



Baseline Macrophyte and Invasive Alien Plant Species Surveys on Lough Arrow and Weed Control Programmes in 2018



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Front cover: Boats putting lengths of jute matting in position for ultimate placement on the lake bed by divers at Loughbrick Bay slipway and pier in September 2018.

Back cover: Drone in transit to record footage on Drumacrittin Lake in July 2018.

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1. INTRODUCTION

INVAS Biosecurity Ltd. (INVAS) was commissioned by IT Sligo and the Interreg VA CANN Programme to conduct baseline macrophyte and invasive alien plant species (IAPS) surveys on Lough Arrow (and the Magheraveely/Kilroosky Marl Lakes Cluster) with follow up management and control, where required.

1.1. Interreg VA Programme

The Interreg VA Programme is one of 60 funding programmes under Interreg Europe. The Programme involves Ireland and the United Kingdom and operates within the border counties of Ireland (Monaghan, Leitrim, Cavan, Louth, Sligo and Donegal), Northern Ireland and Western Scotland. This Programme's ambition is to aid cross border cooperation in order to facilitate better policy. The project supports four priority areas, which include "Research and Innovation", "Sustainable Transport", "Health" and the "Environment".

Under the "Environment" priority, each Member State of the Interreg VA Programme has areas that are protected under the European Union's Birds Directive (2009/147/EC), Habitats Directive (92/43/EC) and the Marine Strategy Framework Directive (2008/56/EC). The objective under this priority is to aid cross border cooperation to facilitate and enhance several environmental areas that include the "Recovery of protected habitats & priority species", "Manage marine protected areas & species", "Improve water quality in transitional waters" and "Improve freshwater quality in cross-border river basins".

1.2. Interreg VA CANN Project

Collaborative Actions for the Natura Network (CANN) is a project developed to meet the obligations of the "Recovery of protected habitats & priority species" under the "Environment" priority of the Interreg VA Programme. The project aims to improve the conservation status of seven protected habitats and seven protected species that are common to all jurisdictions within the project. The protected habitats benefitting from the project include alkaline fens, transition mires and quaking bogs blanket bog, active raised bog, marl lakes, calcareous fens and petrifying springs. There are also seven protected species that will also directly benefit from the project, which include *Austropotamobius pallipes* (White-clawed crayfish), *Circus cyaneus* (Northern harrier), *Euphydryas aurinia* (Marsh fritillary), *Numenius arquata* (Common curlew), *Tringa tetanus* (Green sandpiper), *Gallinago gallinago* (Common snipe), *Crex crex* (Corncrake) and *Lagopus lagopus* (Willow ptarmigan).

The Interreg VA CANN project aims to carry out its objectives through the development of conservation action plans for the selected species and habitats aforementioned. Furthermore, the project intends to carry out *in situ* conservation measures in order to improve their conservation status. The project will monitor the effectiveness of implemented actions with the intention of improving the conservation condition of up to 4,500 hectares of habitat protected under the Natura 2000 Network. These objectives will be implemented and monitored through a consortium of stakeholders that include the Agri-food and Biosciences Institute, Argyll & The Isles Coast and Countryside Trust, Banbridge & Craigavon Borough Council, East Border Region Ltd, Golden Eagle Trust, Monaghan County Council, Scottish Natural Heritage, Ulster University, Ulster Wildlife and the Institute of Technology Sligo.

1.3. Objectives of the Baseline Macrophyte and Invasive Alien Plant Surveys and Weed Management Project

INVAS was appointed by IT Sligo, on behalf of the Interreg VA Programme, to conduct a baseline macrophyte and invasive alien plant species (IAPS) survey on Lough Arrow. The baseline surveys will include an assessment of the macrophyte species and macrophyte community assemblages present in Lough Arrow and will produce a map showing the broad distribution of the principal macrophyte species present. In addition, an assessment of the IAPS present and their distribution will also be conducted. These surveys will be conducted in summer 2018.

Following the baseline surveys and using information gained from this research, INVAS will carry out macrophyte and IAPS trials on Lough Arrow using scientifically validated methods that have proven successful in the past. This weed control work will take place following the surveys in late summer/autumn of 2018. The efficacy of the weed control operations will be quantitatively assessed in 2019.

2. SITE DESCRIPTION

2.1. Lough Arrow

Lough Arrow is a limestone lake situated 24 kilometres south-east of Sligo town, County Sligo (54°03'36.7" North and 8°19'39.1" West). The lake is located on the borders and within the counties of Sligo and Roscommon.

The lake is 1,458 hectares in size with an average depth of 9 metres (maximum 33 metres) (National Parks and Wildlife Service, 2015). In contrast to the lakes considerable size, the lake has a small catchment area (6,255 hectares) and it is primarily replenished by springs located on the lakebed (Inland Fisheries Ireland, 2015). Lough Arrow is considered to be unique in comparison to other Irish lakes as a result of this hydrological characteristic (National Parks and Wildlife Service, 2013). An overview of the lake is illustrated in Figure 2.1.

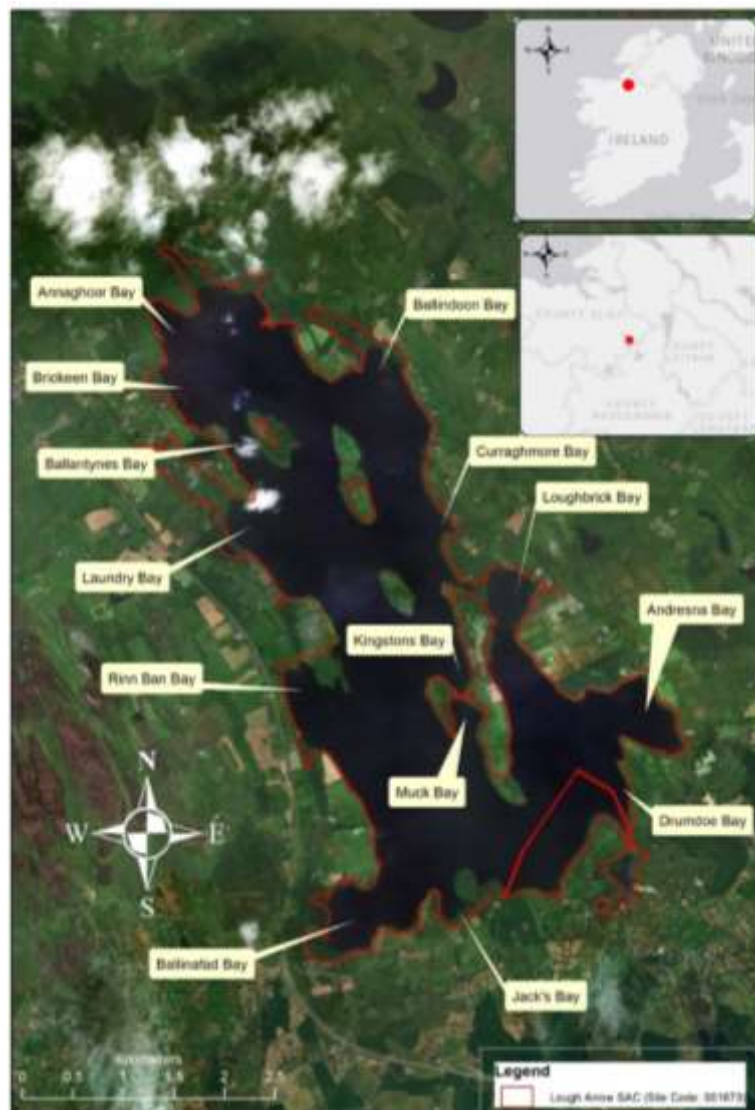


Figure 2.1 Lough Arrow SAC and the location of bays used for sampling during summer and autumn 2018.

The lake is a designated “Special Area of Conservation” under the European Union’s Habitats Directive (92/43/EC) (Site code: 001673) due to the Annex I habitat the lake supports. A representative example of “Hard oligo-mesotrophic waters with benthic vegetation of *Chara spp.* (3140)” occurs within Lough Arrow. The lake is one of 18 designated “Special Areas of Conservation” that support this Annex I habitat nationally (National Parks and Wildlife Service, 2013).

3. METHODS

The baseline macrophyte survey on Lough Arrow was conducted between 23rd and 27th July 2018, at a time of year when macrophyte species were growing vigorously and most easy to accurately identify.

Macrophyte sampling followed a slightly modified version of the Common Standards Monitoring Guidance for Freshwater Lakes (Interagency Freshwater Group 2015). This methodology was agreed with the Interreg VA CANN team at IT Sligo in advance of any sampling.

3.1. Baseline Macrophyte Survey of Lough Arrow

Macrophyte sampling was conducted along a series of predetermined transects. Transect selection was not random but aimed to best characterise the macrophyte species and communities within the lake, while also surveying the diversity of habitat types present. The arrangement of transects was such that those lacustrine areas that are most suited to macrophyte growth (e.g. sheltered shores and bays, depositing areas) were more intensively surveyed than those exposed stony areas where macrophyte growth is likely to be minimal. In advance of the macrophyte survey, drone footage of much of the lake was recorded to determine the locations of obvious stands of submerged or floating-leaved vegetation and to discriminate habitat types. In addition, the knowledge of Inland Fisheries Ireland (IFI) staff who manage the lake was sought before determining the locations of transects. One further factor that influenced the selection of transect locations was the fact that a macrophyte survey, using transects, had been conducted on Lough Arrow in 2001 (Central Fisheries Board, 2002). The locations of the 24 transects used during this survey were kindly provided (J. King pers. comm.) and many of these were replicated. Following interrogation of the above data, transect locations were selected and mapped for survey purposes.



Plate 3.1 Preparing the 100m-long transect rope (orange rope on purpose-built reel) and markers for use on Lough Arrow in July/August 2018.

The exact citing of transect lines at individual locations aimed include areas where macrophytes were present and where the most meaningful macrophyte samples could be recorded. The specific location was determined by examining potential transect lines from a boat (14' aluminium with 25hp outboard engine) using a standardised eight-pronged grapnel

on a graduated rope, a bathyscope and/or while snorkelling. The selection of an appropriate method(s) depended on wind conditions, water depth, water visibility, and macrophyte abundance and speciation.

Following exact site selection, each transect was positioned perpendicular to the shoreline and extended 100m or to the maximum depth of macrophyte colonisation (euphotic zone). Where the depth of plant colonisation exceeded the pre-determined length of the transect rope (100m), transects were concluded roughly half-way to the opposite shore or when little more variation in macrophyte species assemblage was observed (Interagency Freshwater Group 2015). The start and end of each transect line was recorded using handheld GPS and the outer limit was marked using a weighted float. Each transect was marked and sampled at intervals of 0, 2.5, 5, 10, 25, 50, 75 and 100m, depending on the outer limit of macrophyte vegetation. A graduated rope, clearly marked at each sampling distance, was staked at the water margin and extended for 100m or to the limit of the euphotic zone, where it was positioned with a heavy weight and large red float (Plates 3.1 and 3.2). One transect was recorded at each location.



Plate 3.2 Transect line set at 100m from the shore, with buoys marking the specific sampling sites (i.e. 100m, 75m, 50m, etc.) on Lough Arrow in July 2018.

At each site along the marked transect line, the relative abundance/percentage cover of the overall macrophyte growth was visually assessed using the bathyscope or while snorkelling. All macrophyte species, including native and IAPS, were recorded during the survey. Charophytes were recorded but not definitively speciated during the survey as a dedicated charophyte survey had been conducted on the lake in 2017. The DAFOR scale of relative abundance (Dominant - >70%, Abundant – 31-70%; Frequent – 11 to 30%; Occasional – 3 to 10%; Rare - < 3%) was used to quantify the abundance of macrophyte growth present. These were converted to a numerical scale (5 = Dominant, 4 = Abundant, 3 = Frequent, 2 = Occasional and 1 = Rare) for use in the actual transect records (Appendix I).

Water depth (Garmin® echo™101) and GPS coordinates (Garmin® GPSMAP® 64s) were recorded at each site. In shallow water, assessments were made while wading but, in water > 1m, assessments were made from an anchored boat. In addition to relative abundance/percentage cover, macrophyte samples were collected at each site using a grapnel haul with a 7m length of rope and all macrophyte species present in the haul were identified. Estimates of relative abundance/percentage cover (DAFOR) were assigned to the

individual macrophyte species present at each site. Plant samples were taken for laboratory analysis where it was difficult to make an accurate identification on-site.

In addition to the perpendicular transects, shoreline transects were surveyed at each of the perpendicular transect locations. Shoreline transects measured 20m long, started at the 0m sample point on the perpendicular transect and (generally) ran to the left (facing the shore) from this point. The GPS coordinates for each shoreline transect was recorded. Again, relative abundance/percentage cover of the macrophyte vegetation present in the shallow water was visually assessed and assigned using the DAFOR scale, with numerical conversion.

