datchet 3 North.



Figure 9 North shore of Datchet 3 South.

Extent of macrophyte cover

A number of species dominate the site, namely *C. demersum*, *E. nuttallii*, *M. spicatum* and chara species, *C. globularis* and *C. contraria*. (Figure 12 to Figure 15). These species occur in mixed beds throughout much of the lake where the water depth is less than 5 m, with mean DAFOR of “2”, occasional, but often locally abundant. Overall, the extent of macrophyte cover and biomass was relatively high (Figure 10).

In contrast to Datchet 3 North, only one small region of the lake towards the western end was without plants, due to the water depth being greater than 6 metres (Figure 10). Filamentous algae commonly occurred across the site where plants were present, ranging from 1 to 5 on the DAFOR scale.

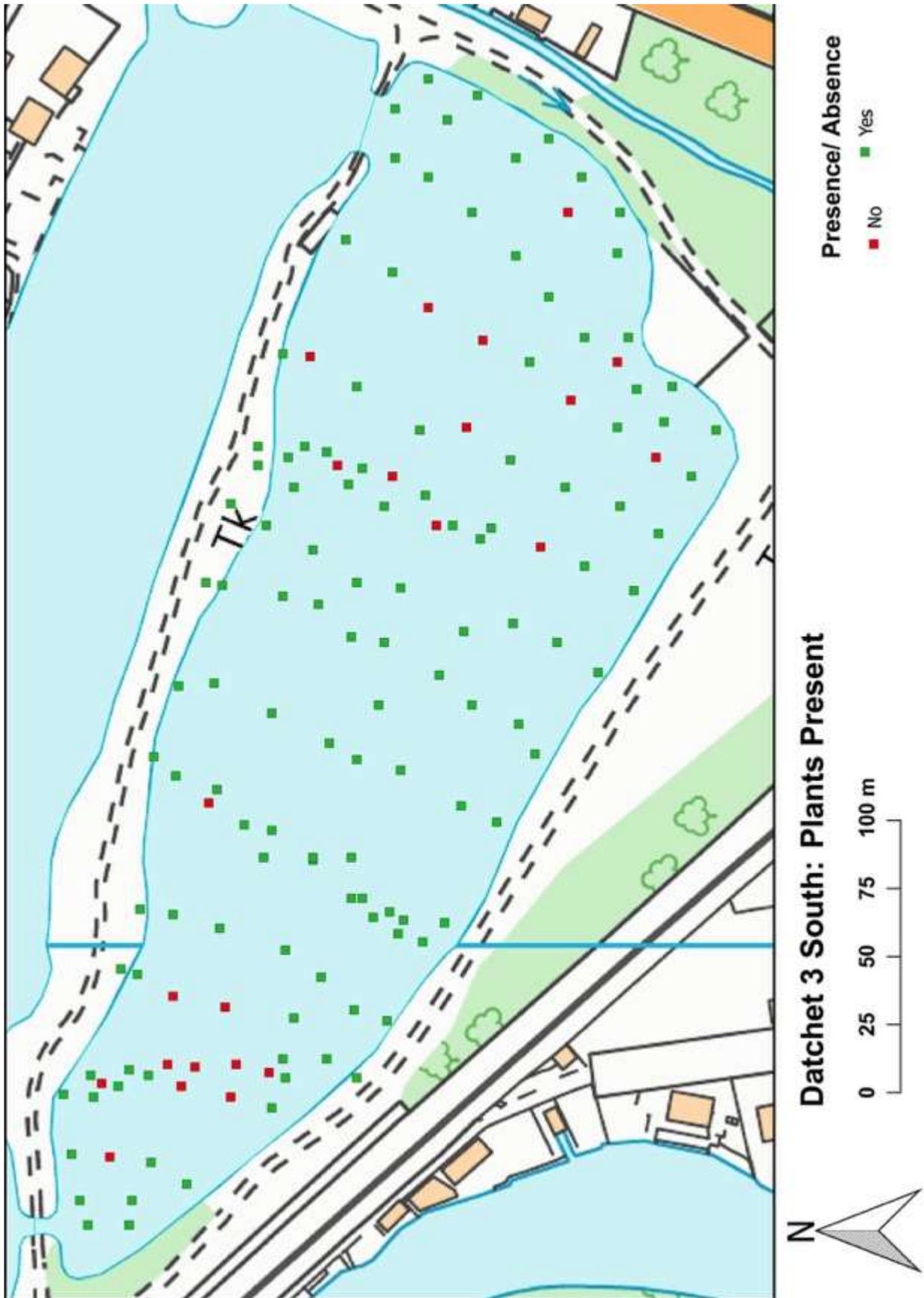


Figure 10 The extent of macrophyte cover at Datchet 3 South.

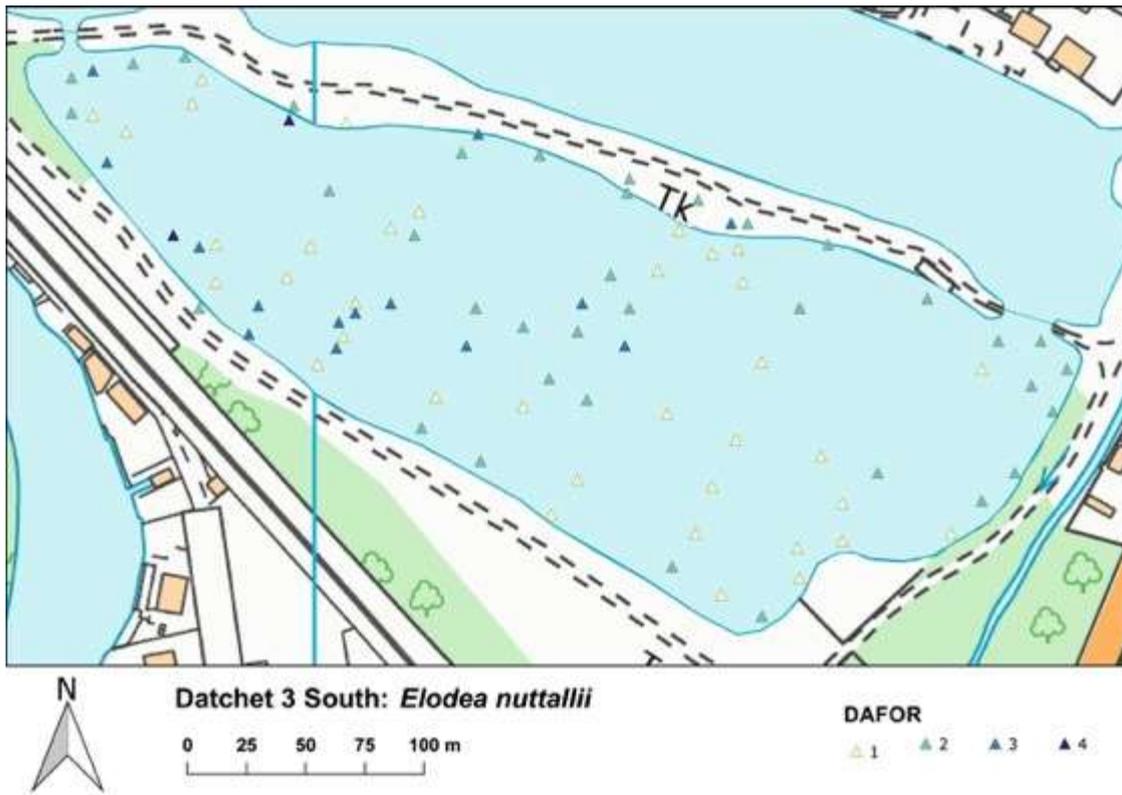


Figure 11 Extent and abundance of *Elodea nuttallii* at Datchet 3 South.

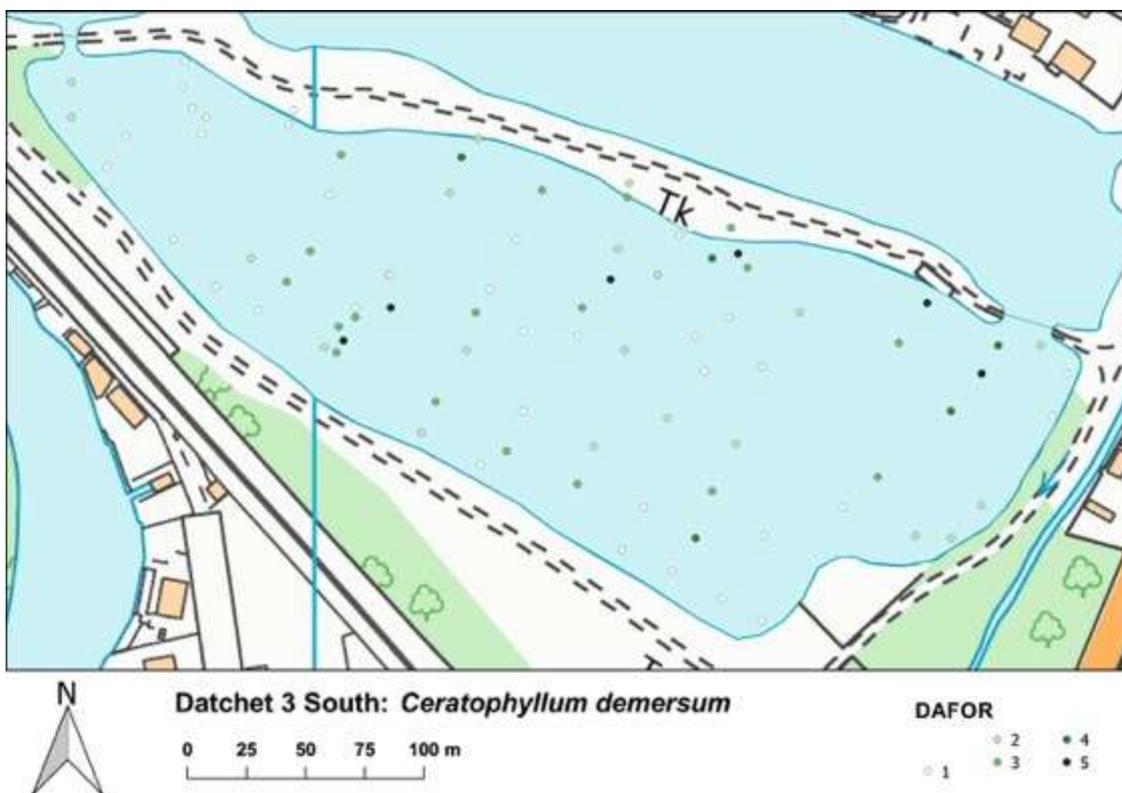


Figure 12 Extent and abundance of *Ceratophyllum demersum* at Datchet 3 South.

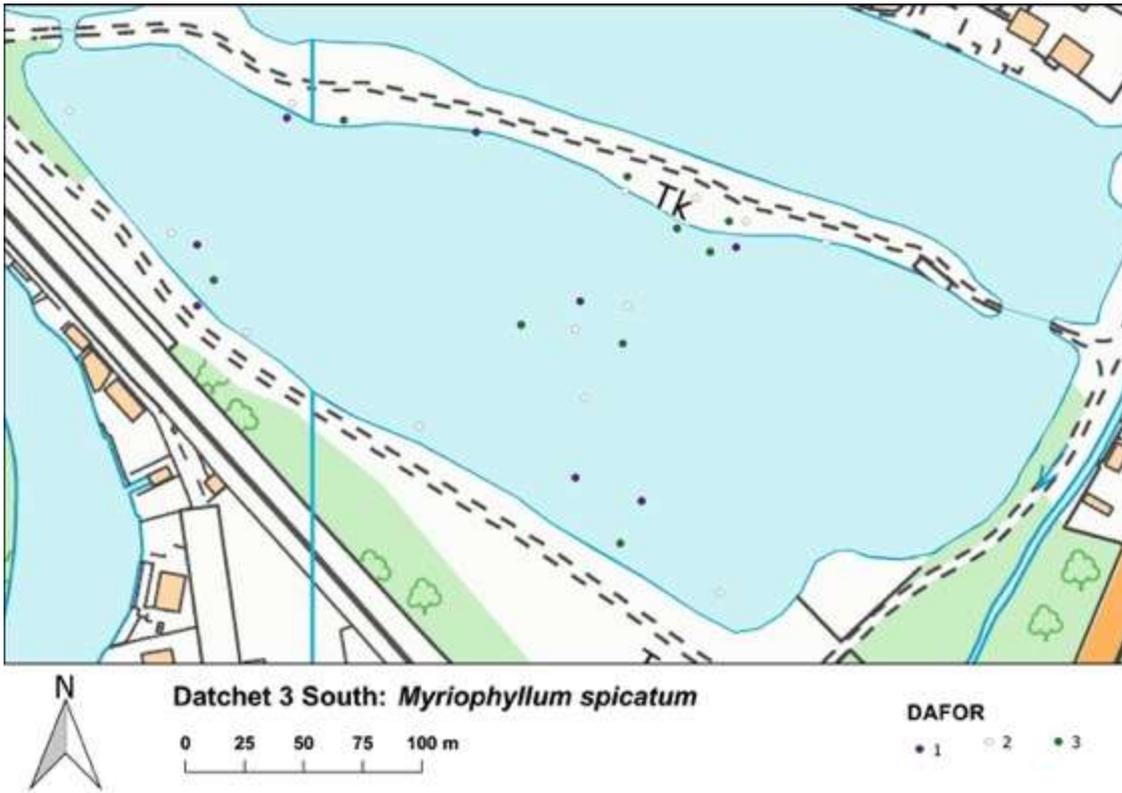


Figure 13 Extent and abundance of *Myriophyllum spicatum* at Datchet 3 South.

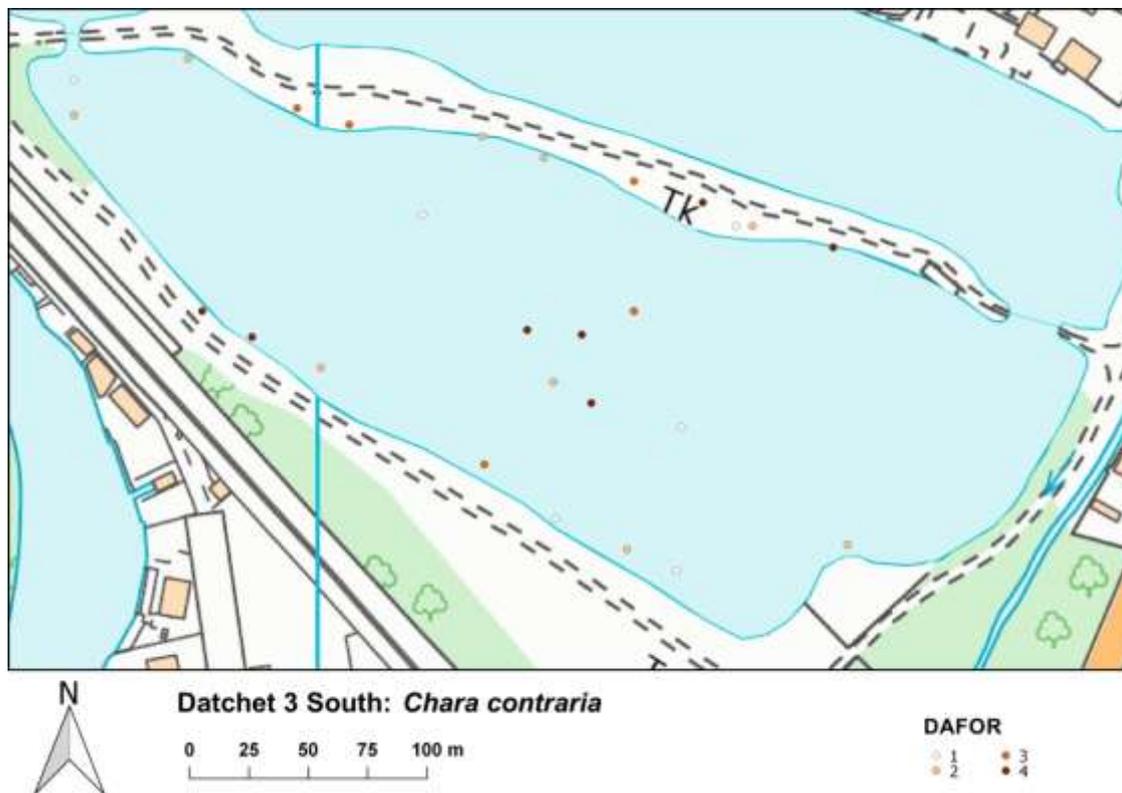


Figure 14 Extent and abundance of *Chara contraria* at Datchet 3 South.

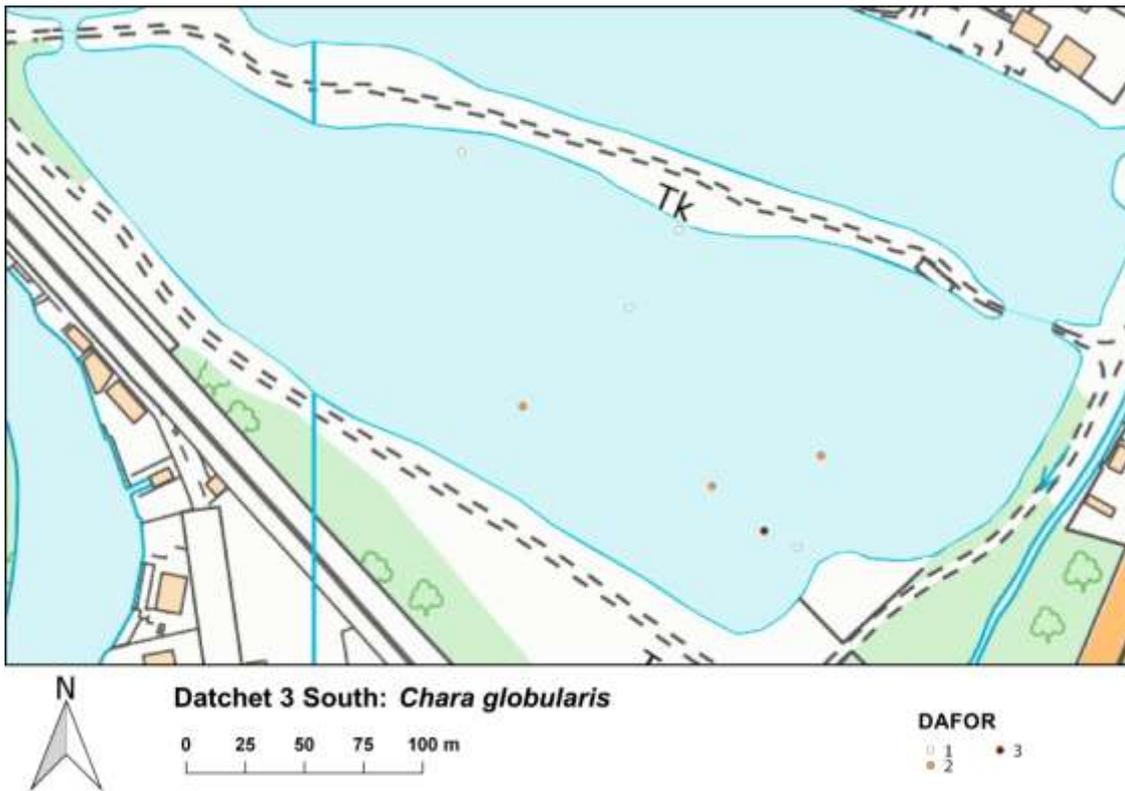


Figure 15 Extent and abundance of *Chara globularis* at Datchet 3 South.

Of particular note, there were two species of *Chara* present as well as *Nitella mucronata* var. *gracillima* and a single occurrence of *Nitellopsis obtusa* growing at 5.1 m depth. *Nitellopsis obtusa* is a current Biodiversity Action Plan species for which a threat is recognised and remains in the UK; it is classified as “vulnerable” within GB. To the best of our knowledge, the occurrence of *N. obtusa* at Datchet 3 South is a new record for this species (N. Stewart, pers. comm.). A freshwater sponge was also recorded at two points; their occurrence usually being associated with clean and clear water and unusual in the SE of the UK (Karen Evans, University of Liverpool, pers. comm.).

Zebra mussels were present, mainly in the shallower areas (Figure 16) where they were associated with hard substrate or attached to plant stems.

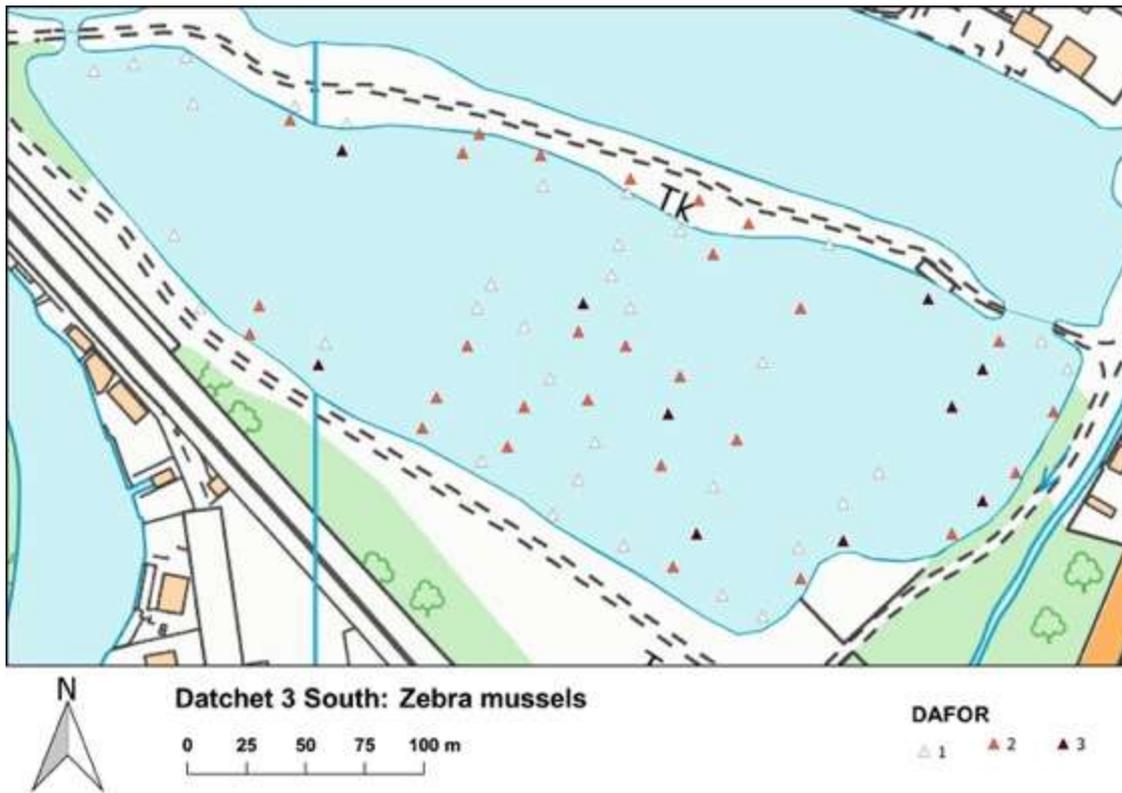


Figure 16 Extent and abundance of *Zebra mussels* at Datchet 3 South.

WFD Survey

Ten aquatic species were observed throughout the survey. A high percentage cover was recorded for *Ceratophyllum demersum* (8.78%) and *Elodea nuttallii* (11.41%), which reflects the findings of the vegetation mapping survey. Marginal vegetation was limited to common taxa such as *Lycopus europaeus*, *Epilobium hirsutum* and *Salix* species. A summary of the species is given in Table 5 and the LEAFPACS 2 metrics in Table 4.

Table 4 LEAFPACS 2 metrics applied to Datchet 3 South.

LEAFPACS metric report				
LMNI	NTAXA	NFG	COV	ALG
6.62	11.00	7.00	4.59	0.36

Table 5 Macrophyte summary; Datchet 3 South

Species	Frequency (n= 203)	LEAFPACS 2 Cover (%)
Aquatic taxa		
<i>Ceratophyllum demersum</i>	55.2	8.78
<i>Chara globularis</i>	2.0	-
<i>Chara contraria</i>	27.1	-
<i>Elodea canadensis</i>	1.0	0.2
<i>Elodea nuttallii</i>	66.5	11.41
<i>Fontinalis antipyretica</i>	2.0	0.6
<i>Lemna trisulca</i>	39.9	3.5
<i>Myriophyllum spicatum</i>	31.5	4.52
<i>Nitellopsis obtusa</i>	0.5	-
<i>Potamogeton pectinatus</i>	3.4	0.33
<i>Potamogeton pusillus</i>	2.5	0.05
<i>Potamogeton trichoides</i>	1.0	0.14
<i>Nitella mucronata</i> var. <i>gracillima</i>	1.0	-
Marginal / emergent taxa		
<i>Lycopus europeaus</i>		-
<i>Lythrum salicaria</i>		-
<i>Epilobium hirsutum</i>		
<i>Salix</i> sp.		
<i>Alnus glutinosa</i>		
<i>Eupatorium cannabinum</i>		
<i>Juncus inflexus</i>		-
<i>Carex pendula</i>		-
<i>Solanum dulcemara</i>		-

3.3. Sunnymeads 3

Survey Date	1 August 2016
Grid reference:	TQ0079174989
OS Grid reference (X,Y):	500791, 174989
Approx. surface area (ha.):	2.29
Maximum recorded depth (m):	5.4

Overview

Sunnymeads 3 is located alongside a railway line and is surrounded by broadleaf woodland shading much of the littoral zone (Figure 17). The site has extensive aquatic macrophyte cover throughout the basin, reaching a maximum depth of 5.4 m.



Figure 17 Sunnymeads 3.

Extent of Macrophyte Cover

Sunnymeads 3 was dominated by *E. nuttallii* and *C. demersum* throughout the site, each generating an average DAFOR score of “3”, occurring frequently and often locally dominant (Figure 19 and Figure 20). Spiked Milfoil (*Myriophyllum spicatum*) was recorded at one point, to the eastern margin of the site. Common pondweed (*Potamogeton natans*) was growing in a localised stand to the northeast of the lake where it was locally abundant, as well as one record near the east shore (Figure 21). Curled pondweed (*Potamogeton crispus*) was recorded on the strandline but not found growing within the site.

Zebra mussels were present in the lake, but only recorded at a single survey point (TQ0088174916).

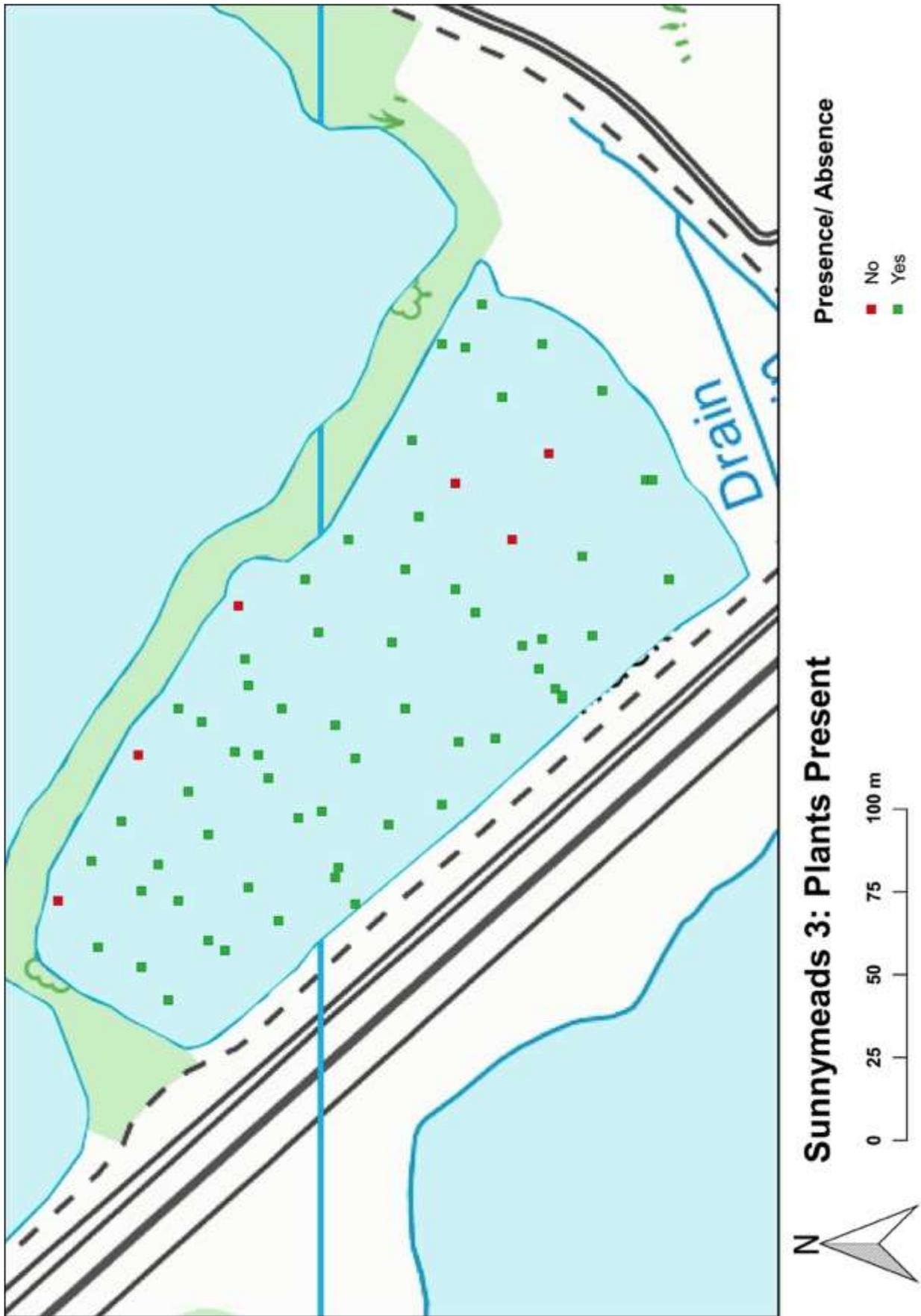


Figure 18 The extent of macrophyte cover at Sunnymeads 3.

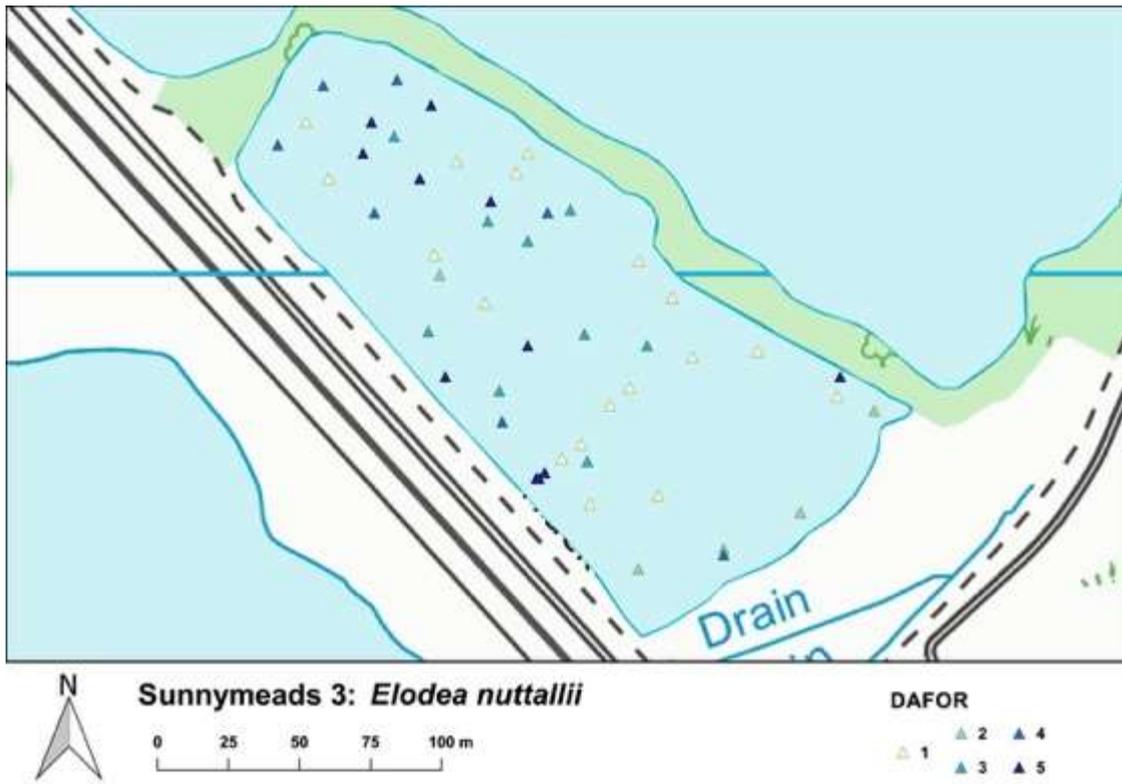


Figure 19 Extent and abundance of *Elodea nuttallii* at Sunnymeads 3.

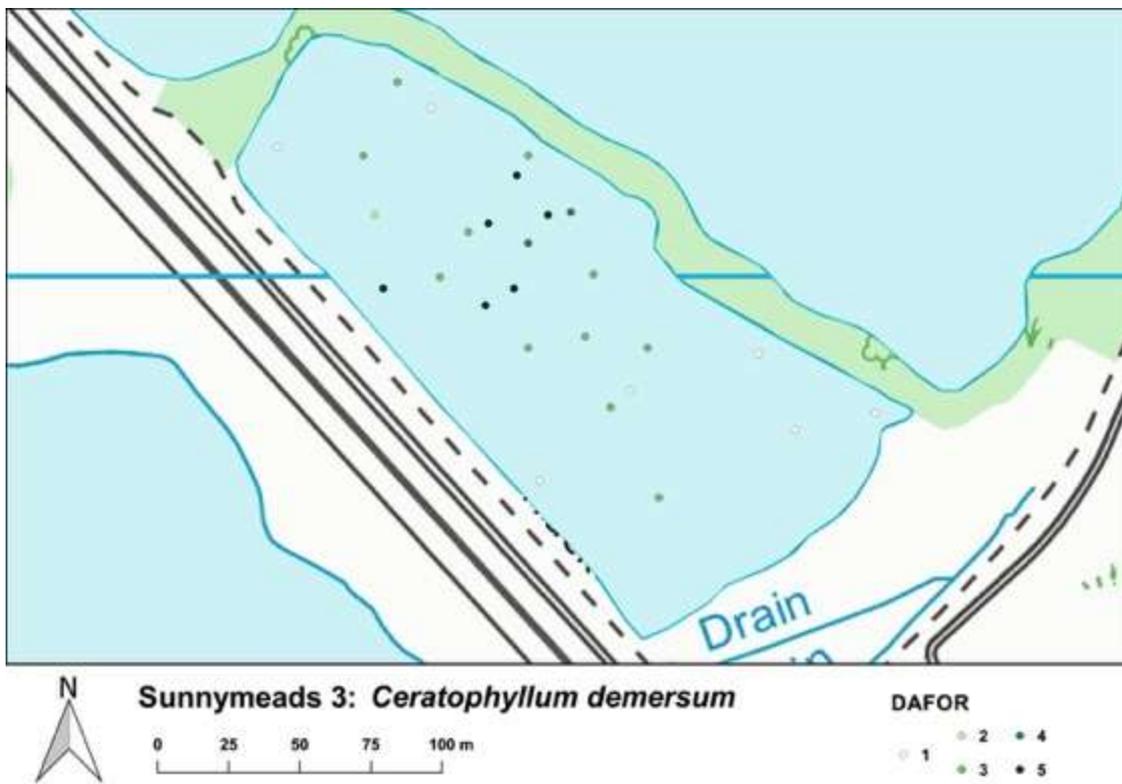


Figure 20 Extent and abundance of *Ceratophyllum demersum* at Sunnymeads 3.

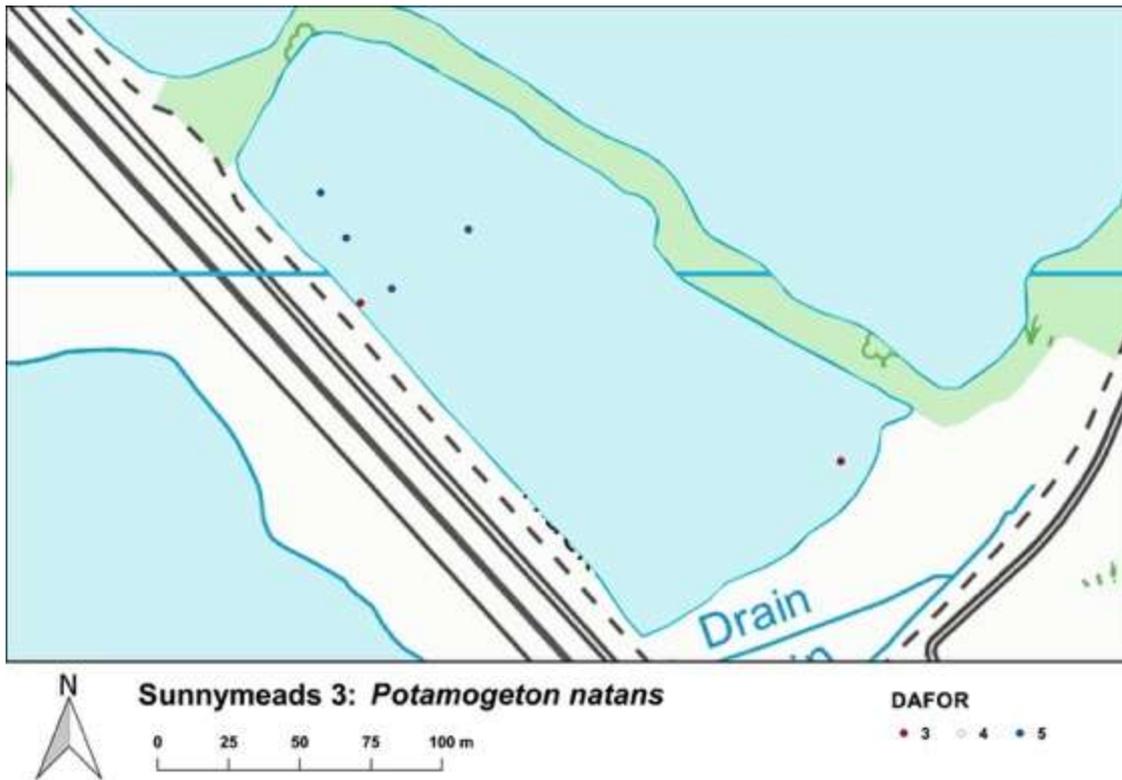


Figure 21 Extent and abundance of *Potamogeton natans* at Sunnymeads 3.

WFD Survey

E. nuttallii and *C. demersum* also dominated the WFD survey, indicating that the coverage of these two species extended close to shore. Vegetation cover was high, calculated to be 20.73 and 10.89 respectively. In total, seven submerged and floating macrophyte species were recorded. Marginal vegetation generally reflected the broadleaf woodland habitat, with *Alnus glutinosa* and *Salix* species dominating the shores. A summary of the species is given in Table 7 and the LEAFPACS 2 metrics in Table 6.

Table 6 LEAFPACS 2 metrics applied to Sunnymeads 3.

LEAFPACS metric report				
LMNI	NTAXA	NFG	COV	ALG
6.84	8.00	5.00	5.66	0.00

Table 7 Macrophyte summary; Sunnymeads 3

Species	Frequency (n= 106)	LEAFPACS 2 Cover (%)
Aquatic taxa		
<i>Ceratophyllum demersum</i>	31.1	10.89
<i>Elodea canadensis</i>	2.8	1.87
<i>Elodea nuttallii</i>	56.6	20.73
<i>Myriophyllum spicatum</i>	0.9	0.95
<i>Persicaria amphibia</i>	0.9	0.14
<i>Potamogeton natans</i>	10.4	9.6
<i>Potamogeton pectinatus</i>	0.9	0.95
Marginal / emergent taxa		
<i>Schoenoplectus lacustris</i>		-
<i>Lythrum salicaria</i>		-
<i>Epilobium hirsutum</i>		
<i>Salix</i> sp.		
<i>Alnus glutinosa</i>		

3.4. Kingsmead Island Lake

Survey Date	5 August 2016
Grid reference:	TQ0087475309
OS Grid reference (X,Y):	500874, 175309
Approx. surface area (ha.):	22.38
Maximum recorded depth (m):	5.2

Overview

Kingsmead Island Lake is primarily used for sailing, with Kingsmead Sailing Club located on the north shore. The site is also used for shore angling. The north of the site has extensive macrophyte cover, thinning to the south and east, with little or no plants in the deeper waters of the southern half of the lake (Figure 23). There were no zebra mussels observed during the macrophyte surveys.



Figure 22 Kingsmead Island Lake.

Extent of macrophyte cover

The most abundant submerged species observed in the lake was the non-native Nuttall's waterweed (*Elodea nuttallii*), which was recorded as frequent ("3" on a DAFOR scale 1-5) on average in the vegetation mapping survey. As can be seen in Figure 24, its open water distribution is generally concentrated within the northern half of the lake. This species was common in both open water and in the shallower marginal regions, most frequently at depths of more than 75 cm. Overall it was recorded at 60% frequency.

Fennel pondweed (*Potamogeton pectinatus*) was also common within the boat and wader transects, and appearing as second most frequent species within the WFD survey. Similarly, it had a significant presence principally within the northern half of the lake, averaging "3" on the DAFOR scale (frequent), as can be seen in Figure 25.

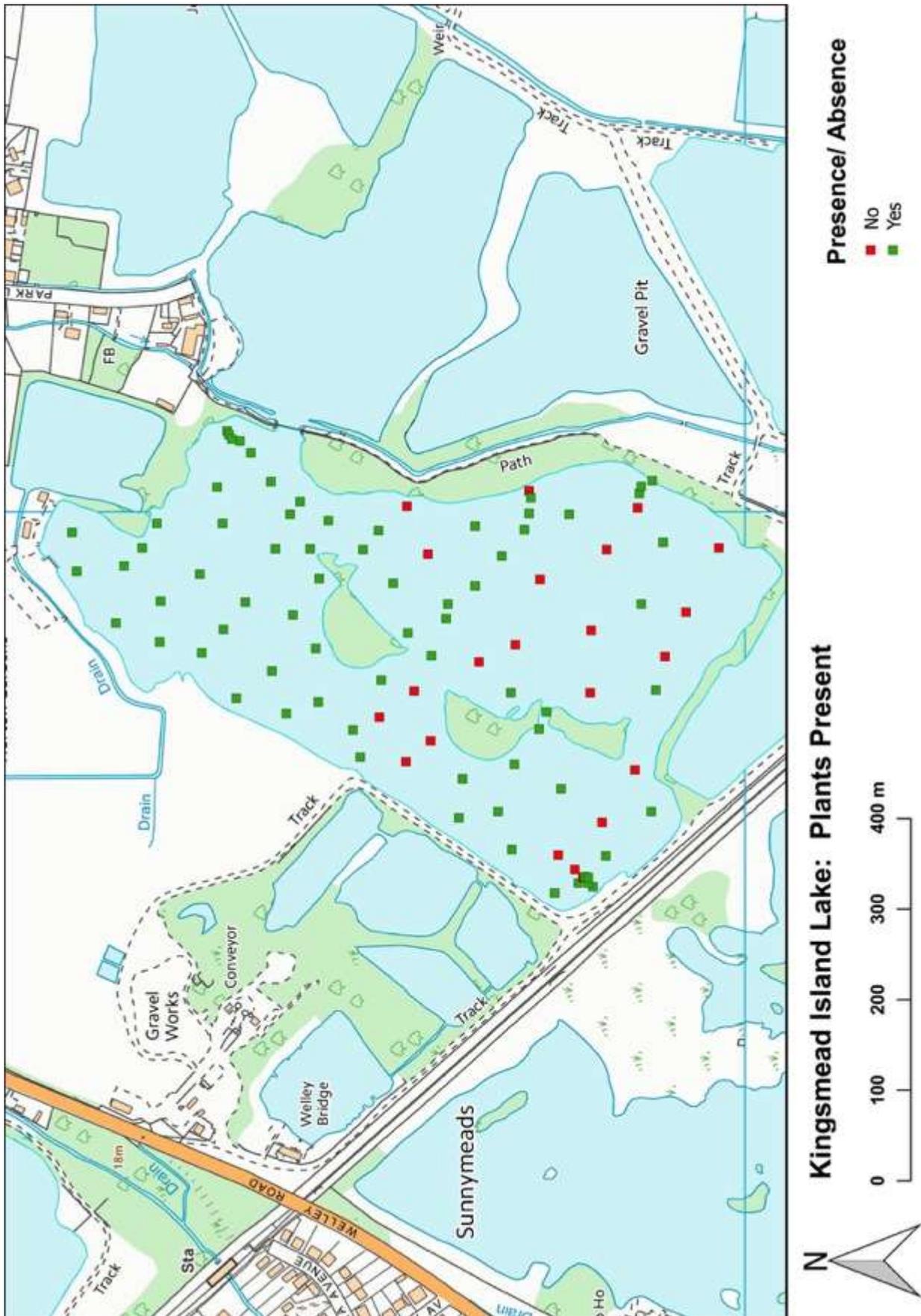


Figure 23 The extent of macrophyte cover at Kingsmead Island Lake.

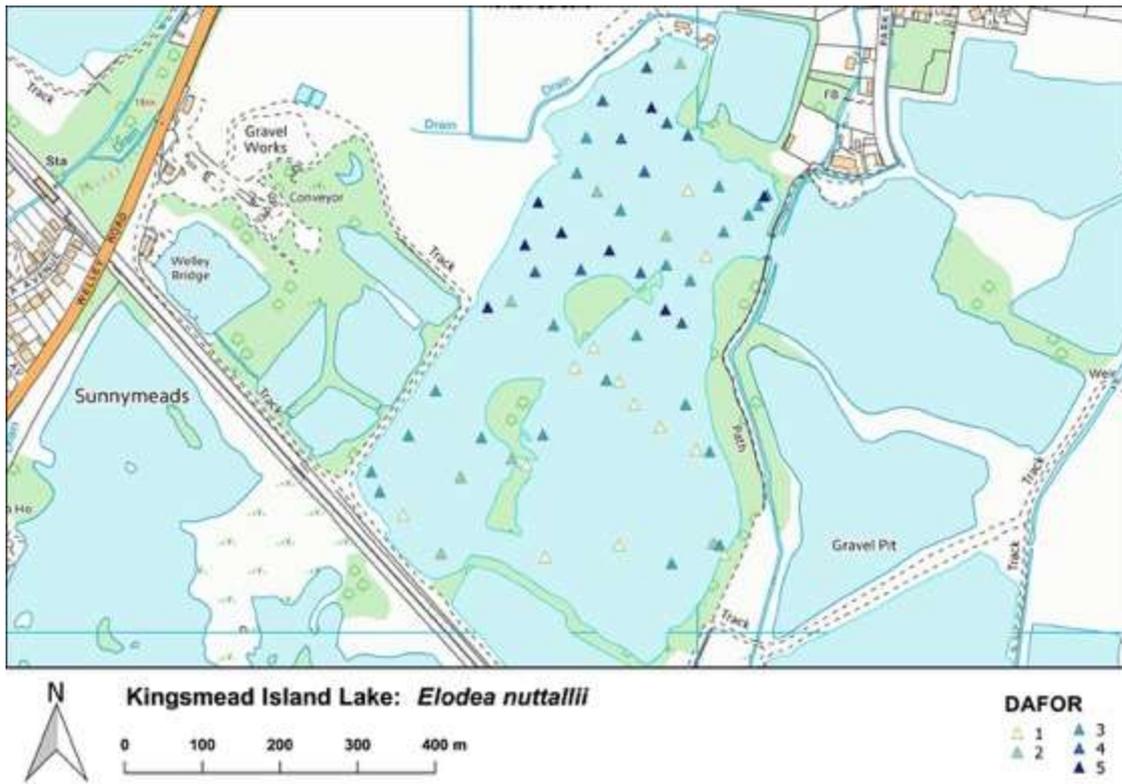


Figure 24 Extent and abundance of *Elodea nuttallii* at Kingsmead Island Lake.

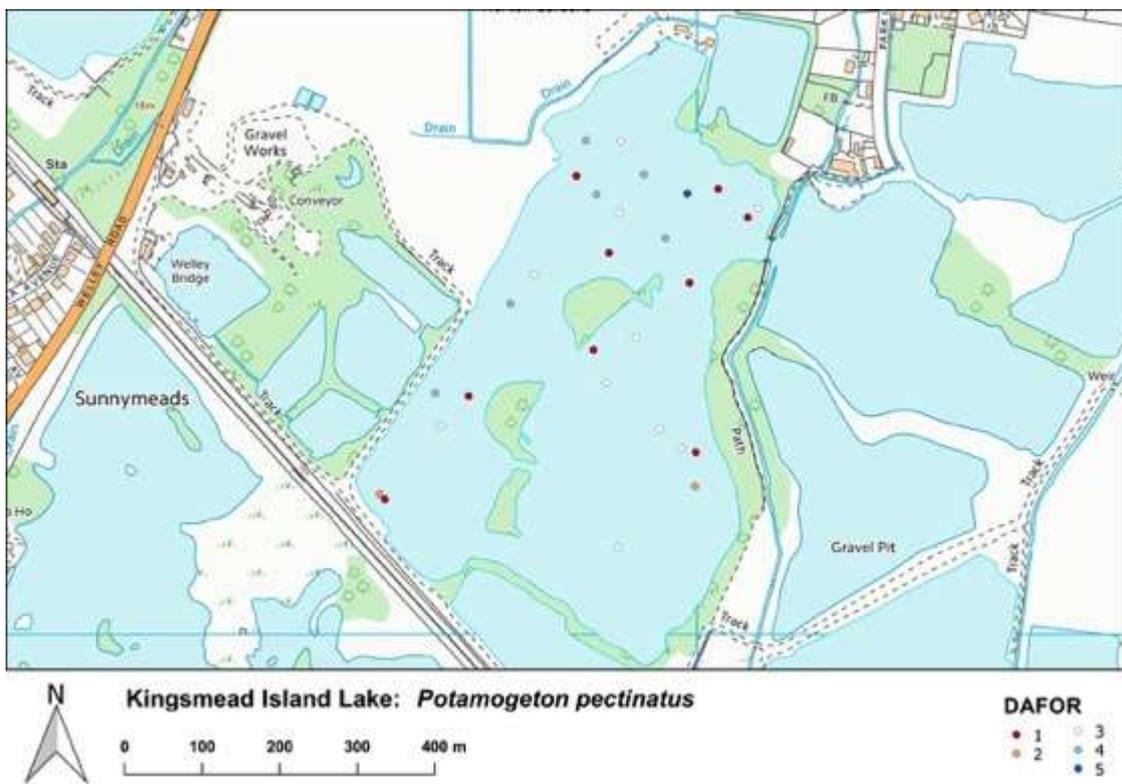


Figure 25 Extent and abundance of *Potamogeton pectinatus* at Kingsmead Island Lake.

