Tuckmill Meadows SSSI

Botanical and vegetation survey report

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Summary

The Oxfordshire Fens Project is a wetland restoration programme run by Freshwater Habitats Trust aimed at protecting the nationally significant concentration of alkaline fen habitat in the county.

This report presents the results of a survey of the plants and vegetation of Tuckmill Meadows carried out in 2022 by Freshwater Habitats Trust. Tuckmill Meadows is a Site of Special Scientific Interest in south-west Oxfordshire notified for its fen habitat.

The survey found 42 wetland plant species, including the notable species Ragged-robin (*Silene flos-cuculi*) and Marsh Valerian (*Valeriana dioica*).

Fen covered 1.3 ha, approximately 22 % of the Site of Special Scientific Interest. Only a small area of species-rich, spring-fed fen was found. The main valley of the Pennyhooks Brook was found to support swamp and other vegetation dominated by tall emergent species. All areas of fen were coarse and dominated by a small number of competitive species, indicating lack of grazing or other disturbance.

In addition to wetland habitat, the site comprised large areas of grassland, most of which was coarse and species-poor. There was a small area of botanically richer calcareous grassland in the west of the site. In total, the survey found 146 plant species, including four notable species.

The condition of the Site of Special Scientific Interest is currently assessed by Natural England as ‘unfavourable – declining’ due to the lack of recent management. The favourable condition of site’s fen and grassland habitats is dependent on regular removal of biomass, either by grazing or mowing. The following recommendations are made to guide future management to recover the condition of the site’s vegetation:

- Continue current management of spring-fed fen, carried out by volunteers. This should aim to improve the condition of the small existing area of species-rich fen and to increase its extent.
- Due to differing hydrology, wetland in the main valley of the Pennyhooks Brook is unlikely to develop with management into the more species-rich vegetation seen in parts of the site. This area would be best be managed rotationally, but the spread of Common Reed (*Phragmites australis*) across this area should be monitored.
- Grassland will require intensive and extensive management to restore to more species-rich vegetation and enable calcareous grassland plants to spread. Spring and summer mowing would be needed to reduce the current coarse structure of the vegetation. If livestock were available to graze the site, then winter grazing could assist with this. If the site is to be grazed in summer, then management should aim to limit the availability of forage in dry areas to encourage animals to graze and disturb wetland areas.

Contents

1 Introduction

1.1 Oxfordshire Fens Project

Oxfordshire contains a remarkable number of alkaline fens, a rare type of wetland fed by springs emerging from limestone. The habitat has a distinctive vegetation with a short, open structure made up of low-growing grasses, rushes and sedges, and a diversity of wetland wildflowers, growing over mats of colourful mosses. Alkaline fen supports some of the richest plant and animal assemblages in the UK, including many rare and threatened species. Alkaline fen is a habitat listed on Annex 1 of the Habitats Directive ('7230 Alkaline fens'), and much of Europe's surviving alkaline fens are believed to be in the UK.

Freshwater Habitats Trust runs the Oxfordshire Fens Project[1], which since 2018 has been working with Oxfordshire-based experts, volunteers, land managers and landowners, to restore alkaline fen habitat, and build and share evidence about the state of the county's fens and how best to protect them.

1.2 Purpose of this report

This report presents the results of a survey carried out by Freshwater Habitats Trust in 2022 of Tuckmill Meadows Site of Special Scientific Interest (SSSI), near Watchfield in south-west Oxfordshire (Figure 1).

The purpose of the survey was to:

- record the botanical diversity of the site;
- classify and map its vegetation and habitats; and
- identify habitat restoration and management interventions that could be undertaken.

The survey focused on fen and other wetland habitats, but surrounding habitat was covered.

[1] https://freshwaterhabitats.org.uk/projects/oxfordshire-fens-project/

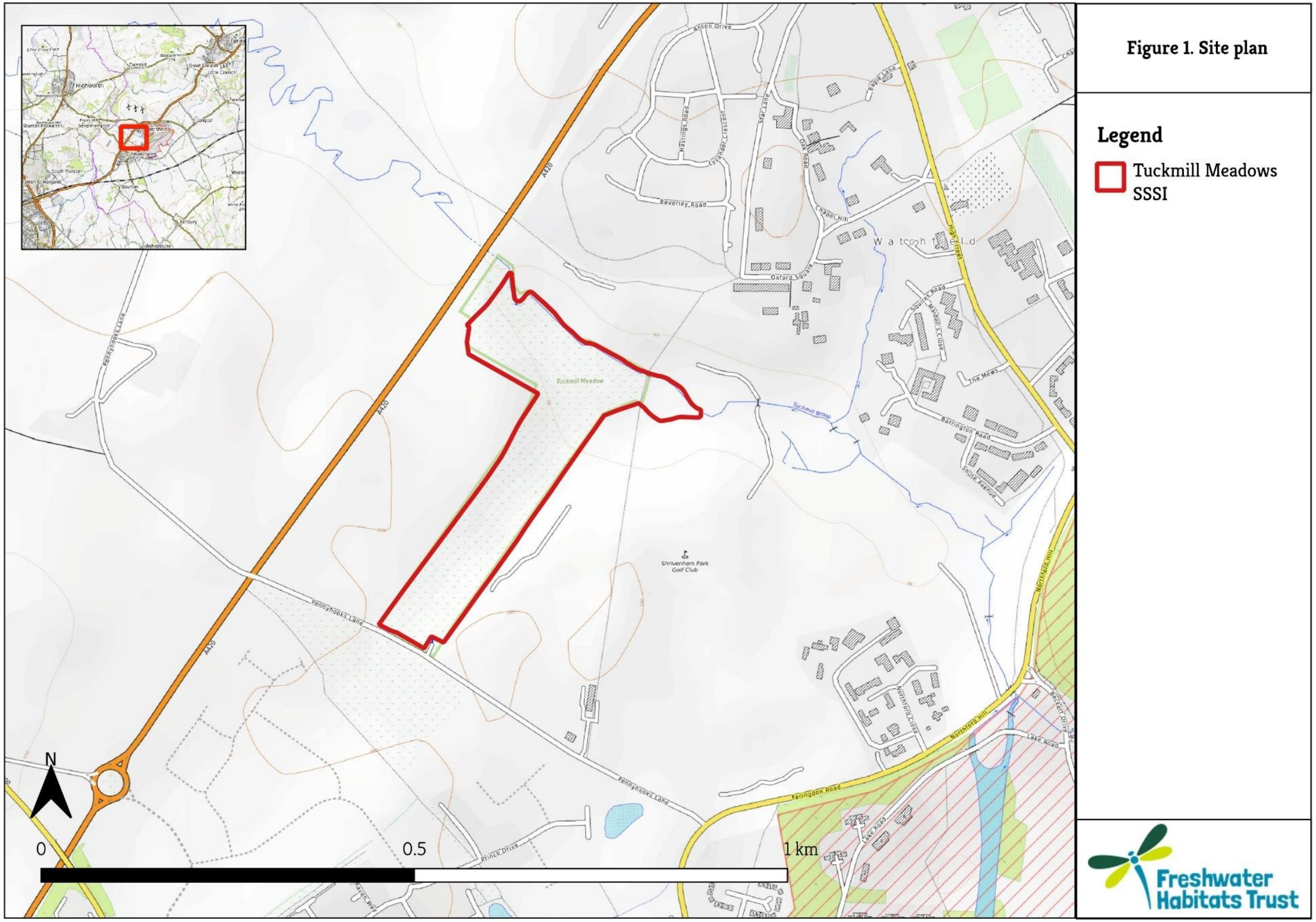

Figure 1. Site plan

2 Methods

2.1 Overview

The survey was carried out on the 17th June 2022, led by Freshwater Habitats Trust's Senior Plant Ecologist David Morris MCIEEM, with assistance from local fen expert Judy Webb and Freshwater Futures Trainee Paola Perez. The survey covered the whole of Tuckmill Meadows SSSI, except for the woodland in the north of the site.

Methods for the botanical and vegetation surveys are described below.

2.2 Botanical survey

A list of all bryophyte (liverworts, hornworts and mosses) and vascular plant species[2] encountered during the survey was compiled. The survey largely focused on vascular plants, as the timing of survey was not favourable to recording bryophytes generally and a more complete list would have required intensive searching in habitats of peripheral interest to the survey (e.g. on trees, in disturbed ground). As the vegetation was very heterogenous across the site, species abundance was not recorded. Nomenclature for species followed Blockeel *et al*. (2020) for bryophytes and Stace (2019) for vascular plants.

If encountered, further information, such as a grid reference, was recorded about notable plants, defined as:

- legally protected species listed on Schedule 8 of the Wildlife and Countryside Act 1981 (as amended); and
- plants of local or national conservation concern, i.e.
  - species of principal importance, listed in accordance with Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006;
  - Nationally Rare or Nationally Scarce taxa (BSBI, 2020);
  - species listed as Near Threatened, Vulnerable, Endangered or Critically Endangered on the vascular plant red lists for Great Britain (Cheffings *et al*., 2005) or England (Stroh *et al*., 2014); or
  - species listed as rare or scarce in Oxfordshire (Erskine *et al*., 2018).

Invasive non-native plant species were also recorded, such as those listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended), or other invasive or potentially invasive non-native plants.

2.3 Vegetation survey

The methodology of the National Vegetation Classification (NVC) was followed to classify the vegetation of the site (Rodwell, 2006). Homogenous stands of vegetation were mapped and assigned to units of the NVC, to sub-community where possible. Assignment of units of the NVC was made in the field. Some vegetation could not be assigned to units of the NVC and was assigned to *ad hoc* units, e.g. disturbed, early successional or artificial habitats or stands of single species not included in the NVC.

