

## Preparation

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## Cover photographs

Main photo: looking east across flower-rich grassland

Smaller photos (top to bottom):  
Six-spot Burnet moth on Field Scabious  
White-clawed crayfish caught during EA fish survey  
Clouded yellow butterfly  
Brown trout caught during EA fish survey  
Black-and-yellow longhorn beetle

Back cover: looking across the floodplain fen to Costessey Hall

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## Summary

The following report presents the findings of an ecological survey carried out in the area of the proposed Queen's Hills 'Country Park' between May and August 2014. The survey concentrated on assessing the vegetation in a number of discrete habitat units across the site. This was supplemented with observations of a representative range of faunal groups, in order to be able to assess the broad ecological value and potential of each of the habitat types present. This information has then been used to make some management recommendations for the site.

The area of Queen's Hills 'Country Park' was found to be surprisingly rich for wildlife, predominantly due to the diversity of habitat types within a relatively small area. The site is particularly important for its floodplain fen and flower-rich valley side grasslands, grading into scrub and mature woodland. This mix of valley side habitats has become increasingly rare in the post-war period. The botanical interest was diverse with 229 species of plants recorded, including a number of localised species. However, the site as a whole is probably most important for its insect populations, which with further survey work are likely to reveal a number of rarities. The River Tud itself is incredibly important and supports a number of species for which the River Wensum is designated a Special Area of Conservation under the European Habitats' Directive.

Priorities for further survey work at the site should include bats and Hymenoptera (ants, bees and wasps). There are a wide range of taxa that would benefit from further investigation depending on the expertise available, but some Coleoptera (beetles) and Diptera families (true flies) could also be particularly interesting.

The biggest management threat to the site is neglect. Within ten years a significant proportion of the valuable grassland and young scrub habitats have been invaded by willow and silver birch scrub, which in places has led to a massive reduction in ecological value. Left unchecked, the majority of the most important wildlife habitats on the site will be lost in a further ten years. Neglect has also meant that the floodplain fen has become rank with a deep litter layer, which has reduced the ability for more localised and specialist wetland plants to persist. Ill-advised tree planting as part of the development of the site has further impacted the site's current value. A wide range of management recommendations are made within the report. However, the overwhelming priority is to restore the balance of open habitats present on the site by significant targeted tree and scrub removal, and then to put in place grazing or mowing regimes to maintain the open areas and transitions into the future.

In the context of the ongoing management needs of this site, it is critical that long-term, sustainable resourcing is secured. This will ensure that the needs of wildlife and the local community are provided for in perpetuity.

Queen's Hills 'Country Park' is a wonderful area, that has the opportunity to become an exemplar of urban nature conservation. By and large, it is resilient to access, and has the opportunity to bring the local community into contact with a very wide range of amazing plants and animals. It is hoped that this small survey provides a first step in understanding that rich resource, managing it sympathetically into the future, and bringing the local population into greater contact with the rich wildlife of Queen's Hills.

## 1. Introduction

This report has been produced on behalf of the Friends of the Tud Valley. It is intended to provide a broad understanding of the current ecological value of the area set aside for Queen's Hill 'Country Park'. Based on an assessment of the current and potential ecological value, management recommendations are made to maintain and improve the ecological interest of the site. This should be used to guide the future managers of the site in making decisions sympathetic to the site's considerable ecological value.

The site has generally been referred to as Queen's Hills Country Park, and this is the convention that will be used in this report. However, it is recommended that its future name should be discussed when the site is in public hands in consultation with the local community. The use of terms such as 'community nature reserve' should be considered as this may be more appropriate and better reflect its desired role. It would also be beneficial to seek designation as a Local Nature Reserve (that could be used as the site name), which is a statutory provision made by local authorities under the 1949 National Parks & Access to the Countryside Act. Designation as a 'County Wildlife Site', administered by Norfolk Wildlife Trust, would also be appropriate.

### 1.1 Site Description

Queen's Hills 'Country Park' comprises about 31.9 hectares (ha) of land within the Tud valley to the west of Norwich in the parish of Costessey (TG154117). It is subject to a section 106 agreement with the developers of the Queen's Hills settlement, and therefore under a legal requirement to be developed as an area of benefit to wildlife and the local community.

The River Tud originates from chalk outcrops near Shipdham in Norfolk at a height of 65 metres above sea level. Flowing easterly for 24 kilometres, the River Tud descends 55 metres before its confluence with the River Wensum. Average river gradient is therefore 2.29 metres km<sup>-1</sup>. Two physical barriers exist along the watercourse: one between the Berry Hall and A47 sites while the other lies between Hill Farm and Costessey gravel works. Both barriers are classed as moderate to fish migration (EA, 2012).

The Tud valley is relatively steep sided in this part of its course, and within the 'Country Park' area drops from a height of about 45 metres above ordnance datum (AOD) on the valley ridge to about 15 metres AOD at the river within a distance of about 500 metres. The sands and gravels that lie between the floodplains of the River Wensum and River Tud are part of the Newport 4 soil association, derived from fluvio-glacial drift (NSRI, 2014). These inter-fluvial soils are generally light, nutrient poor and free draining. The soils of the River Tud floodplain are part of the Isleham 2 soil association, being peaty soils with some groundwater influence; they may be influenced in part by fluvio-glacial drift (NSRI, 2014). There appears to be some calcareous influence, at least in parts, as reflected in aspects of the flora.

Faden's map of Norfolk in 1797 shows much of the present Queen's Hills Area within the Costessey Hall Estate. By the first edition OS map of 1879-1886, the two blocks of woodland were already known as Snakes' Hills and Queen's Hills, there were active brick works in the area, and two fords crossed the river towards the western and eastern boundaries of the proposed 'Country Park' area. The aerial photographs taken by the RAF in 1946 show arable land on the valley sides, and the woodland largely confined to the ridges. The area currently west of the road was largely open and unwooded. Sand and gravel extraction was a major feature of the post war period with extensive working in the area evident in the 1988 aerials. Woodland had colonised much of the area west of the road by this time and the two large ponds within the woodland were also evident.

The combination of physical characteristics and land use history has led to a very varied range of habitats present within a relatively small area. This includes well established secondary valley side woodland, more recent secondary woodland, wet woodland, grassland associated with previous

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aggregate extraction, valley side grassland previously used as arable land, floodplain grassland/ fen within the valley floor, and the river itself. More recent changes associated with the development have led to the creation of the balancing pond, attenuation area and associated earthworks, seeding with a wild flower mix around the balancing pond and road, the planting of woodland, disturbed ground, and neglect leading to significant sallow encroachment into grassland.

## **1.2 Report format**

Section 2 describes the survey methodology adopted for this piece of work. Sixteen discrete areas of the site were identified, based on habitat type, and the flora of each of these areas is described in section 3. Section 4 then considers the faunal groups that were surveyed across the whole site and their relative importance. Each of the sixteen areas are assessed for their current and future ecological value and sensitivity to access in section 5, with consequent management recommendations made in section 6.

## 2. Survey Methodology

The site was subdivided into sixteen discrete habitat units (see Map 1), and surveyed between May and August 2014 (see Table 1). Four monthly surveys involving whole days were undertaken, with a number of shorter visits of about an hour occurring between times.

**Map 1 - Location of Survey Areas**



The primary purpose of the full visits was to extensively search a number of the areas and record all of the plants present, and to make an assessment of their abundance cover within each area (the DAFOR scale used is defined in Table 2). Identification keys were used, where required. For some of the areas, due to the timing of the visit, a number of species will not have been identified (e.g. grasses not in flower), but wherever possible subsequent visits were made to try and make the survey as complete as possible. Any survey will not be entirely comprehensive, particular where a species has a very localised distribution. It is likely that a number of early flowering species will have been missed, due to commencing the survey in mid May. The short visits gathered supplementary observations, or identified particular species or species groups that had not been possible previously.

**Table 1 - Survey dates and visit details**

Date	Survey Areas	Weather	Visit type
May 19 <sup>th</sup> 2014	1, 2, 3, 4	Hot and sunny all day, light winds, up to 25°C	Full visit
May 23 <sup>rd</sup> 2014	1, 2, 7	Sunny, with some cloud, light winds, up to c.20°C	Short visit
June 6 <sup>th</sup> 2014	1, 2, 7	Sunny, with some cloud, light winds	Short visit
June 16 <sup>th</sup> 2014	5, 6, 7, 8, 9, 10	Cloudy, N 3-4, light showers in the morning, up to 15-16°C	Full visit
June 19 <sup>th</sup> 2014	S. side of river (fish survey)	Overcast, with light showers, but brightening later, c.17°C	Fish survey
June 20 <sup>th</sup> 2014	Butterfly area and N balancing pond	Sunny, hot, c.21°C	Short visit
July 4 <sup>th</sup> 2014	1, 2, 6, 7	Sunny, with some cloud, light winds, up to c.20°C	Short visit
July 14 <sup>th</sup> 2014	8, 10, 11, 12, 13, 14	Overcast, with sunny intervals, light W, 18-23°C	Full visit
August 11 <sup>th</sup> 2014	1, 2, 4, 5, 6, 8, 12 (revisits), 15	Sunny, light <i>Cumulus</i> , W4-5, 18-20°C	Full visit
August 18 <sup>th</sup> 2014	2, 5, 6, 8, 16	Sunny with patchy cloud, NW3-4 dropping, up to 18°C	Short visit

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**Table 2 - DAFOR Scale definitions**

<b>Letter</b>	<b>Definition</b>	<b>Level of cover</b>
D	Dominant	> 70%
A	Abundant	30 - 70%
F	Frequent	10 - 30%
O	Occasional	3 - 10%
R	Rare	< 3%

On each of the visits a comprehensive record was also made of all the birds, mammals, reptiles, amphibians, dragonflies and damselflies, and butterflies present. Day-flying moths were recorded, but this represents a tiny fraction of the number of species present. Grasshoppers and crickets were identified and their abundance assessed during the August visits. Information on the fish was gathered from the Environment Agency's electro-fishing survey of June 19<sup>th</sup> and their previous surveys. The aim was to put together the botanical information, and information on a representative group of animals in order to make a broad assessment of the current ecological value of the site, and to identify where the future management emphasis should lie.

### 3. Flora

For each of the discrete areas identified, a description is presented together with a brief assessment of the vegetation, and comments on any notable plants recorded. All the species recorded from each area are then listed, together with a judgement of their cover within that area of the site using the DAFOR scale (see Table 2). The photos referred to in the text are in Appendix 2.

The flora at Queen's Hills was found to be diverse largely due to the range of habitats present within a relatively small area. Most of the plants recorded from the drier ground were common species, usually associated with more base-rich and/or light sandy soils. Interestingly, some of the more unusual plants recorded, such as carline thistle and ploughman's spikenard are incredibly rare in Norfolk away from the light soils over chalk in west Norfolk. This hints at a calcareous origin for the soils at least in parts of the site, or possibly the influence of calcareous groundwater. A number of plants were also found that prefer more acidic conditions, suggesting local variation in soil type. A number of other notable Norfolk plants were recorded during the survey, including small teasel, squirrel-tail fescue, hoary mullein and smooth cat's-ear. Both bee orchid and common spotted orchid were found on adjoining blocks of land, and could be found within the 'Country Park' area, or by the introduction of sympathetic management. Due to the nature of the soils, it may be worth surveying the site for spring-flowering annuals. Sympathetic management of the floodplain, reducing the litter, improving the vegetation structure, and improving water level control, may lead to the discovery of a number of new wetland species on the site.

#### 3.1 Area 1 - Short-turf grassland

A number of short-turf areas were located in the south-facing slopes of the balancing pond (see photos 5 & 6). These comprised low-growing vegetation typically less than 10cm high with a good proportion of bare ground. The grassland lies on nutrient poor sands and gravels that were exposed as part of the earthworks associated with the balancing pond.

These areas are characterised by fine-leaved grasses and a number of plants that are typically associated with open, sunny conditions on nutrient poor soils. These include species such as common centaury, common stork's-bill, crane's-bills and common cudweed. The following plants were recorded from this area:

##### Grasses, sedges, rushes and ferns

<i>Cynosurus cristatus</i>	Crested dog's-tail	O	<i>Holcus lanatus</i>	Yorkshire fog	R
<i>Festuca rubra</i>	Red fescue	F	<i>Poa trivialis</i>	Rough meadow-grass	O

##### Herbs

<i>Achillea millefolium</i>	Yarrow	O	<i>Hypochaeris radicata</i>	Comon cat's-ear	O
<i>Anchusa arvensis</i>	Bugloss	R	<i>Leontodon autumnalis</i>	Autumn hawkbit	O
<i>Centaureum erythraea</i>	Common centaury	O	<i>Leucanthemum vulgare</i>	Oxeye daisy	O
<i>Conyza canadensis</i>	Canadian fleabane	R	<i>Matricaria recutita</i>	Scented mayweed	R
<i>Erodium cicutarium</i>	Common stork's-bill	F	<i>Medicago lupulina</i>	Black medick	A
<i>Filago vulgaris</i>	Common cudweed	F	<i>Plantago lanceolata</i>	Ribwort plantain	F
<i>Galium verum</i>	Lady's bedstraw	F	<i>Plantago media</i>	Hoary plantain	O
<i>Geranium dissectum</i>	Cut-leaved crane's-bill	O	<i>Rumex acetosa</i>	Common sorrel	O
<i>Geranium molle</i>	Dove's-foot crane's-bill	A	<i>Trifolium arvense</i>	Hare's-foot clover	F
<i>Hypericum perforatum</i>	Perforate St John's-wort	O	<i>Vicia sativa</i>	Common vetch	O

#### 3.2 Area 2 - Flower-rich grassland

The majority of the slopes surrounding the balancing pond comprised a medium height flower-rich neutral grassland (see photos 1, 2, 3 & 4). Together, Areas 1 and 2 comprise about 0.9ha. These slopes appeared to have been created through major excavations in creating the balancing pond and hence provided more nutrient-poor conditions in which a diverse flora could flourish. It also appeared that this area had been seeded with a wild flower mix when the balancing pond was created as a

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number of species typical of these seeding mixes were present in this area and not elsewhere on the site. It is difficult to distinguish between species that were native to the site and those that might have been introduced, without knowing the seed mix that was used. There is a clear distinction between the light, sandy soils exposed through the earthworks, and the surrounding more enriched soils where coarser, more rank grassland and scrub is present.

The flora in this area is characterised by fine-leaved grasses and a wide range of flowering herbs. A key feature (certainly in 2014) is the constant nectar source of this area through the spring and summer. This may not be quite so noticeable in drier years. It starts with cowslips in the spring, followed by species such as oxeye daisy, yellow rattle, crane's-bills. Knapweed, bird's-foot trefoil and lady's-bedstraw take over in the early summer followed by field scabious, yarrow and wild carrot in the late summer. Notable plants in this area included single plants of Carthusian pink (not recorded in Beckett & Bull, 1999) and marjoram, both of which were likely to have been introduced as part of the seed mix used in the area. A few plants of ploughman's spikenard were also found in the more enriched grassland on the edge of Area 3. The following plants were recorded from this area:

### Grasses, sedges, rushes and ferns

<i>Agrostis vinealis</i>	Brown bent-grass	A	<i>Helictotrichon pratense?</i>	Meadow oat-grass?	R
<i>Arrhenatherum elatius</i>	False oat-grass	O	<i>Holcus lanatus</i>	Yorkshire fog	O
<i>Cynosurus cristatus</i>	Crested dog's-tail	O	<i>Poa trivialis</i>	Rough meadow-grass	O
<i>Dactylis glomerata</i>	Cock's-foot	O	<i>Pteridium aquilinum</i>	Bracken	O
<i>Festuca rubra</i>	Red fescue	A	<i>Vulpia bromoides</i>	Squirreltail fescue	O

n.b. *Helictotrichon pratense* requires confirmation.

### Herbs

<i>Achillea millefolium</i>	Yarrow	O	<i>Myosotis arvensis</i>	Field forget-me-not	R
<i>Bellis perennis</i>	Daisy	R	<i>Odonites vernus</i>	Red bartsia	R
<i>Centaurea nigra</i>	Black knapweed	O	<i>Oenothera glazioviana</i>	Large-flowered evening-primrose	O
<i>Centaureum erythraea</i>	Common centaury	O	<i>Origanum vulgare</i>	Wild marjoram	R
<i>Cerastium fontanum</i>	Common mouse-ear	O	<i>Papaver rhoeas</i>	Common poppy	R
<i>Cirsium arvense</i>	Creeping thistle	R	<i>Plantago lanceolata</i>	Ribwort plantain	O
<i>Crepis vesicaria</i>	Beaked hawk's-beard	F	<i>Plantago media</i>	Hoary plantain	O
<i>Daucus carota</i>	Wild carrot	F	<i>Primula veris</i>	Cowslip	F
<i>Dianthus carthusianorum</i>	Carthusian pink	R	<i>Prunella vulgaris</i>	Selfheal	R
<i>Erodium cicutarium</i>	Common stork's-bill	O	<i>Ranunculus acris</i>	Meadow buttercup	R
<i>Fragaria vesca</i>	Wild strawberry	O	<i>Rhinanthus minor</i>	Yellow rattle	R
<i>Galium mollugo</i>	Hedge bedstraw	O	<i>Rubus fruticosus agg.</i>	Bramble	R
<i>Galium verum</i>	Lady's bedstraw	F	<i>Senecio jacobaea</i>	Common ragwort	O
<i>Geranium dissectum</i>	Cut-leaved crane's-bill	O	<i>Silene latifolia</i>	White campion	R
<i>Geranium molle</i>	Dove's-foot crane's-bill	O	<i>Silene dioica</i>	Red campion	O
<i>Hypericum perforatum</i>	Perforate St John's-wort	O	<i>Sonchus asper</i>	Prickly sow-thistle	R
<i>Hypochaeris radicata</i>	Comon cat's-ear	O	<i>Taraxacum officinale agg.</i>	Dandelion	O
<i>Inula conyzae</i>	Ploughman's-spikenard	R	<i>Trifolium arvense</i>	Hare's-foot clover	F
<i>Knautia arvensis</i>	Field scabious	O	<i>Trifolium pratense</i>	Red clover	O
<i>Leontodon autumnalis</i>	Autumn hawkbit	F	<i>Tussilago farfara</i>	Coltsfoot	R
<i>Leucanthemum vulgare</i>	Oxeye daisy	F	<i>Veronica chamaedrys</i>	Germander speedwell	O
<i>Lotus corniculatus</i>	Common bird's-foot-trefoil	F	<i>Vicia hirsuta</i>	Hairy tare	O
<i>Malva moschata</i>	Musk-mallow	O	<i>Vicia sativa</i>	Common vetch	O
<i>Medicago lupulina</i>	Black medick	O			

### 3.3 Area 3 - Eastern Snakes' Hills woodland

A mature woodland strip runs along the steep valley side north of the balancing pond (see photos 1 & 5), comprising about 1.9ha. This grades into an area of more recent scrub on the downslope side. It would appear that this is secondary woodland established in the 17<sup>th</sup> or 18<sup>th</sup> centuries as part of the Costessey Hall Estate.