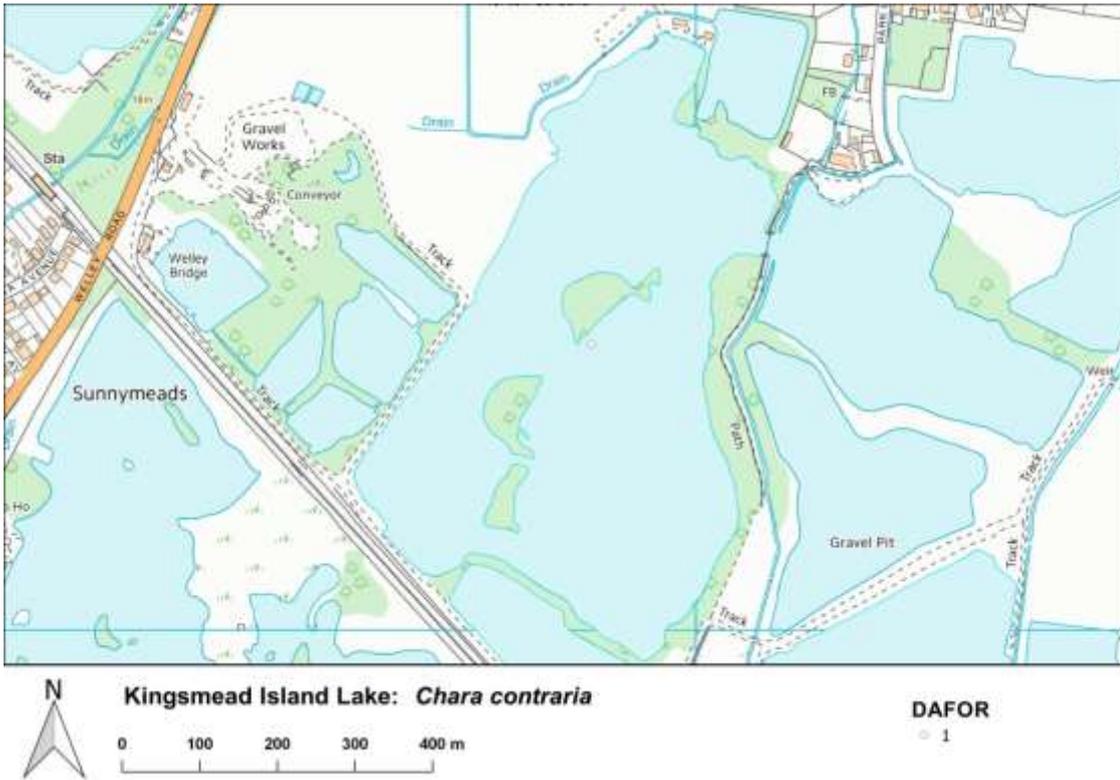


Figure 26 Extent and abundance of *Chara contraria* at Kingsmead Island Lake.

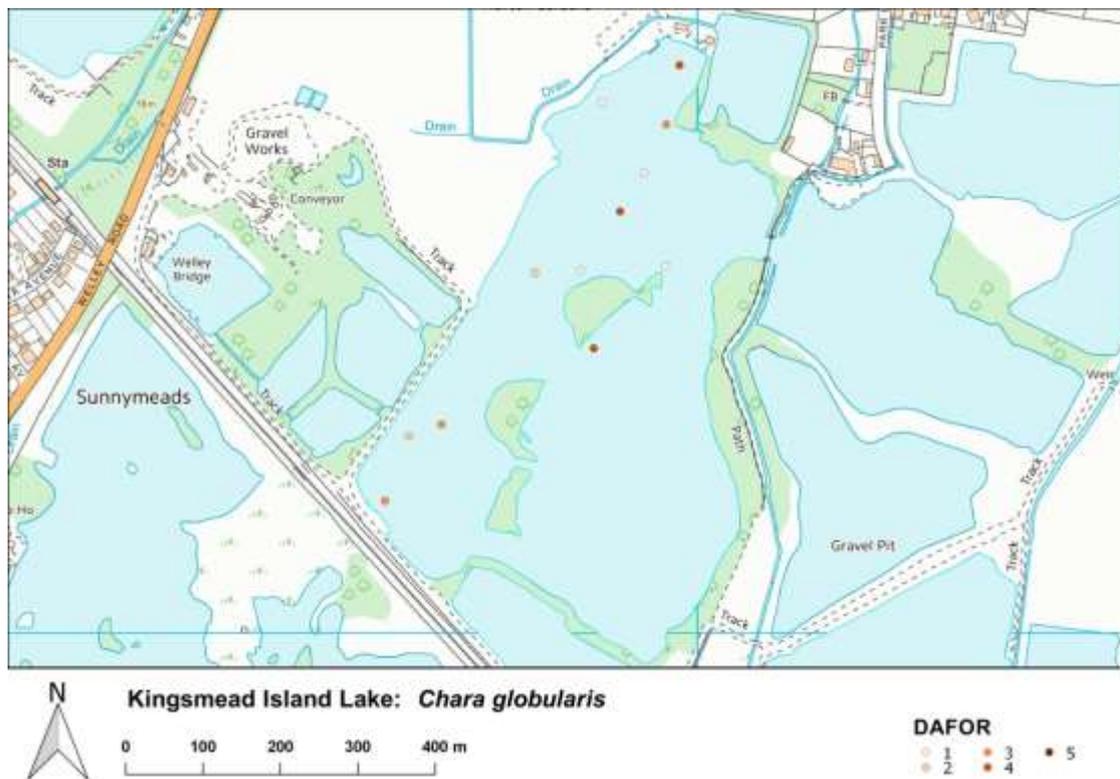


Figure 27 Extent and abundance of *Chara globularis* at Kingsmead Island Lake.

A number of localised patches of *Chara* species were recorded mainly along the western side of the lake, where they were locally abundant (Figure 26 and Figure 27). Charophytes were recorded growing to a maximum depth of 3.9 m.

Other species to note are Lesser pondweed (*Potamogeton pusillus*), Rigid hornwort (*Ceratophyllum demersum*), Canadian pondweed (*Elodea canadensis*) and Spiked water milfoil (*Myriophyllum spicatum*), all of which were infrequent and recorded between 1 and 2 on the DAFOR scale.

Filamentous algal cover was low at Kingsmead Island Lake.

WFD Survey

Nine submerged macrophyte species were recorded during the survey with *Elodea nuttallii* dominant and recorded at 60% of all survey points (57%) within the survey area. This corresponds well with the species abundance found on the vegetation mapping survey. A fairly diverse range of marginal species were recorded, including *Typha latifolia*, *Solanum dulcemara* and *Oenanthe crocata*. A summary of the species is given in

Table 9 and the LEAFPACS 2 metrics in Table 8

Table 8 LEAFPACS 2 metrics applied to Kingsmead Island Lake.

LEAFPACS metric report				
LMNI	NTAXA	NFG	COV	ALG
6.97	10.00	6.00	3.62	0.09

Table 9 Macrophyte summary; Kingsmead Island Lake

Species	Frequency (n= 154)	LEAFPACS 2 Cover (%)
Aquatic taxa		
<i>Ceratophyllum demersum</i>	41.6	0.52
<i>Chara globularis</i>	13.6	1.75
<i>Elodea canadensis</i>	8.4	1.24
<i>Elodea nuttallii</i>	56.5	15.24
<i>Lemna minor</i>	0.6	-
<i>Lemna trisulca</i>	20	3.54
<i>Myriophyllum spicatum</i>	16.9	-
<i>Persicaria amphibia</i>	2.6	3.38
<i>Potamogeton pectinatus</i>	22.1	3.68
<i>Potamogeton pusillus</i>	3.9	0.43
<i>Potamogeton trichoides</i>	0.6	0.29
Marginal / emergent taxa		
<i>Buddleja davidii</i>		
<i>Eupatorium cannabinum</i>		
<i>Sparganium erectum</i>		
<i>Persicaria amphibia</i>		
<i>Typha latifolia</i>		
<i>Solanum dulcamara</i>		
<i>Salix</i> sp.		
<i>Alnus glutinosa</i>		
<i>Lythrum salicaria</i>		
<i>Phragmites australis</i>		
<i>Lycopus europaeus</i>		
<i>Carex pendula</i>		
<i>Epilobium hirsutum</i>		
<i>Iris pseudacorus</i>		
<i>Oenanthe crocata</i>		
<i>Mentha</i> sp.		-

3.5. Horton 2 Lake

Survey Date	2 August 2016
Grid reference:	TQ0124874875
OS Grid reference (X,Y):	501248, 174875
Approx. surface area (ha.):	10.3
Maximum recorded depth (m):	7.9

Overview

Horton 2 is a quiet site with fishing platforms installed for shore anglers. The lake has extensive macrophyte cover to depths of up to 5.5 m, with occasional macrophyte growth to 6.2 m. The maximum recorded depth was 7.9 m.

A single occurrence of quagga mussel (*Dreissena bugensis*) was recorded at TQ0139974978 and zebra mussels at TQ0117274656.



Figure 28 Horton 2 Lake.

Extent of macrophyte cover

The overlay of GPS-recorded sample points onto OS sourced data shows a slight mismatch and hence some points on the diagrams below appear to be plotted on land. All points were within the lake.

At the time of survey, Horton 2 was dominated by *Elodea nuttallii* throughout most of the site, with an averaged DAFOR score of “3” (Figure 30) and overall frequency of 74% (based on all sample points). Canadian waterweed (*Elodea canadensis*) was also recorded at the site and was locally abundant, but appeared to be restricted to the margins with no records exceeding 2.3 m water depth (Figure 31).

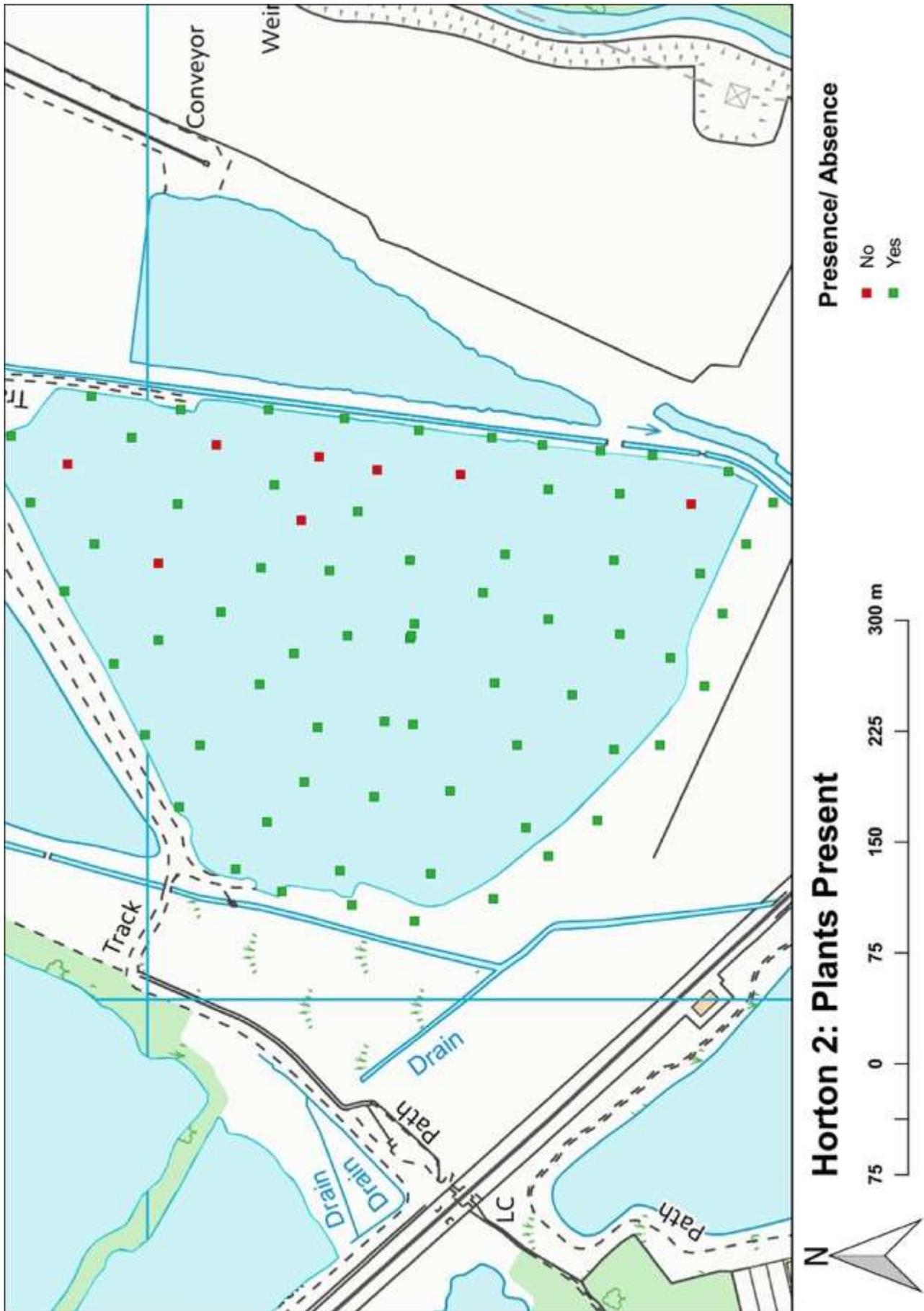


Figure 29 The extent of macrophyte cover at Horton 2.

A number of fine-leaved *Potamogeton* species were recorded growing throughout the lake. *Potamogeton pectinatus* was locally abundant in the northern half of the lake (Figure 33), whereas *P. trichoides* and *P. pusillus* were a little more scattered, but mostly recorded at low abundance growing within mixed species beds (Figure 34 and Figure 35). *Potamogeton crispus* was recorded at only one survey point, towards the eastern margin of the site, with a score of “1”.

Ceratophyllum demersum was also relatively common within the site, particularly around the western side (Figure 32). Charophytes were relatively rare within the site and mainly recorded from the centre of the lake where a localised population (*C. contraria*) was recorded growing in abundance (Figure 36). A full summary of the aquatic species is given in Table 10.

Filamentous algal cover was negligible at Horton 2.

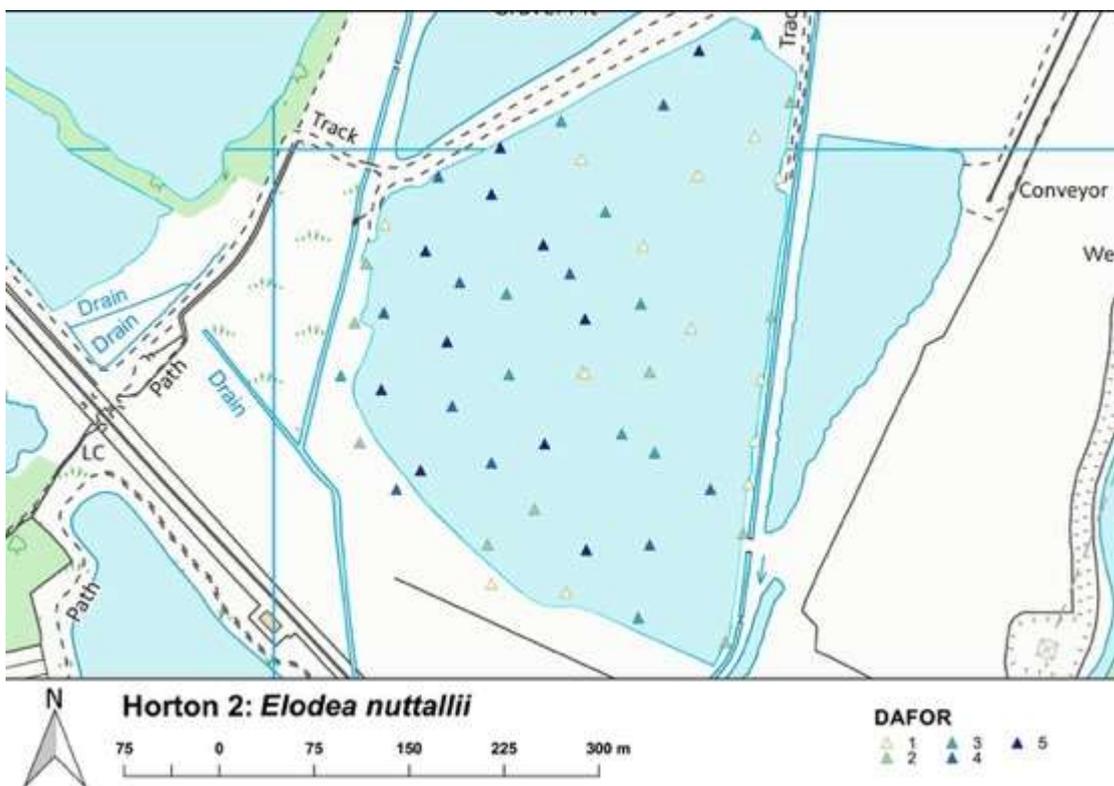


Figure 30 Extent and abundance of *Elodea nuttallii* at Horton 2.

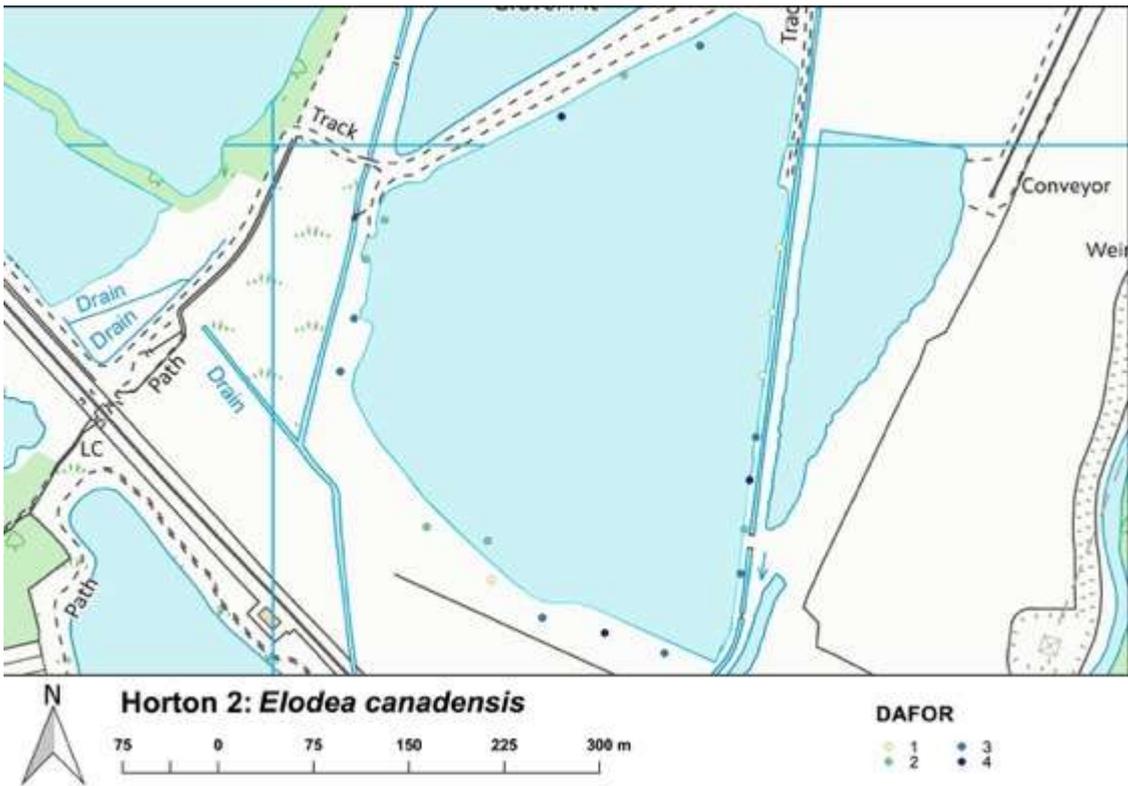


Figure 31 Extent and abundance of *Elodea canadensis* at Horton 2.

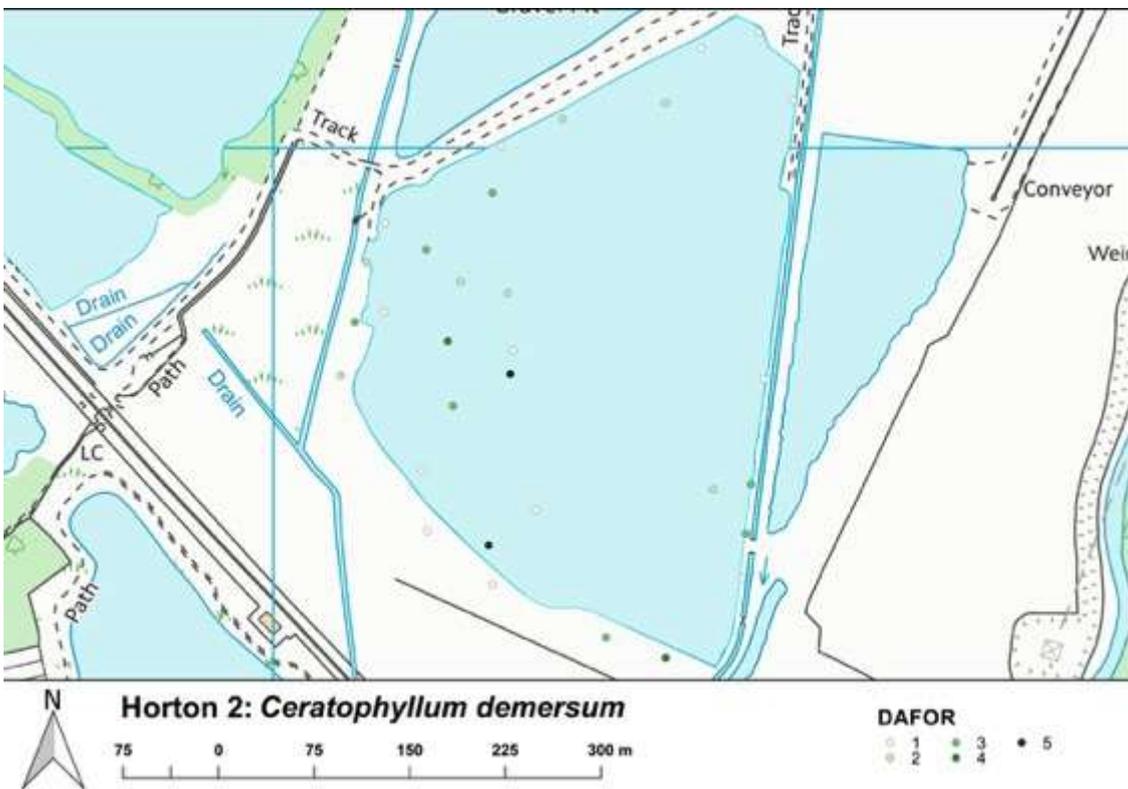


Figure 32 Extent and abundance of *Ceratophyllum demersum* at Horton 2.

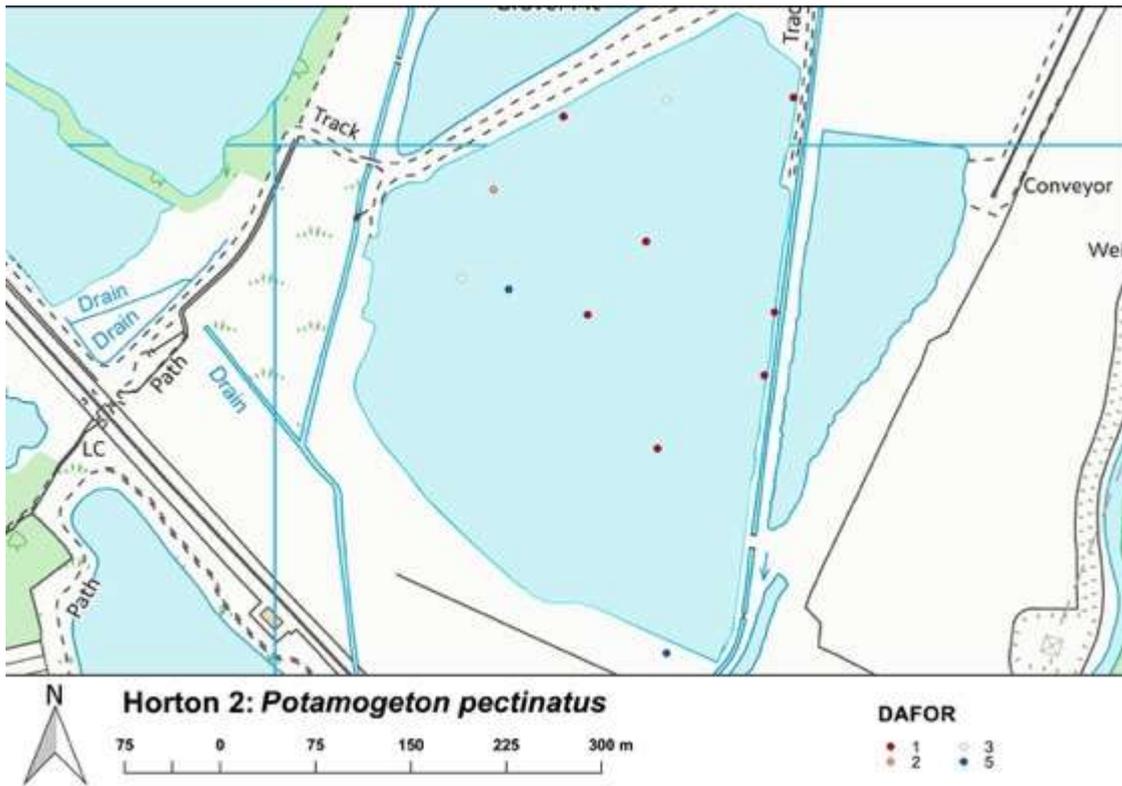


Figure 33 Extent and abundance of *Potamogeton pectinatus* at Horton 2.

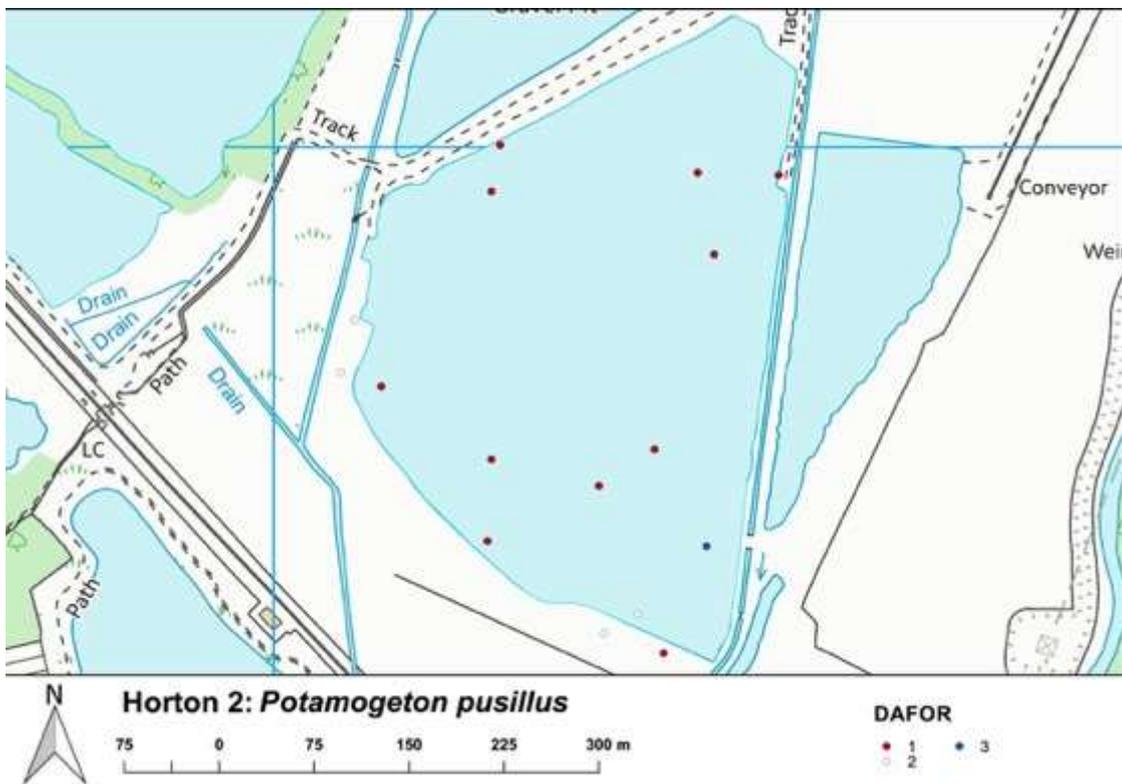


Figure 34 Extent and abundance of *Potamogeton pusillus* at Horton 2.

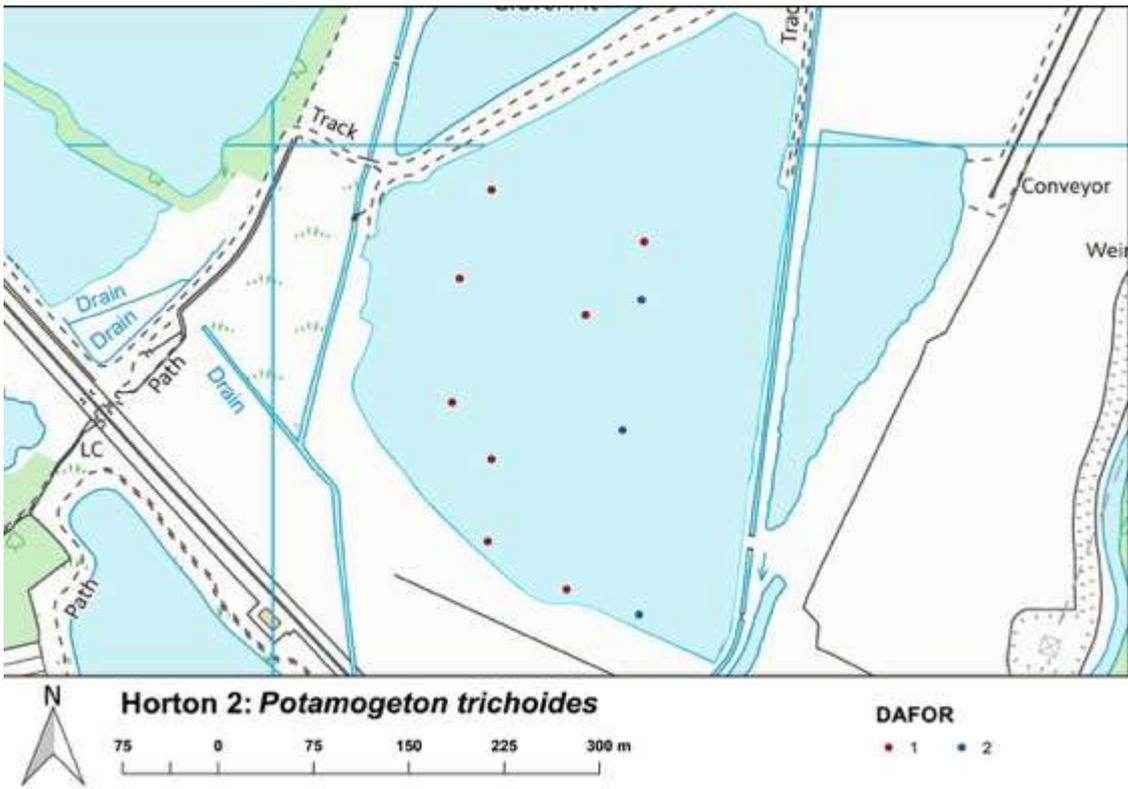


Figure 35 Extent and abundance of *Potamogeton trichoides* at Horton 2.

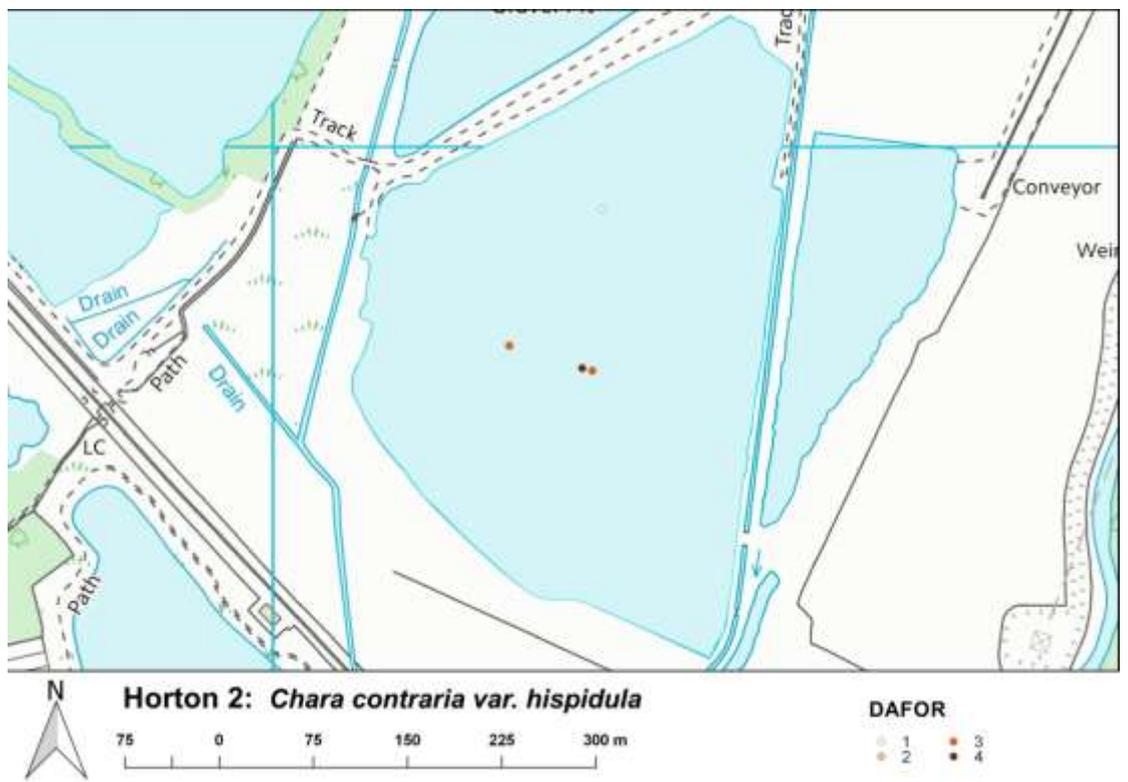


Figure 36 Extent and abundance of *Chara contraria var. hispidula* at Horton 2.

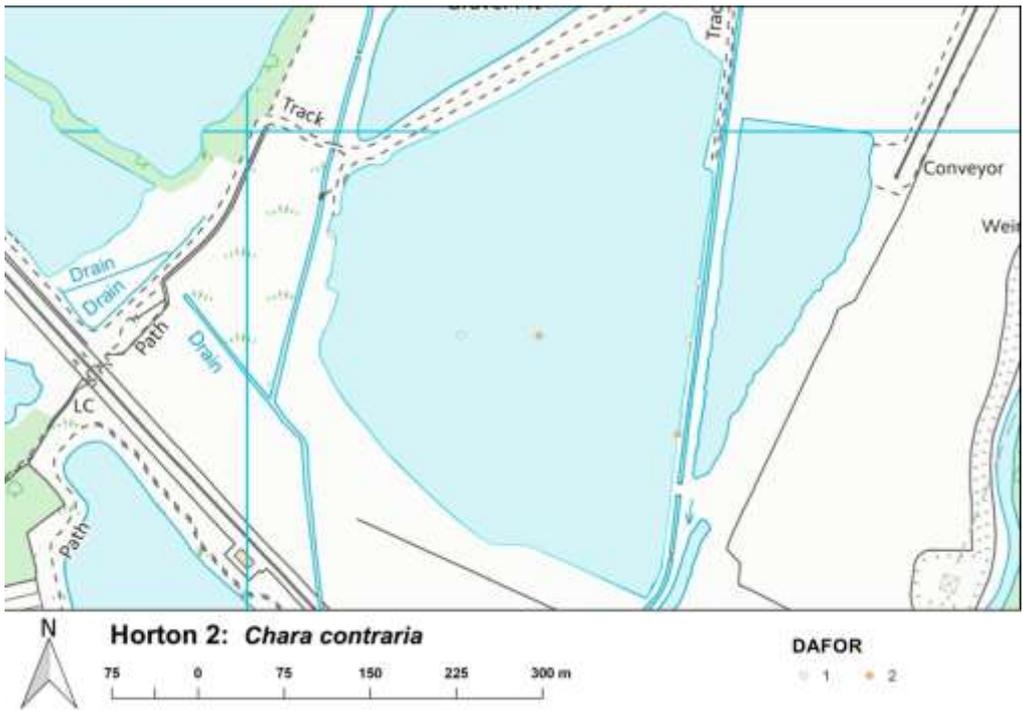


Figure 37 Extent and abundance of *Chara contraria* at Horton 2.

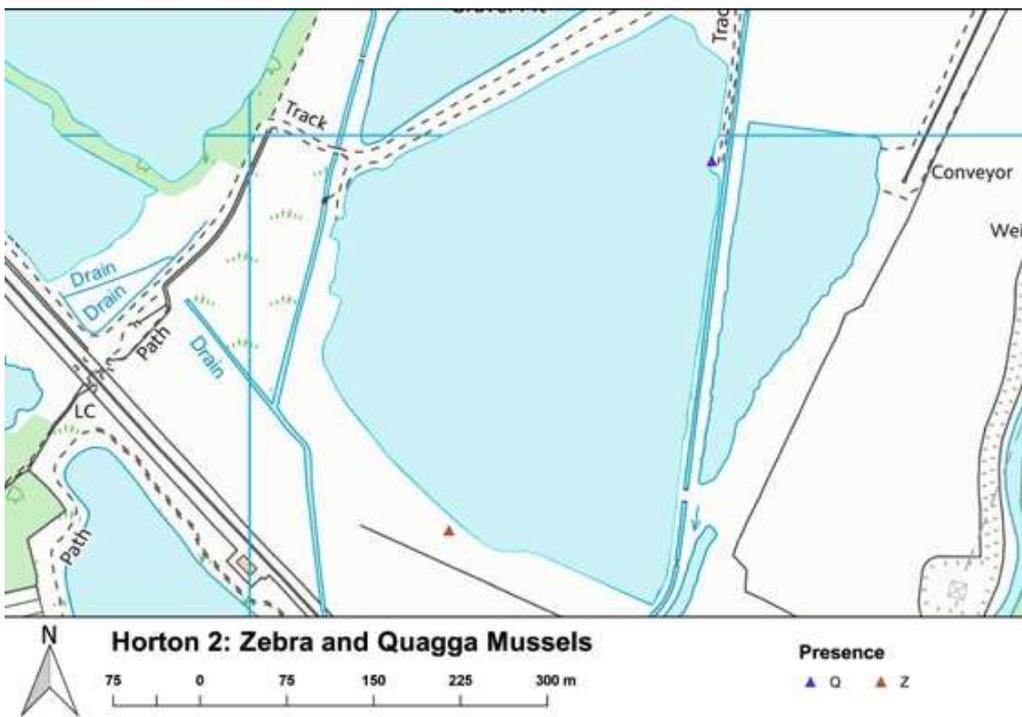


Figure 38 Location of Zebra and quagga mussels at Horton 2.

Table 10 Aquatic macrophyte summary; Horton 2

Species	Frequency (n= 76)
<i>Ceratophyllum demersum</i>	40.8
<i>Chara contraria</i>	7.9
<i>Chara contraria</i> var. <i>hispidula</i>	6.6
<i>Elodea canadensis</i>	27.6
<i>Elodea nuttallii</i>	73.7
<i>Lemna trisulca</i>	3.9
<i>Phragmites australis</i>	2.6
<i>Potamogeton crispus</i>	1.3
<i>Potamogeton pectinatus</i>	15.8
<i>Potamogeton pusillus</i>	21.1
<i>Potamogeton trichoides</i>	14.5

3.6. Wraysbury 2 North

Survey Date	3 August 2016
Grid reference:	TQ0104773844
OS Grid reference (X,Y):	501047, 173844
Approx. surface area (ha.):	37.52
Maximum recorded depth (m):	5.5
Secchi Depth (m)	1.0

Overview

Wraysbury 2 North is one of the larger flooded pits in this area and is widely used by shore anglers with some boat access. The site is surrounded by broadleaf woodland, and is within close proximity to residential developments and is frequently visited by the public. As a result, it suffers from a slight litter problem. The physical structure of the lake is complex: open water areas were recorded at depths exceeding 5 m, but the bathymetry is rather complicated and the site has numerous islands and shallower zones, particularly to the south side of the site. The lake margins shelved off steeply around much of the site and there was very little hydrosere development. As a result, plants were not present throughout the majority of the site, as seen in Figure 39.

Zebra mussels were recorded from only a single point in the vegetation mapping survey (TQ009197358).

Extent of macrophyte cover

Elodea nuttallii was the most commonly observed species at Wraysbury, and where present, was often frequent to locally abundant, particularly around the northeast region of the lake (Figure 40). *Potamogeton pectinatus* was also recorded as locally frequent, but was only at sporadic intervals, as can be seen in Figure 41. *Lemna trisulca*, *L. minor* and *Ceratophyllum demersum* were recorded as occasional and overall, the level bare substrate across the lake floor was extensive, with limited occurrence of plant growth.

WFD Survey

Overall, ten submerged or floating macrophyte species were recorded at Wraysbury 2 North. Vegetation cover was low across the lake, with *Elodea nuttallii* recorded as the most extensive at 4.1% cover (within 4 sectors). Marginal vegetation was often shaded, with species such as *Myosotis scorpiodes*, *Lycopus europaeus* and *Salix*, reflecting the influence of the broadleaf woodland habitat. A summary of the species is given in Table 12 and the LEAFPACS 2 metrics in Table 11.

Table 11 LEAFPACS 2 metrics applied to Wraysbury 2 North.

LEAFPACS metric report				
LMNI	NTAXA	NFG	COV	ALG
7.47	10.0	6.00	2.03	0.22

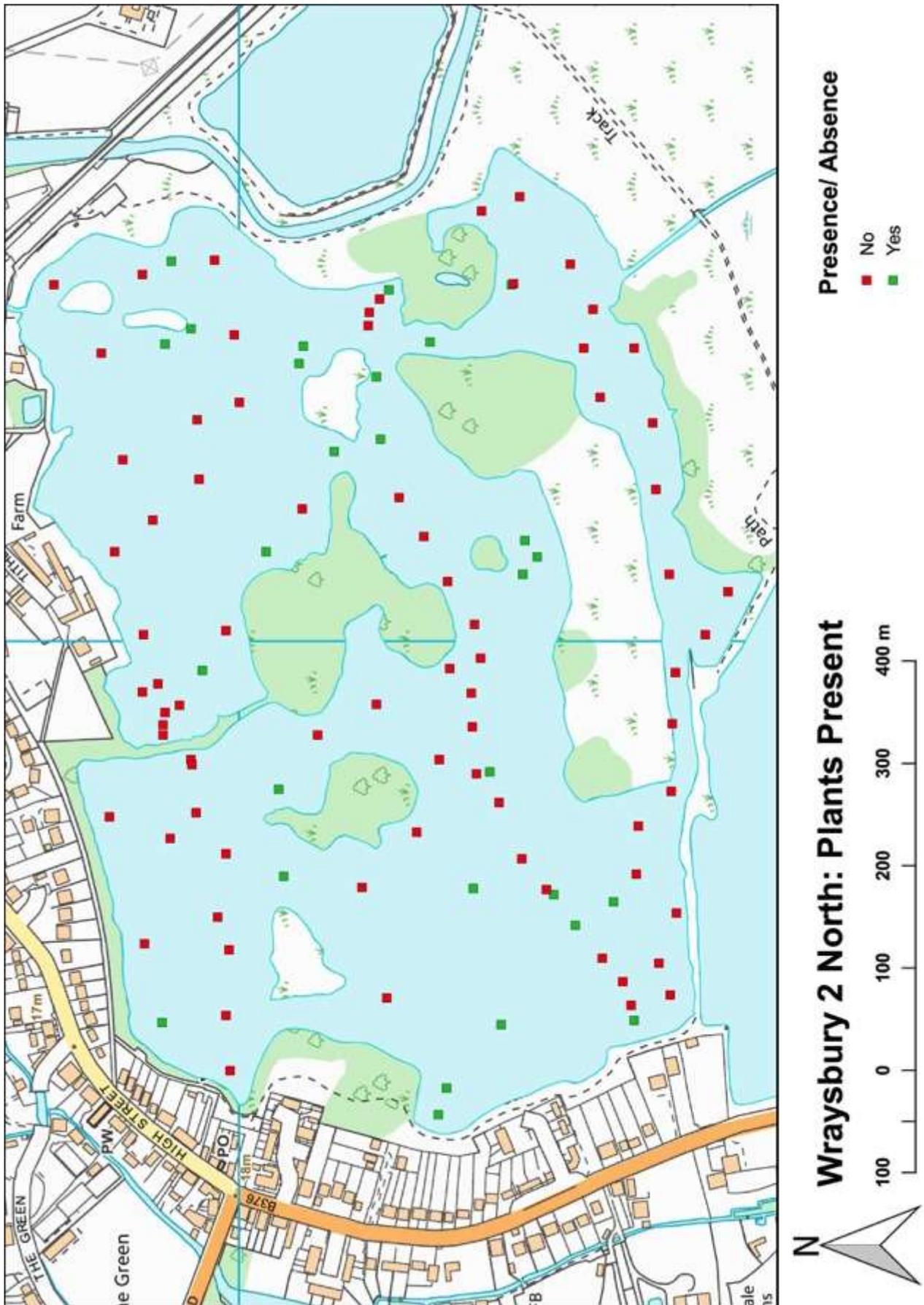


Figure 39 The extent of macrophyte cover at Wraysbury 2 North.

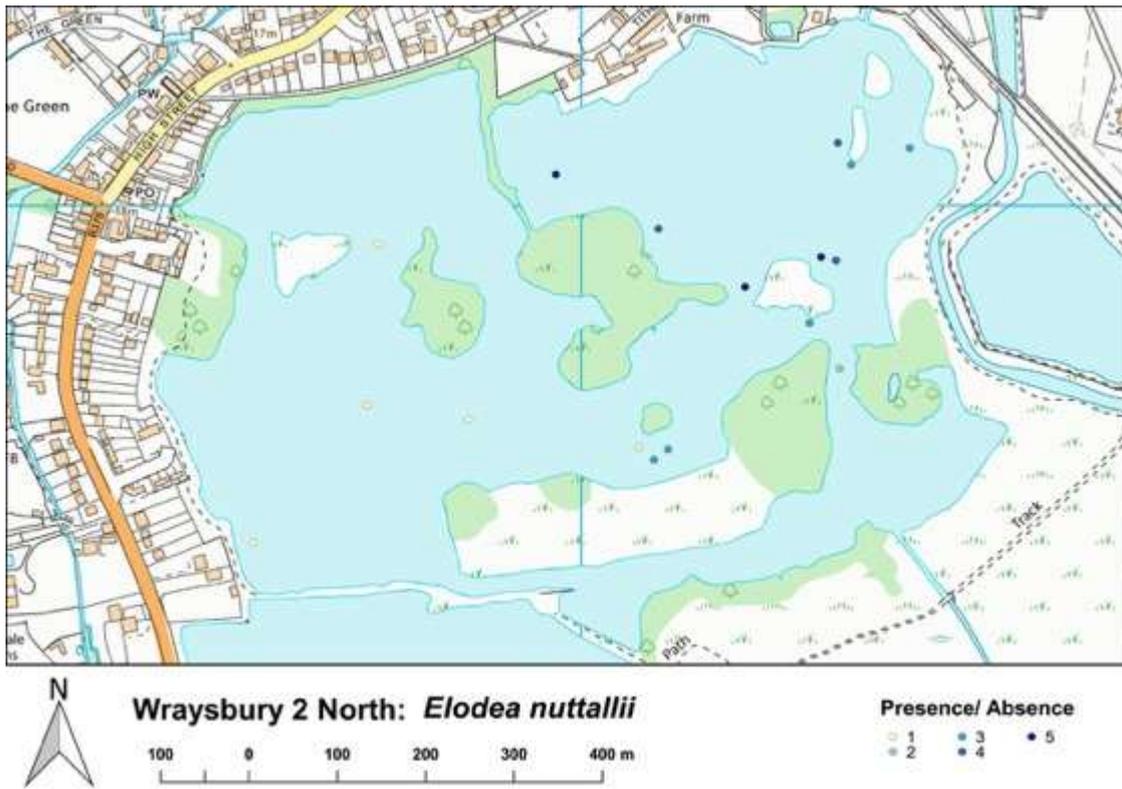


Figure 40 Extent and abundance of *Elodea nuttallii* at Wraysbury 2 North.