Vegetation types were assigned primary and secondary habitat codes of the UK Habitat Classification (Butcher *et al*., 2020). Primary habitats were classified to level four of the hierarchy. For ease of display and discussion in this report, the UK Habitat Classification

[2] In this report, 'species' refers to any taxon at or below the level of taxonomic species, including hybrids and infraspecific tax, as well as species aggregates.

types were grouped into simpler, more easily understandable broad habitat types. These are described in section 3.3.

Vegetation mapping was detailed, with herbaceous vegetation mapped at a scale of approximately 1:1,000, with stands resolved as polygon features if having an area greater than approximately 4m^2. Woodland was mapped at a larger arbitrary scale.

Mapping was undertaken using field survey maps produced in ArcGIS Pro, comprising Bing satellite imagery at 1:1,000 scale and overlain with 100m and 10m grids. The survey maps were printed and annotated in the field, using a Garmin eTrex® 10 handheld GPS unit to locate position (horizontal accuracy approximately 5m). Completed field survey maps were scanned, and georeferenced and digitised in ArcGIS Pro.

In addition, target notes were recorded to describe vegetation structure and other habitat features. Hydrological features such as watercourses, springs and seepages, and artificial drainage, were also recorded.

2.4 Limitations

Extensive areas of the site were dominated by dense tall herb vegetation and were difficult to access and survey thoroughly. However, these areas were likely to have been more uniform and less diverse compared to shorter, more open vegetation. There were no further limitations to the survey.

3 Results

3.1 Overview

Tuckmill Meadows was found to comprise two valleys: in the north, the main valley of the Pennyhooks Brook, a tributary of the River Cole which runs south-east to north-west along the north-eastern boundary of the site; and a tributary valley aligned south-south-west to north-north-east drained by a small unnamed headwater stream. The latter extends form the main valley to Pennyhooks Lane along the southern boundary of the site.

A total of 146 plant species were recorded from the site, consisting of one liverwort species, three moss species and 141 vascular plant species. A full list of species recorded is given in Appendix 1. Further results of the botanical survey are described in section 3.2.

A range of habitats were identified, with a mosaic of wetland, grassland, scrub and woodland, and vegetation types occupying distinct topographic zones within the valleys. Wetland habitat was found across the lower-lying areas of the site and along the sides of the valley in areas of groundwater seepage. The main valley mostly comprised species-poor tall herb fen and swamp vegetation. In the southern tributary valley, there were small areas of richer fen vegetation toward the head of the valley, supporting vegetation characteristic of zones of base-rich groundwater seepage. There was one small area of calcareous grassland on the western side of the tributary valley, but otherwise across the site grassland comprised rank species-poor vegetation dominated by False Oat-grass (*Arrhenatherum elatius*).

Plans of vegetation and habitats recorded are provided in Figures 2 and 3, Appendix 2. Target notes and photographs are provided in Appendix 3, and their locations shown in Figure 2. Figure 3 also shows hydrological features recorded (streams, springs etc.). Further results of the vegetation survey are described in section 3.3.

3.2 Botanical survey

3.2.1 Wetland plants

Following Freshwater Habitats Trust's list of wetland plants[3], the survey recorded one submerged aquatic plant species, and 41 emergent plant species (see Table 2, Appendix 2). This represents 28% of the total number of plants recorded, the other species being largely associated with non-wetland habitats, such as grassland and ruderal vegetation.

Following Wheeler's list of fen species published in Fojt (1993), the survey found 31 'principal fen species' and one 'rare fen species' (see Table 2, Appendix 2). The rare species was the liverwort Endive Pellia (*Pellia endiviifolia*), but this is not a rare plant in wetlands in Oxfordshire. Most of the fen species recorded were tall herb and swamp species, but smaller species characteristic of shorter more open wetland vegetation were present a small area of species-rich fen in the southern part of the site (target note 4), including Fen Bedstraw (*Galium uliginosum*), Marsh Valerian (*Valeriana dioica*), Southern Marsh-orchid (*Dactylorhiza praetermissa*) and the small sedges Carnation Sedge (*Carex nigra*) and Common Sedge (*C. nigra*).

3.2.2 Notable plants

Four species of conservation concern were recorded, listed in Table 1. Grid references and other details of records are provided in Table A2.2.

[3] https://freshwaterhabitats.org.uk/wp-content/uploads/2015/03/34-WETLAND-PLANTS-ENGLISH-RECORDING-FORM-FINAL.pdf

Two of the species of conservation concern were wetland species. Marsh Valerian and Ragged-robin were found only in a small area of species-rich fen in the southern part of the site (target note 4).

The other species of conservation concern, Field Scabious (*Knautia arvensis*) and Hoary Plantain (*Plantago media*), were recorded from a small area of calcareous grassland on the north slope of the southern valley.

Table 1 Species of conservation concern recorded. Species in bold font are wetland species.

Scientific name	Common name	Conservation status
Knautia arvensis	Field Scabious	England Near Threatened
Plantago media	Hoary Plantain	England Near Threatened
Silene flos-cuculi	Ragged-Robin	England Near Threatened
Valeriana dioica	Marsh Valerian	England Near Threatened

3.2.3 Invasive non-native species

No invasive non-native species were recorded.

3.3 Vegetation survey

3.3.1 Wetland habitats

Wetland habitat comprised two types: soligenous fen associated with zones of groundwater seepage in the southern tributary valley, and topogenous fen in the main valley. Patterns of wetland vegetation appeared to be related to topographic features, likely reflecting underlying geology, and to associated hydrological processes. The extent of these two types of wetland and hydrological features are shown in Figure 3.

The topography and associated vegetation patterns differed significantly between the southern and main valleys. The southern valley consisted of a small shallow rounded valleyhead area (target note 1), with a break in slope extending along the western side of the valley, creating a stepped valley side with a broader flatter valley bottom (target note 12). Toward the north-east, the edge of this broader, lower area was marked by a further break in slope, curving round to form the edge of the main valley. On the eastern side of the tributary stream, the valley consisted of a gentle slope up to the boundary of the site.

The first break in slope on the western side supported vegetation indicative of a zone of base-rich groundwater seepage. There was a tufa-forming spring along the middle of this zone on the west side of the valley (target note 8). This seepage appeared to have the strongest influence on the vegetation toward the head of the valley, where there was a small stand of species-rich soligenous fen vegetation (target note 3) referred to the NVC plant community 'M22 *Juncus subnodulosus-Cirsium palustre* fen meadow'. Although dominated by Hard Rush (*Juncus inflexus*) rather than Blunt-flowered Rush (*J. subnodulosus*), such vegetation is encompassed by Wheeler's original concept of this type of fen vegetation (Wheeler, 1980), if not by the NVC. In addition to Marsh Valerian, this was the only area where the small sedge species Carnation Sedge (*Carex panicea*) and Common Sedge (*C. nigra*) were found.

Extending north from this area, groundwater seepage appeared to be weaker, marked out by vegetation with abundant Meadowsweet (*Filipendula ulmaria*), grading from tall herb fen into grassland (target notes 4, 5 and 16). Tall herb fen vegetation was referred to 'M27b *Filipendula ulmaria-Angelica sylvestris* mire, *Urtica dioica-Vicia cracca* sub-community'. The grassland, referred to 'MG1c *Arrhenatherum elatius* grassland, *Filipendula ulmaria* sub-community', formed a long narrow zone below the footpath along that side of the valley. At

the second, lower break in slope, up to the edge of the main valley, was similar vegetation with abundant meadowsweet, marking a further zone of weak groundwater seepage. These two seepage areas were separated by a zone of dry grassland where Meadowsweet and other wetland plants were absent.

Wetland vegetation along the eastern side of the tributary valley comprised extensive stands of tall herb fen dominated by Great Willowherb (*Epilobium hirsutum*) and Meadowsweet, referred to 'OV26c *Epilobium hirsutum* community, *Filipendula ulmaria-Angelica sylvestris* sub-community'. Patches of this vegetation had been mown shortly before the survey (target note 2). Given the similar elevation to seepage zones on the opposite side of the valley, this vegetation is also likely to receive groundwater seepage. Consistent with this, toward the southern end there was a small wet area in a depression, with vegetation dominated Hard Rush, perhaps marking out an area of stronger groundwater discharge (target note 6).

In contrast with the southern valley, the topography of the main valley was broad and flat, and included a series of relict stream channels (target notes 13 and 14). The vegetation consisted of extensive stands of tall herb fen and swamp vegetation, with tall ruderal vegetation and grassland in elevated areas. The wetland vegetation here is likely to be topogenous, i.e. controlled predominantly by water accumulation and vertical, seasonal fluctuations, rather than the soligenous vegetation found in the southern valley, influenced by lateral groundwater movement.

The most extensive type of wetland vegetation in the main valley was the stand of tall herb fen dominated by Common Reed (*Phragmites australis*), present along the lower part of the tributary stream and extending as a broad wedge into the main valley (target notes 14, 15 and 18). This vegetation was difficult to access but appeared to be very species-poor and was referred to 'S4 *Phragmites australis* swamp and reed-beds'. This vegetation appeared to mark out an area where the channel of the tributary stream becomes indistinct, discharging over a broad flat area of the main valley.

Tall herb fen with Common Reed was also found in two other areas, there referred to 'S26 *Phragmites australis-Urtica dioica* tall herb fen'. The western had an open structure and graded into more diverse tall herb fen without Common Reed and with abundant Brown Sedge (*Carex disticha*), Common Comfrey (*Symphytum officinale*), Great Willowherb and Meadowsweet. The latter vegetation was referred to 'M27b *Filipendula ulmaria-Angelica sylvestris* mire, *Urtica dioica-Vicia cracca* sub-community' and 'OV26c *Epilobium hirsutum* community, *Filipendula ulmaria-Angelica sylvestris* sub-community' (target notes 17 and 18). A stand of Common Reed in the north-east of the site comprised dense Common Nettle (*Urtica dioica*) with an open canopy of Common Reed.

