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New Forest Wetland Restoration Vegetation Monitoring: Penny Moor, 2024
Higher Level Stewardship Agreement. The Verderers of the New Forest AG00300016.

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Summary

Penny Moor is a small wetland site in the New Forest Site of Special Scientific Interest. It was subject to significant modifications in the 1960s that were designed to increase the drainage of the surrounding land. This resulted in straightened and deepened watercourses lacking geomorphological diversity and with only limited interaction with the floodplain, together with the loss and degradation of the associated freshwater and wetland habitats and the characteristic species assemblages dependent upon them.

The site was considered to be in unfavourable and declining condition due to the effects of the drainage works and therefore a first phase of restoration to return the watercourse to its old meanders was undertaken in 2013 by Forestry England. Part of the artificial drain supporting typical New Forest wetland flora was retained. Some repair work was carried out in 2020, together with the installation of a stock crossing to reduce erosion. Further works were planned for 2024 on part of the site to complete the restoration by removing remaining spoil embankments and raising the bed level of part of the drainage ditch to improve the interaction with the floodplain. Although the site remains compromised by the railway embankment and culvert, project partners hope that this restoration work will restore the natural hydrological functioning of the site as far as is possible.

The New Forest Freshwater and Wetland Restoration Plan (FWRP) has been developed on behalf of the New Forest Freshwater and Wetland Restoration Forum to establish common ground and provide guidance on the overall restoration process, including establishing overall objectives, criteria for the selection of sites for restoration, likely measures of success, pre-restoration surveys, restoration protocols and appropriate monitoring. This plan is now available. Although most of the restoration pre-dates the plan, Forestry England commissioned habitat, vegetation and species surveys as recommended within the plan to inform subsequent evaluation of the latest phase of the restoration.

These surveys show that Penny Moor supports a range of wetland types that align well with those described within the FWRP, such as Wet Lawn, Ephemeral Pools and Channels, Poached and Disturbed Habitat, Wet Heath, and Valley Bog. The retained drains support a complex mosaic of Soakway vegetation, Ephemeral Pool vegetation and rush pasture and are of value in their own right. The restored watercourse now corresponds well to Slow-flowing Oligotrophic Stream and supports two rare species, Pillwort *Pilularia globulifera* and Hampshire-purslane *Ludwigia palustris,* which have colonised from the drains. However, at the time of the survey, the Wet Lawn remained locally compromised by spoil banks while the central drain probably constrains the Valley Bog. An area of excessively poached Wet Lawn is impacted by concentrated livestock movements around the bridge, where there is a degraded pool.

The results will provide a useful baseline against which to measure the success of the second phase of the restoration.

Contents

Acknowledgements

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1. Introduction

Background to freshwater and wetland restoration in the New Forest

1.1 The freshwaters and wetlands of the New Forest are of exceptional importance at an international level for the habitats and species they support. However, the New Forest has a history of freshwater and wetland modifications that have impacted on the interest features of the New Forest protected sites (Site of Special Scientific Interest, Special Area of Conservation, Special Protection Area and Ramsar site). For over 20 years, work has been undertaken in the New Forest to remove modifications and reinstate natural processes as the driving force behind naturally functioning habitat mosaics that support characteristic assemblages of species.

Penny Moor

1.2 Penny Moor is a small site situated about 1.5km due south of Beaulieu Road station, between the south-west main line and Pig Bush Inclosure. It encompasses an area of wet lawn, wet heath and valley mire in the upper catchment of the Shepton Water (see Map 1).

1.3 Wetland restoration work was carried out at Penny Moor within the New Forest SSSI in 2013. The SSSI unit (428) within Penny Moor was considered to be in unfavourable and declining condition due to the effects of artificial drainage (carried out in the 1960s), which was causing increased erosion of the stream bed, constraining valley mire habitat and reducing the interaction between the watercourse and its floodplain. The restoration included the reconnection of meanders including the installation of a clay bund to help block off flow into the old drainage ditch and infilling of the northern arm of the ditch with heather bales. Additional work was carried out in 2020 to repair the clay bund and install a stock crossing.

1.4 Further works were planned in 2024 to:

- Remove remaining bankside spoil
- Raise the bed level of the drain upstream of the existing bridges
- Remove the bridges and retain gravel stock crossings
- Excavate a very shallow channel in the wet lawn and connect it to the old drain

- Level the bankside spoil and infill the old drain running south of the restored watercourse (see Map 1), replacing the surface vegetation.

1.5 Although the site remains compromised by the railway embankment and culvert, project partners hope that this restoration work will restore the natural hydrological functioning of the site as far as is possible.

Freshwater and wetland restoration monitoring

1.6 The New Forest Freshwater and Wetlands Restoration Strategy 2019 (Hill et al., 2019) was developed with a wide range of stakeholders. Among other aspects, this strategy highlighted the need for effective monitoring and in 2022 the New Forest Freshwater and Wetlands Evidence and Monitoring Plan was finalised (Lake, 2022) and now forms part of the New Forest Freshwater and Wetland Restoration Plan (FWRP). The plan sets out recommendations for both pre-restoration surveys and post-restoration monitoring, and includes a number of monitoring principles and recommended approaches. Following a trial in 2022 (Lake, Bishop, et al., 2023; Lake, Shellswell, et al., 2023), Forestry England has now adopted the approach and has commissioned surveys for subsequent restoration work.

1.7 The approach entails "meso-habitat" mapping in order to provide evidence of any change in extent of the specific meso-habitats that are an important feature of the New Forest wetlands and are described within the FWRP. While specific targets for increases in area are not appropriate, as changes will be driven by natural processes and the exact outcome cannot be predicted, an overall increase in the extent and diversity of wetland habitats is desirable. Meso-habitat mapping is recommended because UKHab[1] does not adequately differentiate these habitats while National Vegetation Classification (Rodwell, 1991), although providing more detail about the vegetation communities, does not show the distribution and extent of the habitats without further interpretation. In addition, in many cases, small-scale features are often mapped as a mosaic rather than individually.

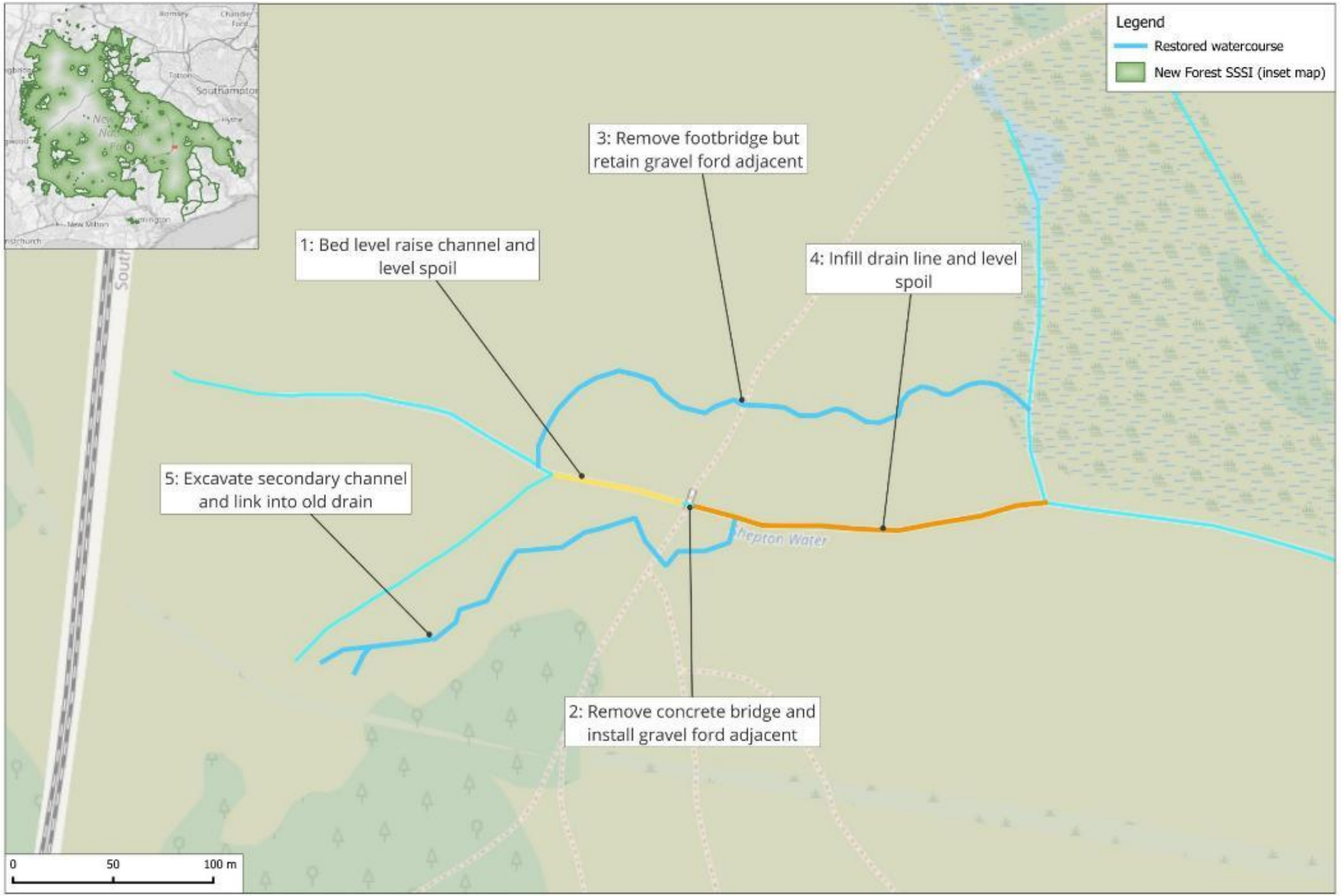
1.8 The monitoring also includes more detailed vegetation surveys to assess the quality of the restored habitat – for example, changes in the cover and diversity of Bog-mosses *Sphagnum* sp. in the mire, or presence of characteristic species such as Pillwort *Pilularia globulifera* in poached marginal habitat.

[1] https://ukhab.org/

1.9 For sites where restoration work has already been undertaken, such as Penny Moor, direct comparison with previous data is not usually possible because, although vegetation may have been described prior to the restoration, generally only a small number of quadrats were undertaken to inform an NVC survey. However, in such cases, meso-habitat mapping and more detailed work can be undertaken in order to describe the vegetation at the interim point and provide a baseline for future surveys.

1.10 In addition, at Penny Moor, a rare plant survey was carried out (recommended as part of pre-surveys in the FWRP) to inform restoration work.