In its natural state, it would probably be oak, ash, hornbeam woodland, but sycamore has become well established in the canopy. The ground flora is typical of woods in this area, and the presence of dog's mercury indicates the long history of woodland on this site. The following plants were recorded from this area:

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## Trees and shrubs

<i>Acer pseudoplatanus</i>	Sycamore	A	<i>Fraxinus excelsior</i>	Ash	F
<i>Betula pendula</i>	Silver birch	O	<i>Ilex aquifolium</i>	Holly	R
<i>Buddleja davidii</i>	Buddleja	R	<i>Ligustrum vulgare</i>	Wild privet	R
<i>Carpinus betulus</i>	Hornbeam	R	<i>Quercus robur</i>	Pedunculate oak	O
<i>Castanea sativa</i>	Sweet chestnut	O	<i>Salix cinerea</i>	Sallow	F
<i>Crataegus monogyna</i>	Hawthorn	R			

## Grasses, sedges, rushes and ferns

<i>Dactylis glomerata</i>	Cock's-foot	O			
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## Herbs

<i>Alliaria petiolata</i>	Garlic mustard	R	<i>Hypericum perforatum</i>	Perforate St John's-wort	R
<i>Anthriscus sylvestris</i>	Cow parsley	R	<i>Mercurialis perennis</i>	Dog's mercury	F
<i>Artemisia vulgaris</i>	Mugwort	R	<i>Pentaglottis sempervirens</i>	Green alkanet	R
<i>Cerastium fontanum</i>	Common mouse-ear	O	<i>Plantago major</i>	Greater plantain	R
<i>Chaerophyllum temululum</i>	Rough Chervil	O	<i>Ranunculus repens</i>	Creeping buttercup	R
<i>Cirsium arvense</i>	Creeping thistle	R	<i>Rubus fruticosus</i> agg.	Bramble	F
<i>Crepis vesicaria</i>	Beaked hawk's-beard	R	<i>Rumex obtusifolius</i>	Broad-leaved dock	R
<i>Epilobium hirsutum</i>	Great willowherb	R	<i>Silene dioica</i>	Red campion	O
<i>Fragaria vesca</i>	Wild strawberry	R	<i>Stachys sylvatica</i>	Hedge woundwort	R
<i>Galium aparine</i>	Cleavers	F	<i>Taraxacum officinale</i> agg.	Dandelion	R
<i>Geranium robertianum</i>	Herb robert	O	<i>Tussilago farfara</i>	Coltsfoot	O
<i>Geum urbanum</i>	Wood avens	R	<i>Urtica dioica</i>	Common nettle	F
<i>Glechoma hederacea</i>	Ground ivy	R	<i>Veronica chamaedrys</i>	Germander speedwell	R
<i>Hedera helix</i>	Common ivy	F	<i>Vicia hirsuta</i>	Hairy tare	R
<i>Heracleum sphondylium</i>	Hogweed	R	<i>Vicia sativa</i>	Common vetch	R

n.b. The number of grass species recorded in this area was limited due to the timing of the visit, which meant that many species were not yet in flower.

### 3.4 Area 4 - Snakes' Hills Pit

This is an area of previously worked sand and gravel that lies between the woodland in Area 3 and Snake's Hills (see photos 7 & 8), comprising about 5.0ha. Around the margins of this area, the soils appear more enriched, and probably relate to areas that were not worked. It has been subject to a very poor planting scheme between 10 and 15 years ago of both native and non-native trees and shrubs. In most areas sufficient light penetrates the canopy to maintain some ground flora. In part of the area, the flora is very sparse, and the ground is dominated by lichens, which may reflect very low nutrient levels. In a more open condition, the ground flora is likely to be diverse due to the nutrient poor soils developed over past sand and gravel workings. Steep south-facing and west-facing slopes are found at the edges of this area and tend to be more open in nature.

Hawthorn, sallow, broom and gorse typically constitute the native scrub in the area. However, many native and non-native species have been introduced as part of the planting scheme. Even where species have been planted that are local to the area, the provenance appeared to be questionable. The ground flora largely included species tolerant of some shade, except in the more open situation on the south-facing slopes, where species such as hoary mullein, biting stoncrop and viper's-bugloss were present. Hoary mullein is a nationally scarce species that is rare outside East Anglia; in Norfolk it mainly occurs on the sands and gravels around Snettisham and on the river sands and gravels around Norwich. The following plants were recorded from this area:

## Trees and shrubs

<i>Acer pseudoplatanus</i>	Sycamore	O	<i>Cytisus scoparius</i>	Broom	O
<i>Alnus glutinosa</i>	Alder	O	<i>Fraxinus excelsior</i>	Ash	F
<i>Betula pendula</i>	Silver birch	O	<i>Prunus</i> sp.	Cherry sp.	O
<i>Buddleja davidii</i>	Buddleja	R	<i>Quercus robur</i>	Pedunculate oak	O
<i>Castanea sativa</i>	Sweet chestnut	O	<i>Salix cinerea</i>	Sallow	R
<i>Corylus avellana</i>	Hazel	O	<i>Sambucus nigra</i>	Elder	R
<i>Crataegus monogyna</i>	Hawthorn	O	<i>Ulex europaeus</i>	Gorse	F

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### Grasses, sedges, rushes and ferns

<i>Agrostis capillaris</i>	Common bent-grass	F	<i>Holcus lanatus</i>	Yorkshire fog	O
<i>Carex nigra</i>	Common sedge	R	<i>Poa trivialis</i>	Rough meadow-grass	O
<i>Dactylis glomerata</i>	Cock's-foot	R	<i>Pteridium aquilinum</i>	Bracken	O
<i>Festuca rubra</i>	Red fescue	R			

### Herbs

<i>Artemisia vulgaris</i>	Mugwort	R	<i>Reseda luteola</i>	Weld	R
<i>Balota nigra</i>	Black horehound	R	<i>Rubus fruticosus</i> agg.	Bramble	F
<i>Chamerion angustifolium</i>	Rosebay willowherb	R	<i>Sedum acre</i>	Biting stonecrop	R
<i>Cirsium arvense</i>	Creeping thistle	R	<i>Sedum</i> sp.	Stonecrop sp.	R
<i>Daucus carota</i>	Wild carrot	R	<i>Silene dioica</i>	Red campion	O
<i>Echium vulgare</i>	Viper's-bugloss	O	<i>Sonchus oleraceus</i>	Smooth sow-thistle	R
<i>Erigeron acer</i>	Blue fleabane	O	<i>Tanacetum vulgare</i>	Tansy	O
<i>Geranium molle</i>	Dove's-foot crane's-bill	O	<i>Taraxacum officinale</i> agg.	Dandelion	R
<i>Glechoma hederacea</i>	Ground ivy	R	<i>Teucrium scorodonia</i>	Wood sage	O
<i>Heracleum sphondylium</i>	Hogweed	R	<i>Tragopogon pratensis</i> agg.	Goat's-beard	R
<i>Hypericum perforatum</i>	Perforate St John's-wort	O	<i>Urtica dioica</i>	Common nettle	R
<i>Medicago sativa</i>	Lucerne	R	<i>Verbascum pulverulentum</i>	Hoary mullein	R
<i>Myosotis arvensis</i>	Field forget-me-not	O	<i>Veronica chamaedrys</i>	Germander speedwell	F
<i>Plantago lanceolata</i>	Ribwort plantain	F	<i>Vicia hirsuta</i>	Hairy tare	O
<i>Potentilla reptans</i>	Creeping cinquefoil	O	<i>Vicia sativa</i>	Common vetch	O
<i>Prunella vulgaris</i>	Selfheal	R	<i>Vicia tetrasperma</i>	Smooth tare	R
<i>Ranunculus repens</i>	Creeping buttercup	R			

n.b. a number of the non-native trees and shrubs planted in this area were not recorded.

### 3.5 Area 5 - Pumping station disturbed ground

An area around the 'car-park' and pumping station has received imported soil associated with bunding work and the construction of the pumping station, and received regular disturbance associated with these works. This area is about 0.3ha in extent.

As a result of the disturbance, this area generally contains a wide range of ruderal species (i.e. those associated with disturbed ground) that are common within arable or urbanised situations. The following plants were recorded from this area:

### Trees and shrubs

<i>Buddleja davidii</i>	Buddleja	R	<i>Fraxinus excelsior</i>	Ash	R
<i>Crataegus monogyna</i>	Hawthorn	R	<i>Salix cinerea</i>	Sallow	R
<i>Cytisus scoparius</i>	Broom	R			

### Grasses, sedges, rushes and ferns

<i>Arrhenatherum elatius</i>	False oat-grass	A	<i>Holcus lanatus</i>	Yorkshire fog	A
<i>Dactylis glomerata</i>	Cock's-foot	F	<i>Lolium perenne</i>	Perennial rye-grass	O
<i>Festuca rubra</i>	Red fescue	O	<i>Vulpia bromoides</i>	Squirreltail fescue	R

### Herbs

<i>Anagallis arvensis</i>	Scarlet pimpernel	R	<i>Matricaria recutita</i>	Scented mayweed	O
<i>Artemisia vulgaris</i>	Mugwort	O	<i>Medicago lupulina</i>	Black medick	F
<i>Centaurea cyanus</i>	Cornflower	O	<i>Persicaria maculosa</i>	Redshank	R
<i>Centaurea nigra</i>	Black knapweed	R	<i>Picris echinoides</i>	Bristly oxtongue	R
<i>Centaureum erythraea</i>	Common centaury	R	<i>Plantago lanceolata</i>	Ribwort plantain	F
<i>Chenopodium album</i>	Fat-hen	O	<i>Plantago major</i>	Greater plantain	O
<i>Chenopodium</i> sp. *	Goosefoot sp.	R	<i>Potentilla reptans</i>	Creeping cinquefoil	O
<i>Cirsium arvense</i>	Creeping thistle	O	<i>Primula veris</i>	Cowslip	F
<i>Conium maculatum</i>	Hemlock	R	<i>Reseda luteola</i>	Weld	R
<i>Daucus carota</i>	Wild carrot	O	<i>Rubus fruticosus</i> agg.	Bramble	R
<i>Echium vulgare</i>	Viper's-bugloss	R	<i>Rumex obtusifolius</i>	Broad-leaved dock	O
<i>Epilobium hirsutum</i>	Great willowherb	O	<i>Senecio jacobaea</i>	Common ragwort	O
<i>Epilobium montanum</i>	Broad-leaved willowherb	R	<i>Senecio vulgaris</i>	Groundsel	R
<i>Erodium cicutarium</i>	Common stork's-bill	O	<i>Silene dioica</i>	Red campion	R
<i>Euphorbia helioscopia</i>	Sun spurge	R	<i>Sisymbrium officinale</i>	Hedge mustard	R
<i>Fallopia convolvulus</i>	Black bindweed	R	<i>Solanum nigrum</i>	Black nightshade	O
<i>Fumaria officinalis</i>	Common fumitory	R	<i>Solidago canadensis</i>	Canadian goldenrod	R

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<i>Geranium dissectum</i>	Cut-leaved crane's-bill	R	<i>Sonchus oleraceus</i>	Smooth sow-thistle	O
<i>Geranium molle</i>	Dove's-foot crane's-bill	R	<i>Taraxacum officinale agg.</i>	Dandelion	O
<i>Helianthus annuus</i>	Sunflower	R	<i>Tragopogon pratensis agg.</i>	Goat's-beard	R
<i>Heracleum sphondylium</i>	Hogweed	O	<i>Trifolium arvense</i>	Hare's-foot clover	R
<i>Hypericum perforatum</i>	Perforate St John's-wort	O	<i>Trifolium repens</i>	White clover	O
<i>Hypochaeris radicata</i>	Common cat's-ear	F	<i>Tussilago farfara</i>	Coltsfoot	O
<i>Leucanthemum vulgare</i>	Oxeye daisy	O	<i>Urtica dioica</i>	Common nettle	O
<i>Linaria vulgaris</i>	Common toadflax	R	<i>Veronica chamaedrys</i>	Germander speedwell	R
<i>Lotus corniculatus</i>	Common bird's-foot-trefoil	O	<i>Veronica officinalis</i>	Heath speedwell	O
<i>Malva moschata</i>	Musk-mallow	R	<i>Vicia hirsuta</i>	Hairy tare	R
<i>Malva sylvestris</i>	Common mallow	R	<i>Vicia sativa</i>	Common vetch	O
<i>Matricaria discoidea</i>	Pineappleweed	R			

\* the *Chenopodium sp.* could not be reliably identified to species.

### 3.6 Area 6 - Inundation grassland

This forms part of the balancing pond that takes the surface water drainage from part of the Queen's Hills development (see photos 2 & 3), comprising about 0.5ha. It constitutes an area of inundation grassland that attenuates the water prior to entering the pond (Area 7).

This area contained an unusual mix of plants, mostly tolerant of some inundation. Some parts seemed to hold water for longer and this had an influence on the species present. The drier areas had species such as oxeye daisy, knapweed and bird's-foot trefoil, with the wetter areas containing species such as floating sweet-grass, marsh foxtail, common spike-rush and greater reedmace. The following plants were recorded from this area:

#### Trees and shrubs

<i>Salix sp.</i>	Willow sp. (thin-leaved)	F	<i>Salix viminalis</i>	Osier	O
<i>Salix cinerea</i>	Sallow	F			

#### Grasses, sedges, rushes and ferns

<i>Agrostis stolonifera</i>	Creeping bent-grass	F	<i>Holcus lanatus</i>	Yorkshire fog	F
<i>Alopecurus geniculatus</i>	Marsh foxtail	F	<i>Lolium perenne</i>	Perennial rye-grass	R
<i>Eleocharis palustris</i>	Common spike-rush	O	<i>Juncus effusus</i>	Soft rush	O
<i>Festuca arundinacea</i>	Tall fescue	R	<i>Juncus inflexus</i>	Hard rush	R
<i>Festuca rubra</i>	Red fescue	F	<i>Phleum pratense</i>	Timothy	R
<i>Glyceria fluitans</i>	Floating sweet-grass	R			

#### Herbs

<i>Achillea millefolium</i>	Yarrow	R	<i>Persicaria sp.</i> * <sup>2</sup>		O
<i>Angelica sylvestris</i>	Wild angelica	R	<i>Persicaria maculosa</i>	Redshank	R
<i>Artemisia vulgaris</i>	Mugwort	O	<i>Picris echinoides</i>	Bristly oxtongue	R
<i>Barbarea verna/ intermedia</i> * <sup>1</sup>	American/Med-flowered winter-cress	R	<i>Plantago lanceolata</i>	Ribwort plantain	F
<i>Centaurea nigra</i>	Black knapweed	O	<i>Potentilla anserina</i>	Silverweed	O
<i>Cirsium arvense</i>	Creeping thistle	O	<i>Pulicaria dysenterica</i>	Common fleabane	F
<i>Daucus carota</i>	Wild carrot	R	<i>Ranunculus repens</i>	Creeping buttercup	A
<i>Dipsacus fullonum</i>	Wild teasel	R	<i>Ranunculus sceleratus</i>	Celery-leaved buttercup	R
<i>Epilobium hirsutum</i>	Great willowherb	O	<i>Rumex conglomeratus</i>	Clustered dock	F
<i>Equisetum palustre</i>	Marsh horsetail	O	<i>Rumex obtusifolius</i>	Broad-leaved dock	F
<i>Galium verum</i>	Lady's bedstraw	R	<i>Senecio erucifolius</i>	Hoary ragwort	R
<i>Geranium dissectum</i>	Cut-leaved crane's-bill	F	<i>Senecio jacobaea</i>	Common ragwort	R
<i>Hypericum tetrapterum</i>	Square-stalked St John's-wort	O	<i>Taraxacum officinale agg.</i>	Dandelion	F
<i>Leucanthemum vulgare</i>	Oxeye daisy	A	<i>Trifolium repens</i>	White clover	F
<i>Lotus corniculatus</i>	Common bird's-foot-trefoil	A	<i>Typha latifolia</i>	Greater reedmace	R
<i>Matricaria discoidea</i>	Pineappleweed	O	<i>Urtica dioica</i>	Common nettle	R
<i>Mentha aquatica</i>	Water mint	R	<i>Veronica serpyllifolia</i>	Thyme-leaved speedwell	O

\*<sup>1</sup> the winter-cress could not be reliably identified to species as the basal leaves were not observed.

\*<sup>2</sup> the *Persicaria sp.* could not be reliably identified to species.

