Lower Thames Crossing

6.3 Environmental Statement Appendices
Appendix 8.5 – Amphibians

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Lower Thames Crossing

6.3 Environmental Statement Appendices
Appendix 8.5 – Amphibians

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1 Introduction

1.1.1 This document presents the results of the amphibian desk study and field surveys carried out between 2017 and 2020 to inform the Environmental Impact Assessment of the A122 Lower Thames Crossing (the Project).

1.1.2 Based on desk study information and survey results, the amphibian features of the Project can be considered to comprise great crested newt (GCN) *Triturus cristatus* and other (more common) amphibian species. These features are described in turn in the following section.

2 Legislation and conservation status

2.1 Great crested newt

2.1.1 In Britain, GCN, their eggs, their breeding sites (hereafter referred to as ponds), and their resting places are afforded protection by the Wildlife and Countryside Act 1981 (as amended). The Act transposes into UK law the Convention on the Conservation of European Wildlife and Natural Habitats 1979 (commonly referred to as the 'Bern Convention'). GCN is listed on Schedule 5 of the Act in respect of section 9, which makes it an offence, inter alia, to:

a. intentionally or recklessly kill, injure, or take (handle) a GCN

b. intentionally or recklessly damage, destroy, or obstruct access to any structure or place that a GCN uses for shelter or protection

c. intentionally or recklessly disturb a GCN while it is occupying a structure or place that it uses for shelter or protection

2.1.2 GCN receives further protection under Regulation 42 of the Conservation of Habitats and Species Regulations 2017 (as amended), which implement the Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive). GCN are listed in Annex IV of the Habitats Directive, which means that member states are required to put in place a system of strict protection as outlined in Article 12. In the UK, the animal species listed in Annex IV of the Habitats Directive are protected under Schedule 2 of the Conservation of Habitats and Species Regulations 2017, which makes it an offence, inter alia, to:

a. deliberately capture, injure, or kill any GCN

b. deliberately disturb a GCN, in particular any disturbance which is likely to:

   i. impair their ability to survive, to breed or reproduce, to rear or nurture their young, or to hibernate or migrate

   ii. to affect significantly the local distribution or abundance of GCN

c. damage or destroy a breeding site or resting place of a GCN

2.1.3 GCN is also listed as a species of principal importance under section 41 of the Natural Environment and Rural Communities Act 2006. It is also included as a priority species on both the Essex Biodiversity Action Plan (Essex Field Club, 2020) and the Kent Biodiversity Action Plan (Kent Biodiversity Action Plan Steering Group, 1997).

2.2 Common toad

2.2.1 Common toad *Bufo bufo* is listed on Schedule 5 of the Wildlife and Countryside Act 1981. Common toad is listed on Schedule 5 of the Act in respect of section 9(5)(a), which makes it an offence, inter alia, to:

a. sell, offer for sale, or hold/transport for sale a dead or live common toad, or any part of a common toad

b. publish or advertise for sale a common toad

2.2.2 Common toad is also listed as a species of principal importance under section 41 of the Natural Environment and Rural Communities Act 2006.

2.2.3 This species is widespread in the UK, but numbers are thought to be declining rapidly (Froglife, 2019).

2.3 Marsh frog

2.3.1 Marsh frog *Pelophylax ridibundus* is a non-native introduced species and is listed on Part 1 of Schedule 9 of the Wildlife and Countryside Act 1981 (as amended). This makes it an offence to release or allow them to escape into the wild.

2.3.2 Marsh frog is not a species of conservation value and is only considered important in the context of this Environmental Statement because of the legislative restrictions that are associated with this species, which could be relevant to certain construction activities.

3 Background ecology

3.1 Great crested newt

3.1.1 GCN are generally long-lived with a lifespan of up to 14 years in the wild (Langton *et al*., 2001). They spend most of their life cycle on land in a terrestrial state. Only breeding and larval development occurs in ponds. Courting, mating and egg-laying usually occurs between mid-March and mid-June. Eggs are laid singly on folded leaves and hatch into GCN larvae that take approximately three months to develop into a young newt, which then leave the water. During the winter, they hibernate in holes in the ground and under stones. GCN can occupy a variety of terrestrial habitats for foraging and hibernation, including areas of rough grassland, woodland and scrub that typically, but not exclusively, fall in close proximity to breeding sites. Breeding ponds are typically unpolluted, free from the presence of fish that eat larval GCN, are interconnected with other ponds, and dry out in some years (Langton *et al*., 2001).

3.1.2 The majority of adult GCN stay within approximately 250m of the breeding pond, with newts from small populations tending to stay within 100m of the breeding pond (depending on the quality of habitats close to the pond; English Nature, 2004). The density of individuals gradually decreases away from the pond. However, newts may travel further when dispersing for the first time, or where there are areas of high-quality foraging and refuge habitat extending beyond this range (Langton *et al*., 2001).

3.2 Common toad

3.2.1 Common toads tend to breed in large (>500m^2) water bodies, including lakes and slow-moving streams and rivers, and have a high fidelity to their spawning grounds. Despite this, they regularly colonise large new field ponds in arable landscapes; this may be more frequent when an established breeding site of a population has become unsuitable or has been destroyed. Heavily shaded sites tend to be avoided, and emergent and submerged vegetation are necessary for spawning (Joint Nature Conservation Committee, 1998). Common toads produce long jelly-like strings of spawn. Their tadpoles look similar to common frog tadpoles, but they can be distinguished by their shorter tail and bulkier head (Froglife, 2019). When spawning is over, toads can disperse up to 1.6km from the breeding ponds (Sinsch, 1988). On land, they spend much of the rest of the year feeding in woodland, gardens, hedgerows and tussocky grassland. They generally hibernate under stones and logs away from water, burying themselves within the soil or leaf litter or hiding beneath dead wood and vegetation. Common toads feed on a variety of invertebrates and even small vertebrates.

3.3 Marsh frog

3.3.1 Marsh frog were introduced into Kent in the 1930s and have become well established throughout the Romney Marsh and low-lying areas of north Kent (Kent Reptile and Amphibian Group, 2019a). This amphibian, which is rarely seen far from water bodies, can be distinguished by its characteristic laughing call. They are active both day and night and like to bask in the sunshine.

The diet of marsh frog mainly comprises invertebrates, but can also include fish, young birds and other amphibians. Native species may be threatened through predation, competition, or disease transmission (GB Non-Native Species Secretariat, 2019).

4 Methodology

4.1 Great crested newt

Survey scope

Zone of Influence

4.1.1 GCN typically range up to 250m from breeding sites, but can also range further afield, up to 500m from breeding sites (English Nature, 2004), particularly where suitable terrestrial habitat is absent from the immediate vicinity of the breeding site or a large population is present. Loss of suitable terrestrial habitat within the Order Limits could consequently affect the productivity of a breeding site up to 500m away. As such, the Zone of Influence (ZoI) over which GCN could reasonably be subject to significant effects at a population level as a result of the Project would therefore not be expected to extend to breeding ponds beyond 500m from the Order Limits.

Survey boundary

4.1.2 The GCN survey boundary, for which targeted field surveys were carried out, is the Order Limits plus 500m.

Desk study survey boundary

4.1.3 The desk study survey boundary for GCN comprises the Order Limits plus 1km. This is the area over which desk-based information was obtained. The purpose of the desk study was to identify recent records of GCN with the area and to provide context to the results of the field surveys.

Desk study

4.1.4 A desk study was carried out in 2020 and subsequently updated in 2022, which considered all protected species records including GCN within 2km of the Order Limits. Records were obtained from Kent & Medway Biological Records Centre (KMBRC; 2022), Essex Wildlife Trust Biological Records Centre (EWTBRC; 2020), Essex Field Club (2022) and the Greenspace Information of Greater London (GiGL) (2022).

4.1.5 It is known that some of the records in the data from EWTBRC (2020) include the results of field surveys carried out for the Project. Where these are known, they have been highlighted as such, but it is not possible to be certain whether there are further records of this sort included.

4.1.6 The locations of statutory and non-statutory designated sites of importance for biodiversity were also obtained within 2km and 1km of the Order Limits respectively. Citations for these sites, which provide information on the reasons for their designation, were reviewed to ascertain whether GCN are included as interest features. All designated sites are shown on Figure 8.1: Designated Sites (Application Document 6.2).

4.1.7 In order to identify suitable GCN habitat (breeding and terrestrial) that could be affected by the Project, potential breeding sites within the GCN survey boundary were initially identified through a detailed review of Ordnance Survey mapping, high-resolution aerial imagery, desk study data, and Phase 1 habitat survey information.

4.1.8 In addition, the following two reports were reviewed for data relating to GCN :

a. Tilbury Power Station: Ecology Survey and Mitigation Plan (RWE Generation UK PLC, 2015)

b. A13 Widening A128 (Orsett Cock) to A1014 (The Manorway) Great Crested Newt Survey Report (AECOM, 2017)

Field surveys

4.1.9 An initial assessment was carried out at all potential GCN breeding ponds. This assessed whether the pond was suitable for supporting breeding GCN; dry; unsuitable for GCN; or no longer present.

4.1.10 Ponds that were found to be dry during the survey were considered unsuitable for supporting breeding GCN. However, these ephemeral ponds could hold water in subsequent years, therefore providing potential breeding habitat for GCN. Preconstruction surveys would be carried out closer to the year of construction to determine the status of these ponds.

4.1.11 Ponds that are no longer present do not provide potential breeding habitat for GCN and, as such, are not considered further in this assessment. In addition, ponds which were deemed unsuitable for supporting breeding GCN were removed from any further survey and therefore not considered further.

Habitat Suitability Index

4.1.12 A Habitat Suitability Index (HSI) assessment was carried out of all suitable GCN breeding ponds (identified above) to assess the potential suitability of such sites for supporting breeding GCN. The methodology followed the method outlined in the Amphibian and Reptile Groups of the UK Advice Note 5: Great Crested Newt Habitat Suitability Index (Amphibian and Reptile Groups of the UK, 2010).

4.1.13 HSI surveys were carried out between July 2017 to May 2018 and updated during the breeding season (April to June 2018 and April to June 2019). The assessment involved scoring habitats based on 10 suitability indices (such as water quality, shade, and frequency of pond drying), all of which are factors known to affect species prevalence. These numerical scores provide a suitability category for the habitat: poor, below average, average, good or excellent.

Presence/absence survey

4.1.14 Presence/absence surveys using conventional methods were carried out between April and June 2018 at all potential breeding ponds within the GCN survey boundary. Ponds where access was not permitted during this period were excluded from these surveys. In cases where access was permitted at the end of the survey season, environmental DNA (eDNA) sampling surveys were carried out instead, where appropriate.

4.1.15 In accordance with industry standard guidelines (English Nature, 2001), the ponds were subject to four survey visits, with two visits conducted within the optimum period (mid-April to mid-May). At least three of four methods, shown in Table 4.1, were employed on each survey visit to maximise the likelihood of detecting GCN. This is the acceptable level of survey effort, as determined by Natural England (English Nature, 2001), to indicate that the species is likely to be absent if not encountered within four survey visits.