Map 1: Penny Moor restoration works



2. Methods

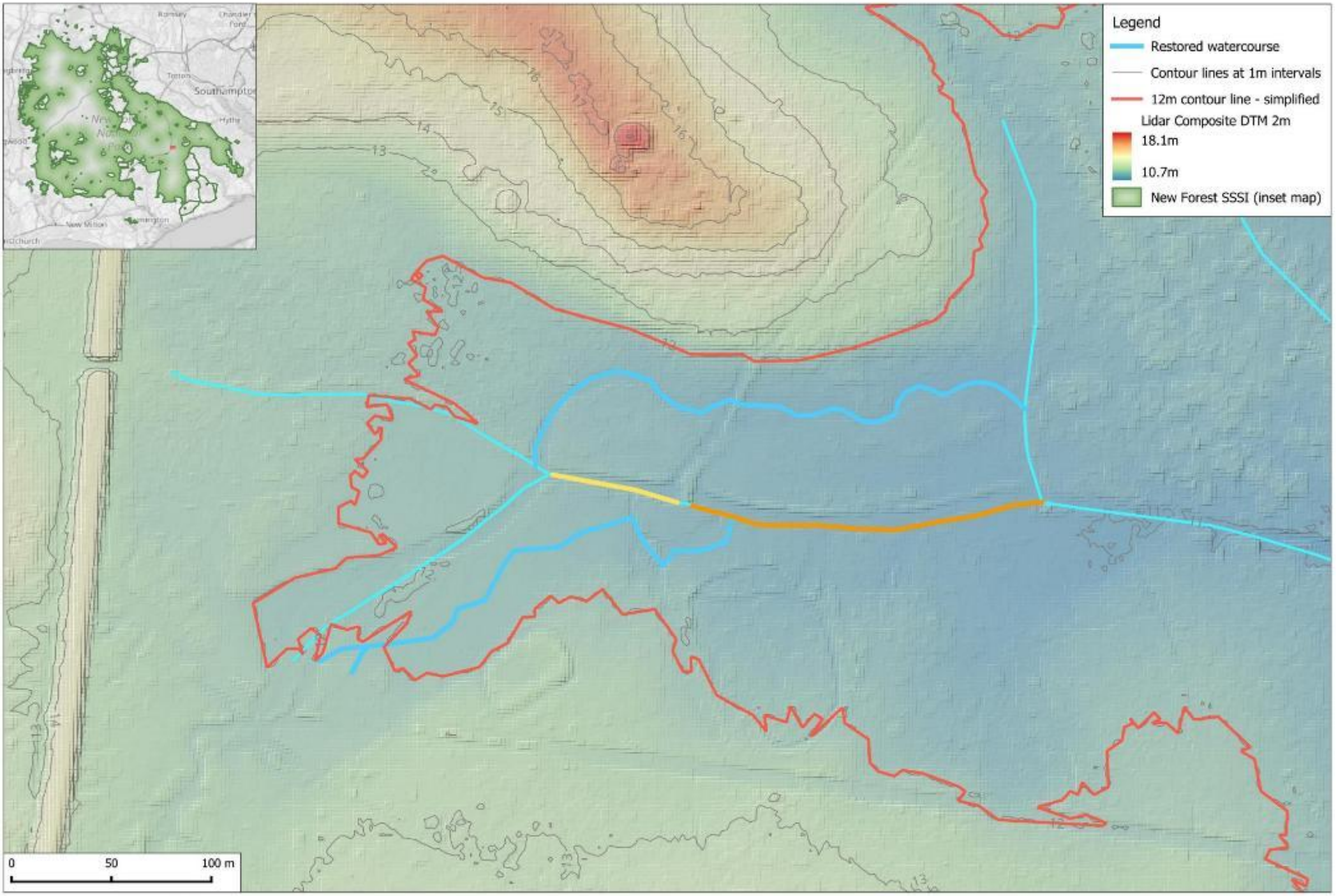
Determining the site boundary

2.1 A monitoring site boundary was identified in order to provide a definitive limit to the survey area to enable comparisons of the extent of different habitats present over time.

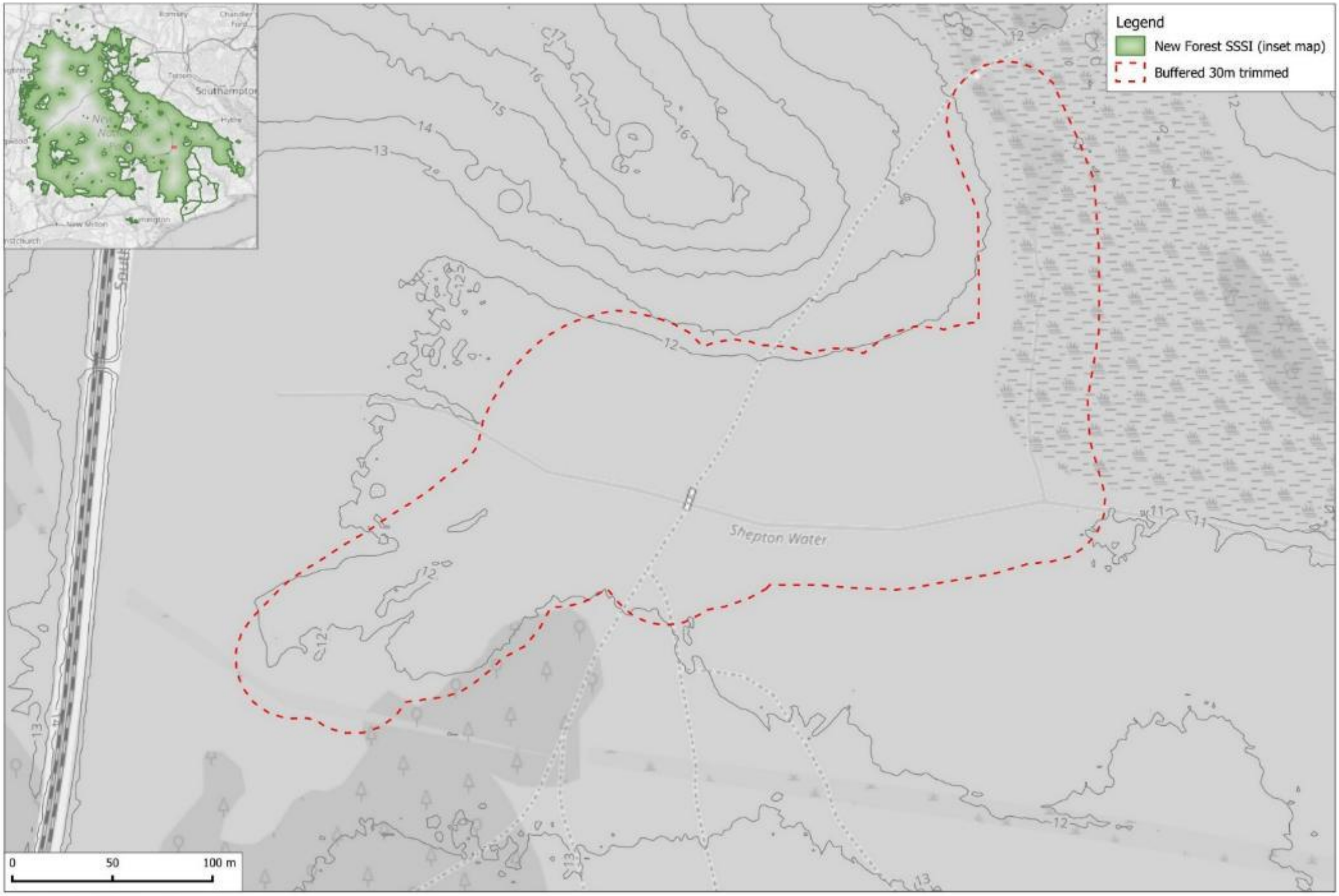
2.2 We used the Environment Agency 2019 Lidar Composite Digital Terrain Model (DTM) which is a raster elevation model. 'Watershed' and 'water outlet' tools were executed in QGIS to define a basin for the site. The elevation was then added to the basin layer so that an appropriate maximum height could be selected, as a basis for the site boundary (see Map 2). The 12m boundary was used.

2.3 On examination and consultation with Forestry England and Natural England staff, this boundary was felt to include a greater area of floodplain lawn than was likely to be impacted by the 2024 restoration work, which was relatively limited in extent. Therefore, the map was used to inform the choice of a 30m buffer from all watercourses (i.e. the restored watercourse and the drains) to create the final boundary. This is shown in Map 3. The western arm of the watercourse was originally intended to be included, but this area of wet valley mire was excluded due the presence of waders during the breeding season when the surveys were carried out.

Map 2 Potential site boundary bsed on Lidar and contour lines



Map 3: Final site boundary



Fixed point photography

2.4 Fixed points were established to enable a comparison of interim and post-restoration conditions. The points are shown in Map 4a and were selected to show key features and habitats, particularly where these are likely to change as a result of the restoration work carried out later in the summer of 2024 (see Map 1).

Meso-habitat mapping and detailed vegetation survey

2.5 Mapping was undertaken within the monitoring boundary using a combination of desk-based examination of aerial imagery combined with field work and were digitised using QGIS 3.34.13. Habitats were characterised by the typology presented in the FWRP. The central drain and southern drains support a complex mix of Soakway transitional to Ephemeral Pool vegetation with floating masses of very swampy rush pasture and marginal Poached and Disturbed Habitat later in the survey period, and were therefore mapped as discrete entities rather than the complex mosaic of habitats that they support.

2.6 Poached and Disturbed Habitat, which could be considered as a condition that applies to any meso-habitat, rather than a habitat in its own right, was found in Ephemeral Pools and Channels (which were generally quite trampled by livestock). The site dried out quite quickly during the survey period, and this habitat also started appearing along the edges of the drains as the water level dropped. These areas were too narrow to map separately and are therefore described as a component of the underlying habitat in this case.

2.7 Field work was undertaken between 3rd and 24th June 2024. It was constrained by the presence of waders in the western arm of the mire, therefore the area west of the track and north of the central drain was avoided.

Map 4a: Locations and directions of fixed point photos

Detailed vegetation monitoring of wetland habitats

2.8 Using the habitat maps, random points were generated within the wetland meso-habitats as follows:

1. Polygons of the same meso-habitat type were merged and non wetland habitat deleted (wet heath was included).
2. Polygons were buffered internally by 10m, to ensure that each quadrat would be at least 10m from the edge of the polygon (to allow for mapping inaccuracies).
3. 15 random points were created within each habitat, with a minimum distance of 10m between points.

2.9 More points were created than were required so that any points that were found to fall within a different habitat to the one allocated (e.g. due to complex habitat mosaics) could be replaced by another random point. However, if required, surveyors moved points onto the nearest example of the habitat. Table 1 shows the number of quadrats recorded within meso-habitats present within the study area at Penny Moor. A minimum of 10 quadrats were recorded from each habitat type. Drain quadrats were split equally between the shallow southern drain (which will be retained) and the central drain (which will be infilled).