### 3.7 Area 7 - Balancing pond

The balancing pond is a shallow water-body (see photos 9 & 10) that receives some of the surface water discharge from the Queen's Hills development after passing through the inundation grassland (Area 6). This area is just over 0.1ha in extent.

All the plants at this site are likely to have been introduced. The following plants were recorded from this area:

#### Herbs

<i>Iris psedacorus</i>	Yellow iris	R	<i>Nymphaea alba</i>	White water-lily	R
<i>Myriophyllum spicatum</i>	Spiked water-milfoil	F	<i>Typha latifolia</i>	Greater reedmace	R

\* the water-milfoil appeared close to *spicatum* (Spiked water-milfoil), but it could have been an introduced variant.

### 3.8 Area 8 - Roadside Fen

The break of slope demarcates an area of floodplain fen/ grassland that follows the river through the site (see photo 11), Area 8 comprising about 0.9ha. Area 8 is the field that lies between Sir Alfred Munning's Way and the River Tud.

The flora was typical of unmanaged, tall-herb floodplain fen. It was dominated by reed sweet-grass and reed canary-grass, with a reasonable mix of flowering plants in midsummer largely represented by meadowsweet and water mint. The following plants were recorded from this area:

#### Grasses, sedges, rushes and ferns

<i>Agrostis stolonifera</i>	Creeping bent-grass	O	<i>Festuca arundinacea</i>	Tall fescue	R
<i>Carex acutiformis</i>	Lesser pond-sedge	O	<i>Glyceria maxima</i>	Reed sweet-grass	F
<i>Carex elata</i>	Tufted-sedge	R	<i>Phalaris arundinacea</i>	Reed canary-grass	D
<i>Deschampsia cespitosa</i>	Tufted hair-grass	O	<i>Phragmites australis</i>	Common reed	R

#### Herbs

<i>Angelica sylvestris</i>	Wild angelica	O	<i>Lamium album</i>	White dead-nettle	R
<i>Anthriscus sylvestris</i>	Cow parsley	R	<i>Lapsana communis</i>	Nipplewort	R
<i>Calystegia sepium</i>	Hedge bindweed	O	<i>Mentha aquatica</i>	Water mint	A
<i>Cirsium arvense</i>	Creeping thistle	O	<i>Myosotis laxa</i>	Tufted forget-me-not	R
<i>Cirsium palustre</i>	Marsh thistle	O	<i>Silene dioica</i>	Red campion	O
<i>Equisetum palustre</i>	Marsh horsetail	O	<i>Stachys sylvatica</i>	Hedge woundwort	R
<i>Filipendula ulmaria</i>	Meadowsweet	F	<i>Stellaria holostea</i>	Greater stitchwort	R
<i>Galium aparine</i>	Cleavers	O	<i>Urtica dioica</i>	Common nettle	F
<i>Galium palustre</i>	Marsh bedstraw	R	<i>Valeriana officinalis</i>	Common valerian	R
<i>Heracleum sphondylium</i>	Hogweed	O			

### 3.9 Area 9 - Riverine wet woodland

An area of wet, riverine woodland follows the River Tud in places (see photo 11), comprising about 0.8ha. The fen/ wet grassland areas (8 and 11) abut the river directly in a number of locations, but there is often a line of trees along the river even where the woodland belt is not present.

The presence of dog's mercury, sanicle and ramsons is indicative of the long history of this riverine woodland. The following plants were recorded from this area:

#### Trees and shrubs

<i>Alnus glutinosa</i>	Alder	A	<i>Fraxinus excelsior</i>	Ash	O
<i>Crataegus monogyna</i>	Hawthorn	O	<i>Sambucus nigra</i>	Elder	O

#### Grasses, sedges, rushes and ferns

<i>Agrostis stolonifera</i>	Creeping bent-grass	F			
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## Herbs

<i>Allium ursinum</i>	Ramsons	R	<i>Mercurialis perennis</i>	Dog's mercury	O
<i>Anthriscus sylvestris</i>	Cow parsley	O	<i>Rosa canina</i>	Dog-rose	O
<i>Filipendula ulmaria</i>	Meadowsweet	R	<i>Sanicula europaea</i>	Sanicle	R
<i>Galium aparine</i>	Cleavers	O	<i>Silene dioica</i>	Red campion	O
<i>Geranium robertianum</i>	Herb robert	O	<i>Stachys sylvatica</i>	Hedge woundwort	O
<i>Geum urbanum</i>	Wood avens	R	<i>Urtica dioica</i>	Common nettle	F
<i>Hedera helix</i>	Common ivy	O			

### 3.10 Area 10 - Enclosed fen

An area of grassland surrounded by wet woodland appeared drier than some of the adjacent areas of fen/ grassland within the floodplain. This area is about 0.2ha in extent.

The flora of parts of this area was more indicative of drier conditions (than Areas 8 and 11), being dominated by false oat-grass, as opposed to the species more typical of wetter conditions. The following plants were recorded from this area:

#### Grasses, sedges, rushes and ferns

<i>Agrostis capillaris</i>	Common bent-grass	O	<i>Glyceria maxima</i>	Reed sweet-grass	F
<i>Arrhenatherum elatius</i>	False oat-grass	A	<i>Holcus lanatus</i>	Yorkshire fog	F
<i>Dactylis glomerata</i>	Cock's-foot	O	<i>Juncus conglomeratus</i>	Compact rush	O

## Herbs

<i>Angelica sylvestris</i>	Wild angelica	O	<i>Lathyrus pratensis</i>	Meadow vetchling	O
<i>Cirsium arvense</i>	Creeping thistle	F	<i>Mentha aquatica</i>	Water mint	O
<i>Cirsium palustre</i>	Marsh thistle	O	<i>Stachys sylvatica</i>	Hedge woundwort	O
<i>Filipendula ulmaria</i>	Meadowsweet	O	<i>Stellaria graminea</i>	Lesser stitchwort	O
<i>Galium aparine</i>	Cleavers	O	<i>Urtica dioica</i>	Common nettle	F
<i>Heracleum sphondylium</i>	Hogweed	O			

### 3.11 Area 11 - Eastern fen

The floodplain fen/ wet grassland in this area lies between the river and an occluded dyke, which marks the break of slope (see photos 12 & 13), comprising about 2.4ha. The dyke on the upland margin is completely vegetated with some water in the bottom, but can be clearly identified on the ground by a line of rushes. Species recorded from the dyke are marked with a <sup>D</sup>. Some species were only recorded from the immediate river banks <sup>B</sup>.

The flora was similar to Area 8, although reed canary-grass was less prevalent. The occluded dykes, particularly at the break of slope could be identified from the dominance of soft rush. The presence of small teasel towards the river is notable as this is a very restricted species in Norfolk; it appears to be frequent along the River Tud in this part of the valley. The following plants were recorded from this area:

#### Grasses, sedges, rushes and ferns

<i>Agrostis capillaris</i>	Common bent-grass	R	<i>Glyceria fluitans</i> <sup>D</sup>	Floating sweet-grass	R
<i>Arrhenatherum elatius</i>	False oat-grass	O	<i>Glyceria maxima</i>	Reed sweet-grass	A
<i>Carex disticha</i>	Brown sedge	R	<i>Holcus lanatus</i>	Yorkshire fog	F
<i>Carex hirta</i>	Hairy sedge	R	<i>Juncus effusus</i> <sup>D</sup>	Soft rush	O
<i>Dactylis glomerata</i>	Cock's-foot	O	<i>Phalaris arundinacea</i> <sup>B</sup>	Reed canary-grass	R
<i>Deschampsia cespitosa</i>	Tufted hair-grass	O			

## Herbs

<i>Angelica sylvestris</i>	Wild angelica	O	<i>Lotus corniculatus</i> <sup>D</sup>	Common bird's-foot trefoil	R
<i>Arctium lappa</i> <sup>B</sup>	Greater burdock	O	<i>Mentha aquatica</i> <sup>D</sup>	Water mint	O
<i>Arctium minus</i>	Lesser burdock	O	<i>Mentha x rotundifolia</i> ?	False apple mint	R
<i>Cirsium arvense</i>	Creeping thistle	O	<i>Myosotis scorpioides</i> <sup>D</sup>	Water forget-me-not	R
<i>Cirsium palustre</i>	Marsh thistle	F	<i>Potentilla anserina</i>	Silverweed	R
<i>Dipsacus pilosus</i> <sup>B</sup>	Small teasel	R	<i>Pulicaria dysenterica</i>	Common fleabane	R
<i>Epilobium montanum</i>	Broad-leaved willowherb	R	<i>Rumex conglomeratus</i>	Clustered dock	O

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<i>Epilobium parviflorum</i>	Hoary willowherb	R	<i>Rumex obtusifolius</i>	Broad-leaved dock	O
<i>Equisetum fluviatile</i> <sup>B</sup>	Water horsetail	R	<i>Scrophularia auriculata</i> <sup>B</sup>	Water figwort	R
<i>Filipendula ulmaria</i>	Meadowsweet	A	<i>Solanum dulcamara</i>	Bittersweet	R
<i>Galium aparine</i>	Cleavers	O	<i>Stachys sylvatica</i>	Hedge woundwort	R
<i>Heraclium sphondylium</i>	Hogweed	R	<i>Urtica dioica</i>	Common nettle	F
<i>Lathyrus pratensis</i>	Meadow vetchling	F	<i>Valeriana officinalis</i> <sup>B</sup>	Common valerian	R

### 3.12 Area 12 - Rank grassland/ scrub

An area of generally rank grassland and scrub lies between the floodplain and the block of sallow scrub that occupies the break of slope before the balancing pond (see photo 14), comprising about 2.7ha. This area has not been subject to past sand and gravel extraction or the earthworks associated with the balancing pond. Hence, it appears to have a deeper, more enriched soil that may also relate to its arable history. Within this area, there are some patches of shorter, and more species-rich turf, which may be indicative of a more nutrient-poor soil or areas of rabbit grazing.

The flora is largely dominated by the coarser grasses, false oat-grass, cock's-foot and Yorkshire fog, with a much lower proportion of flowering plants than Areas 1 and 2. Some patches are indicative of very enriched soils and dominated by nettle, cleavers, bramble and creeping thistle. Area 12 contained the only patch of blackthorn scrub found on the site. A few areas towards Area 2 have a shorter, more diverse sward with species such as centaury, cat's-ears and bird's-foot trefoil present. The largest patch of ploughman's spikenard was found towards Area 2, this being a very localised species in this part of Norfolk. Smooth cat's-ear is notable as a nationally scarce species, often associated with sand workings. The following plants were recorded from this area:

#### Trees and shrubs

<i>Betula pendula</i>	Silver birch	R	<i>Prunus spinosa</i>	Blackthorn	R
<i>Crataegus monogyna</i>	Hawthorn	R	<i>Salix cinerea</i>	Sallow	R

#### Grasses, sedges, rushes and ferns

<i>Agrostis vinealis</i>	Brown bent-grass	O	<i>Festuca rubra</i>	Red fescue	O
<i>Arrhenatherum elatius</i>	False oat-grass	A	<i>Holcus lanatus</i>	Yorkshire fog	A
<i>Dactylis glomerata</i>	Cock's-foot	F	<i>Poa trivialis</i>	Rough meadow-grass	O

#### Herbs

<i>Achillea millefolium</i>	Yarrow	O	<i>Lotus corniculatus</i>	Common bird's-foot-trefoil	R
<i>Artemisia vulgaris</i>	Mugwort	O	<i>Pilosella aurantiaca</i>	Fox-and-cubs	R
<i>Centaureum erythraea</i>	Common centaury	R	<i>Rosa canina</i>	Dog-rose	O
<i>Cirsium arvense</i>	Creeping thistle	F	<i>Rubus fruticosus</i> agg.	Bramble	O
<i>Cirsium palustre</i>	Marsh thistle	R	<i>Rubus idaeus</i>	Raspberry	R
<i>Epilobium montanum</i>	Broad-leaved willowherb	O	<i>Rumex obtusifolius</i>	Broad-leaved dock	R
<i>Galium aparine</i>	Cleavers	O	<i>Senecio jacobaea</i>	Common ragwort	R
<i>Geranium dissectum</i>	Cut-leaved crane's-bill	R	<i>Silene dioica</i>	Red campion	R
<i>Glechoma hederacea</i>	Ground ivy	O	<i>Solidago canadensis</i>	Canadian goldenrod	R
<i>Heraclium sphondylium</i>	Hogweed	O	<i>Sonchus asper</i>	Prickly sow-thistle	R
<i>Hypericum perforatum</i>	Perforate St John's-wort	R	<i>Stellaria graminea</i>	Lesser stitchwort	O
<i>Hypochaeris glabra</i>	Smooth cat's-ear	R	<i>Tanacetum vulgare</i>	Tansy	R
<i>Hypochaeris radicata</i>	Common cat's-ear	R	<i>Torilis japonica</i>	Upright hedge-parsley	O
<i>Inula conyzae</i>	Ploughman's-spikenard	R	<i>Tussilago farfara</i>	Coltsfoot	O
<i>Lactuca virosa</i>	Great lettuce	R	<i>Urtica dioica</i>	Common nettle	F
<i>Lathyrus pratensis</i>	Meadow vetchling	R	<i>Vicia sativa</i>	Common vetch	R
<i>Leontodon autumnalis</i>	Autumn hawkbit	O	<i>Vicia tetrasperma</i>	Smooth tare	R

### 3.13 Area 13 - Western woodland

A block of woodland occupies the land west of Sir Alfred Munning's Way (see photo 15), comprising about 12.7ha. It would appear that this is secondary woodland established in the 17<sup>th</sup> or 18<sup>th</sup> centuries as part of the Costessey Hall Estate. Maps show two large ponds within the woodland, which now appear almost completely silted up. An area of tall herb fen can be found close to the river (Area 14).

The flora of the drier woodland was similar to Area 3, although it appeared more disturbed/ enriched with nettle often dominating the ground flora, particularly away from the rides. Oak was more abundant in the canopy of this woodland, and alder dominated the wet woodland towards the river. Small balsam, although introduced, has a very disjointed and localised distribution across Norfolk. A few plants of small teasel were present in the wet woodland.

### Trees and shrubs

<i>Acer pseudoplatanus</i>	Sycamore	F	<i>Fagus sylvatica</i>	Beech	R
<i>Aesculus hippocastanum</i>	Horse-chestnut	O	<i>Fraxinus excelsior</i>	Ash	O
<i>Alnus glutinosa</i>	Alder	F	<i>Ilex aquifolium</i>	Holly	R
<i>Betula pendula</i>	Silver birch	O	<i>Quercus robur</i>	Pedunculate oak	A
<i>Carpinus betulus</i>	Hornbeam	O	<i>Salix sp.</i>	Willow sp. (thin-leaved)	O
<i>Corylus avellana</i>	Hazel	R	<i>Salix cinerea</i>	Sallow	R
<i>Crataegus monogyna</i>	Hawthorn	O	<i>Sambucus nigra</i>	Elder	R

### Grasses, sedges, rushes and ferns

<i>Agrostis stolonifera</i>	Creeping bent-grass	O	<i>Dryopteris dilatata</i>	Broad buckler-fern	R
<i>Arrhenatherum elatius</i>	False oat-grass	R	<i>Dryopteris felix-mas</i>	Male fern	O
<i>Brachypodium sylvaticum</i>	False brome	O	<i>Holcus lanatus</i>	Yorkshire fog	R
<i>Carex remota</i>	Remote sedge	R	<i>Juncus effusus</i>	Soft rush	R
<i>Dactylis glomerata</i>	Cock's-foot	R			

### Herbs

<i>Alliaria petiolata</i>	Garlic mustard	R	<i>Impatiens parviflora</i>	Small balsam	F
<i>Arctium minus</i>	Lesser burdock	O	<i>Lapsana communis</i>	Nipplewort	R
<i>Circaea lutetiana</i>	Enchanter's-nightshade	R	<i>Mercurialis perennis</i>	Dog's mercury	F
<i>Cirsium arvense</i>	Creeping thistle	R	<i>Potentilla anserina</i>	Silverweed	R
<i>Digitalis purpurea</i>	Foxglove	R	<i>Prunella vulgaris</i>	Selfheal	O
<i>Dipsacus pilosus</i>	Small teasel	R	<i>Rubus fruticosus agg.</i>	Bramble	O
<i>Eupatorium cannabinum</i>	Hemp-agrimony	R	<i>Rubus idaeus</i>	Raspberry	R
<i>Galium aparine</i>	Cleavers	O	<i>Rumex sanguineus</i>	Wood dock	O
<i>Geranium robertianum</i>	Herb robert	O	<i>Silene dioica</i>	Red campion	O
<i>Geum urbanum</i>	Wood avens	O	<i>Stachys sylvatica</i>	Hedge woundwort	O
<i>Glechoma hederacea</i>	Ground ivy	O	<i>Teucrium scorodonia</i>	Wood sage	R
<i>Hedera helix</i>	Common ivy	O	<i>Torilis japonica</i>	Upright hedge-parsley	O
<i>Heracleum sphondylium</i>	Hogweed	R	<i>Urtica dioica</i>	Common nettle	A

### 3.14 Area 14 - Western fen

A small area of tall-herb fen close to the river, comprising about 0.4ha.

This area appeared quite enriched, but was the main locality for hemp-agrimony on the site, and a reasonable number of small teasel plants were present.

### Grasses, sedges, rushes and ferns

<i>Phalaris arundinacea</i>	Reed canary-grass	O			
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### Herbs

<i>Arctium lappa</i>	Greater burdock	O	<i>Galium aparine</i>	Cleavers	F
<i>Calystegia sepium</i>	Hedge bindweed	F	<i>Heracleum sphondylium</i>	Hogweed	R
<i>Cirsium arvense</i>	Creeping thistle	O	<i>Silene dioica</i>	Red campion	O
<i>Dipsacus pilosus</i>	Small teasel	O	<i>Urtica dioica</i>	Common nettle	D
<i>Eupatorium cannabinum</i>	Hemp-agrimony	F			

### 3.15 Area 15 - Sallow scrub

Dense sallow scrub has invaded the grassland east of the balancing pond, largely within the last 10 years (see photo 16), comprising about 2.2ha.