Former stream channels and other topographic depressions within the main valley were dominated by species-poor swamp vegetation (target notes 20, 21 and 23). The oxbow in the north of the valley bottom (target note 21) was dominated by stands of Common Reed, Greater Pond-sedge (*Carex riparia*) and Reed Sweet-grass (*Glyceria maxima*). Similar swamp vegetation was present in relict channels to the east.

3.3.2 Other habitats

Neutral grassland dominated the higher ground around the site, especially in the tributary valley. There, the southern end of the valley and the higher ground along its north side were dominated by extensive, species-poor stands of False Oat-grass, referred to sub-communities of MG1 *Arrhenatherum elatius* grassland (target notes 1, 7 and 12). For recording purposes, especially rank and species-poor stands were referred to the *ad hoc* community 'MG1a Rank', which often had abundant Hogweed (*Heracleum sphondylium*). Most of the grassland was referred to MG1a *Arrhenatherum elatius* grassland, *Festuca rubra* sub-community, which had a slightly less coarse sward, often with abundant sprawling Meadow Vetchling (*Lathyrus pratensis*). Some areas along the north side of the valley were slightly richer, such as along the footpath, with abundant Common Knapweed (*Centaurea*

nigra), referred to MG1e *Arrhenatherum elatius* grassland, *Centaurea nigra* sub-community (target note 11). Very rank stands of Fale Oat-grass had abundant Common Nettle, referred to MG1b *Arrhenatherum elatius* grassland, *Urtica dioica* sub-community.

In the main valley, grassland was more restricted, with the largest area over higher ground in the north of the site. More extensive were stands of tall ruderal vegetation dominated by Common Nettle, referred to OV24 *Urtica dioica-Galium aparine* community. This was found along the Pennyhooks Brook and covered much of the ground in the north-east of the site (target note 26).

In addition to neutral grassland, a small area of rank calcareous grassland was present on the northern slope of the tributary valley (target note 10). This was dominated by Upright Brome (*Bromopsis erecta*), referred to CG3 *Bromopsis erecta* grassland. This was the only area where calcicolous species such as Common Restharrow (*Ononis repens*), Cowslip (*Primula veris*), Hoary Plantain and Salad Burnet (*Poterium sanguisorba*) were recorded.

The three sides of the tributary valley were bounded by hedgerows, mostly of Hawthorn (*Crataegus monogyna*). Along the boundary with Shrivenham golf course in the south-east, the hedgerow included plantings of the non-native Southern Dogwood (*Cornus sanguinea* subsp. *Australis*) and a non-native field maple (*Acer campestre* subsp. *leiocarpum*).

Within the site, were small stands of Elm-leaved Bramble (*Rubus ulmifolius*) and scattered Hawthorn bushes, respectively referred to the plant communities W21 *Crataegus monogyna-Hedera helix* scrub and W24 *Rubus fruticosus-Holcus lanatus* underscrub

The largest stand of woodland was in the north of the site, extending up to the boundary of the A420. However, this was not accessed during the survey. Within the surveyed area, in the main valley were several small areas of woodland dominated by Crack Willow (*Salix x fragilis*), over a field layer dominated by Common Nettle, referred to W6b *Alnus glutinosa-Urtica dioica* woodland, *Salix fragilis* sub-community. There were also mature Alder (*Alnus glutinosa*) trees along the Pennyhooks Brook (target note 22).

The Pennyhooks Brook and the unnamed tributary stream were not surveyed in detail. The brook was difficult to see due to tall vegetation and a fence along much of its length, but it appeared to support typical species of eutrophic watercourses such as Fool's Watercress (*Helosciadium nodiflorum*) and Water Forget-me-not (*Myosotis scorpioides*). The unnamed stream had little vegetation in it as the channel was deep and heavily shaded by tall herb vegetation on its banks, mostly dominated by Great Willowherb and Meadowsweet (target note 9).

4 Discussion and recommendations

4.1 Habitats of nature conservation value

The survey mapped 1.3 ha of lowland fens priority habitat, approximately 22 % of the SSSI. Natural England lists two wetland plant communities as features of the SSSI (Natural England, n.d.): M23 *Juncus acutiflorus/effusus-Galium palustre* rush pasture and S5 *Glyceria maxima* swamp. M23 was not recorded during the survey; it may once have been present in the SSSI but has developed into the current types of fen vegetation, or the identification of M23 was in error, intended to cover the diversity of rush-dominated and tall herb fen vegetation seen during the survey. The latter is considered more likely. The only example of S5 was a small stand in an oxbow in the north of the site; a variety of other swamp vegetation types were also recorded.

The wetland vegetation of greatest botanical value was the small stand of Hard Rush-dominated vegetation where Marsh Valerian and a diversity of other small species of base-rich soligenous fen were recorded. It is likely that this type of vegetation and associated wetland plants was once more extensive, though it is unlikely to have occurred in the main valley, which appeared to be topogenous. Topogenous fen in river valleys in Oxfordshire tends to be naturally species-poor, dominated by tall emergent species. Based on interpretation of vegetation patterns across the site, groundwater seepage appears to be limited to the slopes of the tributary valley.

Grassland is not listed as a feature of the SSSI, though it is referred to in the site's citation and recent condition assessment. Neutral grassland covered 2.0 ha, 35 % of the SSSI, comprising rank, species-poor vegetation dominated by False Oat-grass. There were also extensive areas of tall ruderal vegetation, 0.8 ha in total. These are not priority habitat.

Calcareous grassland, a priority habitat, covered only 0.01 ha. Although very small, the area of this habitat found on the west side of the SSSI supported several species indicative of grassland of greater nature conservation value not seen elsewhere, such as Cowslip, Common Restharrow, Hoary Plantain and Salad Burnet.

Scrub and woodland were limited within the area surveyed. Woodland is not listed as a feature of the SSSI, though the woodland in the north of the SSSI is described in the site's citation. Some areas of woody vegetation appeared to be of recent origin, such as along the stream in the tributary valley and in the north-east of the site, in the main valley. Excluding hedgerows, scrub covered approximately 3 % of the site.

The small stands of Crack Willow recorded during the survey comprise wet woodland priority habitat. However, this is a common type of priority habitat across Oxfordshire's floodplains, developing relatively quickly on unmanaged land.

4.2 Habitat management recommendations

The condition of the SSSI was changed by Natural England in 2020 to 'Unfavourable – declining' to reflect recent lack of management.

The favourable condition of the site's fen and grassland habitats are dependent on regular removal of biomass, either by grazing or mowing. Without this disturbance, vegetation becomes coarse and species-poor, as seen across the site. Although it is positive that a diversity of plants remains at the site, including many wetland species and four notable species, species characteristic of botanically rich vegetation had very small populations. In well-managed grassland and fen, species such as Cowslip, Common Restharrow, Marsh Valerian and Southern Marsh-orchid should be much more abundant.

At the time of the survey, management of Tuckmill Meadows SSSI was about to come under the control of the Earth Trust, with funding from the county council to implement a new

management plan. It is therefore not appropriate to make detailed management recommendations at this stage. However, the following broad recommendations are made to help guide the new management of the SSSI:

- Continue volunteer management of soligenous fen in the tributary valley by scything and raking. This should aim to improve the condition of the small existing area of species-rich fen with notable wetland species such as Marsh Valerian, and to increase the extent of this type of vegetation and the size of populations of scarcer species there. To restore tall / coarse fen vegetation, two to three cuts per year are required, the first in April once vegetation starts to grow.
- Due to differing hydrology, wetland in the main valley is unlikely to develop with management into the more species-rich vegetation seen to the south. This area would be best be managed rotationally, or with light grazing. However, limited management may encourage the spread of Common Reed, which may lead to a decline in vegetation diversity and structure across the area. The spread of Common Reed should therefore be monitored, and an early season cut used as a control measure. Late summer mowing would have a limited effect.
- Grassland should not be neglected but will require intensive and extensive management to restore to more species-rich vegetation and enable calcareous grassland plants to spread. Spring and summer mowing would be needed to reduce the current coarse structure of the vegetation. If livestock were available to graze the site, then winter grazing could assist with this. If the site is to be grazed in summer, then management should aim to limit the availability of forage in dry areas to encourage animals to graze and disturb wetland areas.