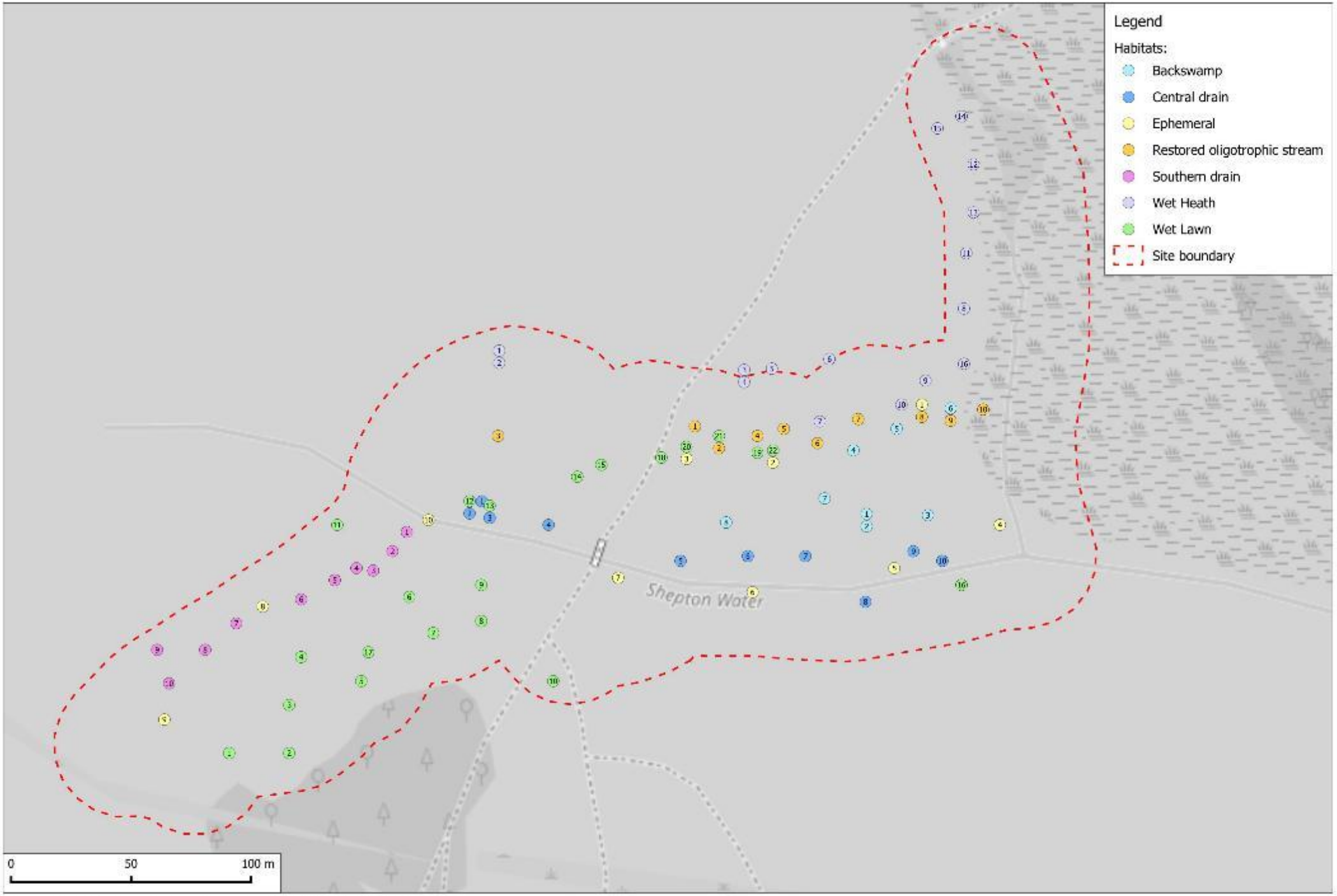
2.10 The percentage cover of vascular plants, bryophytes and lichens were recorded from one 2m x 2m quadrat at each random point. Linear quadrats of 1m x 4m or 0.5 x 8m were used where necessary, for example, for marginal or in-channel vegetation. The percentage of bare ground, open water, litter and dung was also recorded and the bulk of the vegetation (using a drop disc of 15cm diameter, 200g weight). Photographs of each quadrat were also taken for reference. Quadrat locations are shown in Map 4b below.

Table 1: Distribution of quadrats between different meso-habitat types at Penny Moor.

New Forest habitats	No. of quadrats
Lowland wet heathland	16
Wet lawn (including Backswamp)	22 (10)
Ephemeral pools and channels	10
Oligotrophic stream (restored)	10
Drain (Southern and Central)	20

2.11 Note that height measurements were not taken in the restored watercourse as the plants were insufficiently emergent for the drop disc technique to work (i.e. it tended to come to rest on the water surface).

Map 4b: Locations of quadrats



Rare plant survey

2.12 The rare plant survey included recording all rare plants encountered during the meso-habitat mapping and quadrat recording. This was informed by the rare plant survey carried out in 2012 prior to restoration (Sanderson, 2012). The inclusion criteria were based on those used by Sanderson:

- BAP Priority/NERC Section 41 species as listed in Biodiversity Reporting and Information Group (2007) and on the "Natural England" website for all groups studied.
- All Red Data Book species with a threat status of Near Threatened or higher as listed in Cheffings & Farrell (2005) for vascular plants, in Hodgetts (2011) for bryophytes and Woods & Coppins (2011) for lichens.
- All nationally Notable species; these are defined as all Nationally Rare or Nationally Scarce species not included in the above categories. Nationally Rare and Scarce are as defined by the distributions of vascular plants in Preston et al. (2002) the bryophytes listed in Preston (2006) and lichens listed in Woods & Coppins (2011).
- County rare species as listed by Rand & Mundell (2011).
- Localised species of ecological significance within the New Forest, for instance rare relic trees such as Wych Elm or Small-leaved Lime and species such as Climbing Corydalis or Royal Fern which are not actually rare or particularly significant but have been regarded as of interest at some point and are therefore listed on the New Forest rare plant database.

2.13 Rare plant locations were provided to Forestry England staff prior to the restoration work being carried out.

3. Results

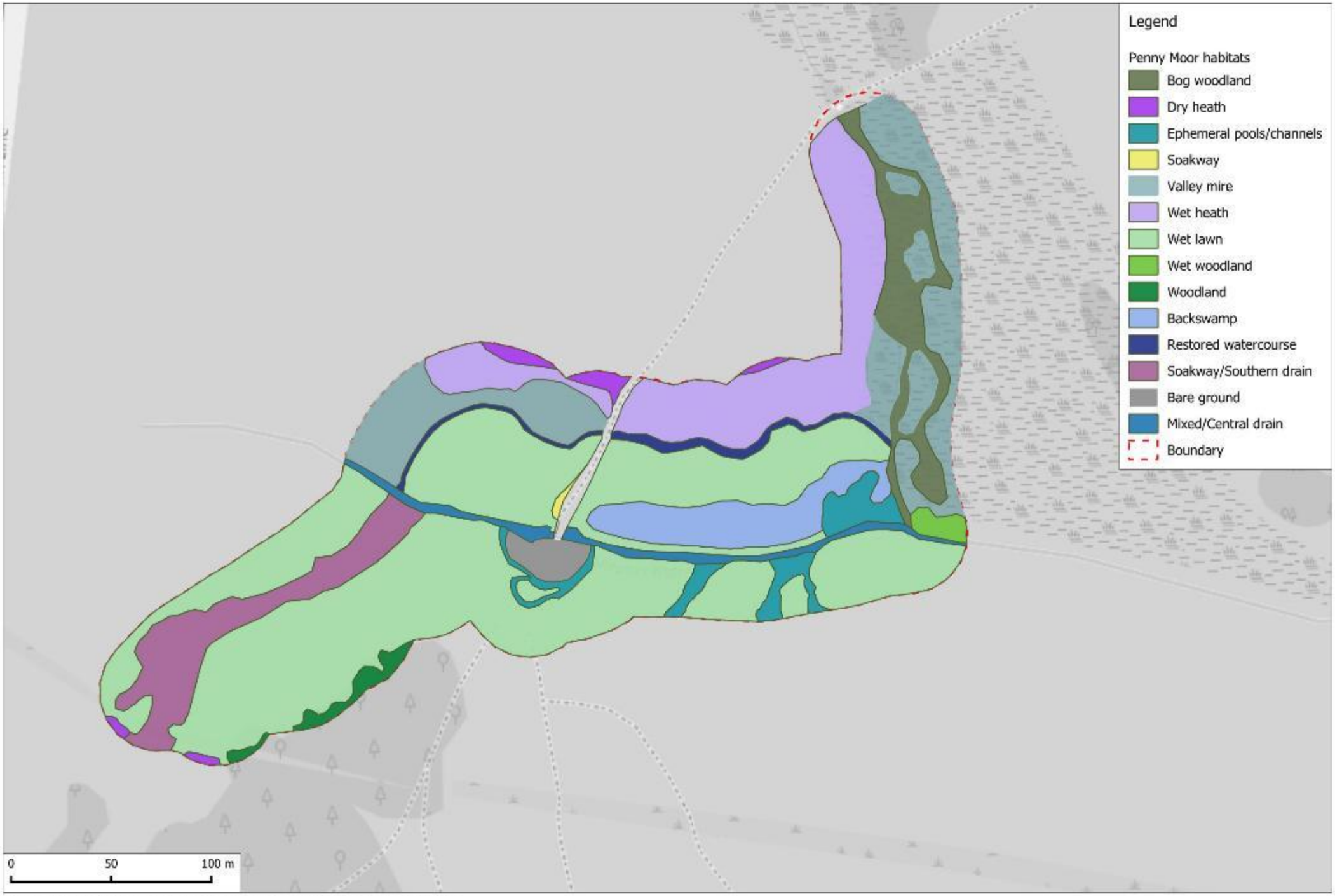
Meso-habitat mapping

3.1 Map 5 shows the results of the meso-habitat mapping at Penny Moor. The shaded rows indicate the habitats that were taken forward for more detailed vegetation surveys. Other habitats were excluded (after discussion with Forestry England) either because they were too small (e.g. Soakway), or were not considered immediately relevant to the 2024 restoration work.

Table 2: The area of different meso-habitat and broader habitat types mapped at Penny Moor in 2024. Meso-habitats as described in the Freshwater and Wetland Restoration Plan are in bold (including complex combinations).

New Forest habitats	Area (ha)
Wet lawn	2.69
Lowland wet heathland	0.75
Drain (including **Soakway/Ephemeral Pools/**rush pasture)	0.48
Backswamp (Wet Lawn)	0.28
Ephemeral pools and channels	0.18
Oligotrophic stream	0.08
Valley Mire	0.77
Bare ground	0.07
Dry woodland	0.06
Bog Woodland	0.31
Wet Woodland	0.03
Dry heath	0.06
Soakway	0.01

Map 5: Meso-habitats



Vegetation

3.2 Figures 1-12 and Table 3 provide summary data about the vegetation surveyed in 2024 (i.e. sward bulk, species-richness and percentage cover of bare ground, plant litter and key plant groups). The raw data are provided in an Excel spreadsheet accompanying this report – species lists for each habitat type can be found in Appendix 1. The graphs are box plots in which the solid box shows the interquartile range, with the median value represented by X. Whiskers indicate the minimum and maximum values.

Wet Heath

Figure 1: Wet Heath north of the restored meanders.

3.3 Lowland wet heath (see Figure 1) forms a narrow zone between the Wet Lawn and Dry Heath in the north of the site, where the land begins to rise. It was quite wet at the time of the survey. It is characterised by large tussocks of Purple Moor-grass *Molinia caerulea* plus Cross-leaved Heath *Erica tetralix*, Bog Myrtle *Myrica gale* and some Heather *Calluna vulgaris*. This taller vegetation is interspersed with mini-lawns of up to 7 species of bog moss

(typically *Sphagnum denticulatum* and *Sphagnum tenellum)*, small sedges (e.g. Carnation Sedge *Carex panicea*, Common Sedge *Carex nigra*, Star Sedge *Carex echinata* and Yellow Sedge *Carex demissa*), rushes (e.g. Jointed Rush *Juncus articulatus* and Bulbous Rush *Juncus bulbosa*) and Common Cottongrass *Eriophorum angustifolium*. More occasional herbs include Oblong-leaved and Round-leaved Sundew *Drosera intermedia* and *D. rotundifolia*, Tormentil *Potentilla erecta* and Heath Milkwort *Polygala serpyllifolia*. West of the track, the Wet Heath is more transitional to Wet Lawn, with tussocks of ericoids interspersed with grassy lawn vegetation (see Wet Lawn). The area surveyed is representative of the Wet Heath described in the New Forest FWRP.

3.4 Note that several planned quadrats west of the track were omitted due to the presence of waders.

Wet Lawn

Figure 2: Wet Lawn in the southern half of the site (LEFT) and the backswamp north of the drain (RIGHT).

3.5 Wet Lawn is the most extensive habitat mapped within the study boundary and predominates south of the valley mire and drain. It is close-grazed and dominated by fine grasses, typically Velvet Bent *Agrostis canina*, and short sedges with a range of typical Wet Lawn herbs including Meadow Thistle *Cirsium dissectum*, Marsh Pennywort *Hydrocotyle vulgaris*, Cuckoo Flower *Cardamine pratensis,* Greater Bird's-foot-trefoil *Lotus pedunculatus*, Lesser Skullcap *Scutellaria minor* and Marsh Bedstraw *Galium palustre*. There are some very closely-grazed Heather bushes. Mosses include *Calliergonella cuspidatum* and *Sphagnum denticulatum*. In some areas a fine-grained mosaic is present, with wetter areas supporting Soakway species such as Bog St.