Table 4.1 GCN population survey techniques

GCN survey technique	Description
Bottle trapping	Traps deployed in ponds in the late afternoon, left overnight and collected early the following morning. Any newts or other amphibians recorded (species, sex, life stage) and released. Traps were not left for longer than six to seven hours in hot weather conditions.
Torchlight search	A high-powered torch was used to search for GCN after sunset. Torch survey results are subject to high variation due to weather conditions, and so were only carried out under the following conditions: night-time air temperature >5°C, no/little wind, no rain.
Egg search	A visual check of submerged vegetation for GCN eggs carried out in daylight either prior to setting bottle traps or during their retrieval in the morning. As soon as GCN eggs were confirmed as present, no further egg searches were carried out on subsequent visits.
Sweep netting	Carried out only if the pond was unsuitable to deploy traps or egg searching was not feasible, due to a lack of suitable vegetation, for example. A stout net was swept through vegetation in the pond to catch GCN.

Population surveys

4.1.16 As stipulated by the guidelines (English Nature, 2001), a further two survey visits are required for ponds where the presence of GCN has been confirmed, to provide an estimate of the size of the GCN population present. As such, six survey visits were carried out at ponds that were found to support GCN during the presence/absence surveys, with three visits taking place during the optimum survey period. These surveys were carried out using bottle trapping and torching techniques, where appropriate, following the recommendations in the GCN Conservation Handbook (Langton *et al.,* 2001).

4.1.17 The guidance provided by Natural England was used to calculate the population size of GCN using the ponds. This was determined by the peak count of adult GCN per pond for any single survey technique over the entire survey period. Where there was reasonable certainty that there was regular interchange of animals between ponds, the size of the metapopulation (a group of associated populations of newts which breed in, and live around, a cluster of ponds) was also assessed. This is expressed as the peak count of adult GCN across all ponds on any given night. Populations or metapopulations are determined as 'small' for maximum counts of up to 10 individuals, 'medium' for maximum counts between 11 and 100 individuals, and 'large' for maximum counts over 100 individuals (English Nature, 2001).

eDNA sampling surveys and analysis

4.1.18 As stipulated above, eDNA sampling surveys were carried out at ponds where access was restricted until the end of GCN survey season. eDNA surveys were also carried out at ponds where impacts from the Project are minimal and so presence/absence of GCN is considered sufficient to determine effect. As such, no further population class surveys were carried out at these ponds.
The samples were then sent to an accredited laboratory equipped to carry out the analysis.

4.1.19 eDNA analysis is a method for monitoring species in water bodies. It is used for determining GCN presence or likely absence by providing a rapid result from a water sample collected from the pond edge. The analysis identifies the presence of GCN DNA which is released into water from skin, faeces or when an animal dies (Biggs *et al*., 2014).

4.1.20 In order to supplement the findings of the eDNA surveys, where suitable vegetation was present, a search for GCN eggs was also carried out. These searches followed survey guidelines outlined in the GCN Conservation Handbook (Langton *et al.,* 2001).

2019–2021 surveys

4.1.21 Between 2019 and 2022, a gap filing exercise was carried out to survey new ponds which previously fell outside of the GCN survey boundary and any ponds for which access was newly granted. eDNA surveys, egg searches, netting and HSI assessments were carried out following the methods outlined above at any ponds deemed suitable to support breeding GCN.

4.2 Common toad

Scope of study

Zone of Influence

4.2.1 Although common toad can travel over large distances, the area over which they could reasonably be subject to significant effects at a population level as a result of the Project (the ZoI) would not be expected to extend beyond the Order Limits.

Survey boundary

4.2.2 The survey boundary for common toad comprises the Order Limits. Due to the widespread distribution and large range of habitats within which common toads are found, specific targeted surveys for this species were not carried out. Instead, presence within all areas of suitable habitat within the survey boundary was assumed on a precautionary basis.

Desk study survey boundary

4.2.3 The desk study survey boundary for common toad is the Order Limits plus 1km. This is the area over which desk-based information was obtained. The purpose of the desk study was to identify recent records of common toad within the area.

Desk study

4.2.4 A desk study was carried out in 2020 and subsequently updated in 2022, which considered all recent protected species records, including common toad, within 2km of the Order Limits. Records were requested from KMBRC (2022), EWTBRC (2020), Essex Field Club (2022) and GiGL (2022).

Terrestrial habitat suitability assessment

4.2.5 The habitats identified within the Order Limits during the Phase 1 habitat and protected species surveys were assessed for their suitability to support common toad. Table 4.2 presents the results of this assessment. Habitats were assessed and categorised as follows:

a. Suitable habitats: high-quality and likely to be used for foraging, resting, and/or hibernation; sites where species are considered to be potentially present.

b. Sub-optimal habitats: of low value to species, likely to be used for commuting/dispersal only and only if adjacent suitable habitat is abundant; species are considered unlikely to be present in large numbers.

c. Unsuitable habitats: considered to be of no value to the species concerned and absence is assumed.

Table 4.2 Habitat suitability assessment for common toad

Phase 1 habitat	Suitability category
Woodland	Suitable
Scrub	Suitable
Felled woodland	Suitable
Grassland excluding improved grassland, arable and amenity	Suitable
Improved grassland and arable fields	Sub-optimal
Amenity grassland	Sub-optimal
Bracken	Sub-optimal
Tall ruderal, ephemeral and short perennial	Suitable
Wet heathland	Unsuitable
Bog habitats	Unsuitable
Fen and swamp	Suitable
Marginal and inundation vegetation	Suitable
Intertidal habitats	Unsuitable
Saltmarsh	Sub-optimal
Quarry	Suitable
Hedgerows	Suitable
Hardstanding	Unsuitable
Houses and gardens	Suitable

Incidental observations

4.2.6 Any incidental observations of common toad that were made during other ecological surveys, including targeted surveys for GCN and reptiles, were recorded and used to inform this assessment.

4.3 Marsh frog

Scope of study

Zone of Influence

4.3.1 The area over which marsh frog could reasonably be subject to significant effects at a population level as a result of the Project (the ZoI) would not be expected to extend beyond the Order Limits.

Survey boundary

4.3.2 The survey boundary for marsh frog comprises the Order Limits. As marsh frog are non-native and are not considered to be of conservation value, specific targeted surveys for this species were not carried out. Instead, incidental sightings during other surveys were recorded.

Desk study survey boundary

4.3.3 The desk study survey boundary for marsh frog is the Order Limits plus 1km. This is the area over which desk-based information was obtained. The purpose of the desk study was to identify recent records of marsh frog within the area.

Desk study

4.3.4 A desk study was carried out in 2020 and subsequently updated in 2022, which considered all recent protected or otherwise notable species records, including marsh frog, within 2km of the Order Limits. Records were requested from KMBRC (2022), EWTBRC (2020), Essex Field Club (2022) and GiGL (2022).

Incidental observations

4.3.5 Any incidental observations of marsh frog that were made during other ecological surveys, including targeted surveys for GCN, otter *Lutra lutra* and water vole *Arvicola amphibius*, were recorded and used to inform this assessment.

5 Results

5.1 Great crested newt

5.1.1 The survey results are outlined below with more detailed results included in Annex A of this document. The locations of all ponds within the GCN survey boundary are shown on Figure 8.8: GCN Presence and Absence Results (Application Document 6.2).

South of the River Thames

Desk study

5.1.2 Kent has good populations of GCN (Kent Reptile and Amphibian Group, 2019b). The desk study data from Kent and Medway Biological Records Centre (2022) indicates that, since 2012, there were 26 GCN records within 2km of the Order Limits. Peter's Pit SAC and SSSI is designated for its large population of GCN, as well as smooth newts *Lissotriton vulgaris*, palmate newts *Lissotriton helveticus* and common frog *Rana temporaria* and is located 1.8km from the Order Limits (JNCC, 2015 and Natural England, 1986). Given the distance from the Order Limits, GCN associated with the SAC population are considered unlikely to be present within the Order Limits. Ebbsfleet Marshes Local Wildlife Site is known to support GCN as well as smooth newts (Kent Wildlife Trust, 2018) and is located 0.49km to the west of the Order Limits. Given the lack of suitable connective habitat, GCN associated with the Local Wildlife Site population are considered unlikely to be present within the Order Limits.

Field study

5.1.3 A total of 125 ponds were initially identified through a detailed review of Ordnance Survey mapping, high-resolution aerial imagery, and Phase 1 information. Of these, 82 ponds had no further GCN assessment or survey due to the following reasons:

a. 13 ponds to which access was not granted.

b. 21 ponds were dry during the GCN breeding season.

c. Five ponds were found to no longer exist.

d. Ten ponds were deemed unsuitable to support breeding GCN.

e. Two ponds were scoped out due to major barriers to movement present between pond and the Project.

f. One was unsafe to access due to steeps banks, deep water and dense vegetation.

g. 14 ponds, located within Shorne Marshes, were within an area that contained nesting marsh harrier *Circus aeruginosus.* However, GCN were found incidentally during water vole surveys here and therefore are known to be present within the site.

h. 16 ponds were scoped out on the basis that they were 250m or further from utility works.

5.1.4 The 14 ponds for which no access was obtained or were unsafe to survey have been classified as 'presence unknown' (see Section 7 of this appendix for further information).

5.1.5 A total of 43 ponds were assessed using HSI, and were categorised as having the following suitability for supporting GCN:

a. Six 'excellent'

b. Six 'good'

c. Ten 'average'

d. 12 'below average'

e. Eight 'poor'

f. One pond was dry at the time of the HSI assessment

5.1.6 Presence/absence surveys using either conventional survey methods or eDNA surveys were carried out at 41 ponds within the GCN survey boundary. Two ponds were not subject to presence/absence surveys as access was revoked following the HSI surveys; desk study data provided by KMBRC has identified the presence of GCN within these ponds. Although no further surveys have been carried out to verify the KMBRC data, GCN presence in these two ponds has been assumed on a precautionary basis. GCN presence was confirmed within a total of 33 ponds (including the two ponds for which GCN presence has been assumed through desk study and the 14 ponds at Shorne Marshes that were within an area that contained nesting marsh harrier). Population size class estimate surveys were carried out at 17 of these ponds.

5.1.7 Where ponds are located close to each other, with good habitat connectivity and no barriers between ponds, there is reasonable certainty that GCN regularly interchange between ponds. As such, GCN from these ponds are considered to form a metapopulation.