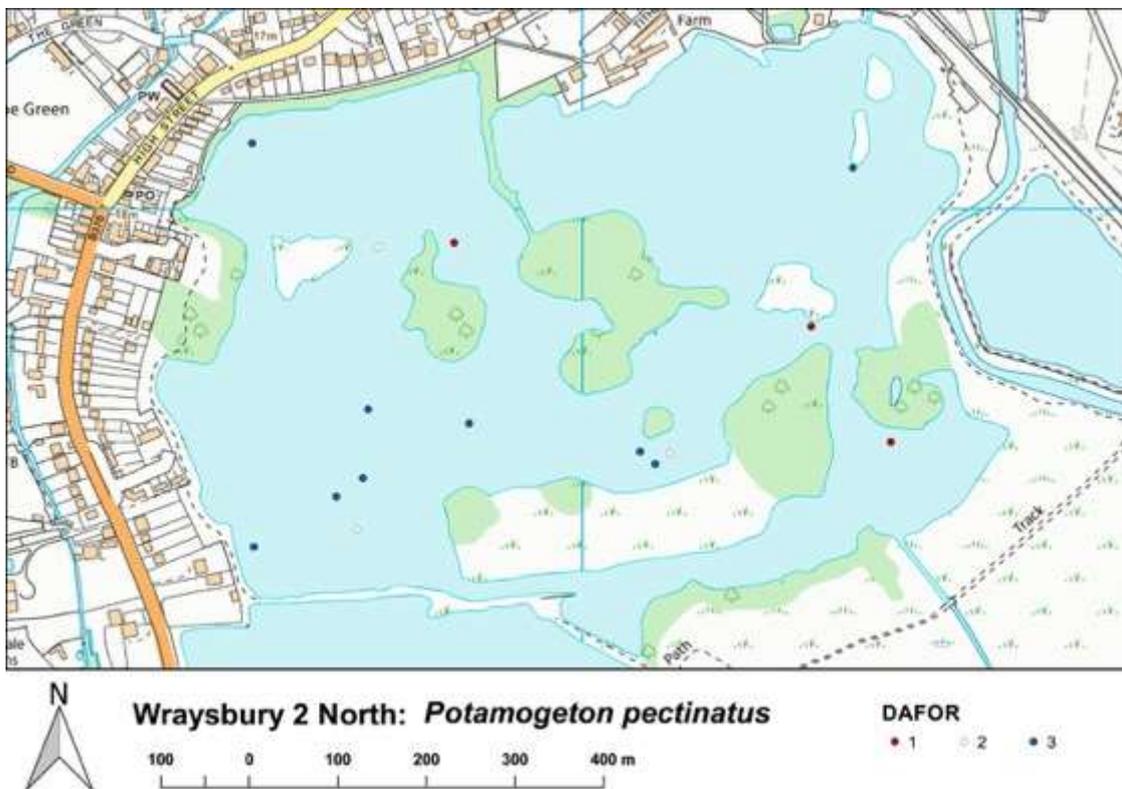


Figure 41 Extent and abundance of *Potamogeton pectinatus* at Wraysbury 2 North.

Table 12 Macrophyte summary; Wraysbury 2 North

Species	Frequency (n= 184)	LEAFPACS 2 Cover (%)
Aquatic taxa		
<i>Ceratophyllum demersum</i>	8.2	0.79
<i>Elodea nuttallii</i>	21.7	4.05
<i>Lemna minor</i>	6	1.66
<i>Lemna trisulca</i>	6.5	2.66
<i>Nuphar lutea</i>	-	0.71
<i>Nymphaea alba</i>	-	0.71
<i>Persicaria amphibia</i>	0.5	1.79
<i>Potamogeton berchtoldii</i>	2.7	1.13
<i>Potamogeton pectinatus</i>	10.3	2.38
<i>Potamogeton trichoides</i>	0.5	-
Marginal / emergent taxa		
<i>Acorus calamus</i>		
<i>Alnus glutinosa</i>		
<i>Carex otrubae</i>		
<i>Carex pendula</i>		
<i>Epilobium hirsutum</i>		
<i>Eupatorium cannabinum</i>		
<i>Iris pseudacorus</i>		
<i>Juncus acutiflorus</i>		
<i>Lycopus europaeus</i>		
<i>Lysimachia vulgaris</i>		
<i>Lythrum salicaria</i>		
<i>Mentha aquatica</i>		
<i>Myosotis scorpiodes</i>		
<i>Persicaria amphibia</i>		
<i>Salix</i> sp.		
<i>Scutellaria galericulata</i>		
<i>Senecio palustris</i>		
<i>Solanum dulcamara</i>		
<i>Sparganium erectum</i>		
<i>Typha angustifolia</i>		

3.7. Wraysbury 2 South

Survey Date	3 August 2016
Grid reference:	TQ0087473294
OS Grid reference (X,Y):	500874, 173294
Approx. surface area (ha.):	20.4
Maximum recorded depth (m):	5.7
Secchi Depth (m)	2.3

Overview

Wraysbury 2 South is a relatively large expanse of open water and is primarily used by the sailing club and shore anglers. Much of the site is fringed by tall willow and alder and is bordered to the south and west by the Staines Road and to the north a narrow gravel bank which separates it from Wraysbury 2 North. Unlike the north pit, Wraysbury 2 South has only one small island near the east shore and is otherwise an uncomplicated basin ranging mostly from 3.5 – 5.0 m in depth (max. recorded depth 5.7 m at TQ0094373277). The lake margins shelved off steeply around much of the site and there was very little hydrosere development. In contrast to Wraysbury 2 North, the South lake was colonised by aquatic plants throughout the basin to a maximum depth of 5.5 m (Figure 43). Zebra mussels were recorded growing in several locations close to shore.



Figure 42 Wraysbury 2 South.

Extent of macrophyte cover

Elodea nuttallii was the most common aquatic plant throughout most of the site, often forming dense beds and locally dominant (Figure 44). *Ceratophyllum demersum* was also relatively common, but tending to occur mostly in the deeper water (Figure 45), whereas *Potamogeton crispus* was more widely distributed, but only rarely exceeding an abundance of 2 (occasional) (Figure 46). Other species recorded were *Chara globularis*, *Persicaria amphibia* and a small patch of *Nymphaea alba* in the far northwest corner.

Filamentous green algae was common throughout the site and in places locally abundant (Figure 47).

WFD Survey

Overall, six submerged or floating macrophyte species were recorded at Wraysbury 2 North. Vegetation cover was relatively low in the shaded margins, but high in open water. The LEAFPACS 2 data probably underestimated cover due to the high proportion of sample points in the littoral zone. *Elodea nuttallii* recorded as the most abundant species (within four sections). Marginal vegetation was relatively sparse beneath the tall trees and shrubbery. *Sparganium erectum*, *Lythrum salicaria*, *Epilobium hirsutum*, *Lycopus europaeus* and *Mentha aquatica* were all common. A summary of the species is given in Table 13 and the LEAFPACS 2 metrics in Table 14.

Table 13 Macrophyte summary; Wraysbury 2 South

Species	Frequency (n= 295)	LEAFPACS 2 Cover (%)
Aquatic taxa		
<i>Ceratophyllum demersum</i>	30.5	9.81
<i>Chara globularis</i>	1.0	0.14
<i>Elodea nuttallii</i>	78.6	25.18
<i>Nymphaea alba</i>	2.0	-
<i>Persicaria amphibia</i>	0.7	2.50
<i>Potamogeton crispus</i>	39.0	10.23
Marginal / emergent taxa		
<i>Alnus glutinosa</i>		
<i>Carex otrubae</i>		
<i>Carex pendula</i>		
<i>Epilobium hirsutum</i>		
<i>Eupatorium cannabinum</i>		
<i>Iris pseudacorus</i>		
<i>Juncus inflexus</i>		
<i>Lycopus europaeus</i>		
<i>Lysimachia vulgaris</i>		
<i>Lythrum salicaria</i>		
<i>Mentha aquatica</i>		
<i>Myosotis scorpiodes</i>		
<i>Persicaria amphibia</i>		
<i>Salix</i> sp.		
<i>Solanum dulcamara</i>		
<i>Sparganium erectum</i>		
<i>Typha latifolia</i>		

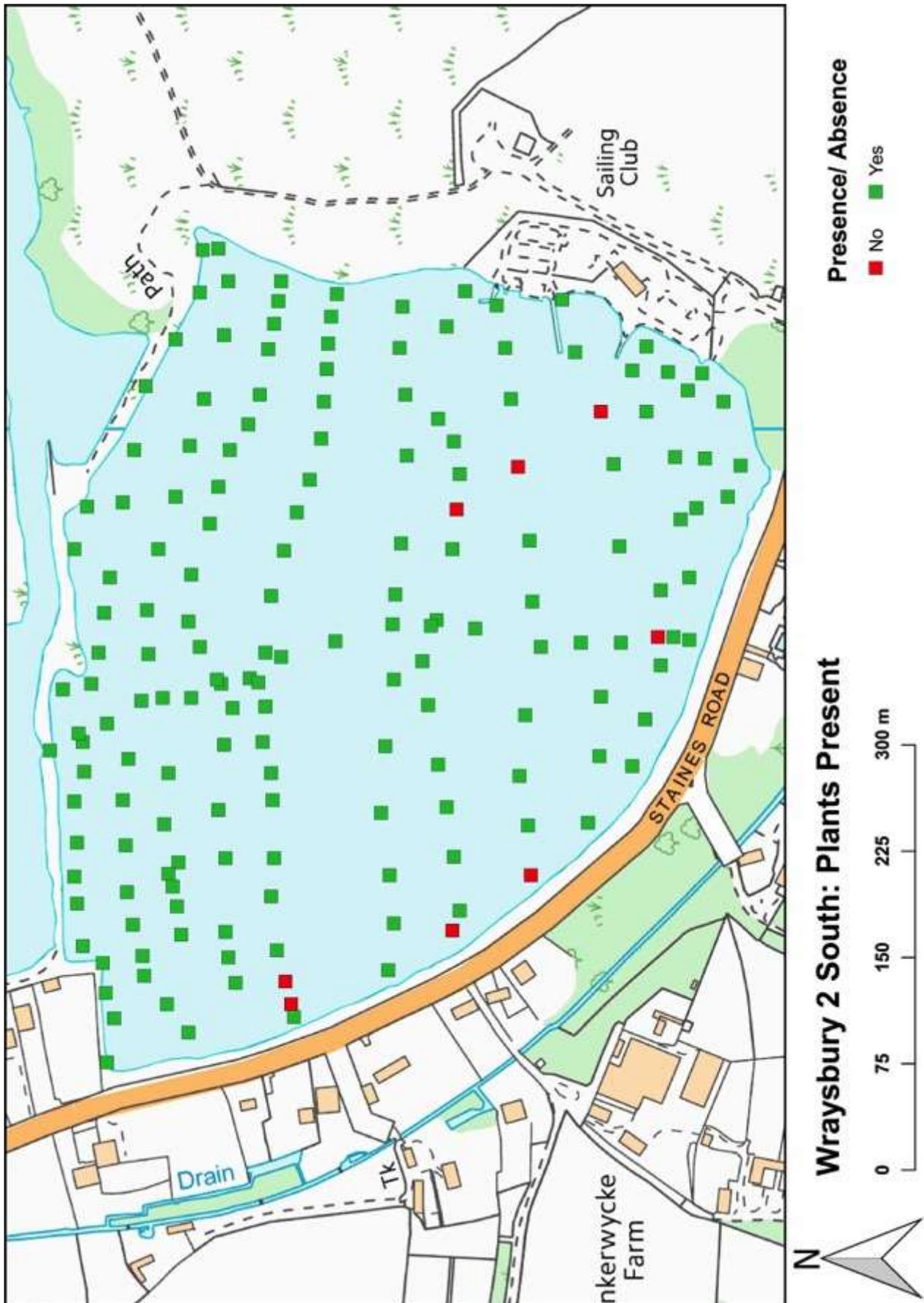


Figure 43 The extent of macrophyte cover at Wraysbury 2 South.

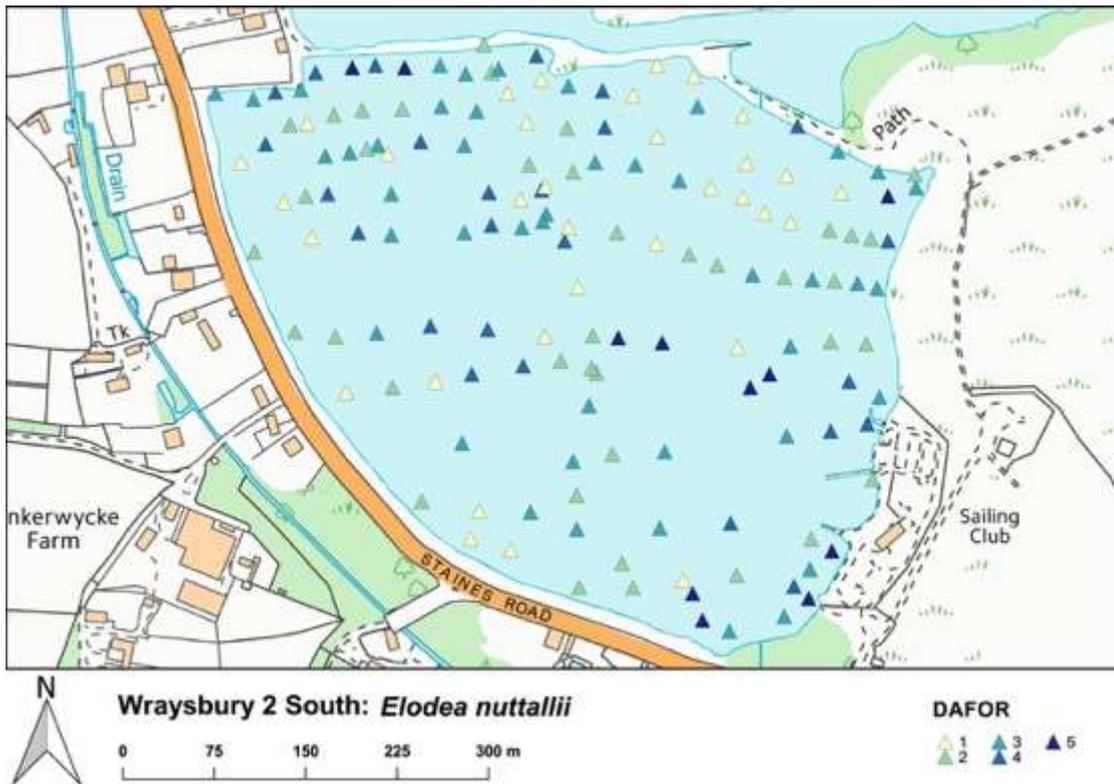


Figure 44 Extent and abundance of *Elodea nuttallii* at Wraysbury 2 South.

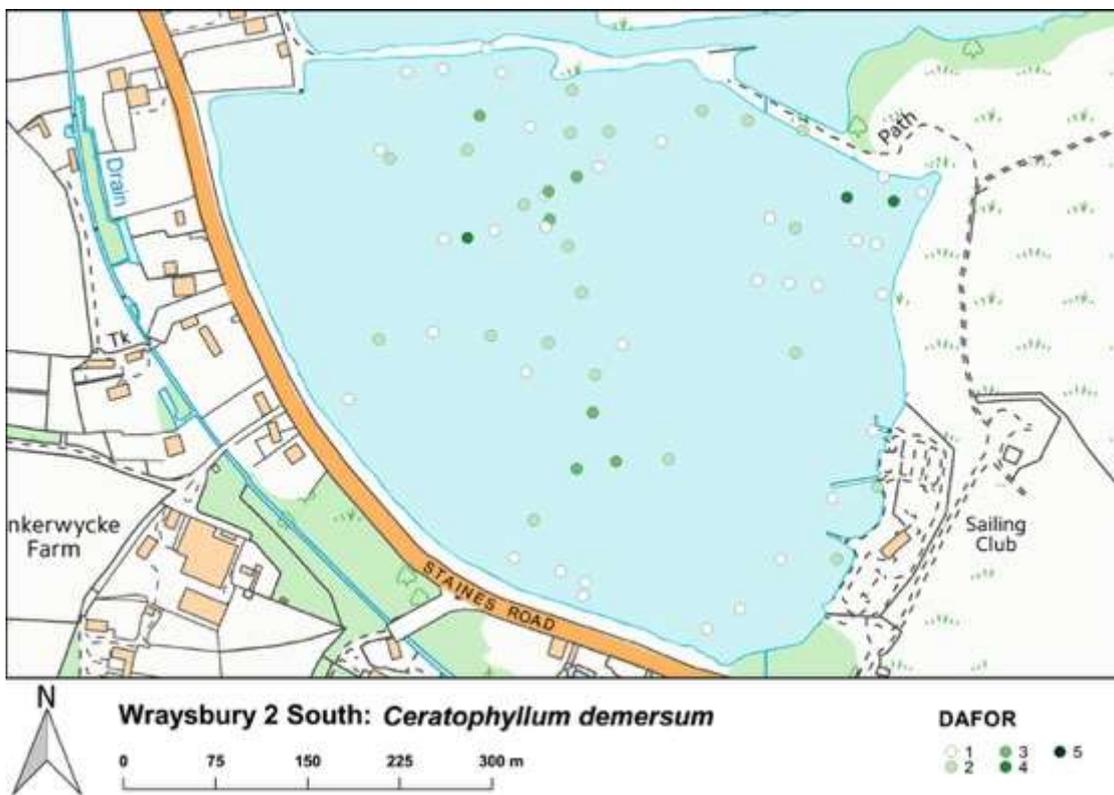


Figure 45 Extent and abundance of *Ceratophyllum demersum* at Wraysbury 2 South.

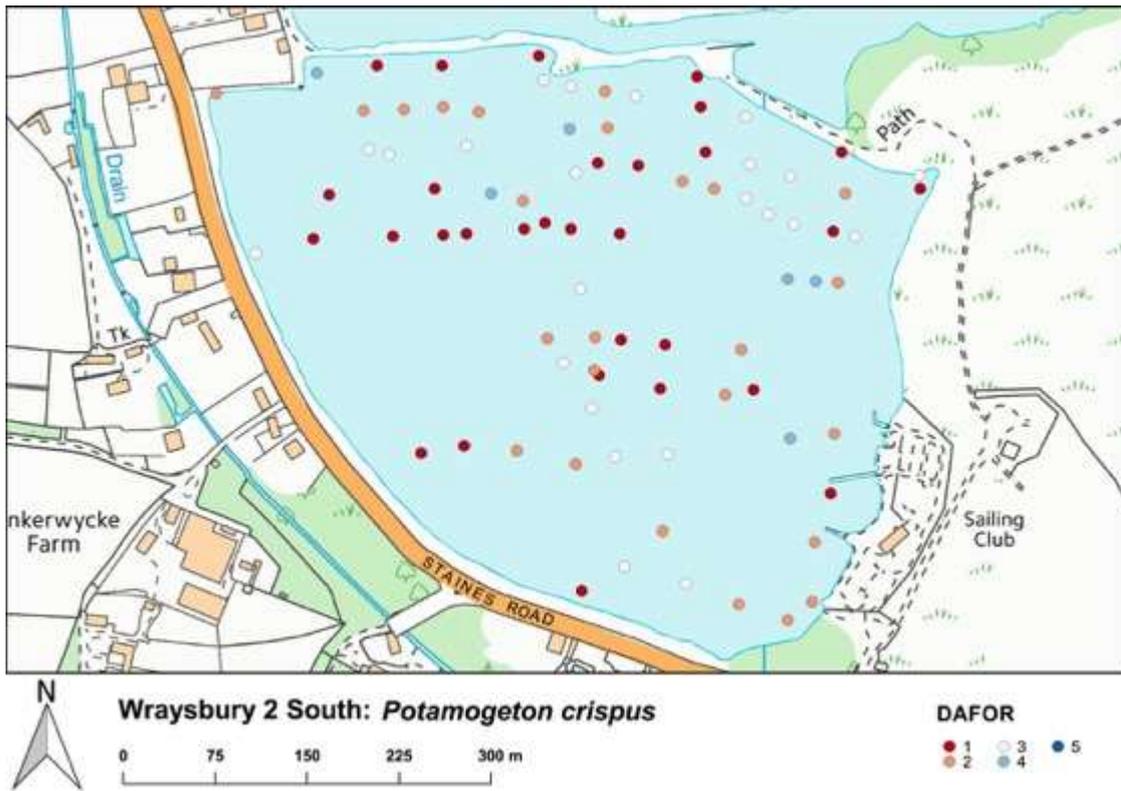


Figure 46 Extent and abundance of *Potamogeton crispus* at Wraysbury 2 South.

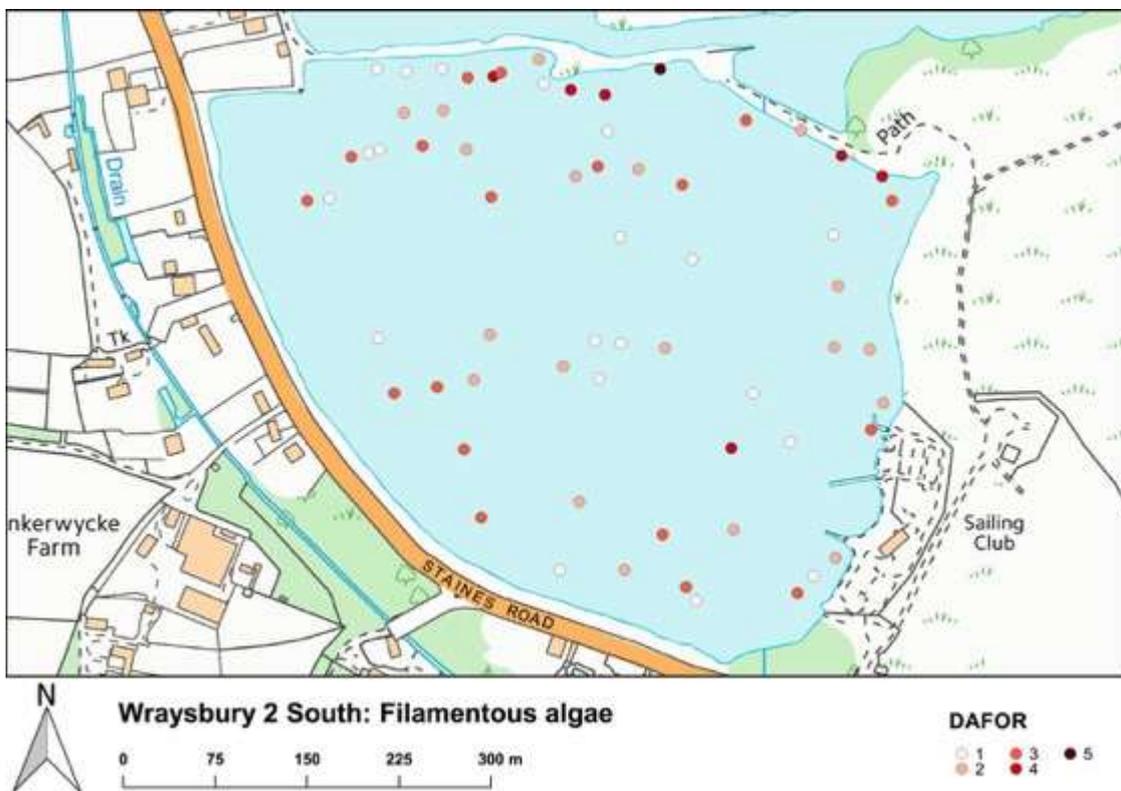


Figure 47 Extent and abundance of filamentous green algae at Wraysbury 2 South.

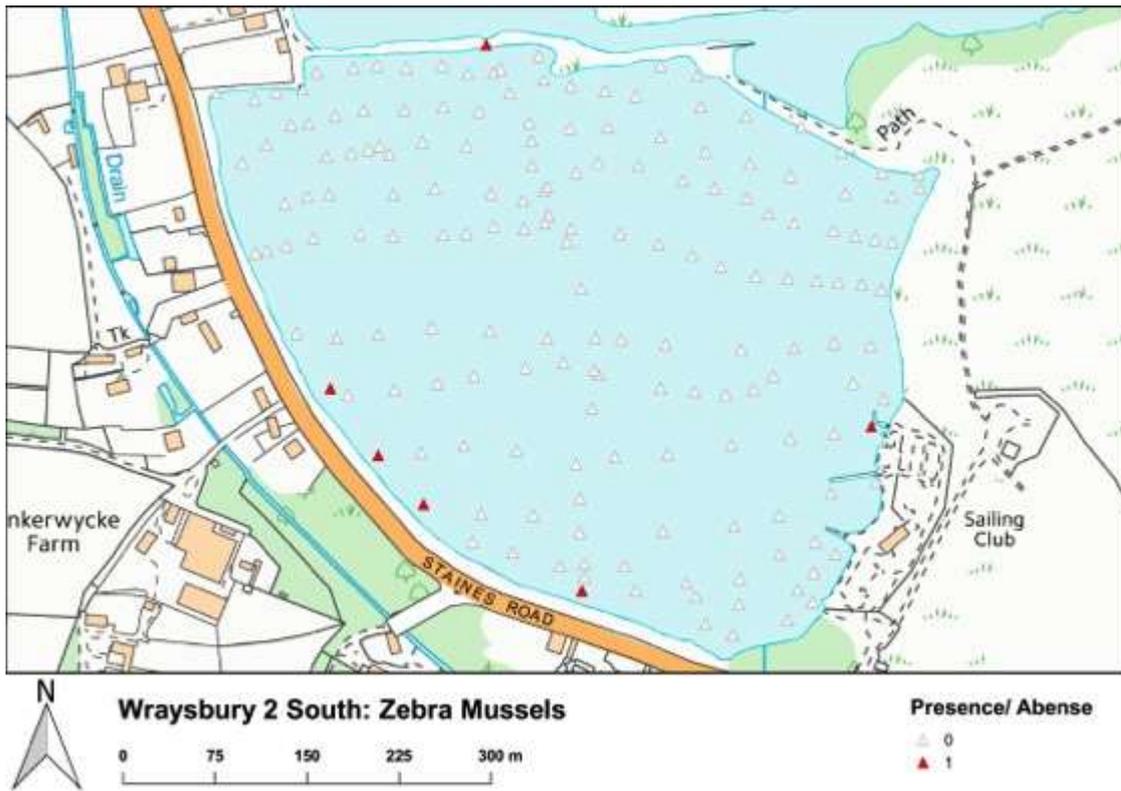


Figure 48 Extent and abundance of *Zebra mussels* at Wraysbury 2 South.

Table 14 LEAFPACS 2 metrics applied to Wraysbury 2 South.

LEAFPACS metric report				
LMNI	NTAXA	NFG	COV	ALG
7.25	6.0	4.00	8.34	0.04

3.8. Lower Hythe Gravel Pit 1

Survey Date	14 July 2016
Grid reference:	TQ0111472943
OS Grid reference (X,Y):	501114, 172943
Approx. surface area (ha.):	1.4
Maximum recorded depth (m):	4.8
Secchi Depth (m)	2.8

Overview

Lower Hythe Gravel Pit 1 is a small pit surrounded on all sides by high trees. The site has no public access and is managed as a private fishery. The pit has relatively steep sloping sides with the majority of open water being between 2.5 – 4.0 m in depth (max. recorded depth 4.8 m at TQ0114672974). There is a shallow area towards the east end of the lake formed by a submerged gravel bank running north south from TQ0116472938. The lake margins have a number of fishing stands cut into the banks, some of which are reinforced with timber and posts. Many of the fishing areas had a small stand of white water lily next to them, presumably planted by the site managers. Similarly, there were two small areas of fringed water lily (*Nymphoides peltata*) and a bed (approx. 1 x 1 m) of the non-native pickerel weed (*Pontederia cordata*) on the south shore as well as greater spearwort (*Ranunculus lingua*) and bog bean (*Menyanthes trifoliata*) on the west shore. Away from the shaded banks, much of the open water was colonised by aquatic plants throughout the basin to a maximum depth of 4.2 m (Figure 50). Zebra mussels were present, but uncommon in the site.



Figure 49 Lower Hythe Gravel Pit 1.

Extent of macrophyte cover

Ceratophyllum demersum was the most abundant species, occurring in dense growths throughout the west of the site and in deeper water on the east side (Figure 51). *Elodea nuttallii* was also common, but rarely at high abundance and more frequent at the eastern end (Figure 52). Other species recorded were *Nuphar lutea*, *Lemna trisulca* (both frequent) and *Nymphaea alba* (or similar cultivar) (occasional). *Potamogeton crispus* and *P. trichoides* were both rare in the site. The water was relatively clear and there was very little filamentous green algae recorded. A summary of the species is given in Table 15.

Note there is a slight disparity with the measured location data and the OS mapping due mainly to poor GPS reception under the trees.

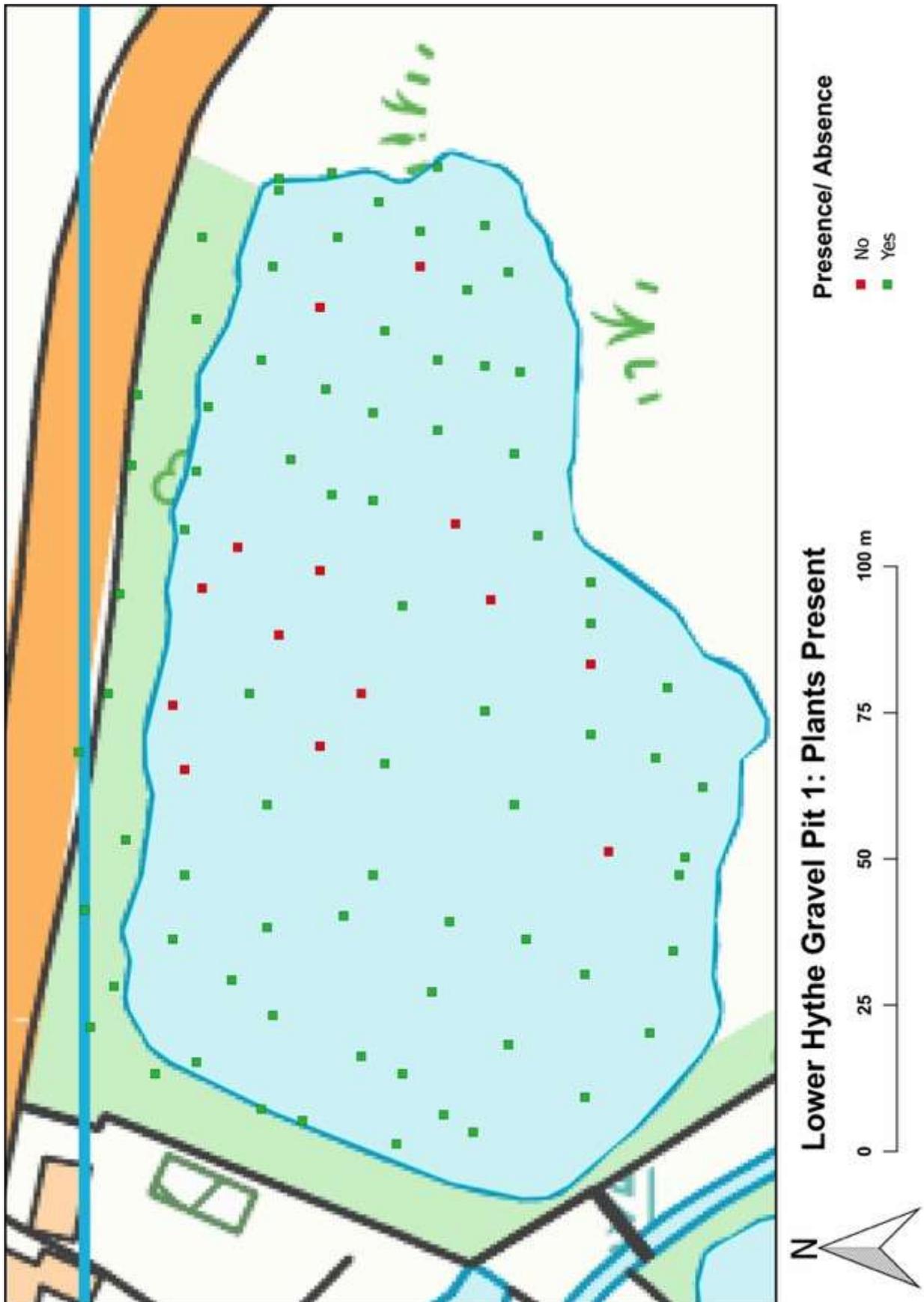


Figure 50 The extent of macrophyte cover at Lower Hythe Gravel Pit 1.

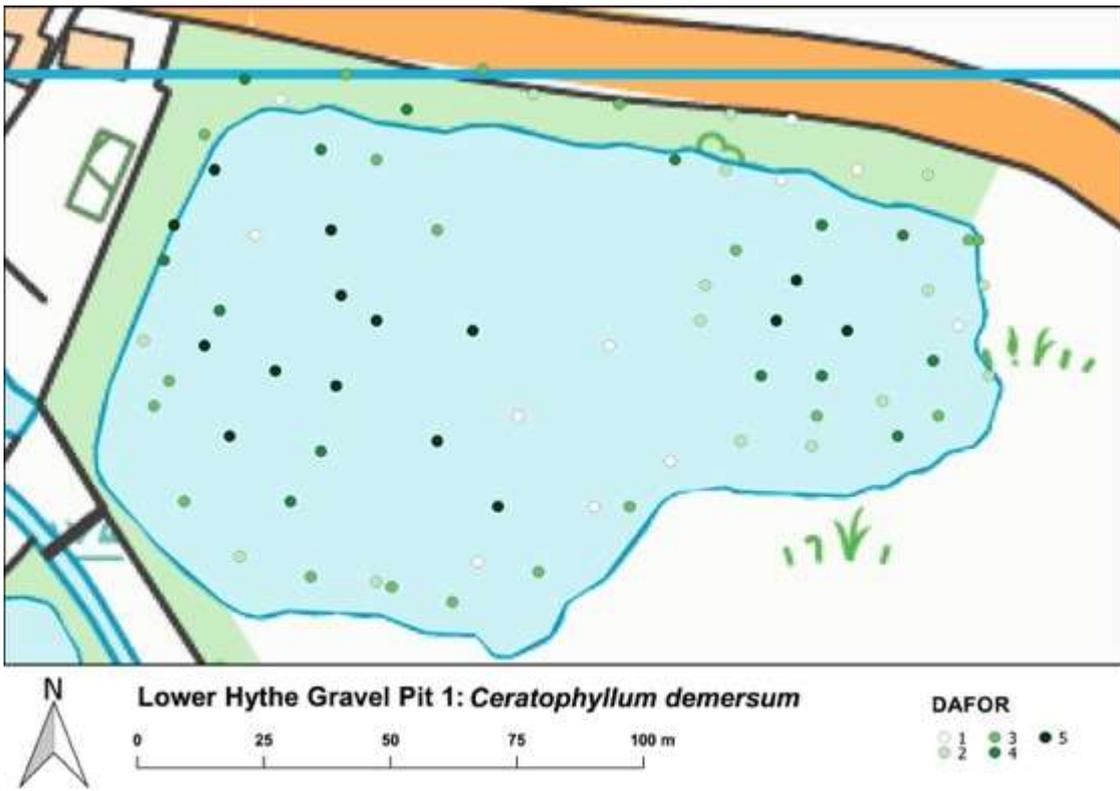


Figure 51 Extent and abundance of *Ceratophyllum demersum* at Lower Hythe Gravel Pit 1.

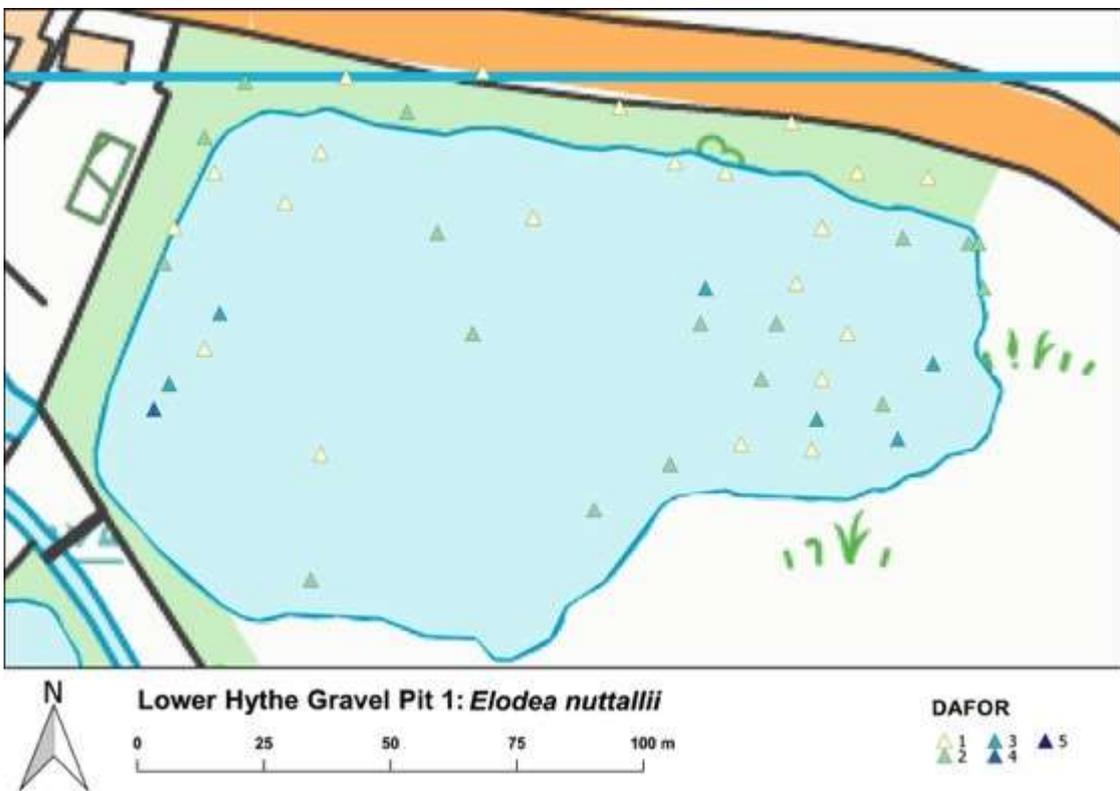


Figure 52 Extent and abundance of *Elodea nuttallii* at Lower Hythe Gravel Pit 1.

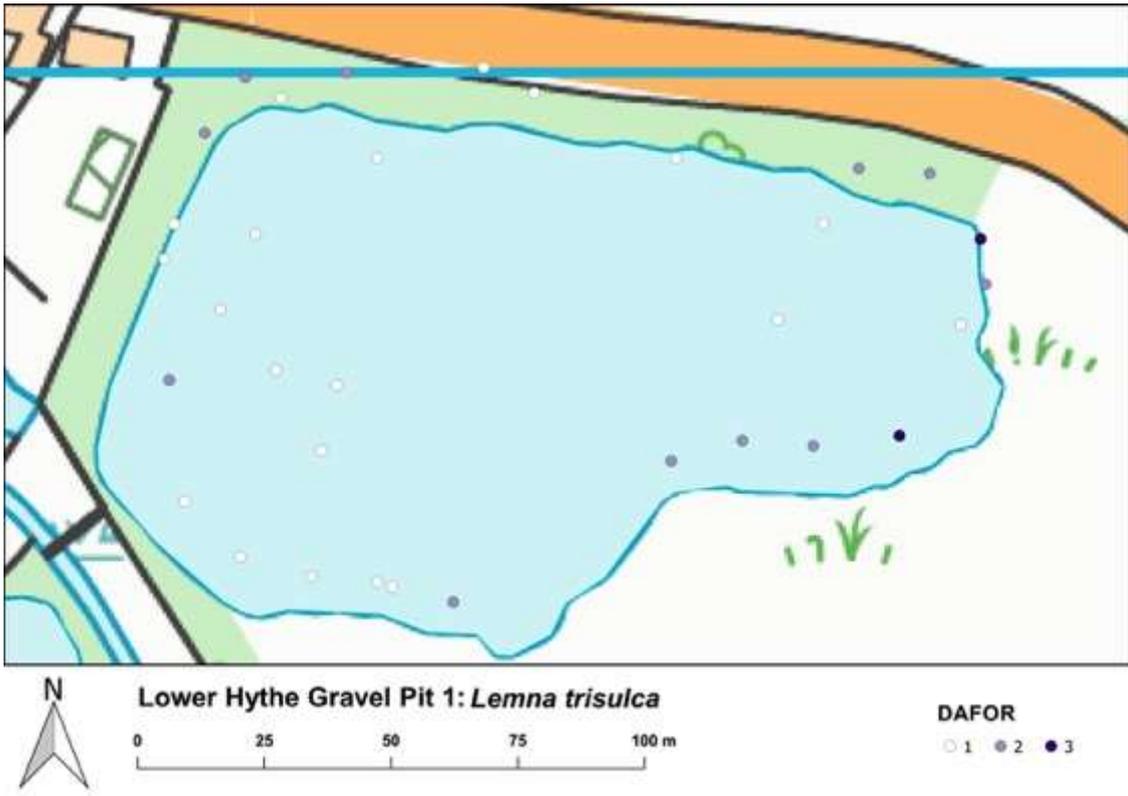


Figure 53 Extent and abundance of *Lemna trisulca* at Lower Hythe Gravel Pit 1.

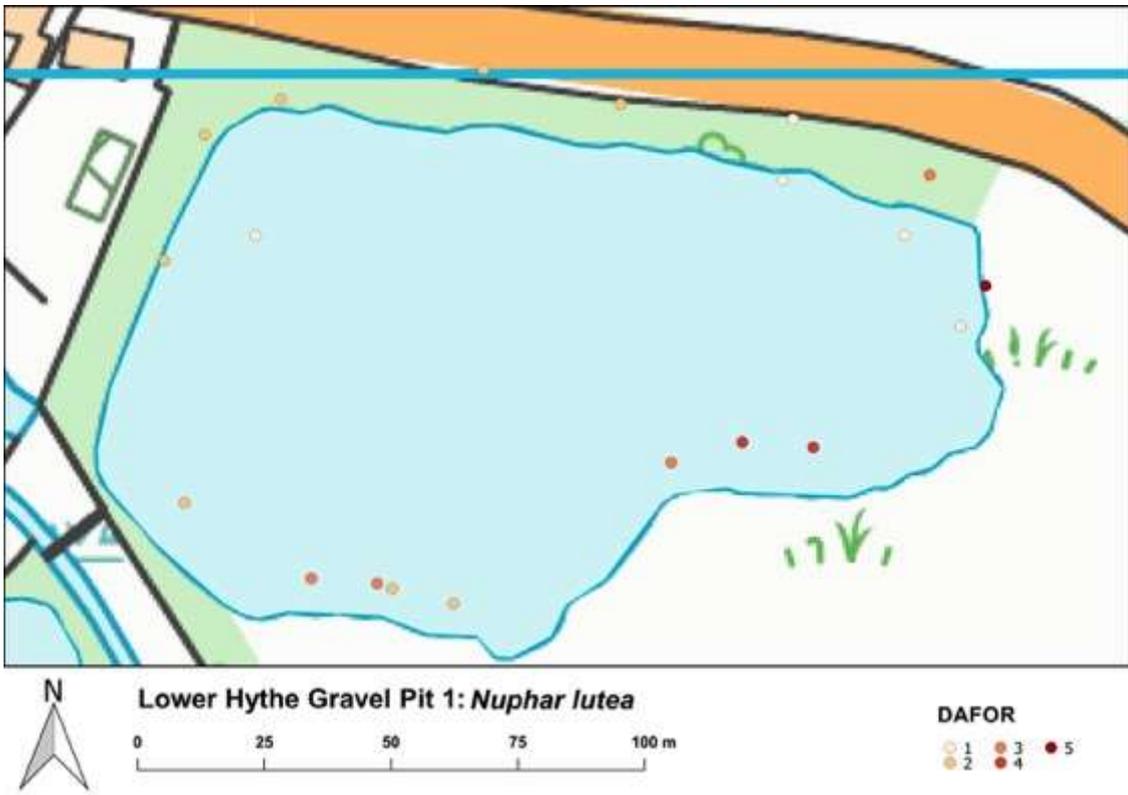


Figure 54 Extent and abundance of *Nuphar lutea* at Lower Hythe Gravel Pit 1.

Table 15 Macrophyte summary; Lower Hythe Gravel Pit 1

Species	Frequency (n= 90)
<i>Ceratophyllum demersum</i>	82.2
<i>Elodea nuttallii</i>	50.0
<i>Lemna trisulca</i>	36.7
<i>Menyanthes trifoliata</i>	1.1
<i>Nuphar lutea</i>	22.2
<i>Nymphaea alba (cultivar?)</i>	2.2
<i>Nymphoides peltata</i>	+
<i>Pontederia cordata</i>	1.1
<i>Potamogeton crispus</i>	1.1
<i>Potamogeton trichoides</i>	2.2

3.9. Lower Hythe Gravel Pit 3

Survey Date	4 August 2016
Grid reference:	TQ0110572692
OS Grid reference (X,Y):	501105, 172692
Approx. surface area (ha.):	2.27
Maximum recorded depth (m):	4.6

Overview

Lower Hythe Gravel Pit 3 (LHGP 3) is a privately owned site, seemingly used for shore angling. Evidence of small jetties was present around the site, many of which were in disrepair. Zebra mussels (*Dreissena polymorpha*) were present at the site, but only recorded at two survey points.



Figure 55 Lower Hythe Gravel Pit 3 (Imagery © 2016 Getmapping PLC from Google).

Extent of macrophyte cover

At the time of survey, submerged macrophytes were growing in dense stands across the entire lake (Figure 56). Two macrophyte species dominated the site: *Elodea nuttallii* and *Ceratophyllum demersum* (Figure 57 and Figure 58). Both species were regularly recorded with a “4” or “5” on the DAFOR scale, which suitably reflected the dense growths of these two plants across the whole site. As can be seen by Figure 56, there were very few survey points which were recorded with no plants.

A localised stand of white water lily (*Nymphaea alba*) was recorded on the south-eastern edge of the lake, while amphibious bistort (*Persicaria amphibia*) was observed in two small clusters, each of which were recorded as “occasional” and “rare” in frequency. A summary of the species is given in Table 16.

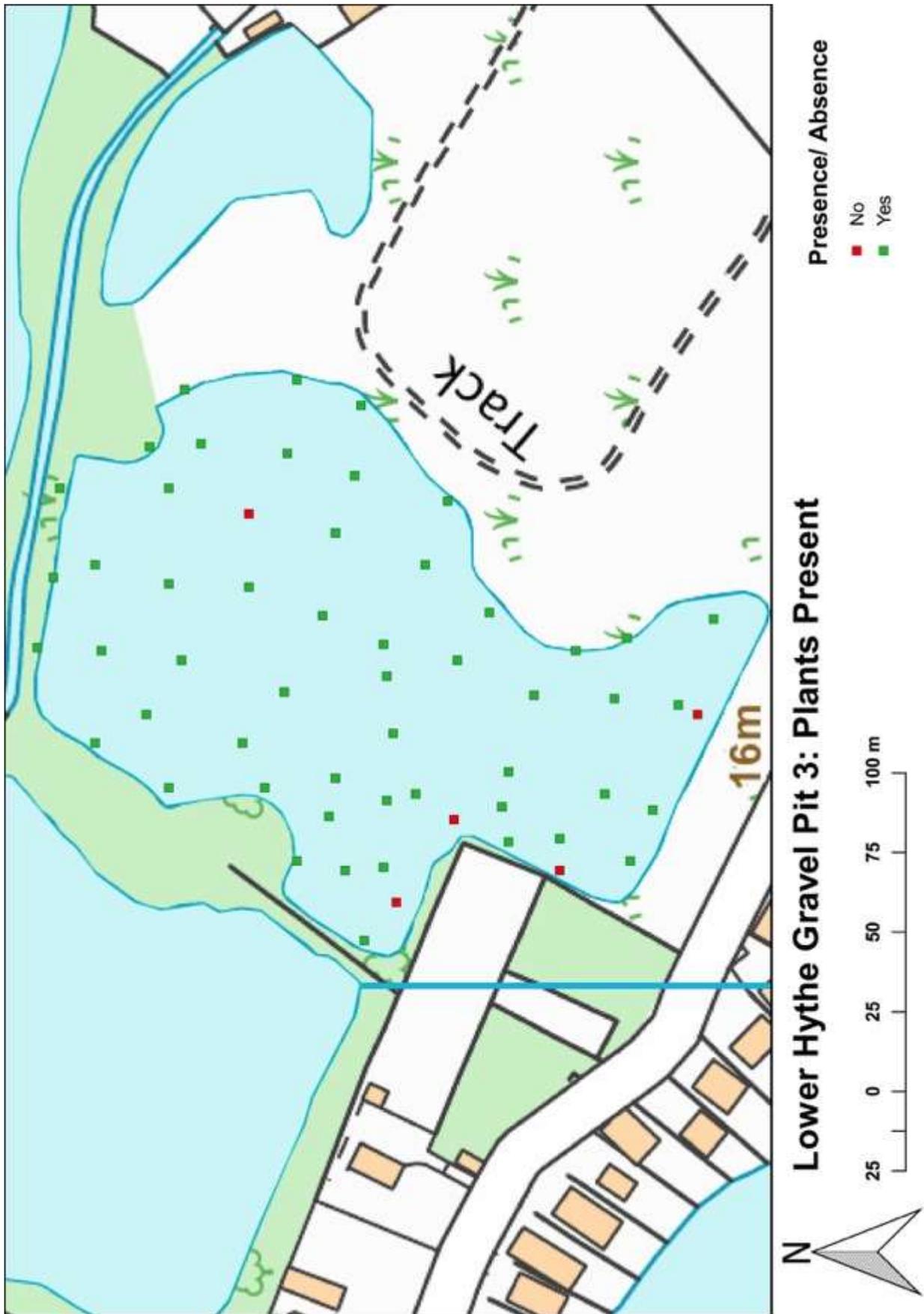


Figure 56 The extent of macrophyte cover at Lower Hythe Gravel Pit 3.