In addition to the detailed macrophyte data that were collected at each transect location, further detail relating to the macrophyte flora of the lake was gathered while travelling from one transect location to another. This information would prove useful when producing the vegetation map for Lough Arrow. Grapnel hauls were taken and examined at regular intervals, normally every c. 100 to 200m, *en route* from one transect site to another. Information relating to the principal macrophyte species present in each haul and any species that may not have been recorded from adjacent transects was gathered from each haul. Again, the DAFOR scale of abundance/percentage cover was used. The route taken between transect locations was normally parallel to the shore and within the euphotic zone, where macrophyte growth could be expected.

Using the information recorded during the above macrophyte survey, sites for macrophyte cutting and jute matting trials were selected.

Secchi depth was recorded at most locations to measure water transparency. Where the weather permitted, drone surveys (DJI Phantom 4 Pro) were conducted along transects in Lough Arrow. These surveys were primarily focused on sites that were appropriate for weed and IAPS control works.

Underwater video surveys using a GoPro (Hero 4+) were conducted where dense vegetation occurred to assist in the selection of sites for weed and IAPS control works. GoPro surveys were also conducted when recording quadrat data to confirm percentage cover and species composition at each quadrat.

3.2. Macrophyte Cutting

Two prime angling locations along the western shore of Lough Arrow were selected for macrophyte cutting in 2018. Both supported large volumes of native broad-leaved pondweed species (*Potamogeton lucens* and *P. perfoliatus*) and IAPS (*Elodea nuttallii*) vegetation that were significantly disruptive to anglers. Weed cutting took place between 3rd and 7th September 2018.

Cutting knives or 'V-blades' were used to mechanically cut the submerged weed in all instances. The paired blades are towed behind the boat on a 10m-length of chain and are designed to cut the weed at lake bed level, ripping the roots from the substrate as much as possible. In this way, the maximum amount of damage is caused to the target plants and regrowth is normally less vigorous.

Prior to any cutting taking place, the designated cutting zones were marked using distinctive buoys. An area of c. 20,000m² was thus marked for use in this operation. The area was checked for obvious obstructions, mainly rocks that could damage the cutting blades or boat. GPS coordinates were used to direct the cutting boat along planned transect lines, parallel to

the shoreline. A floating boom measuring c. 140m in length was strategically set on the water surface down-wind of weed cutting operations in order to trap any weed that drifted away from the cutting zone (Plate 3.3). Trapped weed was regularly harvested from this and brought ashore.



Plate 3.3 Weed cutting boat in action in Laundry Bay and floating boom set down-wind of mechanical cutting operations to trap weed that drifted out of the cutting zone in Lough Arrow in September 2018.

As the weed was cut and rose to the water surface, it was harvested by boat and driven as far ashore as water depth would permit. From here, the cut weed was forked onto dry land by INVAS staff (Plate 3.4).



Plate 3.4 Cut and harvested broad-leaved pondweed being brought ashore from the weed harvester in Lough Arrow, September 2018.

Within three weeks of the weed being cut, semi-quantitative macrophyte information from quadrats (each 1 m² in area) was collected by divers in the area where cutting was conducted. Ten quadrats were recorded in the cut area and ten in an adjacent uncut (control) area of the lake. These were randomly set by the divers and GoPro images taken of each, to include the full area of the quadrat. In the laboratory, each image was examined

and the approximate percentage cover occupied by each macrophyte species present in the quadrat was visually assessed. This task was undertaken by two staff members, working together, in order to provide a greater level of confidence in the results.

At three of the ten sites in the cut and control areas all of the vegetation within the quadrat, to lake bed level (i.e. not including roots), was removed by a diver into a mesh bag and retained for biomass analysis. The fresh weight of the vegetation sample was recorded after it had been left on the shore for 5 minutes to remove excess water.

3.3. Jute Matting

An area of lake that was totally overgrown with the IAPS *E. nuttallii*, located on the eastern shore of Lough Arrow, was selected for treatment with jute matting. The invasive and obstructive weed in this area was covered with jute matting in order to block out all incident light and to kill the target vegetation. Jute matting had proved to be very effective in killing another submerged IAS in Lough Corrib (Caffrey *et al.* 2010, 2011) and it was anticipated that it could offer the same weed control advantages with *E. nuttallii* at this site. The jute laying operation was conducted between 24th and 28th September 2018.

Approximately three weeks prior to placing the jute on the IAPS weed, the areas selected for treatment were cut using the cutting knives or 'V-blades'. The cut weed was removed from the water to a suitable adjacent shoreline.

The area of *E. nuttallii*-infested lake bed to be treated with jute matting was carefully marked with buoys and sheets of jute matting were prepared for laying. (The jute matting comes in rolls that are 900m long and 5m wide. The roll weighs c. 900kg (Plate 3.5).) The jute matting was stored in the Inland Fisheries Ireland (IFI) stores at Ballinacorney and sheets for laying were cut to size at this location. It was here, also, that the weights used to secure the jute matting to the lake bed were made. Each weight comprised a 0.5m² piece of jute matting into which c. 2kg of washed pea gravel was placed. The gravel was secured in place in the jute envelope using a length of flexible wire (Plate 3.5). On each jute weight, a length of wire measuring c. 30cm was left exposed to enable the weight to be stitched into the jute mat, an operation normally conducted by divers on the lake bed.



Plate 3.5 Preparing jute sheets from the mother roll for deployment in the lake, while weights of pea gravel and jute are prepared to hold the jute mat in place on the lake bed.

Depending on the specific location where the jute matting was to be laid, lengths of jute between 25 and 100m, all 5m wide, were cut and transported to the site. The jute sheet was brought onto the water by one or two boats and allowed to saturate with water and sink to the lake bed (Plate 3.6). This normally took less than 5 minutes. Divers in the water ensured

the correct placement of the jute on the target weed, secured all of the weights and stitched jute mats together, where necessary.



Plate 3.6. Jute mats being towed into position for placement on dense stands of the invasive species *Elodea nuttallii* in Loughbrick Bay in September 2018.

In most instances, a single layer of jute matting was laid. Based on previous experience with *Lagarosiphon major* in Lough Corrib, it was thought that a single layer would be sufficient to stop any growth of *E. nuttallii* beneath (and through) the jute weave. However, in case any *E. nuttallii* plants did manage to grow up through the jute, one section within the trial site was covered with a double layer of jute. This section measured 765m².



Plate 3.7 Divers preparing to take quadrat samples prior to jute matting being laid on the invasive species *Elodea nuttallii* at Loughbrick Bay in September 2018.

Quadrat samples (1m²) for relative macrophyte abundance were recorded to evaluate the effectiveness of the jute matting in suppressing the *E. nuttallii* (Plate 3.7). Thirty quadrats were taken prior to any jute being laid – ten where it was proposed to lay the single layer of jute, ten where it was proposed to lay the double layer of jute and ten in a control area adjacent to the treatment zones. The vegetation in all of these areas had been cut prior to the quadrats being taken. (See quadrat assessment method in 3.2) As with the weed cutting trials, three quadrats in each treatment area and the control were analysed for fresh weight biomass (Plate 3.8). No quadrat assessments were made post-treatment as no vegetation was present on the jute that had just been laid. Quadrat samples will be taken at each of these sites during the summer of 2019.



*Plate 3.8 Weed samples from individual quadrats being weighed before the jute matting is laid on the *Elodea nuttallii* at Loughbrick Bay in September 2018.*

3.4. Other IAPS

While shoreline transects were being conducted and while in transit between transect sites on the lake, any terrestrial or riparian IAPS observed were recorded. Local lanes and roadways immediately surrounding Lough Arrow were also surveyed for terrestrial IAPS that may impact on the riparian zones of the lake or adjoining rivers, such as the Unshin River.

4. RESULTS

4.1. Macrophytes and Invasive Species Survey on Lough Arrow

Macrophytes were sampled along 27 transects that were located perpendicular to and parallel with the shoreline on Lough Arrow in July and August 2018. The location of each transect is presented in Figure 4.1. The perpendicular transects extended to the limit of the photic zone or to where no further significant differences in macrophyte species composition was recorded, while the shoreline transects extended 20m along the shoreline at depth 0m. The macrophyte species, present or absent, that were recorded during sampling of the shoreline transects are presented in Table 4.1 while those recorded during sampling of the perpendicular transects are presented in Table 4.2. The relative abundance scores for each macrophyte species in each of the transects is presented in Appendix I.

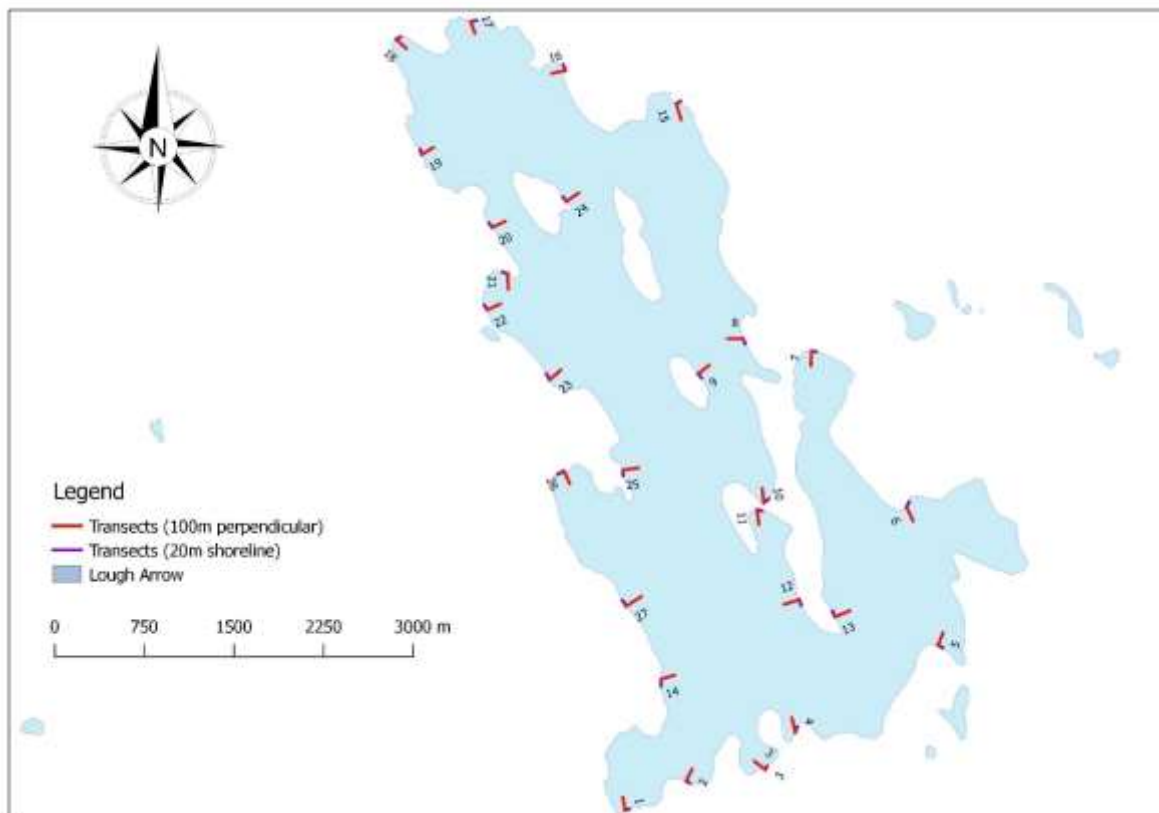


Figure 4.1 Location of shoreline and perpendicular transects for baseline macrophyte and IAPS sampling on Lough Arrow in July and August 2018.

The macrophyte survey was conducted in late July and early August 2018. Water levels in the lake at the time were low and the shoreline (set at 0 metre depth), in places, was some distance from the riparian zone. As such, no riparian macrophyte species were recorded in the shoreline transects.

A diverse macrophyte flora was recorded in Lough Arrow, with 34 species present in the various habitat zones from the shoreline to the deeper open water (Tables 4.1 and 4.2). A graphical representation of the broad distribution of the principal macrophyte species and assemblages recorded in Lough Arrow in 2018 is presented in Figure 4.2.