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Appendix 1 Plant records

Table 2 List of plant species recorded

Scientific name	Common name	Conservation status	Principal (P) / rare (R) fen species	Submerged (S) / Floating (F) / Emergent (E) species
Liverworts				
Pellia endiviifolia	Endive Pellia	-	R	-
Mosses				
Brachythecium rivulare	River Feathermoss	-	-	-
Calliergonella cuspidata	Pointed Spearmoss	-	P	-
Cratoneuron filicinum	Fern-leaved Hookmoss	-	-	-
Ferns and horsetails				
Equisetum arvense	Field Horsetail	-	-	-
Equisetum palustre	Marsh Horsetail	-	P	E
Flowering plants				
Acer campestre	Field Maple	-	-	-
Acer campestre subsp. *leiocarpum*		-	-	-
Acer platanoides	Norway Maple	-	-	-
Achillea millefolium	Yarrow	-	-	-
Agrostis stolonifera	Creeping Bent	-	-	E
Alliaria petiolata	Garlic Mustard	-	-	-
Alnus glutinosa	Alder	-	-	-
Alopecurus pratensis	Meadow Foxtail	-	-	-
Anacamptis pyramidalis	Pyramidal Orchid	-	-	-
Angelica sylvestris	Wild Angelica	-	P	E

Scientific name	Common name	Conservation status	Principal (P) / rare (R) fen species	Submerged (S) / Floating (F) / Emergent (E) species
Anthoxanthum odoratum	Sweet Vernal-grass	-	-	-
Anthriscus sylvestris	Cow Parsley	-	-	-
Arctium minus agg.	Lesser Burdock	-	-	-
Anisantha sterilis	Barren Brome	-	-	-
Arrhenatherum elatius	False Oat-grass	-	-	-
Arum maculatum	Lord-and-ladies	-	-	-
Avenula pubescens	Downy Oat-grass	-	-	-
Ballota nigra	Black Horehound	-	-	-
Bromopsis erecta	Upright Brome	-	-	-
Bromus commutatus	Meadow Brome	-	-	-
Bromus hordeaceus	Soft-brome	-	-	-
Callitriche stagnalis	Common Water-starwort	-	-	S
Caltha palustris	Marsh Marigold	-	P	E
Calystegia sepium	Hedge Bindweed	-	-	-
Carduus crispus	Welted Thistle	-	-	-
Carex acutiformis	Lesser Pond-sedge	-	P	E
Carex disticha	Brown Sedge	-	P	E
Carex flacca	Glaucous Sedge	-	-	E
Carex hirta	Hairy Sedge	-	-	-
Carex nigra	Common Sedge	-	P	E
Carex panicea	Carnation Sedge	-	P	E

Scientific name	Common name	Conservation status	Principal (P) / rare (R) fen species	Submerged (S) / Floating (F) / Emergent (E) species
Carex riparia	Greater Pond-sedge	-	P	E
Carex spicata	Spiked Sedge	-	-	E
Centaurea nigra	Common Knapweed	-	-	-
Cerastium fontanum	Common Mouse-ear	-	-	-
Chaerophyllum temulum	Rough Chervil	-	-	-
Cirsium arvense	Creeping Thistle	-	-	-
Cirsium palustre	Marsh Thistle	-	P	E
Conium maculatum	Hemlock	-	-	-
Convolvulus arvensis	Field Bindweed	-	-	-
Cornus sanguinea	Dogwood	-	-	-
Cornus sanguinea subsp. *australis*	Southern Dogwood	-	-	-
Corylus avellana	Hazel	-	-	-
Crataegus monogyna	Hawthorn	-	-	-
Cymbalaria muralis	Ivy-leaved Toadflax	-	-	-
Cynosurus cristatus	Crested Dog's-tail	-	-	-
Dactylis glomerata	Cock's-foot	-	-	-
Dactylorhiza praetermissa	Southern Marsh-orchid	-	P	E
Deschampsia cespitosa	Tufted Hair-grass	-	-	E
Dipsacus fullonum	Teasel	-	-	-
Eleocharis palustris	Common Spike-rush	-	P	E
Elytrigia repens	Common Couch	-	-	-

Scientific name	Common name	Conservation status	Principal (P) / rare (R) fen species	Submerged (S) / Floating (F) / Emergent (E) species
Epilobium hirsutum	Great Willowherb	-	P	E
Festuca rubra	Red Fescue	-	-	-
Filipendula ulmaria	Meadowsweet	-	P	E
Fraxinus excelsior	Ash	-	-	-
Galium aparine	Cleavers	-	-	-
Galium uliginosum	Fen Bedstraw	-	P	E
Galium verum	Lady's Bedstraw	-	-	-
Geranium dissectum	Cut-leaved Crane's-bill	-	-	-
Geranium robertianum	Herb-Robert	-	-	-
Geum urbanum	Wood Avens	-	-	-
Glechoma hederacea	Ground-ivy	-	-	-
Glyceria maxima	Reed Sweet Grass	-	P	E
Glyceria notata	Plicate Sweet-grass	-	P	E
Hedera helix	Ivy	-	-	-
Apium nodiflorum	Fool's Watercress	-	-	E
Heracleum sphondylium	Hogweed	-	-	-
Holcus lanatus	Yorkshire-fog	-	-	-
Hordeum secalinum	Meadow Barley	-	-	-
Humulus lupulus	Common Hop	-	-	-
Iris pseudacorus	Yellow Iris	-	P	E
Jacobaea vulgaris	Common Ragwort	-	-	-

Scientific name	Common name	Conservation status	Principal (P) / rare (R) fen species	Submerged (S) / Floating (F) / Emergent (E) species
Juncus acutiflorus	Sharp-flowered Rush	-	P	E
Juncus inflexus	Hard Rush	-	-	E
Knautia arvensis	Field Scabious	England Near Threatened	-	-
Lamium album	White Dead-nettle	-	-	-
Lathyrus pratensis	Meadow Vetchling	-	-	-
Leontodon hispidus	Rough Hawkbit	-	-	-
Lolium perenne	Perennial Rye-grass	-	-	-
Lotus corniculatus	Common Bird's-foot-trefoil	-	-	-
Lotus pedunculatus	Greater Bird's-foot-trefoil	-	P	E
Lycopus europaeus	Gypsywort	-	P	E
Mentha aquatica	Water Mint	-	P	E
Myosotis scorpioides	Water Forget-me-not	-	P	E
Ononis repens	Common Restharrow	-	-	-
Persicaria amphibia	Amphibious Bistort	-	-	E
Phalaris arundinacea	Reed Canary-grass	-	P	E
Phragmites australis	Common Reed	-	P	E
Plantago lanceolata	Ribwort Plantain	-	-	-
Plantago major	Greater Plantain	-	-	-
Plantago media	Hoary Plantain	England Near Threatened	-	-
Poa trivialis	Rough Meadow-grass	-	-	-
Potentilla anserina	Silverweed	-	-	-

Scientific name	Common name	Conservation status	Principal (P) / rare (R) fen species	Submerged (S) / Floating (F) / Emergent (E) species
Potentilla reptans	Creeping Cinquefoil	-	-	-
Poterium sanguisorba	Salad Burnet	-	-	-
Primula veris	Cowslip	-	-	-
Prunus spinosa	Blackthorn	-	-	-
Ranunculus acris	Meadow Buttercup	-	-	-
Ranunculus bulbosus	Bulbous Buttercup	-	-	-
Ranunculus repens	Creeping buttercup	-	-	-
Rhamnus cathartica	Buckthorn	-	-	-
Rorippa nasturtium-aquaticum	Watercress	-	-	E
Rosa squarrosa	Glandular Dog Rose	-	-	-
Rubus caesius	Dewberry	-	-	-
Rubus fruticosus agg.	Bramble	-	-	-
Rubus ulmifolius	Elm-leaf Blackberry	-	-	-
Rumex acetosa	Common Sorrel	-	-	-
Rumex hydrolapathum	Water Dock	-	P	E
Rumex obtusifolius	Broad-leaved Dock	-	-	-
Rumex sanguineus	Wood Dock	-	-	-
Salix alba x euxina = S. x fragilis	Crack-willow	-	-	-
Salix cinerea	Grey Willow	-	P	-
Salix purpurea	Purple Willow	-	-	-
Salix viminalis x cinerea = S. x holosericea	Silky-leaved Osier	-	-	-

Scientific name	Common name	Conservation status	Principal (P) / rare (R) fen species	Submerged (S) / Floating (F) / Emergent (E) species
Sambucus nigra	Elder	-	-	-
Schedonorus arundinaceus	Tall Fescue	-	-	-
Schedonorus giganteus	Giant Fescue	-	-	-
Schedonorus pratensis	Meadow Fescue	-	-	-
Scorzoneroides autumnalis	Autumn Hawkbit	-	-	-
Scrophularia auriculata	Water Figwort	-	P	E
Sedum acre	Biting Stonecrop	-	-	-
Silene flos-cuculi	Ragged-Robin	England Near Threatened	P	-
Solanum dulcamara	Bittersweet	-	-	E
Sonchus asper	Prickly Sow-thistle	-	-	-
Sparganium emersum	Unbranched Bur-reed	-	-	-
Sparganium erectum	Branched Bur-reed	-	P	E
Stachys sylvatica	Hedge Woundwort	-	-	-
Stellaria aquatica	Water Chickweed	-	-	E
Symphytum officinale	Common Comfrey	-	P	E
Tamus communis	Black Bryony	-	-	-
Taraxacum agg.	A dandelion	-	-	-
Tragopogon pratensis subsp. *minor*	Goat's Beard	-	-	-
Trifolium pratense	Red Clover	-	-	-
Trifolium repens	White Clover	-	-	-
Urtica dioica	Stinging Nettle	-	-	-

Scientific name	Common name	Conservation status	Principal (P) / rare (R) fen species	Submerged (S) / Floating (F) / Emergent (E) species
Valeriana dioica	Marsh Valerian	England Near Threatened	P	E
Veronica beccabunga	Brooklime	-	-	E
Veronica chamaedrys	Germander Speedwell	-	-	-
Viburnum opulus	Guelder-rose	-	-	-
Vicia cracca	Tufted Vetch	-	-	-

Table 3 Records of notable plant species

Scientific name	Common name	Grid reference	Notes
Knautia arvensis	Field Scabious	SU 23975 09910	
Plantago media	Hoary Plantain	SU 23905 89896	One plant
Silene flos-cuculi	Ragged-Robin	SU 23919 89882	
Valeriana dioica	Marsh Valerian	SU 23919 89882	Frequent in species-rich area of fen meadow