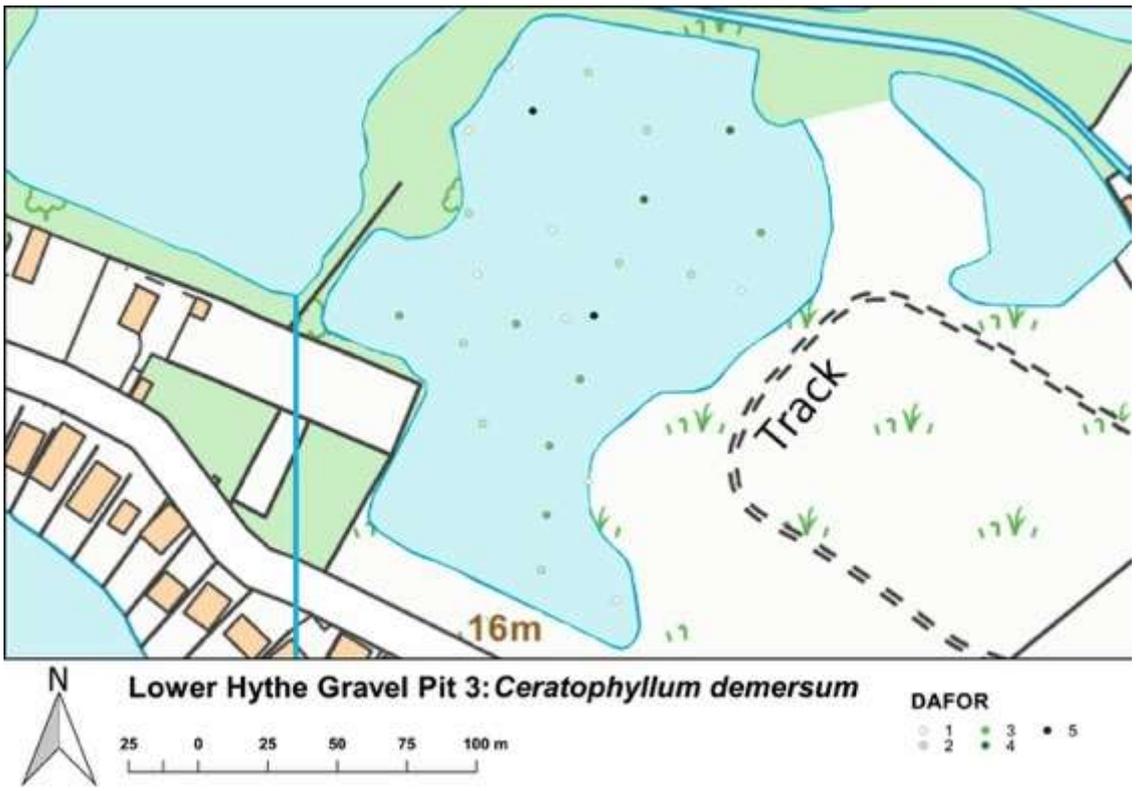


Figure 57 Extent and abundance of *Ceratophyllum demersum* at Lower Hythe Gravel Pit 3.

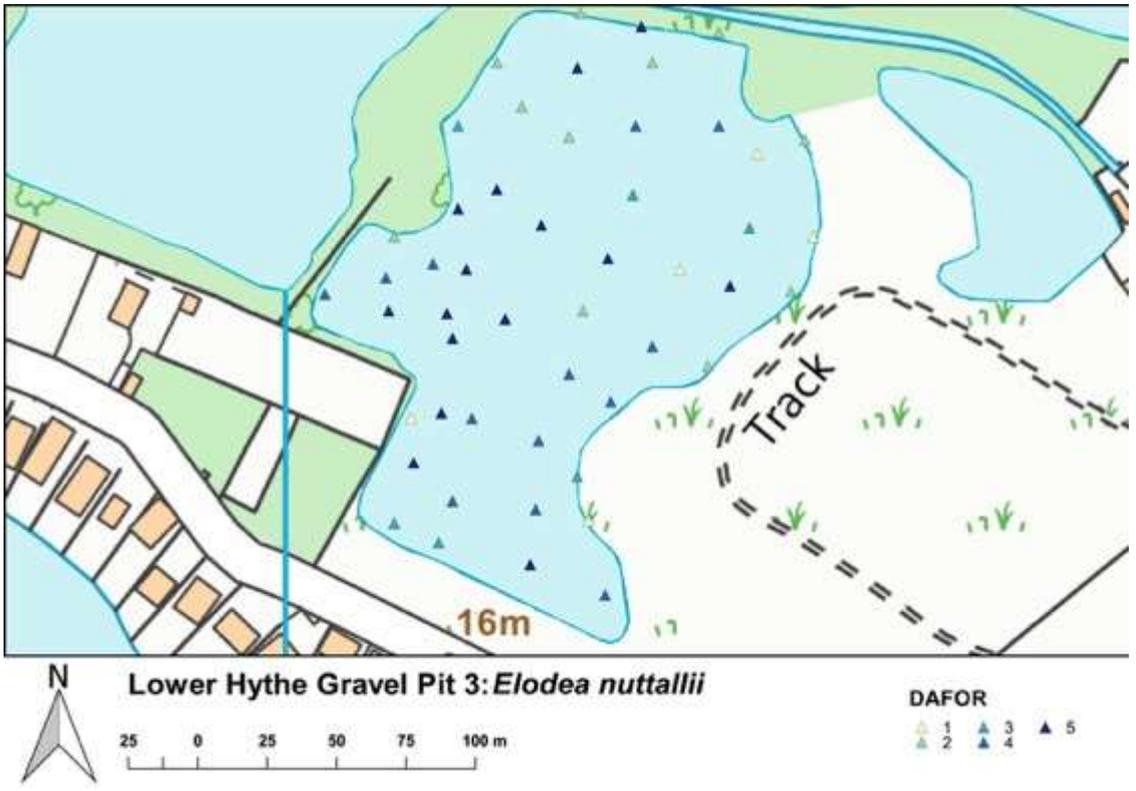


Figure 58 Extent and abundance of *Elodea nuttallii* at Lower Hythe Gravel Pit 3.

Table 16 Macrophyte summary; Lower Hythe Gravel Pit 3.

Species	Frequency (n= 57)
<i>Ceratophyllum demersum</i>	45.6
<i>Elodea nuttallii</i>	87.7
<i>Lemna trisulca</i>	1.8
<i>Nymphaea alba</i> (cultivar?)	1.8
<i>Persicaria amphibia</i>	3.5

3.10. Lower Hythe Gravel Pit 5

Survey Date	4 August 2016
Grid reference:	TQ0110572692
OS Grid reference (X,Y):	501105, 172692
Approx. surface area (ha.):	0.37
Maximum recorded depth (m):	3.8

Overview

Lower Hythe Gravel Pit 5 is located within a short walking distance from LHGP 3, to the northeast of the site. The site is fringed by woodland and rough ground with a permanent Traveller site adjacent to the east shore. The site has a significant problem with litter, both in and around the site, which in places (particularly around the south end) compromised survey access to sections of the water body. The margins are relatively steep sided and the majority of the open water was 2.5 – 3.8 m deep. No zebra mussels were recorded.



Figure 59 Lower Hythe Gravel Pit 5 (Imagery © 2016 Getmapping PLC from Google).

Extent of macrophyte cover

This gravel pit is extremely small in area, with a maximum recorded depth of 3.8 m and had plants present to maximum depth and throughout the majority of the surveyed area (Figure 60). Unlike the adjacent gravel pit (LHGP 3), *Elodea nuttallii* was completely absent. Instead, a high abundance of *C. demersum* was recorded at almost all points where plants were present. The non-native invasive species, least duckweed (*Lemna minuta*) was recorded at relatively high abundance closer to the margins of the lake. This species favours smaller water bodies, where greater shelter facilitates growth. Common duckweed (*Lemna minor*) and Ivy-leaved duckweed (*Lemna trisulca*) were also recorded at low density.

A summary of the species is given in Table 17.

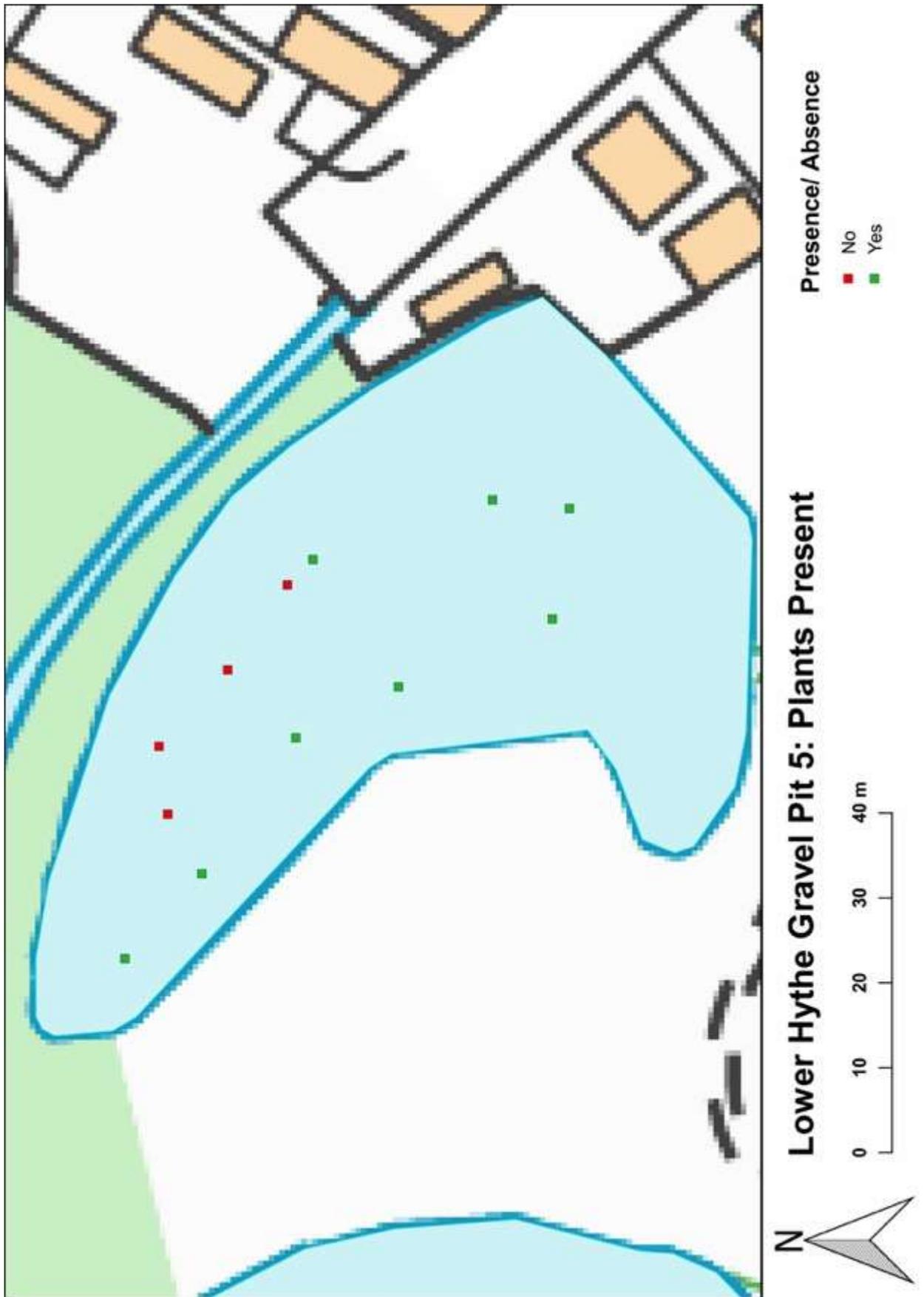


Figure 60 The extent of macrophyte cover at Lower Hythe Gravel Pit 5

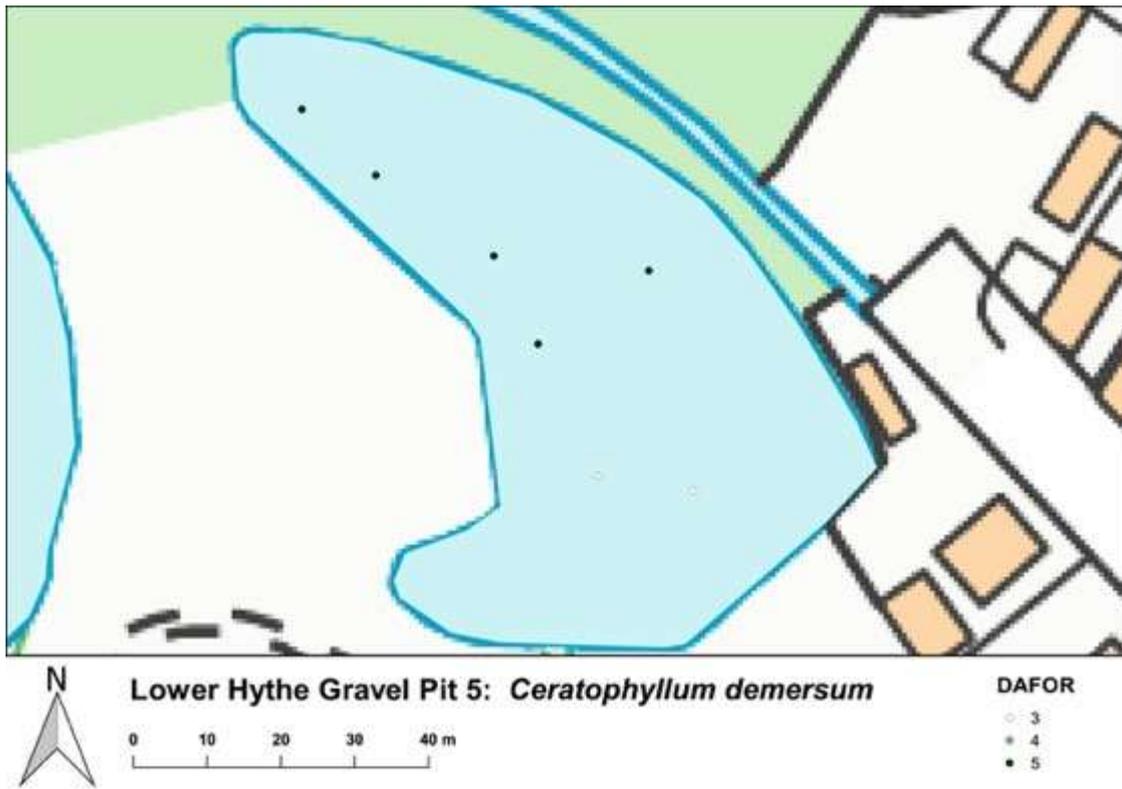


Figure 61 Extent and abundance of *Ceratophyllum demersum* at Lower Hythe Gravel Pit 5.

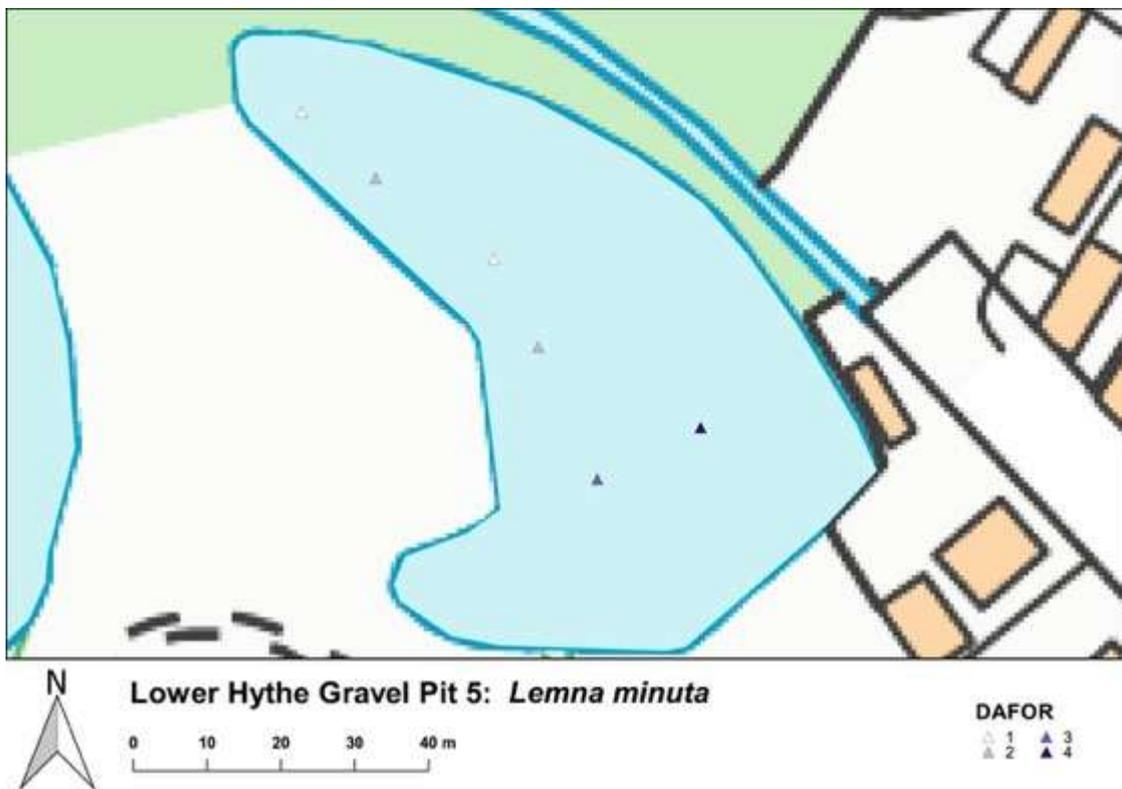


Figure 62 Extent and abundance of *Lemna minuta* at Lower Hythe Gravel Pit 5.

Table 17 Macrophyte summary; Lower Hythe Gravel Pit 5.

Species	Frequency (n= 12)
<i>Ceratophyllum demersum</i>	58.3
<i>Lemna minor</i>	41.7
<i>Lemna minuta</i>	50.0
<i>Lemna trisulca</i>	25.0

3.11. Lake South of Green Lane

Survey Date	5 July 2016
Grid reference:	TQ0312269596
OS Grid reference (X,Y):	503122, 169596
Approx. surface area (ha.):	1.7
Maximum recorded depth (m):	4.5

Overview

The Lake South of Green Lane is fringed by woodland and rough ground to the west and a permanent Traveller site to the east. The site has a significant problem with litter at the south end only. The northern end significantly narrows and is shaded by a canopy of *Salix* which was growing across the lake channel. The margins are shaded by overhanging trees (mainly willow) throughout most of the site. The maximum recorded depth was 4.5 m, but much of the basin was shallower with an average depth of (2.3 m). A single occurrence of zebra mussels was recorded.



Figure 63 Lake South of Green Lane (Imagery © 2016 Getmapping PLC from Google).

Extent of macrophyte cover

Although an extensive vegetation map was completed for this site, a technical error with the handheld GPS device resulted in the position data files being lost and therefore the creation of species maps has not been possible. However, survey notes indicate that growth of plants was relatively widespread in the site, reaching depths of up to 3.5 m. There were no plants recorded in deeper water. *Ceratophyllum demersum* was the most frequent species, and although locally dominant in the north of the site, it was often at low density averaging a “2” on the DAFOR scale (occasional).

Notably, the non-native invasive species *Hydrocotyle ranunculoides* was recorded within the site, growing close to the margins at the southern tip of the lake, where litter was also present. Its distribution was confined to this location and was not observed growing anywhere else on site at the time of survey. The presence this species necessitates additional care during any future management to ensure it is not spread to other sites. Complete removal of this plant and any viable propagules, will be required prior to connection to other water bodies.

The central part of the lake had a stand of *Potamogeton pectinatus* recorded, growing alongside *C. demersum* in open water.

C. demersum and *Elodea nuttallii* dominated the plant community within the southern end of the lake, where the growth of *Salix* subsided. Other species recorded were *Lemna minor*, *Lemna trisulca* and *Persicaria amphibia*, all at low frequency.

Filamentous algae was also prominent within the site, particularly in shallower water (< 3.0 m), scoring a “3” at many of these survey points.

A summary of the species is given in Table 18.

Table 18 Macrophyte summary; Lake South of Green Lane.

Species	Frequency (n= 46)
<i>Ceratophyllum demersum</i>	69.6
<i>Elodea nuttallii</i>	34.8
<i>Filamentous algae</i>	28.3
<i>Lemna minor</i>	8.7
<i>Lemna trisulca</i>	4.3
<i>Persicaria amphibia</i>	2.2
<i>Potamogeton pectinatus</i>	13.0

3.12. Lake South of Norlands Lane 1

Survey Date	4 July 2016
Grid reference:	TQ0325168903
OS Grid reference (X,Y):	503251, 168903
Approx. surface area (ha.):	1.0
Maximum recorded depth (m):	5.0

Overview

Lake South of Norlands Lane 1 is a very small site which supports a healthy aquatic plant community throughout the majority of the water body. Although located within the Thorpe Park complex, it does not appear to serve any particular purpose. The site has managed park grassland to the north and west and woodland to the east. A narrow gravel bar separated it from Fleet Lake to the south, to which the site is connected via a narrow channel in the southwest corner. No zebra mussels were recorded, but they are present in Fleet Lake to which this site is connected.



Figure 64 Lake South of Norlands Lane 1

Extent of macrophyte cover

Aquatic plants were recorded growing throughout most of the lake, except within a deeper zone of water, measuring approximately 4 – 5 metres depth. This zone extends in a channel running approximately north south through the middle of the lake.

Two species dominated the plant community within the lake: *Elodea nuttallii* and *Potamogeton pusillus* (Figure 66 and Figure 67). Although both plants scored a “2” on the DAFOR scale on average, they were widespread throughout the lake. A small stand of *Potamogeton pectinatus* was recorded within the main body of the lake, towards the eastern shore. *Sparganium emersum* was also recorded occasionally, restricted only to the shallow margins (Figure 68).

The northeast arm of the lake is enclosed by high trees, and appeared to support a slightly different plant community, where conditions were more sheltered and lake depth

shallower. At the very end of the lake arm, *Callitriche* sp. was recorded with an average abundance of “2”, occasionally occurring as a “3” (Figure 69). There was also prominent growth of *Ceratophyllum demersum* (Figure 70) in this region, often dominating the plant community, alongside *Lemna trisulca*. As the northern arm widened towards the open water there was a bed of *Elodea canadensis* (Figure 71) recorded growing alongside *Potamogeton trichoides*. The water depth increased beyond this point thus creating a more suitable habitat for the aforementioned species.

Filamentous algae was only common in the narrow eastern end where the water was shallow.

A summary of the species is given in Table 19.

Table 19 Macrophyte summary; Lake South of Norlands Lane 1.

Species	Frequency (n= 46)
<i>Callitriche</i> sp.	9.7
<i>Ceratophyllum demersum</i>	25.7
<i>Elodea canadensis</i>	6.2
<i>Elodea nuttallii</i>	78.8
<i>Glyceria maxima</i>	1.8
<i>Lemna minor</i>	14.2
<i>Lemna minuta</i>	0.9
<i>Lemna trisulca</i>	32.7
<i>Persicaria amphibia</i>	0.9
<i>Potamogeton pectinatus</i>	3.5
<i>Potamogeton pusillus</i>	35.4
<i>Potamogeton trichoides</i>	2.7
<i>Sparganium emersum</i>	9.7
<i>Spirodella polyrhiza</i>	1.8

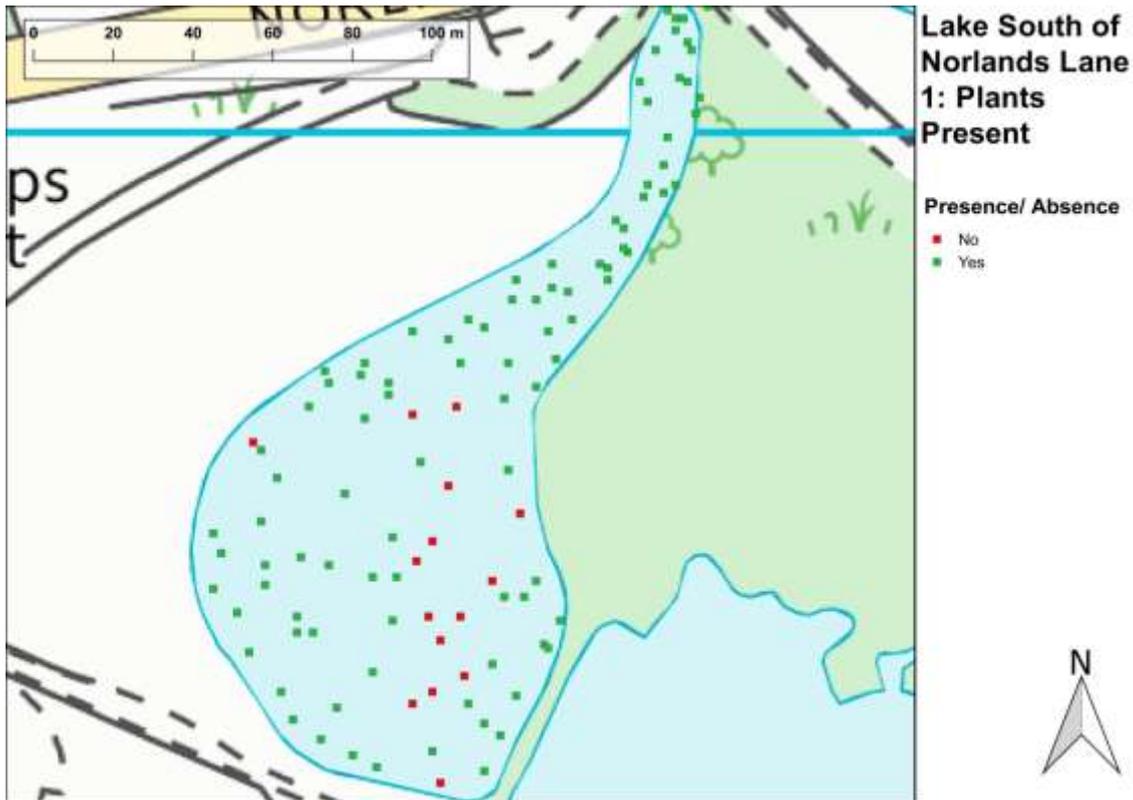


Figure 65 The extent of macrophyte cover at Lake South of Norlands Lane 1

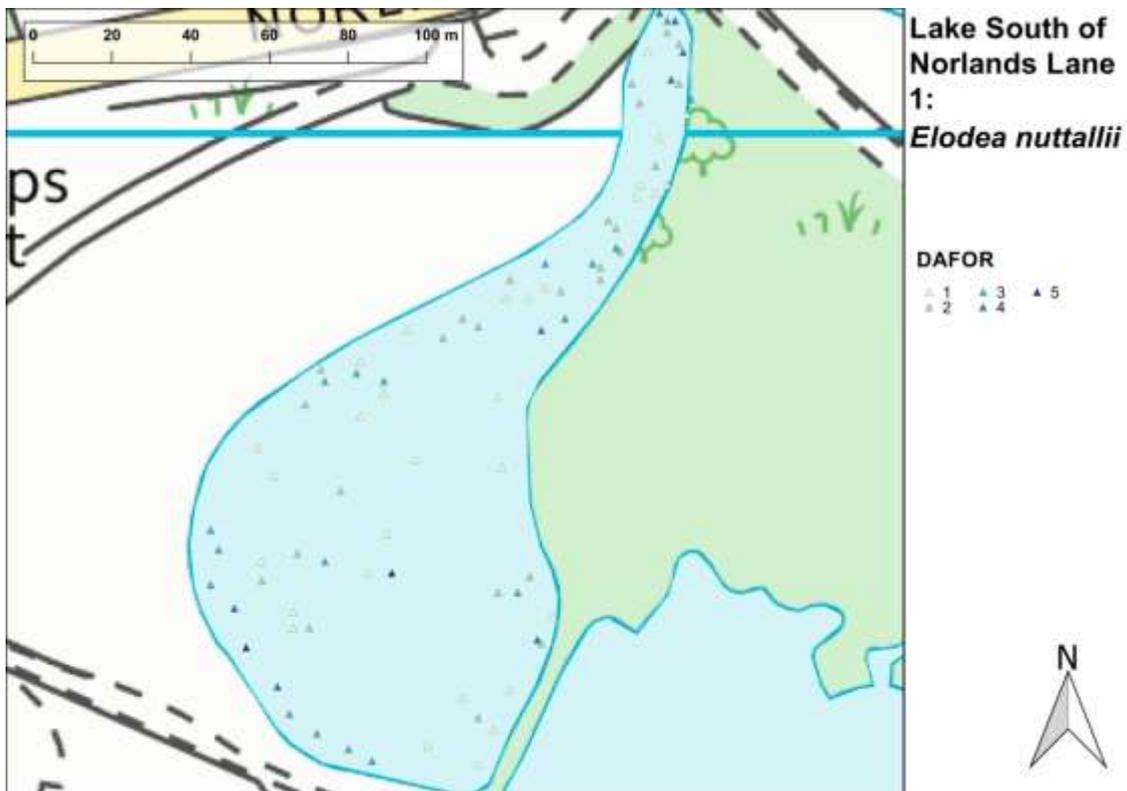


Figure 66 Extent and abundance of *Elodea nuttallii* at Lake South of Norlands Lane 1.

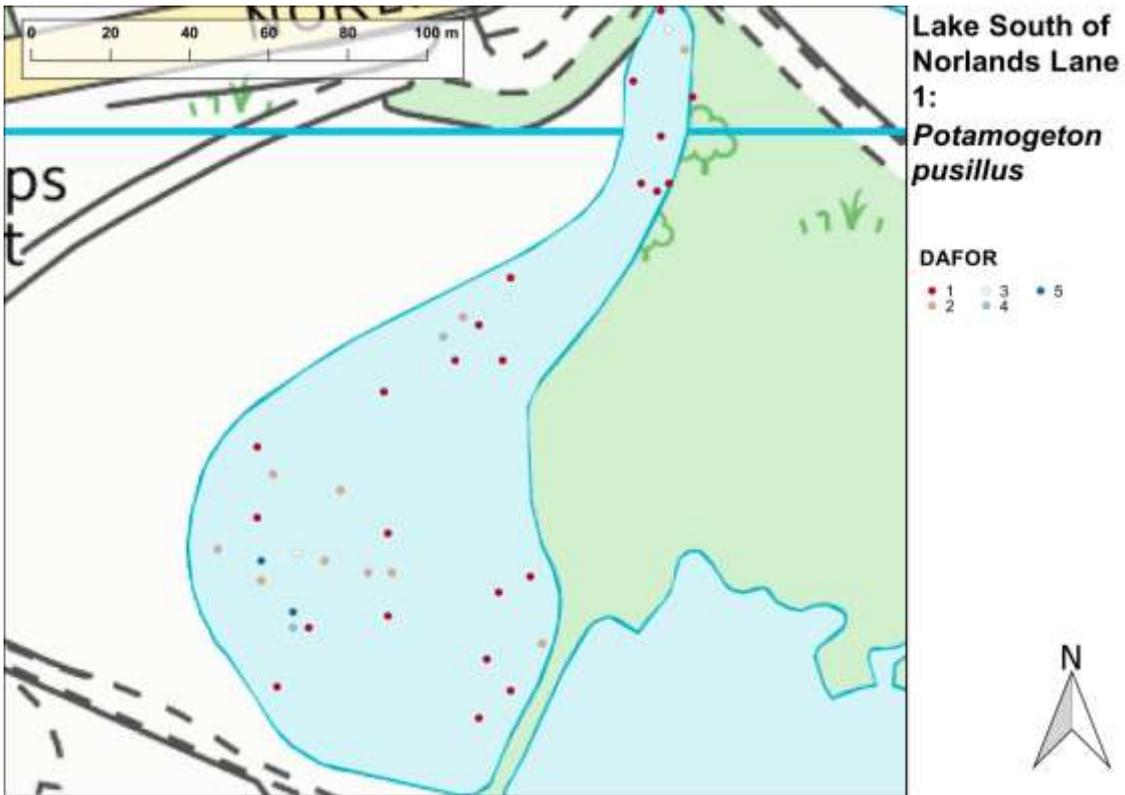


Figure 67 Map showing the extent and abundance of *Potamogeton pusillus* at Lake South of Norlands Lane 1.

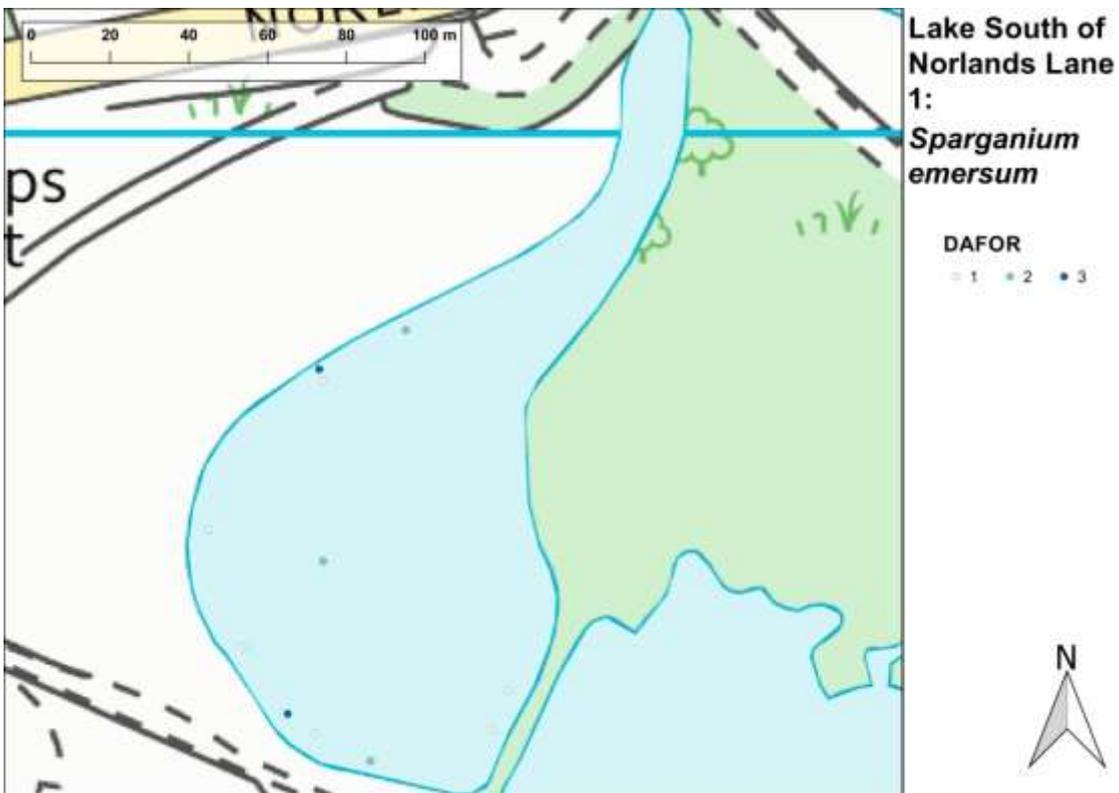


Figure 68 Map showing the and abundance of *Sparganium emersum* at Lake South of Norlands Lane 1.

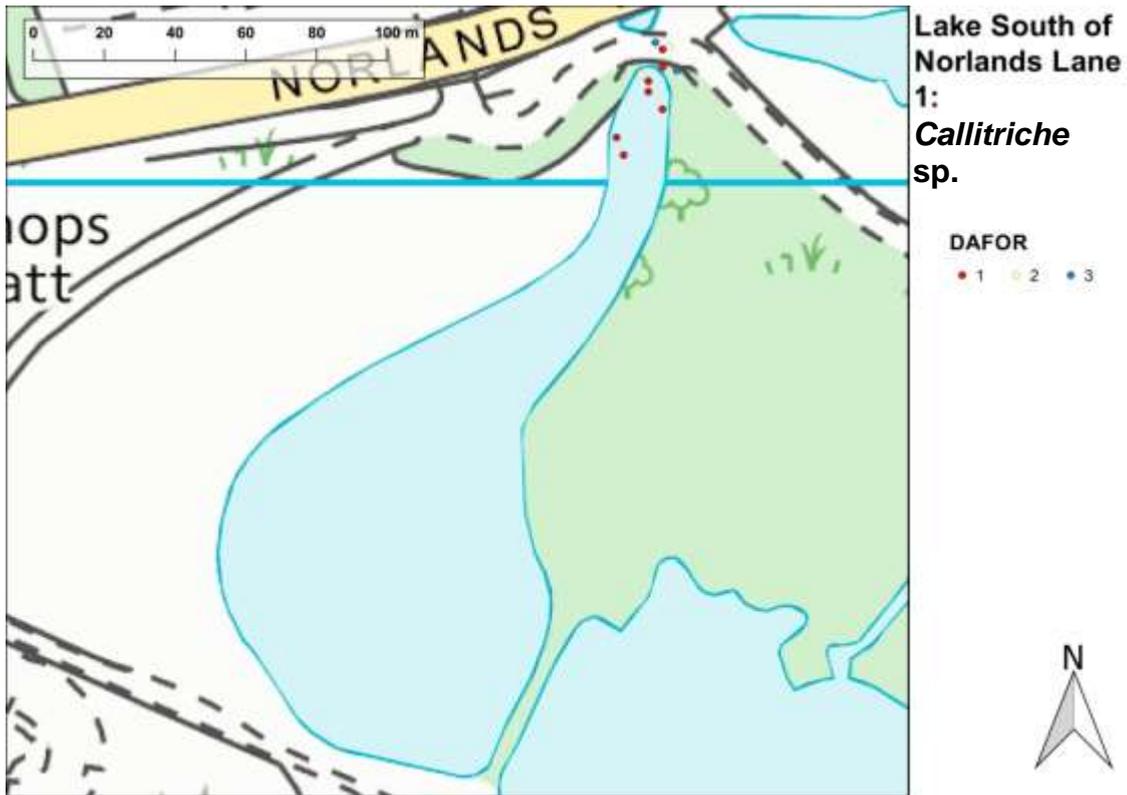


Figure 69 Map showing the location and abundance of *Callitriche* sp. at Lake South of Norlands Lane 1.

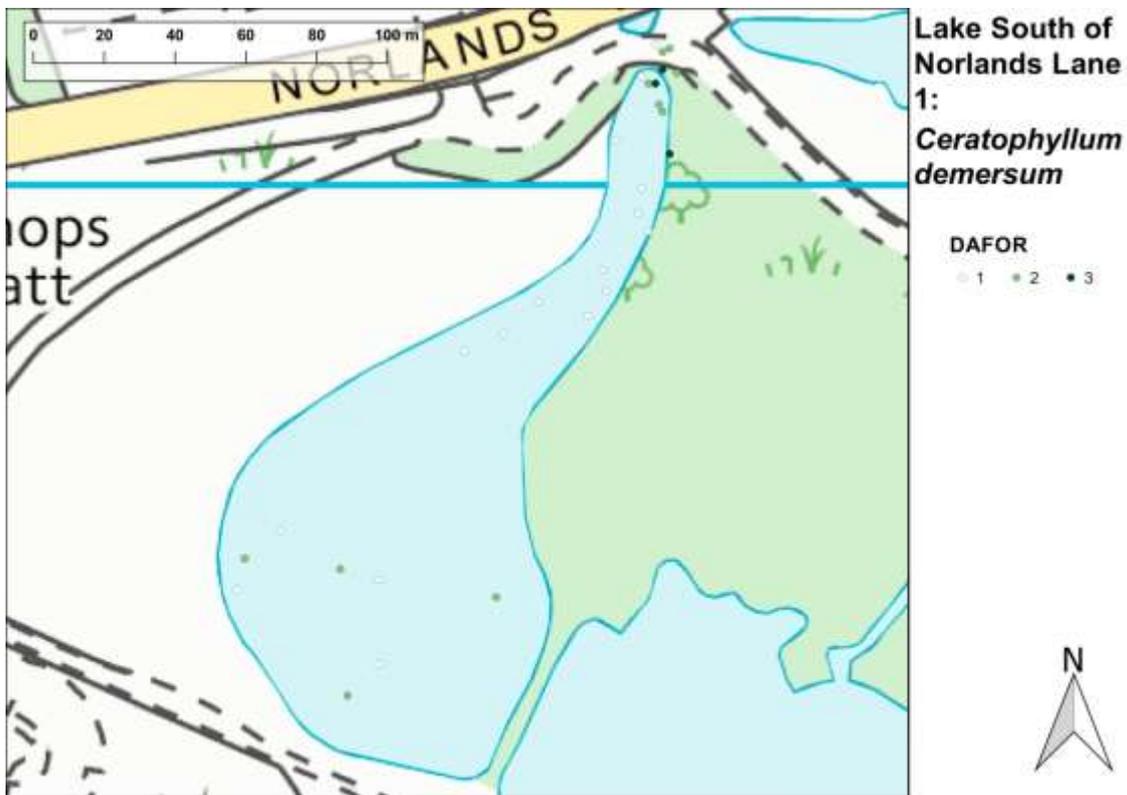


Figure 70 Map showing the and abundance of *Ceratophyllum demersum* at Lake South of Norlands Lane 1.

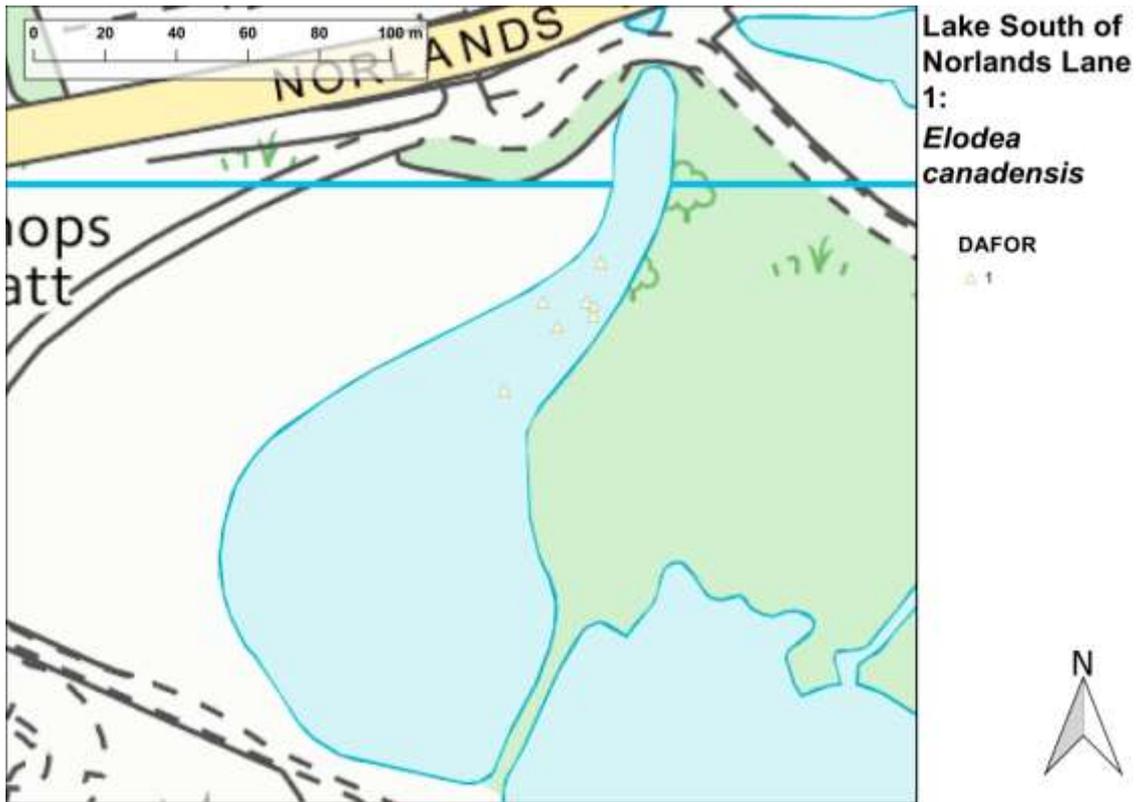


Figure 71 Map showing the and abundance of *Elodea canadensis* at Lake South of Norlands Lane 1.

3.13. Lake South of Norlands Lane 2

Survey Date	7 July 2016
Grid reference:	TQ0342369030
OS Grid reference (X,Y):	503423, 169030
Approx. surface area (ha.):	0.32
Maximum recorded depth (m):	0.8

Overview

Lake South of Norlands Lane 2 is a very shallow (max recorded 0.8 m), semi-terrestrialised pond, with no areas of open water remaining (Figure 72). The site is surrounded by rough grassland, some of which is developing into scrub vegetation and brambles. To the east of the site is a field which appears to be periodically mown, but otherwise unmanaged.



Figure 72 Aerial image of Lake South of Norlands Lane 2 (Imagery © 2016 Getmapping PLC from Google).

Extent of macrophyte cover

The margins are characterised by larger willows, below which is a heavily shaded understory including *Carex acutiformis*, *Phragmites australis*, *Lycopus europaeus*, *Mentha aquatica* and *Epilobium hirsutum*. Where there is shallow water, there are dense areas of willow saplings (mainly less than 3 m high) as well as *Typha latifolia* and *Phragmites australis* forming very dense stands Figure 73.

Within the water and in areas of the margins throughout the site, there are very dense growths of the non-native invasive species *Crassula helmsii* (Figure 74). No other submerged species were recorded. *Lemna minor* was noted in one location. The presence of *C. helmsii* necessitates additional care during any future management to ensure this

species in not spread to other sites. Complete and controlled removal of this plant and any viable propagules, will be required prior to connection to other water bodies.



Figure 73 Typical view of the semi-terrestrialised Lake South of Norlands Road 2.



Figure 74 Emergent (left) and submerged (right) growths of *Crassula helmsii* at the Lake South of Norlands Road 2

A summary of the species is given in Table 20.

Table 20 Macrophyte summary; Lake South of Norlands Lane 2.

Species	Approx. Abundance
Aquatic species	
<i>Crassula helmsii</i>	Dominant
<i>Lemna minor</i>	Rare
Emergent species	
<i>Alnus glutinosa</i>	Occasional
<i>Carex acutiformis</i>	Frequent
<i>Epilobium hirsutum</i>	Occasional
<i>Lycopus europaeus</i>	Frequent
<i>Mentha aquatica</i>	Occasional
<i>Phragmites australis</i>	Abundant
<i>Salix</i> spp.	Abundant
<i>Typha latifolia</i>	Abundant

3.14. Manor Lake

Survey Date	4 July 2016
Grid reference:	TQ0288368552
OS Grid reference (X,Y):	502883, 168552
Approx. surface area (ha.):	15.9
Maximum recorded depth (m):	5.7
Secchi depth (m)	3.4

Overview

Manor Lake forms part of a complex of flooded pits that surround the Thorpe Park Leisure Park. With the exception of two shallower areas on the western side, the margins shelve very steeply to at least 3.5 m, with much of the open water being in the region of 4-5.0 m. The maximum recorded depth was 5.7 m (TQ0279868601). Much of the site is fringed by a narrow strip of willow and alder which in some parts along the northwestern side has been recently cut or thinned.

The lake was very clear during the survey (Secchi depth 3.4 m) and had extensive cover of aquatic plants throughout the basin to maximum depth (Figure 76). Zebra mussels were recorded growing at a number of locations, mainly in shallower water within the littoral zone (Figure 82).



Figure 75 Manor Lake

Extent of macrophyte cover

The aquatic flora in Manor Lake consisted of relatively dense vegetation in mixed species beds with *Elodea nuttallii*, *Potamogeton pusillus*, *P. trichoides* and *Chara globularis* being most frequent and all locally abundant (Figure 77 to Figure 81). In addition, a relatively uncommon stonewort, *Tolypella prolifera*, was recorded (mostly occasional) to the east and west side of the lake (Figure 81). Other species recorded were: *Chara contraria*,

Ceratophyllum demersum, *Zannichellia palustris*, *Potamogeton pectinatus*, *Ranunculus circinatus* and *Potamogeton crispus*. Where *C. contraria* was found, *Chara vulgaris* was also discovered occasionally interspersed within the stand, discovered later upon identification by Nick Stewart. A summary of the species is given in Table 21.