John's-wort *Hypericum elodes*, Many-stemmed Spike-rush *Eleocharis multicaulis*, Water Mint *Mentha aquatica,* Lesser Skullcap and Lesser Spearwort *Ranunculus flammula*, while hummocks support Self-heal *Prunella vulgaris*, Bog Pimpernel *Lysimachia tenella*, Marsh Pennywort, Common Sedge and bog-mosses. Bare ground is frequent – poached areas are described under Poached and Disturbed habitat. This habitat conforms well to the rush form of Wet Lawn as described in the FWRP.

3.6 The spoil bank along the north side of the drain (see Figure 2) supports species typical of drier conditions including Tormentil, Creeping Buttercup *Ranunculus repens* and Common Bent *Agrostis capillaris* and Field Wood-rush *Luzula campestris*, although some typical Wet Lawn species persist, including e.g. Common Lousewort *Pedicularis vulgaris*, Jointed Rush, Marsh Pennywort, and this area was mapped as Wet Lawn.

3.7 The spoil bank prevents water from flowing directly into the drain, creating a 10m wide "backswamp" with Soakway species such as Bog St. John's-wort and Bog Pondweed while drier tussocks support Meadow Thistle and Purple Moor-grass and there is a canopy of Bog Myrtle (note that Soakway vegetation is typical of seasonally wet depressions within Wet Lawn). At the eastern end of the site, there is a significant area of pooled water held back by the spoil banks. Closer to the restored channel, the vegetation is dominated by Jointed Rush with few species and less Bog Myrtle. This apparently more acidic area corresponds well with the less fertile Purple Moor-grass form of Wet Lawn of backswamps and headwaters described in the FWRP, although with significant cover of Bog Myrtle, which, together with the Soakway species, indicates that there is some water flow.

Ephemeral Pools and Channels/Poached and Disturbed Habitat

3.8 At Penny Moor, seasonal pools and channels are found in the Wet Lawn (see Map 5). In general, this vegetation is quite poached with a high cover of bare ground - around 60% (see Table 3) and corresponds well to slow flowing channels/wet lawn pans, which is very similar to Poached and Disturbed Habitat of low-nutrient headwater floodplains. Poached and Disturbed Habitat was also found along the margins of the watercourses as the water level dropped during the survey period. However, these areas were too small to map and these two types of habitat were sampled together.

3.9 Ephemeral Pools and Channels and marginal Poached and Disturbed Habitat supports a range of species. In some places this includes the rare/vulnerable species Hampshire-purslane *Ludwigia palustris*, Pillwort *Pilularia globulifera,*

Lesser Water-plantain *Baldellia ranunculoides* and New Forest Water-crowfoot *Ranunculus x novae-forestae* as well as Water-pepper *Lythrum portula,* Jointed Rush, Bulbous Rush, Lesser Spearwort, Small Sweet-grass *Glyceria declinate*, Floating Club-rush *Eleogiton fluitans,* Water Starwort *Callitriche* etc.

Figure 3: Poached and Disturbed Habitat in an old channel, supporting New Forest Water-crowfoot (LEFT) and on the margins of the southern drain (RIGHT) supporting Pillwort, and Lesser Water-plantain.

3.10 On the southern side of the drain at the bridge, there is a significant area of heavily poached mud (see Figure 3). This is unvegetated, and does not fall within the description of Poached and Disturbed Habitat. It was excluded from the mapped area of Wet Lawn.

Figure 4: Poached area south of the bridge.

Drain and Soakway

3.11 The straight central drain (see Figure 5Figure 3) has become partially infilled and the banks are now broken down. It now supports transitional vegetation somewhere between Soakway vegetation typical of the margins of Slow-

flowing Oligotrophic Streams (Soakway) and that of Ephemeral Pools, while there is a central mass of floating rush pasture vegetation which, due to its precarious location, is only lightly grazed. The channel is species-rich, with on average 15 species per quadrat and 38 recorded overall from the quadrats. Hampshire-purslane and Pillwort are frequent and abundant along the shallow margins, while the central floating mats of vegetation support the rare species Tubular Water-dropwort and Lesser Marshwort among rushes, Common Cottongrass, Branched Bur-reed *Sparganium erectum*, Bogbean *Menyanthes trifoliata,* Lesser Water-plantain, Lesser Spearwort, Greater Bird's-foot-trefoil, Water-purslane, Water Mint with Bog Pondweed and Water-crowfoots. Unfortunately, New Zealand Pigmyweed *Crassula helmsii* was present in one quadrat.

3.12 The overall cover of vegetation is higher than in the Southern Drain (see below and Figure 10) and there is a higher cover of herbs in particular (see Figure 11). The sward bulk is a little greater.

Figure 5: The central drain with its spoil embankment on the left and Wet Lawn on the right.

3.13 A significant eroded pool is located by the bridge (removed as part of the restoration). This is a modified feature, rather than a typical floodplain of stream pool and is largely unvegetated (see point 4 in Table 5 below).

3.14 The stabilised southern drain (see Figure 6) is also straight but up to 9m wide, although this varies, and with very extensive marginal vegetation (there are no spoil heaps). This includes more Bog St. John's-wort than the central drain, suggesting more water movement, also more Many-stemmed Spike-rush. Pillwort is again present wherever the margins are shallow, and both Tubular Water-dropwort and Lesser Marshwort are again present in the central floating mass of vegetation in the northern section together with Marsh Speedwell and Common Spike-rush *Eleocharis palustris.* This channel is also very species-rich, with on average around 12 species per quadrat (see Table 3).

3.15 New Zealand Pigmyweed *Crassula helmsii* was present in 7 quadrats.

Figure 6: The southern drain. The broad shallow margins support abundant Floating Club-rush and Hampshire-purslane with Pillwort, while the floating mat of taller vegetation (to the right of the photo) supports Tubular Water-dropwort and Lesser Marshwort.

3.16 The more natural form of the restored channel (see Figure 7) makes it visually distinctive compared to the two drains, as it is very shallow and is sinuous in form. It is fairly well-vegetated and there is an uninterrupted gradation from open water through poached margins to rush dominated Wet Lawn, with no vertical bank. The vegetation is characterised by typical Slow-flowing Oligotrophic Stream species, including Floating Club-rush, Common Cottongrass, Jointed Rush, Round-leaved Water Crowfoot, Cuckoo Flower, and Narrow-fruited Watercress. The rare species Hampshire-purslane and Pillwort have also colonised, although are less widely distributed than the drains. Bog Pondweed and Bog St. John's-wort are also less frequent. Spiked Water-milfoil *Myriophyllum spicatum* was locally frequent (although not recorded within quadrats).

3.17 Species-richness within the restored channel is currently less than the well-established drains (19 species in 10 quadrats – see also Figure 9) and the cover of vegetation lower (see Figure 10), particularly for herbs (see Figure 8). The vegetation is also currently more homogenous than that of the drains (e.g. as seen in the smaller range bars in Figure 7).

Figure 7: The restored channel, looking upstream towards the mire.

Figure 8: Box plots indicating the cover of different plant groups according to habitat type at Penny Moor.

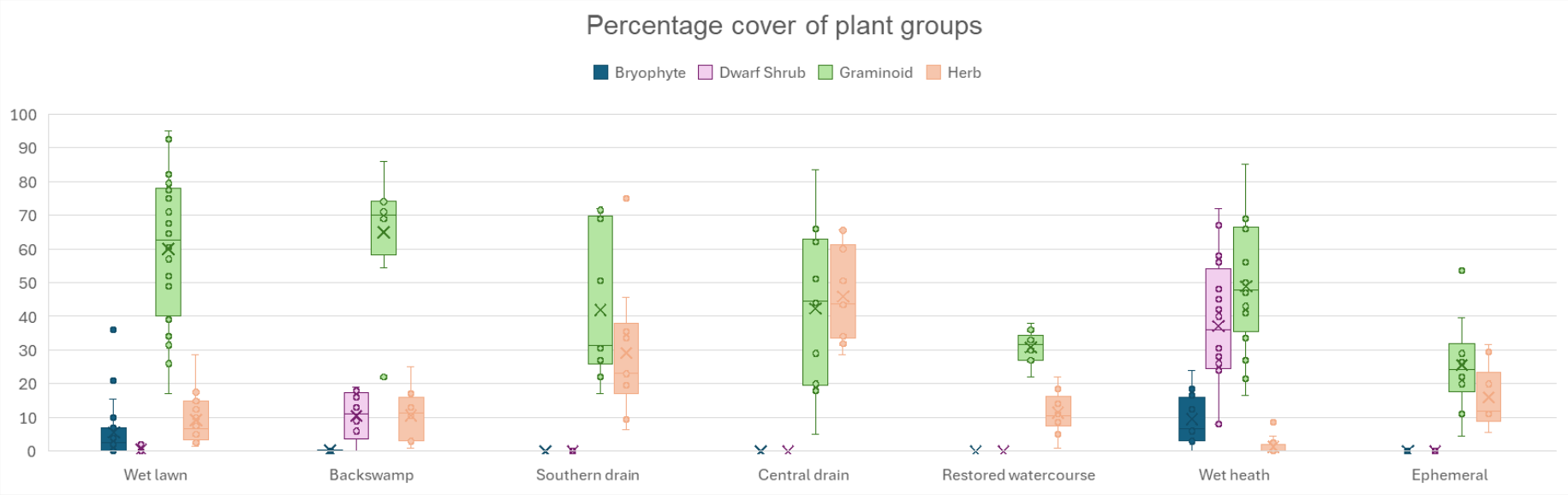


Table 3: Species richness and other variables recorded from quadrats within each wetland habitat type surveyed at Penny Moor.

	Wet lawn	Bog Myrtle lawn	Southern drain	Central drain	Restored watercourse	Wet heath	Poached and disturbed
Species richness	13 (+/-1.1)	12.5 (+/-1.1)	11.8 (+/-0.6)	15.9 (+/-1.3)	8.1 (+/-0.6)	14.2 (+/-1.4)	13 (+/-0.8)
Vegetation bulk (cm)	6.8 (+/-0.6)	12.8 (+/-1.2)	15.4 (+/-4.9)	18.1 (+/-4.9)	-	19.8 (+/-1.7)	4.6 (+/-0.7)
Bare ground (%)	23.9 (+/-3.2)	4.6 (+/-2.1)	0.9 (+/-0.9)	0	0	6.5 (+/-1.8)	61 (+/-3.6)
Total veg cover (%)	75.3 (+/-4.3)	86.3 (+/-5.9)	71.2 (+/-9.8)	88.2 (+/-5.6)	42.2 (+/-1.9)	96.8 (+/-2.4)	41.6 (+/-3.8)
Leaf litter (%)	0	7.1 (+/-2.6)	0	0	0	0.7 (+/-0.3)	0
Dung (%)	0.1 (+/-0.1)	0.5 (+/-0.2)	2.4 (+/-1.7)	0	0	1.1 (+/-0.5)	0

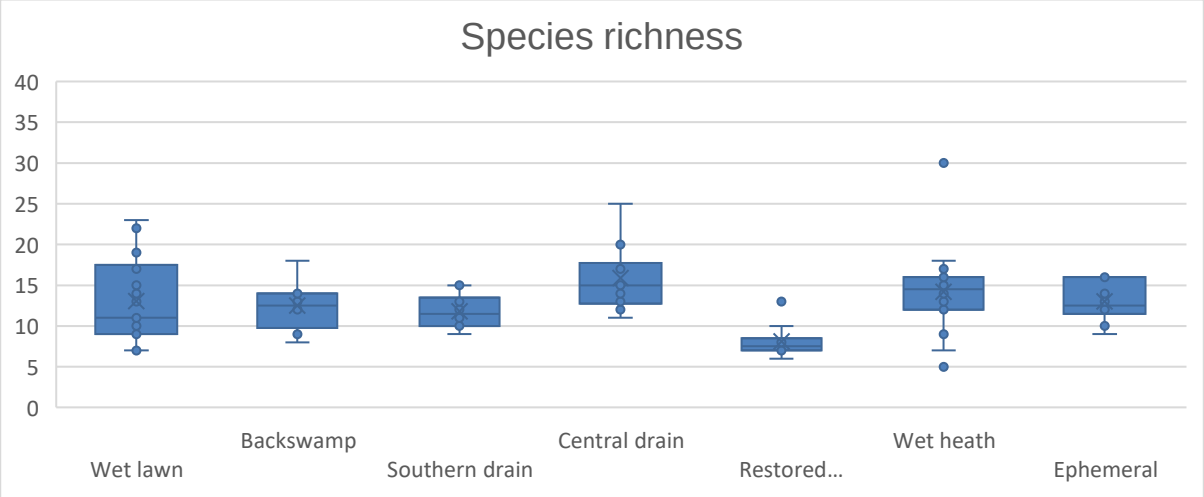


Figure 9: Average species richness within different meso-habitat and areas at Penny Moor in 2024.