Appendix 2 Vegetation and habitat plans

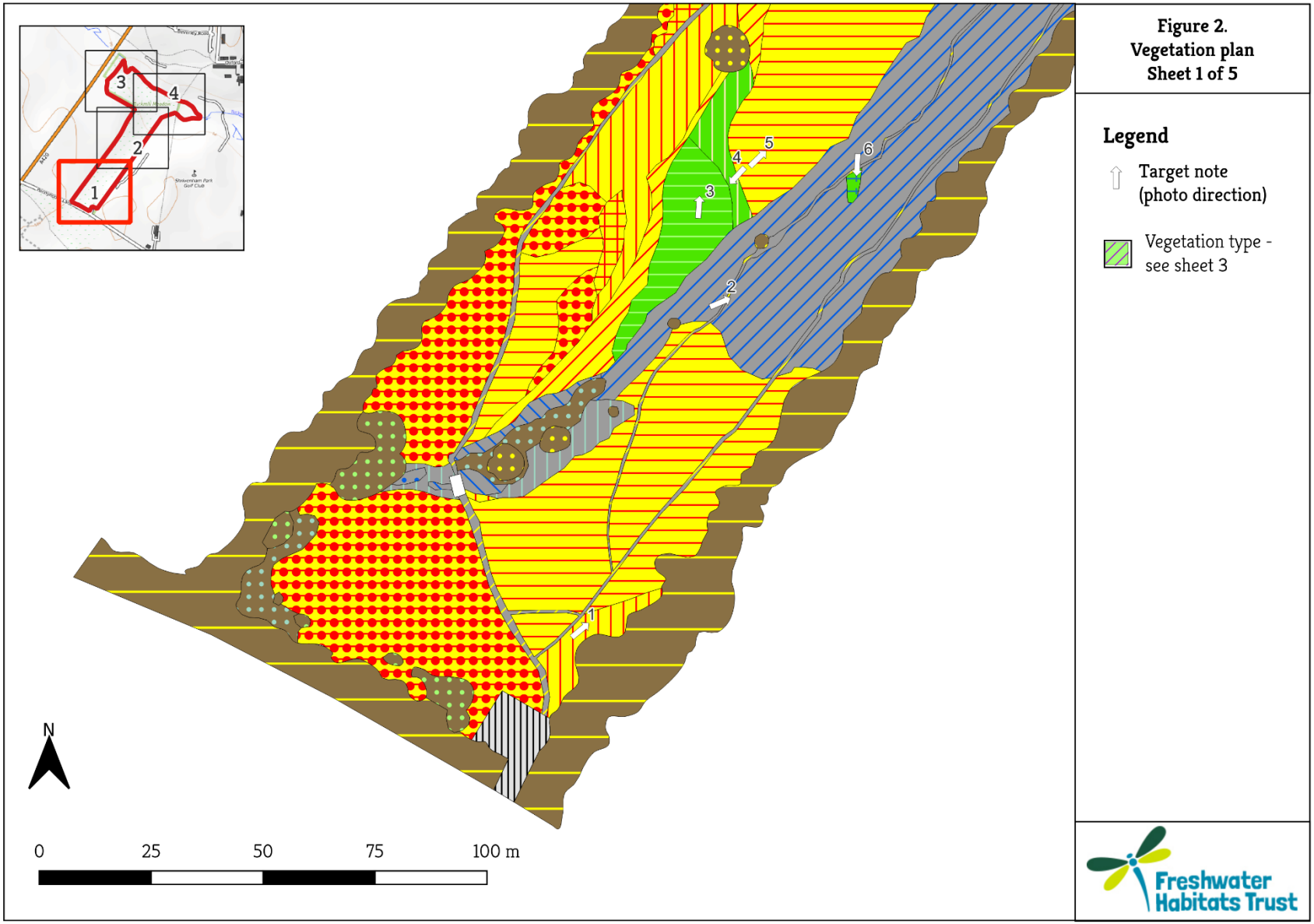
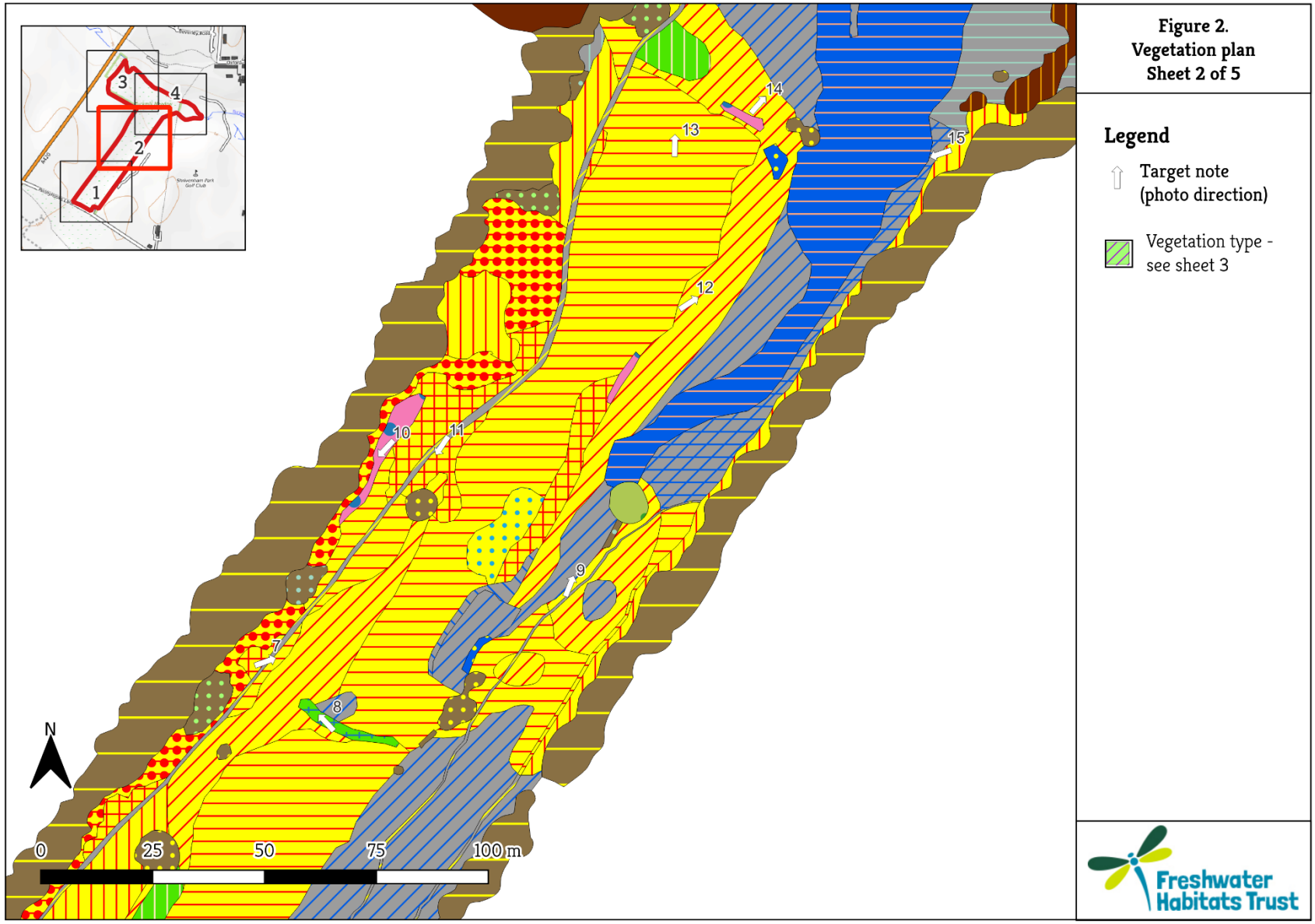


Figure 2.
Vegetation plan
Sheet 1 of 5
Legend
Target note
(photo direction)
Vegetation type -
see sheet 3
N
0
25
50
75
100 m
1
2
3
4
5
6


1
2
3
4
7
8
9
10
11
12
13
14
15
N
0
25
50
75
100 m
Figure 2.
Vegetation plan
Sheet 2 of 5
Legend
Target note
(photo direction)
Vegetation type -
see sheet 3
Freshwater
Habitats Trust

