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Gaudet Luce Golf & Leisure Complex, Worcestershire
ENSIS Report on aquatic habitats 2017

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Gaudet Luce Golf & Leisure Complex, Worcestershire:

Report on aquatic habitats 2017

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Cover Photo: Northwestern margin of Cockshute Pool (S. Goodrich) © ENSIS Ltd.

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1. Introduction and Project Objectives

1.1. Study Rationale

Gaudet Luce Golf & Leisure Complex is located in the county of Worcestershire (Figure 1), southeast of Droitwich Spa town. Founded in 1995, the golf course has undergone an extensive transformation which has included a new Par Three course, reconfiguration of the 18 hole Phoenix Course and the planting of over 50,000 trees across the golf complex, which were supplied to Gaudet Luce via a Forestry Commission grant. Drainage systems have also been improved over time, alongside the installation of new bunkers and tee renovation (Midlands Business News, 2013; Fernihough, 2017).

Beyond the boundaries of the teeing grounds, bunkers, fairways and putting greens, a variety of valuable wildlife habitats are carefully managed by the Gaudet Luce green keepers. Swathes of rough are habitat to a diverse range of native plant species, commonly including Common Bird's-foot-trefoil (*Lotus corniculatus*), Red Clover (*Trifolium pratense*) and Grass Vetchling (*Lathyrus nissolia*). These areas – twelve sites totalling approximately one hectare – were planted by the greenkeepers and consist of annual and biennial wildflower seed mixes. The Adder, (*Vipera berus*) has previously been observed residing within the rough but has not been officially

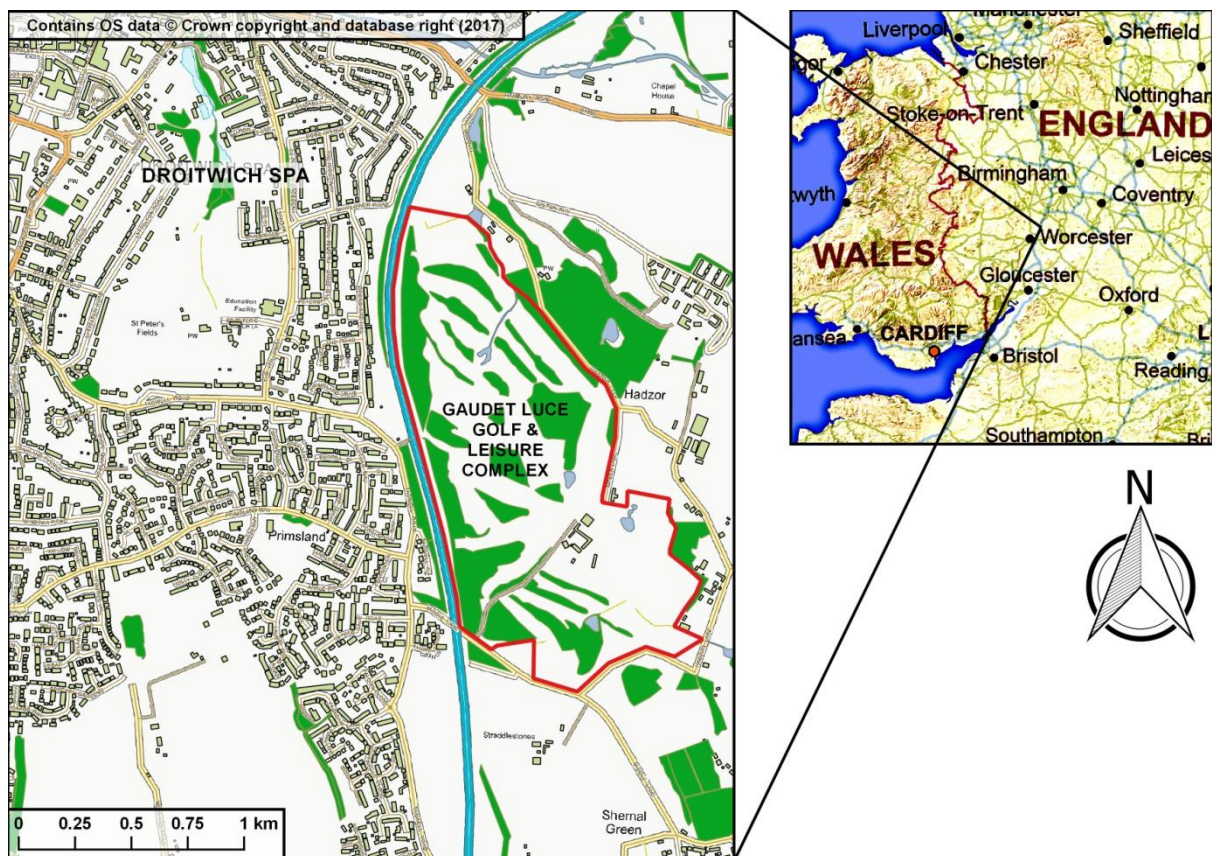


Figure 1 Map to show the location of Gaudet Luce Golf & Leisure Complex in Worcestershire.

recorded¹ (Pers. comm. Fernihough, 2017).

Out-of-bounds areas have been managed as woodland since the golf course was established and consist of common tree species such as Field Maple (*Acer campestre*) and Oak (*Quercus* sp.).

Notable aquatic habitats comprise multiple ponds of varying sizes, most of which are significantly abundant in marginal vegetation. Submerged aquatic macrophytes are present but vary in frequency between the water bodies (further detail in section 3.1).

In addition to the assembly of natural habitats supported by the Gaudet Luce Golf Course, a number of initiatives have been implemented which have introduced multiple functions to the site, beyond the realms of golf. One such initiative was the installation of beehives within the managed woodland, where honey is regularly harvested. Another initiative that has been implemented is the growing and harvesting of ornamental flowering plants for floristry, alongside nurturing fruit and vegetables for local use. A strip of land within the out of bounds area has been set aside for these purposes, which would otherwise lie fallow and unused.

1.2. Overall objective

To gain a greater understanding of how Gaudet Luce Golf Course supports native flora and fauna, ENSIS Ltd were commissioned to undertake a general habitat survey of the golf course. A more detailed aquatic macrophyte survey was also conducted on the ponds that support substantial aquatic life. The data obtained will be used to create a species inventory of the site, which will contribute towards the promotion of the golf club for both future and current members who are interested in the natural environment present on the course.