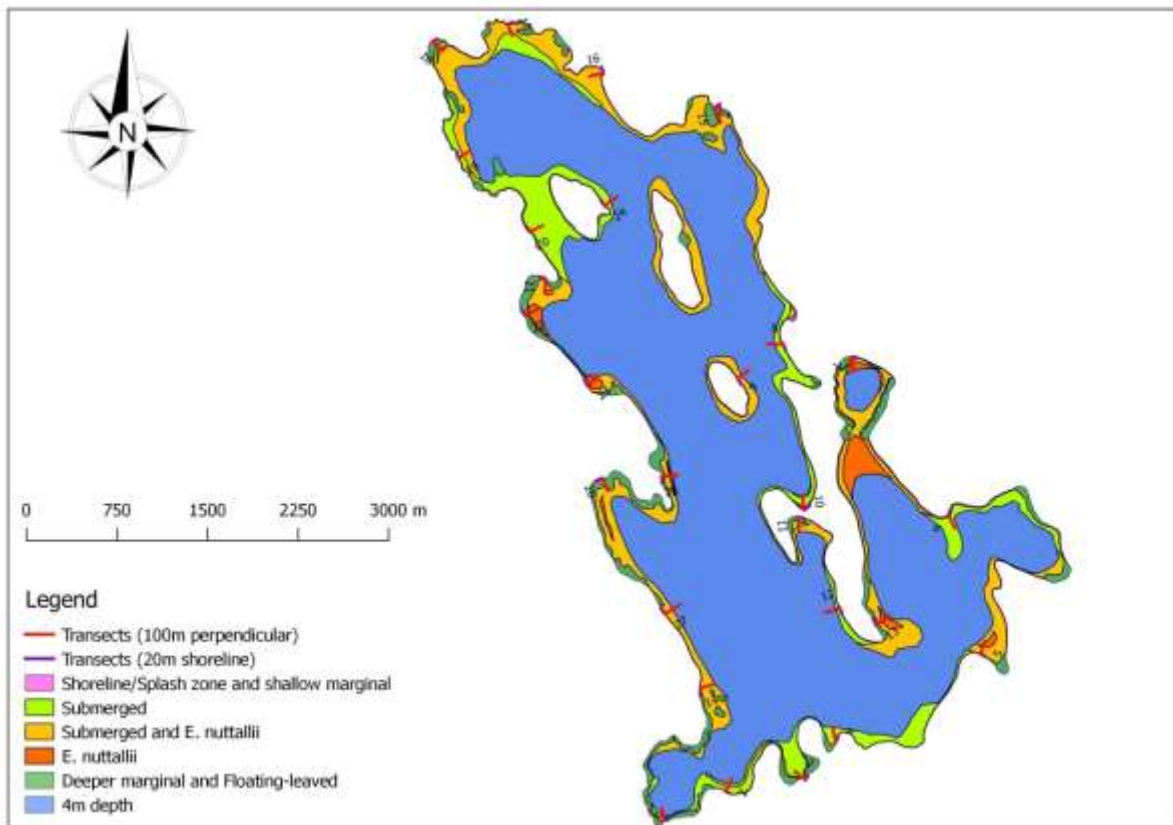


Figure 4.2 Graphical representation of the broad distribution of macrophyte and invasive alien plant species in Lough Arrow, based on surveys conducted in July and August 2018. (This map is available electronically and can be interrogated to provide greater detail.)

At many locations, the shoreline of Lough Arrow is steep and the macrophyte flora is relatively restricted to narrow vegetation bands that may extend no farther from the shoreline than 25m (Figure 4.2).

The Secchi depth throughout the lake varied from 3.4 to 4.4m during the course of the survey in 2018.

4.1.1. Shoreline Transects

Along the shoreline, at 0m depth, 23 macrophyte species were recorded (Table 4.1 and Appendix I). *Littorella uniflora* (Shoreweed) was the most common and abundant macrophyte species. This isoetid formed occasionally shallow but more commonly dense vegetation tufts among the gravel and stones that occupied much of this shoreline habitat. This species can grow in the water but can also grow farther up the shore where it is not constantly inundated with water. Present along the shoreline and growing into water up to 0.5m deep was the erect *Eleocharis palustris* (Spike-rush). This dark green rush can grow to 0.75m tall and occasionally produced dense vegetation stands that locally dominated the shoreline flora (see Transects 10, 11 and 27 in Appendix I). Another emergent species that was present in almost 50% of the shoreline transects was *Mentha aquatica* (Water mint), here producing relatively low-growing bushy plants. The tall *Equisetum fluviatile* (Water horsetail) also occasionally occupied this habitat, but never with any significant vegetative vigour. It preferred to grow where the water ranged from 0.2 to 1m deep.

Table 4.1 Macrophyte species recorded from the 27 shoreline transects on Lough Arrow in July and August 2018. Presence and absence is recorded in this Table while relative abundance data for each transect is available in Appendix I.

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	Total
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	2
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Chara sp. (cf. virgata)</i>	-	4	-	-	-	-	-	-	1	2	4	-	-	-	-	1	-	-	-	-	-	-	-	-	-	2	-	6
Filamentous algae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	1
<i>Eleocharis palustris</i>	-	-	2	3	-	3	2	-	-	5	4	-	-	3	-	2	-	-	-	1	-	-	-	2	-	-	5	11
<i>Elodea nuttallii</i>	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
<i>Equisetum fluviatile</i>	-	-	1	-	-	2	2	-	-	2	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	6
<i>Fontinalis antipyretica</i>	-	-	-	-	1	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	1	1	2	-	-	1	-	6
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	2	-	-	-	-	-	-	-	-	3
<i>Lemna trisulca</i>	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Littorella uniflora</i>	-	-	2	-	4	5	-	-	3	3	-	-	4	-	5	-	-	2	1	2	3	3	-	3	5	5	15	
<i>Mentha aquatica</i>	-	-	2	-	1	3	-	-	-	-	-	-	2	1	2	-	2	2	-	3	-	-	-	2	3	-	2	12
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-	-	-	-	-	-	-	-	-	2
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	-	-	2	1	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
<i>Nuphar lutea</i>	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	2
<i>Phalaris arudinacea</i>	-	-	-	-	-	2	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	2
<i>Phragmites australis</i>	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	3	-	3	-	-	4
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	2
<i>Potamogeton filiformis</i>	-	3	-	-	3	-	-	1	-	-	-	-	3	-	2	1	-	-	-	2	2	-	-	-	3	-	9	
<i>Potamogeton gramineus</i>	-	2	-	2	-	-	-	2	2	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	2	6
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	1
<i>Scirpus lacustris</i>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	2
<i>Sparganium erectum</i>	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1

Two *Potamogeton* species, *P. filiformis* (Slender-leaved pondweed) and *P. gramineus* (Various-leaved pondweed), were commonly recorded in the shoreline transects (Table 4.1), although both are categorised as submerged species for the purposes of this survey (Table 4.2). The former species often produced dense, low-growing, ‘hairy’ mats of straw-coloured vegetation that washed in the waves on the shoreline. The latter species likewise produced low-growing vegetation, producing small leaves that are less prone to damage in this often turbulent habitat zone.

‘Dwarf’, scattered stands of *Chara sp. (cf. virgata)* (Delicate stonewort) were recorded among the gravel and stones in six shoreline transects. At two of these, the diminutive and heavily encrusted alga occupied a ground cover in excess of 30% (see Appendix I). Small, localised stands of *Myriophyllum alterniflorum* (Alternate water-milfoil) and *Fontinalis antipyretica* (Greater water-moss) were present in a number of these shoreline transects (Table 4.1 and Appendix I), although rarely with any significant vegetative abundance. At Annaghcor Bay (Figure 2.1 and Transect 18 in Figure 4.1) large plumes of filamentous green algae were present on the shoreline and in the shallow water. The alga was bright green and growing vigorously. No obvious signs of organic enrichment were evident in the vicinity of this site.

A number of other macrophyte species were recorded in the shoreline transects but these were generally uncommon and present with low abundance. It is noteworthy that small stands of the highly invasive *Elodea nuttallii* (Nuttall’s pondweed) were present in two of the 27 shoreline transects (Table 4.1).

4.1.2. Perpendicular Transects

Beyond the shoreline, in water that is generally less than 1.5m deep, a variety of marginal macrophyte species were recorded. The majority of these species were also present on the shoreline/splash zone but gained more vegetative expression in the clear water beyond the

more disturbed shoreline. Prominent among these marginal macrophyte species were the tall reeds, *Phragmites australis* (Common reed) and *Scirpus lacustris* (Common club-rush). These were most common along the sheltered western shoreline and in bays that were sheltered from the prevailing north-westerly wind (Figure 4.2). Each species produced continuous monodominant stands along sections of the shallow shoreline, with *S. lacustris* always occupying slightly deeper water than *P. australis*. The selection of transects was not designed to target these tall reedbed species and, hence, they may appear somewhat underrepresented in Table 4.2.

Table 4.2 Macrophyte species recorded from the 27 perpendicular transects on Lough Arrow in July and August 2018. Presence and absence is recorded in this Table, while relative abundance data for each quadrat is available in Appendix I.

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	Total
Shoreline/Splash zone																												
<i>Littorella uniflora</i>	-	+	+	+	+	+	+	-	-	+	+	-	+	+	-	+	-	-	+	+	+	+	+	-	+	+	+	19
<i>Myriophyllum alterniflorum</i>	-	+	+	-	+	-	-	-	+	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	7
Marginal																												
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	2
<i>Botulphia ranunculoides</i>	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Eleocharis palustris</i>	-	-	+	+	-	+	+	-	-	+	+	-	+	+	-	+	-	-	-	+	-	-	-	+	-	+	+	12
<i>Equisetum fluviatile</i>	-	-	+	-	-	+	+	-	-	+	-	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	7
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	2
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-	-	-	-	-	3
<i>Mentha aquatica</i>	-	-	-	+	-	+	+	-	-	-	-	-	+	+	+	-	+	+	-	+	-	-	-	+	+	-	+	12
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-	2
<i>Phalaris arundinacea</i>	-	-	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	2
<i>Phragmites australis</i>	+	+	-	-	-	-	-	-	-	+	-	-	-	-	+	-	-	-	+	-	-	+	+	-	+	+	-	9
<i>Scirpus lacustris</i>	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	+	+	+	6
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Sparganium erectum</i>	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Typha latifolia</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Floating-leaved																												
<i>Nuphar lutea</i>	+	-	+	+	-	+	+	-	-	-	-	-	+	-	+	+	+	-	+	-	+	-	-	+	-	-	-	12
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	3
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	2
<i>Sparganium angustifolium</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Free-floating																												
<i>Lemna trisulca</i>	+	-	-	-	-	-	-	-	+	-	-	-	+	-	+	-	-	-	+	-	-	-	+	-	-	+	-	7
Submerged																												
<i>Chara sp. (cf. rudis)</i>	-	-	-	-	-	-	-	-	-	+	-	-	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-	4
<i>Chara sp. (cf. virgata)</i>	+	+	-	+	-	+	-	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	20
<i>Elodea canadensis</i>	+	-	-	-	-	-	-	-	+	+	-	+	+	+	-	-	-	-	+	-	-	-	-	-	-	-	-	6
<i>Elodea nuttallii</i>	+	+	+	-	+	-	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	21
Filamentous algae	-	-	+	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	+	-	-	+	-	-	-	-	-	5
<i>Fontinalis antipyretica</i>	+	+	-	+	-	+	-	-	-	+	-	+	-	+	-	-	-	-	-	-	+	+	-	-	-	+	+	12
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Potamogeton filiformis</i>	-	+	+	+	-	+	-	+	-	+	-	+	-	+	+	+	+	+	+	+	+	+	+	+	-	+	+	17
<i>Potamogeton gramineus</i>	-	+	-	+	+	-	+	+	+	+	-	+	-	+	-	-	-	-	+	-	+	+	-	+	-	+	+	15
<i>Potamogeton lucens</i>	+	+	-	-	-	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	15
<i>Potamogeton pectinatus</i>	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-	4
<i>Potamogeton perfoliatus</i>	-	+	+	+	+	+	+	+	-	+	-	+	-	+	+	+	+	+	-	+	-	-	+	+	+	+	+	16
<i>Potamogeton pusillus</i>	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2

Other tall, emergent species recorded during the survey included *Phalaris arundinacea* (Reed canary grass), *Typha latifolia* (Bulrush), *Sparganium erectum* (Branched burreed) and *S. emersum* (Unbranched burreed), none present in more than two of the 27 perpendicular transects examined (Table 4.2).

While *L. uniflora* grew abundantly along the shoreline, it was also well represented in water to a maximum depth of 1.0m (Transect 7, Appendix I). In water between 0.1 and 1.0m deep, this diminutive species formed extensive tufts of dark-green vegetation in 16 of the 27 transects. *Eleocharis palustris* was also well represented among the marginal macrophyte species, being present in 12 transects and growing in water to 0.7m deep. A similarly tall and slender species, *Equisetum fluviatile*, occasionally formed very dense stands to c. 1.5m tall, notably along the margins of Ballindoon Bay (Transect 15 in Appendix I and Figure 2.1).