Table 21 Macrophyte summary; Manor Lake

Species	Frequency (n= 196)	LEAFPACS 2 Cover (%)
Aquatic taxa		
<i>Ceratophyllum demersum</i>	6.6	1.12
<i>Chara globularis</i>	35.7	5.40
<i>Chara contraria</i>	16.8	2.47
<i>Elodea nuttallii</i>	47.4	8.89
Filamentous algae	15.8	5.57
<i>Lemna trisulca</i>	0.5	0.24
<i>Myriophyllum spicatum</i>	2.0	0.31
<i>Potamogeton crispus</i>	1.0	0.38
<i>Potamogeton pectinatus</i>	7.1	3.97
<i>Potamogeton pusillus</i>	40.8	5.27
<i>Potamogeton trichoides</i>	22.4	5.62
<i>Ranunculus circinatus</i>	3.1	0.49
<i>Tolypella prolifera</i>	6.6	-
<i>Zannichellia palustris</i>	1.0	-
Marginal / emergent taxa		
<i>Alisma plantago-aquatica</i>		
<i>Bolboschoenus maritimus</i>		
<i>Epilobium hirsutum</i>		
<i>Glyceria maxima</i>		
<i>Lycopus europaeus</i>		
<i>Lythrum salicaria</i>		
<i>Mentha aquatica</i>		
<i>Oenanthe crocata</i>		
<i>Phragmites australis</i>		
<i>Sparganium erectum</i>		
<i>Typha latifolia</i>		

WFD Survey

A total of 13 submerged or floating macrophyte species were recorded from three survey sections in Manor Lake. *Tolypella prolifera* does not occur in the LEAFPACS 2 species list however, hence only 12 are recorded in the metrics (Table 22). Section 2, located to the north east of the lake, was the only section where the shore did not shelve steeply, and here there was a relatively high cover of *C. contraria*. Steep sides and littoral shading

around much of the site meant that there was only limited growth of aquatic plants in the margins compared to the deeper open water and the LEAFPACS 2 data probably underestimated total cover due to the high proportion of sample points in the littoral zone. *Elodea nuttallii*, *Potamogeton pusillus* and *Chara globularis* were recorded as the most abundant species. Marginal vegetation was relatively sparse beneath the tall trees and willow scrub, but in more open areas a number of species were recorded including: *Phragmites australis*, *Sparganium erectum*, *Typha latifolia*, *Glyceria maxima* *Lythrum salicaria*, *Epilobium hirsutum*, *Lycopus europaeus* and *Mentha aquatica*. A summary of the species is given in Table 21 and the LEAFPACS 2 metrics in Table 22.

Table 22 LEAFPACS 2 metrics applied to Manor Lake.

LEAFPACS metric report				
LMNI	NTAXA	NFG	COV	ALG
7.02	12.0	7.00	3.31	0.14

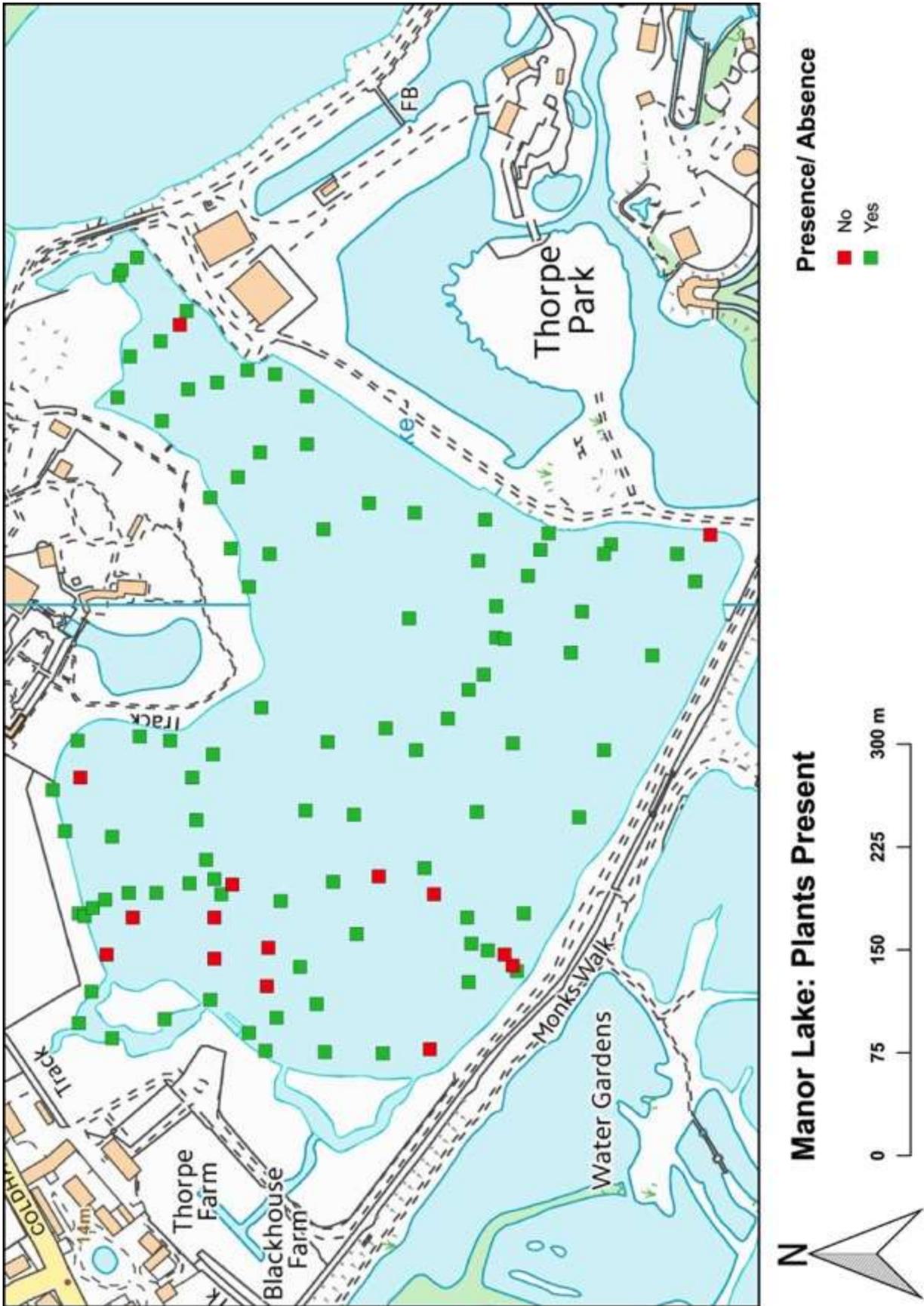


Figure 76 The extent of macrophyte cover at Manor Lake

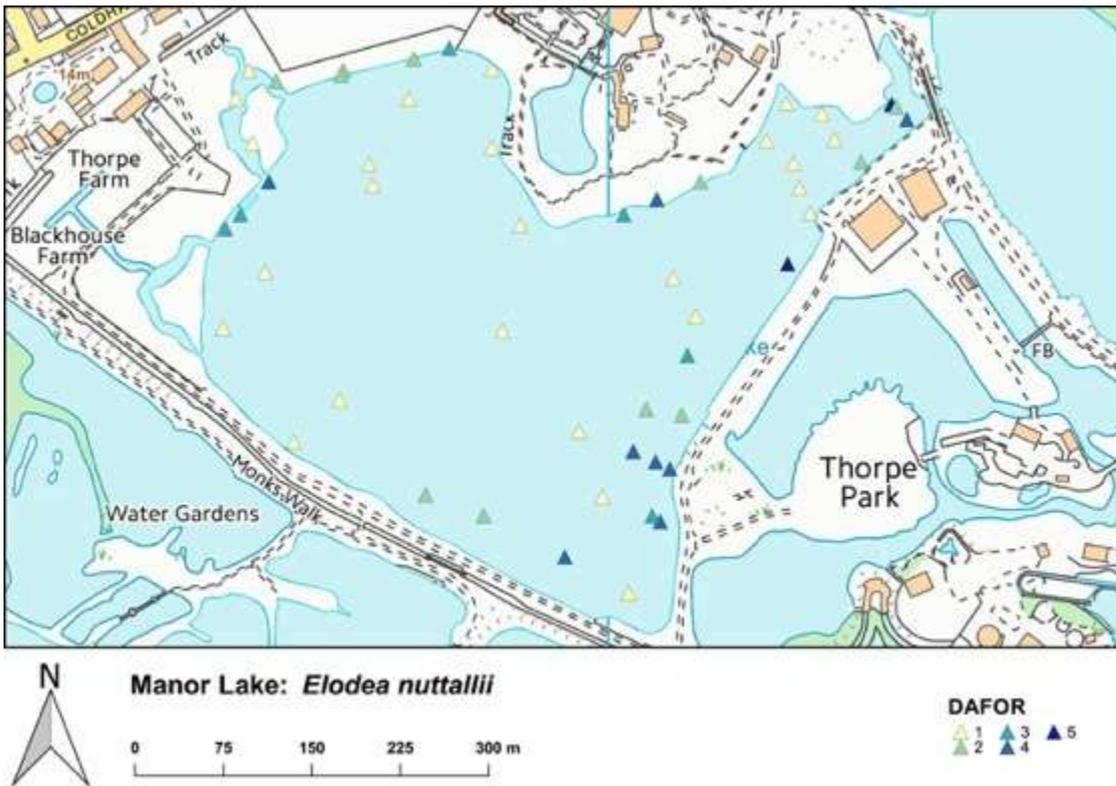


Figure 77 Extent and abundance of *Elodea nuttallii* at Manor Lake.

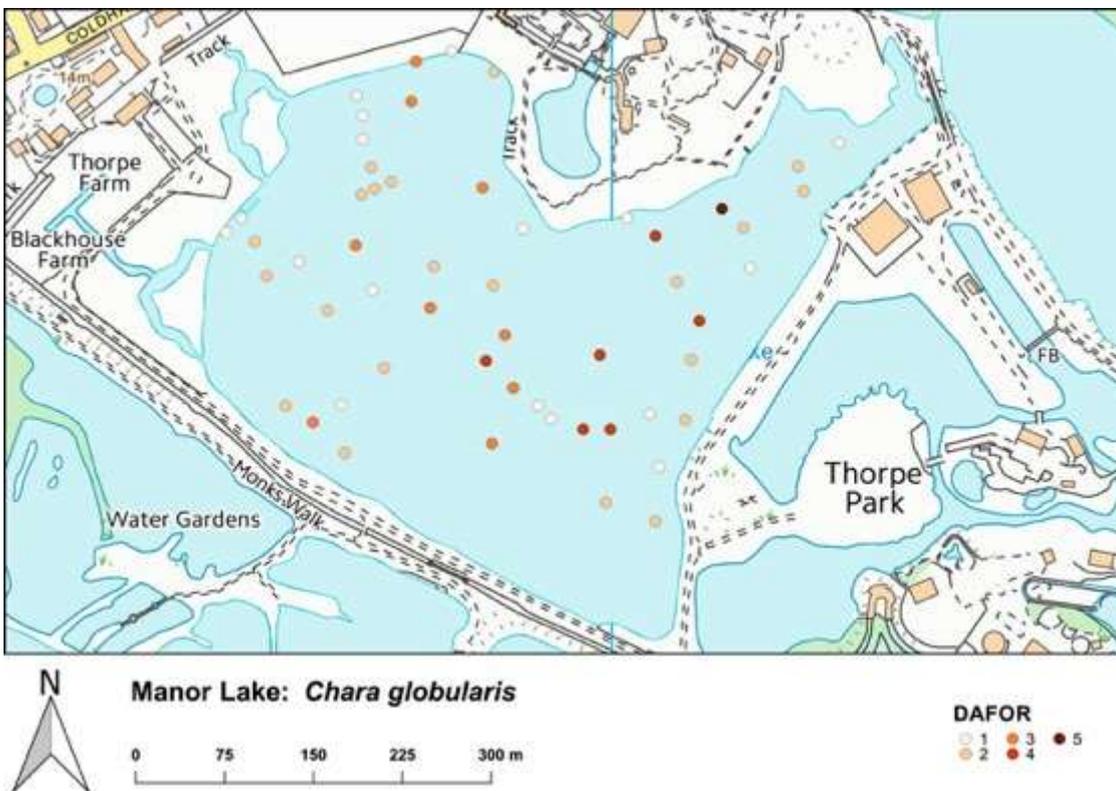


Figure 78 Extent and abundance of *Chara globularis* at Manor Lake.

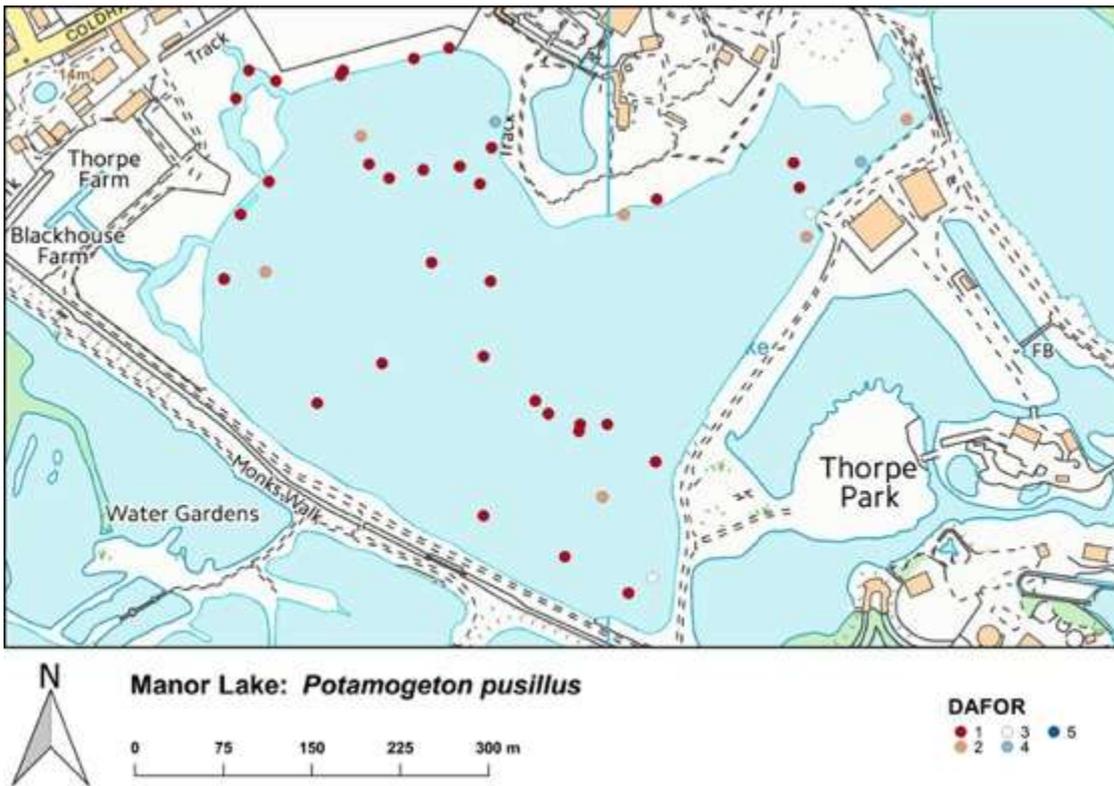


Figure 79 Extent and abundance of *Potamogeton pusillus* at Manor Lake.

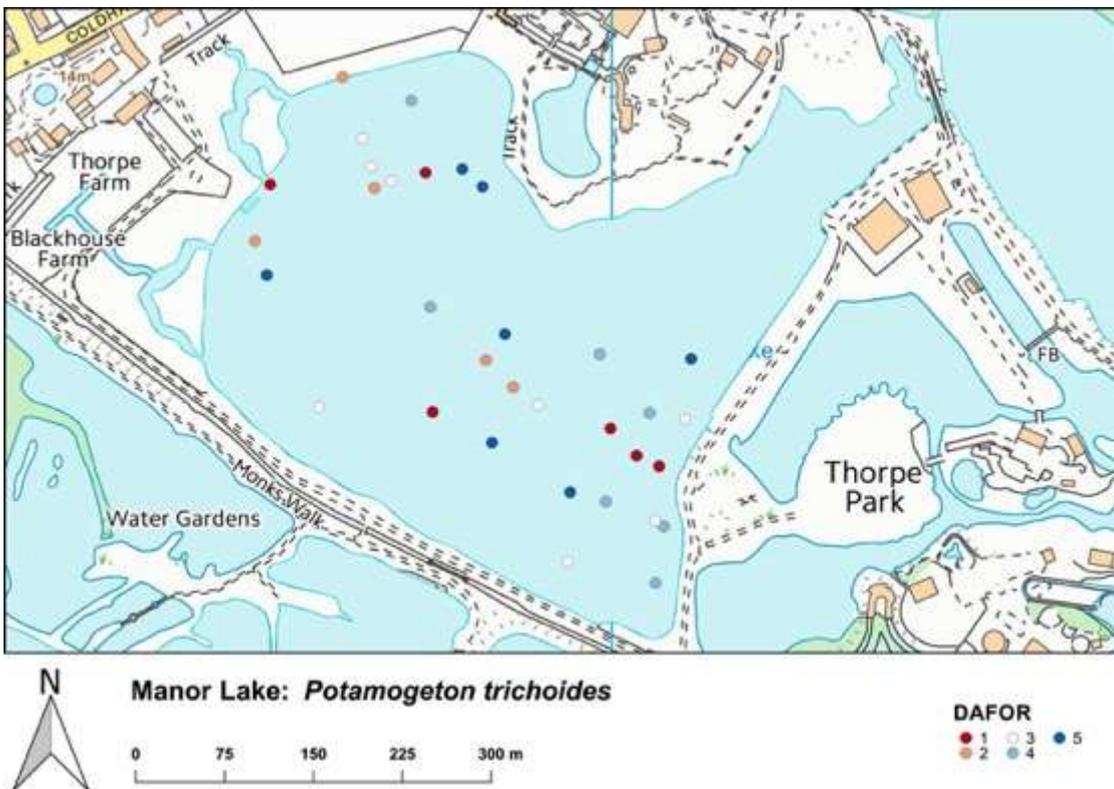


Figure 80 Extent and abundance of *Potamogeton trichoides* at Manor Lake.

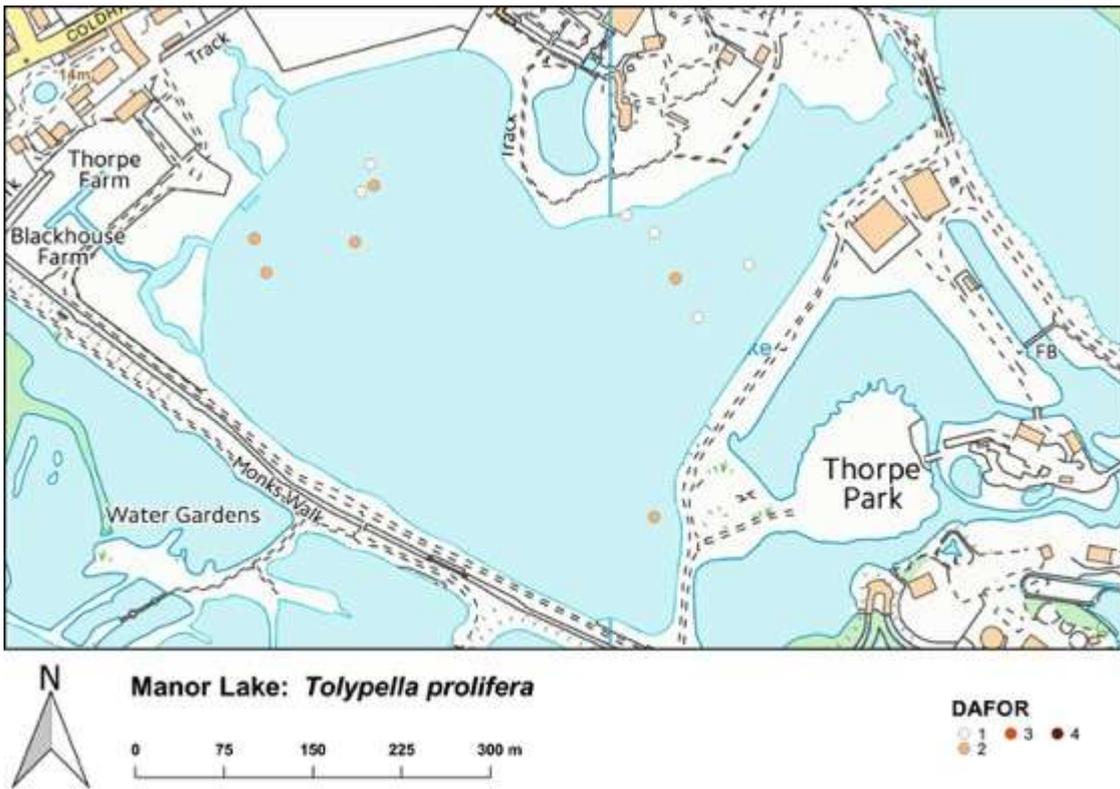


Figure 81 Extent and abundance of *Tolypella prolifera* at Manor Lake.

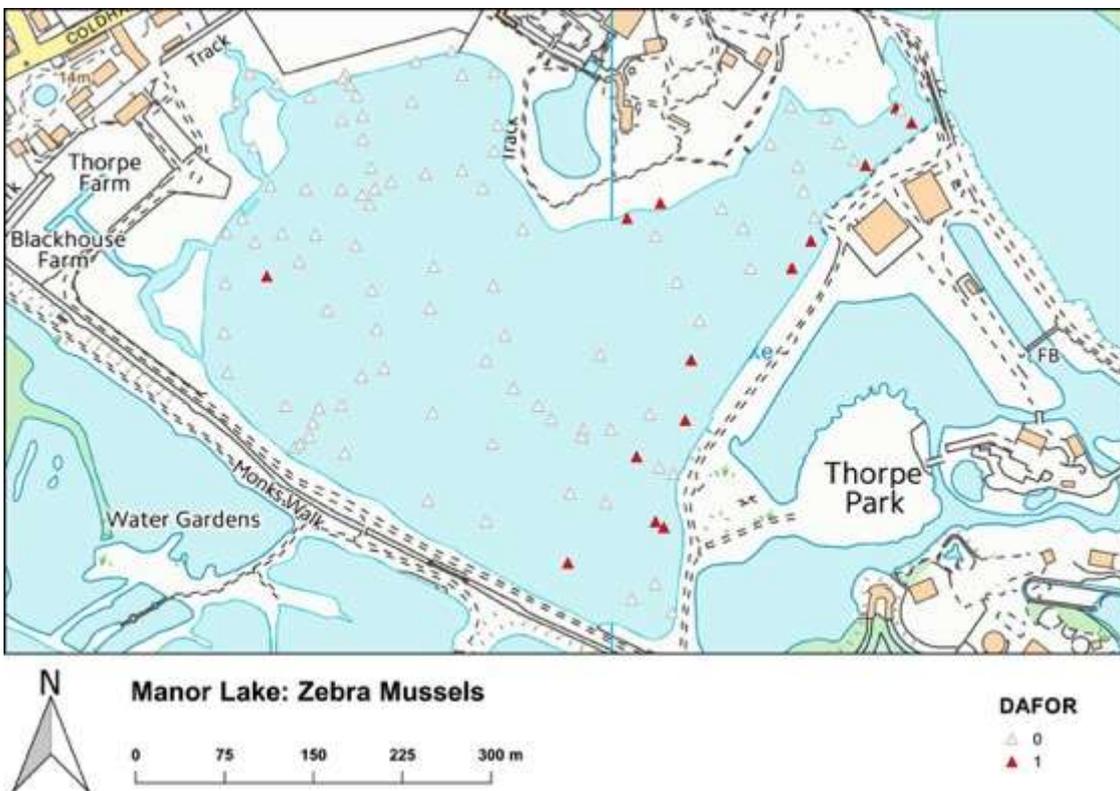


Figure 82 Extent and abundance of *Zebra mussels* at Manor Lake.

3.15. Fleet Lake

Survey Date	6 July 2016
Grid reference:	TQ0350368661
OS Grid reference (X,Y):	503503, 168661
Approx. surface area (ha.):	10.0
Maximum recorded depth (m):	5.5
Secchi depth (m)	3.5

Overview

Fleet Lake forms part of a complex of flooded pits that surround the Thorpe Park Leisure Park. With the exception of a recently in-filled area to the southwest of the site, most of the margins shelve very steeply to at least 3.5 m, with much of the open water being in the region of 4-5.0 m. The maximum recorded depth was 5.5 m at two points (TQ0339368764 & TQ0344868757). Much of the site is fringed by a narrow strip of willow and alder with a quite extensive development of *Phragmites* along the eastern shore. The area around the southwest side has been subject to land reclamation within the past 10 years and here there is a relatively shallow area of less than 1.0 m extending 10 to 20 m off shore.

The lake was very clear during the survey (Secchi depth 3.5 m) and had extensive cover of aquatic plants throughout the basin to maximum depth (Figure 84). Zebra mussels were common within the site, mainly at depths of less than 3 m, but also attached to plants to depths of 5 m (Figure 93).



Figure 83 East shore of Fleet Lake

Extent of macrophyte cover

Fleet lake comprised of dense vegetation in mixed species beds throughout most of the open water with *Elodea nuttallii* and *Potamogeton pusillus* dominant and *P. trichoides*,

Ceratophyllum demersum, *Chara globularis*, *Chara contraria* var. *hispidula*, *Tolypella prolifera*, *P. pectinatus* and *Myriophyllum spicatum* were recorded as frequent and all locally abundant (Figure 85 to Figure 91). In addition, the nationally rare stonewort, *Nitellopsis obtusa* was recorded as locally abundant in the east side on the site (Figure 92). A summary of the species is given in Table 23.

Table 23 Macrophyte summary; Fleet Lake

Species	Frequency % (n= 263)	LEAFPACS 2 Cover (%)
Aquatic taxa		
<i>Ceratophyllum demersum</i>	38.8	6.26
<i>Chara contraria</i> var. <i>hispidula</i>	12.5	2.84
<i>Chara globularis</i>	12.2	4.42
<i>Elodea nuttallii</i>	59.7	16.85
<i>Filamentous algae</i>	8.4	8.48
<i>Fontinalis antipyretica</i>	2.7	0.27
<i>Lemna trisulca</i>	1.1	-
<i>Myriophyllum spicatum</i>	5.7	0.52
<i>Nitellopsis obtusa</i>	8.0	2.72
<i>Potamogeton pectinatus</i>	8.7	1.33
<i>Potamogeton pusillus</i>	49.4	8.71
<i>Potamogeton trichoides</i>	23.6	6.98
<i>Ranunculus circinatus</i>	9.1	1.46
<i>Tolypella prolifera</i>	24.3	-
<i>Zannichellia palustris</i>	0.4	0.49
Marginal / emergent taxa		
<i>Alisma plantago-aquatica</i>		
<i>Bolboschoenus maritimus</i>		
<i>Epilobium hirsutum</i>		
<i>Lycopus europaeus</i>		
<i>Lythrum salicaria</i>		
<i>Oenanthe crocata</i>		
<i>Phragmites australis</i>		
<i>Sparganium erectum</i>		
<i>Typha latifolia</i>		

WFD Survey

A total of 14 submerged or floating macrophyte species were recorded from three survey sections in Fleet Lake. *Tolypella prolifera* does not occur in the LEAFPACS 2 species list however, hence only 13 are recorded in the metrics (Table 24). Dense growths of emergent reeds (mainly *Phragmites australis*) along the east side limited the presence of submerged species in the littoral zone along the east shore. Similarly, the north and west

shores shelf steeply and are shaded and therefore have lower cover than the open water. The LEAFPACS 2 data therefore underestimated total cover due to the high proportion of sample points in the littoral zone. *Elodea nuttallii*, *Potamogeton pusillus*, *P. trichoides* and *C. demersum* were recorded as the most abundant species. Marginal vegetation was dominated by *Phragmites australis*, with *Typha latifolia*, *Sparganium erectum* and *Epilobium hirsutum* common. A summary of the species is given in Table 23 and the LEAFPACS 2 metrics in Table 24.

Table 24 LEAFPACS 2 metrics applied to Fleet Lake.

LEAFPACS metric report				
LMNI	NTAXA	NFG	COV	ALG
6.64	13.0	6.00	4.72	0.14

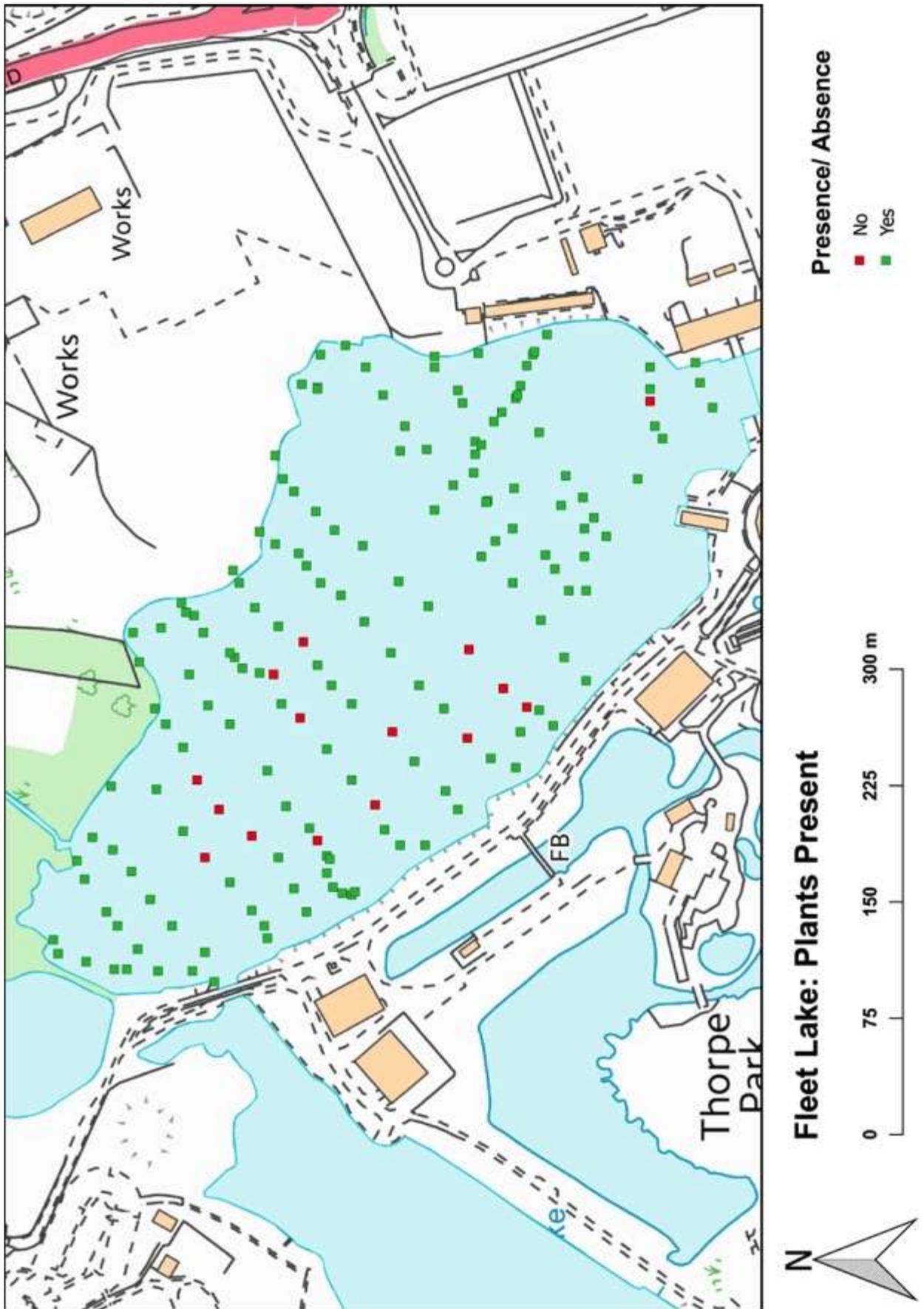


Figure 84 The extent of macrophyte cover at Fleet Lake

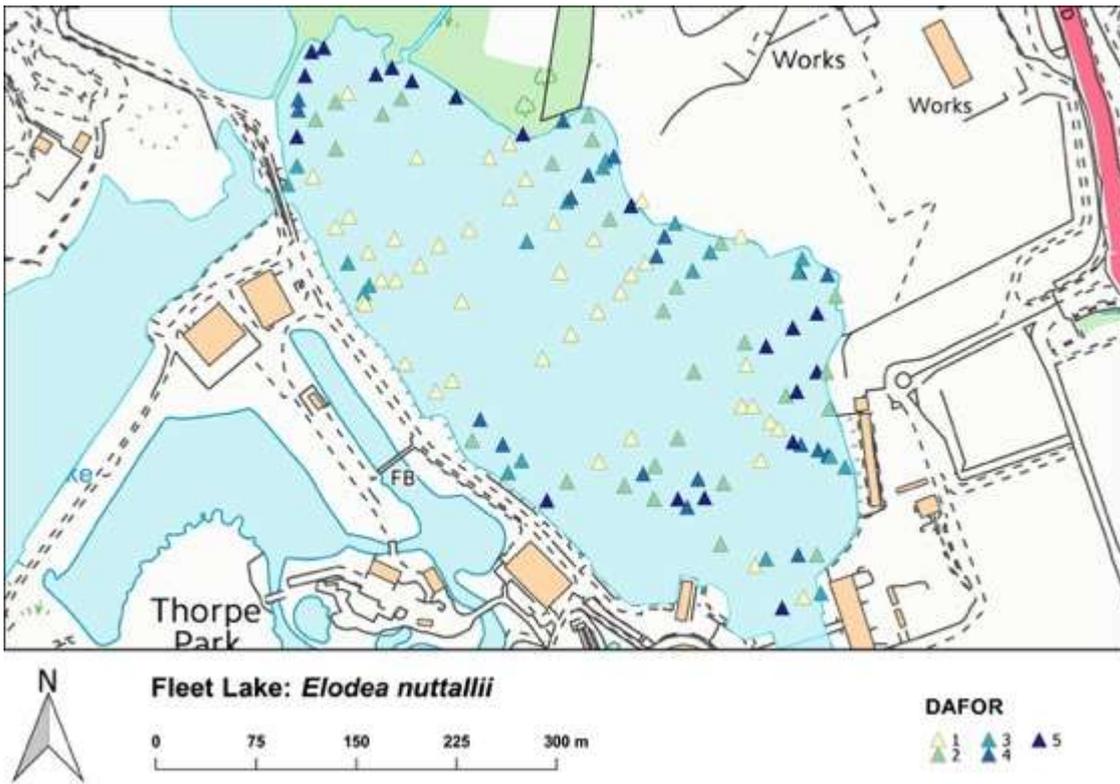


Figure 85 Extent and abundance of *Elodea nuttallii* at Fleet Lake.

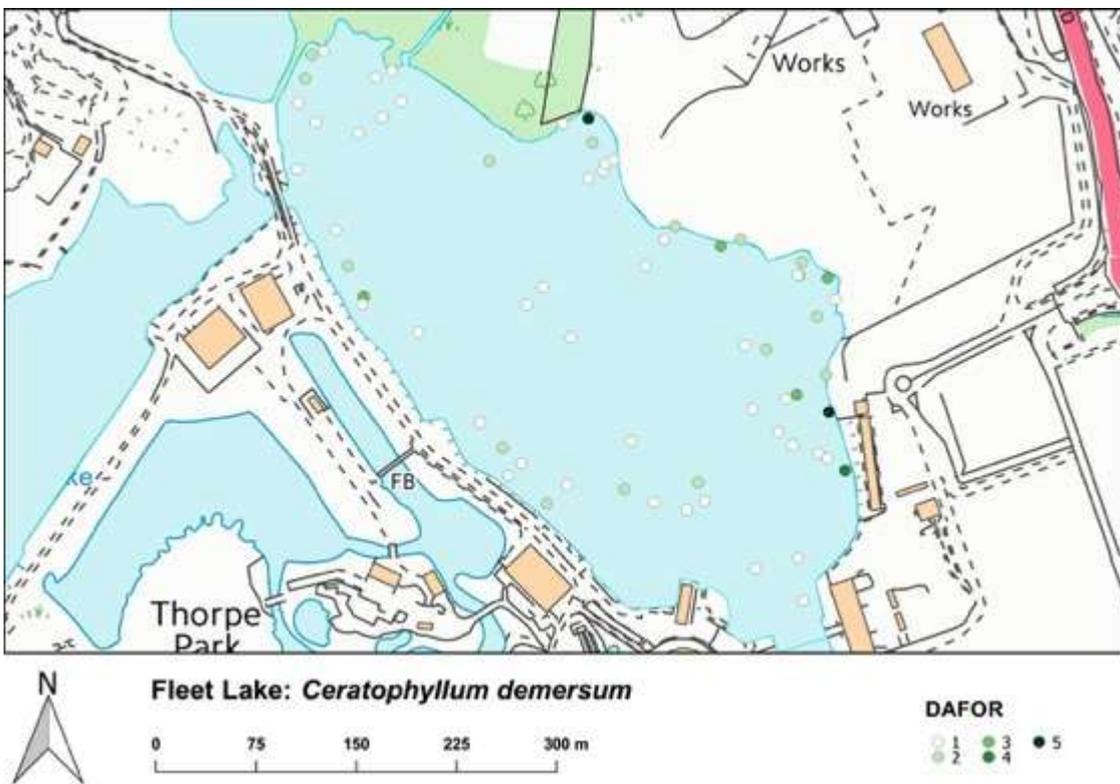


Figure 86 Extent and abundance of *Ceratophyllum demersum* at Fleet Lake.

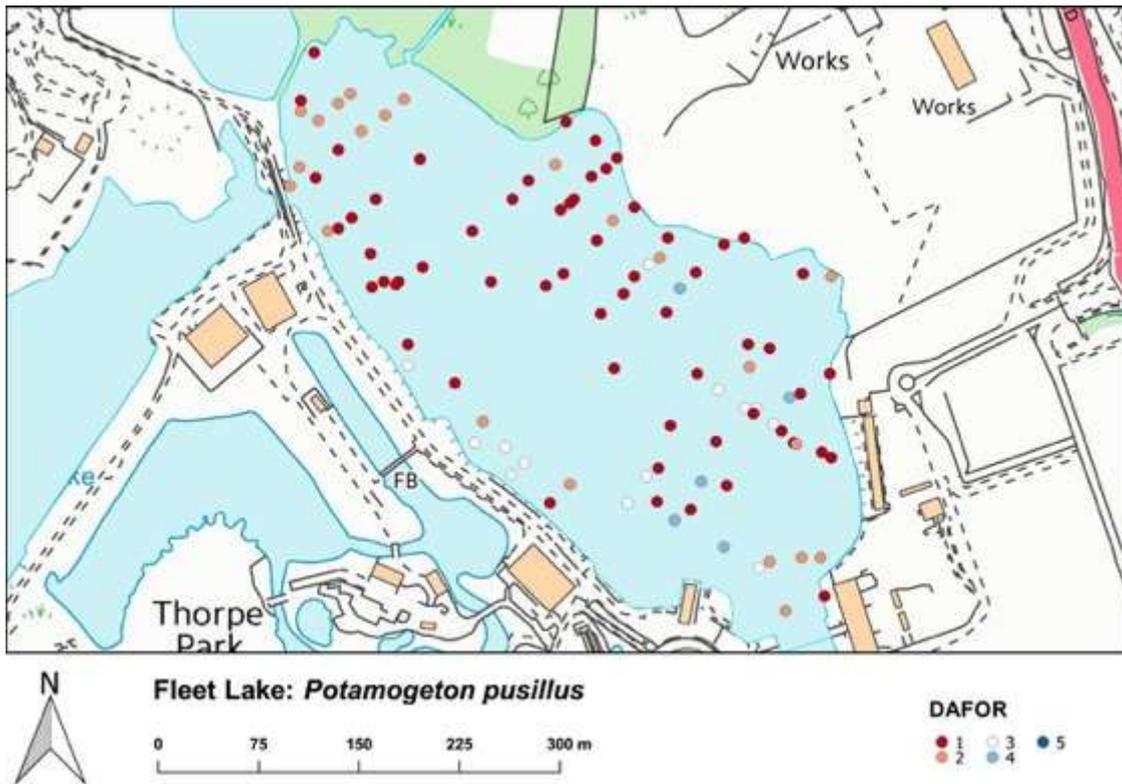


Figure 87 Extent and abundance of *Potamogeton pusillus* at Fleet Lake.

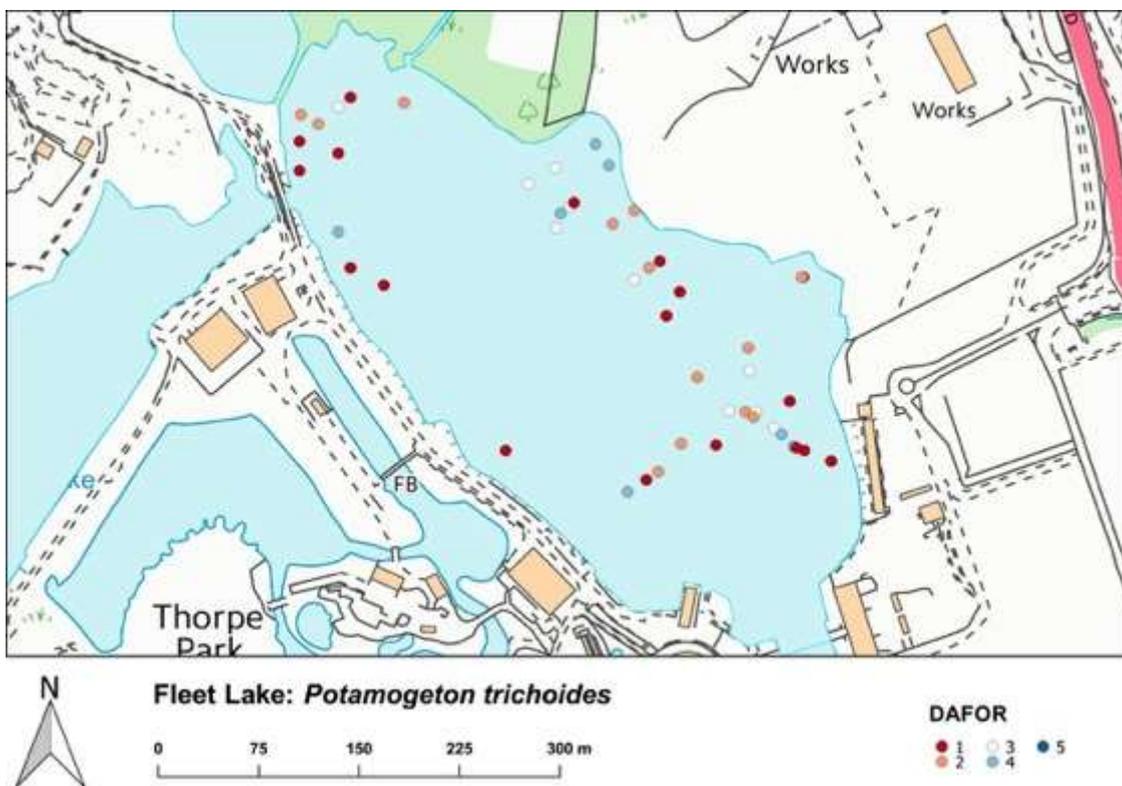


Figure 88 Extent and abundance of *Potamogeton trichoides* at Fleet Lake.

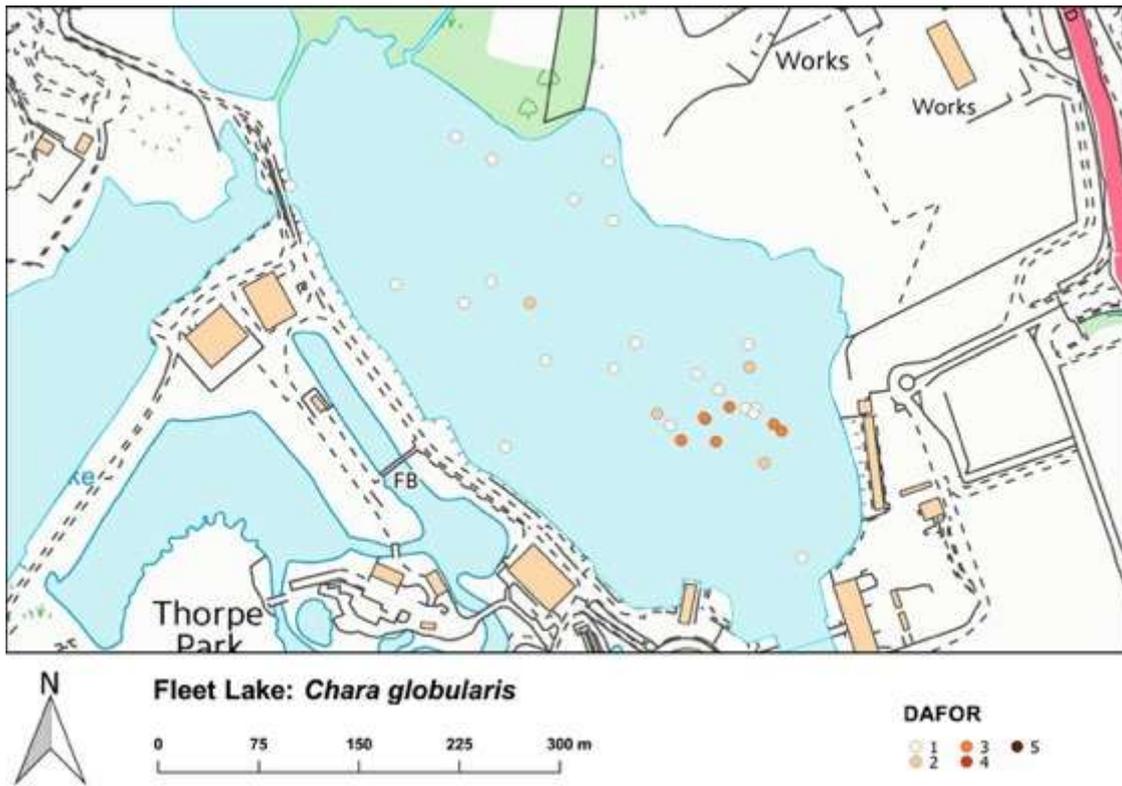


Figure 89 Extent and abundance of *Chara globularis* at Fleet Lake.

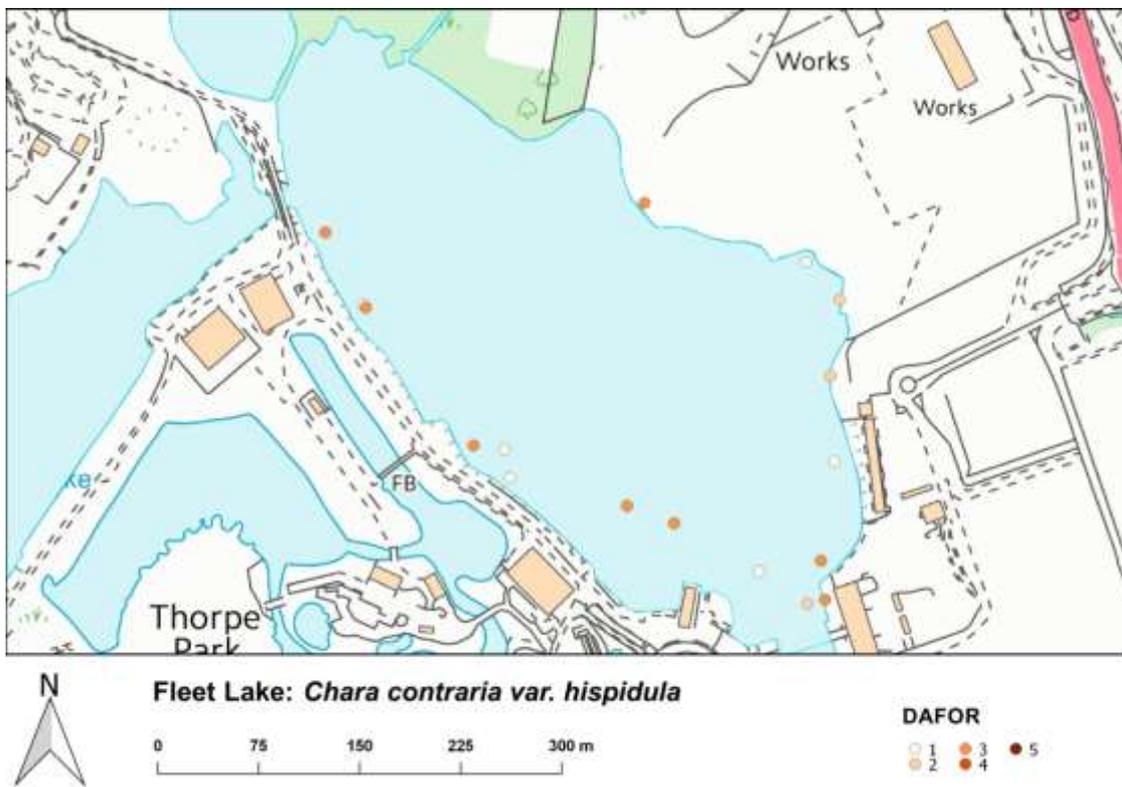


Figure 90 Extent and abundance of *Chara contraria var. hispidula* at Fleet Lake.