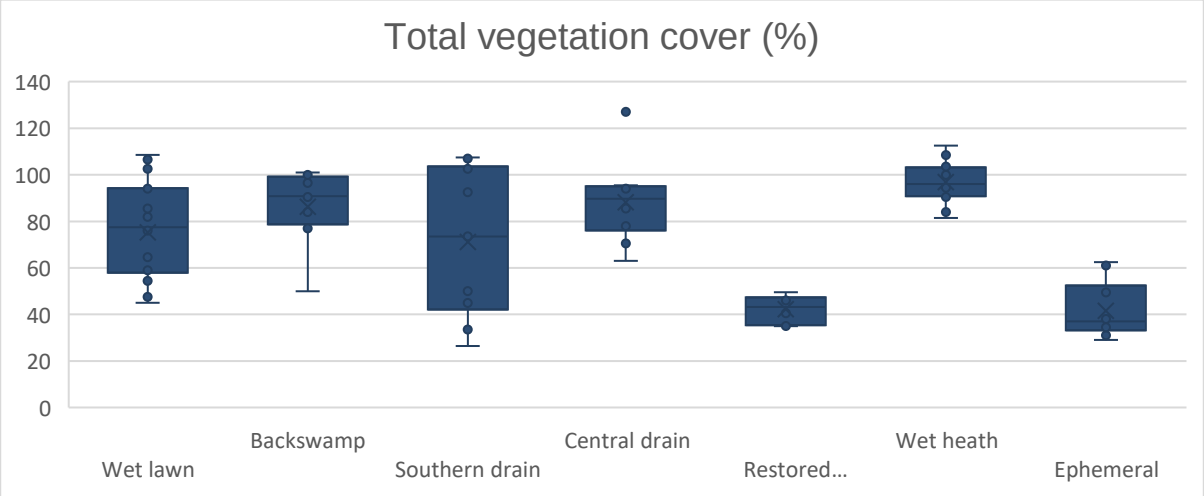


Figure 10: Average total vegetation cover (i.e. all plant groups summed) within different meso-habitats and areas at Penny Moor in 2024. Totals over 100% indicate a more complex sward structure in which different species overlap.

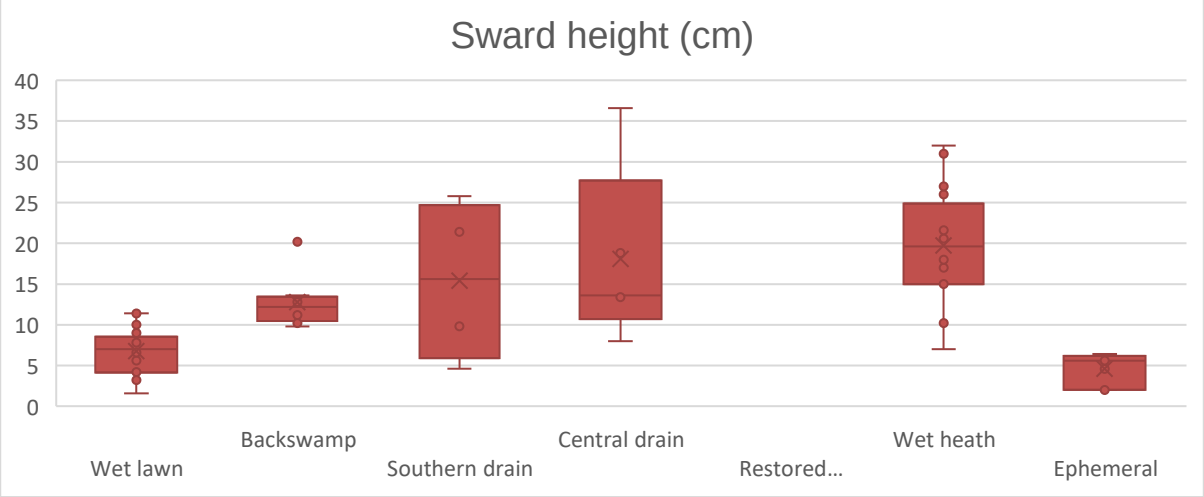


Figure 11: Average sward height measured by drop disk within different meso-habitat and areas at Penny Moor in 2024 (sward height was not measured for the Restored watercourse).

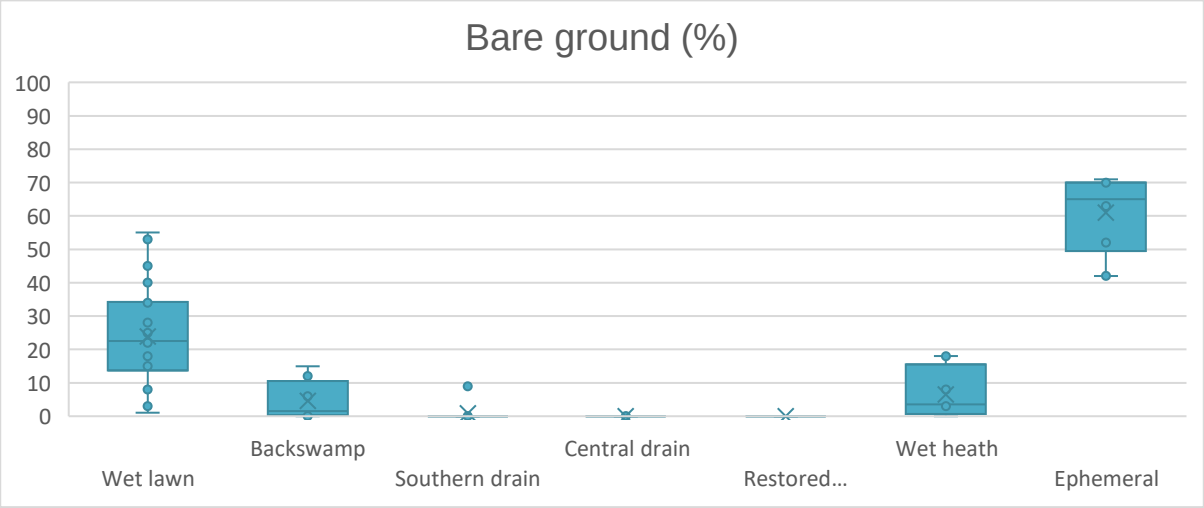


Figure 12: Average cover of bare ground within different meso-habitat and areas at Penny Moor in 2024.

Rare plants

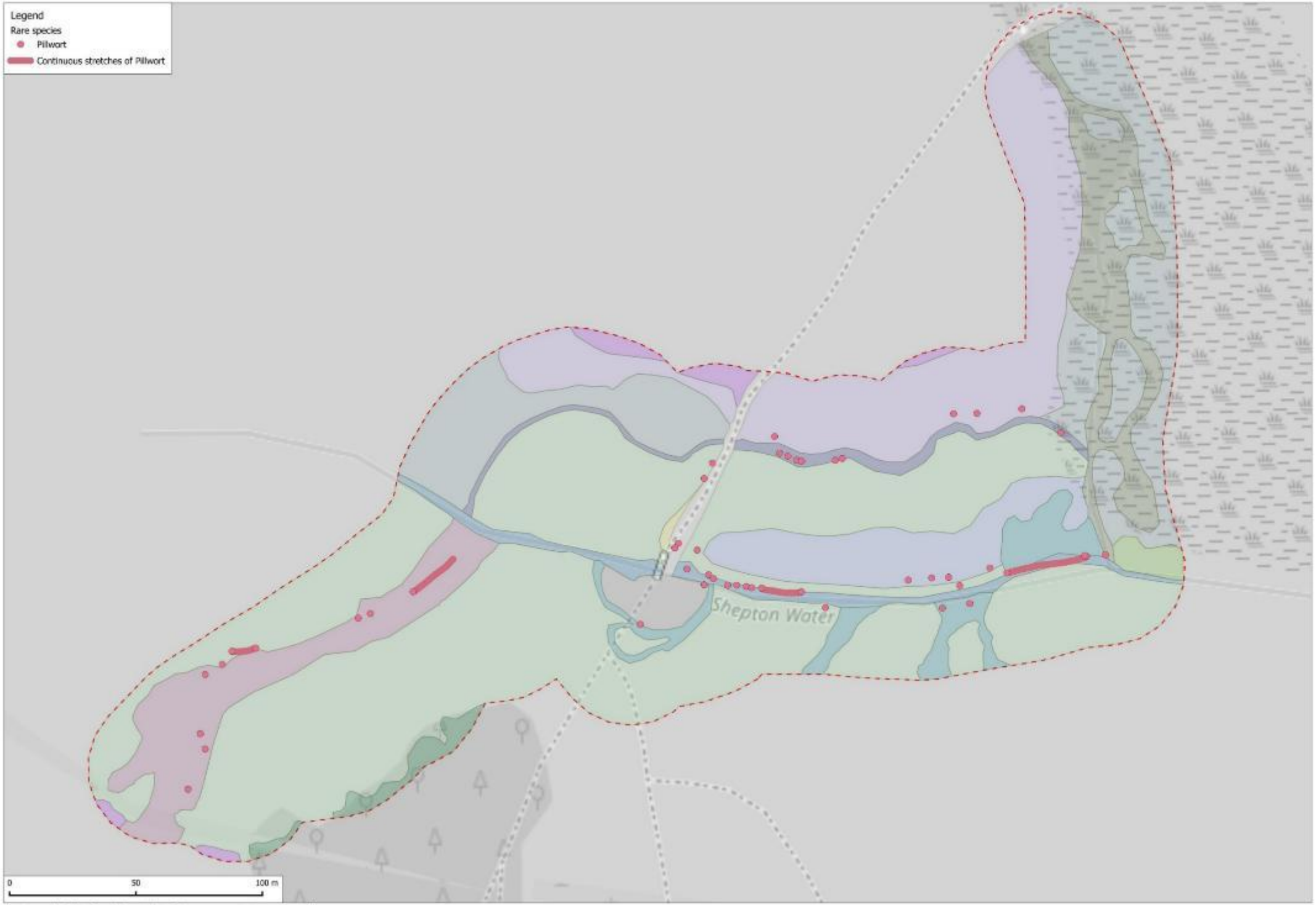
3.18 Nine rare plant species were recorded during the survey in 2024. These are listed in Table 4 and locations shown in Maps 6-9. Grid references of these records are listed in Appendix 2. Rare species data obtained from the Hampshire Biodiversity Information Centre (HBIC) are shown in Appendix 3 for completeness, but are generally mapped at a lower resolution, making them more difficult to interpret. Only one species noted in 2014 within the study area was not relocated in 2024. This was Lesser Butterfly-orchid *Platanthera bifolia*, for which there was a record near the bank in the south-west of the study area (an area unlikely to be affected by the restoration).