1.3. Specific objectives

Carry out macrophyte surveys of the water bodies present on the golf course and assess the extent of macrophyte cover.

Undertake a general habitat survey of Gaudet Luce golf course and initiate a baseline survey of species from which a more detailed inventory can be established over time.

2. Methods

2.1. Aquatic Macrophyte Survey

A macrophyte survey of Gaudet Luce Golf Course was carried out on 15th June 2017.

In brief, the survey consisted of two components at Cockshute Pool: a boat survey encompassing submerged species in open water across the pond and a survey of the emergent and marginal species. The latter component was solely carried out at Gilton Brook Pond and Ponds 3,4 and 5 since access to the open water was

¹ Protected by UK and European legislation. Listed on Annex III of the Bern Convention and protected under the Wildlife and Countryside Act, 1981. Also listed as a priority species on the UK Biodiversity Action Plan (UK BAP) (Wildscreen Arkive, 2017¹)

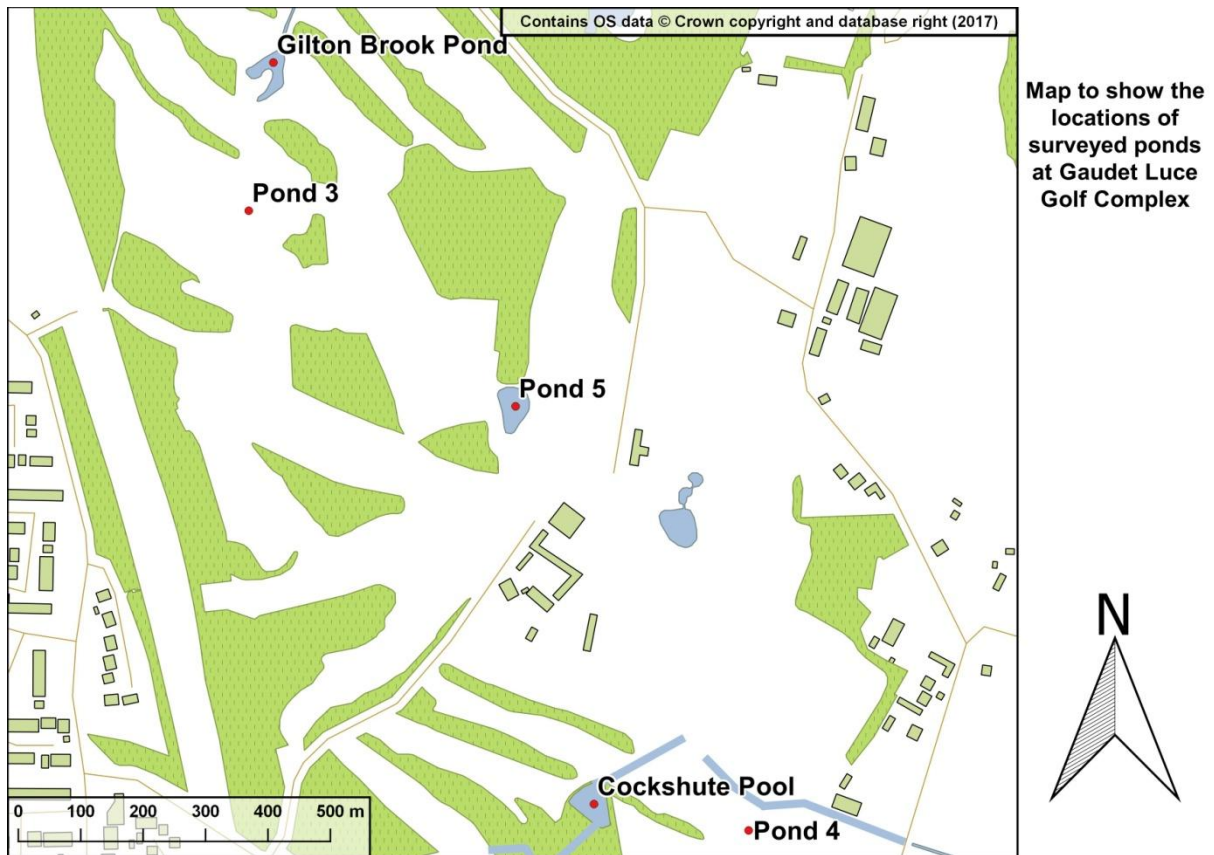


Figure 2 Map to show the location of surveyed ponds at Gaudet Luce Golf Club.

restricted and limiting for a boat. A visual survey from the shore of submerged macrophytes was completed in these instances. Figure 2 shows the locations of the ponds.

Four components of water chemistry were recorded at Cockshute Pool: pH, conductivity, temperature and oxygen levels using a YSI 550 DO probe.

Where possible, surveying was performed using a bathyscope, but a double-headed rake was also deployed where poor water clarity restricted visibility. All boats and survey equipment were cleaned before and after survey using an approved aquatic disinfectant (Virkon AQ), with additional care being taken where alien plant species were present (e.g. *Elodea* spp.).

In-situ macrophyte identifications were made by Stefania Goodrich, Ben Goldsmith and Ewan Shilland. Voucher specimens were collected for taxonomically ambiguous species and identifications confirmed either from fresh materials (on the evening of the survey) or at a later date from pressed specimens. Vouchers of charophytes were preserved in alcohol and identified in-house for confirmation. Quality control was performed in-house with reference to previously collected herbaria specimens. Botanical nomenclature follows Stace (1997) for higher plants and Moore (1986) for Stoneworts.

2.2. Surveys of Butterflies, Odonata, Amphibians and Mammals

Surveys for butterflies, odonata (dragonflies and damselflies), amphibians and mammals were carried out on 15th June 2017, where possible.

Butterfly and mammal surveys were conducted across the golf course simultaneously with the habitat survey and identified to species level. Observations were recorded as presence/absence while systematically traversing the golf course. Dragonflies and amphibians were also recorded as presence/ absence while surveying the ponds on site and identified to species level where possible. Great crested newt eggs were surveyed to establish adult presence, using standard egg searching methodology: a search for folded leaves of aquatic plants was carried out at each pond and a minimal number of leaves unfolded to check for eggs. A full survey for newts was not possible as standard protocol requires searching a pond by torchlight or using a net shortly after dusk, when great crested newts are not sheltering in the deeper areas of the pond.