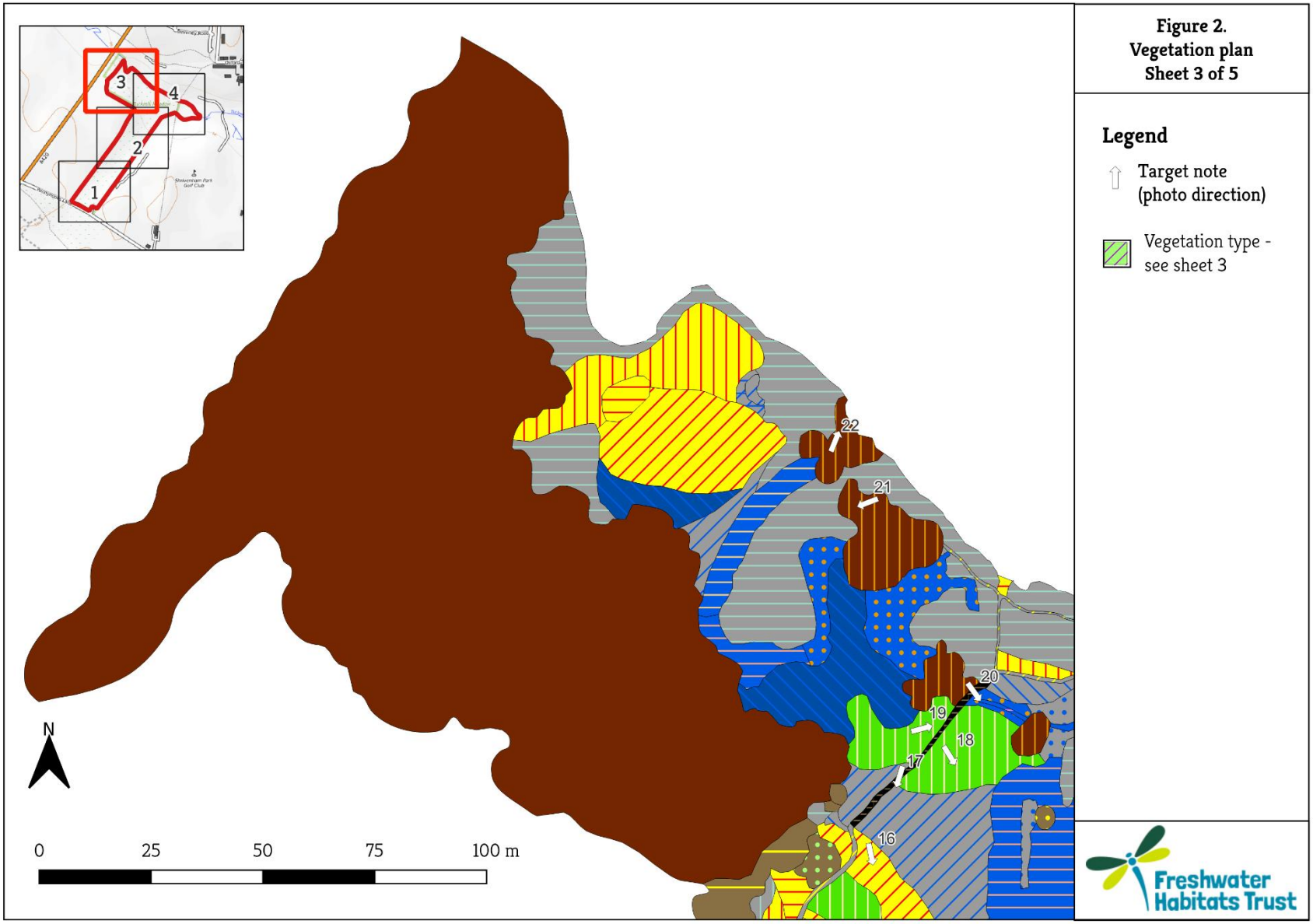


Figure 2.
Vegetation plan
Sheet 3 of 5
Legend
Target note
(photo direction)
Vegetation type -
see sheet 3
1
2
3
4
16
17
18
19
20
21
22
N
0
25
50
75
100 m
Freshwater
Habitats Trust

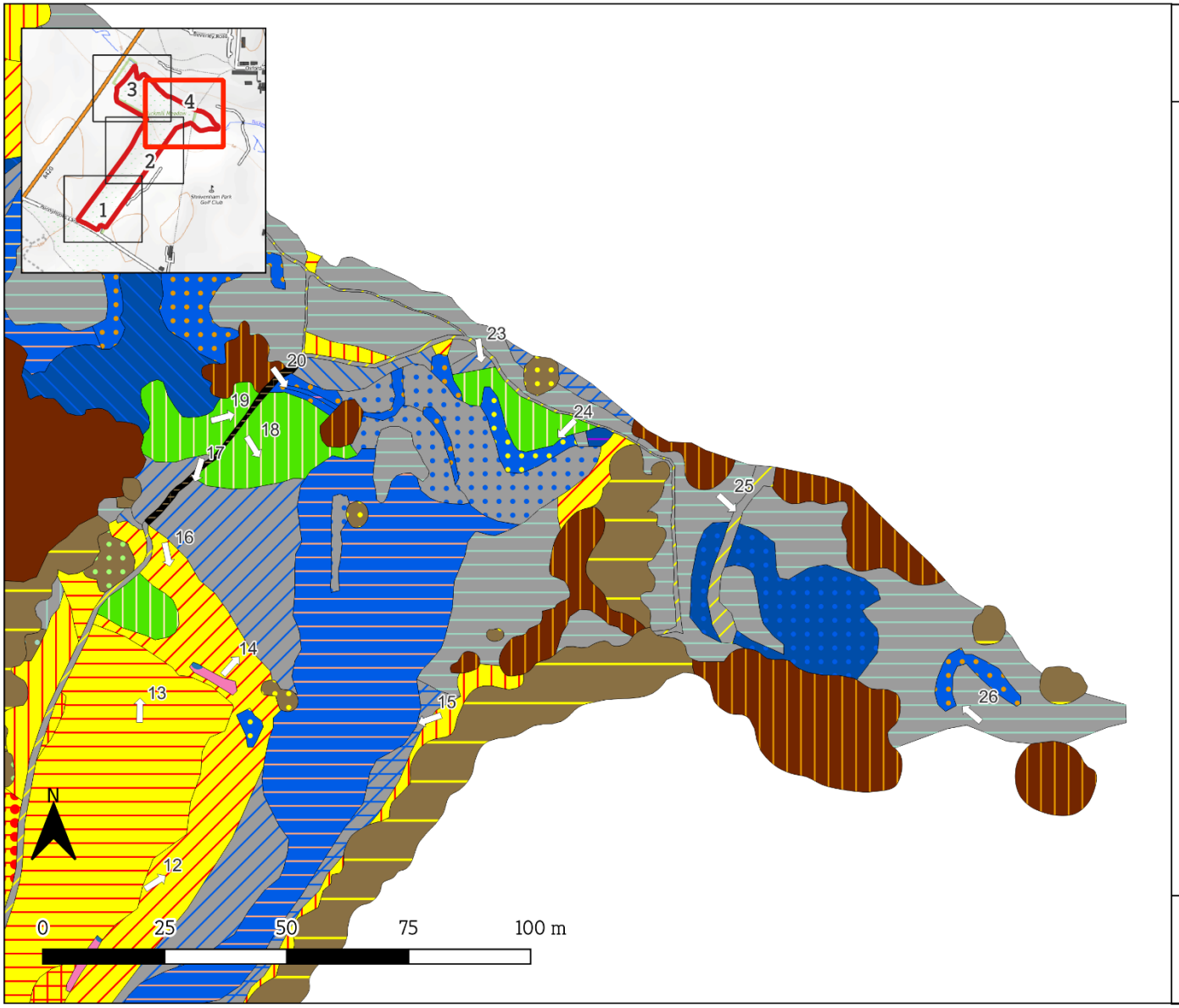


Figure 2.
Vegetation plan
Sheet 4 of 5

Legend

Target note
(photo direction)

Vegetation type -
see sheet 3

Legend to vegetation

- Boardwalk
- Bridge
- Juncus inflexus-dominated vegetation
- M22a Juncus subnodulosus-Cirsium palustre fen-meadow, typical sub-community
- M27b Filipendula ulmaria-Angelica sylvestris mire, Urtica dioica-Vicia cracca sub-community
- CG3 Bromus erectus grassland
- MG1a Rank
- MG1a Arrhenatherum elatius grassland, Festuca rubra sub-community
- MG1b Arrhenatherum elatius grassland, Urtica dioica sub-community
- MG1c Arrhenatherum elatius grassland, Filipendula ulmaria sub-community
- MG1e Arrhenatherum elatius grassland, Centaurea nigra sub-community
- MG12 Festuca arundinacea grassland
- S4a Phragmites australis swamp and reed-beds, Phragmites australis sub-community
- S5a Glyceria maxima swamp, Glyceria maxima sub-community
- S6 Carex riparia swamp
- S7 Carex acutiformis swamp
- S14a Sparganium erectum swamp, Sparganium erectum sub-community
- S26 Phragmites australis-Urtica dioica tall-herb fen
- S26d Phragmites australis-Urtica dioica tall-herb fen, Epilobium hirsutum sub-community
- S28a Phalaris arundinacea tall-herb fen, Phalaris arundinacea sub-community
- OV23c Lolium perenne-Dactylis glomerata community, Plantago major-Trifolium repens sub-community
- OV24a Urtica dioica-Galium aparine community, typical sub-community
- OV24b Urtica dioica-Galium aparine community, Arrhenatherum elatius-Rubus fruticosus agg. sub-community
- OV26 Epilobium hirsutum community
- OV26c Epilobium hirsutum community, Filipendula ulmaria-Angelica sylvestris sub-community
- OV26d Epilobium hirsutum community, Arrhenatherum elatius-Heracleum sphondylium sub-community
- OV26e Epilobium hirsutum community, Urtica dioica-Cirsium arvense sub-community
- Bare/disturbed ground
- W21 Crataegus monogyna-Hedera helix scrub
- W21a Crataegus monogyna-Hedera helix scrub, Hedera helix-Urtica dioica sub-community
- W22 Prunus spinosa-Rubus fruticosus scrub
- W24 Rubus fruticosus-Holcus lanatus underscrub
- Dense scrub
- W6b Alnus glutinosa-Urtica dioica woodland, Salix fragilis sub-community
- Trees
- Woodland