Table 4: Notable plant species recorded in 2012 and/or 2024 and their conservation status (see Stroh et al., 2014 Leach, 2021, Rand & Mundell, 2011). S41 refers to 'Priority Species' listed under Section 41 of the NERC Act (2006).

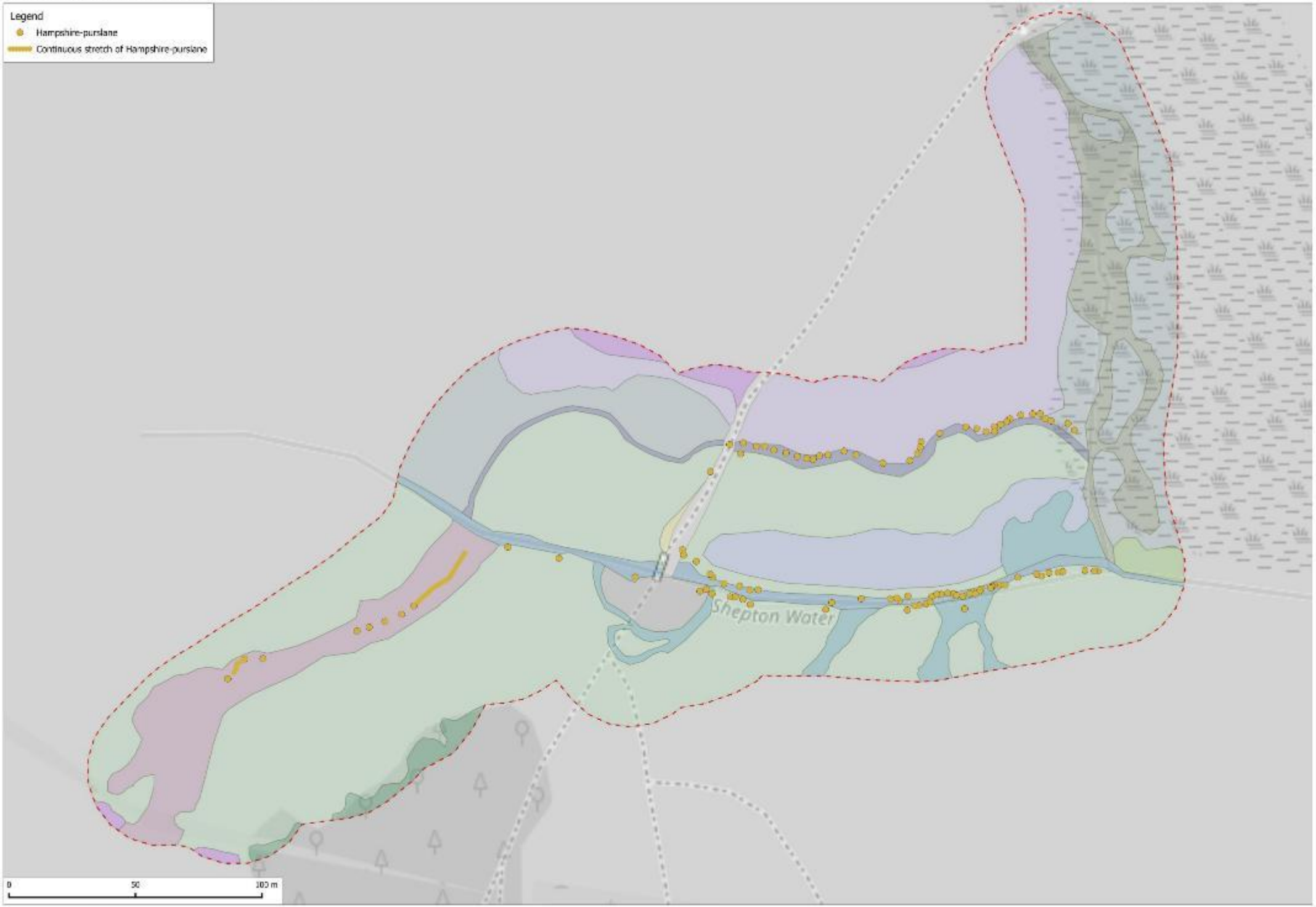
Species	Status and notes	2012	2024
Pillwort *Pilularia globulifera*	Nationally Scarce, S41; England RDB Vulnerable; GB RDB Least Concern. Widespread and sometimes abundant in the New Forest – forms one of the most important meta-populations in Europe.	Patchy along the left bank of the ditch poached by stock and more abundant along right bank in flow lines, also at stock crossing.	Frequent along both banks of both drains plus at least 11 new locations in the restored watercourse. Also occasionally present in Ephemeral Pools.
Hampshire-purslane *Ludwigia palustris*	Nationally Rare, England RDB Vulnerable; GB RDB Near Threatened. Largely confined to New Forest, spreading.	Abundant in main drain in transitional soakway habitat.	Abundant in both the Central and Southern drains and now present in the Restored Oligotrophic Stream.
Tubular Water-dropwort *Oenanthe fistulosa*	England RDB Vulnerable, GB RDB Vulnerable. Widespread in New Forest, often grazed short.	Substantial population in swampy rush pasture floating in centre of drain.	Substantial population, in Central Drain plus at least 2 locations in Southern Drain.
New Forest Water-crowfoot *Ranunculus x novae-forestae*	Unlisted, rare, endemic. Widespread and occasional in the New Forest.	One record from ditch noted from New Forest rare plant database.	Present at several locations in the Central Drain and occasionally present in Ephemeral Pools south of the drain.
Lesser Water-plantain *Baldellia ranunculoides*	England RDB Least Concern; GB RDB Least Concern, Widespread in the New Forest.	Not specifically mentioned but likely to have been present.	Present in the Central Drain near the bridge.
Intermediate Bladderwort *Utricularia intermedia*	England RDB Data Deficient; GB RDB Least Concern. Only known from the Denny Bog metapopulation	Single population within 2024 study area in northern arm of mire (likely to have been directly impacted by restoration work).	Successfully relocated in the northern arm of the mire.
Soft-leaved Sedge *Carex montana*	England RDB Least Concern; GB RDB Least Concern. Can be abundant on richer Bracken/grass communities	Recorded at 4 locations along access track.	Recorded at 3 locations (include one extended patch) along access track.

Species	Status and notes	2012	2024
Chamomile *Chamaemelum nobile*	England RDB Vulnerable; GB RDB Vulnerable; S41. Widespread in the New Forest	Not mentioned.	Recorded at one location in Wet Lawn.
Marsh St. John's-wort *Hypericum elodes*	England RDB Near Threatened; GB RDB Least Concern. Widespread in New Forest	Not specifically mentioned except as a component of soakway vegetation.	Frequent, particularly in Southern Drain (not mapped).
New Zealand Pigmyweed *Crassula helmsii*	INNS. Can sometimes suppress Pillwort and Hampshire-purslane.	Not mentioned.	Occasional within drains, particularly the Southern Drain

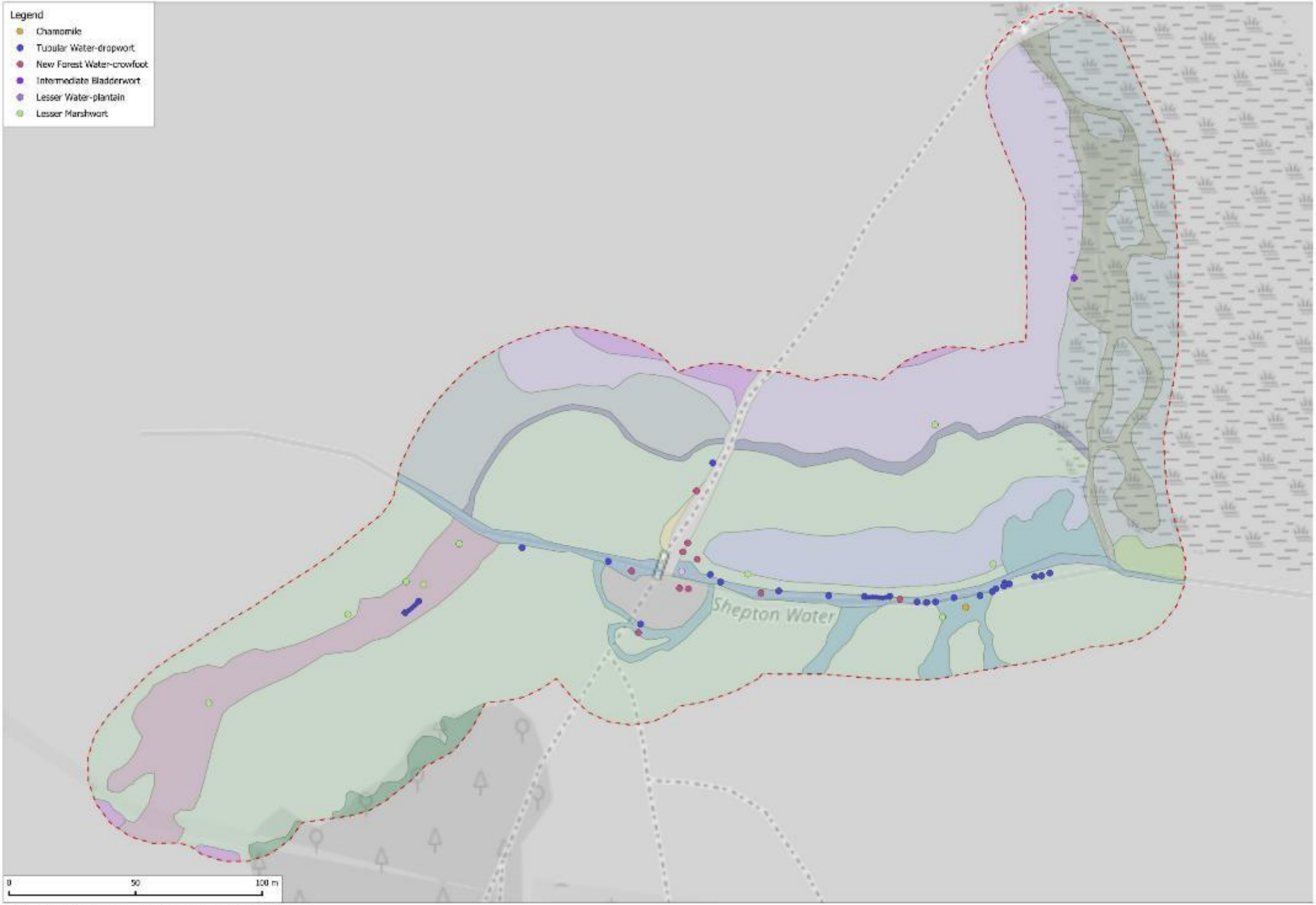
Map 6: Penny Moor Pillwort location, 2024