2.3. General Habitat Survey

A general habitat survey was conducted at Gaudet Luce Golf Course on 15th June 2017. This involved traversing the golf course systematically while mapping observed habitats, using a combination of GPS (Global Positioning System) to record location and a series of sketch maps with annotations. Notable plant species were recorded during this process and photographed for additional reference.

All maps presented in this report are derived from Ordnance Survey OpenData.

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3. Survey Results

3.1. Aquatic Macrophyte Survey

3.1.1. Cockshute Pool

The open water to Cockshute Pool was dominated by Rigid Hornwort (*Ceratophyllum demersum*), which scored a '5' (dominant) on the DAFOR scale. Figure 3 demonstrates the coverage of this species across the pond. Ivy-Leaved Duckweed (*Lemna trisulca*) was frequently recorded, while Common Duckweed (*Lemna minor*) was less abundant, seen only occasionally during the survey. Lesser Pondweed (*Potamogeton pusillus cf.*) and Horned Pondweed (*Zannichellia palustris*) were of equal abundance, both scoring '2' piece on the survey and therefore occasionally seen within the water column. One individual specimen of a stonewort (*Chara sp.*) was recorded at the northside of the pond near the outflow.

The pond is limited in emergent vegetation, supporting only two species. Reedmace (*Typha latifolia*), dominates the open water with a DAFOR abundance of 3 (frequent). This species is concentrated mainly towards the northern margin of the pond and is found occasionally on the eastern and western flanks. The southwest corner of Cockshute Pool is dominated by a population of White water lily (*Nymphaea alba*) (Figure 4).

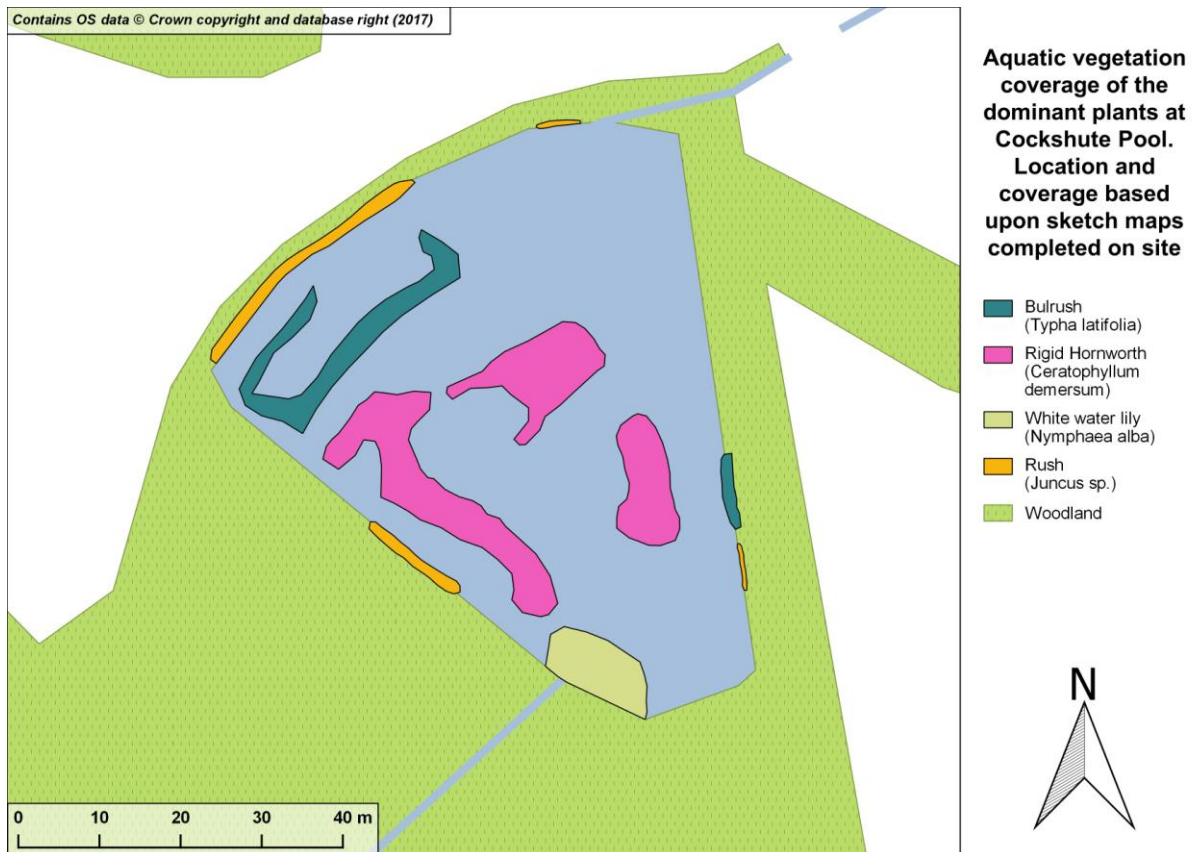


Figure 3 Aquatic vegetation coverage of dominant plants at Cockshute Pool. Location and coverage based upon sketch maps completed on site.



Figure 4 Cockshute Pool, photos taken facing southeast (left) and northwest (right).

Although the plant species assemblage at Cockshute Pool suggests a productive, nutrient-rich water body, the pond does not appear to be suffering from the negative effects of eutrophication. Algal biomass was low and the dominance of the most abundant aquatic macrophytes did not restrict light penetration through the water column or impinge on the growth of other submerged plant species, such as Lesser Pondweed. This is supported by the presence of the stonewort *Chara* sp. which suggests that the littoral zone of the pond is receiving sufficient light and oxygen for stoneworts to photosynthesize. The limited growth of charophytes also indicates that nutrients are not at excessive levels.