Where the canopy is closed there is virtually no understorey or ground flora, except nettle and bramble. A number of sheltered glades occur throughout the area and these contain flora typical of the area. The presence of several plants of carline thistle is particularly notable, as this plant usually

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occurs on light soils over chalk and the Flora of Norfolk only shows one record away from the chalk of west Norfolk (Beckett & Bull, 1999). A few plants of ploughman's spikenard were also notable. The yellow sedge was a stunted specimen on the edge of the path and may have been introduced to the site.

### Trees and shrubs

<i>Betula pendula</i>	Silver birch	O	<i>Salix cinerea</i>	Sallow	A
<i>Buddleja davidii</i>	Buddleja	O			

### Grasses, sedges, rushes and ferns

<i>Agrostis stolonifera</i>	Creeping bent-grass	O	<i>Dryopteris dilatata</i>	Broad buckler-fern	R
<i>Arrhenatherum elatius</i>	False oat-grass	O	<i>Elymus repens</i>	Common couch-grass	R
<i>Carex viridula oedocarpa</i>	Common yellow sedge	R	<i>Holcus lanatus</i>	Yorkshire fog	F
<i>Dactylis glomerata</i>	Cock's-foot	F			

### Herbs

<i>Anagallis arvensis</i>	Scarlet pimpernel	R	<i>Leontodon autumnalis</i>	Autumn hawkbit	O
<i>Angelica sylvestris</i>	Angelica	R	<i>Leucanthemum vulgare</i>	Oxeye daisy	R
<i>Artemisia vulgaris</i>	Mugwort	R	<i>Medicago lupulina</i>	Black medick	O
<i>Carlina vulgaris</i>	Carlina thistle	R	<i>Mentha aquatica</i>	Water mint	R
<i>Centaurium erythraea</i>	Common centaury	R	<i>Potentilla reptans</i>	Creeping cinquefoil	O
<i>Cerastium fontanum</i>	Common mouse-ear	O	<i>Pulicaria dysenterica</i>	Common fleabane	R
<i>Chamerion angustifolium</i>	Rosebay willowherb	O	<i>Rubus fruticosus agg.</i>	Bramble	F
<i>Cirsium arvense</i>	Creeping thistle	F	<i>Senecio jacobaea</i>	Common ragwort	O
<i>Cirsium vulgare</i>	Spear thistle	R	<i>Sonchus arvensis</i>	Perennial sow-thistle	O
<i>Dipsacus fullonum</i>	Wild teasel	O	<i>Taraxacum officinale agg.</i>	Dandelion	R
<i>Epilobium montanum</i>	Broad-leaved willowherb	O	<i>Torilis japonica</i>	Upright hedge-parsley	O
<i>Glechoma hederacea</i>	Ground ivy	F	<i>Tussilago farfara</i>	Coltsfoot	R
<i>Heracleum sphondylium</i>	Hogweed	R	<i>Urtica dioica</i>	Common nettle	O
<i>Hypericum perforatum</i>	Perforate St John's-wort	O	<i>Veronica chamaedrys</i>	Germander speedwell	R
<i>Inula conyzae</i>	Ploughman's-spikenard	R	<i>Vicia sativa</i>	Common vetch	R

### 3.16 Area 16 - River channel

The river channel provides conditions for a number of species that are not found elsewhere on the site (see photo 17), comprising about 0.6ha.

The water-crowfoot beds occurred where the river was fast flowing. All the other species occurred where the river was slow flowing. Bulrush does not appear to have been recorded from the Tud previously (Beckett & Bull, 1999).

### Herbs

<i>Berula erecta</i>	Lesser water-parsnip	O	<i>Rorippa nasturtium-aquaticum</i>	Water-cress	O
<i>Mentha aquatica</i>	Water mint	O	<i>Schoenoplectus lacustris lacustris</i>	Bulrush	O
<i>Nuphar lutea</i>	Yellow water-lily	O	<i>Sparganium emersum</i>	Unbranched bur-reed	O
<i>Ranunculus penicillatus</i>	Stream water-crowfoot	F	<i>Sparganium erectum</i>	Branched bur-reed	O

### 3.17 Additional plants recorded from the area

Observations in the wider area were very limited, and hence further, more thorough survey will undoubtedly reveal other species to be present.

### Trees and shrubs

<i>Sorbus aucuparia</i>	Rowan	Rare in 'butterfly area'
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### Herbs

<i>Agrimonia eupatoria</i>	Agrimony	Rare on south side of river (golf course land)
<i>Dactylorhiza fuchsii</i>	Common-spotted orchid	1 plant on spoil banks adjacent to old showroom site on south side of river (golf course land)
<i>Hyacinthoides non-scripta</i>	Bluebell	In woods adjacent to 'butterfly area'
<i>Ophrys apifera</i>	Bee orchid	3 plants on banks of balancing pond on south side of river (golf course land); 8 plants in 'butterfly area'

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## 4. Fauna

### 4.1 Birds

A total of 50 species of birds were recorded during the course of the survey, including 36 species that were confirmed or probably breeding on the site. Table 3 lists all the species, along with their status at the site and abundance recorded during the survey. Due to the time of year, the species recorded largely represent the breeding population of the site, or species using the site for feeding and breeding locally. The site is also likely to be particularly important for passage migrants during the spring and autumn, as the Tud valley is known to be an important migratory route across Norfolk (Gardiner, 2012).

The mix of habitats present on the site means that the bird interest of the site is reasonably diverse. Particularly notable are a number of species that are red listed species of conservation concern (BTO, 2009), namely grey partridge, song thrush, marsh tit and linnet. The pair of grey partridge were probably visiting the site from the nearby Easton estate, but the other three species were breeding on the site. Turtle dove *Streptopelia turtur* was previously breeding on the site in Area 4, and probably lost partly as a result of the tree planting in this area. Some of the other species recorded are amber-listed (BTO, 2009). All Birds of Conservation Concern are indicated in Table 1.

The scrub and woodland are the most important habitats for birds on the site. The dry scrub is important for whitethroat, garden warbler, bullfinch and linnet in particular, with the wetter scrub holding the willow warbler population. The woodland supports a typical assemblage for the area, and is important for both song thrush and marsh tit (wet woodland). The valley ridge woodlands to the west of Norwich hold a strong nuthatch population in this part of Norfolk (BTO, 2011), with two pairs recorded from Queen's Hills during the survey. The value of the scrub largely relates to its transitions to the grassland and woodland, and this can be lost where the scrub becomes too dense. Kingfisher and grey wagtail occur along the river and are likely to breed on the site or nearby.

**Table 3 - Birds recorded at Queen's Hills**

#### Legend

<b>Taxonomy:</b>		follows the latest conventions from the British Ornithologists' Union
<b>Visits:</b>	I	individuals
	P	pairs
<b>Status:</b>	red	red-listed species (BTO, 2011)
	orange	amber-listed species (BTO, 2011)
	B	confirmed breeding on site
	P	probably breeding on site, but not confirmed
	N	no evidence of breeding on site, but probably breeding in the locality
	F	flyover record only
	*	breeding pairs likely to be significantly underestimated due to the timing of visits

Common name	Species	May visits	June visits	July visits	Aug. visits	Status on the site	Main Habitat
Black-headed gull	<i>Chroicocephalus ridibundus</i>			2I		F	Flyover
Blackbird	<i>Turdus merula</i>	3P	2P	4P		B - > 9 pairs*	Woodland/ grassland
Blackcap	<i>Sylvia atricapilla</i>	3P	1P	8P	1P	B - > 12 pairs	Woodland
Blue tit	<i>Cyanistes caeruleus</i>	2P		4P	1P	B - > 6 pairs*	Woodland
Bullfinch	<i>Pyrrhula pyrrhula</i>	2P		2P	2P	B - c.4 pairs	Scrub
Buzzard	<i>Buteo buteo</i>			1I		N	Woodland/ grassland
Carion crow	<i>Corvus corone</i>	1P	1P	1P		P - 1 pair	Woodland/ grassland
Chaffinch	<i>Fringilla coelebs</i>	3P		1P		B - > 4 pairs*	woodland
Chiffchaff	<i>Phylloscopus collybita</i>	4P	2P	6P	2I	B - > 12 pairs	woodland
Coal tit	<i>Periparus ater</i>				1P	B - 1 pair	Woodland
Collared dove	<i>Streptopelia decaocto</i>	1P	2P			N	Woodland
Dunnoek	<i>Prunella modularis</i>			2P		B - > 2 pairs	Scrub
Garden warbler	<i>Sylvia borin</i>	6P				B - c. 6 pairs	Grassland/ scrub
Goldfinch	<i>Carduelis carduelis</i>	4P	5P	6P	3P	B - c. 10 pairs	Grassland/ scrub
Great-spotted woodpecker	<i>Dendrocopus major</i>			1P		B - 1-2 pairs	Woodland
Great tit	<i>Parus major</i>	2P	1P	2P	1P	B - > 5 pairs*	Woodland/ scrub

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Greenfinch	<i>Chloris chloris</i>	1P				B - > 1 pair*	Woodland
Green woodpecker	<i>Picus viridis</i>				1P	B - 1 pair	Woodland/ grassland
Grey heron	<i>Ardea cinerea</i>		1I			N	Pond
Grey partridge	<i>Perdix perdix</i>			1P		N	Grassland/ scrub
Grey wagtail	<i>Motacilla cinerea</i>				1I	N	River
House martin	<i>Delichon urbicum</i>	15I		40I	10I	N	Pond
Jackdaw	<i>Corvus monedula</i>	1P			1P	B - 1-2 pairs	Woodland
Jay	<i>Garrulus glandarius</i>	1P	1P	3P		B - > 5 pairs	Woodland
Kestrel	<i>Falco tinnunculus</i>		1P	1P	1P	N	Grassland
Kingfisher	<i>Alcedo atthis</i>			1P		P - 1 pair	River
Lesser black-backed gull	<i>Larus fuscus</i>		2I			F	Flyover
Linnet	<i>Carduelis camabina</i>	2P	2P			B - > 2 pairs	Grassland/ scrub
Long-tailed tit	<i>Aegithalos caudatus</i>	2P		1P		B - > 3 pairs*	Woodland/ scrub
Magpie	<i>Pica pica</i>		2P		2P	B - > 2 pairs	Woodland/ scrub
Marsh tit	<i>Poecile palustris</i>				1P	B - 1 pair	Wet woodland
Moorhen	<i>Gallinula chloropus</i>				1P	B - 1 pair	River
Nuthatch	<i>Sitta europaea</i>		1P	1P		B - 2 pairs	Woodland
Pheasant	<i>Phasianus colchicus</i>		1P	2P		B - 2 pairs	Grassland/ scrub
Pied wagtail	<i>Motacilla alba</i>				1P	N	Open water/ grassland
Red-legged partridge	<i>Alectoris rufa</i>	1P				N	Grassland/ scrub
Robin	<i>Erithacus rebecula</i>			2P		B - > 2 pairs*	Woodland
Sand martin	<i>Riparia riparia</i>	1I				F	Pond
Sedge warbler	<i>Acrocephalus schoenobaenus</i>	1P				B - 1 pair	Floodplain fen
Song thrush	<i>Turdus philomelos</i>	1P		1P		B - > 2 pairs*	Woodland
Sparrowhawk	<i>Accipiter nisus</i>				1P	P - 1 pair	Woodland/ scrub
Stock dove	<i>Columba oenas</i>	1P		1P		B - 1 pair	Woodland
Swallow	<i>Hirundo rustica</i>	5I			2I	N	Pond
Swift	<i>Apus apus</i>	1I		10I	1I	N	Flyover
Tawny owl	<i>Strix aluco</i>				1P	P - 1 pair	Woodland
Treecreeper	<i>Certhia familiaris</i>		2P	4P		B - c.5 pairs	Woodland
Willow warbler	<i>Phylloscopus trochilus</i>	6P	3P		3I	B - c.8 pairs	Sallow scrub
Whitethroat	<i>Sylvia communis</i>	7P	4P	2P		B - c.12 pairs	Grassland/ scrub
Woodpigeon	<i>Columba palumbus</i>	1P	3P	2P	3P	B - > 6 pairs*	Woodland/ scrub
Wren	<i>Troglodytes troglodytes</i>		2P	5P	1P	B - > 8 pairs*	Woodland

## 4.2 Mammals

Table 4 lists the mammals recorded during the survey, either directly or from their signs. A number of interesting species are present on the site. What appeared to be a redundant badger sett was found in the woodland west of the road (Area 13), and dung pits were found adjacent to the willow scrub to the east of the site (Area 15). A harvest mouse nest was found in the inundation grassland (Area 6), and further searching would probably show the species to be present in the floodplain fen (Areas 8 and 11). Harvest mice are generally restricted to wetlands and areas of long grass, and their current conservation status is uncertain largely due to the difficulty of surveying them. Otter *Lutra lutra* will undoubtedly use the river and adjacent ground from time to time, although accessibility to the river precluded a comprehensive search for otter signs. Roe deer were seen on most visits and appeared to largely use the floodplain fen during the daytime. Water vole *Arvicola terrestris* has certainly been present locally on the Tud in the past, and it may be possible to return it to the site if it is no longer present. Given the suburban setting, the river and adjacent woodland and floodplain fen are surprisingly undisturbed, and it is easy to envisage otter and deer using this area on a regular basis.

No assessment was made of the bat population, but the site is likely to be very important for bats, due to the presence of mature trees that can act as roost/ hibernaculum sites, and the quality of the feeding habitat. The mix of grassland, scrub, woodland and wetland habitats and their associated rich invertebrate populations provide ideal feeding conditions for a good diversity of bat species. The recent Big Norwich Bat Project has significantly increased the knowledge of bat populations in the area (Big Norwich Bat Project, 2012). Common pipistrelle *Pipistrellus pipistrellus*, soprano pipistrelle *Pipistrellus pygmaeus*, Nathusius' pipistrelle *Pipistrellus nathusii*, Noctule *Nyctalus noctula*, Daubenton's *Myotis daubentonii*, brown long-eared *Plecotus auritus* and Barbastelle *Barbastella barbastellus* bats have all been recorded locally in the Tud valley. Particularly notable is the presence of Barbastelle bats in the area, as Norfolk holds an important population that is of European significance.

More systematic survey is also likely to show that the site also holds good small mammal populations.

**Table 4 - Mammals recorded at Queen's Hills**

**Legend**

Visits: S signs only  
\* present - either heard or seen

Common name	Species	May visits	June visits	July visits	Aug. visits	Main habitat
Badger	<i>Meles meles</i>		S		S	Woodland, grassland and scrub
Bank vole	<i>Myodes glareolus</i>	S				Grassland
Common shrew	<i>Sorex araneus</i>			*		Woodland, grassland and scrub
Harvest mouse	<i>Micromys minutus</i>				S	1 nest (Area 7); floodplain fen/ rank grassland?
Mole	<i>Talpa europaea</i>		S	S		Woodland, grassland and scrub
Muntjac deer	<i>Muntiacus reevesi</i>	1				Woodland, grassland and scrub
Rabbit	<i>Oryctolagus cuniculus</i>	*	*	S	S	Grassland and scrub
Red fox	<i>Vulpes vulpes</i>			*		Woodland, grassland and scrub
Roe deer	<i>Capreolus capreolus</i>	*	*	1		Floodplain fen during daytime

### 4.3 Reptiles & Amphibians

A single grass snake *Natrix natrix* was observed on July 14<sup>th</sup> in an area of the drier floodplain grassland (Area 10), and one was seen to swim across the balancing pond (Area 7) on August 11<sup>th</sup>. Grass snake does not appear to be very common in the local Wensum and Tud valleys, so these records are notable. Three slow worms *Anguis fragilis* were observed under sheets on August 11<sup>th</sup> at the top of the south-facing slope in Area 4.

Common frog *Rana temporaria* breeds on the site, as several of this year's froglets were observed on July 14<sup>th</sup>.

Both common lizard *Zootoca* [formerly *Lacerta*] *vivipara* and adder *Vipera berus* have been recorded from the north of Queen's Hills in the site known as the 'butterfly area' (A. Brown, *pers. comm.*). Both these species may well also occur in the Queen's Hills 'Country Park' area, as the habitat would appear to be suitable. Smooth newt *Lissotriton* [formerly *Triturus*] *vulgaris* and common toad *Bufo bufo* are also highly likely to occur, although there do not appear to be any records of these species from the area.

It is interesting to speculate as to how Snakes' Hills got its name.

### 4.4 Fish

The River Tud has generally good water quality, and is one of the least obstructed rivers in Norfolk. As such it has a diverse fish population, and is particularly good for the more migratory species such as brown trout *Salmo trutta*. The River Tud is considered one of the best trout rivers in Norfolk (Clark, *pers. comm.*). The fish survey that took place on June 19<sup>th</sup> electro-fished a 90 metre stretch of the river. Whilst it will not record all the fish present, it allows the population to be estimated from the sample taken. The survey on June 19<sup>th</sup> recorded 70 brown trout, 3 chub *Squalius cephalus*, 1 brook lamprey *Lampetra planeri*, 26 minnow *Phoxinus phoxinus*, 54 stone loach *Barbatula barbatula* and 78 bullhead *Cottus gobio*. A good distribution of size classes was present for all species, indicating successful breeding and recruitment in the local population. Other species recorded at this site in previous years and at other locations throughout the Tud include dace *Leuciscus leuciscus*, roach *Rutilus rutilus*, European eel *Anguilla anguilla*, three-spined stickleback *Gasterosteus aculeatus*, pike *Esox lucius*, and gudgeon *Gobio gobio*.