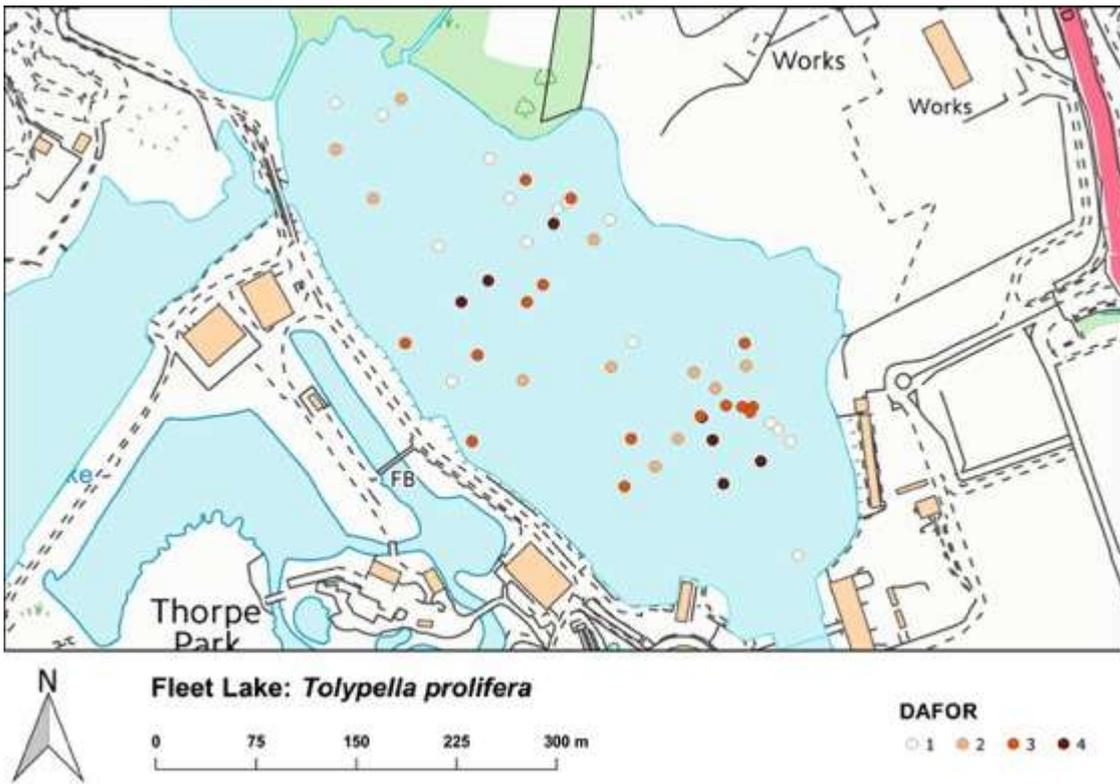


Figure 91 Extent and abundance of *Tolypella prolifera* at Fleet Lake.

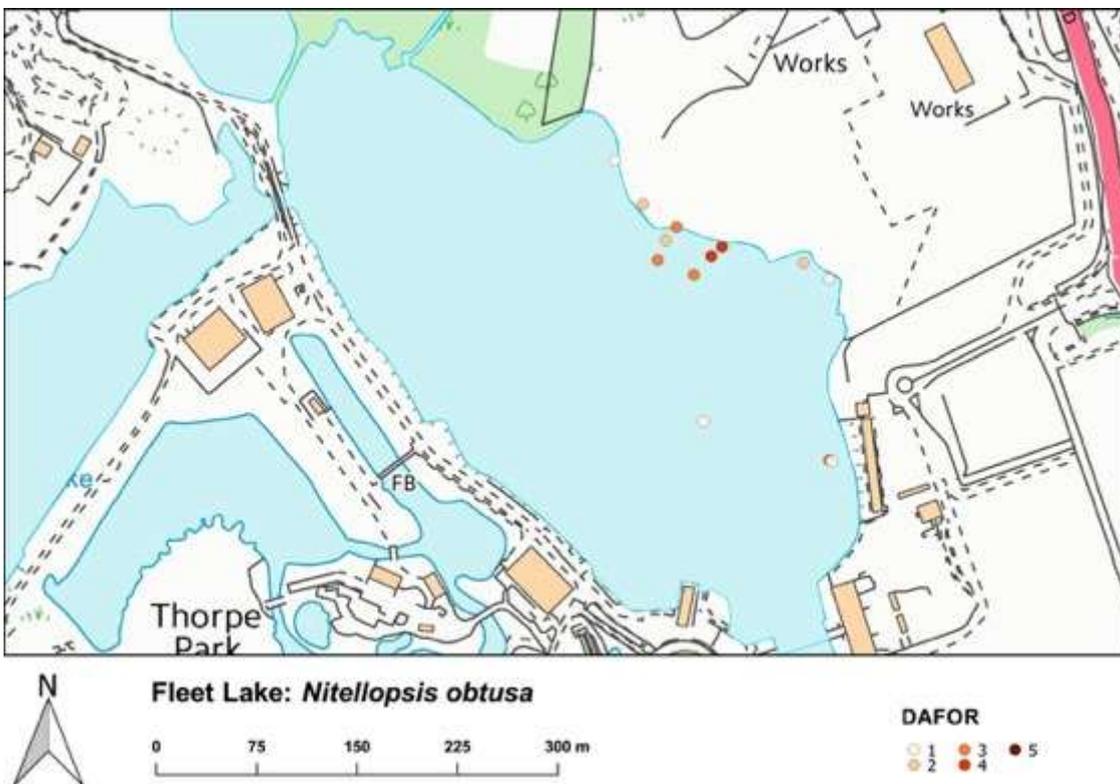


Figure 92 Extent and abundance of *Nitellopsis obtusa* at Fleet Lake.

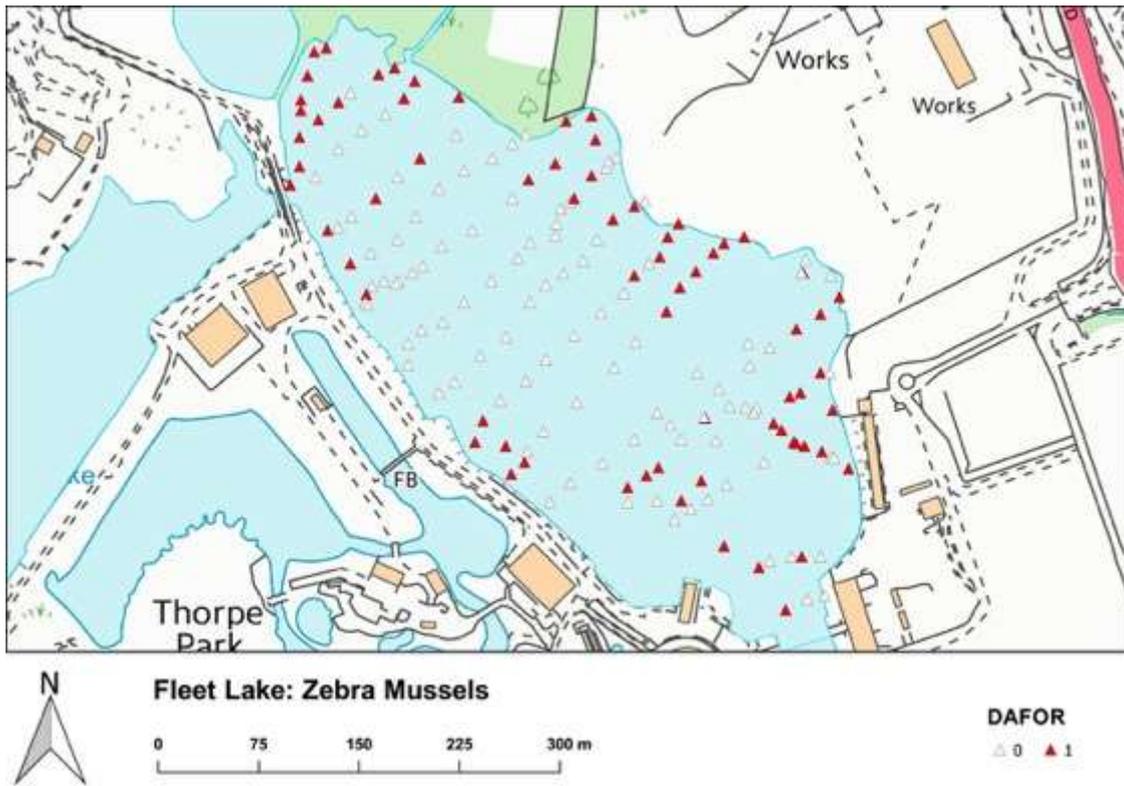


Figure 93 Extent and abundance of *Zebra mussels* at Fleet Lake.

3.16. Abbey Lake

Survey Date	8 July 2016
Grid reference:	TQ0379468075
OS Grid reference (X,Y):	503794, 168075
Approx. surface area (ha.):	13.2
Maximum recorded depth (m):	7.1
Secchi depth (m)	3.0

Overview

Abbey Lake forms part of a complex of flooded pits that surround the Thorpe Park Leisure Park. In the most part, the margins shelve very steeply to at least 3.5 m, with much of the open water being in the region of 4-5.0 m. The maximum recorded depth was 7.1 m (TQ0389168064). Much of the site is fringed by a willow and alder with a line of tall conifers (*Leylandii* sp., Figure 94) on the west shore. The site is used for water skiing, with boats coming through from the adjacent St. Ann's Lake.

The lake was very clear during the survey (Secchi depth 3.0 m) and had extensive cover of aquatic plants throughout the basin to a maximum depth of 6.5 m (Figure 95). Zebra mussels were common within the site to depths up to 4 m, and occasionally attached to plants to depths of 5.6 m (Figure 102).



Figure 94 West shore of Abbey Lake showing conifers

Extent of macrophyte cover

Abbey Lake comprised of dense vegetation in mixed species beds throughout most of the open water with *Elodea nuttallii* and *Potamogeton pusillus* dominant, with *Ceratophyllum demersum*, *Chara vulgaris* var. *longibracteata*, *Chara globularis*, *Tolypella prolifera* and *Ranunculus circinatus* recorded as frequent and all locally abundant (Figure 96 to Figure 100). In addition, the nationally rare stonewort, *Nitellopsis obtusa* was recorded within the site in a number of areas, but mainly at low abundance (Figure 101). *Nitella mucronata* var. *gracillima* was recorded at one survey point at a depth of 6 m. A summary of the species is given in Table 25.

Table 25 Macrophyte summary; Abbey Lake

Species	Frequency % (n= 242)	LEAFPACS 2 Cover (%)
Aquatic taxa		
<i>Ceratophyllum demersum</i>	8.7	2.07
<i>Chara vulgaris</i> var. <i>longibracteata</i>	10.7	1.91
<i>Chara globularis</i>	28.9	11.39
<i>Elodea nuttallii</i>	68.2	21.58
<i>Filamentous algae</i>	15.7	4.79
<i>Nitellopsis obtusa</i>	5.4	1.13
<i>Persicaria amphibia</i>	0.4	0.04
<i>Potamogeton pectinatus</i>	2.9	0.51
<i>Potamogeton pusillus</i>	57.4	17.31
<i>Potamogeton trichoides</i>	2.1	0.92
<i>Ranunculus circinatus</i>	7.9	0.37
<i>Tolypella prolifera</i>	14.0	-
Marginal / emergent taxa		
<i>Bolboschoenus maritimus</i>		
<i>Epilobium hirsutum</i>		
<i>Iris pseudacorus</i>		
<i>Lycopus europaeus</i>		
<i>Lysimachia vulgaris</i>		
<i>Myosotis laxa</i>		
<i>Oenanthe crocata</i>		
<i>Phragmites australis</i>		
<i>Rumex hydrolapathum</i>		

WFD Survey

A total of 12 submerged or floating macrophyte species were recorded from four survey sections in Abbey Lake. *Tolypella prolifera* does not occur in the LEAFPACS 2 species list however, hence only 11 are recorded in the metrics (Table 26). Steep sides and littoral shading around much of the site meant that there was only limited growth of aquatic plants in the margins compared to the deeper open water and the LEAFPACS 2 data probably underestimates total cover due to the high proportion of sample points in the littoral zone (defined by the methodology). *Elodea nuttallii*, *Potamogeton pusillus* and *Chara globularis* were recorded as the most abundant species. Marginal vegetation was relatively sparse due to shading (see Table 25 for species recorded). A summary of LEAFPACS 2 metrics is given in Table 26.

Table 26 LEAFPACS 2 metrics applied to Abbey Lake.

LEAFPACS metric report				
LMNI	NTAXA	NFG	COV	ALG
6.86	11.0	5.00	5.64	0.08

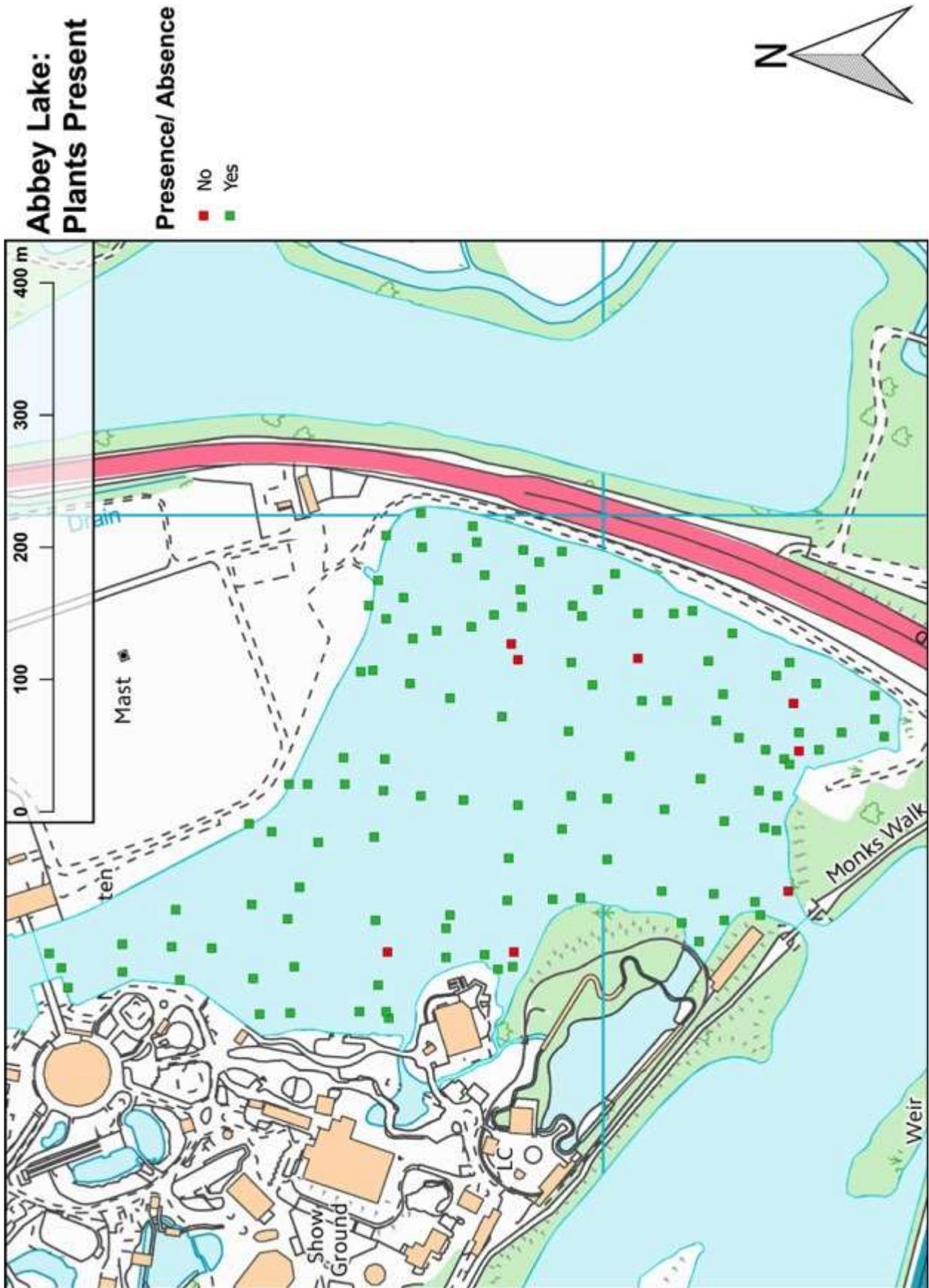


Figure 95 The extent of macrophyte cover at Abbey Lake

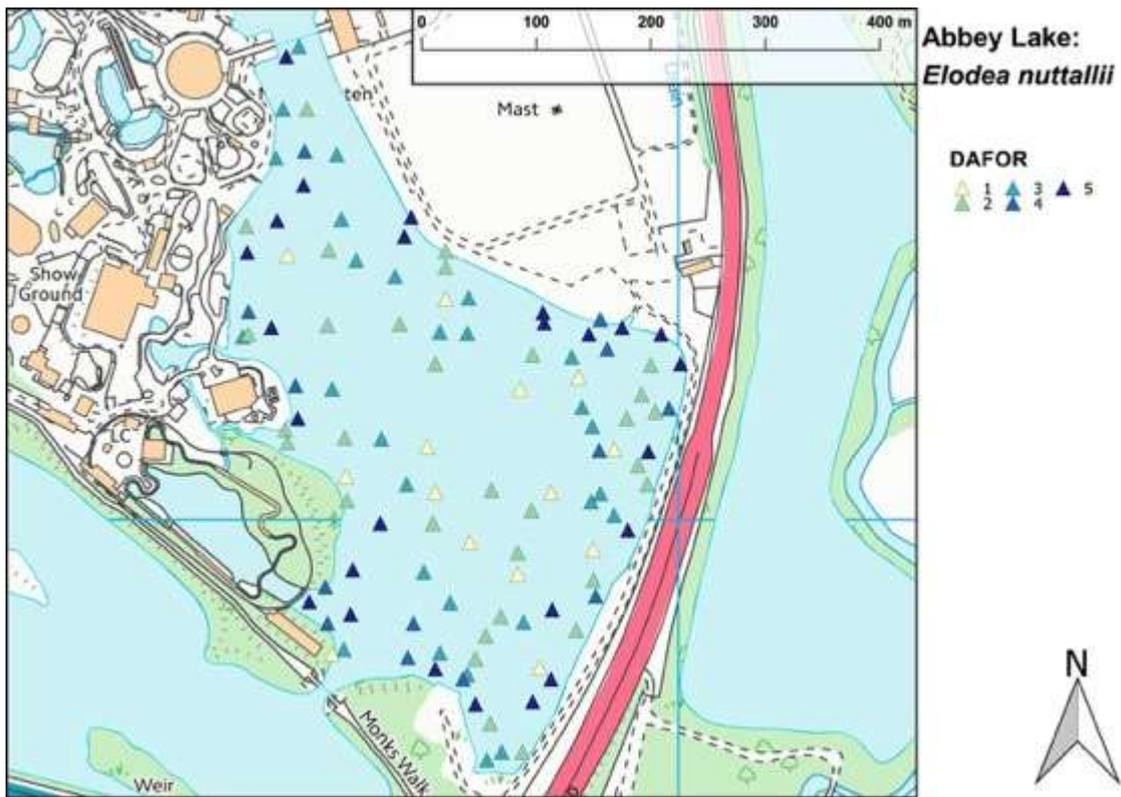


Figure 96 Extent and abundance of *Elodea nuttallii* at Abbey Lake.

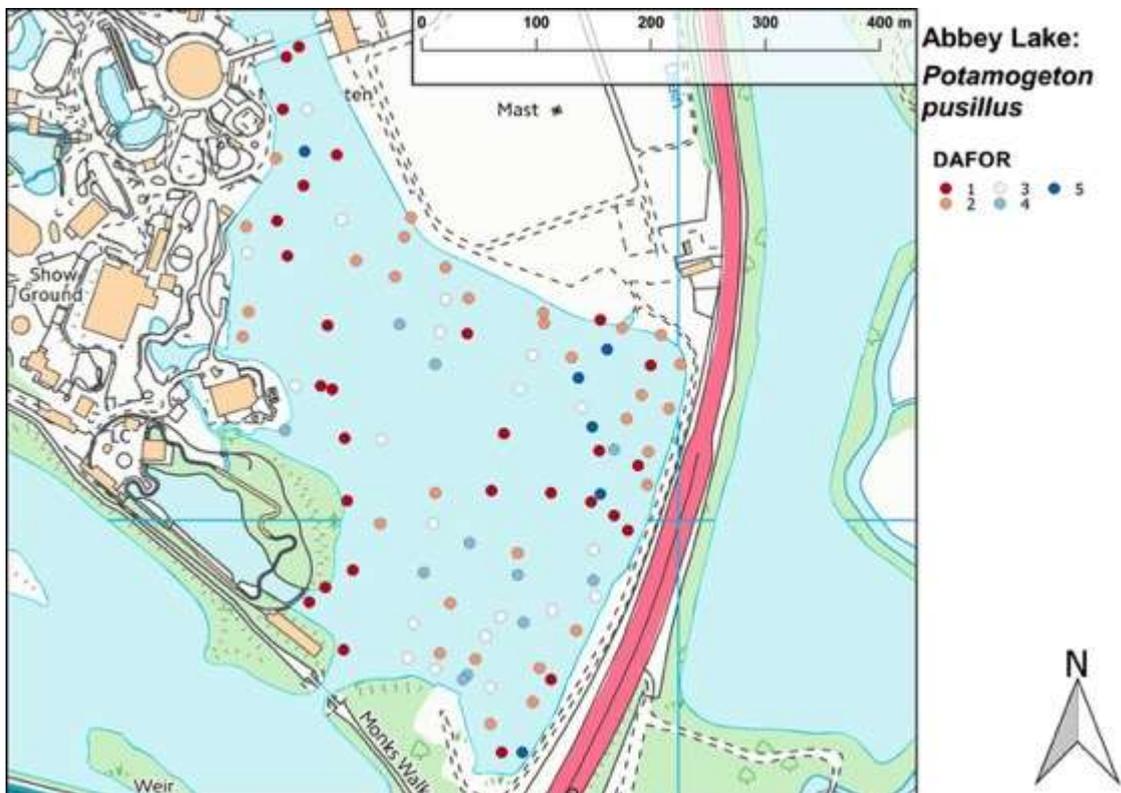


Figure 97 Extent and abundance of *Potamogeton pusillus* at Abbey Lake.

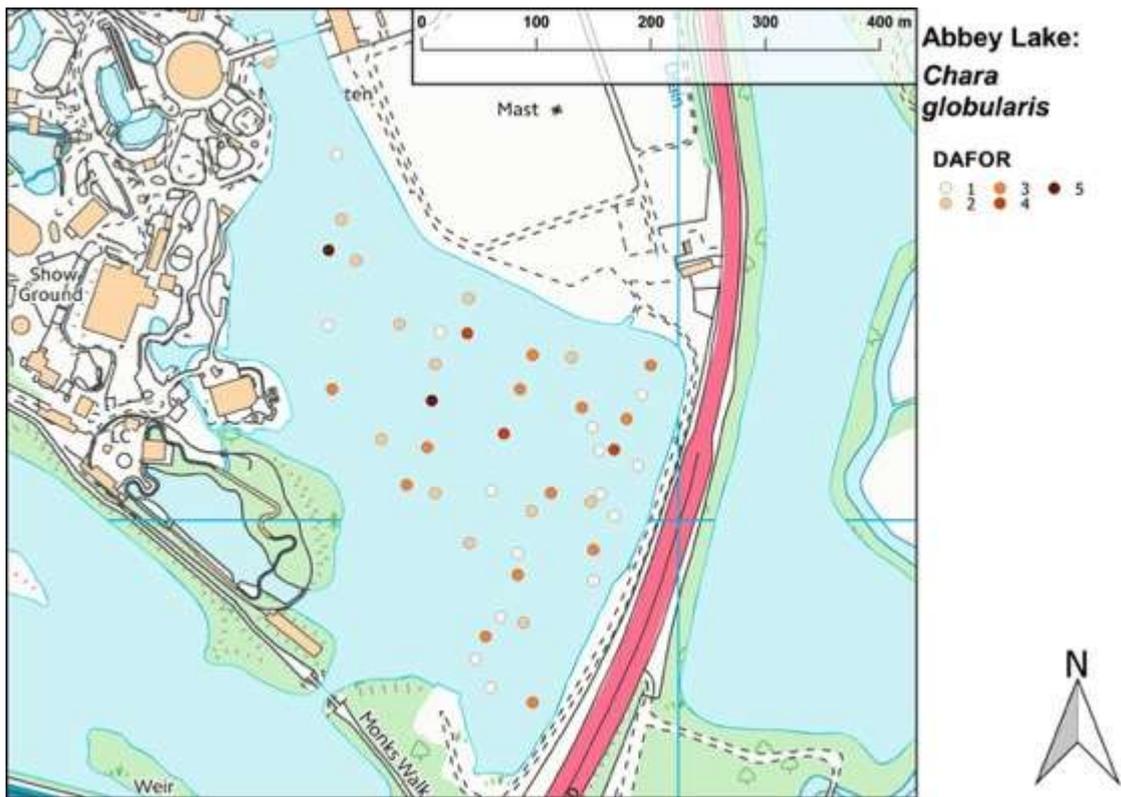


Figure 98 Extent and abundance of *Chara globularis* at Abbey Lake.



Figure 99 Extent and abundance of *Chara vulgaris* var. *longibracteata* at Abbey Lake.

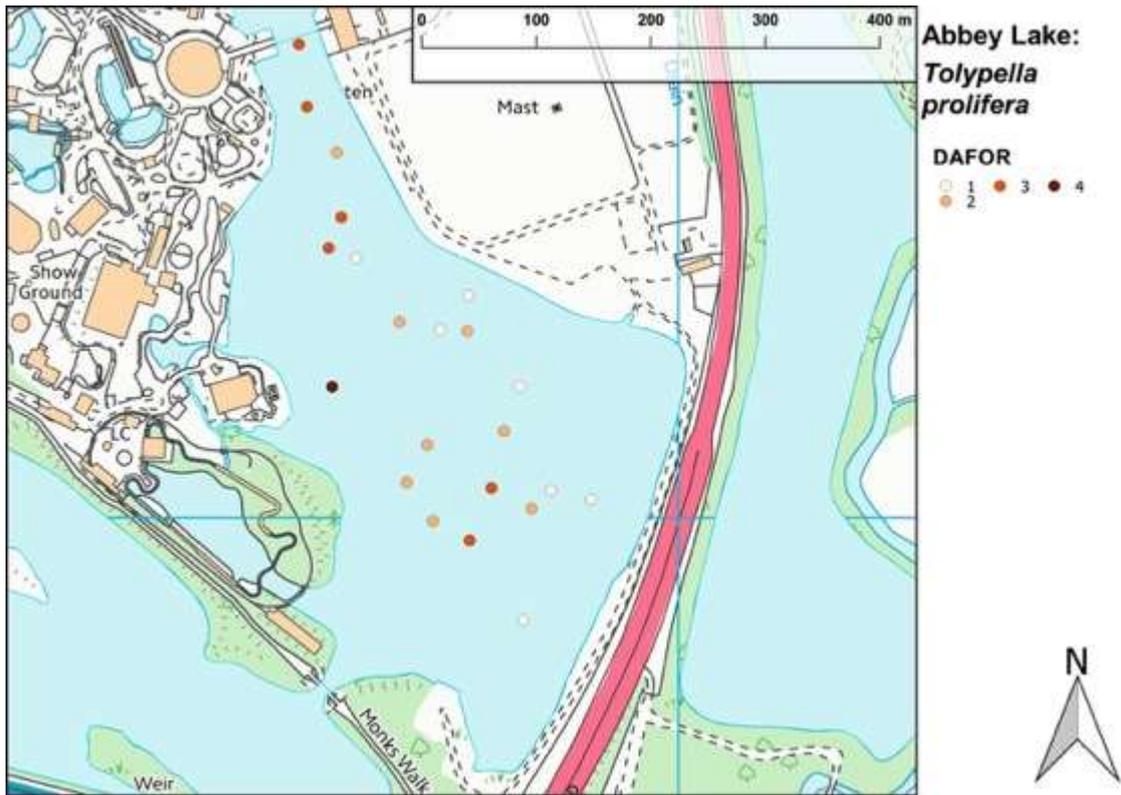


Figure 100 Extent and abundance of *Tolypella prolifera* at Abbey Lake.



Figure 101 Extent and abundance of *Nitellopsis obtusa* at Abbey Lake.

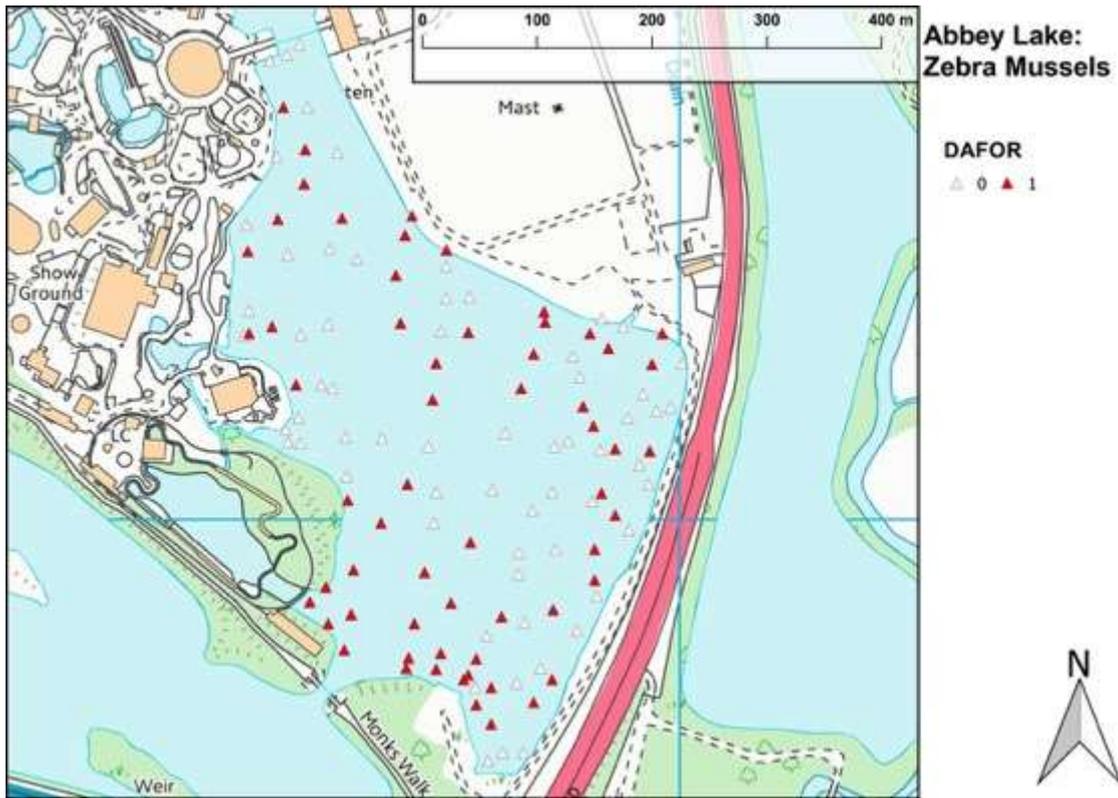


Figure 102 Extent and abundance of *Zebra mussels* at Abbey Lake.

3.17. St. Ann's Lake

Survey Date	9 August 2016
Grid reference:	TQ0287968108
OS Grid reference (X,Y):	502879, 168108
Approx. surface area (ha.):	40.4
Maximum recorded depth (m):	Unknown

Overview

St. Ann's Lake forms part of a complex of flooded pits that surround the Thorpe Park Leisure park. The site is relatively large and extensively used for water skiing and wake boarding with the central part of the lake having a fixed water ski tow line. The site is also used by an angling club. Much of the site is fringed by a willow and alder, but with cleared, areas of mown grass around the Ski club. Where assessed, the majority of the lake had relatively steeply shelving margins.

Access to the lake was restricted by the site managers (JB Waterski), who were not prepared to cease boat or towed skiing to allow survey boats to operate (the waterski centre opens at 8 am until dusk). As a result, it was only possible to complete shore based surveys and no vegetation mapping was undertaken. The results from the shore-base WFD survey are presented below, but it should be noted that they do not adequately represent the site, particularly given that the littoral zone shelves steeply and in many areas the shallow areas are subject to erosional impacts from ski boats.

Zebra mussels were noted within the site and were relatively common on hard surfaces in the littoral zone.



Figure 103 St. Ann's Lake (Waterski club)

Extent of macrophyte cover

Where observed from the bank, the open water areas of St. Ann's Lake had plants growing well away from shore and it is reasonable to expect a similar depth distribution to that seen in the adjoining Abbey Lake (see Section 3.16). The higher impact of ski boat traffic may however influence plant growth to some extent.

Within the marginal areas, there was very limited plant growth where shading from overhanging trees dominated. In areas without trees, there was generally lower abundance of aquatic plants below approximately 60 cm water depth, most likely as a result from physical disturbance from wave action caused by boats.

Table 27 Macrophyte summary; St. Ann's Lake (Littoral survey only)

Species	LEAFPACS 2 Cover (%)
Aquatic taxa	
<i>Ceratophyllum demersum</i>	1.33
<i>Chara vulgaris</i>	3.43
<i>Elodea canadensis</i>	3.25
<i>Elodea nuttallii</i>	5.80
<i>Filamentous algae</i>	13.6
<i>Lemna trisulca</i>	2.13
<i>Myriophyllum spicatum</i>	1.18
<i>Nitellopsis obtusa</i>	2.36
<i>Persicaria amphibia</i>	1.00
<i>Potamogeton pectinatus</i>	3.84
<i>Potamogeton pusillus</i>	9.08
<i>Sparganium emersum</i>	0.10
<i>Zannichellia palustris</i>	0.50
Marginal / emergent taxa	
<i>Carex pseudocyperus</i>	
<i>Epilobium hirsutum</i>	
<i>Iris pseudacorus</i>	
<i>Lycopus europaeus</i>	
<i>Lysimachia vulgaris</i>	
<i>Lythrum salicaria</i>	
<i>Mentha aquatica</i>	
<i>Myosotis laxa</i>	
<i>Schoenoplectus</i>	
<i>Sparganium erectum</i>	
<i>Typha latifolia</i>	

WFD Survey

Based only on the littoral transects, a total of 13 submerged or floating macrophyte species were recorded from St. Ann's Lake (Table 27). Given that there were dense plant beds observed in open water that were not covered within the survey, the LEAFPACS 2 data is not considered to be representative of the site and should therefore be viewed with caution. A summary of LEAFPACS 2 metrics is given in Table 28.

Table 28 LEAFPACS 2 metrics applied to St. Ann's Lake (Littoral survey only).

LEAFPACS metric report				
LMNI	NTAXA	NFG	COV	ALG
7.90	12.0	7.00	3.88	0.29

3.18. Abbey Lake 1

Survey Date	7 July 2016
Grid reference:	TQ0411768137
OS Grid reference (X,Y):	504117, 168137
Approx. surface area (ha.):	9.2
Maximum recorded depth (m):	8.3
Secchi depth (m)	2.2

Overview

Abbey Lake 1 lies just to the east of the Thorpe Park gravel pits. The flooded pit is used primarily for angling and has a number of fishing platforms around the south and west shore. The site is surrounded by tall willow and alder to the east and north, but trees and scrub have mostly been cleared around the southeast and south shores; in some places with the felled branches left in the water.

The margins are steeply shelving around most of the lake to depths in excess of 4 m, with the majority of the open water area ranging in depth from 4 to 6 m, with a deeper area extending to 8.3 m in the southeast end at TQ0424067864. Aquatic plants were common to depths of 5.5 m and in places extended to 7 m, but there were a significant number of areas without any macrophytes present (Figure 105).



Figure 104 Abbey Lake 1

Extent of macrophyte cover

Elodea nuttallii was the most abundant and frequently observed species at Abbey Lake 1, and was present throughout most of the northern half of the site, but less common in the south where the open water was mostly in excess of 6 m (Figure 106). *Lemna trisulca* was

recorded frequently, mainly in the marginal points, but occasionally in open water. Despite the close proximity to Abbey Lake where *P. pusillus* was abundant, *P. berchtoldii* was the common fine leaved species recorded in Abbey Lake 1, where it occurred in mixed beds with *E. nuttallii* (Figure 108). Other common species were *Ceratophyllum demersum* (Figure 109) and two *Chara* species (Figure 110); *C. Globularis* in deeper water and a shallower growing species, *C. contraria*.

Table 29 Macrophyte summary; Abbey Lake 1

Species	Frequency % (n= 255)	LEAFPACS 2 Cover (%)
Aquatic taxa		
<i>Ceratophyllum demersum</i>	6.3	0.70
<i>Chara globularis</i>	6.3	1.49
<i>Chara contraria</i>	5.9	1.15
<i>Elodea nuttallii</i>	52.5	10.21
<i>Filamentous algae</i>	0.4	0.38
<i>Lemna trisulca</i>	33.7	6.40
<i>Persicaria amphibia</i>	2.7	0.61
<i>Potamogeton berchtoldii</i>	15.3	2.71
<i>Potamogeton pectinatus</i>	0.8	0.32
Marginal / emergent taxa		
<i>Epilobium hirsutum</i>		
<i>Lycopus europaeus</i>		
<i>Lysimachia vulgaris</i>		
<i>Lythrum salicaria</i>		
<i>Phragmites australis</i>		
<i>Sparganium erectum</i>		
<i>Stachys palustris</i>		

WFD Survey

A total of nine submerged or floating macrophyte species were recorded from four survey sections in Abbey Lake 1. Steep sides and littoral shading around much of the site meant that there was only limited growth of aquatic plants in the margins compared to the deeper open water. The LEAFPACS 2 data therefore probably underestimates total cover slightly due to the high proportion of sample points in the littoral zone (defined by the methodology). *Elodea nuttallii* and *Lemna trisulca* achieved the highest cover scores, with *Potamogeton berchtoldii* and the two *Chara* species the only other species with cover scores greater than 1. Marginal vegetation was relatively sparse where trees shaded the edge, but the south and east shores had some emergent and marginal wetland species present (see Table 29 for species recorded). A summary of LEAFPACS 2 metrics is given in Table 30.

Table 30 LEAFPACS 2 metrics applied to Abbey Lake 1.

LEAFPACS metric report				
LMNI	NTAXA	NFG	COV	ALG
7.03	9.0	6.00	2.66	0.02

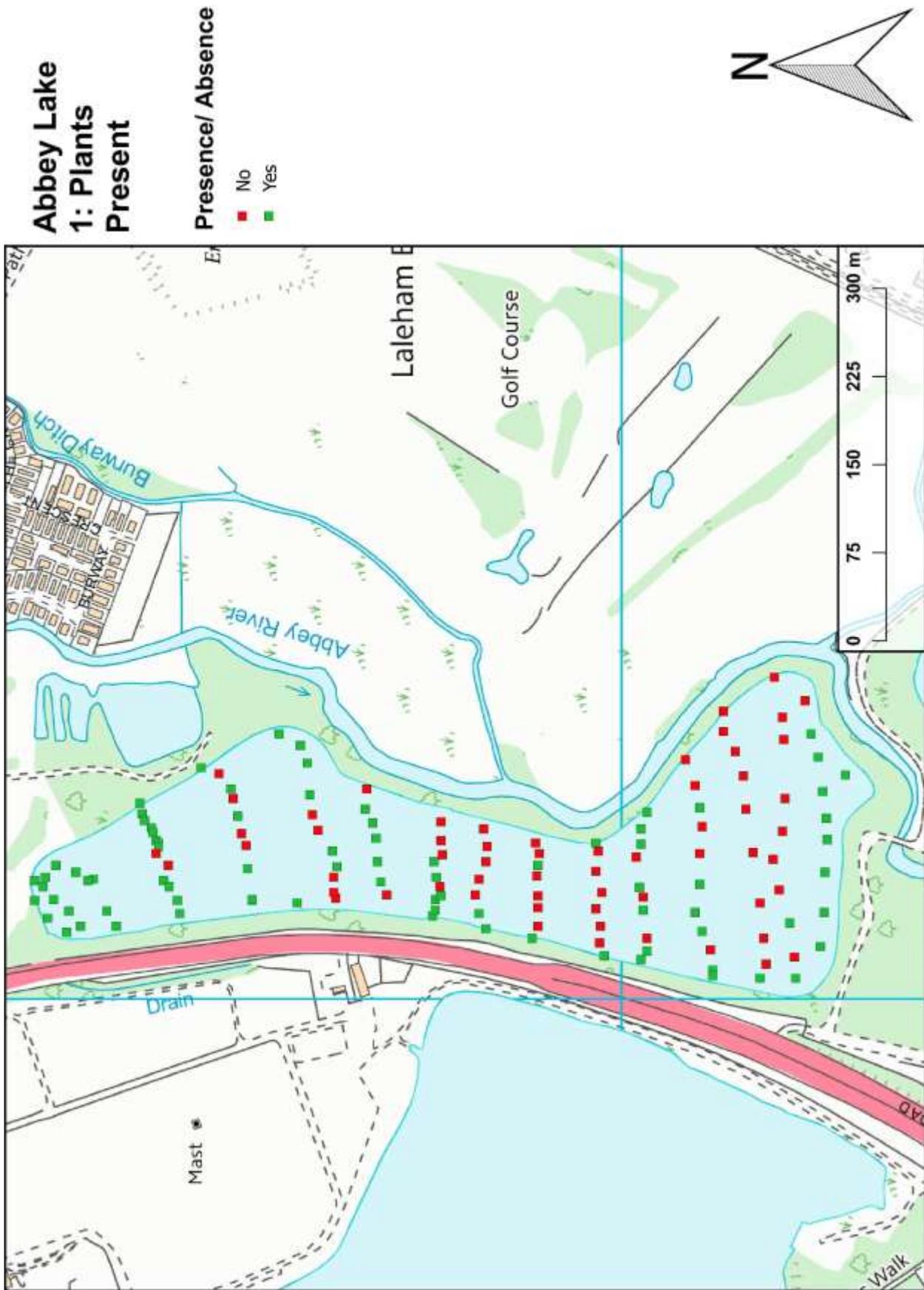


Figure 105 The extent of macrophyte cover at Abbey Lake 1

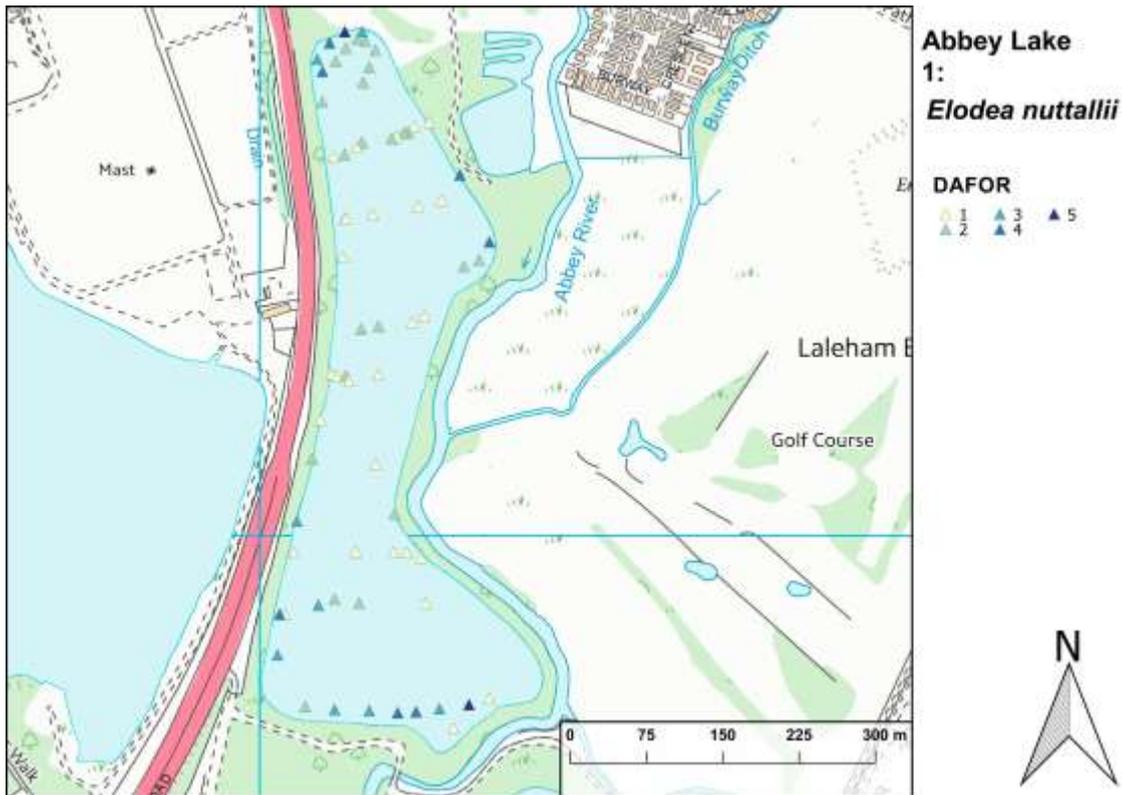


Figure 106 Extent and abundance of *Elodea nuttallii* at Abbey Lake 1.

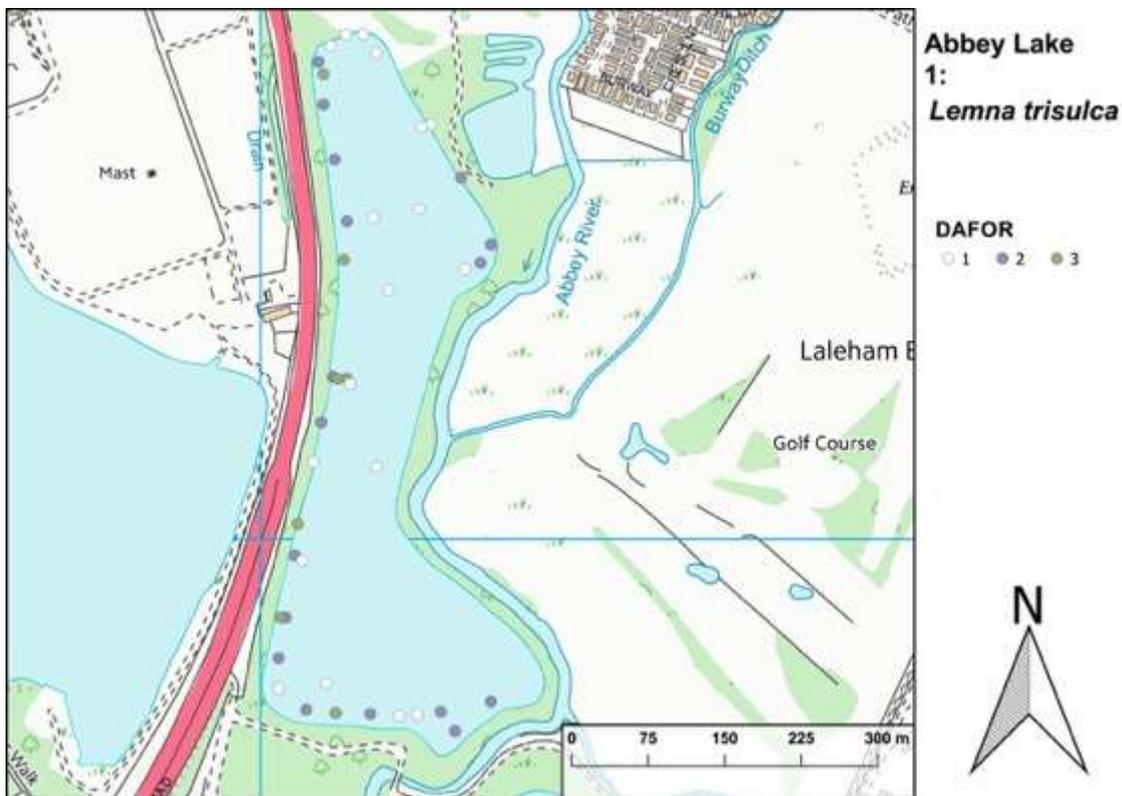


Figure 107 Extent and abundance of *Lemna trisulca* at Abbey Lake 1.

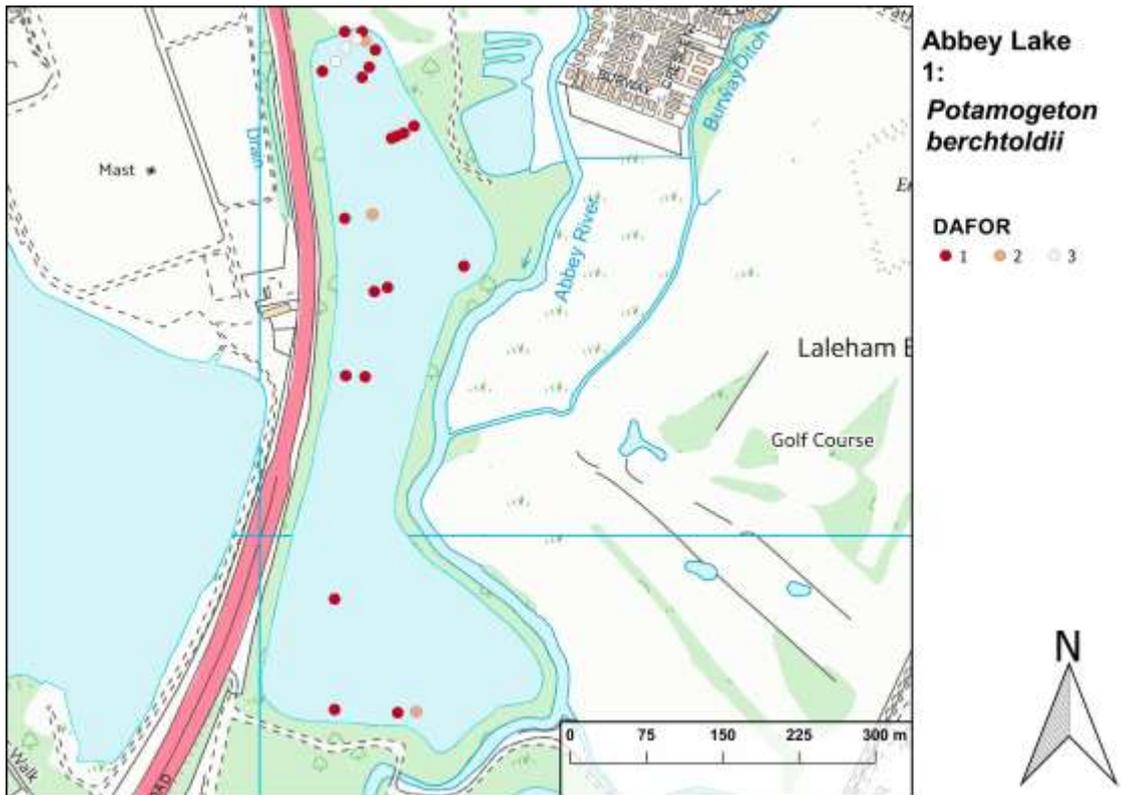


Figure 108 Extent and abundance of *Potamogeton berchtoldii* at Abbey Lake 1.