Marginal vegetation by comparison was diverse in its range, forming a good habitat. Two species of trees dominating the assemblage: Willow (*Salix* sp.) and Common Alder (*Alnus glutinosa*). Young specimens of these trees were low growing on the western shore amongst the marginal plants, while a mature stand of Willow, Alder, numerous Ash trees (*Fraxinus excelsior*) and large Oaks (*Quercus* sp.) were located on the eastern shore, providing partial shade to the pond. An understory of bramble (*Rubus* sp.), nettles (*Urtica dioica*), wood avens (*Geum urbanum*), hawthorn (*Crataegus monogyna*), hazel (*Corylus avellana*) and crab apple (*Malus sylvestris*) was present in the woodland, with native bluebells (*Hyacinthoides non-scripta*) interspersed within the wetter areas towards Cockshute Pool shore. Greater Pond Sedge (*Carex riparia*) was frequently observed along the southwest shoreline of the pond, as was Great willowherb (*Epilobium hirsutum*), both of which are commonly seen marginal species on the edge of productive water bodies. Rushes were also frequent within the assemblage, specifically Soft Rush (*Juncus effusus*) and Hard Rush (*Juncus inflexus*). Other species which were occasionally observed within the margins include Gypsywort (*Lycopus europaeus*), Water Mint (*Mentha aquatica*), Bittersweet (*Solanum dulcamara*) and Brooklime (*Veronica beccabunga*). Celery-leaved buttercup (*Ranunculus sceleratus*) was recorded only once, scoring a '1' on the DAFOR scale (rare). The marginal and aquatic habitats of Cockshute Pool are shown in Figure 3.

Water chemistry results are displayed in Table 1. Interpretation of these results is limited at this stage without a baseline for comparison, however it can be seen that the pH is typical for a lowland, shallow water body, while the dissolved oxygen levels are higher than the targets recommended in the JNCC CSM guidelines for freshwater lakes (JNCC, 2015).

Table 1 Water chemistry results for Cockshute Pool. Variables measured at the outflow.

	Temp. (°C)	DO	pH	Conductivity (µS)
Outflow	19.6	8.6	7.58	1198

Table 2 provides a full summary of species recorded at Cockshute Pool in 2017.

Table 2 Species recorded at Cockshute Pool. Abundance scored using the DAFOR scale, where D= Dominant; A= Abundant; F= Frequent; O= Occasional; R= Rare.

Botanical Name	Common Name	Abundance	DAFOR
Submerged			
<i>Ceratophyllum demersum</i>	Rigid Hornwort	5	D
<i>Chara sp.</i>	-	1	R
<i>Lemna minor</i>	Common Duckweed	2	O
<i>Lemna minuta</i>	Least Duckweed	1	R
<i>Lemna trisulca</i>	Ivy-Leaved Duckweed	2	O
<i>Potamogeton pusillus cf.</i>	Lesser Pondweed	2	O
<i>Zannichellia palustris</i>	Horned Pondweed	2	O
Emergents			
<i>Nymphaea alba</i>	White Water lily	3	F
<i>Typha latifolia</i>	Reedmace	3	F
Marginals			
<i>Alnus glutinosa</i>	Common Alder	2	O
<i>Arum maculatum</i>	Lords-and-Ladies	1	R
<i>Carex hirta</i>	Hairy Sedge	2	O
<i>Carex obtrubae</i>	False Fox-sedge	1	R
<i>Carex riparia</i>	Greater Pond Sedge	3	F
<i>Epilobium hirsutum</i>	Great willowherb	3	F
<i>Galium palustre</i>	Common Marsh-bedstraw	2	O
<i>Juncus effusus</i>	Soft Rush	1	R
<i>Juncus inflexus</i>	Hard Rush	3	F
<i>Lycopus europaeus</i>	Gypsywort	2	O
<i>Mentha aquatica</i>	Water Mint	2	O
<i>Nasturtium officinale</i>	Watercress	2	O
<i>Ranunculus sceleratus</i>	Celery-leaved buttercup	1	R
<i>Salix sp.</i>	Willow	3	F
<i>Solanum dulcamara</i>	Bittersweet	2	O
<i>Veronica beccabunga</i>	Brooklime	2	O

3.1.2. Gilton Brook Pond

Gilton Brook Pond (Figure 5) was originally installed by Severn Trent and its primary purpose is to collect storm water runoff from the nearby motorway 240 m to the west. It was not possible to access the open water by boat and so submerged macrophytes were recorded by eye. Open water was predominantly located on the northwest arm of the pond, where the water was clear and no submerged plants were observed. Filamentous algae was present in this area, at an abundance of '3' (frequent) on the DAFOR scale. One instance of Curly-leaf Pondweed (*Potamogeton crispus*) was seen growing on the southeast arm of the pond at an abundance of '1' on the DAFOR scale, while Common Duckweed was seen intermittently within the emergent vegetation.

The emergent assemblage was dominated by Common Reed (*Phragmites australis*), which formed a monoculture across the majority of the pond, as shown by Figure 6. Although this prevented a corridor of open water and limited light penetration and oxygen to the water column below, the stand functions as a productive wetland. Consequently, the extent of submerged macrophytes was very limited. Towards the edge of Common Reed growth on the northwest arm of the pond, at the interface of open water, Branched Bur-reed (*Sparganium erectum*) was observed growing at an occasional level of abundance ('2' on the DAFOR scale). Similarly, marginal species such as Yellow Flag Iris (*Iris pseudacorus*) and Soft Rush also took advantage of the increased open conditions of the water and were observed growing in small populations. Marsh Marigold (*Caltha palustris*) and the non-native species Monkeyflower (*Mimulus guttatus*) were recorded growing in amongst the terrestrialised Common Reed stands, while Common Teasel (*Dipsacus fullonum*) was intermittently growing within the marginal vegetation, straddling the border of the golf course rough. A very mature, hollowed Oak tree is located on the centrally protruding section of shore (see Figure 6), which provides partial shading to the pond, alongside younger specimens of Alder and Willow.

Table 3 provides a full summary of species recorded at Gilton Brook Pond in 2017.



Figure 5 Gilton Brook Pond.