The presence of bullhead and brook lamprey are particularly notable, as these are both species for which the River Wensum is designated a Special Area of Conservation (SAC) under the European Habitats' Directive.

What appear to be chub have been introduced to the balancing pond, and appear to be successfully breeding with fish of all ages observed.

#### 4.5 Butterflies & Moths (Lepidoptera)

Twenty-one species of butterfly were recorded during the survey, which is a good diversity for a relatively short survey (see Table 5). The assemblage is largely associated with open herb-rich grassland and the interface with young scrub. Particularly notable are the presence of green hairstreak and brown argus as breeding species. Green hairstreak has a limited Norfolk distribution, especially in this part of the county (Watts & McIlwrath, 2002), and is associated with the gorse/ broom scrub present on parts of this site. It is a difficult species to assess numbers as it is quite cryptic and difficult to observe, so the presence of four individuals on May 19<sup>th</sup> is notable. Although the distribution of brown argus has expanded considerably in recent years, it is still a localised insect in Norfolk (Watts & McIlwrath, 2002). At Queen's Hills, it is strongly associated with the herb-rich areas around the balancing pond (Areas 1 & 2), where its foodplants of stork's-bill and crane's-bill are found. The presence of two fresh individuals of the migratory species, clouded yellow, on August 11<sup>th</sup> is indicative of local breeding in the area. There is some uncertainty as to the ability of this species to survive a British winter, but clouded yellows have been observed in the Queen's Hills area for two consecutive years (Brown, *pers. comm.*).

A number of other butterfly species have been recorded from the northern side of Queen's Hills (Brown, *pers. comm.*), most notable of which is white-letter hairstreak *Satyrrium w-album*. This species is an elm feeder with a localised Norfolk distribution, particularly following Dutch Elm Disease. Wall brown *Lasiommata megera* is a declining species (Asher *et al.*, 2001) that has only been recorded on a couple of occasions and not for three years. Purple hairstreak *Neozephyrus quercus* is an oak feeder and may be frequent within the mature woodland, but can be overlooked due to its habit of spending much of its time in the tree canopy. Orange-tip *Anthocharis cardamines* is a spring-flying species and had largely finished flying by the first visit in May. Painted lady *Vanessa cardui* is a regular migrant, sometimes in large numbers. Two very rare vagrants were recorded during 2014. Yellow-legged tortoiseshell *Nymphalis xanthomelas* was an astonishing discovery as only the second British record. It followed an influx into Holland, and coincided with a number of other records in south-east England, present at Queen's Hills between July 13<sup>th</sup> and 16<sup>th</sup>. At the same time, a silver-washed fritillary *Argynnis paphia* turned up and was last recorded on August 21<sup>st</sup>.

The moths recorded during the survey are listed in Table 6. They include species that are day-flying or easily disturbed during the daytime, and represent a tiny fraction of the species that will be present. Moth recording at the author's garden on the edge of the Tud valley in New Costessey over 14 years has identified about 700 species. Given the diversity of habitat in a relatively small area at Queen's Hills, the moth assemblage is likely to be significant and may well contain rare or localised species.

**Table 5 - Butterflies recorded from Queen's Hills**

**Legend**

**Visits:**  
 1 1 individual  
 2 1-10 individuals  
 3 10-100 individuals  
 4 100-1,000 individuals

**Larval foodplants:** taken from Asher *et al.*, 2001

Common name	Species	May visits	June visits	July visits	Aug. visits	Main Habitat	Main Larval foodplants
Brimstone	<i>Gonepteryx rhamni</i>	2				Grassland/ scrub	Buckthorn
Brown argus	<i>Aricia agestis</i>	3	2		1	Grassland	Crane's-bills, stork's-bills
Clouded yellow	<i>Colias croceus</i>				2	Grassland	Clovers & other legumes
Comma	<i>Polygonia c-album</i>				2	Scrub edge	Common nettle
Common blue	<i>Polyommatus icarus</i>	3	2		2	Grassland	Bird's-foot trefoil
Essex skipper	<i>Thymelicus lineola</i>			3	1	Grassland	Cock's-foot & other grasses
Gatekeeper	<i>Pyronia tithonus</i>				3	Grassland/ scrub	Fine grasses (e.g. bents)
Green hairstreak	<i>Callophrys rubi</i>	2				Scrub	<i>L. corniculatus</i> , gorse, broom
Green-veined white	<i>Pieris napi</i>			2		Grassland/ scrub edge	Wild crucifers
Holly blue	<i>Celastrina argiolus</i>	1				Woodland	Holly, ivy
Large skipper	<i>Ochlodes venata</i>		1	2		Grassland	Cock's-foot & other grasses
Large white	<i>Pieris brassicae</i>	2		2	1	Grassland	Crucifers
Meadow brown	<i>Maniola jurtina</i>			4	3	Grassland	Wide range of grasses
Peacock	<i>Inachis io</i>			2	2	Grassland/ scrub edge	Common nettle
Red admiral	<i>Vanessa atalanta</i>			1	2	Grassland/ scrub	Common nettle
Ringlet	<i>Aphantopus hyperantus</i>			3		Grassland/ scrub	Coarse grasses (e.g. cock's-foot)
Small copper	<i>Lycaena phlaeas</i>	1				Grassland	Common sorrel
Small skipper	<i>Thymelicus sylvestris</i>			3		Grassland	Mainly Yorkshire fog
Small tortoiseshell	<i>Aglais urticae</i>	2	2	2	2	Grassland/ scrub	Common nettle
Small white	<i>Pieris rapae</i>			2		Grassland	Cultivated brassicas
Speckled wood	<i>Pararge aegeria</i>	2		2	2	Woodland/ scrub	Various grasses

**Table 6 - Moths recorded from Queen's Hills**

**Legend**

**Taxonomy:** follows Agassiz *et al.*, 2013

**Visits:**  
 1 1 individual  
 2 1-10 individuals  
 3 10-100 individuals  
 cat caterpillars

**Larval foodplants:** taken from Skinner, 1984 (macro-moths), and Sterling & Parsons, 2012 (micro- moths)

Species	Common name (macro-moths only)	May visits	June visits	July visits	Aug. visits	Main Habitat	Main Larval foodplants
<i>Agapeta hamana</i>				1		Grassland	Thistles
<i>Agriphila tristella</i>					2	Grassland	Various grasses
<i>Anthophila fabrciana</i>			2			Scrub edge	Common nettle
<i>Aplocera plagiata</i>	Treble-bar	1				Grassland/ scrub	St John's-worts
<i>Autographa gamma</i>	Silver Y			2		Grassland	Many herbaceous plants
<i>Callistege mi</i>	Mother shipton	1	2			Grassland	Clovers
<i>Campptogramma bilineata</i>	Yellow shell	1	1			Grassland/ scrub	Dock, chickweed, others
<i>Cathera pusaria</i>	Common white wave		1			Woodland	Various trees and shrubs
<i>Celypha lacunana</i>			2			Grassland/ scrub	Many herbaceous plants
<i>Chiasmia clathrata</i>	Latticed heath				1	Grassland	Clovers/ trefoils
<i>Chrysoteuchia culmella</i>			2	2		Grassland	Various grasses
<i>Cochylis dubitana</i>					1	Grassland	Ragworts, hawk's-beards
<i>Glyphiperix simplicella</i>		2				Grassland/ scrub	Cock-s-foot, tall fescue
<i>Homoeosoma sinuella</i>			2	2		Grassland	Ribwort plantain
<i>Hypena proboscidalis</i>	Snout		2	2		Nettles	Common nettle
<i>Nemophora degeerella</i>		1				Scrub	Unknown
<i>Orgyia antiqua</i>	Vapourer				1	Scrub	Various trees and shrubs
<i>Panemeria tenebrata</i>	Small yellow underwing	1				Grassland/ scrub	Common mouse-ear
<i>Parapoynx stratiotata</i>			1			Fen near pond	Water plants
<i>Phlogothera meticolosa</i>	Angle shades		1			Grassland/ scrub	Many herbaceous plants
<i>Platyptilia gondactyla</i>			1			Grassland/ scrub	Colt's-foot
<i>Plutella xylostella</i>				1		Grassland	Many brassicas
<i>Scopula immutata</i>	Lesser cream wave			1		Fen	Meadowsweet, valerian

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<i>Scotopteryx chenopodiata</i>	Shaded broad-bar				2	Fen/ grassland	Vetches, clovers
<i>Tyria jacobaeae</i>	Cinnabar moth	2	2	3 cat	1 cat	Grassland/ scrub	Ragwort
<i>Udea lutealis</i>					2	Fen	Many herbaceous plants
<i>Xanthorhoe montanata</i>	Silver-ground carpet	2				Scrub	Bedstraws and others
<i>Zygaena filipendulae</i>	Six-spot burnet		2	3		Grassland	Bird's-foot trefoil

n.b. a further eight species of micro-moth were retained for subsequent identification.

#### 4.6 Dragonflies & Damselflies (Odonata)

Sixteen species of dragonfly and damselfly were recorded from Queen's Hills during the survey (see Table 7). This is a good assemblage for a site that has relatively little freshwater habitat. Many species of Odonata feed away from water where there is an abundance of insect life and only visit water bodies to mate and lay eggs. They are often found in grassland and fen, and particularly on the woodland/ scrub edge where they find sheltered, sunny spots to feed and rest. Several of the species seen at Queen's Hills were only observed feeding and may have bred elsewhere, but the majority (11 species) were associated with using the balancing pond for breeding. This is impressive, given that the water within the pond will be eutrophic (rich in organic and mineral nutrients) in nature and likely to contain trace pollutants such as hydrocarbons. Banded demoiselle is the only species reliant on flowing water, so associated with the river rather than the pond. Small red-eyed damselfly is a species that only colonised Britain in 1999, and is now widespread throughout Norfolk and the rest of south-east England (British Dragonfly Society, 2014). The hairy dragonfly was previously a scarce insect that in Norfolk was largely confined to the Broads, but in recent years has expanded its range considerably (British Dragonfly Society, 2014).

**Table 7 - Odonata recorded from Queen's Hills**

#### Legend

Visits:	1	1 individual
	2	1-10 individuals
	3	10-100 individuals

Common name	Species	May visits	June visits	July visits	Aug. visits	Main Habitat
Azure damselfly	<i>Coenagrion puella</i>	3	3	2		Pond/ grassland
Banded demoiselle	<i>Calopteryx splendens</i>		2	2		River
Black-tailed skimmer	<i>Orthetrum cancellatum</i>		1	2	1	Pond
Blue-tailed damselfly	<i>Ischnura elegans</i>		2	1		Pond
Broad-bodied chaser	<i>Libellula depressa</i>		3			Pond
Brown hawker	<i>Aeshna grandis</i>			2	2	Feeding in floodplain
Common blue damselfly	<i>Enallagma cyathigerum</i>				3	Pond/ grassland
Common darter	<i>Sanguineum striolatum</i>				2	Pond
Emperor dragonfly	<i>Anax imperator</i>	1		1	2	Pond
Four-spotted chaser	<i>Libellula quadrimaculata</i>	2		1		Pond
Hairy dragonfly	<i>Brachytron pratense</i>		1			N. side pond
Large red damselfly	<i>Pyrrosoma nymphula</i>	2	2			Pond
Migrant hawker	<i>Aeshna mixta</i>				2	Feeding in floodplain
Ruddy darter	<i>Sympetrum sanguineum</i>				2	Pond
Small red-eyed damselfly	<i>Erythromma viridulum</i>	2	3	2	3	Pond
Southern hawker	<i>Aeshna cyanea</i>			1		Feeding in floodplain

#### 4.7 Grasshoppers & Crickets (Orthoptera)

Queen's Hills is clearly important for thermophilous (warmth-loving) species. Grasshoppers and crickets appeared abundant at the site, so specific searches were made during the August visits. Given that this was a very restricted survey, it was notable that six of the seventeen extant Norfolk species were discovered. Two of these species, long-winged conehead and Roesel's bush-cricket were virtually unknown in Norfolk 15 years ago (Norfolk & Norwich Naturalists' Society, 2001), but have undergone massive range expansions in recent years (Orthoptera Recording Scheme, 2014).

Oak bush-cricket *Meconema thalassinum*, dark bush-cricket *Pholidoptera griseoptera*, speckled bush-cricket *Leptophyes punctatissima* and meadow grasshopper *Chorthippus parallelus* are all species that could well occur at the site due to the habitats present. There is the possibility of one or two other species also occurring, making this an important Norfolk site.

**Table 8 - Orthoptera recorded from Queen's Hills**

**Legend**

**Taxonomy:** follows Marshall & Haes, 1988  
**Visits:** 1 1 individual  
 2 1-10 individuals  
 3 10-100 individuals  
 4 100-1,000 individuals

Common name	Species	Aug. visits	Main Habitat
Common green grasshopper	<i>Omocestus viridulus</i>	2	Tall, rank grassland
Common groundhopper	<i>Tetrix undulata</i>	1	Low vegetation with bare ground
Field grasshopper	<i>Chorthippus brunneus</i>	4	Low vegetation with bare ground
Lesser marsh grasshopper	<i>Chorthippus albomarginatus</i>	3	Edge of floodplain fen/ grassland
Long-winged conehead	<i>Conocephalus discolor</i>	3	Coarse herbaceous vegetation/ fen
Roesel's bush-cricket	<i>Metrioptera roeselii</i>	2	Occluded dyke on edge of floodplain/ fen

**4.8 Other invertebrates**

A number of other notable invertebrates were observed during the survey. The most interesting was white-clawed crayfish *Austropotamobius pallipes*, where four adults and one juvenile were seen during the electro-fishing survey of the river on June 19<sup>th</sup>. This species is of European importance and one of the species for which the River Wensum is notified as an SAC. It has undergone significant declines, including in the Wensum, due to the introduction of the non-native Signal crayfish *Pacifastacus leniusculus*, which is a carrier of crayfish plague that the native species has little resistance to. In addition, a single hornet was noted on May 19<sup>th</sup> (on the edge of Area 3) and the striking black-and-yellow longhorn beetle *Rutpela maculata* was seen on hogweed flowers in the floodplain (Area 10).

Queen's Hills is clearly an important site for invertebrates, and several groups would be worthy of further investigation. This is particularly the case for thermophilous species, which benefit from the locations on the site where the vegetation is open, bare ground is present, slopes are south-facing, there is an abundance of flowering plants, and the substrate is sandy in nature. In this context, bumblebees, solitary bees and wasps (Hymenoptera) would be very interesting to study. More intensive moth recording would undoubtedly provide some interesting records. Beetles, spiders and hoverflies would also be groups worthy of investigation.

## 5. Area ecological assessment

The following section provides an assessment of the current and potential ecological value of each area. This judgement is made in a local Norfolk context, but contextualised with national or international importance where appropriate. The considerations in categorising the level of ecological value are summarised in Table 9. The potential ecological value will often be dependent on the adoption of the management measures outlined in section 6.

Sensitivity to access from an ecological perspective is also assessed to guide management decisions. The factors taken into account in making the judgement on sensitivity to access are outlined in Table 10.

**Table 9 - Definitions of 'Ecological Value' Categories**

Ecological Value	Features of interest
HIGH	<ul style="list-style-type: none"> <li>Habitats or species of international/ national importance.</li> <li>Likely presence of Red Data Book (RDB)/ Nationally scarce invertebrates.</li> <li>Species of restricted national/ regional distribution.</li> </ul>
MEDIUM	<ul style="list-style-type: none"> <li>Habitats or species of local (Norfolk) importance.</li> <li>Biodiversity Action Plan (BAP) habitats/ species that have a restricted national distribution.</li> </ul>
LOW	<ul style="list-style-type: none"> <li>Habitats that are generally species-poor with few/no localised species.</li> <li>Species that are largely generalists and widespread.</li> </ul>

**Table 10 - Definitions of 'Access Sensitivity' Categories**

Access sensitivity	Factors considered (not all factors will necessarily apply)
Resilient to access	<ul style="list-style-type: none"> <li>Vegetation communities able to withstand moderate trampling.</li> <li>The species present able to withstand some disturbance.</li> <li>Management operations not compromised by access.</li> <li>Ground conditions do not compromise access.</li> <li>Any issues encountered can be managed.</li> </ul>
Sensitive to access	<ul style="list-style-type: none"> <li>Vegetation communities are sensitive to moderate trampling, maybe at particular times of the year.</li> <li>The species present (e.g. mammals such as otter, ground-nesting birds) are sensitive to disturbance.</li> <li>Management operations could be compromised by access at certain times of the year.</li> <li>Ground conditions are prohibitive to access, maybe at certain times of the year.</li> </ul>

It should also be borne in mind that the area of the Queen's Hills 'Country Park' is of high landscape value. The Tud valley in this area is one of the more deeply cut valleys within Norfolk. Views from the tops of the valley sides give commanding views across a wide area. The wooded valley sides and ridges are characteristic features of the Tud valley west of Norwich. The more natural valley side grasslands and scrub dropping down to the floodplain have been lost in many parts of the valley, so their presence at Queen's Hills is important. Future management actions, as proposed in section 6, have taken account of the need to be sympathetic to the landscape value, history and context of the site.

### 5.1 Area 1 - Short-turf grassland

#### **Current Ecological Value:**

**HIGH:** This area is particularly important for its open, short-turf grassland that supports important populations of thermophilous insects. It is the main location for common stork's bill, which supports the breeding population of the brown argus butterfly.

***Potential Ecological Value:***

HIGH: This is dependent on maintaining the area largely free of scrub. A number of enhancement measures are identified (see 6.1).

***Sensitivity to access:***

This area is resilient to access, though sensitive to eutrophication from dog faeces.