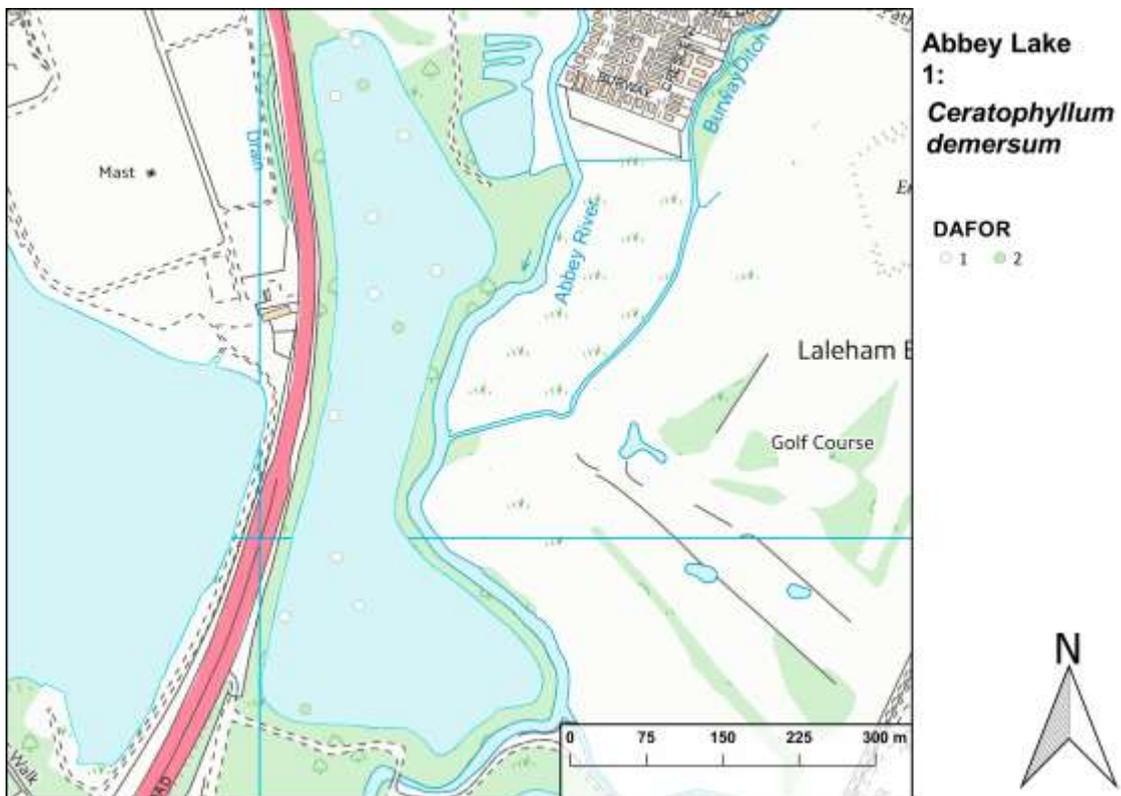


Figure 109 Extent and abundance of *Ceratophyllum demersum* at Abbey Lake 1.

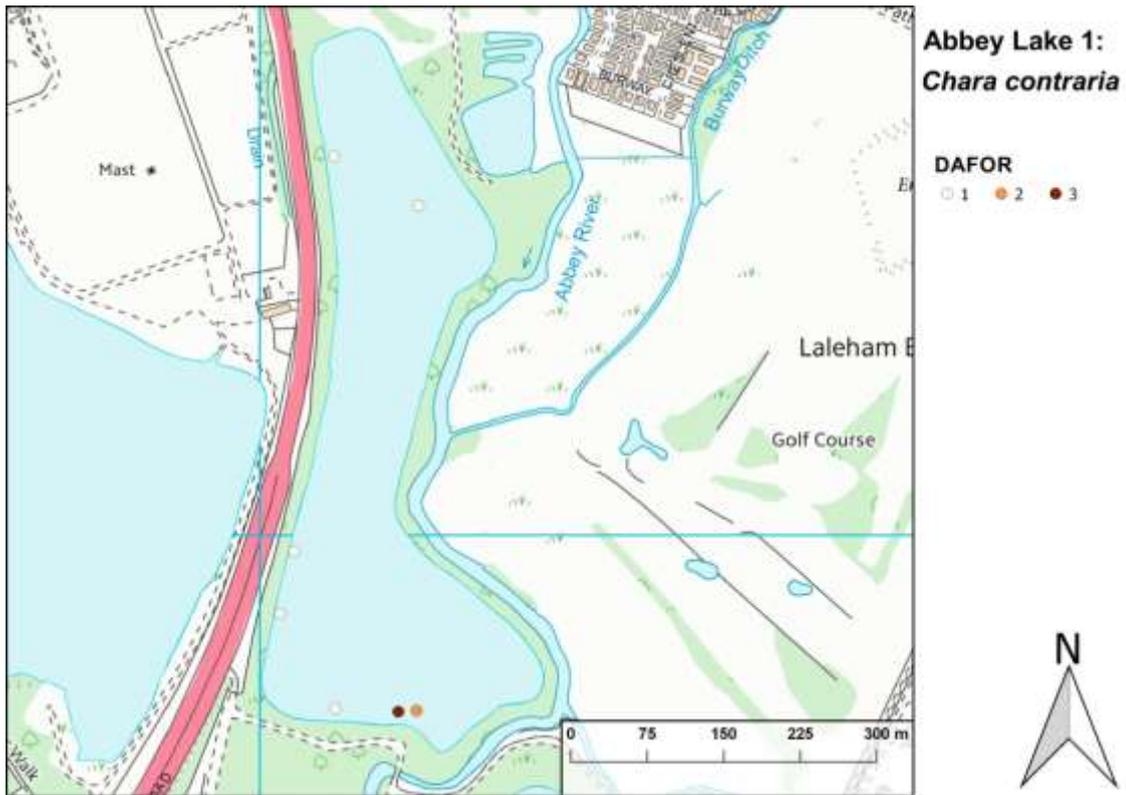


Figure 110 Extent and abundance of *Chara contraria* at Abbey Lake 1.

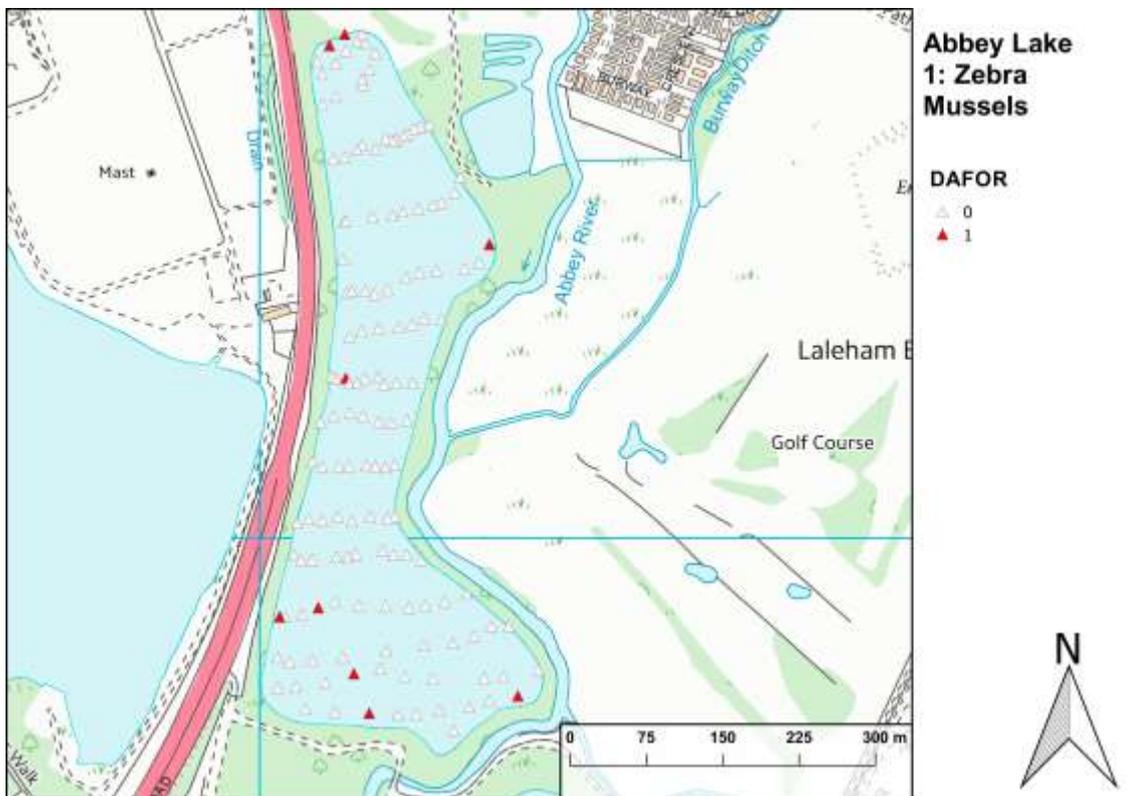


Figure 111 Extent of *Zebra mussels* at Abbey Lake.

3.19. Abbey Lake 2

Survey Date	7 July 2016
Grid reference:	TQ0431767620
OS Grid reference (X,Y):	504317, 167620
Approx. surface area (ha.):	6.3
Maximum recorded depth (m):	6.6
Secchi depth (m)	3.4

Overview

Abbey Lake 2 is southeast of Abbey Lake 1, and although only approximately 60 m apart, they are separated by the Abbey River channel and unlikely therefore to have a direct surface link. The flooded pit is used primarily for angling and has a number of fishing platforms around the shore. The site is surrounded by tall willow and alder and has heavily shaded margins with occasional beds of *Typha angustifolia*.

The margins are steeply shelving around most of the lake to depths in excess of 3 m, with the majority of the open water area ranging in depth from 4 to 5 m, and a maximum recorded depth of 6.6 m at TQ0432667571. The water was relatively clear during the survey, but in contrast to other nearby lakes there were almost no submerged aquatic plants recorded (Figure 113). Zebra mussels were recorded sporadically to a depth of 2.6 m.



Figure 112 Abbey Lake 2

Extent of macrophyte cover

Elodea nuttallii, *Chara contraria* and the moss *Fontinalis antipyretica* were the only submerged species recorded from the site, but only recorded from single locations. The other plant recorded in Figure 113 are for emergent, primarily *Typha angustifolia*.

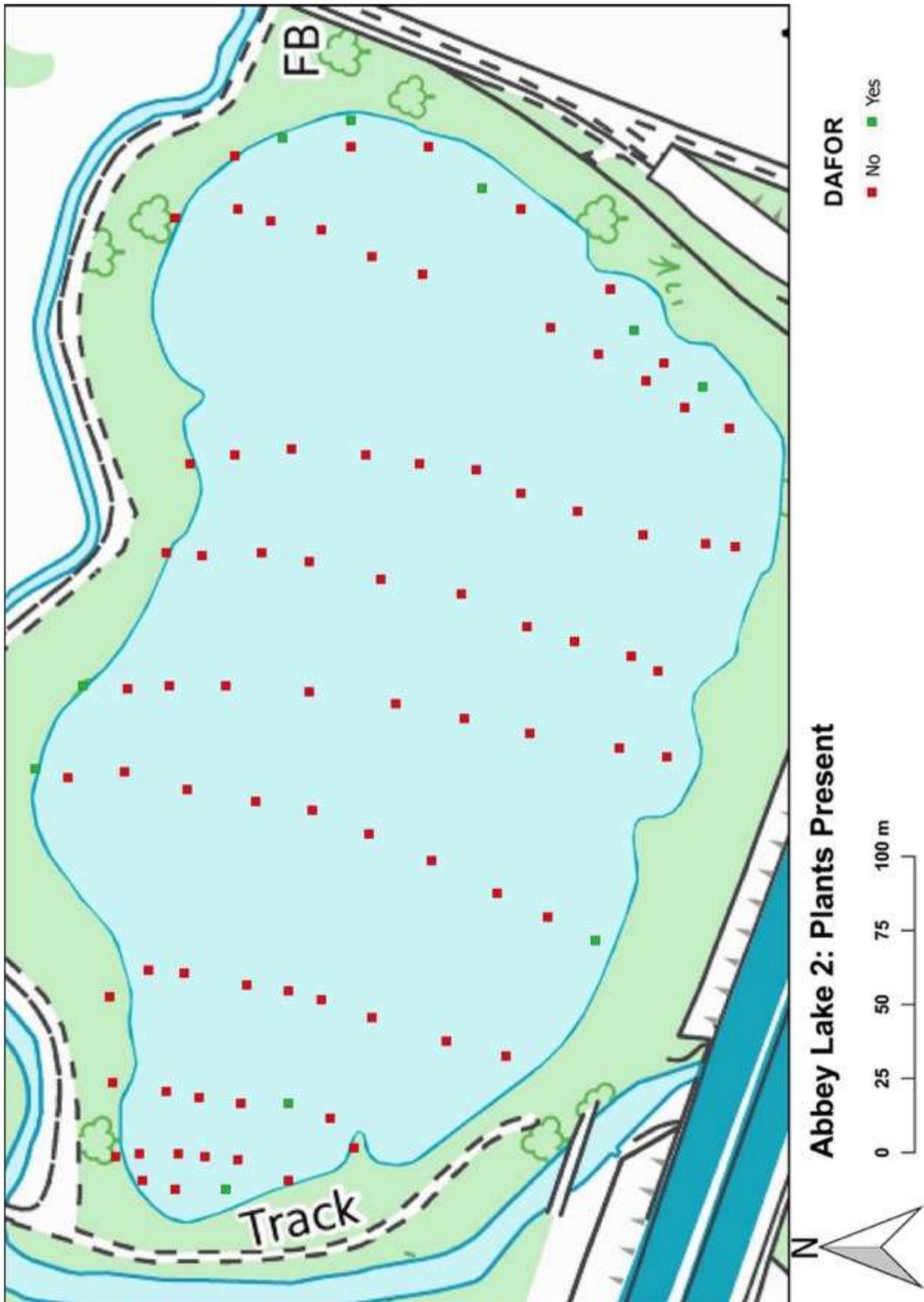


Figure 113 The extent of macrophyte cover at Abbey Lake 2

WFD Survey

Only two submerged or floating macrophyte species were recorded from four survey sections in Abbey Lake 2, and no plants found on the boat transects. *Persicaria amphibia* was most common, but only recorded from 12 points in shallow water. *Elodea nuttallii* and *Chara contraria* were not encountered in the WDF survey.

Emergent vegetation consisting of occasional beds of *Typha angustifolia* was the only notable feature, other species were infrequent and the heavy shading and steep banks limited marginal wetland plants.

A summary of the plant species is given in Table 31 and the LEAFPACS 2 metrics presented in Table 32.

Table 31 Macrophyte summary; Abbey Lake 2

Species	Frequency % (n= 179)	LEAFPACS 2 Cover (%)
Aquatic taxa		
<i>Elodea nuttallii</i>	0.6	
<i>Persicaria amphibia</i>	7.8	1.80
<i>Chara contraria</i>	0.6	
<i>Fontinalis antipyretica</i>	1.7	0.71
Marginal / emergent taxa		
<i>Lycopus europaeus</i>		
<i>Lysimachia vulgaris</i>		
<i>Lythrum salicaria</i>		
<i>Mentha aquatica</i>		
<i>Myosotis scorpioides</i>		
<i>Phragmites australis</i>		
<i>Sparganium erectum</i>		
<i>Typha angustifolia</i>		

Table 32 LEAFPACS 2 metrics applied to Abbey Lake 2.

LEAFPACS metric report				
LMNI	NTAXA	NFG	COV	ALG
6.22	2.0	2.00	1.26	0.0

3.20. Old Littleton Lane Lake

Survey Date	5 July 2016
Grid reference:	TQ0589666948
OS Grid reference (X,Y):	505896, 1669480
Approx. surface area (ha.):	0.3
Maximum recorded depth (m):	6.6

Overview

Old Littleton Lane Lake is a very small water body situated just south of the M3 motorway and has two permanent Traveller sites directly to the north and west. The northern end of the lake had a significant amount of litter and dumped material on the shore and in the water. The majority of the lake is sheltered and under canopy, restricting the growth of submerged macrophytes in the shallower margins. Although an extensive vegetation map was completed for this site, a technical error with the handheld GPS device has rendered creating a species map impossible and therefore a descriptive account is given here using the non-georeferenced survey data.

No zebra mussels were recorded during the survey.



Figure 114 Old Littleton Lane Lake

Extent of macrophyte cover

Ceratophyllum demersum occurred over an extensive area of the lake (recorded at 8% of survey points), often scoring 4 and 5 on the DAFOR scale (abundant and dominant) and growing to a maximum depth of 5.0 m. Only the deepest area of the lake towards the southern end was not populated by this species.

A significant concern was the abundance of the non-native *Lemna minuta*, which covered the majority of the lake (Figure 114). Despite the extent of *L. minuta*, the health and growth of *C. demersum* appeared to be unaffected. *Lemna minor* and *Lemna trisulca* were occasionally recorded among their invasive counterpart species, generally scoring only a “1” on the DAFOR scale. Frogbit (*Hydrocharis morsus-ranae*), which is relatively rare in the

UK was recorded at three locations in the margins along with *Persicaria amphibia*. Filamentous algae was occasional and did not appear to be of major concern.

Overall, the lake exhibited signs of being hyper-eutrophic, dominated only by one submerged macrophyte and one floating species.

A summary of the plant species is given in Table 33.

Table 33 Macrophyte summary; Old Littleton Lane Lake

Species	Frequency % (n= 34)
Aquatic taxa	
<i>Ceratophyllum demersum</i>	88.2
<i>Filamentous algae</i>	14.7
<i>Hydrocharis morsus-ranae</i>	8.8
<i>Lemna minor</i>	47.1
<i>Lemna minuta</i>	100.0
<i>Lemna trisulca</i>	29.4
<i>Persicaria amphibia</i>	11.8
Marginal / emergent taxa	
<i>Carex riparia</i>	
<i>Sparganium erectum</i>	

3.21. Littleton East

Survey Date	10 August 2016
Grid reference:	TQ0645367617
OS Grid reference (X,Y):	506453,167617
Approx. surface area (ha.):	39.4
Maximum recorded depth (m):	7.2
Secchi depth (m)	1.9

Overview

Littleton East is host to a regularly used sailing club, situated on the southwest side of the lake. The northern shore is populated by residential development, where gardens extend close to the water's edge and so have consequently altered the expected marginal vegetation.

The morphology of the lake was more complex than many other of the lakes surveyed. The west side of the site was characterised by steeply shelving margins to depths of 4 to 7 m. The north end of the site had more gently sloping margins with much of the open water between 1 and 4 m deep. A very shallow area extended from the centre of the lake to the southeast, ranging from less than 1 m to 2 m, and sloping gently to shore. The south and southwest bays were again deeper (mostly 4 to 5 m).



Figure 115 Littleton East – west shore.

Extent of macrophyte cover

Submerged vegetation was observed throughout the majority of the lake, except within a corridor which extended from the southwest the northeast shore, where depths were too great for plant growth (Figure 116). *Elodea nuttallii* was growing most extensively across the site (Figure 117), recorded at the majority of survey points and averaging a DAFOR value of “3”, occurring frequently. Two species of *Chara* were also recorded, mostly in the shallower areas of the site, and locally very abundant forming *Chara* “lawns” (Figure 118 and Figure 119). Both *M. spicatum* and *C. demersum* were recorded sporadically,

occurring within small regions of the site. Notably, the nationally rare stonewort, *Nitellopsis obtusa* was also recorded quite widely within the site (Figure 120), adding to the importance of these sites for this species. Filamentous algae was locally abundant and widespread throughout the site.

Zebra mussels were present within the lake margins (Figure 121).

Table 34 Macrophyte summary; Littleton East.

Species	Frequency % (n= 321)	LEAFPACS 2 Cover (%)
Aquatic taxa		
<i>Elodea nuttallii</i>	57.9	15.88
<i>Myriophyllum spicatum</i>	5.3	2.14
<i>Ceratophyllum demersum</i>	9.0	1.55
<i>Chara contraria</i> (and vars.)	22.7	13.6
<i>Nitellopsis obtusa</i>	6.9	3.04
<i>Potamogeton pusillus</i>	0.6	0.36
<i>Potamogeton trichoides</i>	1.9	-
<i>Ranunculus circinatus</i>	0.6	-
Marginal / emergent taxa		
<i>Alnus glutinosa</i>		
<i>Buddleja davidii</i>		
<i>Epilobium hirsutum</i>		
<i>Epilobium palustre</i>		
<i>Eupatorium cannabinum</i>		
<i>Lycopus europaeus</i>		
<i>Lysimachia vulgaris</i>		
<i>Lythrum salicaria</i>		
<i>Phragmites australis</i>		
<i>Salix sp.</i>		
<i>Scutellaria galericulata</i>		
<i>Solanum dulcamara</i>		
<i>Sparganium erectum</i>		
<i>Stachys palustris</i>		

WFD Survey

Seven submerged and floating macrophytes were recorded, inclusive of filamentous algae. *Elodea nuttallii* and *Chara* species were recorded with highest cover, at 15.9% and 13.6%. Marginal vegetation was mostly consisted of generalist species, with exception to the northern and eastern shore where *Phragmites australis* was also recorded (see Table 34 of species recorded). A summary of LEAFPACS 2 metrics is given in Table 35.

Table 35 LEAFPACS 2 metrics applied to Littleton East

LEAFPACS metric report				
LMNI	NTAXA	NFG	COV	ALG
6.46	6.0	4.00	7.24	0.28

Littleton East: Plants Present

Presence/ Absence

- No
- Yes

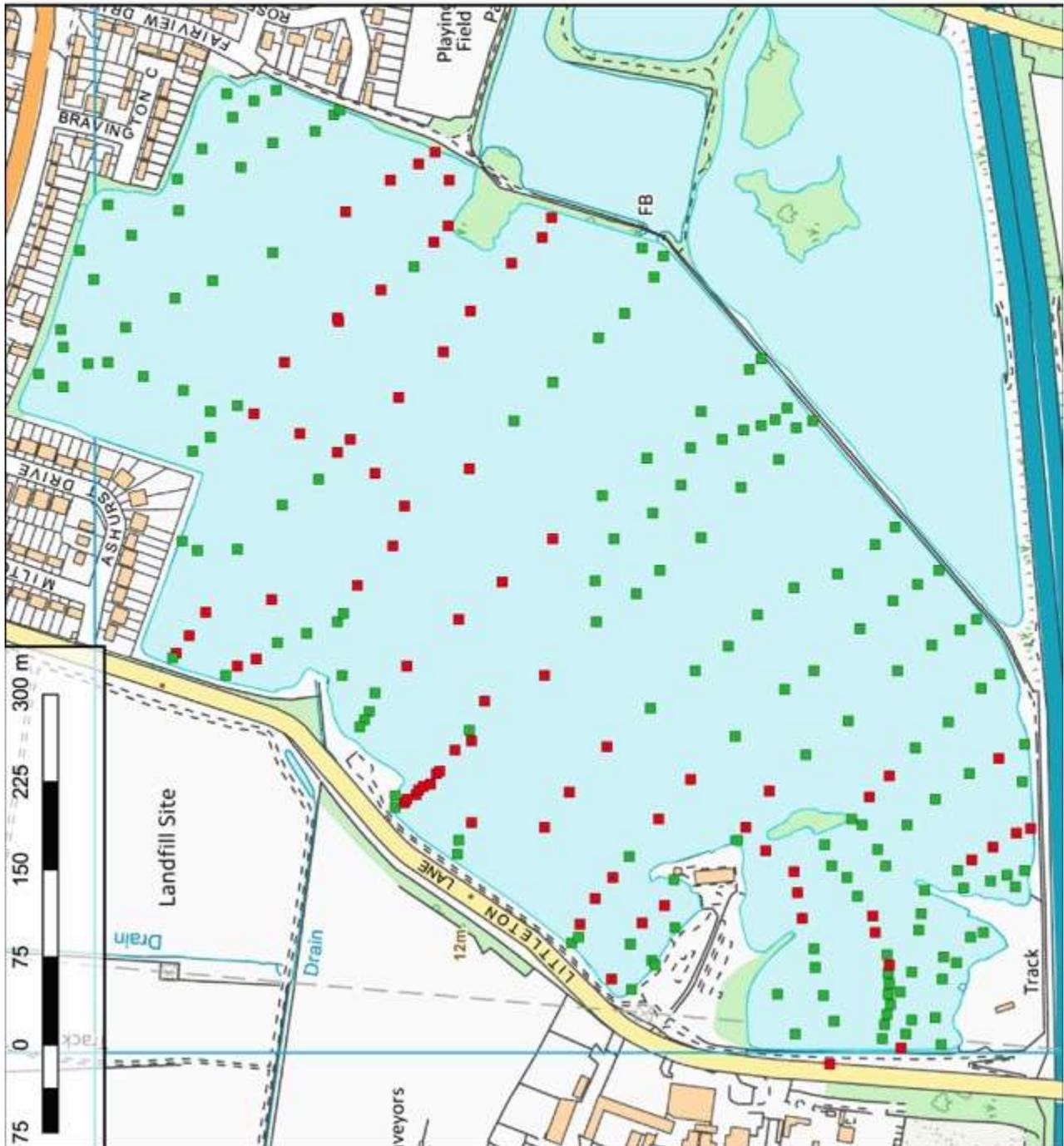
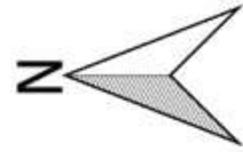
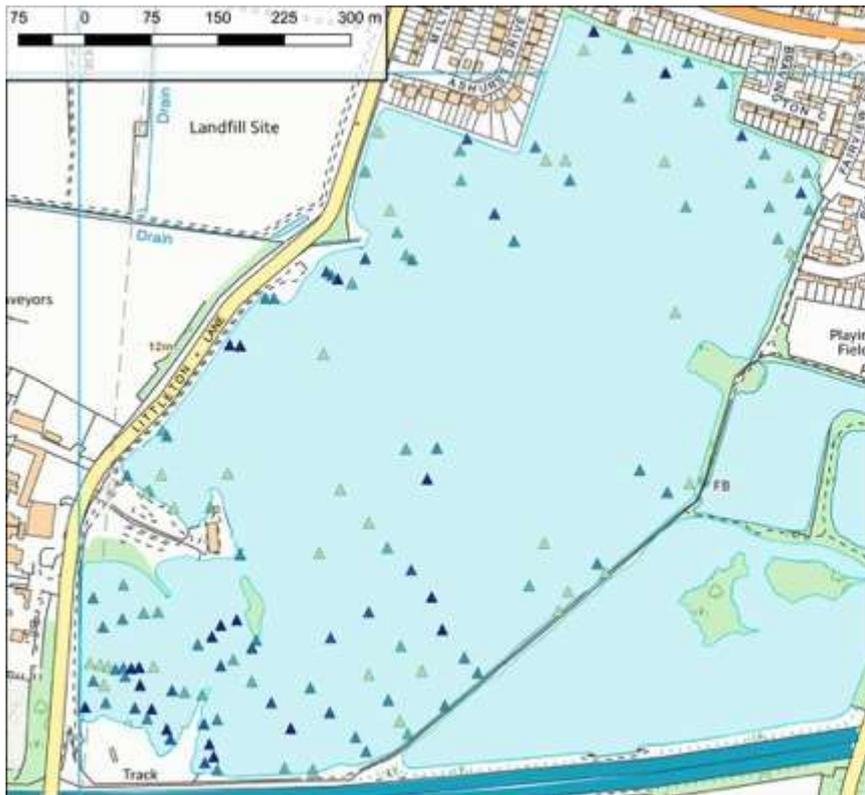


Figure 116 The extent of macrophyte cover at Littleton East



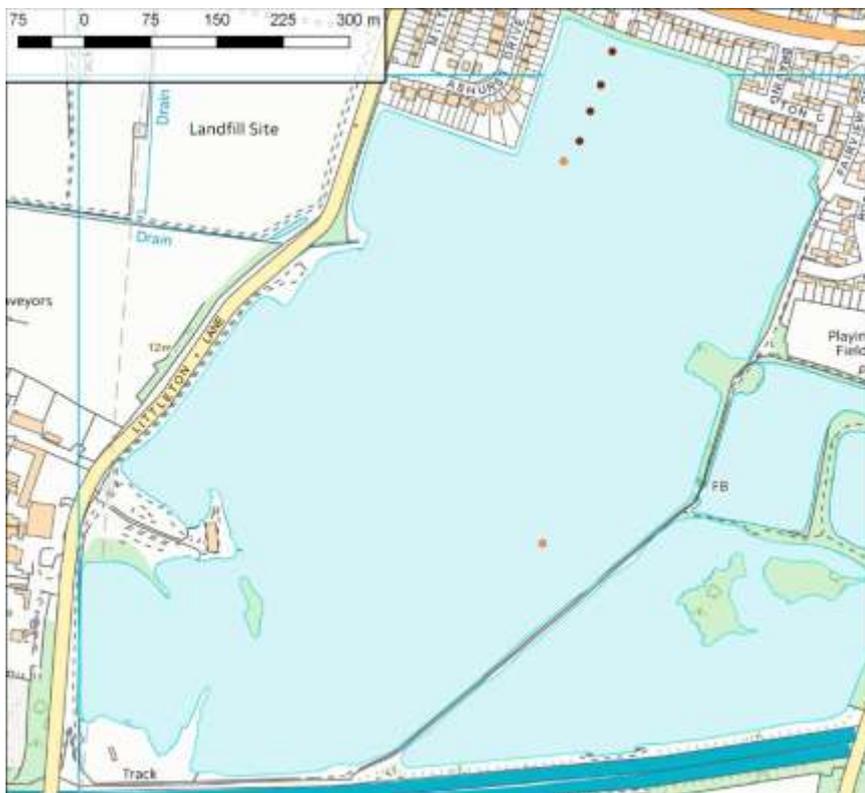
**Littleton East:
*Elodea nuttallii***

DAFOR

- ▲ 1 ▲ 3 ▲ 5
- ▲ 2 ▲ 4



Figure 117 Extent and abundance of *Elodea nuttallii* at Littleton East



**Littleton East:
Chara contraria
*var. hispidula***

DAFOR

- 3 ● 5



Figure 118 Extent and abundance of *Chara contraria* var. *hispidula* at Littleton East.

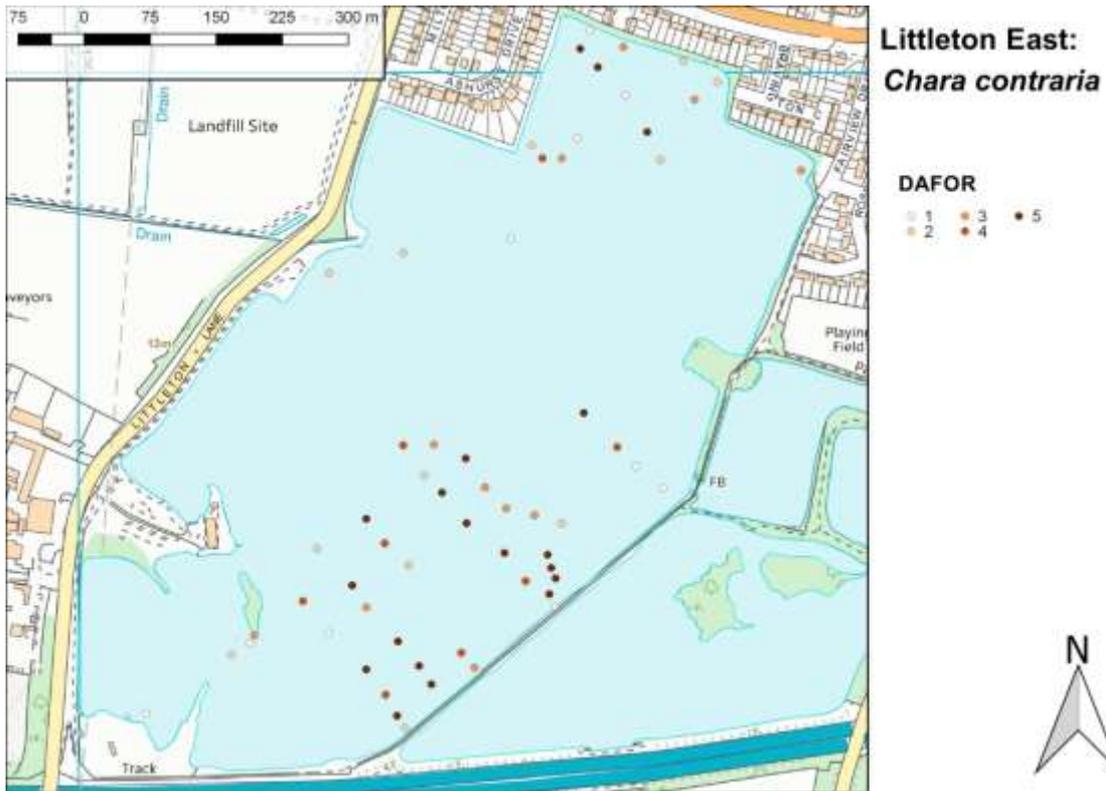


Figure 119 Extent and abundance of *Chara contraria* at Littleton East.

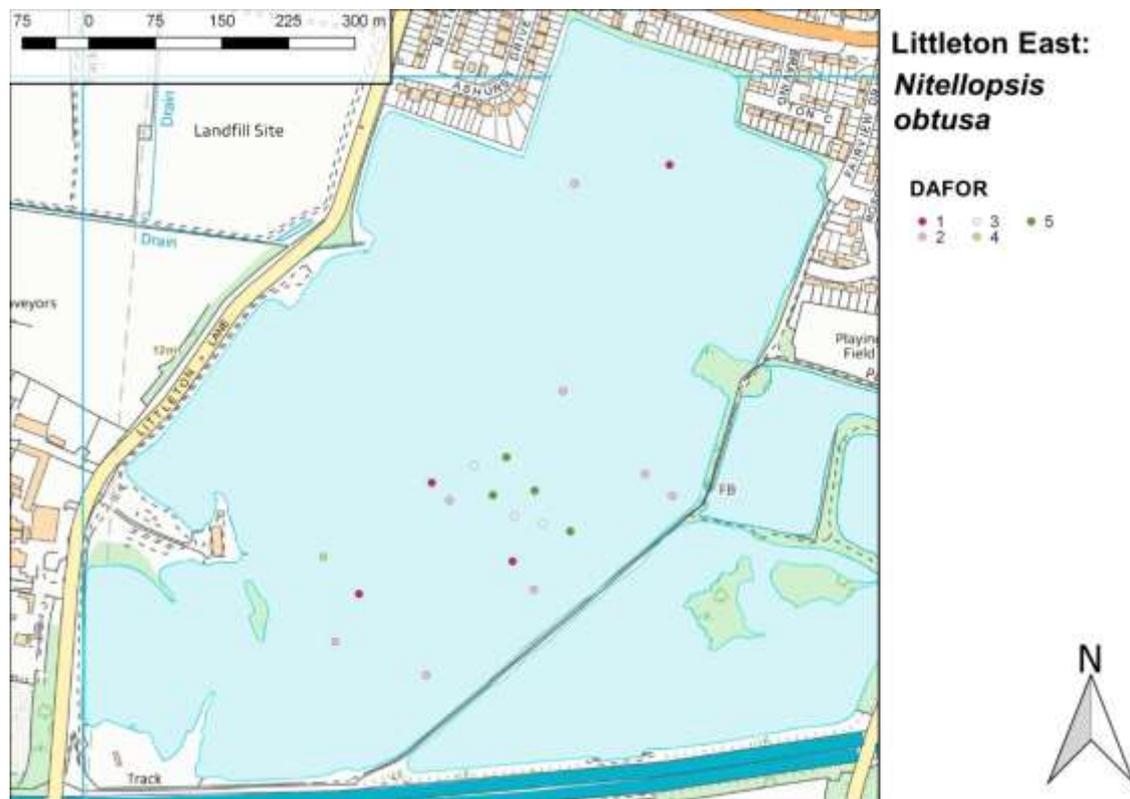
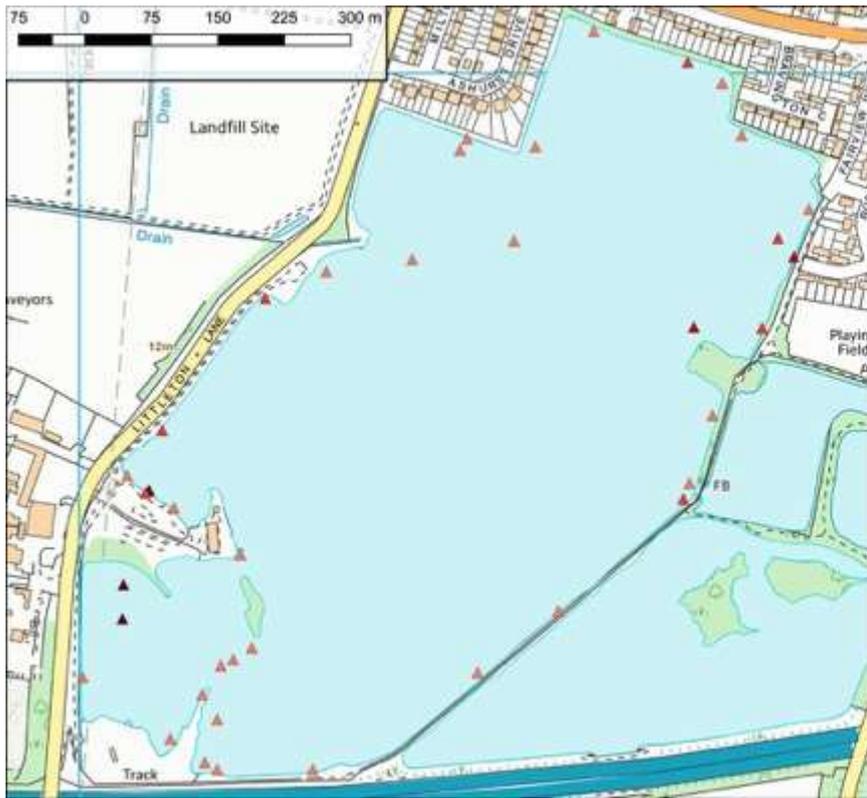


Figure 120 Extent and abundance of *Nitellopsis obtusa* at Littleton East.



**Littleton East:
Zebra Mussels**

DAFOR

- ▲ 1
- ▲ 2
- ▲ 3
- ▲ Present



Figure 121 Extent of *Zebra mussels* at Littleton East.

3.22. Sheepwalk East

Survey Date	11 August 2016
Grid reference:	TQ0712567426
OS Grid reference (X,Y):	507125, 167426
Approx. surface area (ha.):	5.07
Maximum recorded depth (m):	9.3

Overview

Sheepwalk East is located close to residential areas and the paths around the lake are popular for recreation. Litter and dumping of rubbish is a problem around the site. Aquatic plants were widespread in the site to a maximum depth of 7.0 m, with only a small area of the lake being deeper than this in the southerly basin where it reached a maximum depth of 9.3 metres, where no plants were present (Figure 123). No zebra mussels were seen during the survey.



Figure 122 Sheepwalk East (Imagery © 2016 Getmapping PLC from Google).

Extent of macrophyte cover

The site was species poor and dominated by *Elodea nuttallii* (Figure 124). *Chara contraria* was the only other common species forming a substantial stand in the centre of the lake where depths were between approximately 4 – 5 metres (Figure 125). A small patch of *Nymphaea alba* and *Persicaria amphibia* was recorded growing at the far western end, close to the shore margins, beyond which it was too deep for plants to colonise. *Ceratophyllum demersum* was recorded as rare in the site. Notably, *Tolypella* was recorded at one point, towards the deepest zone of the lake, at 6.8 m (Figure 126). This specimen was relatively fine in structure and therefore towards *T. intricata*, but ecologically, growing where one would expect *T. prolifera*. Nick Stewart (BSIS stonewort recorder) has suggested it is most likely *T. prolifera*, but will seek a second opinion.

WFD Survey

Five submerged/ floating macrophytes were recorded. The dominance by *E. nuttallii* was reflected on the WFD survey, where water body cover totalled 42.3%. *Chara contraria* scored fairly high in cover, with 10.9%. Marginal vegetation was limited mainly to generalist taxa. A summary of the species is given in Table 36 and the LEAFPACS 2 metrics in Table 37.

Table 36 Macrophyte summary; Sheepwalk East.

Species	Frequency % (n= 321)	LEAFPACS 2 Cover (%)
Aquatic taxa		
<i>Ceratophyllum demersum</i>	2.0	0.63
<i>Chara contraria</i>	14.8	10.85
<i>Elodea nuttallii</i>	57.7	42.31
Filamentous algae		1.71
<i>Nymphaea alba</i>	2.7	-
<i>Persicaria amphibia</i>	2.0	3.41
<i>Tolypella cf. prolifera</i>		
Marginal / emergent taxa		
<i>Alnus glutinosa</i>		
<i>Buddleja davidii</i>		
<i>Epilobium hirsutum</i>		
<i>Lycopus europeus</i>		
<i>Lythrum salicaria</i>		
<i>Mentha sp.</i>		
<i>Persicaria amphibia</i>		
<i>Phragmites australis</i>		
<i>Salix sp.</i>		
<i>Tussilago farfara</i>		
<i>Typha latifolia</i>		
<i>Ulex europeus</i>		

Table 37 LEAFPACS 2 metrics applied to Sheepwalk East

LEAFPACS metric report				
LMNI	NTAXA	NFG	COV	ALG
6.94	5.0	3.00	11.78	0.3

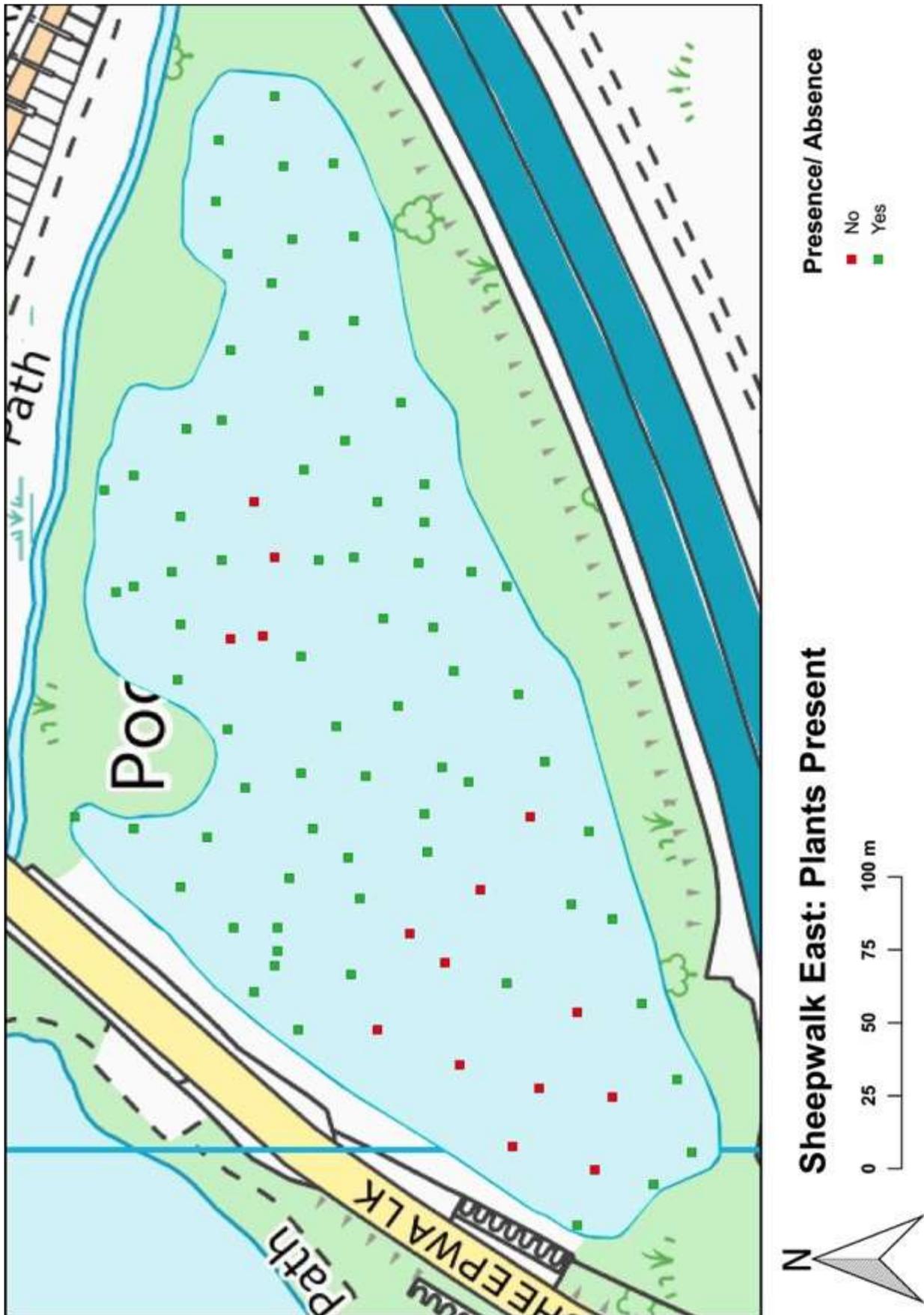


Figure 123 The extent of macrophyte cover at Sheepwalk East

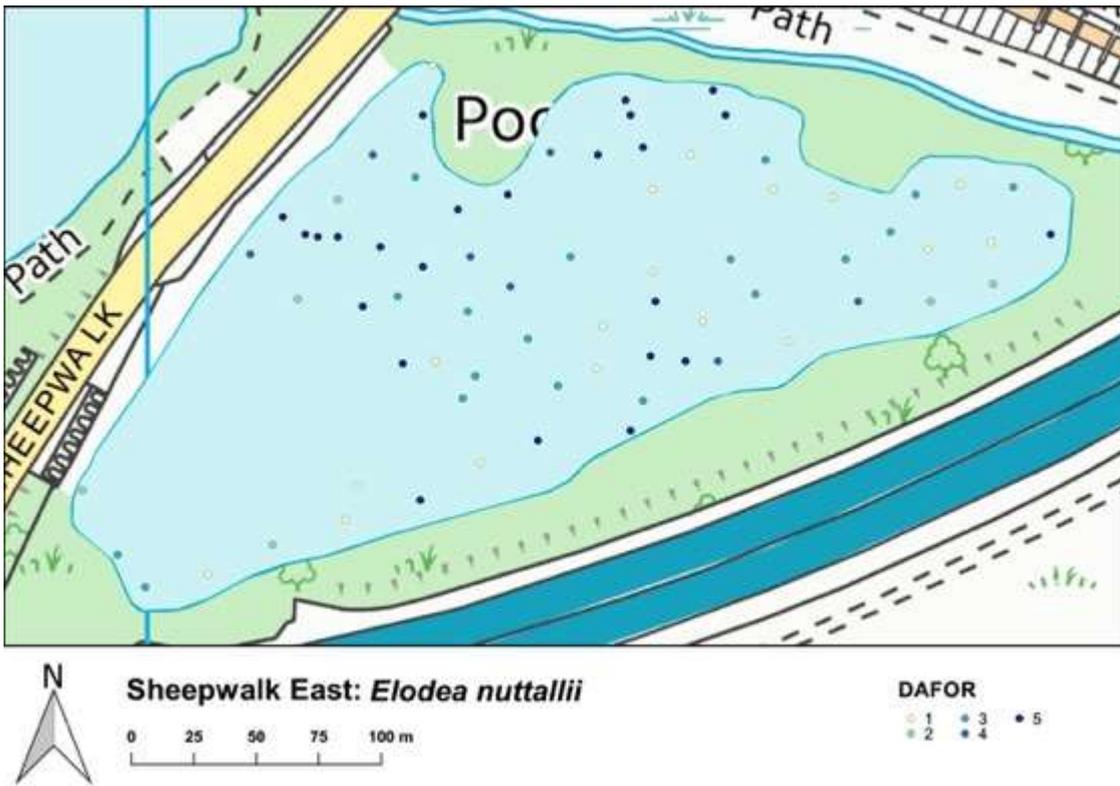


Figure 124 Extent and abundance of *Elodea nuttallii* at Sheepwalk East.