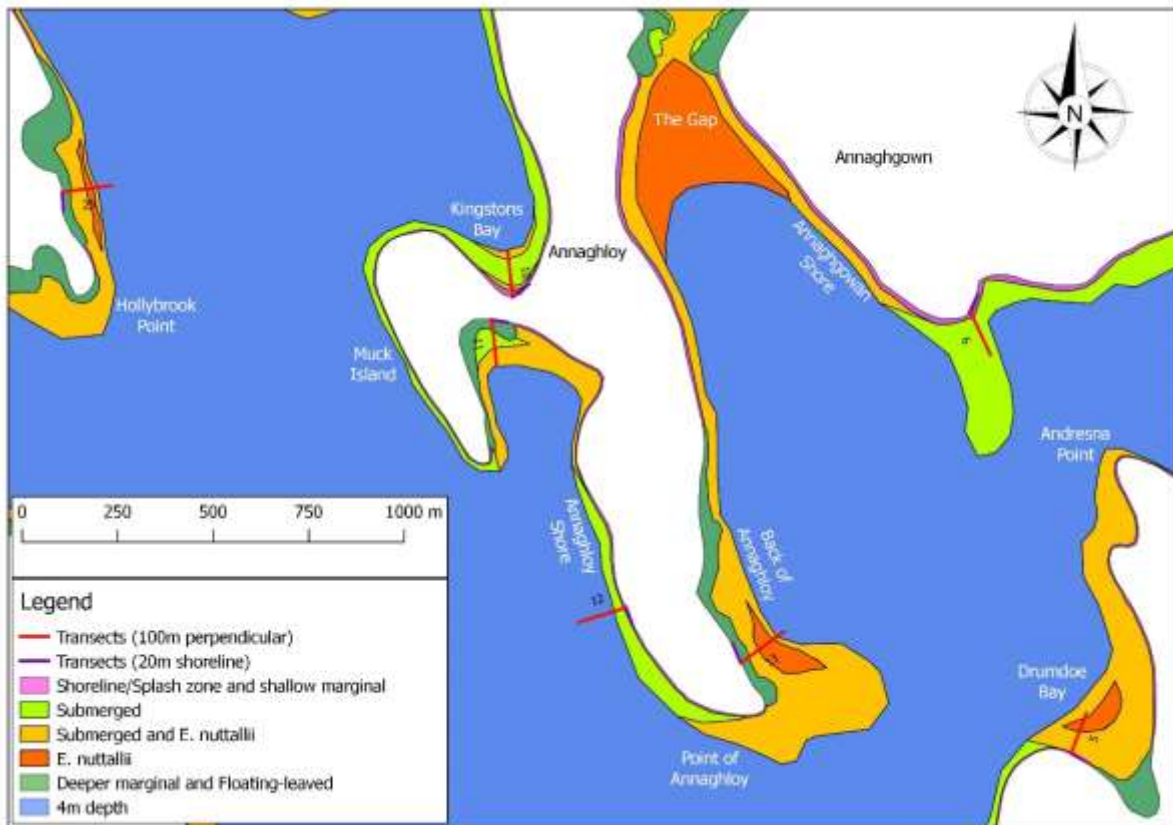


Figure 4.3 Graphical representation of the broad distribution of macrophyte and invasive alien plant species in a section of Lough Arrow that includes Loughbrick Bay and The Gap, based on surveys conducted in July and August 2018.

A number of other macrophyte species were present in this marginal lacustrine habitat but most were localised and rarely present with any significant vegetative cover. These included *Alisma plantago-aquatica* (Common water-plantain), *Baldellia ranunculoides* (Lesser water-plantain), *M. aquatica*, *Menyanthes trifoliata* (Bogbean), *Hippuris vulgaris* (Marestail) and *Iris pseudacorus* (Yellow flag) (Table 4.2).

Filamentous algae (mainly *Cladophora* sp. (cf. *glomerata*) (Blanket weed) and *Spirogyra intestinalis* (Water silk)) were recorded at only five of the 27 transects examined in Lough Arrow (Table 4.2). The locations where this alga was present ranged from the south to the north of the lake and from the east to the west shore. In four of the five transects, the algae grew abundantly and presented significant, if localised, ground cover. At none of the locations were unsightly surface or shoreline scums in evidence.

Lemna trisulca (Ivy-leaved duckweed) was the only free-floating macrophyte recorded during the baseline macrophyte survey on Lough Arrow, where it was present in seven transects. In five of these (Transects 1, 9, 15, 19 and 23 in Appendix I) the plant grew abundantly and was present for more or less the entire length of the transect, from shallow to deep water. While this is a free-floating plant, it rarely floats on the water surface and spends most of its life cycle in a submerged state. It favours sheltered bays and mesotrophic to eutrophic habitats.

Four floating-leaved species were recorded from the transects and included *Nuphar lutea* (Yellow water-lily), *Potamogeton natans* (Broad-leaved pondweed), *Polygonum amphibium*

(Amphibious bistort) and *Sparganium angustifolium* (Narrow-leaved burreed) (Table 4.2). A fifth floating-leaved species, *Nymphaea alba* (White water-lily) was observed but not recorded in any of the 27 transects. *Nuphar lutea* was by far the most common of these nymphaeid species, being recorded from 12 transects that were generally located in relatively shallow and sheltered bays or locations (Table 4.2 and Figure 4.1). It achieved its best vegetative expression in Transects 13, 16 and 17 (see Appendix I). The other floating-leaved species were localised in distribution, although produced abundant vegetation stands in suitable, sheltered habitats (Transects 13 and 15 in Appendix I, Figure 4.1).

During the macrophyte survey on Lough Arrow in summer 2018, the IAPS *E. nuttallii* was the most frequently recorded species, present in 21 of the 27 transects. This is a submerged macrophyte that grows optimally in water from 1 to 3m deep, although it can grow in water to 5m deep. The deepest it was recorded growing in Lough Arrow in 2018 was 4.5m in Loughbrick Bay (Figure 2.1). It is a native of North America, first recorded in Ireland in the early 1990s, and is currently widespread in lakes and large rivers in the country. It is a perennial plant that is capable of producing extremely dense stands that can fully occupy the water column in watercourses to 3m deep. Only female plants are present in Ireland and the plant's primary dispersal mechanism is *via* fragmentation, where even short stem fragments (< 10cm long) can produce roots from nodes and readily establish new colonies. The plant is quite adaptable regarding trophic preference, although it is most prolific in eutrophic waters. It is not known when or how *E. nuttallii* was introduced to Lough Arrow but it was not recorded when a macrophyte survey of the lake was conducted in 2001 (Central Fisheries Board 2002). It is probable that the plant was introduced inadvertently on an angling boat or trailer that had travelled from an infested water body.



Plate 4.1. Dense growth of the invasive Elodea nuttallii collected while grapnel sampling on the western shore of Lough Arrow in July 2018.

In 16 of the 21 transects that *E. nuttallii* was recorded from, it occupied a percentage ground cover of between 11 and 30% (Frequent or Score 3), in seven transects it occupied between 31 and 70% (Abundant or Score 4) and in four it presented > 70% (Dominant or Score 5) cover (see Appendix I). The areas where this invasive species achieved its greatest vegetative expression were in Drumdoe and Loughbrick Bays in the south-western corner of

the lake (Transects 5 and 7, Figure 2.1, 4.1, 4.2 and Appendix I) and in Laundry Bay and the vicinity of Rinn Ban Bay (Transects 21, 22, 25 and 26, Figures 4.1, 4.2 and Appendix I) on the more sheltered western side of the lake. In areas where the plant grew most densely, it rarely grew in mixed assemblage with any other macrophyte species. Where it did not produce monodominant stands, it commonly grew as an understory species with tall-growing, broad-leaved *Potamogeton* species or even alongside charophyte (Stonewort) species.

When the 2001 macrophyte survey was conducted (Central Fisheries Board 2002), *Elodea canadensis* (Canadian pondweed) was recorded from 50% of the 24 transects examined, with moderate abundance in the lake. In 2018 *E. canadensis* was present in less than 25% of the transects surveyed, again with moderate vegetative abundance (Table 4.2 and Appendix I). Only at one location (Transect 1, Ballinafad) did this species establish a large dominant submerged stand, here to a depth of 0.9m. It is clear that the range and abundance of this 'naturalised' macrophyte has reduced in the 17 years since the previous survey.

Of the broad-leaved pondweed species present in Lough Arrow in 2018, *Potamogeton perfoliatus* (Perfoliate pondweed) and *P. lucens* (Shining pondweed) were the most vegetatively abundant. The only other broad-leaved pondweed present was *P. gramineus* (Various-leaved pondweed) and, while it occurred in 15 of the 27 transects, it only displayed a percentage cover score above 3 (11 to 30%) at one site (Kingston's Bay, Transect 10 in Appendix I and Figure 2.1), growing to a maximum depth of 0.7m at this site. The maximum depth that this submerged species was recorded at in the lake was 1.1m.

Potamogeton perfoliatus and *P. lucens* were recorded from 16 and 15 transects, respectively (Table 4.2). These were widely distributed within the lake. Both species achieved their optimum growth in water between 2 and 4m deep, although small stands of *P. perfoliatus* were recorded growing to a water depth of 5.4m, just south of Carraghmore Bay (Transect 8 in Appendix I and Figure 2.1). The latter species was recorded with a percentage cover Score of ≥ 3 from 13 transects, ≥ 4 from five transects and at 5 from two transects, while *P. lucens* was present with a vegetative abundance of ≥ 3 in 12 transects, ≥ 4 in nine transects and at 5 from three transects. While the two species occasionally grew together in the same section of lake, they rarely entered into mixed assemblage with each other. It is noteworthy that, where one of these species was clearly dominant (at Score 5), the other species was not recorded in that transect. And where the two species were recorded within the one transect, particularly with abundance, they were commonly recorded at different sites within the transect length.

A number of key angling areas within the lake were overgrown with broad-leaved *Potamogeton* species, to the extent that anglers could not fish obstruction-free or where they could not fish at all. Among the worst affected were Drumdoe Bay, Andresna Bay, Ballindoon Bay, Laundry Bay, Rinn Ban Bay and Aughanagh Shore (Figures 2.1 and 4.2, and Appendix I).

After the invasive *E. nuttallii*, *Chara* sp. (cf. *virgata*) was the most commonly recorded macrophyte in the perpendicular transects examined (Table 4.2). Where it was present it generally grew abundantly, with 50% of the transects from which the species was recorded reporting abundance levels at 5 (Dominant; > 70% cover). The stands were always dense and relatively low-growing, creating highly calcium-encrusted vegetation beds to about 30cm tall. This charophyte species grew abundantly in water from 0.3 to 2m deep, achieving its maximum depth of 3.2m in Kingston's Bay (Transect 10). Another charophyte species was

recorded in the lake, although it was recorded with less frequency than *C. virgata*. This was the more robust *Chara* sp. (cf. *rudis*) (Plate 4.2), which can form dense calcium-encrusted stands to at least 70cm high. This species was recorded from four of the 27 transects but with an abundance score of 5 at three of them (see Appendix I). It appeared to grow in shallower water than *C. virgata*, achieving a maximum depth of 1.9m off the Aughanagh Shore (Figure 2.1).



Plate 4.2. Dense stands of *Chara* sp. (cf. *rudis*) (one with strands of *Elodea nuttallii* attached) taken while transect sampling in Lough Arrow in July/August 2018.

The dark green moss *Fontinalis antipyretica* was present in 12 of the 27 transects analysed in 2018. At many sites it presented relatively low-growing, submerged stands that grew in water < 1m deep. In a few transects, however, the moss presented large, loose vegetation stands that carpeted the section of lake in which it grew. At Ballinafad (Transect 1) *F. antipyretica* grew vigorously and produced a significant biomass of vegetation at a depth of 3.6m. In the shallow Ballindoon Bay, this moss dominated the submerged flora, in places as an understory species, from 5 to > 75m from the shoreline (Transect 15 in Appendix I).

The Slender-leaved pondweed (*P. filiformis*) was commonly recorded on the shoreline (see Table 4.1) but was also a regular feature of the open-water macrophyte community. At the transect sites in Lough Arrow in 2018, this low-growing, rhizomatous species achieved its best representation in Jack's Bay (Transect 3) and Drumdoe Bay (Transect 5), at the southern end of the lake (Figure 2.1). The optimal growing depth for this plant in Lough Arrow was between 0.2 and 0.8m, and the maximum depth at which it was recorded was 1.1m, at Annaloy Shore (Transect 12, Figure 4.1). This is an exposed rocky shore where *P. filiformis* was the only macrophyte recorded along the transect (see Appendix I).

Potamogeton pectinatus (Fennel pondweed) was recorded from four transects, with low vegetative abundance. This is a species that can grow in mesotrophic water but proliferates in eutrophic or organically enriched water. At one of the sites, straggling stands of this submerged species were recorded growing with low abundance from the 75m site to beyond the 100m sites on the transect rope, the latter at a depth of 4.2m (Little Douris Bay, Transect 4).