**5.2 Area 2 - Flower-rich grassland**

***Current Ecological Value:***

HIGH: The range of flowering plants and the long flowering season of this area make it an important feature in its own right, but particularly in supporting a rich invertebrate fauna. Although artificial in origin due to the earthworks associated with the balancing pond and likely seeding of the grassland, this area is now one of the most important on the site and an uncommon habitat in this part of Norfolk. The open nature of the grassland, its low nutrient status, its range of aspects, and its interface with adjacent areas of scrub mean that it provides a range of ecological niches that are particularly attractive to insects. Of the taxa studied, butterflies used this area extensively, with the populations of green hairstreak, brown argus and common blue being particularly notable. A very high population of field grasshopper use this area.

***Potential Ecological Value:***

HIGH: This is dependent on maintaining the area largely free of scrub. A number of enhancement measures are identified (see 6.2).

***Sensitivity to access:***

This area is resilient to access, though sensitive to eutrophication from dog faeces.

**5.3 Area 3 - Eastern Snakes' Hills woodland**

***Current Ecological Value:***

MEDIUM: This woodland is typical of the valley ridges to the west of Norwich, where hornbeam is often present in the canopy. The understorey and ground flora is not particularly diverse and gives the impression of past disturbance causing some localised enrichment. There is a reasonable mature woodland bird assemblage, with species such as nuthatch, song thrush, treecreeper and blackcap present. The area is likely to be important in providing nursery and hibernacula roost sites, and feeding habitat, for some bat species. Further research may show the woodland to have some saproxylic (living on dead/ decaying wood) and other woodland invertebrate value.

***Potential Ecological Value:***

MEDIUM: Maintenance of the woodland is largely minimum intervention, and should aim over the long-term to encourage a more diverse age structure, dead wood component and removal of non-native species. A number of enhancement measures are identified (see 6.3).

***Sensitivity to access:***

This area has high resilience to access, although further assessment of badger use of the whole site may identify areas that are more sensitive to access.

**5.4 Area 4 - Snakes' Hills Pit**

***Current Ecological Value:***

LOW/MEDIUM: The value of this area has been significantly reduced by the tree planting that took place about 10 years ago. The margins of this area that have remained unplanted and retained a more natural open, short-turf grassland or grassland to scrub transition show the potential value of this area.

The impression from the ground flora is generally that this would be an area of low nutrient grassland developed over previous gravel workings. Hoary mullein is a nationally scarce species that was recorded from this area (Beckett & Bull, 1999). In a more open state this would be more akin to Areas 1 and 2. The dry scrub contains some bird interest, with bullfinch and garden warbler numbers particularly notable. Turtle dove was previously present on the site and may have been lost due to habitat loss or wider population declines. The gorse and broom scrub on the edge of this area is probably the stronghold for green hairstreak on the site. Slow worms were found in an open, south-facing slope within this area.

***Potential Ecological Value:***

HIGH: This is dependent on a significant reduction in tree cover, which would enhance the area for the flora, birds associated with dry scrub and the scrub edge, thermophilous and other invertebrates associated with low nutrient grassland and scrub/woodland transitions, and reptiles. A number of enhancement measures are identified (see 6.4).

***Sensitivity to access:***

This area is resilient to access, though sensitive to eutrophication from dog faeces.

### **5.5 Area 5 - Pumping station disturbed ground**

***Current Ecological Value:***

LOW: This is a highly disturbed area that contains a range of ruderal (associated with disturbed ground) plants associated with arable land, gardens or urban environments. A number of the species here were not found elsewhere on the site, but they are generally very common species apart from heath speedwell, which is notable in this part of Norfolk. Many of the species will have colonised naturally following disturbance, but some had obviously been introduced with imported material. Many of these species persist for a long time in the seed bank, and may therefore partly reflect this area's arable history. It does provide some additional diversity in the context of the whole site. There is some invertebrate interest in this area.

***Potential Ecological Value:***

LOW: This would be an obvious area to locate any aspect of the site development that required further disturbance (e.g. access or management related infrastructure, orchard creation). A key objective of this area would be to prevent the spread of some of the more aggressive introduced species (e.g. Canadian goldenrod) into other parts of the site. A number of enhancement measures are identified (see 6.5).

***Sensitivity to access:***

The area is very resilient to access, although dumping of plant material could introduce further aggressive, non-native species into the site and should therefore be controlled.

### **5.6 Area 6 - Inundation grassland**

***Current Ecological Value:***

MEDIUM: Although artificial in nature as part of the attenuation for the Sustainable Urban Drainage Scheme (SUDS), this area provides a habitat that is unusual in a naturally occurring state. As such it supports a flora that is able to support intermittent, rainfall dependent, shallow inundation. The plant community is different to all other areas of the site, including some species from the neighbouring flower-rich grassland (e.g. oxeye daisy, bird's-foot trefoil), but also including a number of species specific to the area (e.g. common spike-rush, hoary ragwort). The area has some bird interest (e.g. breeding willow warbler), and was the area where a single harvest mouse nest was found. It has some invertebrate interest, and further investigation of other taxa may show it to be important for a number of specialised species.

***Potential Ecological Value:***

MEDIUM/ HIGH: This area is very susceptible to sallow encroachment, and the biggest challenge will be to maintain the open character of much of the area. A number of enhancement measures are identified (see 6.6).

***Sensitivity to access:***

This area is reasonably resilient to access, although unattractive to most visitors particularly following a rainfall event when the ground retains shallow flooding for a number of days.

### **5.7 Area 7 - Balancing pond**

***Current Ecological Value:***

MEDIUM: The interest of this area lies in the fact that it currently provides the only substantial area of standing water on the site. It is clearly important for a diverse dragonfly and damselfly assemblage and may hold other aquatic invertebrate interest. It is visited by a number of bird species, although this may be more significant at quieter times of day such as dawn and dusk. It may also be important for nocturnal visiting mammals, particularly bats.

***Potential Ecological Value:***

MEDIUM: The pond will always be compromised to a degree by its water quality, being the recipient of eutrophic and polluted water from the SUDS. Its value may also be compromised by the introduction of fish that has taken place, which may have further impacts on the water quality and the invertebrate assemblage. A number of enhancement measures are identified (see 6.7).

***Sensitivity to access:***

It is not appropriate for access into the pond itself, but it provides an obvious draw for people visiting the site. The margins of the pond are resilient to access.

### **5.8 Area 8 - Roadside Fen**

***Current Ecological Value:***

MEDIUM: This floodplain fen is important in providing undisturbed wetland in connectivity with the river. The water mint, hogweed and meadowsweet in particular provide nectaring sites for insects, and the fen itself supports a number of invertebrates not found elsewhere on the site. Further investigation of other invertebrate taxa may well indicate other important species groups. It provides feeding and resting areas for roe deer, may support a harvest mouse population, and is probably an important feeding area for bats. It is not particularly important for breeding birds, but may hold some interest in winter especially when flooded.

***Potential Ecological Value:***

MEDIUM/ HIGH: The potential value in this area lies in sympathetic vegetation and water level management. This may provide conditions for a number of more scarce wetland plants (e.g. marsh orchids) that are not currently able to compete with the rank grassland/ fen and litter levels. A number of enhancement measures are identified (see 6.8).

***Sensitivity to access:***

This area, together with the river itself (Area 16) and other areas of floodplain fen, grassland and woodland (Areas, 9, 10 and 11) are the most sensitive areas to access on the site. This relates primarily to the disturbance of mammals (roe deer and otter), but also to the potential conflicts with management. It is currently unattractive and difficult to access and therefore not much used. Some limited and directed access (e.g. through the use of a boardwalk) could be provided, but this needs to be considered in conjunction with the least sensitive areas and compatibility with future management (see 6.8).

### 5.9 Area 9 - Riverine wet woodland

***Current Ecological Value:***

MEDIUM/ HIGH: Wet woodland is a priority habitat under the UK's Biodiversity Action Plan (BAP). They can be particularly important in supporting a restricted and specialised invertebrate assemblage. The woodland plants, sanicle and ramsons were both found in this area and are localised species in a Norfolk context (Beckett & Bull, 1999). These areas will undoubtedly provide resting and feeding areas for otter from time to time, and some of the older trees may also provide nursery or hibernacula roost sites for bats.

***Potential Ecological Value:***

MEDIUM/ HIGH: Maintenance of the interest of these areas is principally through minimum intervention and low level disturbance. A number of enhancement measures are identified (see 6.9).

***Sensitivity to access:***

This area is one of those more sensitive to disturbance (see 5.8 above).

### 5.10 Area 10 - Enclosed fen

***Current Ecological Value:***

LOW/ MEDIUM: This area of enclosed floodplain fen/ grassland holds similar interest to Areas 8 and 11, although in parts it appears drier than the other two blocks. It is undisturbed and the shelter provided by the surrounding wet woodland means that it is attractive to insects.

***Potential Ecological Value:***

MEDIUM/ HIGH: See 5.8. A number of enhancement measures are identified (see 6.10).

***Sensitivity to access:***

See 5.8.

### 5.11 Area 11 - Eastern fen

***Current Ecological Value:***

MEDIUM: This area is very similar to Area 8 (see 5.8), and contains similar features of interest. In parts, the fen goes right to the river channel and therefore provides conditions for a number of plants that are only found in the immediate environs of the river. An occluded dyke occurs at the break of slope, and a number of cross drains historically dissected the fen. These dykes contain some plant and invertebrate interest that does not occur elsewhere on the site and may have some value for invertebrate groups such as water beetles and snails.

***Potential Ecological Value:***

MEDIUM/ HIGH: See 5.8. Some restoration of the dyke network, together with sympathetic water level management may be particularly key to improving the value of this area. A number of enhancement measures are identified (see 6.11).

***Sensitivity to access:***

See 5.8.

### 5.12 Area 12 - Rank grassland/ scrub

***Current Ecological Value:***

LOW/ MEDIUM: This area is one of the least interesting on the site, largely dominated by species-poor, rank grassland, areas of nutrient-enriched vegetation (e.g. nettles, cleavers, brambles) and scrub. The more diverse areas are where the soils are less enriched or where grazing has occurred. It

provides conditions for some generally widespread invertebrate species that mostly occur elsewhere on the site and is probably important for small mammals (and hence, their predators).

***Potential Ecological Value:***

LOW/ MEDIUM: The future value of this area will largely be determined by the ability to reduce nutrients through sympathetic grazing or cutting management, or through measures such as localised turf-stripping. A number of enhancement measures are identified (see 6.12).

***Sensitivity to access:***

This area is very resilient to access and could be the focus for enhanced access facilities (e.g. community orchard).

### 5.13 Area 13 - Western woodland

***Current Ecological Value:***

MEDIUM: The present value of the valley-side woodland is similar to Area 3 (see 5.3), although on this side of the road this grades into wet woodland dominated by alder in the floodplain. The wet woodland is largely dominated by nettle in the ground flora, although small teasel is not infrequent.

***Potential Ecological Value:***

MEDIUM: Maintenance of the woodland is largely minimum intervention, and should aim over the long-term to encourage a more diverse age structure, dead wood component and removal of non-native species. It may be appropriate to open up and restore the woodland ponds, but this would be a significant undertaking and the potential benefits would need to be established before proceeding. A number of enhancement measures are identified (see 6.13).

***Sensitivity to access:***

The woodland has high resilience to access. However, the woodland towards the river is likely to be used as a resting up area by otter at least occasionally and therefore should remain largely undisturbed. Much of the woodland is currently difficult to access and improvements could be made, including restricted access to the river where appropriate.

### 5.14 Area 14 - Western fen

***Current Ecological Value:***

LOW/ MEDIUM: This fen appears more enriched than the areas to the east of the road, but holds similar value (see 5.8, 5.11).

***Potential Ecological Value:***

MEDIUM: It will be inappropriate to graze this area due to its size and isolation from other open areas, so cutting management is likely to be necessary to maintain its interest. A number of enhancement measures are identified (see 6.14).

***Sensitivity to access:***

Access through this area would be difficult due to the nature of the vegetation, but access on the edge of the area would provide additional variability of landscape for visitors.

### 5.15 Area 15 - Sallow scrub

***Current Ecological Value:***

LOW/ MEDIUM: There is very little current ecological value where the willow canopy is closed and the ground flora is poor. The glades and other open areas, or areas of younger scrub are more beneficial, providing good sheltered conditions for insects, and some habitat for breeding birds associated with scrub. This was the only area where carline thistle was found.

***Potential Ecological Value:***

MEDIUM/ HIGH: The future value of this area principally relates to reducing the level of scrub, providing continuous grassland connectivity, and improving the age structure of the scrub from grassland through to woodland (where appropriate). The area could then have significant value for invertebrates, birds and mammals. A number of enhancement measures are identified (see 6.15).

***Sensitivity to access:***

This area is resilient to access, although some areas should be kept with minimum disturbance to benefit mammal species such as roe deer and badger.

**5.16 Area 16 - River channel**

***Current Ecological Value:***

HIGH: The River Tud is one of the least modified by anthropogenic changes within Norfolk. As such, it provides high quality habitat for riverine invertebrates, fish and otter. The stretch running on the edge of the 'Country Park' holds good populations of bullhead and white-clawed crayfish, and some brook lamprey, all species for which the River Wensum is designated a SAC under the European Habitats' Directive. The water-crowfoot beds in the faster flowing sections is also an Annex 1 habitat for which the Wensum is designated an SAC. Good quality habitat provides conditions suitable for kingfisher and grey wagtail.

***Potential Ecological Value:***

HIGH: Maintenance of the river channel is principally dependent on maintaining and improving water quality on site and upstream. Any opportunity to improve the quality of point source or diffuse pollution entering the river should be taken. A number of enhancement measures are identified (see 6.16).

***Sensitivity to access:***

Access to the river should largely be restricted, to minimise disturbance to otter and other mammals. It would be appropriate to open up a short section of the river bank to access in a suitable location.

## 6. Management Recommendations

The following section makes management recommendations for each area of the site. In many cases the management actions are necessary to maintain/ improve the ecological value of the site, in some cases they are desirable, and in other cases they are possibilities (this distinction should be clear within the relevant section). It will be necessary to carry out further work before some management actions are enacted, such as the need for topographic/ hydrological survey prior to restoration of floodplain dykes, or the restoration of the woodland ponds.

The future management of the site should be considered in the wider context of its role within the local community and the range of issues that need to be considered, as captured in the checklist prepared by Friends of the Tud Valley (Newby, 2014). A number of the management actions, such as the creation of an orchard, the maintenance of the 'bee banks', and a proportion of the annual scrub clearance, are ideally suited to community involvement.

The overriding imperative of management at Queen's Hills 'Country Park' is to maintain the existing areas of flower-rich grassland/ fen, and to significantly improve connectivity between these areas across the whole site. A surprising proportion of the site has seen its ecological value diminished over the last 10-15 years by scrub invasion and unsympathetic tree planting. It is critical that this is reversed in order to preserve the considerable value of the site into the future.

Opportunities should be sought wherever possible to improve the experience of people visiting the site, where this is compatible with the nature conservation interest and management operations. This could include increasing the range of activities available to visitors.

Table 11 attempts to provide an estimate of the likely capital and maintenance costs of management on the site, although this is not exhaustive. Future management costs may be reduced if there was significant voluntary input, but many of the tasks will also require specialist input. The costs do not include those associated with the maintenance of the SUDS. The costs are intended as an indicative guide to the future managers of the site, but they will need to ascertain for themselves their future liability.

In procuring future management security in these situations, 'The Land Trust' provides a very helpful model (The Land Trust, 2014) as a charity set up specifically to secure the long-term management of public open spaces. This generally involves securing an 'in perpetuity' (usually defined as a period of 50-80 years) endowment to secure the sustainable management of the site into the future. Other options involve income generation or renewable energy projects, all designed to secure inflation-linked contributions to the annual management costs for that period of time, as well as to cover a proportion of the capital costs. On this basis, using the costs detailed in Table 11 and subject to a more comprehensive assessment of costs and future income sources, it is estimated that an appropriate endowment for Queen's Hills 'Country Park' would be in the order of £2m to £4m. The experience and involvement of The Land Trust in securing and delivering the future management of Queen's Hills 'Country Park' would be highly beneficial.

**Table 11 - Assessment of Potential Management Costs**

Management Action	Basis of costs	Cost estimate/ £
<b>CAPITAL COSTS*<sup>1</sup></b>		
Scrub clearance - Area 4	5ha x 80% @ £7,000/ha	28,000
Scrub clearance - Area 6	0.5ha x 40% @ £7,000/ha	1,400
Scrub clearance - Area 15	2.2ha x 60% @ £7,000/ha	9,100
Fencing - floodplain	1,300m. @ £8.50/m	11,050
Fencing - dry grassland	1,250m. @ £8.50/m	10,625
Grazing infrastructure (corrals, drinking)	2 corrals + 2 drinking	5,000
Floodplain topographic/ hydrological survey		5,000
Woodland pond topographic/ hydrological survey		5,000
Dyke restoration, water control and wetland features	1,100m @ £2.50/m + water control	5,750

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Access infrastructure (paths, access points, etc.)		10,000
Interpretation (panels, leaflets)	10 panels @ £500/ each; 1,000 leaflets	6,000
Woodland management (largely health and safety)	10 days @ £300/ day	3,000
Bird boxes (owls/ kestrel)	4 @ £500/ each	2,000
Bee banks	10 @ £200/ each	2,000
Orchard creation	50 trees @ £20/tree	1,000
Equipment* <sup>2</sup>		30,000
<b>Total estimated capital</b>		<b>134,925</b>
<b>ANNUAL COSTS*<sup>3</sup></b>		
Scrub clearance	1ha @ £5,000/ha	5,000
Mowing * <sup>4</sup>	8ha @ 3ha/year @ £275/ha	825
Grazing (dry grassland) * <sup>4</sup>	8ha @ £200/ha	1,600
Grazing (floodplain grassland)	6ha @ £260/ha	1,560
Woodland management	10 days @ £300/ day	3,000
Wardening* <sup>5</sup>	0.5 FTE (2.5 - 3 days/ week)	25,000
Day to day access management (litter, dog faeces, etc.)	2 hours/ week x 52 x £20/hour	2,080
Non-native species control	2 days @ £300/day	600
Events	10/year x £500/ event	5,000
SUDS maintenance	?	?
Capital replacement costs	c.£75,000 assets over 15 year lifespan	5,000
<b>Total estimated annual</b>		<b>49,665</b>

\*<sup>1</sup> Capital costs are based on current best estimates for this type of site, and would need to be confirmed through contractor quotes.