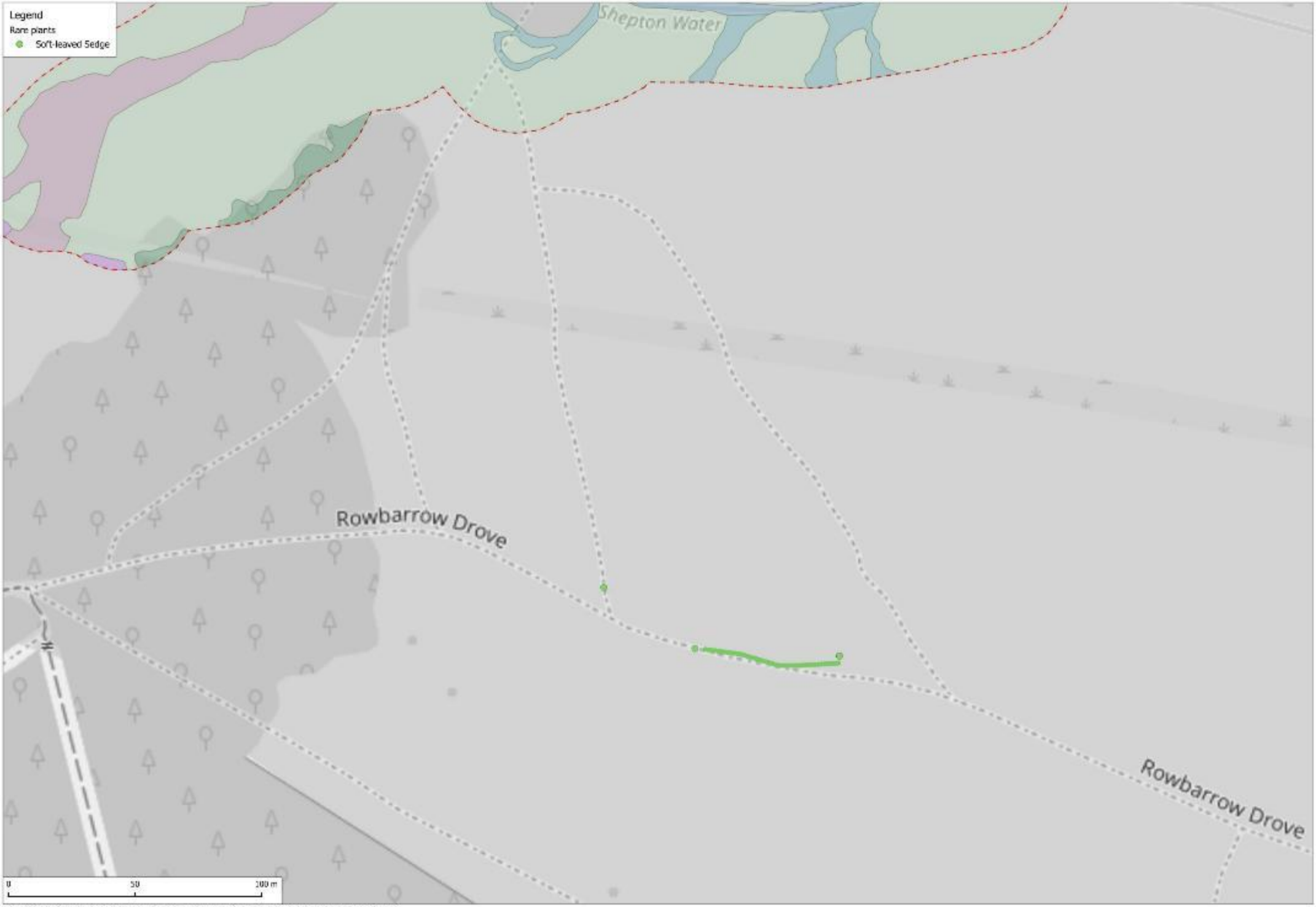
Map 7: Penny Moor Hampshire-purslane locations, 2024



Map 8: Additional rare plant species, 2024



Map 9: Soft-leaved Sedge (access track), 2024



Fixed-point photographs

3.19 Fixed-point photographs taken in 2024 are show in

3.20 Table 5. They are intended to provide a visual overview of the meso-habitats within the area and will enable and post-restoration comparison in the future.

Table 5: Fixed point photos

Fixed Point	Grid Reference	Record Note	Photo
1	SU3547404576	W along restored channel	
2a	SU3548904584	N from small hummock with young birch by bog stream	
2b	SU3548904584	E along new meander from S end of current bridge (to be removed)	

Fixed Point	Grid Reference	Record Note	Photo
3a	SU3548504525	W along drain to be infilled from stream conjunction	
3b	SU3548504525	NW showing bog stream from N and winter wet area (behind birch)	
3c	SU3548504525	E showing conjunction of bog stream and central drain, looking downstream	
4a	SU3530804520	E along central drain from S end of board walk	

Fixed Point	Grid Reference	Record Note	Photo
4b	SU3530804520	SW over winter poached area	
4c	SU3530704530	W from bridge (to be removed) overlooking pool	
4d	SU3530804520	SE over winter poached area	
5	SU3512204432	NW up southern drain at dried southern end (with back to willow tree)	

Fixed Point	Grid Reference	Record Note	Photo
6a	SU3523804533	S along southern drain, from exclosure	
6b	SU3523704527	NE along southern channel to bridge (to be removed)	
7a	SU3519004462	N in southern lawn, level with gravel crossing at area where new shallow channel will be created	
7b	SU3519004462	S in southern lawn, level with gravel crossing, in area where new shallow channel will be created	

4. Discussion

4.1 Despite modifications, the New Forest wetlands are generally of very high nature value. The restoration of natural processes as a driving force shaping habitats and species assemblages is not necessarily expected to change overall diversity of habitats but to change the extent, distribution and quality of such habitats and their component species.

4.2 The drains at Penny Moor support a complex variety of typical New Forest vegetation, which includes some rare species. Therefore, the decision was taken when planning the original restoration to restore the old meanders before carrying out any significant works to the existing drains. This survey shows that Slow-flowing Oligotrophic Stream has successfully been restored and now contains some of these rare species, specifically Pillwort and Hampshire-purslane. It is likely to develop further complexity and diversity over time.

4.3 It is not clear whether the other species found in the floating mats of vegetation in the drains (including Tubular Water-dropwort and Lesser Marshwort) will colonise the restored stream, as they are not species typical of Slow-flowing Oligotrophic Stream, and appear to be flourishing in the drains due to their complex hydrology. However, sensitive reinstatement of the vegetation after the works on the central drain may allow these species to continue persist at this location.

4.4 The surveys reported here provide a baseline that will enable future monitoring to record if and how the wetland habitats change in extent and character as a consequence of the restoration work carried out in 2024. Of particular interest will be the further development of the watercourse, changes to the Wet Lawn, including the Bog Myrtle-dominated area of backswamp where water is currently held back by the spoil banks and the damaged area by the bridge, and any changes to the central drain, particularly with regard to the eroded pool and the species of particular interest.

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Appendix 1: Species lists

Table 6: Species recorded in Wet Heath quadrats.

Species	Common name	Group	Frequency (16 quadrats)
Campylopus brevipilus		Bryophyte	3
Campylopus introflexus		Bryophyte	2
Ceratodon purpurea		Bryophyte	2
Hypnum jutlandicum		Bryophyte	4
Leucobryum sp.		Bryophyte	1
Odontoschisma sphagni		Bryophyte	1
Polytrichum commune		Bryophyte	2
Sphagnum denticulatum		Bryophyte	8
Sphagnum compactum		Bryophyte	3
Sphagnum cuspidatum		Bryophyte	5
Sphagnum fimbriatum		Bryophyte	1
Sphagnum palustre		Bryophyte	1
Sphagnum papillosum		Bryophyte	2
Sphagnum tenellum		Bryophyte	10
Calluna vulgaris	Heather	Dwarf shrub	12
Erica tetralix	Cross-leaved Heath	Dwarf shrub	15
Myrica gale	Bog Myrtle	Dwarf shrub	6
Agrostis canina	Velvet Bent	Graminoid	6
Agrostis stolonifera	Creeping Bent	Graminoid	2
Carex demissa	Yellow Sedge	Graminoid	2
Carex echinata	Star Sedge	Graminoid	2
Carex nigra	Common Sedge	Graminoid	1
Carex panicea	Carnation Sedge	Graminoid	5
Danthonia decumbens	Heath Grass	Graminoid	2
Eleocharis multicaulis	Multi-stemmed Spike-rush	Graminoid	1
Eleocharis quinqueflora	Few-flowered Spike-rush	Graminoid	1
Eriophorum angustifolium	Common Cottongrass	Graminoid	6
Festuca ovina	Sheep's Fescue	Graminoid	1
Juncus acutiflorus	Sharp-flowered Rush	Graminoid	9
Juncus bufonius	Toad Rush	Graminoid	3
Juncus bulbosus	Bulbous Rush	Graminoid	9
Juncus squarrosus	Heath Rush	Graminoid	1
Molinia caerulea	Purple Moor-grass	Graminoid	16
Rhynchospora alba	White Beak-sedge	Graminoid	1
Trichophorum germanicum	Deergrass	Graminoid	5
Drosera intermedia	Oblong-leaved Sundew	Herb	1
Drosera rotundifolia	Round-leaved Sundew	Herb	1
Hydrocotyle vulgaris	Marsh Pennywort	Herb	2

Species	Common name	Group	Frequency (16 quadrats)
Mentha aquatica	Water Mint	Herb	1
Narthecium ossifragum	Bog Asphodel	Herb	2
Poa annua	Annual Meadow-grass	Herb	1
Polygala serpyllifolia	Heath Milkwort	Herb	3
Potentilla erecta	Tormentil	Herb	4
Ranunculus flammula	Lesser Spearwort	Herb	1
Cladonia portentosa		Lichen	1
Betula pendula (in ground flora)	Silver Birch	Tree	1

Table 7: Species recorded in Wet Lawn quadrats.

Species	Common name	Plant group	Wet Lawn (22 quadrats)	Bog Myrtle Lawn (8 quadrats)
Aulocomnium palustre		Bryophyte	6	0
Calliergonella cuspidatum		Bryophyte	14	1
Drepanocladus aduncus		Bryophyte	1	0
Hypnum jutlandicum		Bryophyte	2	0
Rhytidiadelphus squarrosus		Bryophyte	1	0
Sphagnum compactum		Bryophyte	1	0
Sphagnum denticulatum		Bryophyte	10	1
Straminergon stramineum		Bryophyte	1	0
Calluna vulgaris	Heather	Dwarf shrub	4	0
Erica cinerea	Bell Heather	Dwarf shrub	1	0
Erica tetralix	Cross-leaved Heath	Dwarf shrub	1	0
Myrica gale	Bog Myrtle	Dwarf shrub	0	7
Agrostis canina	Velvet Bent	Graminoid	19	4
Agrostis capillaris	Common Bent	Graminoid	2	0
Agrostis stolonifera	Creeping Bent	Graminoid	3	3
Anthoxanthum odoratum	Sweet Vernal-grass	Graminoid	6	0
Carex demissa	Yellow Sedge	Graminoid	12	4
Carex echinata	Star Sedge	Graminoid	13	5
Carex flacca	Glaucous Sedge	Graminoid	1	0
Carex leporina	Oval Sedge	Graminoid	1	1
Carex nigra	Common Sedge	Graminoid	16	6
Carex panicea	Carnation Sedge	Graminoid	17	5
Danthonia decumbens	Heath Grass	Graminoid	2	0
Eleocharis multicaulis	Multi-stemmed Spike-rush	Graminoid	9	5
Eleocharis palustris	Common Spike-rush	Graminoid	0	2
Eleocharis quinqueflora	Few-flowered Spike-rush	Graminoid	1	0
Eleogiton fluitans	Floating Club-rush	Graminoid	0	2
Festuca ovina	Sheep's Fescue	Graminoid	1	0
Glyceria declinata	Small Sweet-grass	Graminoid	1	0
Glyceria fluitans	Floating Sweet-grass	Graminoid	1	1
Holcus lanatus	Yorkshire Fog	Graminoid	2	1
Juncus acutiflorus	Sharp-flowered Rush	Graminoid	4	0
Juncus articulatus	Jointed Rush	Graminoid	17	7
Juncus bulbosus	Bulbous Rush	Graminoid	7	4
Juncus squarrosus	Heath Rush	Graminoid	1	0
Luzula campestris	Field Woodrush	Graminoid	1	0
Luzula multiflora	Heath Woodrush	Graminoid	2	0
Molinia caerulea	Purple Moor-grass	Graminoid	9	4
Anagallis tenellum	Bog Pimpernel	Herb	4	1