5.1.8 A summary of GCN populations and metapopulations south of the River Thames is presented in Table 5.1.

Table 5.1 Summary of GCN populations/metapopulations present within the GCN survey boundary to the south of the River Thames

Population/ metapopulation	Pond number	HSI result	Pond population size	Population/metapopulation size
S1	P003S	Below average	Small	Medium – High levels of turbidity and vegetation cover restricted surveying of pond P221S. Ponds P178S and P179S could not be surveyed, but presence was confirmed with desk study data. Despite the constraints, it is not considered that these three ponds would support sufficient GCN to increase the metapopulation size to 'large', so 'medium' is considered accurate.
	P004S	Below average	Medium	
	P064S	Poor	Small	
	P178S	Excellent	Assumed medium (based on the size of local populations)	
	P179S	Good	Assumed medium (based on the size of local populations)	
	P182S	Good	Assumed medium	
	P203S	Good	Small	
	P221S	Below average	Small	
S2	P021S	Below average	Small	Large – On the basis of high numbers of GCN and the presence of high-quality habitat between the ponds.
	P039S	Average	Large	
	P040S	Poor	Large	
	P183S	Excellent	Large	
	P184S	Excellent	Large	
	P185S	Excellent	Large	
	P186S	Below average	Large	
	P204S	Below average	Large	
	P219S	Good	Small	

Population/ metapopulation	Pond number	HSI result	Pond population size	Population/metapopulation size
	P220S	Average	Small	
	P249S	Poor	Assumed large	
S3	P120S	Average	Assumed small (GCN eggs found only)	Assumed small – Six ponds were located within 250m of pond P120S, but no GCN were recorded in these.
S4	P027S	Unknown	Assumed large	Assumed large – High number of ponds where surveys were not possible due to presence of nesting marsh harrier, but GCN were recorded near these ponds during other protected species surveys.
	P028S	Unknown	Assumed large	
	P029S	Unknown	Assumed large	
	P044S	Unknown	Assumed large	
	P121S	Unknown	Assumed large	
	P125S	Unknown	Assumed large	
	P126S	Unknown	Assumed large	
	P127S	Unknown	Assumed large	
	P128S	Unknown	Assumed large	
	P129S	Unknown	Assumed large	
	P130S	Unknown	Assumed large	
	P131S	Unknown	Assumed large	
	P196S	Unknown	Assumed large	
	P456S	Unknown	Assumed large	

Terrestrial habitat suitability assessment

5.1.9 The habitats within the GCN survey boundary to the south of the River Thames in Kent support mainly ancient and semi-natural broadleaved woodland, neutral grassland, marshy grassland, and hedgerow habitats. These habitats provide potentially suitable terrestrial habitat for GCN.

North of the River Thames

Desk study

5.1.10 The desk study data from Essex Wildlife Trust Biological Records Centre (2020) indicates that, since 2012, there were 58 GCN records within 2km of the Order Limits. Essex Field Club (2022) returned 54 records of GCN within 2km of the Order Limits since 2012. All records were outside of the Order Limits, the nearest record located 28m from the Order Limits. The GiGL records centre (2022) returned 190 records of GCN within 2km of the Order Limits. No geographical locations for the records were provided, however the nearest record was located within the Order Limits.

5.1.11 Cranham Brickfields LNR, located 226m south-west of the Order Limits at its closest point, supports GCN (Natural England, 2008). The site appears to support one pond surrounded by woodland. The pond itself is located over 500m from the Order Limits. Given the distance, abundance of suitable habitat near to the pond and lack of habitat connectivity between the Order Limits and this pond, GCN associated with the nature reserve population are considered unlikely to be present within the Order Limits.

5.1.12 Cranham Marsh SINC is located 260m to the west of the Order Limits at its closest point, supports GCN (GIGL, 2022). The site appears to support several ponds and wetland areas with the closest located over 500m from the Order Limits. Given the distance, abundance of suitable habitat near to the pond and lack of habitat connectivity between the Order Limits and this pond, GCN associated with the nature reserve population are considered unlikely to be present within the Order Limits.

5.1.13 Four non-statutory designated sites were designated in part for their amphibian interest features: Cranham Hall Shaws and Pastures Site of Importance for Nature Conservation (SINC), Tylers Common SINC, Franks Wood and Cranham Brickfields SINC and Stubber's Outdoor Pursuits Centre SINC. It should be noted that these sites are not designated for GCN, but for their potential for amphibian interest features. Cranham Hall Shaws and Pasture SINC is located 386m from the Order Limits, Tylers Common SINC is 274m from the Order Limits, Franks Wood and Cranham Brickfields SINC is within the Order Limits and Stubber's Outdoor Pursuits Centre SINC is within the Order Limits. Given the distance of these sites, it is considered likely that GCN, if present, associated with these sites could be present within the Order Limits.

Field study

5.1.14 A total of 275 ponds were initially identified through a detailed review of Ordnance Survey mapping, high-resolution aerial imagery, and Phase 1

information. Of these, 153 ponds had no further GCN assessment due to the following reasons:

a. 24 ponds to which access was not granted.

b. Six ponds for which no access was granted. However, GCN results were provided from recent surveys carried out as part of the Tilbury2 scheme (RWE Generation UK PLC, 2015), A13 Widening Project (AECOM, 2017) and Natural England Open Access Data Source (Natural England, 2020), for which GCN presence was confirmed at one pond.

c. One pond at which no access was granted during the GCN breeding season. However, an incidental sighting of GCN was recorded during walkover surveys later in the year.

d. 25 ponds were dry during the GCN breeding season.

e. 22 ponds were no longer present.

f. 24 ponds were deemed unsuitable to support breeding GCN due to either saline conditions or being fishing lakes.

g. 51 ponds were scoped out on the basis that they were 250m from utility works.

5.1.15 The 24 ponds for which no access was obtained, and no other information was provided, have been classified as ‘presence unknown’. See Section 7 for further information.

5.1.16 A total of 122 ponds were assessed using HSI, and were categorised as having the following suitability for supporting GCN:

a. Six ‘excellent’

b. 24 ‘good’

c. 29 ‘average’

d. 26 ‘below average’

e. 35 ‘poor’

f. One pond was dry at the time of the HSI assessment

g. One pond was filled in at the time of the HSI assessment

5.1.17 Presence/absence surveys using either conventional survey methods or eDNA surveys were carried out at 117 ponds within the GCN survey boundary. Three ponds were not subject to presence/absence surveys, as follows:

a. One pond was near nesting nightingale, and so was not surveyed in order to avoid disturbing the nightingale. Due to close proximity to ponds within population N01, GCN presence has been assumed here.

b. One pond had access revoked after the HSI was carried out. GCN presence has been classified as ‘presence unknown’. See Section 7 for further information.

c. Three ponds were dry during the GCN survey season.

5.1.18 GCN presence was confirmed/assumed within a total of 41 ponds (including the pond for which GCN presence was confirmed through desk study). Population size class estimate surveys were carried out at 19 of these ponds.

5.1.19 Where ponds are located close to each other, with good habitat connectivity and no barriers between ponds, there is reasonable certainty that GCN regularly interchange between ponds. As such, GCN from these ponds are considered to form a metapopulation.

5.1.20 A summary of GCN populations and metapopulations north of the River Thames is presented in Table 5.2.

Table 5.2 Summary of GCN populations/metapopulations present within the GCN survey boundary north of the River Thames

Population/ metapopulation	Pond number	HSI result	Pond population size	Population/metapopulation size
N1	P193N	Below average	Assumed medium	Medium – on the basis of the following constraints: surveys for pond P193N were heavily constrained, with the peak count considered to be an underestimate; access to pond P195N was denied, but GCN presence has been assumed.
	P195N	Average	Assumed medium	
N2	P001N	Average	Assumed medium	Medium – constraints to survey were recorded at all three ponds. Despite this, it is not considered likely that the metapopulation would be 'large' due to other ponds close by being considered largely unsuitable for breeding.
	P216N	Excellent	Small	
	P222N	Excellent	Small	
	P467N	Average	Assumed present	
N3	P301N	Poor	Assumed medium	Assumed medium – presence confirmed through eDNA only due to constraints to survey, so no peak count was obtained.
N4	P023N	Poor	Small	Assumed medium – small peak count from pond P023N. However, due an incidental GCN record and positive eDNA data of ponds P135N and P307N respectively, it is considered likely that larger peak counts would have been recorded.
	P135N	Unknown	Assumed medium	
	P307N	Unknown	Assumed medium	
N5	P045N	Dry at the time of HSI assessment	Small	Small
	P116N	Poor	Small	
N6	P257N	Below average	Assumed medium	Assumed medium – no assessment of population size has been carried out due to confirmation being provided by eDNA only.
	P258N	Below average	Assumed medium	

Population/ metapopulation	Pond number	HSI result	Pond population size	Population/metapopulation size
N7	P075N	Good	Assumed medium	Assumed large – GCN were recorded present at P079N, P197N and P096N (eDNA only). Negative or inconclusive results were returned from the eDNA surveys of ponds P075N, P077N and P095N; however, due to constraints to survey, GCN presence is assumed.
	P076N	Below average	Assumed medium	
	P077N	Below average	Assumed medium	
	P079N	Poor	Medium	
	P095N	Good	Assumed medium	
	P096N	Excellent	Assumed medium	
	P197N	Average	Assumed medium	
N8	P263N	Good	Assumed medium	Assumed medium – no population size assessment carried out due to only eDNA data available. GCN presence is confirmed in two ponds and assumed in pond P265N.
	P264N	Poor	Assumed small	
	P265N	Below average	Assumed medium	
N9	P317N	Good	Assumed medium	Assumed medium – no population size assessment carried out due to only eDNA data being available. GCN presence confirmed in all ponds.
	P319N	Below average	Assumed medium	
	P321N	Excellent	Assumed medium	
N10	P137N	Poor	Large	Large – on the basis of large numbers of GCN recorded in each pond.
	P206N	Average	Large	
N11/N12	P166N	Poor	Small	Assumed medium – presence of GCN was recorded through eDNA, and therefore no peak count has been obtained.
	P227N	None	Small	
	P240N	Average	Assumed medium	
	P241N	Average	Assumed medium	

Population/ metapopulation	Pond number	HSI result	Pond population size	Population/metapopulation size
N13	P157N	Poor	Assumed large	Assumed large – on a precautionary basis. Survey data may not show an accurate representation of the GCN population due to survey constraints.
	P158N	Good	Small	
	P159N	Poor	Assumed small	
N14	P149N	Below average	Assumed medium	Assumed medium – there were constraints when surveying these ponds.
	P150N	Good	Assumed medium	
N15	P210N	Average	Small	Small – small population recorded in pond P210N and no GCN recorded in pond located 130m from pond P210N.
N16	P098N	Below average	Assumed medium	Assumed medium – presence of GCN was recorded through eDNA, and therefore no peak count has been obtained.
	P313N	Average	Assumed medium	

Terrestrial habitat suitability assessment

5.1.21 The majority of the habitats within the GCN survey boundary to the north of the River Thames in Essex support mainly arable grassland and improved pasture. These habitats are of limited importance to GCN and are unlikely to support this species. However, the mature hedgerows, rough and marshy grassland, scrub and woodland all provide potentially suitable terrestrial habitat (for foraging, hibernation and/or dispersal). As such, GCN are considered to possibly be present within these habitats during their terrestrial phase.

5.2 Common toad

South of the River Thames

Desk study

5.2.1 The desk study data from Kent and Medway Biological Records Centre (2022) indicates that, since 2012, there were 11 records of common toad within 2km of the Order Limits.

Terrestrial habitat suitability assessment

5.2.2 All standing water bodies within the Order Limits to the south of the River Thames, including ponds identified above as suitable for GCN, are considered to provide suitable breeding habitat for common toad.