\*<sup>2</sup> Set up equipment for the management of the site would be likely to include a reciprocating cutter & eco bailer and a range of power and hand tools for professional and voluntary use on the site.

\*<sup>3</sup> Annual costs are based on payment rates through Higher Level Stewardship, and estimated day rates for particular activities, and would need to be confirmed through contractor quotes.

\*<sup>4</sup> The balance of mowing and grazing in the dry grassland areas will be determined by the management regime adopted.

\*<sup>5</sup> Wardening would involve site management, volunteer supervision, biological recording, public engagement, event organisation; costs include support costs such as vehicle hire/ use, employer and administration costs.

## 6.1 Area 1 - Short-turf grassland

**Management objectives:** The areas of short-turf grassland should be managed to encourage the plants that are principally located in these areas, and particularly the thermophilous insects that benefit from these warm sites. They should be maintained largely free of scrub and contain a proportion of bare ground. They should be enhanced through the provision of largely plant-free banks for breeding solitary bees and wasps.

### Management actions:

1. Manage in conjunction with Area 2 either by cutting or grazing. If cutting, this should be on a biennial rotation in several patches and take place after the majority of plants have flowered and set seed in August/ early September. Arisings must be removed. If grazing, this should be extensive with hardy sheep breeds and again should be after the majority of flowering is complete (August to November) and/or in the early spring (March/ April).
2. Remove scrub by cutting and treating with an appropriate herbicide to maintain a scrub component of less than 5%. The retained scrub should be located next to adjacent woodland/ taller scrub in Areas 3, 4 and 12.
3. Create several 'bee banks' to create breeding habitat for solitary, mining Hymenoptera (bees and wasps). These species are often specialised and also have a range of attendant parasitic insects. This site could be very important and the juxtaposition of high quality breeding habitat and flower-rich grassland would be highly beneficial. There should be about 6 banks cut in Areas 1 and 2 using an excavator, be up to 5 metres wide and should provide a range of slopes, aspects and substrates. They should be re-cut or new ones created when they become vegetated. Some excellent examples of this habitat can be found near the 'butterfly area' to the north of Queen's Hills (see Appendix 2 - photos 19 - 21).

## 6.2 Area 2 - Flower-rich grassland

**Management objectives:** The areas of flower-rich grassland should be managed to encourage this important nectar source with a long flowering season, and particularly the wide range of invertebrates that benefit from these warm sites, good nectar source and important range of larval foodplants. They should be maintained largely free of scrub and contain a proportion of bare ground. They should be enhanced through the provision of largely plant-free banks for breeding solitary bees and wasps.

**Management actions:**

Adopt the same management actions as Area 1 (see 6.1).

## 6.3 Area 3 - Eastern Snakes' Hills woodland

**Management objectives:** Maintain the woodland through minimum intervention for the benefit of birds, bats and woodland invertebrates. Improve the age structure where appropriate, woodland edge transitions, dead wood component, and removal of non-native species.

**Management actions:**

1. Remove trees and limbs only where they are a risk for the health and safety of visitors accessing the site; retain cut timber as dead wood.
2. Allow age structure to develop naturally when gaps are created in the canopy through falling trees, or where non-native species are removed.
3. Retain all fallen and standing dead wood where this does not pose a health and safety risk.
4. Manage the woodland edge to maintain a good transition between high forest, scrub and grassland. These woodland edges are often highly beneficial to birds, insects and feeding bats. It may be appropriate to carry out rotational coppicing of the scrub edge (5-10 metre width) to maintain this transition over time.
5. Consider ring-barking a small number of trees (e.g. sycamore) to create more standing dead wood and open up the canopy.

## 6.4 Area 4 - Snakes' Hills Pit

**Management objectives:** Restore the natural open grassland and scrub habitat by removal of a high proportion of the planted trees, particularly the non-native species/ provenances. Create continuous grassland connectivity between the south-facing slope at TG154121 and Area 2. Maintain the steeper south-facing slope and part of the west facing slope adjacent to Snakes' Hills wood largely free of scrub. Retain woodland on the historic link between Snakes' Hills and Queen's Hills woods, except for the grassland link between Area 4 and Area 2, which should be at least 30 metres wide. Retain the majority of the rest of the woodland component adjacent to the mature woodland blocks to the east and west of this area. These objectives will significantly improve the area for breeding birds, insects, reptiles and mammals (including bats).

**Management actions:**

1. Remove the majority of the planted trees and shrubs from this whole area, such that 75-80% of the area is open. All non-native species/ provenances should be removed. Trees should be cut and treated with an appropriate herbicide, with all arisings removed. Some cut material could be left as 'habitat piles' in the retained scrub edge. Woodland to be largely retained adjacent to the mature woodland blocks to east and west and on the historic link between these two blocks. The woodland edge should be sinuous and not linear to provide sheltered bays with a range of microclimates.
2. The south-facing slope at TG154121 and the northern half of the west-facing slope at TG155120 should be maintained largely free of scrub, with no more than 5-10% scrub component.

3. Once open, identify an appropriate cutting/ grazing regime to maintain the open character (see 6.1). If cutting, it may be appropriate to have a longer rotation than Areas 1 and 2.
4. Once open, create four 'bee banks' on both the south-facing and west-facing slopes (see 6.1).
5. Once open, consider a coppice rotation of the trees/ scrub on the transition from grassland to woodland (5-10 metre width) to provide good woodland edge habitat.
6. Install a pole-mounted kestrel nesting box in a suitable location towards the woodland/ scrub edge.

#### **6.5 Area 5 - Pumping station disturbed ground**

**Management objectives:** It may be appropriate to develop this area either as part of the access infrastructure, or through habitat creation (e.g. community orchard). The primary objective should be to remove any aggressive non-native species (e.g. Canadian goldenrod) from this area to stop them from spreading to the rest of the site.

**Management actions:**

1. The desired use of this area will determine the appropriate management actions. If it is to be retained in its present state, then some ongoing disturbance may be appropriate to maintain conditions for the current range of ruderal plants found in the area.
2. Remove aggressive non-native species from the area, including the use of appropriate herbicides if necessary.
3. Prompt removal of any fly tipping, particularly plant material that may lead to undesirable species being introduced to the site.

#### **6.6 Area 6 - Inundation grassland**

**Management objectives:** Maintain the largely open character of this area, to the benefit of the unusual plant assemblage and associated invertebrates. Maintain some scrub for the benefit of breeding/ migrant birds, deer cover, etc.

**Management actions:**

1. Maintain willow and other scrub at no more than 25% of the area. Scrub should be cut and treated with an appropriate herbicide; all arisings should be removed. It will be necessary to rotationally cut and treat or coppice retained scrub to maintain the age structure and to prevent the scrub getting too large.
2. Consider rotational cutting or grazing of the vegetation in conjunction with Areas 1 and 2 (see 6.1).
3. Consider whether it is possible to create shallow depressions (up to c.18" deep and 20-30m<sup>2</sup>) to retain some areas of open water for longer. This will provide additional habitat for invertebrates and amphibians.
4. Install a pole-mounted barn owl nesting box in a suitable location.

#### **6.7 Area 7 - Balancing pond**

**Management objectives:** Maintain the pond for the benefit of aquatic invertebrates and feeding birds/ bats. Consider measures to improve water quality and reduce the filamentous algae dominance.

**Management actions:**

1. Consider whether the introduced chub population is adversely impacting on the aquatic invertebrate assemblage and take action as appropriate.
2. Consider measures to reduce the nutrient status of the water and reduce algal dominance (e.g. barley straw, planting of appropriate local water plants).

3. Consider the creation of an artificial sand martin nesting bank, as sand martins would have been a key feature of the area during the sand and gravel works and now have significantly reduced local breeding habitat.

#### 6.8 Area 8 - Roadside Fen

**Management objectives:** Restore the fen to improve species-richness, vegetation structure, water levels and reduction in litter. The area has been unmanaged for some time and the vegetation has become rank and dominated by certain species. Consider restoration of dykes to improve open water habitat and facilitate improved water level management. Management should be aimed at improving habitat for wetland plants, fen invertebrates, wintering birds and mammals (feeding bats, harvest mice, water vole, deer).

**Management actions:**

1. Reintroduce cattle grazing to the floodplain fen in Areas 8, 10 and 11 and graze in conjunction with part of Area 12 (south of the path). Grazing should be very extensive (4-5 animals initially) and use an appropriate breed (e.g. Highlands). Grazing can be throughout the year, although animals should be removed if excessive poaching occurs in the floodplain. Reintroduction of grazing will require the installation of stock fencing, corral, drinking provision, and access (such as dyke culverts).
2. If cattle grazing is not reintroduced, the fen will need to be rotationally cut (every 4-5 years) and the arisings removed.
3. Carry out a topographic and hydrological study of the floodplain to consider the restoration of the dyke network and the installation of water control to improve retention of water in the floodplain and the creation of open water habitat within restored dykes.
4. Following the study above, reinstate the dyke network across the floodplain and the installation of water control structures. This will need to take into consideration access for cattle, the current value of the occluded dykes (i.e. whether some of these should be retained), the placing of spoil, and the creation of berms or other wetland features on the dyke edges or within the fen. This work should be carried out prior to the reintroduction of grazing/ cutting.

#### 6.9 Area 9 - Riverine wet woodland

**Management objectives:** Wet woodland management should be directed at minimising disturbance.

**Management actions:**

1. Manage by minimum intervention to encourage diverse age structure and dead wood component over time.
2. It is likely that part of the wet woodland would be incorporated within the grazing unit if grazing is reintroduced to the site.

#### 6.10 Area 10 - Enclosed fen

**Management objectives:** Adopt the same management objectives as Area 8 (see 6.8).

**Management actions:**

Adopt the same management actions as Area 8 (see 6.8).

#### 6.11 Area 11 - Eastern fen

**Management objectives:** Adopt the same management objectives as Area 8 (see 6.8).

**Management actions:**

Adopt the same management actions as Area 8 (see 6.8). In addition:

1. consider an access point down to the river, probably at the eastern boundary outside of the grazing unit.
2. Install a pole-mounted barn owl nesting box in a suitable location towards the eastern boundary.

#### 6.12 Area 12 - Rank grassland/ scrub

**Management objectives:** Manage the rank grassland to encourage an improvement in species-richness and vegetation structure, and to reduce patches of enriched vegetation (e.g. nettles, cleavers, bramble). Reduce the sallow scrub component between Area 12 and Area 2 to provide grassland connectivity in a number of places between the two areas. Management should be directed towards encouraging an invertebrate assemblage associated with a varied vegetation structure grading into scrub, and the small mammal population.

**Management actions:**

1. If cattle grazing is reintroduced to the site, graze the area south of the footpath in conjunction with the floodplain.
2. If sheep grazing is introduced to the site, graze the area north of the footpath in conjunction with Areas 1, 2, (possibly 4) and 6.
3. If grazing is not introduced, it will be necessary to introduce a cutting rotation and scrub roguing to reduce nutrient levels and keep scrub at appropriate levels.
4. Limit scrub in this area to its present location adjacent to Area 2, but create 2-3 linkages of 20-30 metres through to Area 2 to facilitate invertebrate movement. It may also be necessary to rotationally cut and treat and/or coppice this scrub block to prevent the scrub/ woodland from becoming too high and shade bearing.
5. Consider the removal of turf and top soil in a number of locations throughout Area 12 to reduce nutrient levels and to improve variability in the vegetation composition and structure. These patches could be of varying sizes between 30 and 100m<sup>2</sup> and could be located in the areas currently dominated by nettles, etc..
6. Eradicate Canadian goldenrod from this area by the application of an appropriate herbicide.

#### 6.13 Area 13 - Western woodland

**Management objectives:** Maintain the woodland through minimum intervention for the benefit of birds, bats and woodland invertebrates. Improve the age structure where appropriate, woodland edge transitions, dead wood component, and removal of non-native species.

**Management actions:**

Adopt the same management actions as Area 3 (see 6.3). The woodland edge transitions in this area are largely to the north and east of the block. In addition:

1. Consider restoration of the woodland ponds. This would involve substantial work and should be undertaken after consideration of the potential ecological benefits. It would also require a significant removal of the canopy to allow sufficient light into the ponds.
2. Access improvements should be considered through the drier woodland, and also down through the wet woodland towards the river. It may be appropriate to introduce a short circular route down to the river, along the river and back up slope into the drier woodland. Disturbance to otter and badger in particular will need to be taken into account.
3. Consider whether it would be a suitable area to create an artificial otter holt.

#### 6.14 Area 14 - Western fen

**Management objectives:** Maintain as tall-herb fen, but aim to improve species-richness, vegetation structure, and reduced litter levels.

**Management actions:**

1. Manage as two blocks by rotational cutting on a 4-5 year rotation. Cut and treat encroaching scrub as necessary.

**6.15 Area 15 - Sallow scrub**

**Management objectives:** Restore to a more natural open grassland and scrub habitat by removal of a reasonable proportion of the sallow scrub. Create continuous grassland connectivity through this area between Area 12 and Area 4. Retain scrub connectivity and particularly towards Snakes' Hills Woods to provide the woodland to scrub and grassland transition. In the areas of retained scrub improve the age structure, reduce canopy cover and provide sheltered inter-connected glades. These objectives will significantly improve the area for breeding birds, insects, reptiles and mammals (including bats and badgers).

**Management actions:**

1. Remove the majority of sallow scrub from this whole area, such that 75-80% of the area is open. Trees should be cut and treated with an appropriate herbicide, with all arisings removed. Some cut material could be left as 'habitat piles' in the retained scrub edge. Scrub should principally be retained towards Snakes' Hills Woods and the eastern boundary of the site. However, the scrub retention in this area should be patchy to provide an interesting mosaic of interconnected grassland areas (essentially wide rides and glades) and interconnected scrub areas. Initially scrub clearance should focus on the edges of existing open areas to increase the size of these areas. Once the desired balance of open and scrub areas is achieved, management should focus on improving the age structure of the scrub on the edges of the open areas (5-10 metre width), such that there is a transition from grassland to young scrub to mature scrub. The scrub edges should be sinuous and not linear to provide sheltered bays with a range of microclimates.
2. Once open, it may be necessary to consider a cutting/ grazing regime to maintain the open character (see 6.1). If cutting, it may be appropriate to have a longer rotation than Areas 1 and 2.
3. It may be necessary to cut and treat or carry out a coppice rotation on the retained blocks of scrub to prevent them becoming too dense. If an area is cut and treated, that area could be left open as an adjacent area is allowed to scrub up, thereby rotating the blocks of scrub over time.
4. Install a pole-mounted kestrel nesting box in a suitable location towards the woodland/ scrub edge.

**6.16 Area 16 - River channel**

**Management objectives:** Maintain the river channel and its immediate environs largely free from disturbance. Maintain the water quality within the river channel. Manage the river for the benefit of the fish and invertebrate populations (particularly those of European importance), otter, bats, kingfisher and grey wagtail.

**Management actions:**

1. Maintain the river channel largely free from disturbance, particularly to benefit otter and kingfisher. Consider introducing a short route down to the river and along the river bank in a location that is likely to minimise disturbance to sensitive mammals, and is compatible with management operations (e.g. grazing).
2. Work with the Environment Agency and others to ensure continual improvements in water quality by addressing any point source or diffuse sources of pollution within the catchment.
3. Consider the River Tud and its floodplain within any future revision of the River Wensum SSSI boundary.

## References

- Agassiz, D. J. L., Beavan, S. D. & Heckford, R. J., 2013, *Checklist of the Lepidoptera of the British Isles*, Field Studies Council, Telford.
- Asher, J., Warren, M., Fox, R., Harding, P., Jeffcote, G. & Jeffcoate, S., 2001, *The Millennium Atlas of Butterflies in Britain and Ireland*, Oxford University Press, Oxford.
- Beckett, G. & Bull, A., 1999, *A Flora of Norfolk*, Gillian Beckett, Norwich.
- Big Norwich Bat Project, 2012, unpublished presentation of initial findings, BTO/ UEA.
- British Trust for Ornithology, 2009, *Birds of Conservation Concern 3*, BTO, Thetford.
- Cham, S., Nelson, B., Parr, A., Prentice, S., Smallshire, D. & Taylor, P. (editors), 2014, *Atlas of Dragonflies in Britain and Ireland*, Field Studies Council, Telford.
- Environment Agency, 2012, *River Tud 2012: Fisheries report*, EA, Norwich.
- Gardiner, A.J., 2012, visible Autumn Migration over West Norwich 2003 - 2011, *Norfolk Bird & Mammal Report 2011*, Norfolk 7 Norwich Naturalists' Society, Norwich, 45, 17-28.
- Marshall, J.A. & Haes, E.C.M., 1988, *Grasshoppers and allied insects of Great Britain and Ireland*, Harley Books, Colchester.
- Newby, J., 2014, *Proposed Queen's Hills Country Park, Costessey: note prepared by the Friends of the Tud Valley*, unpublished note.
- Richmond, D., 2001, *Grasshoppers and allied insects of Norfolk*, Norfolk & Norwich Naturalists' Society, Norwich.
- National Soil Resources Institute, 2014, *Full Soils Site Report for location 615694E, 312036N, 3km x 3km*, National Soil Resources Institute, Cranfield University; accessed via <https://www.landis.org.uk/sitereporter/>.
- Norfolk County Council, 2014, Historical maps of Norfolk, Norfolk County Council, Norwich; accessed via <http://www.historic-maps.norfolk.gov.uk/>
- Orthoptera Recording Scheme, 2014, *Orthoptera & allied insects recording scheme*; accessed via <http://www.orthoptera.org.uk/>
- Stace, C., 2010, *New Flora of the British Isles: third edition*, Cambridge University Press, Cambridge.
- Taylor, M. & Marchant, J.H., 2011, *The Norfolk Bird Atlas: summer and winter distributions 1999 - 2007*, BTO, Thetford.
- The Land Trust, 2014, *Public Sector: How we can help you*, The Land Trust, Warrington.
- Watts, B.R. & McIlwrath, B.J., 2002, *Millenium atlas of Norfolk Butterflies*, Butterfly Conservation, Norfolk.