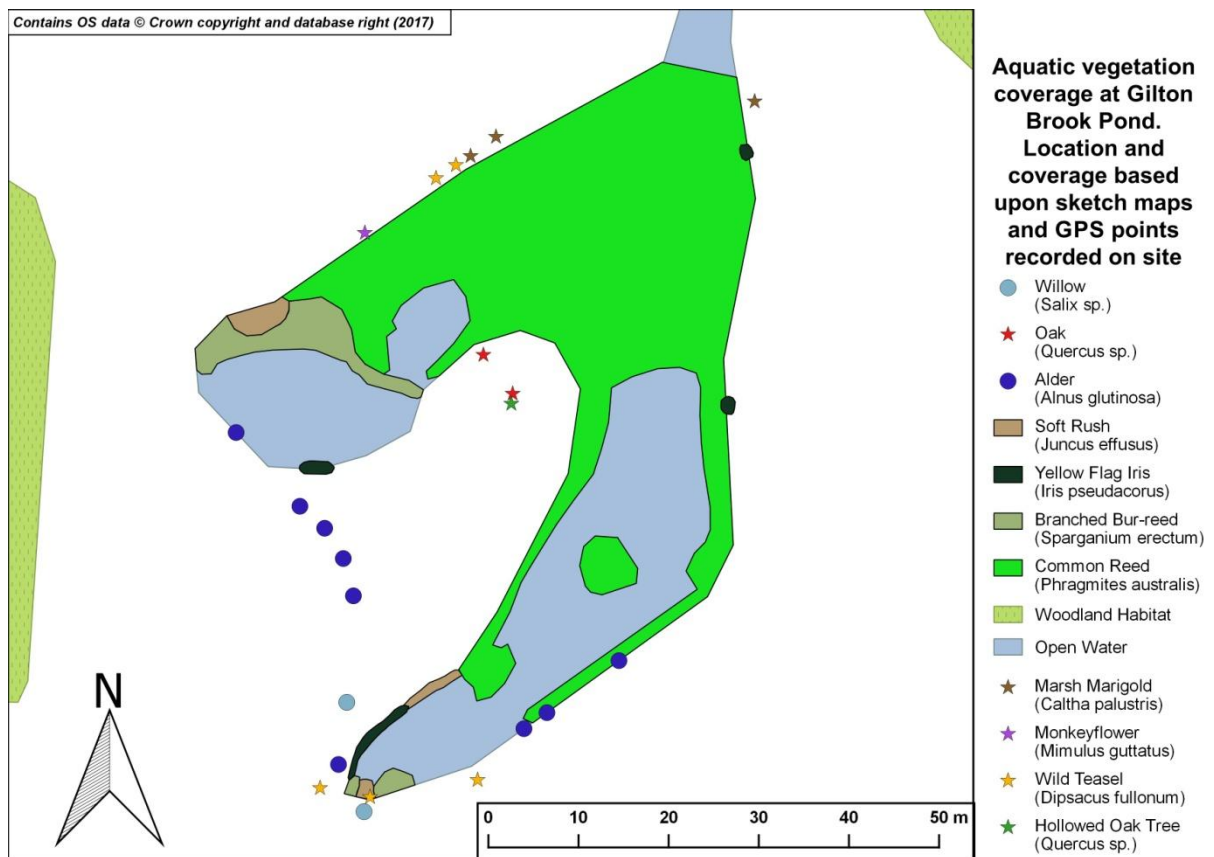


Figure 6 Aquatic vegetation coverage at Gilton Brook Pond. Location and coverage based upon sketch maps and GPS points recorded on site.

Table 3 Species recorded at Gilton Brook Pond. Abundance scored using the DAFOR scale, where D= Dominant; A= Abundant; F= Frequent; O= Occasional; R= Rare.

Botanical Name	Common Name	Abundance	DAFOR
Submerged			
<i>Lemna minor</i>	Common duckweed	2	O
<i>Potamogeton crispus</i>	Curly Pondweed	1	R
Emergents			
<i>Phragmites australis</i>	Common Reed	5	D
<i>Sparganium erectum</i>	Branched Bur-reed	2	O
Marginals			
<i>Alnus glutinosa</i>	Alder	2	O
<i>Caltha palustris</i>	Marsh Marigold	2	O
<i>Carex riparia</i>	Greater Pond Sedge	2	O
<i>Dipsacus fullonum</i>	Wild Teasel	2	O
<i>Epilobium hirsutum</i>	Great Willowherb	3	F
<i>Iris pseudacorus</i>	Yellow Flag Iris	2	O
<i>Juncus effusus</i>	Soft Rush	2	O
<i>Mimulus guttatus</i>	Monkeyflower	1	R
Moss (<i>unident</i>)	Moss	1	R
<i>Ranunculus flammula</i>	Lesser Spearwort	1	R
<i>Salix sp.</i>	Willow	3	F
<i>Solanum dulcamara</i>	Bittersweet	1	R
<i>Stachys sylvatica</i>	Hedge Woundwort	1	R
<i>Veronica beccabunga</i>	Brooklime	1	R

3.1.3. Pond 3

Pond 3 – otherwise unnamed – is a very small and narrow water body with limited species diversity (Figure 7). Common duckweed and Curly-leaf pondweed were observed in the open water, both scoring ‘1’ on the DAFOR scale. Branched Bur-reed was growing on the very edge of the pond, while the marginal vegetation was dominated by Hard Rush (‘5’ on the DAFOR scale) and occasionally Soft Rush (‘2’). Reed Canary-grass (*Phalaris arundinacea*) was also observed within the marginal assemblage (‘1’), alongside Celery-leaved Buttercup (*Ranunculus sceleratus*).

Table 4 provides a full summary of species recorded at Pond 3 in 2017.



Figure 7 Pond 3.

Table 4 Species recorded at Pond 3. Abundance scored using the DAFOR scale, where D= Dominant; A= Abundant; F= Frequent; O= Occasional; R= Rare.

Botanical Name	Common Name	Abundance	DAFOR
Submerged			
<i>Lemna minor</i>	Common duckweed	1	R
<i>Potamogeton crispus</i>	Curly Pondweed	1	R
Emergents			
<i>Sparganium erectum</i>	Branched Bur-reed	1	R
Marginals			
<i>Juncus effusus</i>	Soft Rush	2	O
<i>Juncus inflexus</i>	Hard Rush	5	D
Moss (unident)	Moss		-
<i>Phalaris arundanacae</i>	Reed Canary Grass	1	R
<i>Ranunculus sceleratus</i>	Celery-leaved Buttercup	1	R

3.1.4. Pond 4

Pond 4 is a very small water body, located to the east of Cockshute Pool (Figure 8). It is dominated by Reedmace, although it was noted that some had been cleared in a 2-3m band around the edge. Submerged plants were not visible, although *Nymphaea* cultivars were present (white and pale yellow). Plants recorded include



Figure 8 Pond 4

Yellow Flag Iris, Soft rush, Hard rush, Water mint, Fool's Watercress (*Apium nodiflorum*), Gypsywort, Great willowherb, Water-plantain (*Alisma plantago-aquatica*), Tufted Forget-me-not (*Myosotis laxa*) and Cyperus sedge (*Carex pseudocyprus*).

3.1.5. Pond 5

The new pond suffers from a significant coverage of algae and waters were observed to be very turbid. An aerator has been installed which is clearly necessary for the environment created. It appears that Spiked Milfoil (*Myriophyllum spicatum*), Fennel Pondweed (*Potamogeton pectinatus*) and White Water-lily cultivar have been planted.