5.2.3 The habitats within the Order Limits to the south of the river in Kent support mainly ancient and semi-natural broadleaved woodland, neutral grassland, marshy grassland and hedgerow habitats. These habitats provide potentially suitable terrestrial habitat for common toad. As such, common toads are considered possibly to be present within these habitats during their terrestrial phase.

Incidental observations

5.2.4 Common toad was recorded on four occasions during GCN surveys within four ponds south of the river (P017S, P039S, P189S and P221S).

North of the River Thames

Desk study

5.2.5 The desk study data from Essex Wildlife Trust Biological Records Centre (2020) indicates that, since 2012, there were 15 common toad records within 2km of the Order Limits. Essex Field Club (2022) returned 14 records of common toad within 2km of the Order Limits. All records were outside of the Order Limits, the nearest record located 615m from the Order Limits.

5.2.6 The GiGL records centre (2022) returned 12 records of common toad within 2km of the Order Limits since 2012. The nearest record was at a distance of 15m, but no specific geographical location was provided.

5.2.7 Common toad is not listed as a qualifying or interest feature for any statutory designated site north of the River Thames.

5.2.8 Four non-statutory designated sites north of the River Thames were designated in part for their amphibian interest features: Cranham Hall Shaws and Pastures

SINC, Tylers Common SINC, Franks Wood and Cranham Brickfields SINC and Stubber's Outdoor Pursuits Centre SINC. It should be noted that these sites are not designated for common toad, but for their potential for amphibian interest features. Cranham Hall Shaws and Pasture SINC is located 386m from the Order Limits, Tylers Common SINC is 274m from the Order Limits, Franks Wood and Cranham Brickfields SINC is within the Order Limits and Stubber's Outdoor Pursuits Centre SINC is within the Order Limits.

Terrestrial habitat suitability assessment

5.2.9 All standing water bodies within the Order Limits to the north of the River Thames, including ponds identified above as suitable for GCN, are considered to provide suitable breeding habitat for common toad.

5.2.10 The majority of the habitats within the Order Limits to the north of the river in Essex comprise mainly arable grassland and improved pasture. These habitats are of limited importance to common toad and are unlikely to support this species. However, the mature hedgerows, rough and marshy grassland, scrub and woodland all provide potentially suitable terrestrial habitat (foraging, hibernation and dispersal). As such, common toads are considered to possibly be present within these habitats during their terrestrial phase.

Incidental sightings

5.2.11 Common toad was recorded on one occasion during GCN presence/absence surveys within a pond north of the river (P045N). One common toad was recorded north of the river in a pile of dead wood within the Wilderness woodland during the 2018 terrestrial invertebrate survey.

5.3 Marsh frog

South of the River Thames

Desk study

Kent and Medway Biological Records Centre (2022) returned 14 records of marsh frog with 2km of the Order Limits.

Incidental observations

6.1.1 Marsh frogs were recorded on seven separate occasions within five different ponds (P008S, P013S, P042S, P120S and P232S) during GCN surveys to the south of the River Thames. Marsh frogs were also observed during the targeted otter and water vole surveys; however, detailed locations or numbers were not recorded.

North of the River Thames

Desk study

6.1.2 The desk study data from Essex Wildlife Trust Biological Records Centre (2020) indicates that, since 2012, there were eight marsh frog records within 2km of the Order Limits.

6.1.3 Essex Field Club (2022) returned 13 records of marsh frog within 2km of the Order Limits. All records were outside the Order Limits, the nearest record located 17m from the Order Limits.

6.1.4 No records of marsh frog within 2km of the Order Limits were returned by the GiGL records centre (2022) Incidental observations.

6.1.5 Marsh frogs were recorded on 37 separate occasions within 14 different ponds (P079N, P086N, P087N, P088N, P089N, P117N, P157N, P160N, P162N, P163N, P166N, P209N, P227N and P235N) during GCN surveys to the south of the River Thames. A marsh frog was heard calling within Top Meadow Golf Course during the Phase 1 habitat surveys. Marsh frogs were also seen during the targeted otter and water vole surveys; however, detailed locations were not recorded.

7 Limitations and assumptions

7.1 Great crested newt

Ponds for which GCN presence is unknown ('presence unknown' ponds)

7.1.1 GCN presence could not be determined at 36 ponds due to land access restrictions or health and safety reasons. Of these ponds, 11 clearly formed part of a known metapopulation and have been included within that metapopulation (see Table 5.1 and Table 5.2). Medium populations of GCN have been assumed to be present on a precautionary basis (unless other information suggests otherwise).

Assumed population size

7.1.2 Population surveys could not be carried out at the 14 ponds located within Shorne Marshes (metapopulation S4) due to the presence of nesting marsh harrier. Marsh harrier is listed in Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). The nest sites are therefore protected from disturbance and so these ponds were not surveyed. A large metapopulation size has been assumed across these ponds due to a large amount of high-quality terrestrial habitat, a large number of ponds in the area and because GCN were sighted on several occasions during other surveys carried out outside the nesting period.

7.1.3 Access was revoked at Ponds P178S and P179S. However, desk study records obtained from KMBRC confirm GCN presence within these ponds in 2014. Given GCN are still present within the local area, GCN have been assumed to be still present within these ponds. As population size was not provided, the population size within these ponds has been assumed to be medium.

Dry ponds

7.1.4 Where ponds were found to be dry during the survey season, they were considered to be unsuitable for breeding GCN. Therefore, GCN were considered to be absent from these ponds.

Surveys

eDNA

7.1.5 eDNA analysis can produce false positive or false negative results. Evidence suggests false negatives, which can occur in ponds that are only used intermittently by newts, are more likely to occur than false positives. As GCN are well known to use some ponds, especially small ones, for foraging only (non-breeding ponds), they may only visit sporadically during the spring and summer, increasing the chance that the timing of an eDNA survey would not coincide with the presence of newts, thereby producing a false negative. False negatives may also occur when there is a small population of newts (especially in large ponds), and the amount of eDNA in the sample is below the detectable level.

7.1.6 Certain environmental factors can also affect the detectability of eDNA. eDNA breaks down significantly more quickly in samples taken from areas with no shading compared to heavily shaded areas, which could result in eDNA being undetected. In addition, the presence of algae or sediment in samples can inhibit the eDNA lab test and result in an indeterminate result. Effort was made to reduce the amount of algae and sediment collected within a sample.

7.1.7 There is also a considerable risk of contaminating the pond sample by bringing in GCN DNA in mud and water from other areas on boots and survey equipment. DNA can remain on surfaces even after they have been dried and can persist in soil for many years. There are recorded examples of eDNA cross-contaminating pond water samples from surveyors' boots. This limitation was reduced by cleaning and disinfecting equipment and boots thoroughly after each survey.

7.1.8 Guidance (Biggs *et al.*, 2014) for undertaking eDNA surveys recommends taking samples from 20 locations around the whole perimeter of the pond, as evidence suggests that eDNA is less likely to be detected if the whole pond perimeter is not sampled. eDNA surveys at 28 ponds were conducted from less than 80% of the pond perimeter due to dense vegetation and/or health and safety considerations preventing full access, which may have produced false negative results.

7.1.9 Of these 28 ponds, four returned positive results, three returned an inconclusive result for GCN eDNA and the remaining 21 returned negative results. An assessment was carried out of the 24 ponds that returned inconclusive or negative results that considered desk study results, the proximity to known GCN populations and HSI scores to assess the likely presence/absence of GCN within these ponds. Further details are provided in Table 7.1.

Table 7.1 eDNA survey limitations

Pond number	eDNA result	% of pond sampled	Quality of sample	Presence	HSI score	Notes
P008S	Negative	10	Good	Assumed absent	Average	Although constrained, population surveys also found nothing. GCN considered likely to be absent.
P025N	Negative	60	Moderate	Assumed absent	Below average	Conventional surveys also carried out at this pond, which were also fairly constrained. However, below average HSI score suggests pond is largely unsuitable for GCN, and results from all surveys point towards a consistent negative. GCN therefore assumed absent. Not near any desk study records or known metapopulations.
P026N	Inconclusive	40	Moderate	Assumed absent	Below average	Carried out in conjunction with conventional surveys. Considered unsuitable due to below average his.
P075N	Negative	30	Moderate	Assumed present	Good	Close to known GCN populations.
P095N	Negative	10	Good	Assumed present	Good	Close to known GCN populations.
P099N	Negative	40	Good	Unknown	Below average	Close to known GCN populations.
P104N	Negative	10	Good	Assumed absent	Below average	No known GCN populations within neighbouring ponds.
P106N	Negative	15	Good	Assumed absent	Good	No known GCN populations within neighbouring ponds.
P118N	Negative	10	Good	Assumed absent	Poor	Although GCN ponds within the area, no GCN were found within adjacent pond.

Pond number	eDNA result	% of pond sampled	Quality of sample	Presence	HSI score	Notes
P245N	Negative	50	Moderate	Assumed absent	Good	No known GCN populations within neighbouring ponds.
P256N	Negative	20	Moderate	Assumed absent	Poor	Although GCN populations are within the ponds within 700m, the pond is isolated within a woodland copse in an arable field.
P258N	Positive	40	Good	Present	Below average	Presence confirmed.
P261N	Inconclusive	30	Good	Assumed absent	Poor	No known GCN populations within neighbouring ponds.
P263N	Positive	10	Good	Present	Good	Presence confirmed.
P264N	Negative	20	Good	Assumed present	Poor	Close to known GCN populations.
P301N	Positive	10	Good	Present	Poor	Presence confirmed.
P304N	Negative	20	Good	Assumed absent	Good	No known GCN populations within neighbouring ponds.
P312N	Negative	30	Moderate	Assumed absent	Poor	No known GCN populations within neighbouring ponds.
P316N	Negative	20	Good	Assumed absent	Poor	No known GCN populations within neighbouring ponds.
P321N	Positive	70	Good	Present	Excellent	Presence confirmed.
P323N	Inconclusive	10	Good	Unknown	Good	Barely any water left in pond at time of survey, considered likely to be dry soon and thus unsuitable for GCN.

Pond number	eDNA result	% of pond sampled	Quality of sample	Presence	HSI score	Notes
P326N	Negative	100	Low	Assumed absent	Below average	Water sample quality low but no inhibition or degradation. Egg search not carried out as no suitable egg-laying vegetation. HSI below average. Close to desk-study record. Ponds in the area all unknown or scoped out. Result considered likely to be correct.
P342N	Negative	30	Good	Assumed absent	Poor	Not near any desk study records or known metapopulations. Considered likely to be unsuitable for GCN based on poor HSI score.
P343N	Negative	40	Good	Assumed absent	Poor	Not near any desk study records or known metapopulations. Considered likely to be unsuitable for GCN based on poor HSI score.
P351S	Negative	20	Good	Unknown	Average	Not near any desk study records or known metapopulations. Cannot confidently assume absence, therefore unknown.
P410N	Negative	20	Good	Assumed absent	Poor	Considered likely to be unsuitable for GCN based on poor HSI score.
P430N	Negative	30	Good	Assumed absent	Poor	Considered likely to be unsuitable for GCN based on poor HSI score.
P467N	Negative	20	Good	Unknown	Average	Within desk study record area and within metapopulation N2 250m buffer.