Figure 2.
Vegetation plan
Sheet 5 of 5

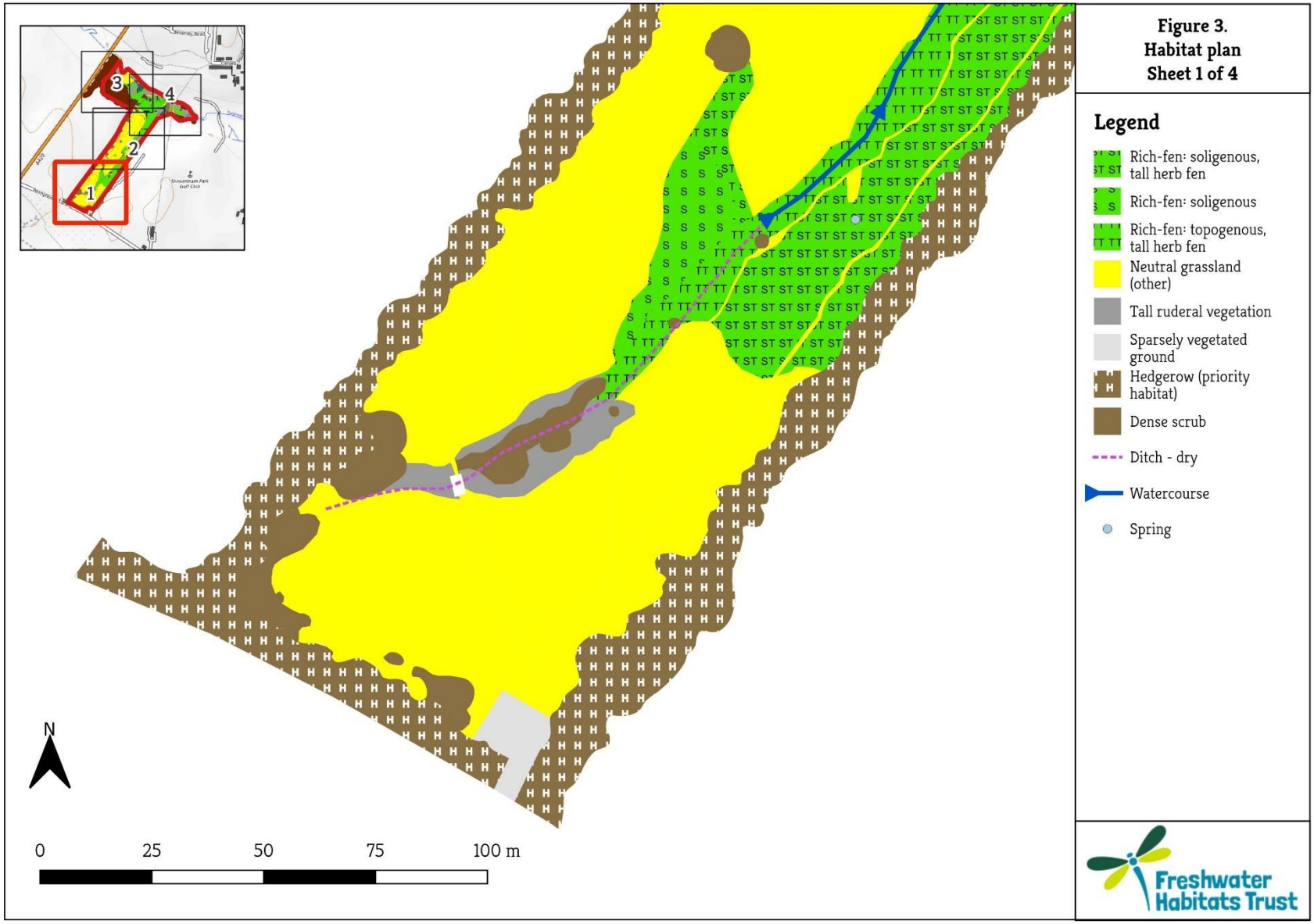


Figure 3.
Habitat plan
Sheet 1 of 4
Legend
Rich-fen: soligenous, tall herb fen
Rich-fen: soligenous
Rich-fen: topogenous, tall herb fen
Neutral grassland (other)
Tall ruderal vegetation
Sparsely vegetated ground
Hedgerow (priority habitat)
Dense scrub
Ditch - dry
Watercourse
Spring
N
0
25
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75
100 m
1
2
3
4

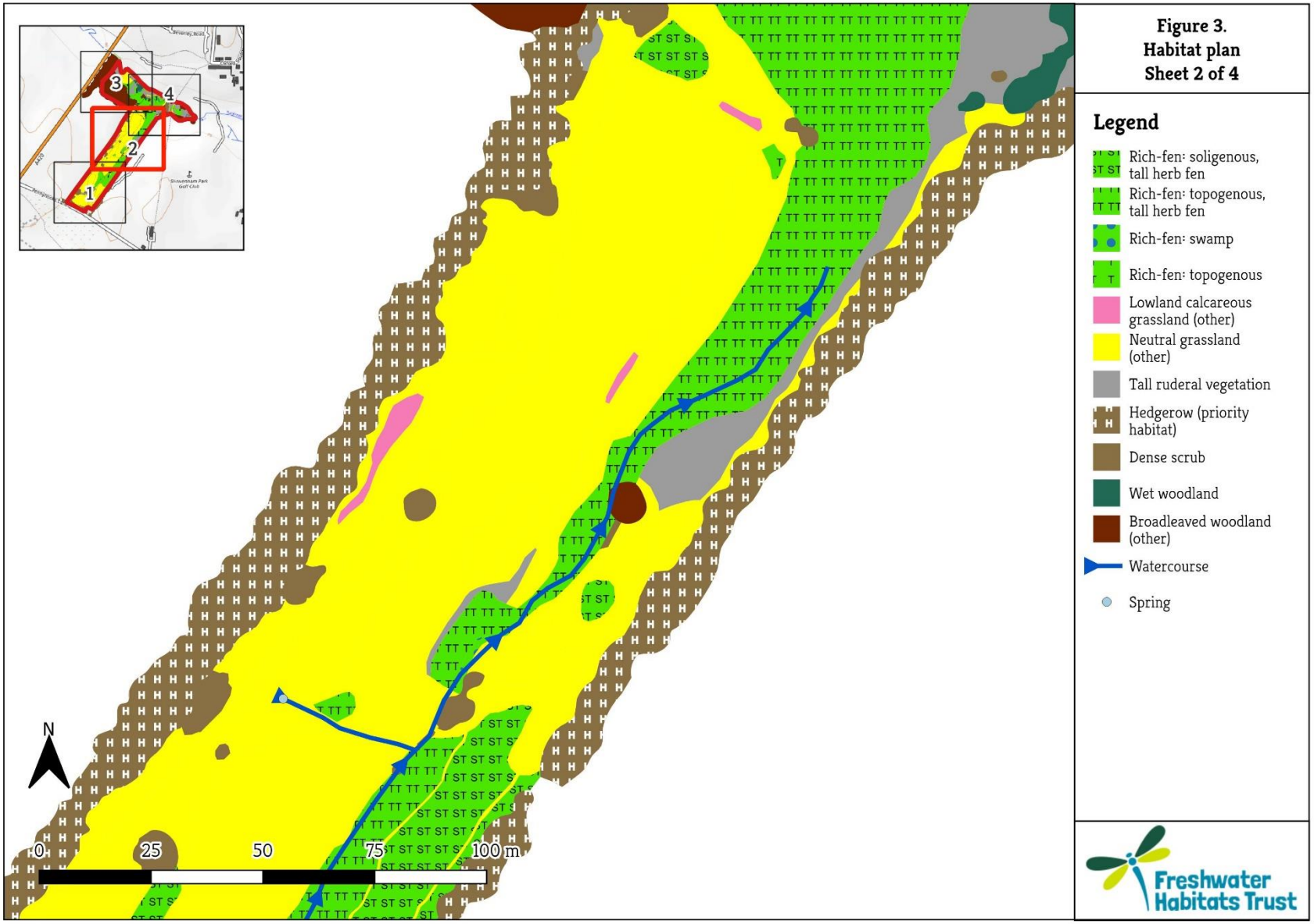
Figure 3.
Habitat plan
Sheet 2 of 4
Legend
Rich-fen: soligenous, tall herb fen
Rich-fen: topogenous, tall herb fen
Rich-fen: swamp
Rich-fen: topogenous
Lowland calcareous grassland (other)
Neutral grassland (other)
Tall ruderal vegetation
Hedgerow (priority habitat)
Dense scrub
Wet woodland
Broadleaved woodland (other)
Watercourse
Spring
N
0
25
50
75
100 m
1
2
3
4
Freshwater Habitats Trust