Another *Potamogeton* species was recorded in just two transects; this was *Potamogeton pusillus* (Lesser pondweed), a submerged species that typically grows in nutrient-rich

habitats. It was recorded with low vegetative abundance at both sites (Transects 5 and 9, Appendix I).

A single plant of *Myriophyllum spicatum* (Spiked milfoil) was recorded along Transect 11 in Muck Bay at a depth of 0.4m. The plant was healthy but isolated.

4.2. Results from Weed Cutting Trials

Cutting of indigenous weed species, primarily *Potamogeton perfoliatus* and *P. lucens*, and the IAPS *Elodea nuttallii*, in Laundry Bay and Rinn Ban Bay on Lough Arrow (Plate 4) took place from 3rd to the 7th September 2018. The weed was cut within clearly demarcated zones using the cutting knives or V-blades and then harvested onto defined areas of an adjacent shoreline.



Plate 4.3. Map of Lough Arrow showing the locations where weed cutting and jute mat laying was conducted in September 2018.

The weed cutting operations focused on two areas of dense weed growth on the west side of Lough Arrow, in Rinn Ban and Laundry Bays. These are areas of the lake that have been extensively used by trout anglers over the years. However, in recent times, they have become overgrown with submerged weed, making boating and fishing difficult in these prime angling waters.

Cutting was conducted parallel to the shoreline in the vegetated zone, which was clearly marked with buoys. The cutting route was GPS-guided to ensure that the boat operator did not miss any appreciable area of weed within the area of lake demarcated for cutting. While every effort was made to keep straight lines and to ensure that no area within the zone was missed, the action of wind on the boat made this difficult at times. However, aided by GPS, the weed cutting personnel were confident that an effective operation was conducted. In most areas, a double cut was given in order to minimise the risk of missing any tall vegetation stands. Weed was cut and harvested from a total area of 8,703m² and 12,410m² in Rinn Ban and Laundry Bay, respectively, during this period (Figure 4.4). The total area cut in this sector of the lake in 2018 was 21,113m².

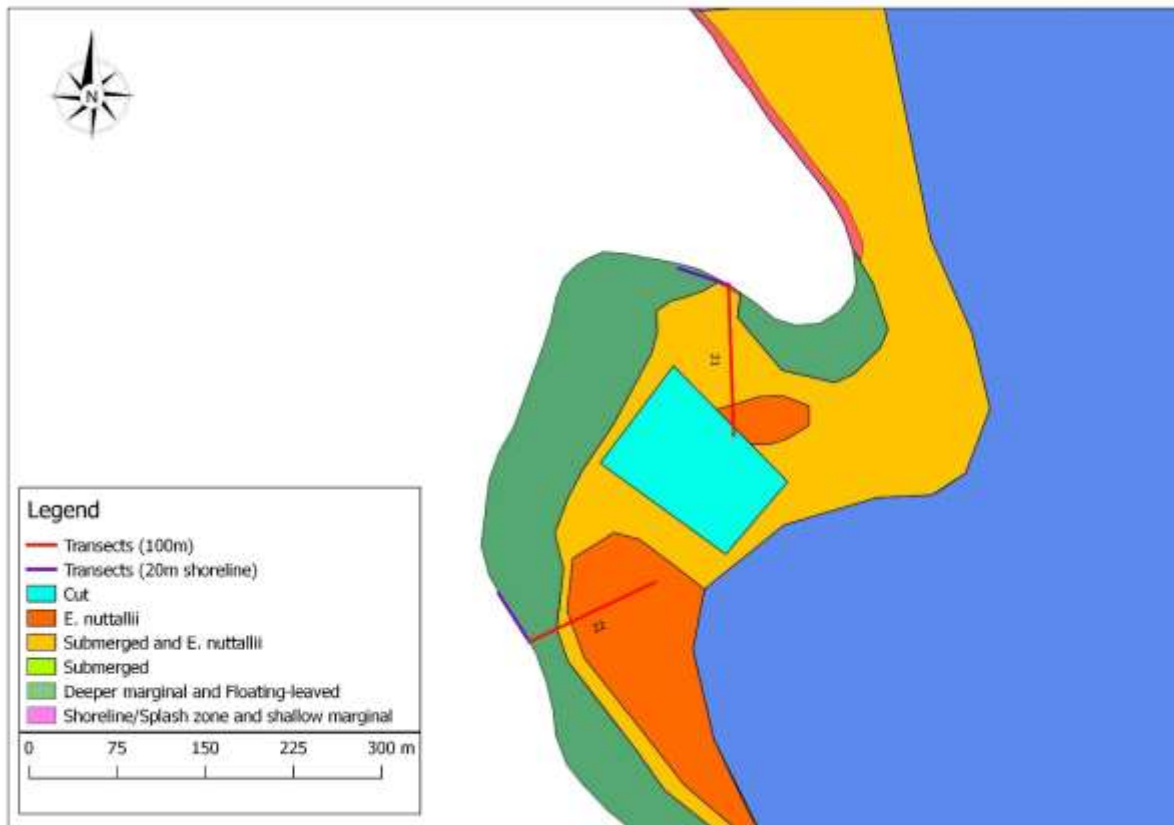


Figure 4.4 The area of lake in Laundry Bay, Lough Arrow, that was mechanically cut (bright blue) in September 2018.

In preparation for the installation of jute matting in Loughbrick Bay later that month, areas of dense *E. nuttallii* infestation that had been identified for jute mat laying were mechanically cut. Just a single cut was given to the sections to be used for jute matting, with the intention of removing any *E. nuttallii* canopy and at least some of the submerged weed. This would permit the jute to bring the remaining attached weed to the lake bed as it saturates and sinks. An area of c. 6,000m² in Loughbrick Bay and 3,400m² in The Gap was cut in this manner.



Plate 4.4. Quadrats (1m²) set in uncut control (left) and cut (right) sections of Laundry Bay in September 2018.

The percentage cover and the fresh weight biomass (g/m²) of submerged macrophyte species and *E. nuttallii* that was recorded from the ten quadrats (1m²) in the cut section of Laundry Bay and an adjacent control area are presented in Tables 4.3 and 4.4, and Plate

4.4, respectively. The data contained in these tables will be used to assess the efficacy of the mechanical cutting operation when similar quadrat data are recorded in this section of lake in 2019, one year after the cutting was conducted.

Table 4.3 Percentage cover of the principal macrophyte and invasive alien plant species (*Elodea nuttallii*) recorded from random quadrats (1m²) in mechanically cut and uncut sections of Laundry Bay in September 2018.

Bay	Treatment	Quadrat	Depth	<i>Elodea nuttallii</i>	<i>Chara</i> spp.	Broad-leaved <i>Potamogeton</i> spp.
Laundry Bay	Cut	1	2.2	10	10	10
Laundry Bay	Cut	2	2.1	10	-	-
Laundry Bay	Cut	3	2.8	-	-	30
Laundry Bay	Cut	4	2.3	20	10	10
Laundry Bay	Cut	5	2.4	-	-	20
Laundry Bay	Cut	6	2.3	-	-	-
Laundry Bay	Cut	7	1.9	10	-	10
Laundry Bay	Cut	8	2.3	-	10	10
Laundry Bay	Cut	9	2.6	10	-	-
Laundry Bay	Cut	10	2.4	-	-	10
Laundry Bay	Uncut	1	2.1	20	20	80
Laundry Bay	Uncut	2	2.3	10	-	90
Laundry Bay	Uncut	3	1.8	30	20	70
Laundry Bay	Uncut	4	2.7	-	10	80
Laundry Bay	Uncut	5	2.3	10	30	60
Laundry Bay	Uncut	6	2.4	20	20	80
Laundry Bay	Uncut	7	2.5	-	-	70
Laundry Bay	Uncut	8	2.1	10	10	80
Laundry Bay	Uncut	9	2	10	-	90
Laundry Bay	Uncut	10	1.9	-	10	60

Table 4.4 Biomass (fresh weight, g/m²) of the principal macrophyte and invasive alien plant species (*Elodea nuttallii*) recorded from random quadrats (1m²) in mechanically cut and uncut sections of Laundry Bay in September 2018.

	Treatment	Biomass (kg/m ²)	<i>Elodea nuttallii</i>	<i>Chara</i> spp.	Broad-leaved <i>Potamogeton</i> spp.
Laundry Bay	Cut	1.814368	40	60	-
Laundry Bay	Cut	2.721552	30	70	-
Laundry Bay	Cut	1.360776	60	40	-
Laundry Bay	Uncut	3.628736	90	2	3
Laundry Bay	Uncut	4.53592	90	5	2
Laundry Bay	Uncut	4.082328	80	3	2

4.3. Results from Jute Laying Trials

In total, 3,590m² of *Elodea nuttallii*-infested lake bed in the vicinity of Loughbrick Bay (see Plate 4.3) was treated with jute matting in September 2018.

The jute matting was strategically laid to create a number of 'biosecure' lanes or corridors in the vicinity of the slipway and pier at Loughbrick Bay and at The Gap (Plate 4.5) for anglers, boaters and other water users. The double layer of jute was deployed directly out from the slipway and extended 85m into the lake, to a maximum depth of c. 4m. (This was a depth beyond which no significant stands of *E. nuttallii* were present.) The corridor was c. 9m wide and covered an area of 765m².



Plate 4.5. Location of the slipway and pier at Loughbrick Bay and The Gap immediately south of the bay.

From the pier exit another jute mat corridor was laid, using a single layer of jute on this occasion. This covered a total lake bed area of 900m² and, again, extended to the limit of the dense *E. nuttallii* in the bay. A third jute mat corridor was positioned to cater for boats that left the slipway and headed directly for the canal rather than The Gap. This comprised a single layer of jute and covered an area of 425m² (Plate 4.6).



Plate 4.6. Arrangement of jute mat 'biosecure' corridors from the slipway and pier in Loughbrick Bay in September 2018.

In order to maintain the biosecurity of the area and to limit the spread of *E. nuttallii* fragments by boats, a further single layer of jute matting was placed outside The Gap, again extending from relatively shallow water close to the narrows to water beyond which dense stands of the

invasive plant species were not recorded (see Plate 4.3). This single sheet of jute matting extended for 300m and covered an area of 1,500m².

Table 4.5 Percentage cover of the principal macrophyte and invasive alien plant species (*Elodea nuttallii*) recorded from random quadrats (1m²) in sections of Loughbrick Bay designated for treatment with a single and double layer of jute matting in September 2018. Adjacent untreated (control) areas were also assessed.

Bay	Treatment	Quadrat	Depth	<i>Elodea nuttallii</i>	<i>Chara</i> spp.	Broad-leaved <i>Potamogeton</i> spp.
Loughbrick	Single	1	0.7	1	10	1
Loughbrick	Single	2	0.8	1	8	1
Loughbrick	Single	3	1.1	1	9	1
Loughbrick	Single	4	1.1	8	8	-
Loughbrick	Single	5	1.4	10	-	-
Loughbrick	Single	6	1.3	10	-	-
Loughbrick	Single	7	1.4	9	-	-
Loughbrick	Single	8	1.4	8	-	-
Loughbrick	Single	9	1.7	10	-	-
Loughbrick	Single	10	1.8	10	-	-
Loughbrick	Double	1	0.7	1	7	2
Loughbrick	Double	2	0.9	1	8	2
Loughbrick	Double	3	1.2	8	5	1
Loughbrick	Double	4	1.3	9	-	-
Loughbrick	Double	5	1.2	10	-	-
Loughbrick	Double	6	1.3	9	5	-
Loughbrick	Double	7	1.4	10	-	-
Loughbrick	Double	8	1.7	10	-	-
Loughbrick	Double	9	1.6	6	9	-
Loughbrick	Double	10	1.8	-	7	-
Loughbrick	Control	1	1	1	9	3
Loughbrick	Control	2	1.1	7	3	-
Loughbrick	Control	3	1.2	7	3	-
Loughbrick	Control	4	1.2	8	-	2
Loughbrick	Control	5	1.4	6	1	2
Loughbrick	Control	6	1.4	1	8	1
Loughbrick	Control	7	1.4	2	8	-
Loughbrick	Control	8	1.5	9	2	-
Loughbrick	Control	9	1.5	10	-	-
Loughbrick	Control	10	1.7	9	5	-

The percentage cover and the fresh weight biomass (g/m²) of *E. nuttallii* and associated submerged macrophyte species that was recorded from the ten quadrats (1m²) in each of the single jute layer, double jute layer and control sections in Loughbrick Bay are presented in Tables 4.5 and 4.6, respectively. The data contained in these tables will be used to

assess the efficacy of the jute mat laying operations when similar quadrat data are recorded in this section of lake in 2019 and 2020, one and two years after the jute was laid.

Table 4.6. Biomass (fresh weight, g/m²) of macrophyte and invasive alien plant species recorded from three random quadrats in sections of lake to be treated with jute matting and in a control section at Loughbrick Bay in September 2018.