Pond number	eDNA result	% of pond sampled	Quality of sample	Presence	HSI score	Notes
P469N	Negative	90	Low	Assumed absent	Average	No known GCN populations within neighbouring ponds.
P470N	Negative	100	Low	Assumed absent	Poor	Considered likely to be unsuitable for GCN based on poor HSI score.
P472N	Negative	60	Low	Assumed absent	Poor	Considered likely to be unsuitable for GCN based on poor HSI score.

Conventional surveys

Survey conditions

7.1.10 Guidance (English Nature, 2001) for carrying out population surveys recommends using three survey methods per visit (egg searching, bottle trapping, torching or netting). This was not possible for all surveys due to either low water levels or because health and safety considerations (e.g. steep banks, dense vegetation) made it too dangerous to carry out three survey methods.

7.1.11 Thirty-two surveys at 22 ponds were carried out where water conditions were classed as ‘very-turbid’ and therefore sub-optimal for carrying out torch surveys. On two of these occasions, netting was carried out instead of torching. As such, three survey methods were carried out, so the results are considered to be unaffected. On the other 30 surveys, torching was not carried out, meaning only one or two survey methods were used, or torching was attempted. This may have resulted in GCN being under-recorded during these surveys. In these incidences, all the survey information was reviewed to determine if this could have been the case and a reasonable worst-case view taken.

7.1.12 Twenty-one surveys at 14 ponds were carried out where vegetation completely obscured the water during torch surveys and conditions were therefore sub-optimal for torch surveys. On five of these occasions, netting was carried out instead of torching. As such, three survey methods were used, so the results are considered to be unaffected. On the other 16 occasions, torching was not carried out, meaning only one or two survey methods were used, or torching was attempted. This may have resulted in GCN being under-recorded during these surveys. In these incidences, all the survey information was reviewed to determine if this could have been the case and a reasonable worst-case view taken.

7.2 Common toad

7.2.1 All ponds within the Order Limits identified as part of the GCN surveys have the potential to support common toad (Application Document 6.2, Figure 8.8: GCN Presence and Absence Results).

7.2.2 As common toads are known to disperse up to 1.6km from breeding ponds (Sinsch, 1988), presence has been assumed in all ponds and suitable terrestrial habitat throughout the Project.

7.3 Marsh frog

7.3.1 All ponds within the Order Limits identified as part of the GCN surveys have the potential to support marsh frog (Application Document 6.2, Figure 8.8). Marsh frogs are considered to be present within suitable habitat across the Project route.

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Annexes

Annex A Pond Summary Tables

A.1.1 Table A.1 and Table A.2, below, provide a summary of all ponds identified within the GCN survey area to the south and north of the River Thames, respectively. The meaning of the colour of each row is as follows:

a. Green indicates where GCN presence has been confirmed.

b. Orange indicates where GCN presence is unknown.

c. White indicates where GCN are likely to be absent.

d. Grey indicates where a pond has been removed from this assessment and is not considered further

Table A.1 Summary of results for ponds to the south of the River Thames

Pond number	HSI score	GCN presence	Population size	Survey type	Meta-population	Notes
P003S	Below average	Present	Small	Population class estimate surveys	S1	Low detectability warning due to high vegetation cover during visits 3 and 5.
P004S	Below average	Present	Medium	Population class estimate surveys	S1	Low detectability warning due to high levels of turbidity on all visits. As pond is part of 'large' metapopulations, this is considered sufficient.
P008S	Average	Assumed absent	None	Presence / absence surveys and eDNA		10% of shoreline sampled during eDNA surveys. Deep, steep-sided canal prevented bottle trapping, netting and egg searches from being carried out. Low detectability warning recorded during visit 2 due to high vegetation cover. Despite the constraints, given the survey effort carried out, with no GCN presence confirmed, GCN are assumed likely absent.

Pond number	HSI score	GCN presence	Population size	Survey type	Meta-population	Notes
P009S	No pond present.					
P010S	Below average	Absent	None	Presence / absence surveys		Due to bulls within field, torching and bottle trapping could not be carried out during visit 4. Egg searches and netting was still carried out.
P011S	Poor	Absent	None	Presence / absence surveys		Due to bulls within field, torching could not be carried out during visit 4.
P012S	Poor	Absent	None	Presence / absence surveys		No constraints.
P013S	Poor	Absent	None	Presence / absence surveys		Torch surveys were not carried out during visit 4 due to high coverage of vegetation.
P014S	Poor	Absent	None	Presence / absence surveys		Low detectability warning due to high turbidity during visit 1 and 4.
P015S	Below average	Absent	None	Presence / absence surveys		No constraints.
P016S	Below average	Absent	None	Presence / absence surveys		Low detectability warning due to high vegetation cover during visit 1. Due to bulls being present in the field, only two survey methods were carried out on visit 4 (egg search and netting).
P017S	Average	Absent	None	Presence / absence surveys		No constraints.
P018S	Below average	Absent	None	Presence / absence surveys		No constraints.

Pond number	HSI score	GCN presence	Population size	Survey type	Meta-population	Notes
P019S	Fishing lake – unsuitable for supporting GCN.					
P021S	Below average	Present	Small	Population class estimate surveys	S2	Low detectability warning due to high turbidity during visits 2, 3 and 5. On visit 6 the pond was dry, no survey methods carried out.
P027S	Unknown	Present	Assumed large	None	S4	Incidental sighting of GCN during otter and water vole surveys.
P028S	Unknown	Present	Assumed large	None	S4	Incidental sighting of GCN during otter and water vole surveys.
P029S	Unknown	Present	Assumed large	None	S4	Incidental sighting of GCN during otter and water vole surveys.
P031S	Excellent	Absent	None	Presence / absence surveys		Pond considered unsafe to survey due to steep banks and dense vegetation; only torching used surveys were carried out. Low detectability warning during visits 1, 2 and 3 due to high vegetation cover.
P039S	Average	Present	Large	Population class estimate surveys	S2	Low detectability warning recorded due to high vegetation coverage during visit 2. A 'large' population was recorded across the ponds within metapopulation S2 during visit 3. No other surveys were carried out after this.
P040S	Poor	Present	Large	Population class estimate surveys	S2	Low detectability warning recorded due to high level of turbidity during visit 5.
P042S	Poor	Assumed absent	None	Presence / absence surveys		Steep sides and a gravel bottom prevented bottle trapping for visits 1 to 3. Netting was used on visits 2 and 3 to compensate for bottle trapping. Access restrictions prevented visit 4 from being carried out. Despite the constraints, GCN have been assumed to be absent.

Pond number	HSI score	GCN presence	Population size	Survey type	Meta-population	Notes
P044S	Unknown	Present	Assumed large	None	S4	Incidental sighting of GCN during otter and water vole surveys.
P053S	Unknown	Unknown	Unknown	None		No access.
P054S	Dry during the GCN breeding season.					
P056S	Average	Assumed absent	None	Presence / absence surveys		Low detectability warnings during visit 1 and 4 due to high vegetation cover and turbidity. Netting was carried out instead of bottle trapping for all four visits.
P057S	Dry during the GCN breeding season.					
P058S	Dry during the GCN breeding season.					
P059S	Below average	Absent	None	eDNA		No constraints.
P060S	Good	Absent	None	Conventional & eDNA		<80% of the pond was surveyed during eDNA surveys
P061S	Good	Absent	None	eDNA		No constraints.
P062S	Dry during the GCN breeding season.					
P063S	Dry during the GCN breeding season.					
P064S	Poor	Present	Small	Population class estimate surveys	S1	No constraints.
P115S	Excellent	Absent	None	Presence / absence surveys		Low detectability warning during visits 3 and 4 due to high vegetation cover turbidity.

Pond number	HSI score	GCN presence	Population size	Survey type	Meta-population	Notes
P120S	Average	Present	Assumed small	Population class estimate surveys	S3	Bottle traps were not deployed during visit 3 as temperatures were due to fall below 5°C. GCN eggs only recorded.
P121S	Unknown	Present	Assumed large	None	S4	Incidental sighting of GCN during otter and water vole surveys.
P122S	Dry during the GCN breeding season.					
P123S	Dry during the GCN breeding season.					
P124S	Dry during the GCN breeding season.					
P125S	Unknown	Present	Assumed large	None	S4	Incidental sighting of GCN during otter and water vole surveys.
P126S	Unknown	Present	Assumed large	None	S4	Incidental sighting of GCN during otter and water vole surveys.
P127S	Unknown	Present	Assumed large	None	S4	Incidental sighting of GCN during otter and water vole surveys.
P128S	Unknown	Present	Assumed large	None	S4	Incidental sighting of GCN during otter and water vole surveys.
P129S	Unknown	Present	Assumed large	None	S4	Incidental sighting of GCN during otter and water vole surveys.
P130S	Unknown	Present	Assumed large	None	S4	Incidental sighting of GCN during otter and water vole surveys.
P131S	Unknown	Present	Assumed large	None	S4	Incidental sighting of GCN during otter and water vole surveys.
P178S	Excellent	Present	Assumed Medium	Desk study	S1	Access was refused by landowner during the 2018/2019 survey season. Records from KMBRC.

Pond number	HSI score	GCN presence	Population size	Survey type	Meta-population	Notes
P179S	Good	Present	Assumed Medium	Desk study	S1	Access was refused by landowner during the 2018/2019 survey season. Records from KMBRC.
P180S	Fishing lake – unsuitable for supporting GCN.					
P181S	Fishing lake – unsuitable for supporting GCN.					
P182S	Good	Unknown	Unknown	None		HSI survey only; access was refused for subsequent surveys.
P183S	Excellent	Present	Large	Population class estimate surveys	S2	A 'large' population was recorded across the ponds within metapopulation S2 during visit 3. No other surveys were carried out after this.
P184S	Excellent	Present	Large	Population class estimate surveys	S2	Only 50% of pond could be surveyed due to dense scrub along one side of the pond. Visit 2 low detectability warning due to high vegetation cover. A 'large' population was recorded across the ponds within metapopulation S2 during visit 3. No other surveys were carried out after this.
P185S	Excellent	Assumed present	Large	Population class estimate surveys	S2	A 'large' population was recorded across the ponds within metapopulation S2 during visit 3. No other surveys were carried out after this.
P186S	Below average	Present	Large	Population class estimate surveys	S2	A 'large' population was recorded across the ponds within metapopulation S2 during visit 3. No other surveys were carried out after this.
P187S	Fishing lake – unsuitable for supporting GCN.					
P188S	Fishing lake – unsuitable for supporting GCN.					