3.2. Surveys of Butterflies, Odonata, Amphibians and Mammals

3.2.1. Butterflies

Six species of butterfly were observed and recorded while mapping the habitats on the golf course. The observations are detailed in Table 5 and spatially shown on Figure 9. All butterfly species observed are of common occurrence across most of England.

3.2.2. Odonata (Dragonflies and Damselflies)

A few species of dragonflies and damselflies were observed during the survey. Cockshute Pool displayed the highest variation and density, with the majority of damselflies breeding in amongst the emergent vegetation and marginal plants (Figure 10). Two species of damselfly were observed at this pond: Azure Blue and Common Blue. A single Four Spotted Chaser dragonfly was also recorded active at this site. Gilton Brook pond was significantly less populated on the day of survey,

Table 5 Table detailing the butterfly species recorded on 15/06/2017.

Species	Common name	Latitude	Longitude	Abundance	DAFOR
<i>Ochlodes sylvanus</i>	Large Skipper	52.2576186	-2.1322388	2	O
<i>Maniola jurtina</i>	Meadow Brown	52.257496	-2.1323709	2	O
<i>Vanessa atalanta</i>	Red Admiral	52.2575275	-2.1322677	4	A
<i>Polygonia c-album</i>	Comma	52.2574579	-2.1323734	4	A
<i>Aphantopus hyperantus</i>	Ringlet	52.2574633	-2.1328784	4	A
<i>Maniola jurtina</i>	Meadow Brown	52.2529987	-2.1289954	4	A
<i>Pararge aegeria</i>	Speckled Wood	52.2523385	-2.1306468	4	A
<i>Maniola jurtina</i>	Meadow Brown	52.2523546	-2.1306225	5	D
<i>Pararge aegeria</i>	Speckled Wood	52.2576301	-2.1322002	4	A

although the Common Blue, Emerald, Bluetail and Azure damselflies were recorded and a female Four-spotted Chaser dragonfly (Figure 11, left photo). The presence of these species at the ponds indicates the importance of wetland vegetation populating ponds in order to provide habitat for macroinvertebrates.

3.2.3. Amphibians

Metamorphosing common froglets (*Rana temporaria*) were observed in the shaded over, shallow pond behind Cockshute Pool to the southwest (Figure 12).



Figure 9 Map to show the locations of recorded butterflies at Gaudet Luce Golf Complex on 15/06/2017.



Figure 10 Azure damselflies (*Coenagrion puella*) mating, left. A demonstration of the vast number of damselflies seen at Cockshute Pool.



Figure 11 Female Four-spotted Chaser (*Libellula quadrimaculata*), left. Male Azure Damselfly, right.



Figure 12 Metamorphosing common froglet (*Rana temporaria*), left. Great Crested Newt egg, right.

One great crested newt egg (*Triturus cristatus*) was discovered on a folded leaf within the submerged margins of Cockshute Pool, thereby confirming their presence in the pond (Figure 12, right). Great-Crested newts are protected under both European and UK legislation².

The current pond habitat is suitable for breeding great crested newts, which require a small to medium sized pond for feeding and breeding. Ideally, the pond should support submerged aquatic macrophytes that cover no more than two-thirds of the pond area, with emergent/ floating plants covering between one quarter to half the pond area. Open water is also required so that male newts are able to display clearly to the females, with no obstructed view from submerged plants (Langton *et al*, 2001). Observations from this survey of Cockshute Pool satisfy these habitat requirements and it is recommended that current conditions are maintained in order to sustain the great crested newt population.

3.2.4. Mammals

The diversity of mammals was poor on the day of survey although this is not an unusual outcome given that human presence was ubiquitous throughout the golf course. Only the European rabbit (*Oryctolagus cuniculus*) was observed in discrete, quiet areas of the course.

3.3. General Habitat Survey

A range of habitats were noted during the survey of the golf course which have clearly added value to the diversity of species recorded overall. Meadows of tall grass and low growing plants have been set aside as areas of golf course rough, where species diversity was good – species recorded include Oxeye Daisy (*Leucanthemum vulgare*), Yarrow (*Achillea millefolium*), Red Clover (*Trifolium pratense*), Common Birdsfoot Trefoil (*Lotus corniculatus*), (*Trifolium pratense*), Smooth Tare (*Vicia tetrasperma*), Lady's Bedstraw (*Galium verum*) and Grass Vetchling (*Lathyrus nissolia*).

In addition, Bee Orchids (*Ophrys apifera*) were discovered in two locations on the golf course, which are shown in Figure 14. At location A, four individuals were recorded. A further 12 individual plants were recorded at location B, where eight of these were in/about to flower. These were growing on a west facing slope under young Ash, Maple and Birch trees, within a community of rough grassland comprising Hop trefoil (*Trifolium campestre*), Cut-leaved Cranesbill (*Geranium dissectum*), White clover (*Trifolium repens*) and Grass vetchling. The presence of this species was unknown prior to the survey and appears to be maintaining successful sub-populations within this habitat.

Areas of woodland have been created since the golf course was established and have been left to generate naturally. These areas generally consist of Ash (*Fraxinus excelsior*), Alder (*Alnus glutinosa*), Common Hawthorn (*Crataegus monogyna*), Common Lime (*Tilia x europea*), Birch (*Betula pendula*), Beech (*Fagus sylvatica*), Oak (*Quercus* sp.), Rowan (*Sorbus aucuparia*) Field Maple (*Acer campestre*) and

² Classified as Least Concern (LC) on the IUCN Red List. Listed in Appendix II of the Bern Convention, Annexes II and IV of the EC Habitats Directive, the Wildlife and Countryside Act 1981 and Schedule 2 of the Conservation Regulations 1994 (Wildscreen Arkive, 2017²).

Willow (*Salix* sp.). A fairly heavy understory of Holly (*Ilex aquifolium*) was observed within in the wooded areas, which frequently prevented light from penetrating the woodland floor.

Deciduous woodland, meadows and hedgerows located within close proximity of the ponds are essential for great crested newts during the more extreme weather conditions in the year, since they use these terrestrial habitats for foraging and refuge. Gaudet Luce golf course is successful in providing such a mosaic of habitats and given the presence of great crested newts in Cockshute Pool, there is good potential that they are also using the terrestrial habitats for their needs. There is evidence of dead wood that has been left by the greenkeepers as part of their current management plan, which contributes towards providing extra refugia for both great crested newts and invertebrates alike (Latham *et al*,1996).