Bay	Treatment	Biomass (kg/m ²)	<i>Elodea nuttallii</i>	<i>Chara</i> spp.	<i>Myriophyllum spicatum</i>	<i>Lemna trisulca</i>
Loughbrick	Single	9.07184	97	2	3	-
Loughbrick	Single	4.309124	80	5	-	-
Loughbrick	Single	1.360776	85	-	2	-
Loughbrick	Double	5.443104	100	-	-	-
Loughbrick	Double	1.814368	95	3	-	5
Loughbrick	Double	4.762716	90	3	-	-
Loughbrick	Control	7.711064	75	25	-	-
Loughbrick	Control	3.855532	80	20	-	-
Loughbrick	Control	1.814368	90	10	-	-

4.4. Infestations of other IAPS near Lough Arrow

Three riparian and terrestrial IAPS were recorded on the lake shore, on roadside verges and private property near Lough Arrow during the survey in 2018 (Figure 4.5). *Impatiens glandulifera* (Himalayan balsam) was recorded from the roadside at one isolated location near the gates of Ballindoon House (see Figure 2.1). This species is one of 49 invasive alien species of Union concern contained in European IAS legislation. Given the apparent restricted nature of the infestation, it may be deemed prudent to carry out control works before this IAPS reaches the lake and adjoining Unshin River. *Fallopia japonica* (Japanese knotweed) was recorded at 11 locations, primarily on the verges of nearby roads. However, five of the infestations on the east side of the lake were recorded in close proximity to the lakeshore. An infestation of *Persicaria wallichii* (Himalayan knotweed) was recorded along the roadside verge near Bellarush (see Figures 2.1 and 4.5).

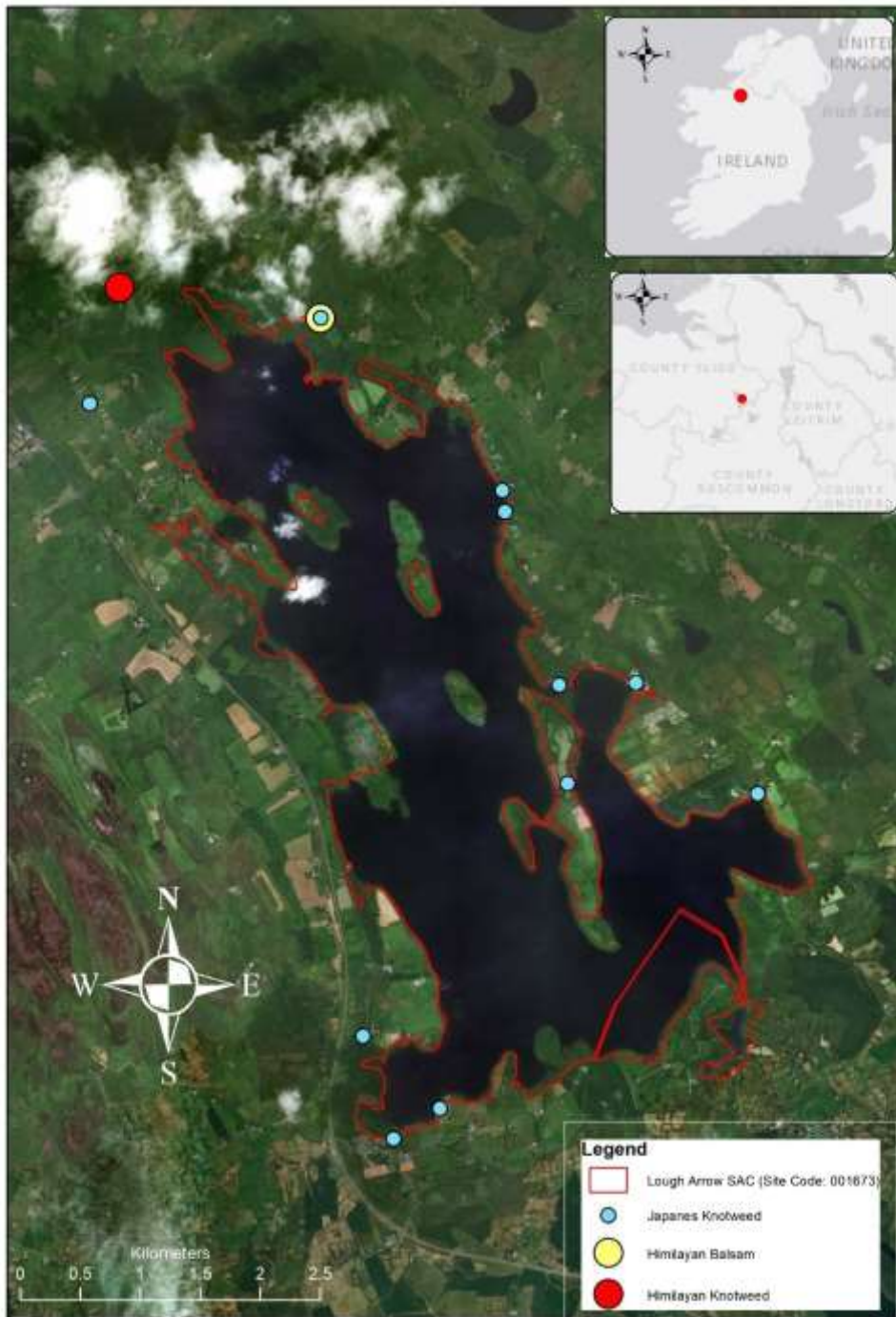


Figure 4.5 Infestations of three terrestrial and riparian IAPS recorded in close proximity to Lough Arrow in 2018.

5. FUTURE WORK PROGRAMME ON LOUGH ARROW FOR 2019 AND 2020

In 2019, the locations in Lough Arrow that were mechanically cut and on which jute matting was laid will be monitored and the effects of these physical intervention measures will be quantified. Quadrat analysis conducted in 2018 and in 2019 will be analysed to determine the level of weed control that was achieved using a) mechanical cutting and where b) a single layer and c) a double layer of jute matting was used.

In early 2019, INVAS Biosecurity Ltd. will work with IT Sligo and IFI to ensure the proper placement of buoys in areas where the jute matting was strategically placed. The objective will be to create clear 'biosecure' corridors or lanes from Loughbrick pier and slipway that will be used by all boaters entering and leaving the lake at this location. The use of these lanes will ensure that live fragments of the invasive alien plant *Elodea nuttallii* will not become caught up in the propellers of outboard motors, on the hulls of boats or on trailers as they enter or leave the lake. This will assist in the national campaign to stop the spread of invasive species in the country. Further assistance will be given to the IT Sligo and the Interreg VA CANN team to create awareness among anglers and other water users of IAPS problems and solutions in the lake.

In early 2019, the results from macrophyte surveys that were conducted on Lough Arrow in 1984, 2001, 2017 and 2018 will be examined and compared. The intention will be to produce a multi-authored scientific paper that describes the changes in the macrophyte status and communities in the lake over this period. Particular attention will be paid to the establishment of the invasive alien plant species *E. nuttallii* since 2001.

When definitive results from the quadrat analysis to be conducted on the jute matting experiment become available, it is proposed to prepare a scientific paper that will describe the results.

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Appendix I

Lake	Lough Arrow							
Transect No.	1							
Date	July_2018							
Secchi depth (m)	4.1							
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	6.8	3.8	1.6	0.9	0.6	0.4	0.3	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	-	-	-	-	1	1	-	-
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	-	-	-	-
<i>Elodea canadensis</i>	-	-	2	5	2	2	2	-
<i>Elodea nuttallii</i>	-	-	-	-	1	-	-	-
<i>Equisetum fluviatile</i>	-	-	-	-	-	-	-	-
<i>Fontinalis antipyretica</i>	-	2	5	-	-	-	-	-
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	-	4	4	-	2	2	1	-
<i>Littorella uniflora</i>	-	-	-	-	-	-	-	-
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	-
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	-	1	-	1	1	1	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	3	2	-	-	-
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	-	-	-	-	-
<i>Potamogeton gramineus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton lucens</i>	-	-	-	3	-	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	-	5	5	5	1
<i>Sparganium angustifolium</i>	-	-	1	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-

Lake	Lough Arrow							
Transect No.	2							
Date	July_2018							
Secchi depth (m)	3.6							
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	14	7.8	2.1	0.5	0.3	0.15	0.1	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	-	-	1	5	4	3	-	4
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	-	-	-	-
<i>Elodea canadensis</i>	-	-	-	-	-	-	-	-
<i>Elodea nuttallii</i>	-	-	1	-	-	-	-	1
<i>Equisetum fluviatile</i>	-	-	-	-	-	-	-	-
<i>Fontinalis antipyretica</i>	-	-	1	1	1	-	2	-
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	-	-	-	-	-	-	-	-
<i>Littorella uniflora</i>	-	-	-	-	2	2	4	-
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	-
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	2	-	1	1	-
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	-	-	-	-	-	-	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	-	-	-	2	2
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	-	1	-	1	3
<i>Potamogeton gramineus</i>	-	-	2	3	2	2	2	2
<i>Potamogeton lucens</i>	-	-	2	-	-	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	-	-	3	-	-	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	-	-	-	-	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-

Lake	Lough Arrow							
Transect No.	3							
Date	July_2018							
Secchi depth (m)	2.3	To bottom						
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	2.3	2.3	1.1	0.4	0.15	0.1	0.1	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	-	-	-	-	-	-	-	-
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	1	-	2	2
<i>Elodea canadensis</i>	-	-	-	-	-	-	-	-
<i>Elodea nuttallii</i>	-	-	-	-	1	-	1	-
<i>Equisetum fluviatile</i>	-	-	-	-	-	-	1	1
<i>Fontinalis antipyretica</i>	-	-	-	-	-	-	-	-
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	-	-	-	-	-	-	-	-
<i>Littorella uniflora</i>	-	-	-	1	3	-	-	2
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	-
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	1	-	-	-
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	-	-	-	-	1	-	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	-	-	-	-	-
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	5	2	-	-	-
<i>Potamogeton gramineus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton lucens</i>	-	-	-	-	-	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	2	-	-	-	-	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	-	-	-	-	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-

Lake	Lough Arrow							
Transect No.	4							
Date	July_2018							
Secchi depth (m)	3.95	175m from shore						
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	4.2	2.2	1.7	0.8	0.35	0.2	0.1	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	-	-	-	1	-	-	-	-
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	-	2	2	3
<i>Elodea canadensis</i>	-	-	-	-	-	-	-	-
<i>Elodea nuttallii</i>	-	-	-	-	-	-	-	-
<i>Equisetum fluviatile</i>	-	-	-	-	-	-	-	-
<i>Fontinalis antipyretica</i>	-	-	-	-	3	1	-	-
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	-	-	-	-	-	-	-	-
<i>Littorella uniflora</i>	-	-	-	-	3	3	3	-
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	2
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	-	-	-	-	-	-	3
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	-	-	-	-	-
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	1	3	2	2	-
<i>Potamogeton gramineus</i>	-	-	-	-	-	-	-	2
<i>Potamogeton lucens</i>	-	-	-	-	-	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	2	2	-	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	3	2	1	4	-	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	-	-	-	-	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	1
<i>Spirogyra intestinalis</i>	2	2	1	2	3	3	4	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-

Lake	Lough Arrow								
Transect No.	5								
Date	July_2018								
Secchi depth (m)	3.9								
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0	
Depth	3	3	3	2.2	0.5	0.3	0.2	0	
Species									
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	-	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	-	-	-	-	-	-	-	-	-
<i>Carex spp.</i>	-	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	-	-	-	-	-
<i>Elodea canadensis</i>	-	-	-	-	-	-	-	-	-
<i>Elodea nuttallii</i>	-	4	2	1	1	1	-	-	-
<i>Equisetum fluviatile</i>	-	-	-	-	-	-	-	-	-
<i>Fontinalis antipyretica</i>	-	-	-	-	-	-	-	-	-
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-	-
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	-	-	-	-	-	-	-	-	-
<i>Littorella uniflora</i>	-	-	-	-	2	1	1	-	-
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	-	-
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	1	-	-	-
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	-	-	-	-	-	-	-	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	-	-	-	-	-	-
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	-	-	-	-	-	-
<i>Potamogeton gramineus</i>	-	-	-	-	2	-	-	-	-
<i>Potamogeton lucens</i>	-	-	-	-	-	-	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	-	3	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	5	5	5	5	-	-	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	1	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	-	-	-	-	-	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-	-