Pond number	HSI score	GCN presence	Population size	Survey type	Meta-population	Notes
P189S	Average	Absent	None	Presence / absence surveys		Due to stone bottom, bottle trapping was difficult within this pond.
P190S	Dry	Absent	None	eDNA		No constraints.
P191S	Dry during the GCN breeding season.					
P192S	Dry during the GCN breeding season.					
P196S	Unknown	Present	Assumed large	None	S4	Incidental sighting of GCN during otter and water vole surveys.
P201S	Unsuitable – newly constructed pond devoid of any vegetation.					
P202S	Fishing lake – unsuitable for supporting GCN.					
P203S	Good	Present	Small	Population class estimate surveys	S1	No constraints.
P204S	Below average	Present	Large	Population class estimate surveys	S2	A ‘large’ population was recorded across the ponds within metapopulation S2 during visit 3. No other surveys were carried out after this.
P217S	Fishing lake – unsuitable for supporting GCN.					
P218S	Fishing lake – unsuitable for supporting GCN.					
P219S	Good	Present	Small	Population class estimate surveys	S2	A ‘large’ population was recorded across the ponds within metapopulation S2 during visit 3. No other surveys were carried out after this.

Pond number	HSI score	GCN presence	Population size	Survey type	Meta-population	Notes
P220S	Average	Present	Small	Population class estimate surveys	S2	Low detectability warning during visit 2 due to high levels of turbidity and vegetation coverage. A 'large' population was recorded across the ponds within metapopulation S2 during visit 3. No other surveys were carried out after this. Pond forms part of a 'large' metapopulation and therefore data considered accurate for assessment.
P221S	Below average	Present	Small	Population class estimate surveys	S1	Bottle trapping could not be carried out during visit 1 due to time constraints. Torching was not carried out during visits 5 and 6 due to high turbidity and vegetation cover. Thick vegetation around 75% of the pond. Limited vegetation suitable for egg laying was present within the pond. As pond is part of 'medium' metapopulations, this is considered sufficient.
P232S	Unknown	Absent	None	Presence / absence surveys		Low detectability warning during visits 1 and 4 due to high vegetation cover. Bottle trapping not possible during visit 1; netting was used instead.
P249S	Poor	Present	Assumed large	None - within metapopulation	S2	Low detectability warning during visit 2 due to high levels of turbidity. A 'large' population was recorded across the ponds within metapopulation S2 during visit 3. No other surveys were carried out after this.
P250S	Dry during the GCN breeding season.					
P251S	Dry during the GCN breeding season.					
P285S	Scoped out as >250m from significant construction works.					
P286S	No pond present.					
P287S	Unknown	Unknown	Unknown	None		No surveys carried out due to health and safety reasons.
P288S	Dry during the GCN breeding season.					
P289S	Dry during the GCN breeding season.					

Pond number	HSI score	GCN presence	Population size	Survey type	Meta-population	Notes
P292S	Average	None	eDNA			No constraints
P293S				No pond present		
P294S	Unknown	Unknown	None			No access
P290S	No pond present.					
P291S	Dry during the GCN breeding season					
P295S	Average	Absent	None	eDNA		No constraints.
P296S	Unknown	Unknown	Unknown	None		No access.
P350S	Scoped out of further survey as over 250m from minor works.					
P351S	Average	Unknown	Unknown	eDNA		eDNA surveys inconclusive.
P352S					Scoped out due to barrier to movement.	
P353S					Scoped out of further survey as over 250m from minor works.	
P360S					Scoped out of further survey as over 250m from minor works.	
P361S	Unknown	Unknown	Unknown	None		No access.
P362S	Unknown	Unknown	Unknown	None		No access.
P364S	Scoped out of further survey as over 250m from minor works.					
P369S	Scoped out of further survey as over 250m from minor works.					
P371S	Dry during the GCN breeding season.					
P373S	Unknown	Unknown	Unknown	None		No access.
P374S	Unknown	Unknown	Unknown	None		No access.
P375S	Dry during the GCN breeding season.					
P376S	Scoped out of further survey as over 250m from minor works.					
P377S	Dry during the GCN breeding season.					

Pond number	HSI score	GCN presence	Population size	Survey type	Meta-population	Notes
P378S	Dry during the GCN breeding season.					
P379S	Scoped out of further survey as over 250m from minor works.					
P380S	Scoped out of further survey as over 250m from minor works.					
P381S	Scoped out due to barrier to movement.					
P382S	Scoped out of further survey as over 250m from minor works.					
P383S	Scoped out of further survey as over 250m from minor works.					
P384S	Scoped out of further survey as over 250m from minor works.					
P385S	Scoped out of further survey as over 250m from minor works.					
P396S	Unknown	Unknown	Unknown	None		No access.
P398S	Scoped out of further survey as over 250m from minor works.					
P399S	Scoped out of further survey as over 250m from minor works.					
P400S	Scoped out of further survey as over 250m from minor works.					
P456S	Unknown	Present	Assumed large	None	S4	Incidental sighting of GCN during otter and water vole surveys.
P483S	Unsuitable – swimming pool					
P464S	Unknown	Unknown	Unknown	None		No access.
P465S	Unknown	Unknown	Unknown	None		No access.
P466S	Dry during the GCN breeding season					
P473S	Dry during the GCN breeding season.					
P485S	Dry during the GCN breeding season					

Pond number	HSI score	GCN presence	Population size	Survey type	Meta-population	Notes
P501S	Unknown	Unknown	Unknown	None		No access.
P503S	Unknown	Unknown	Unknown	None		No access.
P505S	Unknown	Unknown	Unknown	None		No access.

Table A.2 Summary of results for ponds to the north of the River Thames

Pond number	HIS score	GCN presence	Population size	Survey type	Meta-population	Notes
P001N	Average	Present	Assumed medium	Population class estimate surveys	N2	Only 50% of the pond could be torched or bottle trapped due to dense vegetation and deep water. GCN presence confirmed. Population class estimate accurate as pond unlikely to hold 'large' class estimate.
P002N	Average	Absent	None	Presence / absence surveys		Visit 2: did not bottle trap or net as the water was too shallow. Torching and egg search only. Visit 3: hardly any water and choked with bulrush, only egg search. Visit 4: water body full of dense bulrush, 100% algae cover so couldn't torch. Water too shallow to bottle trap. Dry ponds are generally considered to be unsuitable for breeding GCN.
P007N	No pond present.					
P020N	Poor	Assumed absent	None	Presence / absence surveys		Deep lake with steep sides prevented bottle trapping being carried out; netting used instead. Only 66% of perimeter could be surveyed on visits 2 and 3 and only 40% on visit 4. Low detectability warning due to high levels of turbidity were recorded on visits 1, 2 and 3.

Pond number	HIS score	GCN presence	Population size	Survey type	Meta-population	Notes
P022N	Fishing lake – unsuitable for supporting GCN.					
P023N	Poor	Present	Small	Population class estimate surveys	N4	Low detectability warning during visit 1 due to high turbidity.
P024N	Below average	Absent	None	Presence / absence surveys		Low detectability warning during visits 1 and 2 due to high turbidity.
P025N	Below absent	Assumed absent	None	Conventional & eDNA		Pond very deep and choked with rush and branches, not safe to trap or net during visit 3. Low detectability warnings on all visits due to high vegetation cover. Low detectability warning for high turbidity during visit 2. eDNA: Only 60% shoreline sampled and sample only moderate quality.
P026N	Below average	Assumed absent	None	Presence / absence surveys and eDNA		No vegetation to egg search on all 4 visits. Too shallow and dangerous to bottle trap on all 4 visits. 40% of shoreline sampled during eDNA surveys. eDNA returned an inconclusive result.
P035N	Poor	Absent	None	eDNA		No constraints.
P041N	Fishing lake – unsuitable for supporting GCN.					
P043N	Unknown	Unknown	Unknown	None		No access.
P045N	Unknown	Present	Small	Population class estimate surveys	N5	Low detectability warning during visits 1, 2, 3 and 5 due to high vegetation cover. Torching replaced with netting during visit 4.
P046N	Good	Dry at the time when further surveys were due to be carried out.				

Pond number	HIS score	GCN presence	Population size	Survey type	Meta-population	Notes
P047N	No pond present.					
P048N	No pond present.					
P049N	Poor	Dry at the time when further surveys were due to be carried out.				
P050N	Dry during the GCN breeding season.					
P051N	Poor	Unknown	Unknown	None		No access for further surveys.
P065N	Poor	Absent	None	Presence / absence surveys		Only 10% of the pond could be safely surveyed during torching. Low detectability warning during visits 2 and 3.
P066N	No pond present.					
P067N	Good	Absent	None	eDNA		No constraints
P068N	No pond present.					
P069N	Scoped out of further survey as over 250m from minor works.					
P070N	Unknown	Absent	None	Desk study		Access was refused by landowner during the 2018/2019 survey season. Results provided by AECOM (2017) A13 Widening Report.
P071N	Dry during the GCN breeding season.					
P072N	No pond present.					
P073N	No pond present.					
P074N	No pond present.					
P075N	Good	Assumed present	Assumed medium	eDNA	N7	30% of shoreline sampled during eDNA surveys due to dense vegetation.
P076N	Below average	Assumed present	Assumed medium	eDNA	N7	eDNA inconclusive. Landfill site and deep mud prevented surveys using conventional methods.

Pond number	HIS score	GCN presence	Population size	Survey type	Meta-population	Notes
P077N	Below average	Assumed present	Assumed medium	eDNA	N7	eDNA inconclusive. Landfill site and deep mud prevented surveys using conventional methods.
P079N	Poor	Present	Medium	Population class estimate surveys	N7	No constraints.
P080N	Good	Absent	None	eDNA		No constraints.
P081N	Average	Absent	None	eDNA		No constraints.
P083N	Fishing lake – unsuitable for supporting GCN.					
P084N	Fishing lake – unsuitable for supporting GCN.					
P085N	Dry during the GCN breeding season.					
P086N	Good	Absent	None	Presence / absence surveys		Low detectability warning on all four visits due to high turbidity. Water levels too low to bottle trap during visit 1.
P087N	Average	Absent	None	Presence / absence surveys		Low detectability warning on all four visits due to high turbidity. Bottle trapping not carried out during visit 1.
P088N	Poor	Assumed absent	None	Presence / absence surveys		Low detectability warning during visits 1 and 2 due to high turbidity. Bottle trapping was not carried out during visit 1.
P089N	Poor	Assumed absent	None	Presence / absence surveys		Low detectability warning during visits 1, 2 and 3 due to high turbidity. Bottle trapping and egg searching was not carried out during visits 1 and 4.
P090N	Fishing lake – unsuitable for supporting GCN.					
P091N	Poor	Absent	None	eDNA		No constraints.
P092N	Good	Absent	None	eDNA		No constraints.

Pond number	HIS score	GCN presence	Population size	Survey type	Meta-population	Notes
P093N	Fishing lake – unsuitable for supporting GCN.					New pond identified within GCN survey boundary due to design changes.
P094N	Poor	Absent	None	eDNA		No constraints.
P095N	Good	Assumed present	Assumed medium	eDNA	N7	10% of shoreline sampled during eDNA surveys due to dense vegetation restricting access.
P096N	Excellent	Present	Assumed medium	eDNA	N7	No constraints.
P097N	Unknown	Unknown	Unknown	None		No access.
P098N	Below average	Present	Assumed medium	eDNA	N16	No constraints.
P099N	Below average	Assumed Present	Assumed medium	eDNA	N16	40% of shoreline sampled during eDNA surveys.
P100N	Average	Absent	None	eDNA		No constraints.
P101N	Average	Dry at the time further surveys were carried out.				
P102N	Excellent	Absent	None	eDNA		No constraints.
P104N	Below average	Assumed absent	None	eDNA		10% of shoreline sampled during eDNA surveys due to steep banks and dense vegetation.
P105N	Below average	Absent	None	Presence / absence surveys		Only 30% of shoreline accessible for torching. Low detectability warning during visits 1, 3 and 4 due to high turbidity.
P106N	Good	Assumed absent	None	eDNA		15% of shoreline sampled during eDNA surveys. GCN assumed absent as no GCN were recorded within adjacent ponds (P080N and P081N).
P107N	Fishing lake – unsuitable for supporting GCN.					