Ditches on the golf course also provide varying habitats, where typical wetland plant species were recorded, such as Great Willowherb, Watercress (*Nasturtium officinale*), Fool's Watercress (*Apium nodiflorum*), and rushes. These ditches are valuable habitat for amphibians seeking refuge and connectivity between water bodies and invertebrates. They consequently encourage a variety of wildlife such as birds and bats to the golf course to feed.

4. Recommendations

Overall, Gaudet Luce Golf Course supports a wide range of species and habitats, given its main function is a golf course. The management plan which is currently in place has been effective at supporting current populations of flora and fauna; however there are a few recommendations which will further encourage species to the golf course, thereby increasing diversity and interest to the golf course members.

The Reedmace at Cockshute Pool currently gets cut back by approximately 50-75% every year in order to impede its spread and maintain a clear view across the water body. This management appears to be entirely appropriate for the pond, but could be improved by also focussing on the marginal zones, where the buffer can be widened by approximately two metres. The woodland growth on the eastern shore currently does not require any management, unless the trees become unsafe. In this instance, any fallen or cut wood should be left *in situ* as deadwood habitat.

Water quality data was collected for this survey in order to establish a baseline for any future monitoring at Cockshute Pool. Although water quality is not considered to be an essential component to monitor in this particular instance - since the quality of the aquatic habitats are more reflective of local environmental processes – it is recommended that it is annually measured if possible in order to be able to monitor any changes to the aquatic environment. Keeping Cockshute Pool a fish-free zone would further help to maintain the current water quality and avoid any detrimental changes to the aquatic environment. It is not recommended to artificially add any aquatic plants to the pond as there is a risk of introducing invasive species. The removal of sediments from the pond would only be absolutely necessary if the reed encroachment and loss in water depth becomes unmanageable; otherwise this action would not be recommended due to the resulting severe disturbance to the aquatic ecosystem.

Heavier clearance could be carried out if required at Pond 4, which would be to the benefit of open water. The cultivated water lilies as seen at this pond added an aesthetically pleasing appearance to the pond and provides habitat to dragonflies. On the day of survey a Four-spotted Chaser dragonfly (*Libellula quadrimaculata*) was observed at the pond, and a Broad-bodied Chaser (*L. depressa*) nearby.

Over time, Gilton Brook Pond has become a well-established, mid-succession water body, dominated by common reed. This development has created a naturally occurring wetland, beneficial to both wildlife and the aquatic ecosystem. The common reed currently receives an annual cut in order to clear the pond and create an opening through the emergent vegetation for the golf players. Cutting back the reeds also serves another purpose: its regular maintenance removes excess nutrients from the system. This is particularly beneficial to Gilton Brook Pond since it functions as a sink for motorway runoff, which contains a multitude of water impurities such as heavy metals. Fertilising the fairways inevitably contributes to the extent of surplus nutrients entering the ponds too. Wetlands such as this have been constructed on a larger scale to control the level of surface runoff and pollutants in urbanised environments, as they act as a filtering system (Shutes, 2001). Since species such as common reed and reedmace are fast-growing species, they can be cut back regularly – thereby removing excess nutrients and pollutants from the local environment and slowing the eutrophication process.

It is therefore recommended that the common reed is cut back on a rotational basis, during the autumn/ winter period, where only less than half of the reed is removed at any one time to allow for the natural recovery of invertebrate populations. It should however be allowed to continue to establish and function as a wetland rather than an open water pond. Seasonal wetlands also provide excellent habitat for breeding dragonflies and damselflies, as well as amphibian species seeking refugia and foraging ground. Damselflies in particular are weak fliers and so therefore tend to rely on the interior of wetlands for protection from predators and the opportunity to deposit fertilised eggs on the stalks of the reeds. Once established, they do not disperse far from their larval habitat and so a permanent wetland would benefit the local populations (Colding and Folke, 2009).

The new pond, Pond 5 (Figure 13), would greatly benefit from the installation of a variety of marginal species such as Yellow Flag Iris, Purple Loosestrife (*Lythrum salicaria*), Flowering Rush (*Butomus umbellatus*) and Marsh Marigold (*Caltha palustris*). In addition, a buffer strip around the water body of naturally established wildflowers and grasses would add an attractive, softer appearance, as opposed to the current regime of mowing to the edge of the pond.



Figure 13 Pond 5, a newly installed pond, would greatly benefit from the planting of marginal plants and the allowance of a buffer zone around the edge to soften the edges and encourage wildlife to it.

There is excellent coverage of woodland on the golf course, which contributes to the mosaic of habitats available for wildlife and plants. Since the woodland has essentially been left to establish without human interference, it has undergone natural succession over time. As a result, there is quite a heavy understory predominantly consisting of Holly which noticeably shades out sunlight from the woodland floor. It is therefore recommended that the understory is managed by cutting it back in the winter on a rotational basis (between late September and February to avoid bird breeding season) in order to open up the lower canopy and provide a level of 'patchiness', where tree species are at different stages of growth (Fuller and Peterken, 2010). Any timber that is cut should be left onsite in piles to provide deadwood habitat. Valuable scrub which is beginning to develop already and provides excellent habitat for birds, invertebrates and small mammals include Hawthorn, Buckthorn (the main feeding plant for the Brimstone butterfly (Woodland Trust, 2017)), Privet, Whitebeam and Wayfaring Tree (Sutherland and Hill, 2010).

The areas of grassland 'rough' constitute for valuable wildflower meadows on the golf course, which support a wide range of invertebrate species, including butterflies. It is recommended to follow a low maintenance plan for these habitats but maximise their potential species diversity by implementing a rotational mowing regime. The effects of this can be varied by cutting at different heights, altering the frequency and cutting only in late autumn or early spring. This will also limit the damage inflicted upon invertebrate populations, introduce different grassland communities and

prevent any damage inflicted upon the orchid populations. To benefit from a healthy population of invertebrates, it is recommended to cut some areas two to three times a year to a height of 5-10 cm, while leaving other areas of the sward to be cut on a 2-3 year rotation³. Leaving the cuttings *in situ* will cause nutrient enrichment, as well as prevent seedlings from germinating and hindering the smaller, delicate plants from growing (Ausden and Treweek, 2010). It is therefore recommended to always remove the cuttings from the grassland roughs to reduce the nutrient levels, thereby increasing species diversity and competition.