Lake	Lough Arrow							
Transect No.	6							
Date	July_2018							
Secchi depth (m)	3.8							
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	9.3	3.8	3.3	1.7	1.1	0.4	0.1	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	-	-	-	-	-	-	-	-
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	-	-	-	3
<i>Elodea canadensis</i>	-	-	-	-	-	-	-	-
<i>Elodea nuttallii</i>	-	-	-	-	-	-	-	-
<i>Equisetum fluviatile</i>	-	-	-	-	-	-	-	2
<i>Fontinalis antipyretica</i>	-	-	-	-	-	-	1	1
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	-	-	-	-	-	-	-	-
<i>Littorella uniflora</i>	-	-	-	-	-	2	3	4
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	1
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	1	-	-	-	-	-	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	-	-	-	-	-
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	-	-	4	4	3
<i>Potamogeton gramineus</i>	-	-	-	-	2	-	-	-
<i>Potamogeton lucens</i>	-	-	-	-	-	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	-	5	5	5	-	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	-	-	-	-	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-

Lake	Lough Arrow							
Transect No.	7							
Date	July_2018							
Secchi depth (m)	3.9							
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	4.2	1.7	1.3	1.1	1	1	0.3	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	1
<i>Chara sp. (cf. rudis)</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	-	5	-	-	3	2	2	-
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	-	-	-	2
<i>Elodea canadensis</i>	-	-	-	-	-	-	-	-
<i>Elodea nuttallii</i>	-	5	5	-	-	-	-	-
<i>Equisetum fluviatile</i>	-	-	-	-	-	2	-	2
<i>Fontinalis antipyretica</i>	-	-	-	-	-	-	-	-
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	-	-	-	-	-	-	-	-
<i>Littorella uniflora</i>	-	-	-	-	4	2	3	5
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	3
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	-	-	-	2	2	-	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	2
<i>Phragmites australis</i>	-	-	-	-	-	-	-	-
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	-	-	-	-	-
<i>Potamogeton gramineus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton lucens</i>	-	-	3	4	3	3	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	-	-	-	-	2	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	-	-	-	-	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-

Lake	Lough Arrow								
Transect No.	8								
Date	July_2018								
Secchi depth (m)	4.1								
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0	
Depth	12	8.2	5.4	2.6	0.6	0.3	0.1	0	
Species									
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	-	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	-	-	-	-	-	-	-	-	-
<i>Carex spp.</i>	-	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	-	-	-	-	-
<i>Elodea canadensis</i>	-	-	-	-	-	-	-	-	-
<i>Elodea nuttallii</i>	-	-	-	-	-	-	-	-	-
<i>Equisetum fluviatile</i>	-	-	-	-	-	-	-	-	-
<i>Fontinalis antipyretica</i>	-	-	-	-	-	-	-	-	-
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-	-
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	-	-	-	-	-	-	-	-	-
<i>Littorella uniflora</i>	-	-	-	-	-	-	-	-	-
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	-	-
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	-	-	-	-
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	-	-	-	-	-	-	-	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	-	-	-	-	-	-
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	-	-	-	-	-	-
<i>Potamogeton gramineus</i>	-	-	-	-	2	3	3	-	-
<i>Potamogeton lucens</i>	-	-	-	4	-	-	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	-	-	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	-	-	3	2	-	-	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	-	-	-	-	-	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-	-

Lake	Lough Arrow							
Transect No.	9							
Date	July_2018							
Secchi depth (m)	4.1							
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	21	18	16	6.2	1.5	0.6	0.2	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	-	-	-	-	5	2	1	1
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	-	-	-	-
<i>Elodea canadensis</i>	-	-	-	-	1	3	-	-
<i>Elodea nuttallii</i>	-	-	-	1	3	-	-	-
<i>Equisetum fluviatile</i>	-	-	-	-	-	-	-	-
<i>Fontinalis antipyretica</i>	-	-	-	-	-	-	-	-
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	-	-	-	-	-	3	-	-
<i>Littorella uniflora</i>	-	-	-	-	-	-	-	-
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	-
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	-	-	2
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	-	-	-	-	-	-	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	-	-	-	-	-
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	-	-	3	-	1
<i>Potamogeton gramineus</i>	-	-	-	-	-	3	2	2
<i>Potamogeton lucens</i>	-	-	-	-	-	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	1	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	-	-	-	-	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-

Lake	Lough Arrow							
Transect No.	10							
Date	July_2018							
Secchi depth (m)	3.9	175m from shore						
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	3.2	2.2	1.2	0.7	0.4	0.3	0.2	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	-	1	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	5	-	5	5	5	5	5	2
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	-	-	-	5
<i>Elodea canadensis</i>	-	-	-	-	-	-	-	-
<i>Elodea nuttallii</i>	1	-	-	-	-	1	-	-
<i>Equisetum fluviatile</i>	-	-	-	-	-	-	-	2
<i>Fontinalis antipyretica</i>	-	-	-	-	-	-	-	-
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	-	-	-	-	-	-	-	-
<i>Littorella uniflora</i>	-	-	-	-	-	-	-	3
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	-
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	-	-	1
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	-	-	-	-	-	-	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	-	-	-	-	-
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	-	-	-	-	-
<i>Potamogeton gramineus</i>	-	-	-	2	4	4	3	2
<i>Potamogeton lucens</i>	-	4	2	-	-	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	-	-	-	-	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-

Lake	Lough Arrow							
Transect No.	11							
Date	July_2018							
Secchi depth (m)	4 140m from shore							
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	2.6	1.8	1.5	0.8	0.4	0.4	0.2	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	-	5	5	4	3	3	4	4
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	-	4	3	4
<i>Elodea canadensis</i>	-	2	2	-	-	-	-	-
<i>Elodea nuttallii</i>	3	-	-	1	-	2	2	1
<i>Equisetum fluviatile</i>	-	-	-	-	-	-	-	-
<i>Fontinalis antipyretica</i>	-	1	-	-	-	-	-	-
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	-	-	-	-	-	-	-	-
<i>Littorella uniflora</i>	-	-	-	-	-	4	3	3
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	-
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum spicatum</i>	-	-	-	-	-	1	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	-	-	-	-	-	-	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	3	-	-	-	-
<i>Polygonum amphibium</i>	-	-	-	-	-	-	2	3
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	-	3	3	3	-
<i>Potamogeton gramineus</i>	-	-	-	2	-	-	-	-
<i>Potamogeton lucens</i>	-	-	-	-	-	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	4	-	-	-	-	1	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	-	-	-	-	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-

Lake	Lough Arrow							
Transect No.	12							
Date	July_2018							
Secchi depth (m)	3.4							
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	6.5	5.1	3.8	1.4	1.1	0.6	0.2	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	-	-	-	-	-	-	-	-
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	-	-	-	-
<i>Elodea canadensis</i>	-	-	-	-	-	-	-	-
<i>Elodea nuttallii</i>	-	-	-	-	-	-	-	-
<i>Equisetum fluviatile</i>	-	-	-	-	-	-	-	-
<i>Fontinalis antipyretica</i>	-	-	-	-	-	-	-	-
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	-	-	-	-	-	-	-	-
<i>Littorella uniflora</i>	-	-	-	-	-	-	-	-
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	-
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	-	-	-	-	-	-	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	-	-	-	-	-
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	-	3	-	-	-
<i>Potamogeton gramineus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton lucens</i>	-	-	-	-	-	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	-	-	-	-	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-

Lake	Lough Arrow							
Transect No.	13							
Date	July_2018							
Secchi depth (m)	4.1							
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	5.9	1.9	1.3	0.9	0.7	0.4	0.3	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	1
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	-	1	4	5	3	-	-	-
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	2	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	3	3	-	-
<i>Elodea canadensis</i>	-	-	2	-	-	-	-	-
<i>Elodea nuttallii</i>	-	5	4	1	-	1	-	-
<i>Equisetum fluviatile</i>	-	-	-	-	3	-	-	2
<i>Fontinalis antipyretica</i>	-	-	-	-	-	-	-	-
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	-	-	-	-	-	-	-	2
<i>Littorella uniflora</i>	-	-	-	-	3	-	-	-
<i>Mentha aquatica</i>	-	-	-	-	-	3	3	2
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	-	-	-	-	2	-	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	-	-	-	-	-
<i>Polygonum amphibium</i>	-	-	-	-	-	3	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	-	-	-	-	-
<i>Potamogeton gramineus</i>	-	-	-	-	3	-	-	-
<i>Potamogeton lucens</i>	-	-	-	-	-	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	-	3	3	-	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-

Lake	Lough Arrow							
Transect No.	14							
Date	July_2018							
Secchi depth (m)	3.7 160m from shore							
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	2.6	2	1.9	1.2	1	0.4	0.2	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	-	-	5	5	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	4	5	-	-	5	4	4	-
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	-	-	-	3
<i>Elodea canadensis</i>	3	3	1	-	-	-	-	-
<i>Elodea nuttallii</i>	3	2	2	2	-	-	-	-
<i>Equisetum fluviatile</i>	-	-	-	-	-	-	-	2
<i>Fontinalis antipyretica</i>	4	-	-	-	-	-	-	-
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	-	-	-	-	-	-	-	-
<i>Littorella uniflora</i>	-	-	-	-	3	4	3	4
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	1
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	2	-	-	-	-	-	2	2
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	-	-	-	-	-	-	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	-	-	-	-	-
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	-	3	3	4	3
<i>Potamogeton gramineus</i>	-	-	-	-	2	-	-	-
<i>Potamogeton lucens</i>	-	-	-	-	-	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	-	3	2	-	-	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	-	-	-	-	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-

Lake	Lough Arrow							
Transect No.	15							
Date	July_2018							
Secchi depth (m)	1.4	To bottom						
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	1.4	1.4	1.3	1.3	1.1	0.6	0.5	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	1	-	1
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	-	-	-	-	-	-	-	-
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	2	2	2	3	3	4	-
<i>Eleocharis palustris</i>	-	-	-	-	-	-	-	-
<i>Elodea canadensis</i>	-	-	-	-	-	-	-	-
<i>Elodea nuttallii</i>	3	1	3	1	1	2	-	-
<i>Equisetum fluviatile</i>	-	-	-	3	5	2	2	-
<i>Fontinalis antipyretica</i>	-	5	5	4	5	4	-	2
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	4	-	4	-	4	4	-	-
<i>Littorella uniflora</i>	-	-	-	-	-	-	-	-
<i>Mentha aquatica</i>	-	-	-	-	-	-	2	2
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	2	2
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	-	-	-	2	4	3	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	2
<i>Phragmites australis</i>	2	-	-	-	-	-	-	-
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	-	-	-	-	-
<i>Potamogeton gramineus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton lucens</i>	4	5	5	-	-	-	-	-
<i>Potamogeton natans</i>	-	-	-	5	5	2	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	-	-	-	-	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	4	2	2	-	-	2	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-

Lake	Lough Arrow							
Transect No.	16							
Date	July_2018							
Secchi depth (m)	4.4 500m from shore							
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	2.6	2.2	1.4	1.2	1	0.4	0.2	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	-	-	-	-	-	1	1	1
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	-	-	2	2
<i>Elodea canadensis</i>	-	-	-	-	-	-	-	-
<i>Elodea nuttallii</i>	3	3	3	2	2	-	-	-
<i>Equisetum fluviatile</i>	-	-	-	-	-	-	-	-
<i>Fontinalis antipyretica</i>	-	-	-	-	-	-	-	-
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	-	-	-	-	-	-	-	-
<i>Littorella uniflora</i>	-	-	-	-	2	2	4	5
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	-
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	2	1	4	2	-	-	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	-	-	-	-	-
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	-	-	1	-	2
<i>Potamogeton gramineus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton lucens</i>	-	-	3	4	2	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	-	-	-	3	-	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	-	-	-	-	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-

Lake	Lough Arrow							
Transect No.	17							
Date	July_2018							
Secchi depth (m)	2 To bottom							
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	2	1.6	1	0.8	0.6	0.5	0.4	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	-	-	1	2	2	1	-	-
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	-	-	-	-
<i>Elodea canadensis</i>	-	-	-	-	-	-	-	-
<i>Elodea nuttallii</i>	-	-	2	2	2	2	-	-
<i>Equisetum fluviatile</i>	-	-	-	-	-	-	-	-
<i>Fontinalis antipyretica</i>	-	-	-	-	-	-	-	-
<i>Hippuris vulgaris</i>	-	-	-	-	-	3	2	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	1
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	-	-	-	-	-	-	-	-
<i>Littorella uniflora</i>	-	-	-	-	-	-	-	-
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	2
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	2	-	2	4	3	-	-	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	-	-	-	-	-
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	-	2	3	-	1
<i>Potamogeton gramineus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton lucens</i>	-	-	-	-	-	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	3	3	3	2	-	-	-	-
<i>Potamogeton perfoliatus</i>	-	-	-	-	1	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	-	-	-	-	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-