Pond number	HIS score	GCN presence	Population size	Survey type	Meta-population	Notes
P108N	Fishing lake – unsuitable for supporting GCN.					
P109N	Good	Absent	None	Presence / absence surveys		Pond could not be surveyed using bottle traps as the pond was lined. Low detectability warning due to high levels of turbidity recorded during visit 3.
P110N	No pond present.					
P111N	Dry during the GCN breeding season.					
P112N	Dry during the GCN breeding season.					
P116N	Poor	Present	Small	Population class estimate surveys	N5	Low detectability warnings during visits 3, 4 and 6 due to either high turbidity or high vegetation cover. Torching not carried out on visits 3 and 6 due to algae and floating vegetation; netting used to compensate. Egg search was not carried out during visit 4; netting was carried out instead.
P117N	Poor	Absent	None	Presence / absence surveys		Bottle trapping was not carried out on visit 1. No other constraints were recorded.
P118N	Poor	Assume absent	None	eDNA		10% of shoreline sampled during eDNA surveys due to dense scrub.
P132N	No pond present.					
P133N	No pond present.					
P134N	No pond present.					

Pond number	HIS score	GCN presence	Population size	Survey type	Meta-population	Notes
P135N	Unknown	Present	Assumed medium	None - within metapopulation	N4	Access denied during 2018/2019 survey seasons. GCN were seen during Phase 1 surveys. Population class estimates were proposed during the 2020 survey season, but all evening surveys were cancelled due to the COVID-19 pandemic.
P136N	Below average	Absent	None	eDNA		No constraints.
P137N	Poor	Present	Large	Population class estimate surveys	N10	Low detectability warning during visit 3 and 6 due to high vegetation cover and turbidity.
P138N	Good	Absent	None	eDNA		No constraints
P139N	Dry during the GCN breeding season					
P140N	Poor	Absent	None	eDNA		No constraints
P141N	Average	Absent	None	Presence / absence surveys		Low detectability warning during visit 1 due to high levels of turbidity.
P142N	Scoped out as >250m from significant construction works.					
P143N	Dry during the GCN breeding season					
P144N	Scoped out as >250m from significant construction works.					
P145N	Good	Absent	None	Presence / absence surveys		Low detectability warning due to high vegetation cover and turbidity during visits 1, 2 and 3.
P146N	Good	Absent	None	Presence / absence surveys		Low detectability warning during visit 1 and 2 due to high turbidity.
P147N	No pond present.					

Pond number	HIS score	GCN presence	Population size	Survey type	Meta-population	Notes
P148N	No pond present.					
P149N	Below average	Present	Assumed medium	Population class estimate surveys	N14	Access restricted to 50% of the pond during visits 3 and 4. Visit 6 not undertaken due to livestock in field. Low detectability warning during visit 5 due to high turbidity.
P150N	Good	Present	Assumed medium	Population class estimate surveys	N14	Access to all sides of pond restricted due to dense vegetation. Only 3 visits carried out as land access was revoked. Low detectability warning during visits 2 and 3 due to high turbidity.
P151N	Dry during the GCN breeding season					
P152N	No pond present.					
P153N	No pond present.					
P154N	Below average	Absent	None	Presence / absence surveys		Low detectability warning during visit 4 due to high levels of turbidity.
P155N	Dry during the GCN breeding season.					
P156N	No pond present.					

Pond number	HIS score	GCN presence	Population size	Survey type	Meta-population	Notes
P157N	Poor	Present	Assumed large	Population class estimate surveys	N13	Low detectability warning during visit 2 due to high levels of turbidity. Only 75% of the perimeter of P157N could be surveyed due to the access restrictions into the garden of the private residence. Pond was very deep in places, making trapping difficult around some edges. The peak count indicates a 'medium' population. However, a precautionary approach has been applied and metapopulation N13 has been assessed as 'large'.
P158N	Good	Present	Small	Population class estimate surveys	N13	No constraints.
P159N	Poor	Present	Assumed small	None - within metapopulation	N13	No access to 25% of pond as this encroached onto the railway embankment. Low detectability warning during visits 1 and 5 due to high turbidity. Bottle trapping replaced with netting during visit 2. P159N is considered to be part of a 'large' metapopulation. Therefore, this is considered to be a good representation of the data.
P160N	Poor	Absent	None	Presence / absence surveys		Low detectability warning during visit 1 and 2 due to high turbidity.
P161N	No pond present.					
P162N	Average	Absent	None	Presence / absence surveys		Low detectability warning during visit 2 due to high turbidity. Water could not be accessed during visit 4 to bottle trap and egg search due to dense boggy vegetation.

Pond number	HIS score	GCN presence	Population size	Survey type	Meta-population	Notes
P163N	Average	Absent	None	Presence / absence surveys		Low detectability warning during visits 1, 2 and 3 due to high turbidity. Due to access restrictions, torching surveys could not be carried out.
P164N	Fishing lake – unsuitable for supporting GCN.					
P165N	Fishing lake – unsuitable for supporting GCN.					
P166N	Good	Present	Small	Population class estimate surveys	N11/N12	Torching was not carried out on all six visits due to access restrictions. Low detectability warning during visit 1 due to high turbidity.
P167N	Fishing lake – unsuitable for supporting GCN.					
P168N	Unknown	Unknown	Unknown	None		No access.
P169N	Unknown	Unknown	Unknown	None		No access.
P170N	Average	Absent	None	eDNA		No constraints.
P171N	Below average	Absent	None	Presence / absence surveys		Dense vegetation prevented torching surveys being carried out. Low detectability warning for high levels of turbidity were recorded for visit 2.
P172N	Saline – unsuitable for supporting GCN.					
P173N	Saline – unsuitable for supporting GCN.					
P174N	Saline – unsuitable for supporting GCN.					
P175N	Saline – unsuitable for supporting GCN.					
P176N	Unknown	Absent	None	Desk study		Access was refused by landowner during the 2018/2019 survey season. Results provided by Tilbury2.

Pond number	HIS score	GCN presence	Population size	Survey type	Meta-population	Notes
P177N	Unknown	Absent	None	Desk study		Access was refused by landowner during the 2018/2019 survey season. Results provided by Tilbury2.
P193N	Below average	Present	Assumed medium	Population class estimate surveys	N1	Surveys carried out at this pond were heavily constrained as most of the shoreline was inaccessible (95%) due to dense vegetation, steep sides and deep water preventing the use of bottle traps. Torching, netting and egg searches were carried out where the shoreline was accessible and safe to do so. Despite the peak count indicating a small population, given the constraints, a 'medium' class size is considered more appropriate.
P194N	Saline – unsuitable for supporting GCN.					
P195N	Average	Assumed present	Assumed medium	None	N1	Landowner refused access throughout the GCN breeding season due to nesting nightingale close to the pond. An HSI was carried out outside of the bird breeding season.
P197N	Average	Present	Assumed medium	Population class estimate surveys	N7	P197N originally fell inside the survey area in 2018. However, design changes removed it from the survey area during the 2018 survey season. One conventional survey visit in 2018, during which GCN were found. Design changes bought this pond back into the survey area in 2019, but surveys were not deemed safe due to deep silt and mud preventing from surveyors accessing the shoreline. As GCN were already confirmed present, eDNA surveyors were not carried out.

Pond number	HIS score	GCN presence	Population size	Survey type	Meta-population	Notes
P198N	Saline – unsuitable for supporting GCN.					
P199N	Average	Absent	None	Presence / absence surveys		Pond dry on visit 3.
P200N	Dry during the GCN breeding season.					
P206N	Average	Present	Large	Population class estimate surveys	N10	Low detectability warning during visit 6 due to high levels of turbidity.
P207N	Saline – unsuitable for supporting GCN.					
P208N	Fishing lake – unsuitable for supporting GCN.					
P209N	Poor	Assumed absent	None	Presence / absence surveys		Only torching used during visits 1 and 2. Low detectability warning due to high turbidity during visits 1 and 2.
P210N	Average	Present	Small	Population class estimate surveys	N15	Low detectability warning during visits 1 due to high vegetation cover and visit 2 due to high levels of turbidity.
P211N	Average	Absent	None	eDNA		No constraints.
P212N	Dry during the GCN breeding season.					
P213N	Dry during the GCN breeding season.					
P214N	Poor	Assumed absent	None	Presence / absence surveys		Low detectability warning during all four visits due to high turbidity. No bottle trap surveys were carried out due to heavily polluted water and water hazard sign. Egg searches were done from side of pond but with difficultly.

Pond number	HIS score	GCN presence	Population size	Survey type	Meta-population	Notes
P215N	Average	Absent	None	Presence / absence surveys		Low detectability warning during visits 2 and 3 due to high vegetation cover. Bottle trapping not used during visit 2; replaced with netting instead, although thick vegetation made netting difficult. Walkover surveys later in 2018 found this pond to be dry.
P216N	Excellent	Present	Small	Population class estimate surveys	N2	Low detectability warning due to high turbidity during visits 1 and 6 due to high turbidity.
P222N	Excellent	Present	Small	Population class estimate surveys	N2	Low detectability warning during visits 1, 2, 3 and 5 due to high vegetation cover and turbidity.
P223N	Dry during the GCN breeding season.					
P224N	Below average	Absent	None	Presence / absence surveys		Water levels too shallow to bottle trap during visits 1, 3 and 4. Low detectability warning during visit 2 due to high turbidity.
P225N	Dry during the GCN breeding season					
P227N	Unknown	Present	Small	Population class estimate surveys	N11/N12	Torching not carried out due to access restrictions. Low detectability warning during visit 1 and 2 due to high turbidity.
P228N	Average	Absent	None	Presence / absence surveys		Bottle trapping not carried out during visit 2. Low detectability warning due to vegetation cover was recorded during visits 1, 2 and 4 and due to turbidity during visits 2 and 3.