Location A on Figure 14 is another area of rough grassland, with planted trees. These areas provide good habitat, although it is clear that soil fertility is high since it was noted that has been dominated by thistles (*Cirsium* spp.). Although difficult to eradicate, it is possible to do so by repeatedly cutting down the top growth of the thistle over a number of years, thereby weakening the plant. This is best done just before the flower begins to colour as the plant will have used the majority of its energy reserves in flower production (RHS, 2017). A mowing regime akin to the wildflower meadows as outlined above would also be suitable in this case; it would be particularly pertinent to remove the cuttings in order to help reverse the soil nutrient enrichment that has already occurred.

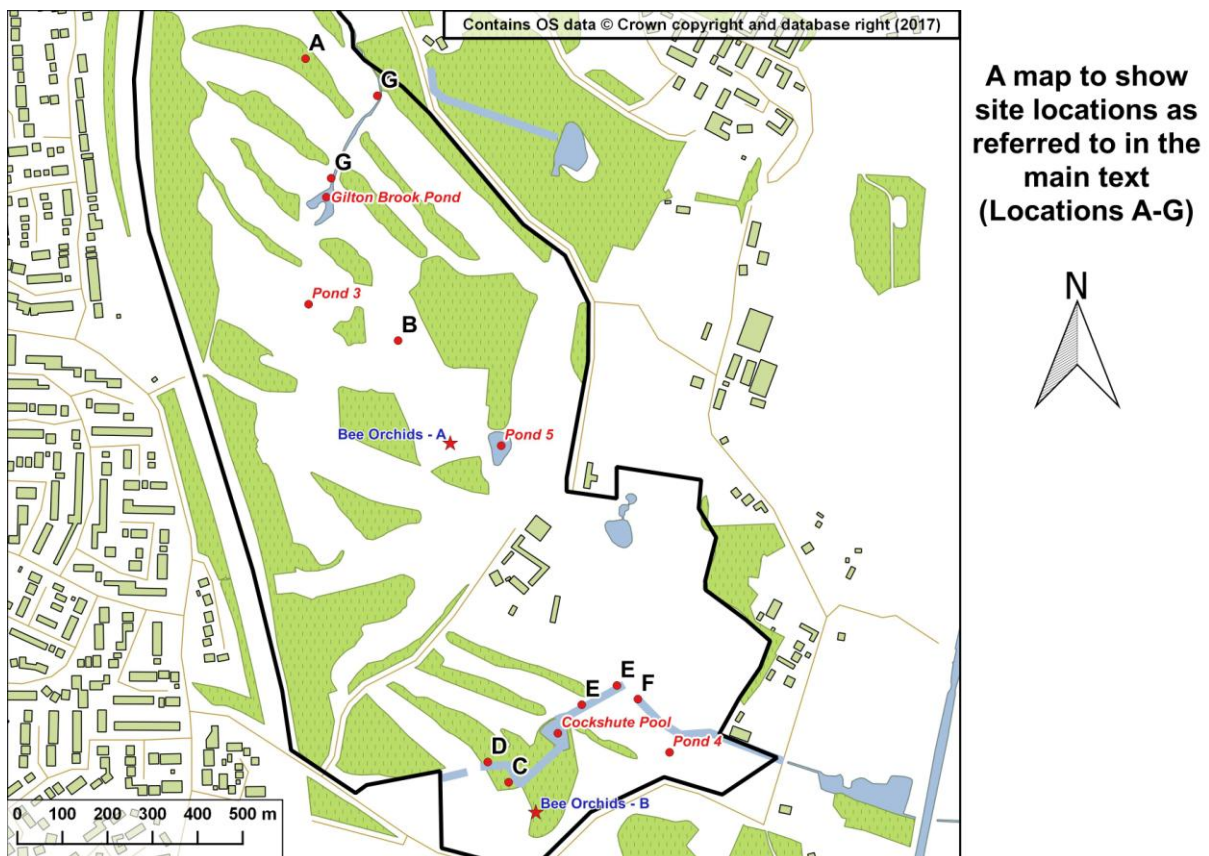


Figure 14 Site locations as referred to in the main text, lettered A-G.

³ For detailed management advice specific to ungrazed grassland communities, 'Managing Habitats for Conservation' by Sutherland and Hill (2010) is highly recommended.



Figure 15 An example of the mowed grass to the hedge base which could benefit from a 2-3 m buffer zone.

The ‘wildflower’ area of Oxe-eye daisies and Sweet Williams (*Dianthus* sp.) – marked as Location B – although attractive, would perhaps be of greater value to the local wildlife and nearby habitats if it instead consisted of a native wildflower mix. Reputable suppliers can be found listed on the Natural England website⁴.

It was noted that many of the hedgerows are mowed closely to the hedge base (see Figure 15). It is recommended that an unmowed buffer zone of approximately 2-3 m wide is introduced to all hedges on the golf course, where the rowing regime allows for a cut in the late autumn and early spring. This could be introduced as a stepped, two-tier system, where a buffer of 1 m wide closest to the hedge is cut only once a year, and a further buffer of 1m is cut twice a year at a lower length to smooth the transition into the golf course. This will also allow low growing wildflowers to establish and provide an intermediate habitat for wildlife and

consequently be of an aesthetically pleasing appearance.

Many of the ditches on the golf course are currently mowed to the top of the bank. This was noted to be the case at the ditch which flows towards Cockshute Pool (Location C). It is recommended to leave a buffer strip of at least one metre (although ideally five metres if possible) from the bank top, mowing only once or twice between September to March to promote marginal vegetation for invertebrates. This is also applicable to the ditches marked as locations D and E and G. Location F is a heavily shaded, deeply incised ditch which runs southeast along a footpath. A mixed species hedge runs along the ditch, consisting of Hazel, Hawthorne, Dog Rose and Blackthorn (*Prunus spinosa*). Notably, a few specimens of Elm trees were also present, some of which had been killed by Dutch Elm Disease.

Gaudet Luce Golf Course currently provides a variety of habitats which support a range of species. The longevity and quality of these habitats can be increased by implementing the management strategies above, which will consequently encourage more wildlife and plant species to establish on the golf course grounds. This will inevitably bring further interest to the club members and new members alike.

⁴ <https://naturalengland.blog.gov.uk/2017/08/15/how-to-create-a-wildflower-meadow/>

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