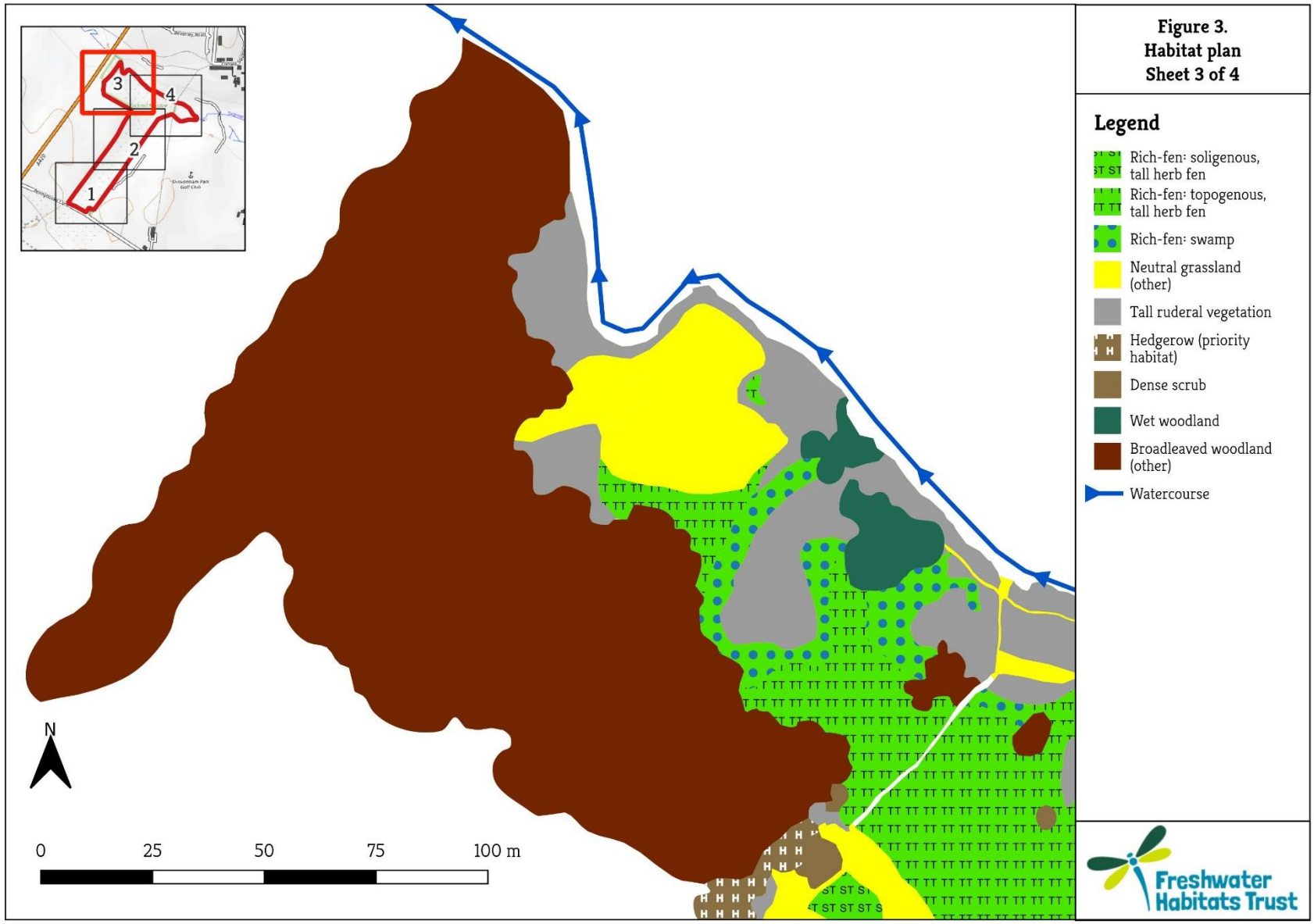
Figure 3.
Habitat plan
Sheet 3 of 4
Legend
Rich-fen: soligenous, tall herb fen
Rich-fen: topogenous, tall herb fen
Rich-fen: swamp
Neutral grassland (other)
Tall ruderal vegetation
Hedgerow (priority habitat)
Dense scrub
Wet woodland
Broadleaved woodland (other)
Watercourse
1
2
3
4
N
0
25
50
75
100 m
Freshwater Habitats Trust

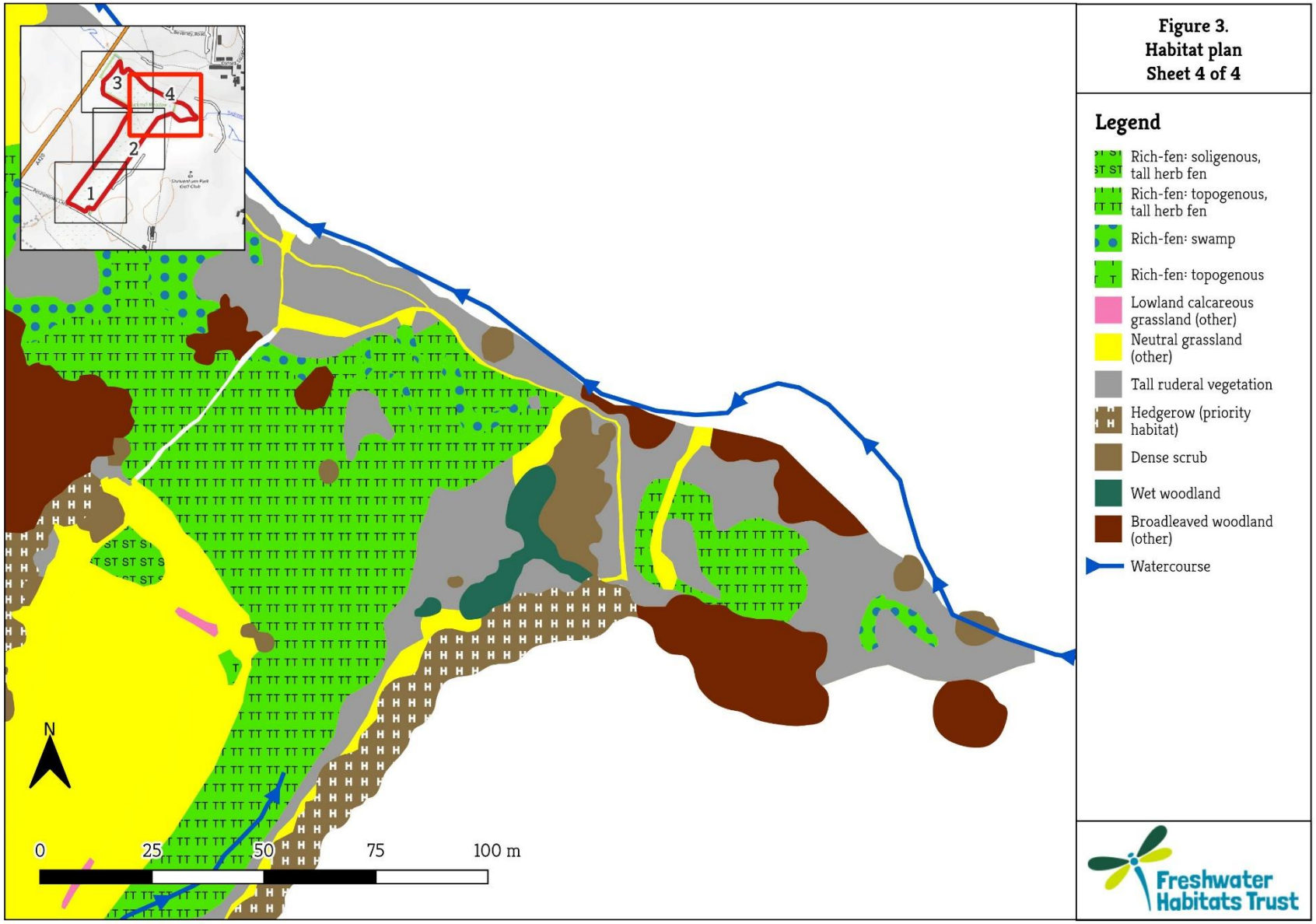
Figure 3.
Habitat plan
Sheet 4 of 4
Legend
Rich-fen: soligenous, tall herb fen
Rich-fen: topogenous, tall herb fen
Rich-fen: swamp
Rich-fen: topogenous
Lowland calcareous grassland (other)
Neutral grassland (other)
Tall ruderal vegetation
Hedgerow (priority habitat)
Dense scrub
Wet woodland
Broadleaved woodland (other)
Watercourse
1
2
3
4
N
0
25
50
75
100 m
Freshwater Habitats Trust

Appendix 3 Target notes

Table 4 Target notes recorded

#	Description	Photograph
1	View from top of side valley	
2	Area of mown tall herb fen	

#	Description	Photograph
3	Area of seepage fen. Vegetation is quite dense but nevertheless much more species-rich than anywhere else on site, dominated by *Juncus inflexus* with abundant tall herb and scattered small sedges. Only location where *Valeriana dioica* was found. *Dactylorhiza praetermissa* scattered through more open areas.	
4	Zone of rank tall herb fen dominated by *Filipendula ulmaria*, with abundant *Arrhenatherum*, forming transition to grassland.	

#	Description	Photograph
5	View downstream from area of seepage toward top of side valley	
6	Small depression with vegetation dominated by *Juncus inflexus* - looks like small spring.	

#	Description	Photograph
7	Extensive rank *Arrhenatherum* grassland.	
8	Small stream fed by spring. Vegetation with abundant *Juncus inflexus*, over tufa-rich ground with *Cratoneuron filicinum*.	

#	Description	Photograph
9	Over-deepened stream with rank tall herb vegetation on banks.	
10	Rank calcareous grassland on bank above footpath, with abundant *Bromopsis erecta.*	

#	Description	Photograph
11	Grassland with *Centaurea nigra* along footpath.	
12	Vegetation zonation around small stream draining side valley, with rank grassland on valley slopes and zones of tall herb fen and *Phragmites australis* along stream.	

#	Description	Photograph
13	View from above into floodplain of Pennyhooks Brook.	
14	Bottom of main valley viewed from slopes above, looking toward Pennyhooks Brook, and showing extensive stand of *Phragmites australis* extending into valley along tributary stream.	

#	Description	Photograph
15	Stand of *Phragmites australis* along lower part of tributary stream.	
16	Rank vegetation on bank, with small zone mid-slope dominated by *Filipendula ulmaria* and *Carex acutiformis*, flanked by vegetation with abundant *Filipendula* but in which *Arrhenatherum* is dominant.	

#	Description	Photograph
17	Tall herb fen in valley bottom, with transition to grassland on slope above. Darker area on slope marks a stand of tall herb fen vegetation (target note 16).	
18	Tall herb fen in valley bottom, with zone of *Phragmites australis* along stream at junction between main valley and smaller valley.	

#	Description	Photograph
19	Tall herb vegetation in bottom of valley along Pennyhooks Brook.	
20	Swamp vegetation in paleochannel, dominated by *Carex riparia* and *Sparganium erectum.*	

#	Description	Photograph
21	Oxbow dominated by *Glyceria maxima.*	
22	Mature Alder tree on bank of Pennyhooks Brook.	

#	Description	Photograph
23	Valley bottom with rank tall herb fen dominated by *Filipendula ulmaria*, tall ruderal vegetation dominated by *Urtica dioica*, and small relict stream channels with swamp vegetation.	
24	View of valley bottom area where it meets tributary valley, with extensive tall herb vegetation.	

#	Description	Photograph
25	Rank tall herb fen with *Phragmites australis.*	
26	Rank vegetation in floodplain, dominated by *Urtica dioica* with stands of *Carex riparia* in paleochannels.