Pond number	HIS score	GCN presence	Population size	Survey type	Meta-population	Notes
P229N	Below average	Absent	None	Presence / absence surveys		Bottle trapping not carried out during visits 2 and 4. Low detectability warning due to vegetation cover was recorded during visits 1 and 3 and due to turbidity during visits 1, 2 and 3.
P230N	Average	Absent	None	Presence / absence surveys		Low detectability warning during visit 3 due to high vegetation coverage and visit 4 due to high turbidity.
P231N	Average	Absent	None	Presence / absence surveys		Thick algae and dense vegetation, difficult to torch. Low detectability warning during visit 2 due to high vegetation coverage and visit 4 due to high turbidity.
P233N	Dry during the GCN breeding season.					
P235N	Average	Absent	None	Presence / absence surveys		Pond was too shallow to undertake bottle trapping or netting.
P236N	Dry during the GCN breeding season.					
P237N	Scoped out as >250m from significant construction works.					
P238N	Fishing lake – unsuitable for supporting GCN.					
P239N	Average	Absent	None	eDNA		No constraints

Pond number	HIS score	GCN presence	Population size	Survey type	Meta-population	Notes
P240N	Average	Present	Assumed medium	eDNA	N11/N12	Population class estimate surveys were originally proposed during the 2020 surveys season at this pond. However, due to restrictions on overnight stays due to the COVID-19 pandemic, population class estimate surveys could not be carried out. As GCN are already confirmed to be present within this pond through incidental sightings, egg search or netting would have provided no further information. On a precautionary basis, a 'medium' population has been assumed within this pond.
P241N	Average	Present	Assumed medium	eDNA	N11/N12	Population class estimate surveys were originally proposed during the 2020 survey season at this pond. However, due to restrictions on overnight stays due to the COVID-19 pandemic, population class estimate surveys could not be carried out. As GCN are already confirmed to be present within this pond through incidental sightings, egg search or netting would have provided no further information. On a precautionary basis, a 'medium' population has been assumed within this pond.
P242N	Unknown	Unknown	Unknown	None		No access.
P243N	Average	Absent	None	eDNA		No constraints.
P244N	Excellent	Absent	None	eDNA		No constraints.
P245N	Good	Assumed absent	None	eDNA		50% of shoreline sampled during eDNA surveys.
P246N	Below average	Absent	None	eDNA		No constraints.

Pond number	HIS score	GCN presence	Population size	Survey type	Meta-population	Notes
P247N	Below average	Absent	None	eDNA		No constraints.
P248N	Unsuitable – a series of containers used for aquaculture.					
P252N	Unknown	Unknown	Unknown	None		No access.
P253N	Unknown	Unknown	Unknown	None		No access.
P254N	Unsuitable – sporting lake.					
P255N	No pond present.					
P256N	Poor	Assumed absent	None	eDNA		20% of shoreline sampled during eDNA surveys.
P257N	Below average	Present	Assumed medium	eDNA	N6	No constraints.
P258N	Below average	Present	Assumed medium	eDNA	N6	40% of shoreline sampled during eDNA surveys.
P259N	Average	Absent	None	eDNA		No constraints.
P260N	Poor	Absent	None	eDNA		No constraints.
P261N	Poor	Assumed absent	None	eDNA		30% of shoreline sampled during eDNA surveys. eDNA survey returned an inconclusive result.
P262N	Unknown	Unknown	Unknown	None		No access.
P263N	Good	Present	Assumed medium	eDNA	N8	10% of shoreline sampled during eDNA surveys.
P264N	Poor	Assumed present	Assumed small	eDNA	N8	20% of shoreline sampled during eDNA surveys.
P265N	Below average	Assumed present	Assumed medium	eDNA	N8	Inconclusive eDNA result. GCN assumed present due to close proximity to known GCN populations.

Pond number	HIS score	GCN presence	Population size	Survey type	Meta-population	Notes
P266N	Fishing lake – unsuitable for supporting GCN.					
P267N	Unknown	Unknown	Unknown	None		No access.
P269N	No pond present.					
P270N	Sporting lake – unsuitable for supporting GCN.					
P271N	Scoped out as >250m from significant construction works.					
P272N	Scoped out as >250m from significant construction works.					
P273N	Scoped out as >250m from significant construction works.					
P274N	Scoped out as >250m from significant construction works.					
P275N	Scoped out as >250m from significant construction works.					
P276N	Unknown	Unknown	Unknown	None	N13	No access.
P277N	Dry during the GCN breeding season.					
P278N	Scoped out as >250m from significant construction works.					
P279N	Unknown	Unknown	Unknown	None		No access.
P299N	Unknown	Unknown	Unknown	None		No access.
P300N	Unknown	Unknown	Unknown	None		No access.
P301N	Poor	Present	Assumed medium	eDNA	N3	10% of shoreline sampled during eDNA surveys due to steep banks and dense vegetation.
P302N	Below average	Absent	None	eDNA		No constraints.
P303N	Unknown	Unknown	Unknown	None		No access.
P304N	Good	Assumed absent	None	eDNA		20% of shoreline sampled during eDNA surveys.

Pond number	HIS score	GCN presence	Population size	Survey type	Meta-population	Notes
P305N	Good	Absent	None	eDNA		No constraints.
P306N	Dry during the GCN breeding season.					
P307N	Unknown	Present	Assumed medium	Desk study	N4	Access was refused by landowner during the 2018/2019 survey season. eDNA results from Natural England.
P308N	Dry during the GCN breeding season.					
P309N	Dry during the GCN breeding season.					
P310N	Dry during the GCN breeding season.					
P311N	Good	Absent	None	eDNA		No constraints.
P312N	Poor	Assumed absent	None	eDNA		30% of shoreline sampled during eDNA surveys.
P313N	Average	Present	Assumed medium	eDNA	N16	No constraints.
P314N	Scoped out of further survey as over 250m from minor works.					
P315N	Unknown	Absent	None	None		New pond recently dug. GCN assumed absent as currently unsuitable. Pre-construction survey will be needed.
P316N	Poor	Assumed absent	None	eDNA		20% of shoreline sampled during eDNA surveys due to dense vegetation. GCN assumed absent as no GCN were recorded within adjacent pond (P260N).
P317N	Good	Present	Assumed medium	eDNA	N9	No constraints.
P318N	Dry during the GCN breeding season.					

Pond number	HIS score	GCN presence	Population size	Survey type	Meta-population	Notes
P319N	Below average	Present	Assumed medium	eDNA	N9	No constraints.
P320N	Below average	Absent	None	eDNA		No constraints.
P321N	Excellent	Present	Assumed medium	eDNA	N9	70% of shoreline sampled during eDNA surveys.
P322N	Scoped out of further survey as over 250m from minor works.					
P323N	Good	Assumed absent	None	eDNA		eDNA inconclusive.
P324N	Scoped out of further survey as over 250m from minor works.					
P325N	Unknown	Unknown	Unknown	None		No access.
P326N	Below average	Assumed absent	None	eDNA		Low-quality water sample.
P327N	Scoped out of further survey as over 250m from minor works.					
P329N	Scoped out of further survey as over 250m from minor works.					
P331N	Scoped out of further survey as over 250m from minor works.					
P333N	Scoped out of further survey as over 250m from minor works.					
P334N	Scoped out of further survey as over 250m from minor works.					
P336N	Scoped out of further survey as over 250m from minor works.					
P337N	Scoped out of further survey as over 250m from minor works.					
P338N	Unknown	Unknown	Unknown	None		No access.
P339N	Scoped out of further survey as over 250m from minor works.					
P340N	Scoped out of further survey as over 250m from minor works.					

Pond number	HIS score	GCN presence	Population size	Survey type	Meta-population	Notes
P341N	Scoped out of further survey as over 250m from minor works.					
P342N	Poor	Assumed absent	None	eDNA		30% of shoreline sampled during eDNA surveys.
P343N	Poor	Assumed absent	None	eDNA		40% of shoreline sampled during eDNA surveys.
P344N	Scoped out of further survey as over 250m from minor works.					
P345N	Scoped out of further survey as over 250m from minor works.					
P346N	Scoped out of further survey as over 250m from minor works.					
P347N	Scoped out of further survey as over 250m from minor works.					
P349N	Scoped out of further survey as over 250m from minor works.					
P355N	Scoped out of further survey as over 250m from minor works.					
P356N	Scoped out of further survey as over 250m from minor works.					
P402N	Unknown	Unknown	Unknown	None		No access.
P403N	Unknown	Unknown	Unknown	None		No access.
P404N	Unknown	Unknown	Unknown	None		No access.
P409N	Scoped out of further survey as over 250m from minor works.					
P410N	Poor	Assumed absent	None	eDNA		30% of shoreline sampled during eDNA surveys.
P411N	Unknown	Unknown	Unknown	None		No access.
P414N	Scoped out of further survey as over 250m from minor works.					
P419N	Scoped out of further survey as over 250m from minor works.					
P420N	Dry during the GCN breeding season.					

Pond number	HIS score	GCN presence	Population size	Survey type	Meta-population	Notes
P421N	Scoped out of further survey as over 250m from minor works.					
P422N	Scoped out of further survey as over 250m from minor works.					
P423N	Dry during the GCN breeding season.					
P424N	Scoped out of further survey as over 250m from minor works.					
P425N	Scoped out of further survey as over 250m from minor works.					
P426N	Scoped out of further survey as over 250m from minor works.					
P427N	Scoped out of further survey as over 250m from minor works.					
P428N	Scoped out of further survey as over 250m from minor works.					
P429N	Scoped out of further survey as over 250m from minor works.					
P430N	Poor	Assumed absent	None	eDNA		30% of shoreline sampled during eDNA surveys.
P431N	Scoped out of further survey as over 250m from minor works.					
P437N	Scoped out of further survey as over 250m from minor works.					
P438N	Scoped out of further survey as over 250m from minor works.					
P440N	Unknown	Unknown	Unknown	None		No access.
P442N	Scoped out of further survey as over 250m from minor works.					
P443N	Scoped out of further survey as over 250m from minor works.					
P445N	Scoped out of further survey as over 250m from minor works.					
P446N	Dry during GCN survey season.					
P447N	Scoped out of further survey as over 250m from minor works.					
P450N	Scoped out of further survey as over 250m from minor works					

Pond number	HIS score	GCN presence	Population size	Survey type	Meta-population	Notes
P451N	Scoped out of further survey as over 250m from minor works.					
P458N	Unknown	Unknown	Unknown	None		No access.
P459N	Unknown	Unknown	Unknown	None		No access.
P460N	Scoped out of further survey as over 250m from minor works.					
P461N	Scoped out of further survey as over 250m from minor works.					
P462N	Scoped out of further survey as over 250m from minor works.					
P467N	Average	Assumed present	Assumed medium	eDNA	N2	20% of shoreline surveyed during eDNA surveys.
P468N	Scoped out of further survey as over 250m from minor works.					
P469N	Average	Assumed absent	None	eDNA		Low-quality water sample.
P470N	Poor	Assumed absent	None	eDNA		Low-quality water sample.
P472N	Poor	Assumed absent	None	eDNA		60% of shoreline surveyed during eDNA surveys.
P488N	No pond present.					
P492N	No pond present.					
P493N	No pond present.					
P510N	Unknown	Unknown	Unknown	None		No access
P511N	Unknown	Unknown	Unknown	None		No access

Pond number	HIS score	GCN presence	Population size	Survey type	Meta-population	Notes
P512N	Good	Absent	None	eDNA		30% of shoreline surveyed during eDNA surveys due to dense vegetation restricting access.
P513N	Poor	Absent	None	eDNA		No constraints.
P514N	Poor	Absent	None	eDNA		No constraints.

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