## Appendix 1 - Plants recorded at Queen's Hills

Taxonomy follows Stace, 2010.

### Trees and shrubs - 23

Species	Common name	Areas where species recorded
<i>Acer pseudoplatanus</i>	Sycamore	3, 4, 13
<i>Aesculus hippocastanum</i>	Horse-chestnut	13
<i>Alnus glutinosa</i>	Alder	4, 9, 13
<i>Betula pendula</i>	Silver birch	3, 4, 12, 13, 15
<i>Buddleja davidii</i>	Buddleja	3, 4, 5, 15
<i>Carpinus betulus</i>	Hornbeam	3, 12
<i>Castanea sativa</i>	Sweet chestnut	3, 4
<i>Corylus avellana</i>	Hazel	4, 13
<i>Crataegus monogyna</i>	Hawthorn	3, 4, 5, 9, 12, 13
<i>Cytisus scoparius</i>	Broom	4, 5
<i>Fagus sylvatica</i>	Beech	13
<i>Fraxinus excelsior</i>	Ash	3, 4, 5, 9, 13
<i>Ilex aquifolium</i>	Holly	3, 13
<i>Ligustrum vulgare</i>	Wild privet	3
<i>Prunus spinosa</i>	Blackthorn	12
<i>Prunus sp.</i>	Cherry sp.	4
<i>Quercus robur</i>	Pedunculate oak	3, 4, 13
<i>Salix cinerea</i>	Sallow	3, 4, 5, 6, 12, 13, 15
<i>Salix sp.</i>	Willow sp. (thin-leaved)	6, 13
<i>Salix viminalis</i>	Osier	6
<i>Sambucus nigra</i>	Elder	4, 9, 13
<i>Sorbus aucuparia</i>	Rowan	*
<i>Ulex europaeus</i>	Gorse	4

### Grasses, sedges, rushes and ferns - 36

Species	Common name	Areas where species recorded
<i>Agrostis capillaris</i>	Common bent-grass	4, 10, 11
<i>Agrostis stolonifera</i>	Creeping bent-grass	6, 8, 9, 13, 15
<i>Agrostis vinealis</i>	Brown bent-grass	2, 12
<i>Alopecurus geniculatus</i>	Marsh foxtail	6
<i>Arrhenatherum elatius</i>	False oat-grass	2, 5, 10, 11, 12, 13, 15
<i>Brachypodium sylvaticum</i>	False brome	13
<i>Carex acutiformis</i>	Lesser pond-sedge	8
<i>Carex elata</i>	Tufted-sedge	8
<i>Carex disticha</i>	Brown sedge	11
<i>Carex hirta</i>	Hairy sedge	11
<i>Carex nigra</i>	Common sedge	4
<i>Carex remota</i>	Remote sedge	13
<i>Carex viridula oedocarpa</i>	Common yellow sedge	15
<i>Cynosurus cristatus</i>	Crested dog's-tail	1, 2
<i>Dactylis glomerata</i>	Cock's-foot	2, 3, 4, 5, 10, 11, 12, 13, 15
<i>Deschampsia cespitosa</i>	Tufted hair-grass	8, 11
<i>Dryopteris dilatata</i>	Broad buckler-fern	13, 15
<i>Dryopteris felix-mas</i>	Male fern	13
<i>Eleocharis palustris</i>	Common spike-rush	6
<i>Elymus repens</i>	Common couch-grass	15
<i>Festuca arundinacea</i>	Tall fescue	6, 8
<i>Festuca rubra</i>	Red fescue	1, 2, 4, 5, 6, 12
<i>Glyceria fluitans</i>	Floating sweet-grass	6, 11
<i>Glyceria maxima</i>	Reed sweet-grass	8, 10, 11
<i>Helictotrichon pratense?</i>	Meadow oat-grass?	2
<i>Holcus lanatus</i>	Yorkshire fog	1, 2, 4, 5, 6, 10, 11, 12, 13, 15
<i>Juncus conglomeratus</i>	Compact rush	10
<i>Juncus effusus</i>	Soft rush	6, 11, 13
<i>Juncus inflexus</i>	Hard rush	6
<i>Lolium perenne</i>	Perennial rye-grass	5, 6

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<i>Phalaris arundinacea</i>	Reed canary-grass	8, 11, 14
<i>Phleum pratense</i>	Timothy	6
<i>Phragmites australis</i>	Common reed	8
<i>Poa trivialis</i>	Rough meadow-grass	1, 2, 4, 12
<i>Pteridium aquilinum</i>	Bracken	2, 4
<i>Vulpia bromoides</i>	Squirreltail fescue	2, 5

### Herbs - 170

Species	Common name	Areas where species recorded
<i>Achillea millefolium</i>	Yarrow	1, 2, 6, 12
<i>Agrimonia eupatoria</i>	Agrimony	*
<i>Alliaria petiolata</i>	Garlic mustard	3, 13
<i>Allium ursinum</i>	Ramsons	9
<i>Anagallis arvensis</i>	Scarlet pimpernel	5, 15
<i>Anchusa arvensis</i>	Bugloss	1
<i>Angelica sylvestris</i>	Wild angelica	6, 8, 11, 15
<i>Anthriscus sylvestris</i>	Cow parsley	3, 8, 9, 10
<i>Arctium lappa</i>	Greater burdock	11, 14
<i>Arctium minus</i>	Lesser burdock	11, 13
<i>Artemisia vulgaris</i>	Mugwort	3, 4, 5, 6, 12, 15
<i>Ballota nigra</i>	Black horehound	4
<i>Barbarea verna/ intermedia</i>	American/Med-flowered winter-ress	6
<i>Bellis perennis</i>	Daisy	2
<i>Berula erecta</i>	Lesser water-parsnip	16
<i>Calystegia sepium</i>	Hedge bindweed	8, 14
<i>Carlina vulgaris</i>	Carlina thistle	15
<i>Centaurea cyanus</i>	Cornflower	5
<i>Centaurea nigra</i>	Black knapweed	2, 5, 6
<i>Centaureum erythraea</i>	Common centaury	2, 5, 12, 15
<i>Cerastium fontanum</i>	Common mouse-ear	2, 3, 15
<i>Chaerophyllum temululum</i>	Rough Chervil	3
<i>Chamerion angustifolium</i>	Rosebay willowherb	4, 15
<i>Chenopodium album</i>	Fat-hen	5
<i>Chenopodium sp.</i>	Goosefoot sp.	5
<i>Circaea lutetiana</i>	Enchanter's-nightshade	13
<i>Cirsium arvense</i>	Creeping thistle	2, 3, 4, 5, 6, 8, 10, 11, 12, 13, 14, 15
<i>Cirsium palustre</i>	Marsh thistle	8, 10, 11, 12
<i>Cirsium vulgare</i>	Spear thistle	15
<i>Conium maculatum</i>	Hemlock	5
<i>Conyza canadensis</i>	Canadian fleabane	1
<i>Crepis vesicaria</i>	Beaked hawk's-beard	2, 3
<i>Dactylorhiza fuchsii</i>	Common-spotted orchid	*
<i>Daucus carota</i>	Wild carrot	2, 4, 5, 6
<i>Dianthus carthusianorum</i>	Carthusian pink	2
<i>Digitalis purpurea</i>	Foxglove	13
<i>Dipsacus fullonum</i>	Wild teasel	6, 15
<i>Dipsacus pilosus</i>	Small teasel	11, 14
<i>Echium vulgare</i>	Viper's-bugloss	4, 5
<i>Epilobium hirsutum</i>	Great willowherb	3, 5, 6
<i>Epilobium montanum</i>	Broad-leaved willowherb	5, 11, 12, 15
<i>Epilobium parviflorum</i>	Hoary willowherb	11
<i>Equisetum fluviatile</i>	Water horsetail	11
<i>Equisetum palustre</i>	Marsh horsetail	6, 8
<i>Erigeron acer</i>	Blue fleabane	4
<i>Erodium cicutarium</i>	Common stork's-bill	1, 2, 5
<i>Eupatorium cannabinum</i>	Hemp-agrimony	13, 14
<i>Euphorbia helioscopia</i>	Sun spurge	5
<i>Fallopia convolvulus</i>	Black bindweed	5
<i>Filago vulgaris</i>	Common cudweed	1
<i>Filipendula ulmaria</i>	Meadowsweet	8, 9, 10, 11
<i>Fragaria vesca</i>	Wild strawberry	2, 3
<i>Fumaria officinalis</i>	Common fumitory	5
<i>Galium aparine</i>	Cleavers	3, 8, 9, 10, 11, 12, 13, 14

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<i>Galium mollugo</i>	Hedge bedstraw	2
<i>Galium palustre</i>	Marsh bedstraw	8
<i>Galium verum</i>	Lady's bedstraw	1, 2, 6
<i>Geranium dissectum</i>	Cut-leaved crane's-bill	1, 2, 5, 6, 12
<i>Geranium molle</i>	Dove's-foot crane's-bill	1, 2, 4, 5
<i>Geranium robertianum</i>	Herb robert	3, 9, 13
<i>Geum urbanum</i>	Wood avens	3, 9, 13
<i>Glechoma hederacea</i>	Ground ivy	3, 4, 12, 13, 15
<i>Hedera helix</i>	Common ivy	3, 9, 13
<i>Helianthus annuus</i>	Sunflower	5
<i>Heracleum sphondylium</i>	Hogweed	3, 4, 5, 8, 10, 11, 12, 13, 14, 15
<i>Hyacinthoides non-scripta</i>	Bluebell	*
<i>Hypericum perforatum</i>	Perforate St John's-wort	1, 2, 3, 4, 5, 12, 15
<i>Hypericum tetrapterum</i>	Square-stalked St John's-wort	6
<i>Hypochaeris glabra</i>	Smooth cat's-ear	12
<i>Hypochaeris radicata</i>	Comon cat's-ear	1, 2, 5, 12
<i>Impatiens parviflora</i>	Small balsam	13
<i>Inula conyzae</i>	Ploughman's-spikenard	2, 12, 15
<i>Iris psedacorus</i>	Yellow iris	7
<i>Knautia arvensis</i>	Field scabious	2
<i>Lactuca virosa</i>	Great lettuce	12
<i>Lamium album</i>	White dead-nettle	8
<i>Lapsana communis</i>	Nipplewort	8, 13
<i>Lathyrus pratensis</i>	Meadow vetchling	10, 11, 12
<i>Leontodon autumnalis</i>	Autumn hawkbit	1, 2, 12, 15
<i>Leucanthemum vulgare</i>	Oxeye daisy	1, 2, 5, 6, 15
<i>Linaria vulgaris</i>	Common toadflax	5
<i>Lotus corniculatus</i>	Common bird's-foot-trefoil	2, 5, 6, 11, 12
<i>Malva moschata</i>	Musk-mallow	2, 5
<i>Malva sylvestris</i>	Common mallow	5
<i>Matricaria discoidea</i>	Pineappleweed	5, 6
<i>Matricaria recutita</i>	Scented mayweed	1, 5
<i>Medicago lupulina</i>	Black medick	1, 2, 5, 15
<i>Medicago sativa</i>	Lucerne	4
<i>Mentha aquatica</i>	Water mint	6, 8, 10, 11, 15, 16
<i>Mentha x rotundifolia?</i>	False apple mint	11
<i>Mercurialis perennis</i>	Dog's mercury	3, 9, 13
<i>Myosotis arvensis</i>	Field forget-me-not	2, 4
<i>Myosotis laxa</i>	Tufted forget-me-not	8
<i>Myosotis scorpioides</i>	Water forget-me-not	11
<i>Myriophyllum spicatum</i>	Spiked water-milfoil	7
<i>Nuphar lutea</i>	Yellow water-lily	16
<i>Nymphaea alba</i>	White water-lily	7
<i>Odontites vernus</i>	Red bartsia	2
<i>Oenothera glazioviana</i>	Large-flowered evening-primrose	2
<i>Ophrys apifera</i>	Bee orchid	*
<i>Origanum vulgare</i>	Wild marjoram	2
<i>Papaver rhoeas</i>	Common poppy	2
<i>Pentaglottis sempervirens</i>	Green alkanet	3
<i>Persicaria sp.</i>		6
<i>Persicaria maculosa</i>	Redshank	5, 6
<i>Picris echioides</i>	Bristly oxtongue	5, 6
<i>Pilosella aurantiaca</i>	Fox-and-cubs	12
<i>Plantago lanceolata</i>	Ribwort plantain	1, 2, 4, 5, 6
<i>Plantago major</i>	Greater plantain	3, 5
<i>Plantago media</i>	Hoary plantain	1, 2
<i>Potentilla anserina</i>	Silverweed	6, 11, 13
<i>Potentilla reptans</i>	Creeping cinquefoil	4, 5, 15
<i>Primula veris</i>	Cowslip	2, 5
<i>Prunella vulgaris</i>	Selfheal	2, 4, 13
<i>Pulicaria dysenterica</i>	Common fleabane	6, 11, 15
<i>Ranunculus acris</i>	Meadow buttercup	2
<i>Ranunculus penicillatus</i>	Stream water-crowfoot	16
<i>Ranunculus repens</i>	Creeping buttercup	3, 4, 6

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<i>Ranunculus sceleratus</i>	Celery-leaved buttercup	6
<i>Reseda luteola</i>	Weld	4, 5
<i>Rhinanthus minor</i>	Yellow rattle	2
<i>Rorippa nasturtium-aquaticum</i>	Water-cress	16
<i>Rosa canina</i>	Dog-rose	9, 12
<i>Rubus fruticosus</i> agg.	Bramble	2, 3, 4, 5, 12, 13, 15
<i>Rubus idaeus</i>	Raspberry	12, 13
<i>Rumex acetosa</i>	Common sorrel	1
<i>Rumex conglomeratus</i>	Clustered dock	6, 11
<i>Rumex obtusifolius</i>	Broad-leaved dock	3, 5, 6, 11, 12
<i>Rumex sanguineus</i>	Wood dock	13
<i>Sanicula europaea</i>	Sanicle	9
<i>Schoenoplectus lacustris lacustris</i>	Bulrush	16
<i>Scrophularia auriculata</i>	Water figwort	11
<i>Sedum acre</i>	Biting stonecrop	4
<i>Sedum</i> sp.	Stonecrop sp.	4
<i>Senecio erucifolius</i>	Hoary ragwort	6
<i>Senecio jacobaea</i>	Common ragwort	2, 5, 6, 12, 15
<i>Senecio vulgaris</i>	Groundsel	5
<i>Silene latifolia</i>	White campion	2
<i>Silene dioica</i>	Red campion	2, 3, 4, 5, 8, 9, 12, 13, 14
<i>Sisymbrium officinale</i>	Hedge mustard	5
<i>Solanum dulcamara</i>	Bittersweet	11
<i>Solanum nigrum</i>	Black nightshade	5
<i>Solidago canadensis</i>	Canadian goldenrod	5
<i>Sonchus arvensis</i>	Perennial sow-thistle	15
<i>Sonchus asper</i>	Prickly sow-thistle	2, 12
<i>Sonchus oleraceus</i>	Smooth sow-thistle	4, 5
<i>Sparganium emersum</i>	Unbranched bur-reed	16
<i>Sparganium erectum</i>	Branched bur-reed	16
<i>Stachys sylvatica</i>	Hedge woundwort	3, 8, 9, 10, 11, 13
<i>Stellaria graminea</i>	Lesser stitchwort	10, 12
<i>Stellaria holostea</i>	Greater stitchwort	8
<i>Tanacetum vulgare</i>	Tansy	4, 12
<i>Taraxacum officinale</i> agg.	Dandelion	2, 3, 4, 5, 6, 15
<i>Teucrium scorodonia</i>	Wood sage	4, 13
<i>Torilis japonica</i>	Upright hedge-parsley	12, 13, 15
<i>Tragopogon pratensis</i> agg.	Goat's-beard	4, 5
<i>Trifolium arvense</i>	Hare's-foot clover	1, 2, 5
<i>Trifolium pratense</i>	Red clover	2
<i>Trifolium repens</i>	White clover	5, 6
<i>Tussilago farfara</i>	Coltsfoot	2, 3, 5, 12, 15
<i>Typha latifolia</i>	Greater reedmace	6, 7
<i>Urtica dioica</i>	Common nettle	3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15
<i>Valeriana officinalis</i>	Common valerian	8, 11
<i>Verbascum pulverulentum</i>	Hoary mullein	4
<i>Veronica chamaedrys</i>	Germander speedwell	2, 3, 4, 5, 15
<i>Veronica officinalis</i>	Heath speedwell	5
<i>Veronica serpyllifolia</i>	Thyme-leaved speedwell	6
<i>Vicia hirsuta</i>	Hairy tare	2, 3, 4, 5
<i>Vicia sativa</i>	Common vetch	1, 2, 3, 4, 5, 12, 15
<i>Vicia tetrasperma</i>	Smooth tare	4, 12

\* species recorded at Queen's Hills away from the 'Country Park' area.