Lake	Lough Arrow							
Transect No.	18							
Date	July_2018							
Secchi depth (m)	1.5	To bottom						
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	1.5	1.3	1.1	0.4	0.3	0.2	0.2	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	5	-	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	-	4	3	3	3	-	-	-
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	4	4
<i>Eleocharis palustris</i>	-	-	-	-	-	-	-	-
<i>Elodea canadensis</i>	-	-	-	-	-	-	-	-
<i>Elodea nuttallii</i>	3	-	1	-	-	-	-	-
<i>Equisetum fluviatile</i>	-	-	-	-	-	-	-	-
<i>Fontinalis antipyretica</i>	-	-	-	-	-	-	-	-
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	1
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	-	-	-	-	-	-	-	-
<i>Littorella uniflora</i>	-	-	-	-	-	-	-	-
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	2
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	2
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	-	-	-	-	-	-	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	4	3	4	-	5
<i>Polygonum amphibium</i>	-	-	-	-	-	-	1	1
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	-	1	1	-	-
<i>Potamogeton gramineus</i>	-	-	-	2	2	-	3	2
<i>Potamogeton lucens</i>	2	2	1	-	-	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	2	2	2
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	4	4	2	-	5
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-

Lake	Lough Arrow							
Transect No.	19							
Date	July_2018							
Secchi depth (m)	1.7	To bottom						
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	1.7	1.3	0.9	0.5	0.5	0.3	0.2	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	5	5	5	2	1	-	-	-
<i>Chara sp. (cf. virgata)</i>	-	-	-	-	-	-	-	-
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	-	-	-	-
<i>Elodea canadensis</i>	-	-	3	-	-	-	-	-
<i>Elodea nuttallii</i>	3	3	1	-	-	-	-	-
<i>Equisetum fluviatile</i>	-	-	-	-	-	-	-	-
<i>Fontinalis antipyretica</i>	-	-	-	-	-	-	-	-
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	2
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	-	-	-	2	2	-	3	-
<i>Littorella uniflora</i>	-	-	-	-	-	-	-	2
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	-
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	-	-	-	-	3	2	2
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	-	-	-	-	-
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	2	-	-	-	-	-	-
<i>Potamogeton gramineus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton lucens</i>	-	2	2	-	-	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	-	-	-	-	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-

Lake	Lough Arrow							
Transect No.	20							
Date	July_2018							
Secchi depth (m)	2.3	To bottom						
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	2.3	2.8	2.1	1.2	0.6	0.4	0.3	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	5	4	2	2	3	2	1	-
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	-	-	-	1
<i>Elodea canadensis</i>	-	-	-	-	-	-	-	-
<i>Elodea nuttallii</i>	-	-	-	-	-	-	-	-
<i>Equisetum fluviatile</i>	-	-	-	-	-	-	-	-
<i>Fontinalis antipyretica</i>	-	-	-	-	-	-	-	-
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	-	-	-	-	-	-	-	-
<i>Littorella uniflora</i>	-	-	-	-	3	3	2	1
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	3
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	-	-	-	-	-	-	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	-	-	-	-	-
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	-	-	-	-	-
<i>Potamogeton gramineus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton lucens</i>	-	-	-	-	-	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	3	3	4	2	-	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	-	-	-	-	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-

Lake	Lough Arrow							
Transect No.	21							
Date	July_2018							
Secchi depth (m)	3.8							
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	2.6	2.1	1.6	1.1	0.4	0.2	0.1	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	3	2	5	5	4	4	3	-
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	-	-	-	-
<i>Elodea canadensis</i>	-	-	-	-	-	-	-	-
<i>Elodea nuttallii</i>	5	2	3	2	-	-	-	-
<i>Equisetum fluviatile</i>	-	-	-	-	-	-	-	-
<i>Fontinalis antipyretica</i>	-	-	-	-	-	2	1	1
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	-	-	-	-	-	-	-	-
<i>Littorella uniflora</i>	-	-	-	-	-	4	4	2
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	-
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	-	2	-	-	-	-	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	-	-	-	-	-
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	-	-	-	3	2
<i>Potamogeton gramineus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton lucens</i>	2	2	3	3	-	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	-	-	-	-	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-

Lake	Lough Arrow							
Transect No.	22							
Date	July_2018							
Secchi depth (m)								
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	2.4	2	1.6	1.3	0.8	0.4	0.2	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	5	-	-	5	-	-	-	-
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	-	-	-	-
<i>Elodea canadensis</i>	-	-	-	-	-	-	-	-
<i>Elodea nuttallii</i>	5	5	5	4	-	-	-	-
<i>Equisetum fluviatile</i>	-	-	-	-	-	-	-	-
<i>Fontinalis antipyretica</i>	-	-	-	-	2	2	1	1
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	-	-	-	-	-	-	-	-
<i>Littorella uniflora</i>	-	-	-	-	3	4	2	3
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	-
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	-	-	-	-	-	-	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	3	-	-	-	-
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	-	-	2	2	2
<i>Potamogeton gramineus</i>	-	-	-	-	-	2	2	-
<i>Potamogeton lucens</i>	-	2	5	4	-	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	-	-	-	-	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	5	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-

Lake	Lough Arrow							
Transect No.	23							
Date	July_2018							
Secchi depth (m)								
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	2.8	2.4	1.7	1.2	1	0.6	0.2	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	-	-	-	-	3	4	-	-
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	-	-	-	-
<i>Elodea canadensis</i>	-	-	-	-	-	-	-	-
<i>Elodea nuttallii</i>	-	3	4	5	3	-	2	-
<i>Equisetum fluviatile</i>	-	-	-	-	-	-	-	-
<i>Fontinalis antipyretica</i>	-	-	-	-	-	-	-	2
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	4	3	2	2	1	-	-	-
<i>Littorella uniflora</i>	-	-	-	-	-	3	3	3
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	-
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	-	-	-	-	-	-	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	-	3	2	2	3
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	-	1	-	-	-
<i>Potamogeton gramineus</i>	-	-	-	-	3	2	3	-
<i>Potamogeton lucens</i>	-	-	-	-	-	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	-	3	3	2	2	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	-	-	-	-	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-

Lake	Lough Arrow							
Transect No.	24							
Date	July_2018							
Secchi depth (m)								
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	6.8	3.8	1.6	0.9	0.6	0.4	0.3	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	-	-	-	-	-	2	2	-
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	-	-	-	2
<i>Elodea canadensis</i>	-	-	-	-	-	-	-	-
<i>Elodea nuttallii</i>	-	-	-	-	-	-	-	-
<i>Equisetum fluviatile</i>	-	-	-	-	-	-	-	-
<i>Fontinalis antipyretica</i>	-	-	-	-	-	-	-	-
<i>Hippuris vulgaris</i>	-	-	2	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	-	-	-	-	-	-	-	-
<i>Littorella uniflora</i>	-	-	-	-	-	-	-	-
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	2
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	-	-	1	2	1	-	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	-	-	-	-	-
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	-	-	-	-	-
<i>Potamogeton gramineus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton lucens</i>	-	4	-	-	-	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	3	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	-	-	2	4	-	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	-	-	-	-	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-

Lake	Lough Arrow							
Transect No.	25							
Date	July_2018							
Secchi depth (m)								
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	5.6	3.2	2.4	1.2	0.5	0.3	0.2	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	-	-	-	-	3	2	2	-
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	-	-	-	-
<i>Elodea canadensis</i>	-	-	-	-	-	-	-	-
<i>Elodea nuttallii</i>	-	4	4	-	-	-	-	-
<i>Equisetum fluviatile</i>	-	-	-	-	-	-	-	-
<i>Fontinalis antipyretica</i>	-	-	-	-	-	-	-	-
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	-	-	-	-	-	-	-	-
<i>Littorella uniflora</i>	-	-	-	-	2	2	2	3
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	3
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	-	-	-	-	-	-	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	-	4	3	4	3
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	-	-	-	-	-
<i>Potamogeton gramineus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton lucens</i>	-	-	4	3	-	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	-	3	-	3	-	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	3	-	-	-	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-

Lake	Lough Arrow							
Transect No.	26							
Date	July_2018							
Secchi depth (m)								
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	2.4	2	1.6	0.9	0.3	0.2	0.1	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	-	-	2	2	-	2	2	2
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	-	-	-	-
<i>Elodea canadensis</i>	-	-	-	-	-	-	-	-
<i>Elodea nuttallii</i>	2	3	3	4	-	-	-	-
<i>Equisetum fluviatile</i>	-	-	-	-	-	-	-	-
<i>Fontinalis antipyretica</i>	-	-	-	-	-	2	2	1
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	5	5	3	1	-	-	-	-
<i>Littorella uniflora</i>	-	-	-	-	-	3	4	5
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	-
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	1	-	-
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	-	-	-	-	-	-	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	2	-	-	-	-
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	-	-	-	3	3
<i>Potamogeton gramineus</i>	-	-	-	-	-	2	-	-
<i>Potamogeton lucens</i>	-	3	2	-	-	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	-	2	-	-	-	-
<i>Potamogeton perfoliatus</i>	2	2	2	-	-	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	4	4	2	2	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-

Lake	Lough Arrow							
Transect No.	27							
Date	July_2018							
Secchi depth (m)								
Site - perpendicular (m)	100	75	50	25	10	5	2.5	0
Depth	11.2	7.7	3.6	1.5	1.2	0.4	0.2	0
Species								
<i>Alisma plantago-aquatica</i>	-	-	-	-	-	-	-	-
<i>Apium nodiflorum</i>	-	-	-	-	-	-	-	-
<i>Baldellia ranunculoides</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. rudis)</i>	-	-	-	-	-	-	-	-
<i>Chara sp. (cf. virgata)</i>	-	-	-	4	3	3	3	-
<i>Carex spp.</i>	-	-	-	-	-	-	-	-
<i>Cicuta virosa</i>	-	-	-	-	-	-	-	-
<i>Cladium mariscus</i>	-	-	-	-	-	-	-	-
<i>Cladophora glomerata</i>	-	-	-	-	-	-	-	-
<i>Eleocharis palustris</i>	-	-	-	-	-	-	1	5
<i>Elodea canadensis</i>	-	-	-	-	-	-	-	-
<i>Elodea nuttallii</i>	-	-	2	3	1	-	-	-
<i>Equisetum fluviatile</i>	-	-	-	-	-	-	-	-
<i>Fontinalis antipyretica</i>	-	-	-	-	-	1	2	-
<i>Hippuris vulgaris</i>	-	-	-	-	-	-	-	-
<i>Hydrocotyle vulgaris</i>	-	-	-	-	-	-	-	-
<i>Iris pseudacorus</i>	-	-	-	-	-	-	-	-
<i>Juncus spp.</i>	-	-	-	-	-	-	-	-
<i>Lemna minor</i>	-	-	-	-	-	-	-	-
<i>Lemna trisulca</i>	-	-	-	-	-	-	-	-
<i>Littorella uniflora</i>	-	-	-	-	-	3	3	5
<i>Mentha aquatica</i>	-	-	-	-	-	-	-	2
<i>Menyanthes trifoliata</i>	-	-	-	-	-	-	-	-
<i>Myostis scorpioides</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum alterniflorum</i>	-	-	-	-	-	-	-	-
<i>Myriophyllum spicatum</i>	-	-	-	-	-	-	-	-
<i>Nasturtium aquaticum</i>	-	-	-	-	-	-	-	-
<i>Nuphar lutea</i>	-	-	-	-	-	-	-	-
<i>Nymphaea alba</i>	-	-	-	-	-	-	-	-
<i>Phalaris arudinacea</i>	-	-	-	-	-	-	-	-
<i>Phragmites australis</i>	-	-	-	-	-	-	-	-
<i>Polygonum amphibium</i>	-	-	-	-	-	-	-	-
<i>Potamogeton crispus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton filiformis</i>	-	-	-	-	-	2	3	-
<i>Potamogeton gramineus</i>	-	-	-	-	2	3	-	2
<i>Potamogeton lucens</i>	-	-	5	5	1	-	-	-
<i>Potamogeton natans</i>	-	-	-	-	-	-	-	-
<i>Potamogeton obtusifolius</i>	-	-	-	-	-	-	-	-
<i>Potamogeton praelongus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pectinatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton perfoliatus</i>	-	-	-	-	-	-	-	-
<i>Potamogeton pusillus</i>	-	-	-	-	-	-	-	-
<i>Ranunculus lingua</i>	-	-	-	-	-	-	-	-
<i>Scirpus lacustris</i>	-	-	-	-	3	-	-	-
<i>Sparganium angustifolium</i>	-	-	-	-	-	-	-	-
<i>Sparganium emersum</i>	-	-	-	-	-	-	-	-
<i>Sparganium erectum</i>	-	-	-	-	-	-	-	-
<i>Spirogyra intestinalis</i>	-	-	-	-	-	-	-	-
<i>Typha latifolia</i>	-	-	-	-	-	-	-	-



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