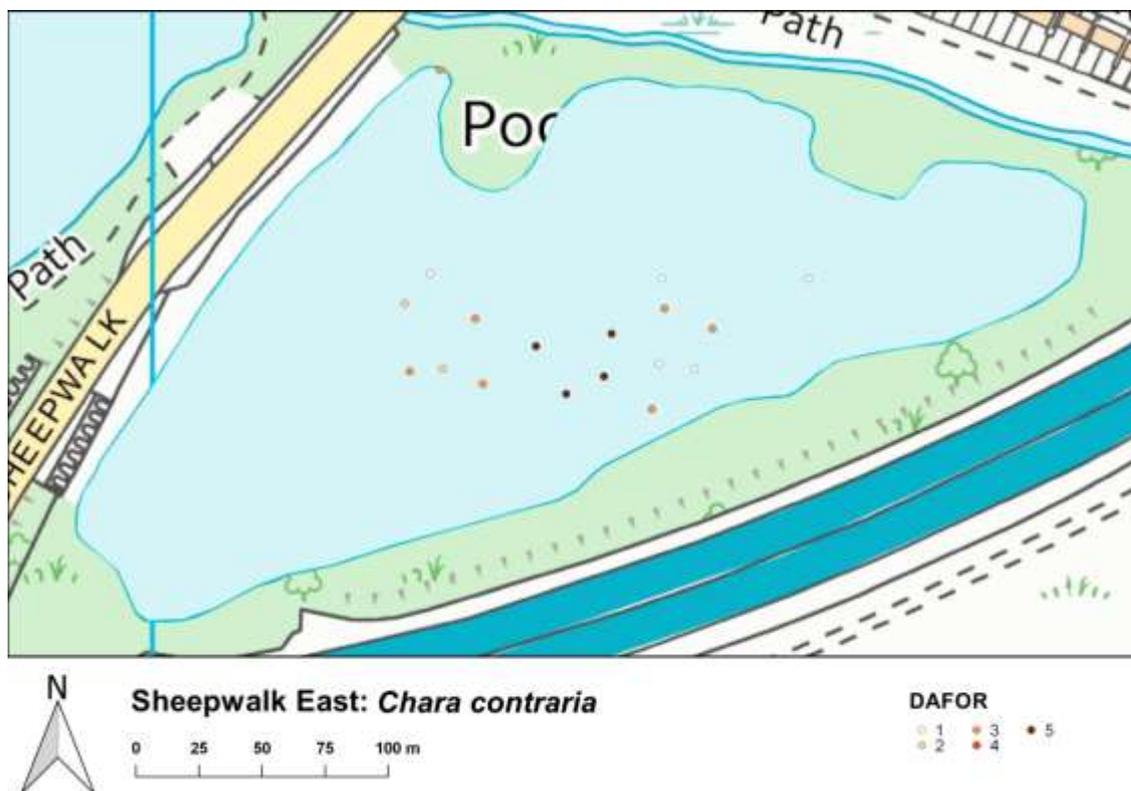


Figure 125 Extent of *Chara contraria* at Sheepwalk East.

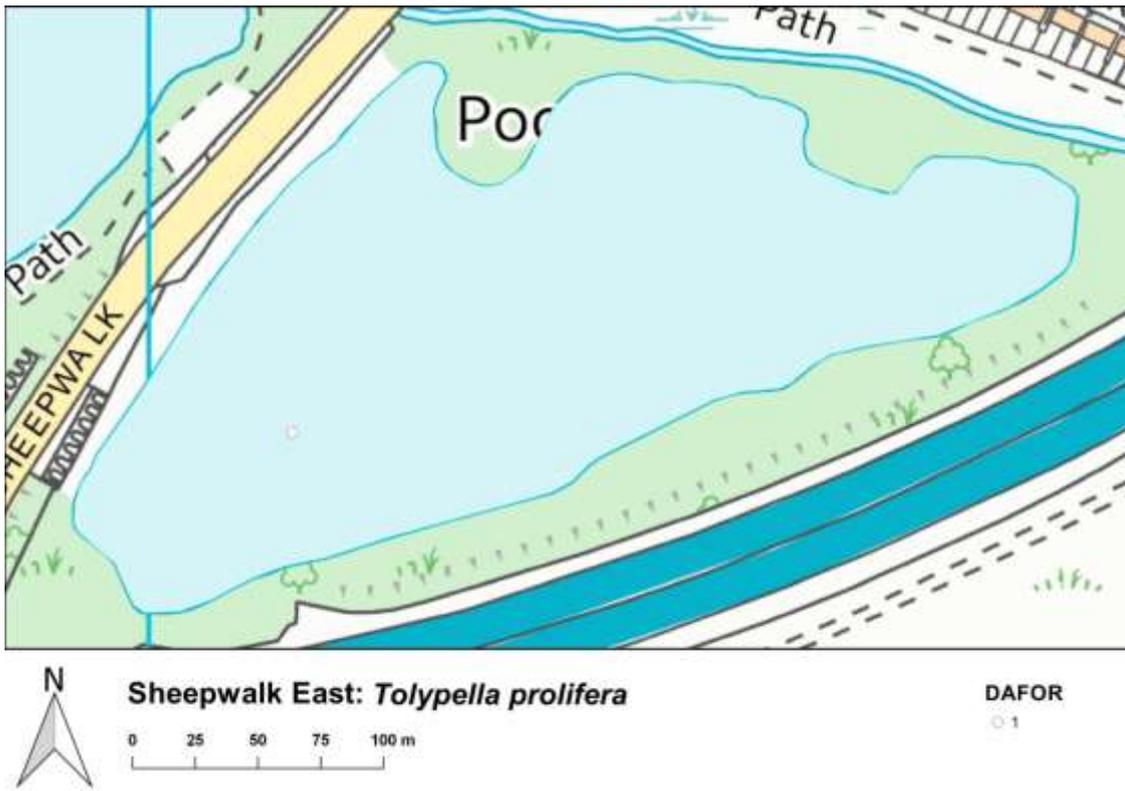


Figure 126 Extent of *Tolypella cf. prolifera* at Sheepwalk East.

3.23. Sheepwalk West 2

Survey Date	7 July 2016
Grid reference:	TQ0666667334
OS Grid reference (X,Y):	506666, 167334
Approx. surface area (ha.):	8.2
Maximum recorded depth (m):	8.9
Secchi depth (m)	2.7

Overview

Sheepwalk West 2 is a popular lake for fishing. Although mostly devoid of any aquatic plants, there are two small islands close to the north shore, which have created a shallower corridor where submerged plants occur. The majority of plants recorded on this survey were located within this region growing at depths of less than 3.5 m. The open water areas were mainly in excess of 5 m and without plants (Figure 128). Water clarity was high; a secchi reading measured 2.7 m depth. No zebra mussels were recorded.

Survey time was limited due to problems with permissions and access. The time was used to complete a full vegetation map of the site, but did not allow for the WFD survey to be undertaken.



Figure 127 Sheepwalk West 2.

Extent of macrophyte cover

The most frequent species recorded was *Elodea nuttallii*, which occurred at the far western end of the lake and most commonly within the shallow corridor of water towards the northern shore (Figure 129). On average, it scored a “3” on the DAFOR scale (frequent) but there were localised areas where it was dominant and inhibited growth of any other species. *Ceratophyllum demersum* (Figure 130), *Potamogeton crispus* and *Potamogeton pusillus* were also recorded growing within this area of the lake, but were rare. There was a small patch of *Nymphaea alba* towards the north-eastern shore.

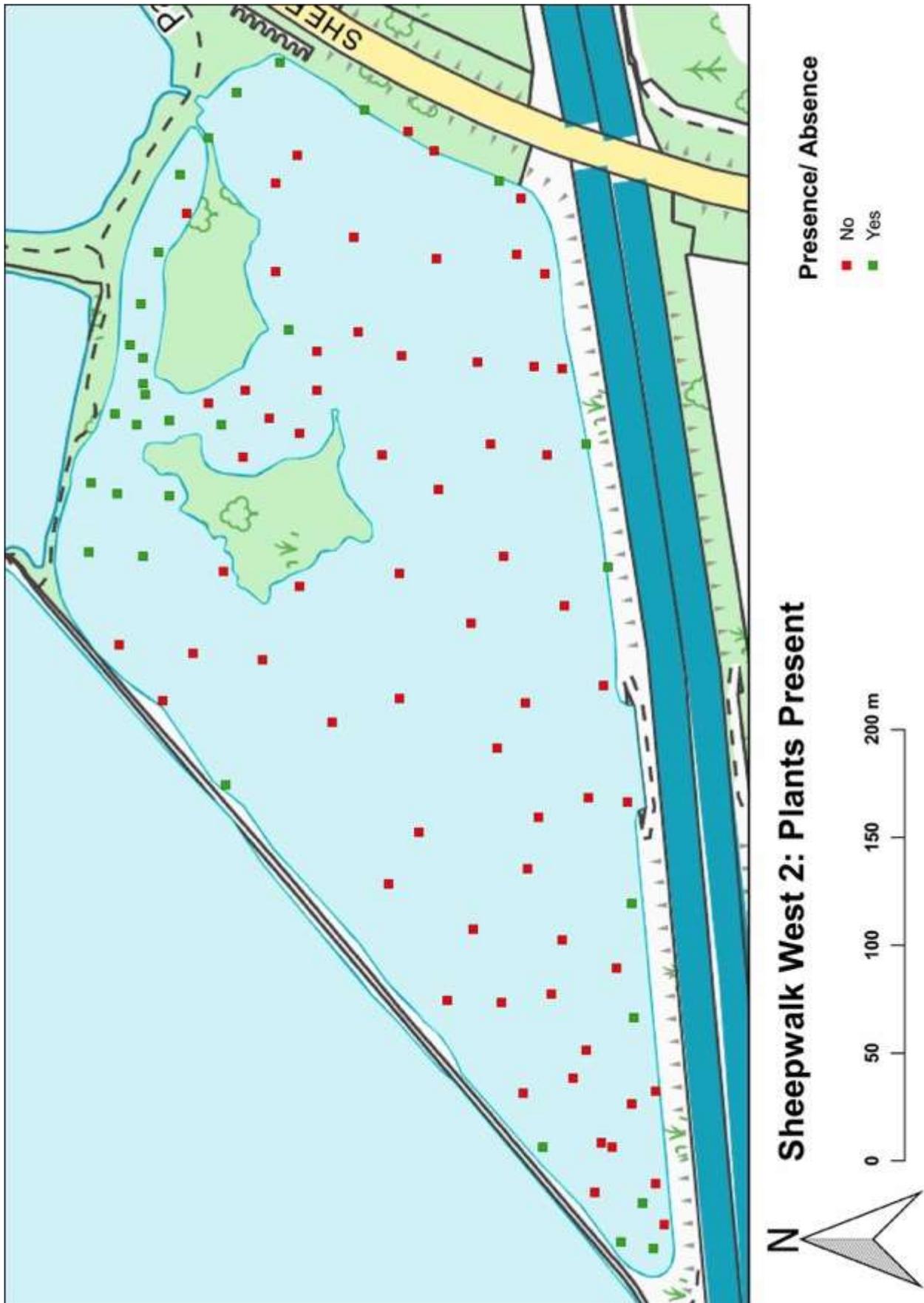


Figure 128 The extent of macrophyte cover at Sheepwalk West 2

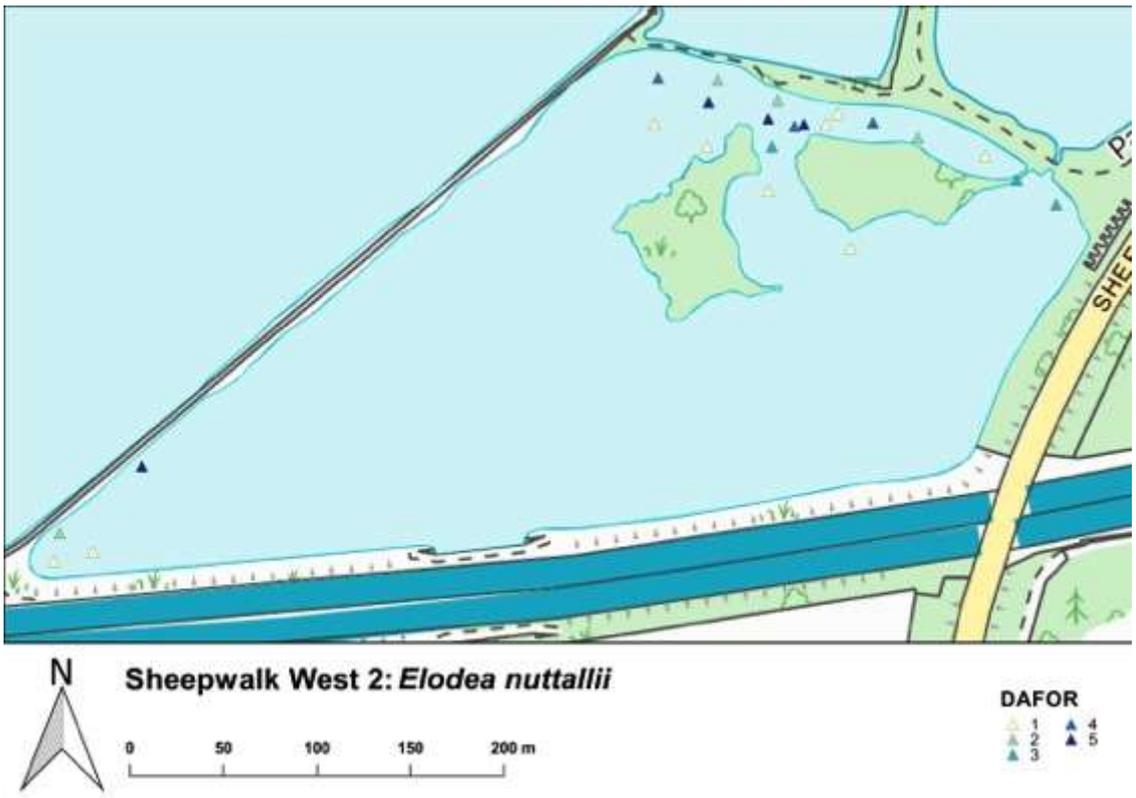


Figure 129 Extent and abundance of *Elodea nuttallii* at Sheepwalk West 2.

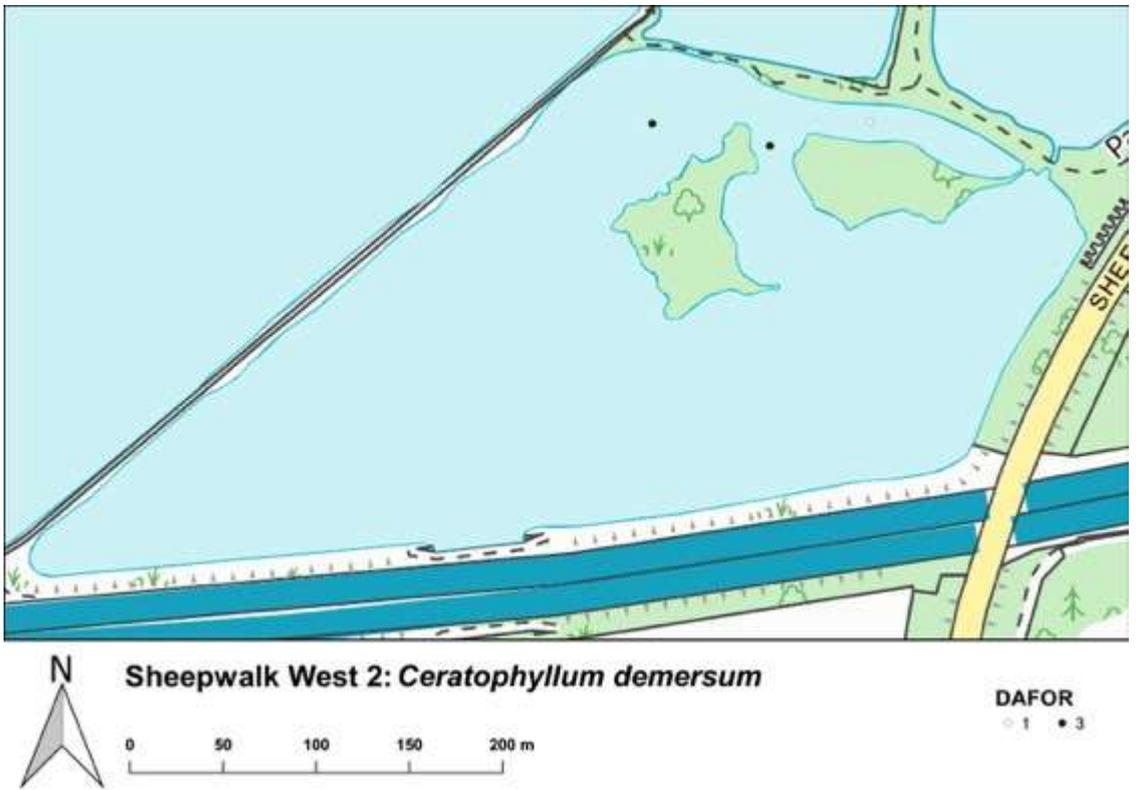


Figure 130 Extent and abundance of *Ceratophyllum demersum* at Sheepwalk West 2.

3.24. Ferry Lane West 2

Survey Date	11 July 2016
Grid reference:	TQ0731966459
OS Grid reference (X,Y):	507319, 166459
Approx. surface area (ha.):	<1
Maximum recorded depth (m):	3.2

Overview

Ferry Lane West 2 is a very small body of water surrounded by broadleaf woodland, and sparse emergent vegetation on the east and west shore. Boat access to the site was hindered by very dense vegetation and a full map was not undertaken. Instead, a single transect was undertaken from north to south and the rest of the site observed from the margins. The water was very clear and aquatic plants present throughout the site.



Figure 131 Ferry Lane West 2 (Imagery © 2016 Getmapping PLC from Google).

Extent of macrophyte cover

Ceratophyllum demersum dominated the site throughout the entire basin, forming a very dense macrophyte bed. *Lemna minor* and *L. trisulca* were common in the margins and both occasional in open water. There was a small bed of *Persicaria amphibia* on the east shore. No other submerged or floating leaved aquatic macrophytes were recorded. There was a narrow band of emergent reed (*Phragmites australis*) on the west and northeast shores and *Typha latifolia* on the southeast shore. The east shore was less shaded and had a number of wetland plants on the shore (Table 38).

Table 38 Macrophyte summary; Ferry Lane West 2.

Species	Estimated cover (%)
Aquatic taxa	
<i>Ceratophyllum demersum</i>	95
<i>Lemna minor</i>	2
<i>Lemna trisulca</i>	5
<i>Persicaria amphibia</i>	2
Marginal / emergent taxa	
<i>Epilobium hirsutum</i>	
<i>Equisetum palustre</i>	
<i>Lycopus europaeus</i>	
<i>Lythrum salicaria</i>	
<i>Mentha aquatica</i>	
<i>Phragmites australis</i>	
<i>Typha latifolia</i>	

3.25. Ferry Lane West 3

Survey Date	09 August 2016
Grid reference:	TQ0733966335
OS Grid reference (X,Y):	507339, 166335
Approx. surface area (ha.):	<1
Maximum recorded depth (m):	4.3

Overview

Ferry Lane West 3 is a very small site lying within a privately owned residential property. The site is surrounded by large willows and broadleaf woodland and the majority of the littoral zone is under canopy and heavily shaded. The margins shelve steeply around most of the site and the water was turbid and mostly without aquatic plants. A number of large fish (carp) were seen during the survey.



Figure 132 Ferry Lane West 3. South end, looking north.

Extent of macrophyte cover

The presence of macrophytes was minimal due to heavy shading by overhanging trees (Figure 133). *Potamogeton berchtoldii* was recorded at highest frequency, but at low abundance and confined to shallow water towards the eastern shore (Figure 134). *Chara globularis* was observed at two points, each scoring “1” in abundance (Figure 135). A small stand of *Nymphaea alba* was recorded on the southern side (presumably planted). *Persicaria amphibia*, *Elodea nuttallii* and *Lemna trisulca* were also present at the site at very low frequency (Table 39).

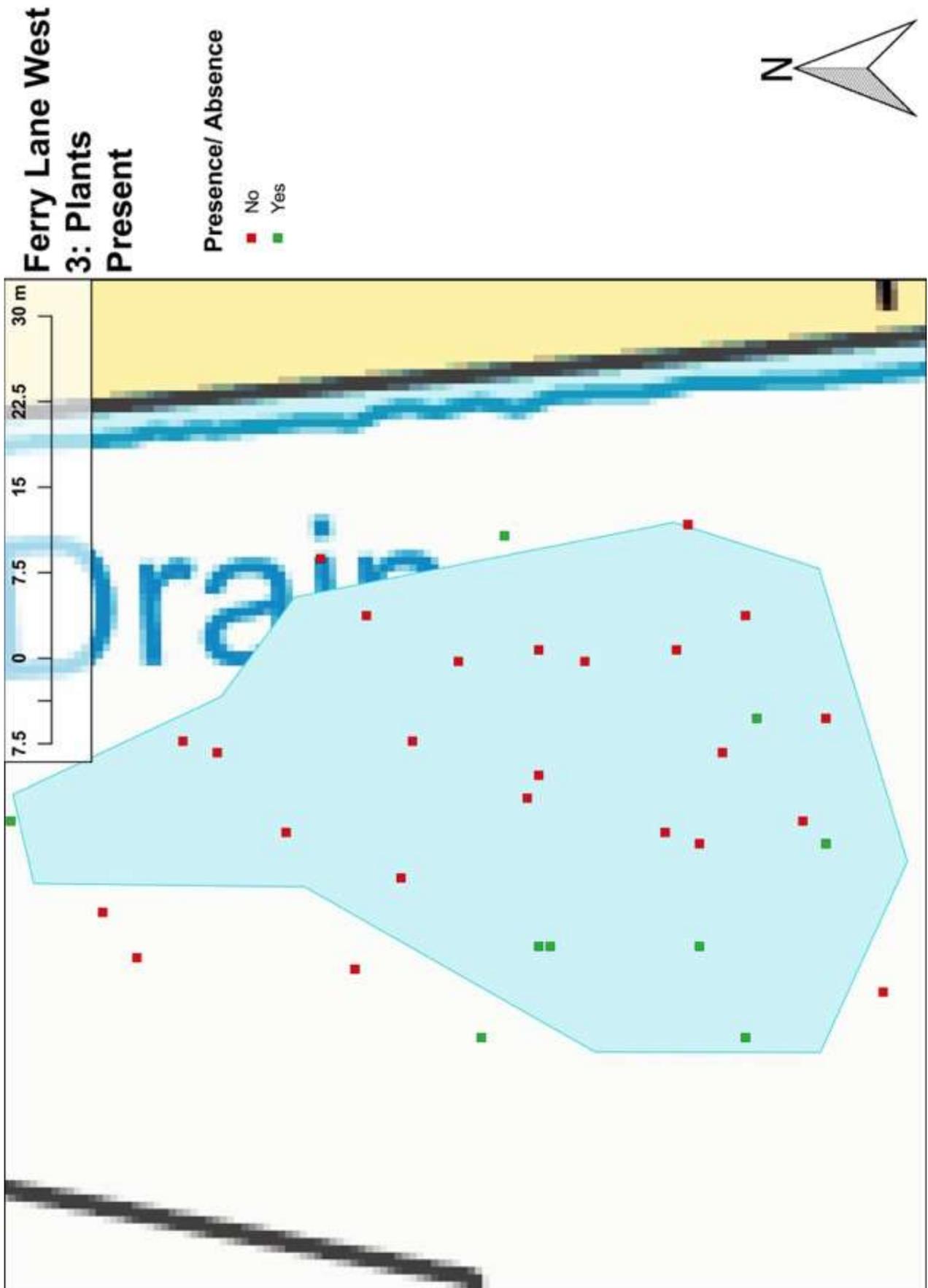


Figure 133 The extent of macrophyte cover at Ferry Lane West 3

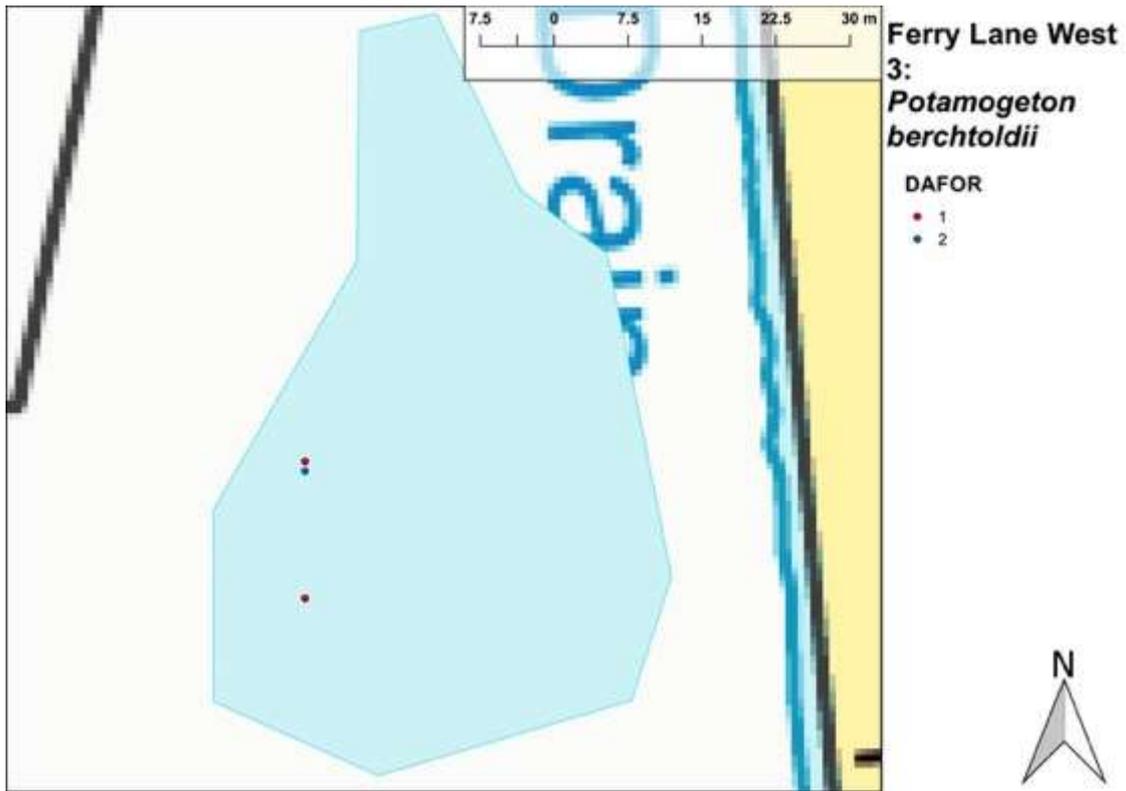


Figure 134 Extent and abundance of *Potamogeton berchtoldii* at Ferry Lane West 3.

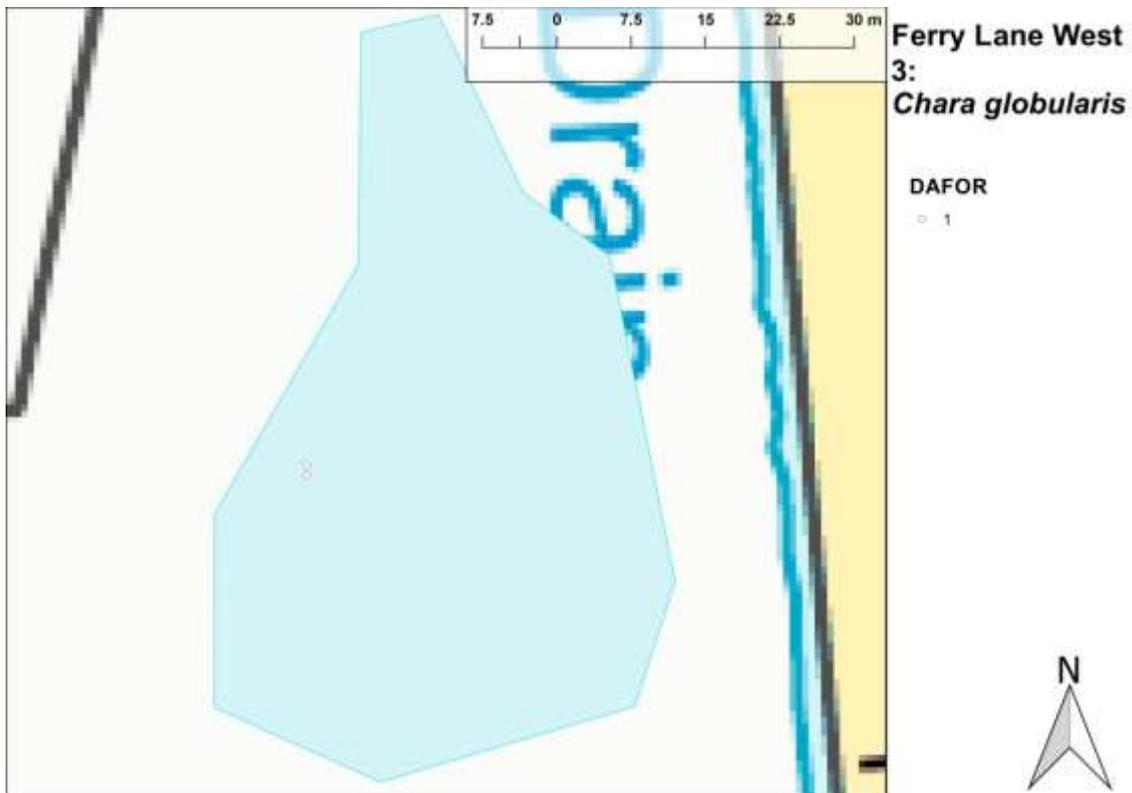


Figure 135 Extent and abundance of *Chara globularis* at Ferry Lane West 3.

Table 39 Macrophyte summary; Ferry Lane West 3.

Species	Frequency % (n= 37)
Aquatic taxa	
<i>Chara globularis</i>	5.4
<i>Elodea nuttallii</i>	2.7
<i>Lemna trisulca</i>	21.6
<i>Nymphaea alba</i>	2.7
<i>Persicaria amphibia</i>	2.7
<i>Potamogeton berchtoldii</i>	10.8
Marginal / emergent taxa	
<i>Lycopus europaeus</i>	
<i>Lythrum salicaria</i>	
<i>Mentha aquatica</i>	
<i>Phragmites australis</i>	
<i>Typha latifolia</i>	

3.26. Ferry Lane

Survey Date	06 July 2016
Grid reference:	TQ0766766261
OS Grid reference (X,Y):	507667, 166261
Approx. surface area (ha.):	10.86
Maximum recorded depth (m):	5.6

Overview

Ferry Lane is specifically used as a public bathing lake, privately owned and managed by Shepperton Open Water Swim. Access issues on the morning of the survey significantly delayed progress, while in the afternoon the survey was unexpectedly terminated by the site owner in order to allow for swimmers to start their afternoon session. As a result, while the WFD survey was completed, the vegetation mapping was not and so results from this are limited to the points assessed during the WFD survey (Figure 137).



Figure 136 Ferry Lane.

Extent of macrophyte cover

WFD boat transects and surveyor observations indicate that the eastern half of the lake is generally too deep for aquatic plant growth, with *E. nuttallii* restricted to depths of less than 3.8 m. The lake basin becomes shallower around the small island and towards the western shore, allowing the colonisation of *Elodea nuttallii*, *Potamogeton pusillus*, *Potamogeton trichoides* and charophytes. The eastern shore of Ferry Lane is very open, with low growing marginal vegetation. This has allowed for optimal plant growth conditions, where populations of *E. nuttallii*, *Ceratophyllum demersum*, *P. pusillus* and *P. trichoides* were recorded until water depth became too great. The remainder of the lake shore was under tree canopy, limiting light penetration to the water and consequently restricting plant growth in places.

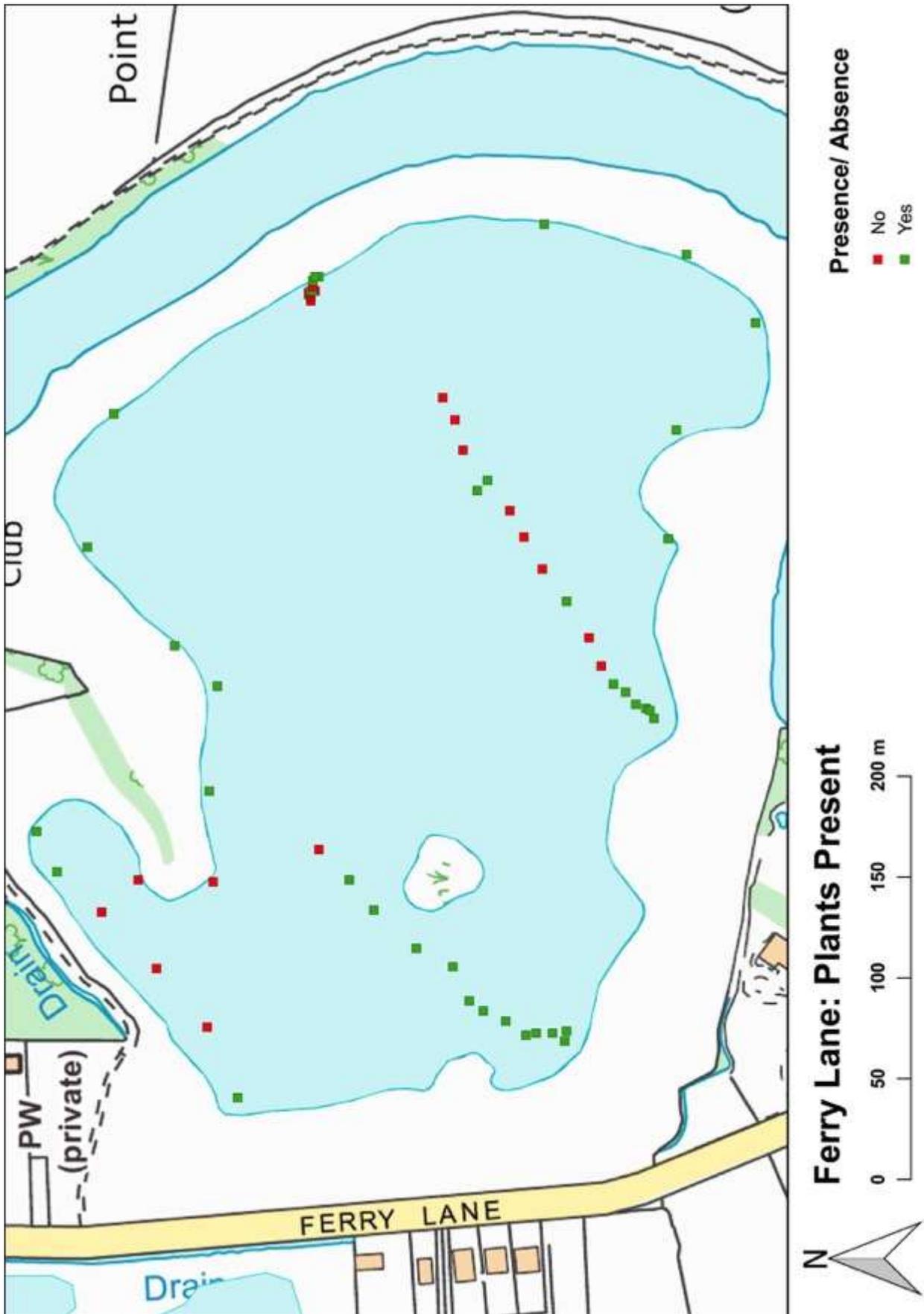


Figure 137 The extent of macrophyte cover at Ferry Lane (WFD survey only).

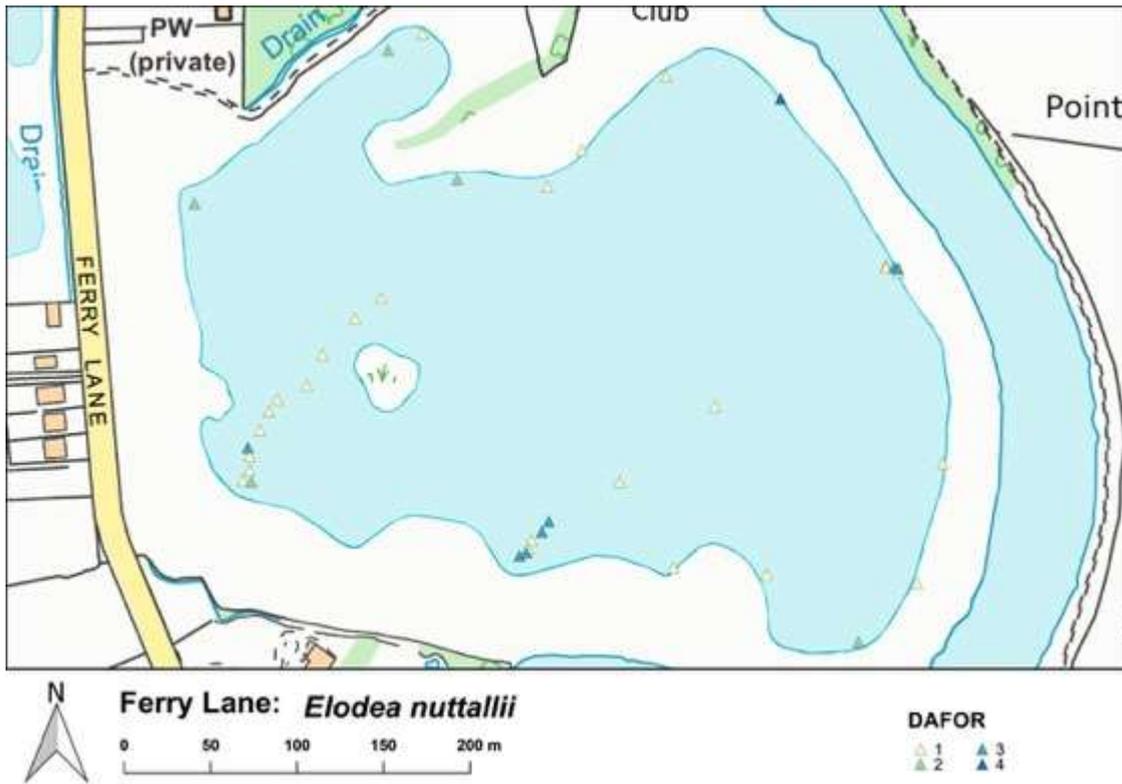


Figure 138 Extent and abundance of *Elodea nuttallii*. at Ferry Lane (WFD survey only).

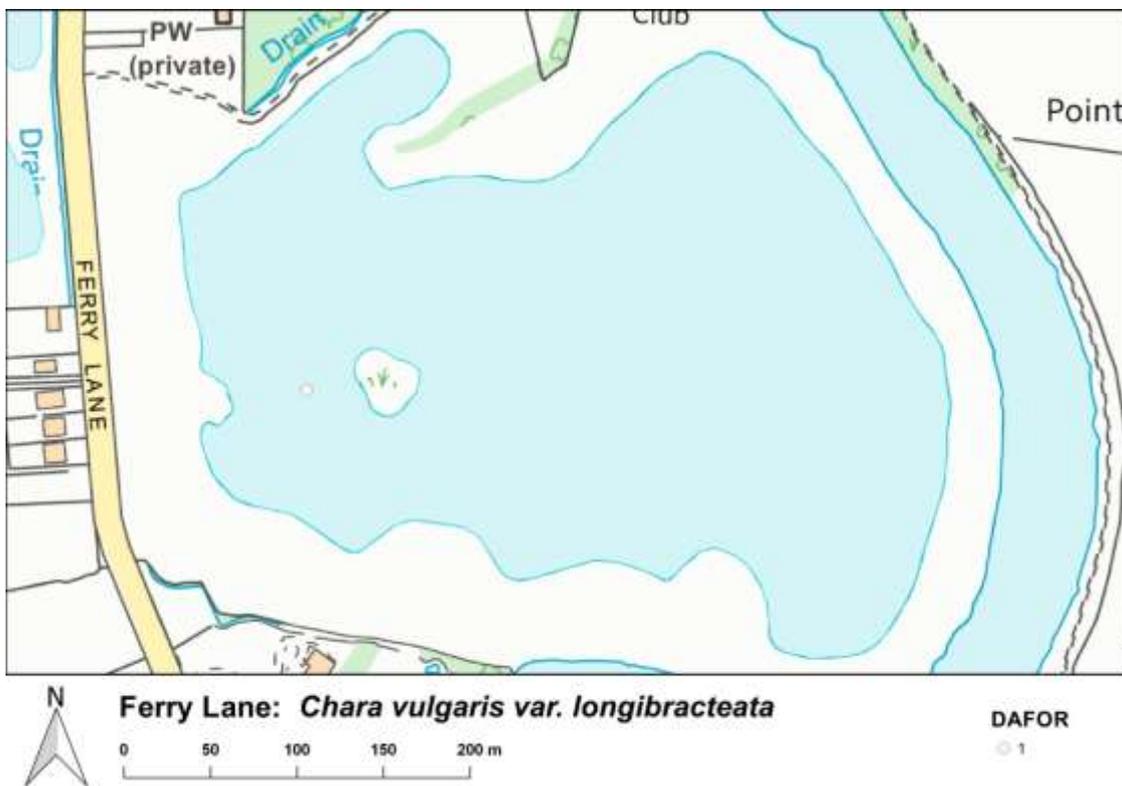


Figure 139 Extent and abundance of *Chara vulgaris var. longibracteata* at Ferry Lane (WFD survey only).

WFD Survey

Nine submerged/ floating macrophytes were recorded, most significantly *E. nuttallii*, which dominated water body cover by 11.8%. This was recorded growing from 25 cm depth through to beyond 75 cm on the wader surveys, persisting up to 3.8 metres on the boat surveys (Figure 138). *C. demersum* and *P. pusillus* also occupied a relatively high proportion of the water body cover, each with 4.2% and appearing in all three sections of the WFD survey. A small, localised population of *Chara vulgaris var. longibracteata* was recorded on the boat transect, west of the island (Figure 139). *Chara globularis* was also recorded within the wader transects on this section. Marginal vegetation consisted of typical lake habitat species, such as *Juncus effusus*, *Lycopus europaeus*, *Epilobium hirsutum* and *Salix* species. A summary of the species is given in Table 40 and the LEAFPACS 2 metrics in Table 41.

Table 40 Macrophyte summary; Ferry Lane.

Species	Frequency % (n= 119)	LEAFPACS 2 Cover (%)
Aquatic taxa		
<i>Ceratophyllum demersum</i>	25.2	4.2
<i>Chara (contraria & globularis)</i>	11.8	1.11
<i>Elodea nuttallii</i>	75.6	11.84
<i>Fontinalis antipyretica</i>	0.8	0.03
<i>Lemna trisulca</i>	7.6	0.78
<i>Nymphaea alba</i>	0.8	-
<i>Persicaria amphibia</i>	4.2	2.46
<i>Potamogeton pectinatus</i>	0.8	0.08
<i>Potamogeton pusillus</i>	35.3	4.22
<i>Potamogeton trichoides</i>	12.6	2.49
Marginal / emergent taxa		
<i>Acorus calamus</i>		
<i>Alnus glutinosa</i>		
<i>Epilobium hirsutum</i>		
<i>Equisetum palustre</i>		
<i>Iris pseudacorus</i>		
<i>Juncus effusus</i>		
<i>Lycopus europaeus</i>		
<i>Lythrum salicaria</i>		
<i>Mentha aquatica</i>		
<i>Myosotis scorpiodes</i>		
<i>Persicaria amphibia</i>		
<i>Salix</i> sp.		
<i>Scutellaria galericulata</i>		
<i>Solanum dulcamara</i>		
<i>Typha latifolia</i>		

Table 41 LEAFPACS 2 metrics applied to Ferry Lane

LEAFPACS metric report				
LMNI	NTAXA	NFG	COV	ALG
6.74	9.0	7.00	3.02	0.00

4. Data Summaries

4.1. LEAFPACS 2 data

The LEAFPACS 2 metrics were calculated for 15 of the 26 sites (Table 42). Of these, St. Ann's lake should be treated with extreme caution due to the survey being restricted to only littoral (wader) surveys, in a site clearly dominated by deep growing aquatic macrophytes (see Section 3.17). No data were produced for Sheepwalk West 2 due to access and permission problems discussed in Section 3.23.

Table 42 A summary of the LEAFPACS 2 metrics for all WFD survey sites

Lake Name	LMNI	NTAXA	NFG	COV	ALG
Datchet 3 North	6.32	3	3	0.60	0.00
Datchet 3 South	6.62	11	7	4.59	0.36
Sunnymeads 3	6.84	8	5	5.66	0.00
Kingsmead Island Lake	6.97	10	6	3.62	0.09
Wraysbury 2 North	7.47	10	6	2.03	0.22
Wraysbury 2 South	7.25	6	4	8.34	0.04
Manor Lake	7.02	12	7	3.31	0.14
Fleet Lake	6.64	13	6	4.72	0.14
Abbey Lake	6.86	11	5	5.64	0.08
St. Ann's Lake*	7.90	12	7	3.88	0.29
Abbey 1	7.03	9	6	2.66	0.02
Abbey 2	6.22	2	2	1.26	0.00
Littleton East	6.46	6	4	7.24	0.28
Sheepwalk West 2	No data				
Sheepwalk East	6.94	5	3	11.78	0.30
Ferry Lane	6.74	9	7	3.02	0.00

* Low confidence - based on very limited data

4.2. Species summaries for all sites

Within the 26 sites surveyed a total of 34 aquatic macrophyte taxa were recorded (Table 43). The most frequently encountered species were *Ceratophyllum demersum* (in 23 sites) and the non-native *Elodea nuttallii* (in 22 sites). *Lemna trisulca* (18 sites) and *Persicaria amphibia* (17 sites) were encountered and many of the lakes, but rarely at high abundance, particularly in the case of *P. amphibia*.

Of conservation interest and of particular significance to this project, is the occurrence of the nationally rare stonewort *Nitellopsis obtusa* at five of the survey sites. Datchet 3 and Littleton East are thought to be previously unknown sites for this species. Threats to this species are likely to come from increased turbidity and from highly competitive species, including non-native, invasive species (e.g. *Elodea nuttallii* and *Crassula helmsii*). Furthermore, there are no records from the UK (or internationally?) of *Nitellopsis obtusa* growing in flowing water, and therefore this species is placed under particular threat from the proposed scheme.

The stonewort *Tolypella prolifera* (common in the Thorpe Park sites) is also rare in the UK and similarly placed at risk from the project.

Table 43 A summary of the LEAFPACS 2 metrics for all WFD survey sites

Shaded cells; [grey] = no survey, [orange] = non-native species, [green] = species of conservation interest.

Taxon Name	Datchet 3 North	Datchet 3 South	Kingsmead Island Lake	Sunnymeads 3	Horton 2	Wraysbury 2 North	Wraysbury 2 South	Lower Hythe Gravel Pit 1	Lower Hythe Gravel Pit 2	Lower Hythe Gravel Pit 3	Lower Hythe Gravel Pit 4	Lower Hythe Gravel Pit 5	Lake South of Green Lane	Lakes South of Norlands Lane (1)	Lakes South of Norlands Lane (2)	Manor Lake	Fleet Lake	Abbey Lake	St. Ann's Lake	Abbey 1	Abbey 2	Littleton East	Old Littleton Lane Lake	Sheepwalk West 2	Sheepwalk East	Ferry Lane West 2	Ferry Lane West 3	Ferry Lane	Total occurrences
<i>Callitriche</i> sp.														x															1
<i>Ceratophyllum demersum</i>	x	x	x	x	x	x	x	x		x		x	x	x		x	x	x	x	x		x	x	x	x	x	x	x	23
<i>Chara</i> spp. (all species)	x	x	x		x											x			x	x	x	x		x	x			x	12
<i>Chara contraria</i> var. <i>contraria</i>	x?	x	x		x											x	x	x		x	x	x		x					2
<i>Chara contraria</i> var. <i>hispidula</i>		x?			x												x		x			x							4(5)
<i>Chara globularis</i>		x	x				x									x	x	x	x	x							x		9
<i>Chara vulgaris</i>																	x		x										2
<i>Chara vulgaris</i> var. <i>longibracteata</i>																	x												1
<i>Chara vulgaris</i> var. <i>papillata</i>																x				x									2
<i>Crassula helmsii</i>															x														1
<i>Elodea canadensis</i>		x	x	x	x									x					x										6
<i>Elodea nuttalli</i>	x	x	x	x	x	x	x	x		x			x	x		x	x	x	x	x	x	x		x	x		x	x	22
Filamentous algae													x			x	x	x	x	x			x		x				8
<i>Fontinalis antipyretica</i>		x															x				x						x		4
<i>Hydrocharis morsus-ranae</i>																							x						1
<i>Lemna minor</i>			x			x						x	x	x	x								x			x			8
<i>Lemna minuta</i>												x		x									x						3
<i>Lemna trisulca</i>		x	x		x	x		x		x		x	x	x		x	x		x	x			x	x		x	x	x	18
<i>Menyanthes trifoliata</i>								x																					1
<i>Myriophyllum spicatum</i>		x	x	x												x	x		x			x							7

Taxon Name	Datchet 3 North	Datchet 3 South	Kingsmead Island Lake	Sunnymeads 3	Horton 2	Wraysbury 2 North	Wraysbury 2 South	Lower Hythe Gravel Pit 1	Lower Hythe Gravel Pit 2	Lower Hythe Gravel Pit 3	Lower Hythe Gravel Pit 4	Lower Hythe Gravel Pit 5	Lake South of Green Lane	Lakes South of Norlands Lane (1)	Lakes South of Norlands Lane (2)	Manor Lake	Fleet Lake	Abbey Lake	St. Ann's Lake	Abbey 1	Abbey 2	Littleton East	Old Littleton Lane Lake	Sheepwalk West 2	Sheepwalk East	Ferry Lane West 2	Ferry Lane West 3	Ferry Lane	Total occurrences
<i>Nitella mucronata</i> var. <i>gracillima</i> .		x																		x									2
<i>Nitellopsis obtusa</i>		x															x	x	x			x							5
<i>Nuphar lutea</i>						x		x																					2
<i>Nymphaea alba</i>						x	x	x		x														x	x		x	x	8
<i>Persicaria amphibia</i>			x	x		x	x			x			x	x				x	x	x	x		x	x	x	x	x	x	17
<i>Potamogeton berchtoldii</i>						x														x				x			x		4
<i>Potamogeton crispus</i>					x		x	x								x								x					5
<i>Potamogeton natans</i>				x																									1
<i>Potamogeton pectinatus</i>	x	x	x	x	x	x							x	x		x	x	x	x	x								x	14
<i>Potamogeton pusillus</i>	x	x	x		x									x		x	x	x	x			x						x	11
<i>Potamogeton trichoides</i>		x	x		x	x		x						x		x	x	x				x						x	11
<i>Ranunculus circinatus</i>																x	x	x				x							4
<i>Sparganium emersum</i>														x					x										2
<i>Spirodela polyrhiza</i>																													0
<i>Tolypella prolifera</i>																x	x	x							x?				3(4)
<i>Zanichellia palustris</i>																x	x		x										3

5. References

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