Species	Common name	Plant group	Wet Lawn (22 quadrats)	Bog Myrtle Lawn (8 quadrats)
Callitriche sp.	Water-starwort	Herb	1	0
Cardamine pratense	Cuckoo Flower	Herb	7	1
Cirsium dissectum	Meadow Thistle	Herb	6	0
Cirsium palustre	Marsh Thistle	Herb	0	1
Crassula helmsii	New Zealand Pigmyweed	Herb	2	0
Galium palustre	Marsh Bedstraw	Herb	6	2
Hydrocotyle vulgaris	Marsh Pennywort	Herb	21	6
Hypericum elodes	Marsh St. John's-wort	Herb	6	4
Leontodon saxatile	Lesser Hawkbit	Herb	1	0
Lotus pedunculatus	Greater Bird's-foot-trefoil	Herb	9	1
Ludwigia palustris	Hampshire-purslane	Herb	2	1
Lythrum portula	Water-purslane	Herb	2	0
Mentha aquatica	Water Mint	Herb	4	5
Myosotis secunda	Creeping Forget-me-not	Herb	2	1
Pedicularis sylvatica	Common Lousewort	Herb	4	0
Potamogeton polygonifolius	Bog Pondweed	Herb	1	3
Potentilla anserina	Silverweed	Herb	1	1
Potentilla erecta	Tormentil	Herb	10	2
Ranunculus acris	Meadow Buttercup	Herb	3	0
Ranunculus flammula	Lesser Spearwort	Herb	15	5
Sagina procumbens	Procumbent Pearlwort	Herb	2	0
Scutellaria minor	Lesser Skullcap	Herb	7	1
Rubus fruticosus agg.	Bramble	Shrub	1	1
Salix auriculata	Eared Willow	Shrub	1	1

Table 8: Species recorded in Ephemeral Pools and Channels/Poached and Disturbed.

Species	Common name	Plant group	Count
Sphagnum tenellum		Bryophyte	1
Juncus bulbosa	Bulbous Rush	Graminoid	6
Carex panicea	Carnation Sedge	Graminoid	1
Carex nigra	Common Sedge	Graminoid	4
Eleocharis palustris	Common Spike-rush	Graminoid	2
Agrostis stolonifera	Creeping Bent	Graminoid	3
Eleogiton fluitans	Floating Club-rush	Graminoid	5
Glyceria fluitans	Floating Sweet-grass	Graminoid	2
Juncus articulatus	Jointed Rush	Graminoid	6
Eleocharis multicaulis	Multi-stemmed Spike-rush	Graminoid	3
Juncus acutiflorus	Sharp-flowered Rush	Graminoid	2
Glyceria declinata	Small Sweet-grass	Graminoid	5
Agrostis canina	Velvet Bent	Graminoid	1
Carex demissa	Yellow Sedge	Graminoid	1
Potamogeton polygonifolius	Bog Pondweed	Herb	3
Ludwigia palustre	Hampshire-purslane	Herb	4
Ranunculus flammula	Lesser Spearwort	Herb	8
Baldellia ranunculoides	Lesser Water-plantain	Herb	4
Hydrocotyle vulgaris	Marsh Pennywort	Herb	4
Hypericum elodes	Marsh St. John's-wort	Herb	3
Ranunculus x novae-forestae	New Forest Water-crowfoot	Herb	2
Pilularia globulifera	Pillwort	Herb	4
Myriophyllum spicatum	Spiked Water-milfoil	Herb	1
Ranunculus trichophyllus	Thread-leaved Water-crowfoot	Herb	1
Alisma plantago-aquatica	Water-plantain	Herb	1
Lythrum portula	Water-purslane	Herb	5
Callitriche sp.	Water-starwort	Herb	3

Table 9: Species recorded in Slow-flowing Oligotrophic Stream/Drain quadrats.

Species	Common name	Plant group	Southern drain	Central drain	Restored oligotrophic stream
Agrostis canina	Velvet Bent	Graminoid	2	0	0
Agrostis stolonifera	Creeping Bent	Graminoid	6	1	0
Carex nigra	Common Sedge	Graminoid	3	1	0
Carex panicea	Carnation Sedge	Graminoid	1	1	1
Eleocharis palustris	Common Spike-rush	Graminoid	9	0	2
Eleogiton fluitans	Floating Club-rush	Graminoid	8	9	8
Eriophorum angustifolium	Common Cottongrass	Graminoid	1	5	10
Glyceria declinata	Small Sweet-grass	Graminoid	0	0	0
Glyceria fluitans	Floating Sweet-grass	Graminoid	3	0	0
Juncus articulatus	Jointed Rush	Graminoid	2	7	10
Juncus acutiflorus	Sharp-flowered Rush	Graminoid	5	4	0
Juncus bulbosus	Bulbous Rush	Graminoid	2	1	2
Juncus effusus	Soft Rush	Graminoid	3	5	5
Sparganium erectum	Branched Bur-reed	Graminoid	4	2	0
Ajuga reptans	Bugle	Herb	0	5	0
Alisma plantago-aquatica	Water-plantain	Herb	2	1	0
Anagallis tenella	Bog Pimpernel	Herb	0	2	0
Apium inundatum	Lesser Marshwort	Herb	5	1	0
Baldellia ranunculoides	Lesser Water-plantain	Herb	2	3	1
Callitriche sp.	Water Starwort	Herb	1	6	0
Cardamine pratense	Cuckoo Flower	Herb	3	3	4
Crassula helmsii	New Zealand Pigmyweed	Herb	7	1	0
Equisetum palustre	Marsh Horsetail	Herb	5	3	1
Galium palustre	Marsh Bedstraw	Herb	6	3	0
Hydrocotyle vulgaris	Marsh Pennywort	Herb	7	3	1
Hypericum elodes	Marsh St. John's-wort	Herb	10	4	3
Lotus pedunculatus	Greater Bird's-foot-trefoil	Herb	4	8	6
Ludwigia palustris	Hampshire-purslane	Herb	6	2	0
Lythrum portula	Water-purslane	Herb	0	7	9
Mentha aquatica	Water Mint	Herb	7	4	0
Menyanthes trifoliata	Bogbean	Herb	2	4	2
Myosotis laxa	Tufted Forget-me-not	Herb	2	0	0
Myosotis secunda	Creeping Forget-me-not	Herb	1	2	0
Myriophyllum sp.	Water-milfoil	Herb	3	1	0
Nasturtium microphyllum	Narrow-fruited Watercress	Herb	0	2	5
Oenanthe fistulosa	Tubular Water-dropwort	Herb	4	1	0

Species	Common name	Plant group	Southern drain	Central drain	Restored oligotrophic stream
Pilularia globulifera	Pillwort	Herb	0	0	0
Potamogeton polygonifolius	Bog Pondweed	Herb	5	5	0
Ranunculus aquatilis	Common Water-crowfoot	Herb	4	5	2
Ranunculus flammula	Lesser Spearwort	Herb	7	0	0
Ranunculus omiophyllus	Round-leaved Water-crowfoot	Herb	0	9	8
Ranunculus peltatus	Pond Water-crowfoot	Herb	0	2	0
Ranunculus x novae-forestae	New Forest Water-crowfoot	Herb	0	1	0
Ranunculus repens	Creeping Buttercup	Herb	1	1	1
Jacobaea aquatica	Marsh Ragwort	Herb	1	0	0
Veronica scutellata	Marsh Speedwell	Herb	4	0	0
Salix cinerea	Grey Willow	Shrub	1	3	0

Appendix 2: Plants of conservation concern location records.

Table 10: Location records for plants of conservation concern. A number of records outside of the study area that were made on return to the car park have been included (e.g. Wild Gladiolus and Slender Marsh-bedstraw).

Species	Grid Reference	Record Note
Ranunculus x novae-forestae	SU3532004511	
Ranunculus x novae-forestae	SU3531604511	
Ranunculus x novae-forestae	SU3532304550	
Ranunculus x novae-forestae	SU3540304507	
Ranunculus x novae-forestae	SU3532304523	
Ranunculus x novae-forestae	SU3531904529	
Ranunculus x novae-forestae	SU3531704526	
Ranunculus x novae-forestae	SU3534804510	
Ranunculus x novae-forestae	SU3530004494	
Ranunculus x novae-forestae	SU3529704518	
Oenanthe fistulosa	SU3541404506	
Oenanthe fistulosa	SU3541004506	
Oenanthe fistulosa	SU3544104511	
Oenanthe fistulosa	SU3543504508	
Oenanthe fistulosa	SU3542504508	
Oenanthe fistulosa	SU3541704506	
Oenanthe fistulosa	SU3539904508	continuous to next point
Oenanthe fistulosa	SU3538904508	
Oenanthe fistulosa	SU3537504508	
Oenanthe fistulosa	SU3535504510	
Oenanthe fistulosa	SU3533204514	
Oenanthe fistulosa	SU3532804517	
Oenanthe fistulosa	SU3530104497	
Oenanthe fistulosa	SU3528804522	
Oenanthe fistulosa	SU3525404527	
Oenanthe fistulosa	SU3520804502	continuous to next point
Oenanthe fistulosa	SU3521304506	
Oenanthe fistulosa	SU3532904561	
Oenanthe fistulosa	SU3546204517	
Oenanthe fistulosa	SU3545904516	
Oenanthe fistulosa	SU3545604516	
Oenanthe fistulosa	SU3544604513	
Oenanthe fistulosa	SU3544504513	
Oenanthe fistulosa	SU3544404512	
Oenanthe fistulosa	SU3544004510	
Gladiolus illyricus	SU3610704343	

Species	Grid Reference	Record Note
Gladiolus illyricus	SU3610504363	
Gladiolus illyricus	SU3610104359	
Gladiolus illyricus	SU3609904389	
Gladiolus illyricus	SU3609704393	
Gladiolus illyricus	SU3609704393	
Gladiolus illyricus	SU3609704410	
Gladiolus illyricus	SU3609604412	
Galium constrictum	SU3574704311	
Galium constrictum	SU3574804312	
Galium constrictum	SU3574804312	
Genista anglica	SU3611704446	
Chamaemelum nobile	SU3542904504	
Utricularia minor	SU3547004684	
Carex montana	SU3542404251	
Carex montana	SU3536704254	
Carex montana	SU3533104278	
Utricularia intermedia	SU3547204634	
Baldellia ranunculoides	SU3531704518	
Chamaemelum nobile	SU3539704249	
Oenanthe fistulosa	SU3539504508	
Oenanthe fistulosa	SU3521004504	
Ludwigia palustris	SU3547204574	
Ludwigia palustris	SU3547004577	
Ludwigia palustris	SU3546304578	
Ludwigia palustris	SU3546104579	
Ludwigia palustris	SU3545904581	
Ludwigia palustris	SU3545604581	
Ludwigia palustris	SU3545104580	
Ludwigia palustris	SU3544704579	
Ludwigia palustris	SU3544604578	
Ludwigia palustris	SU3544304577	
Ludwigia palustris	SU3544104576	
Ludwigia palustris	SU3544104574	
Ludwigia palustris	SU3543704574	
Ludwigia palustris	SU3543404575	
Ludwigia palustris	SU3542904576	
Ludwigia palustris	SU3541904573	
Ludwigia palustris	SU3541204570	
Ludwigia palustris	SU3541104568	
Ludwigia palustris	SU3541004565	
Ludwigia palustris	SU3540704563	
Ludwigia palustris	SU3539704561	

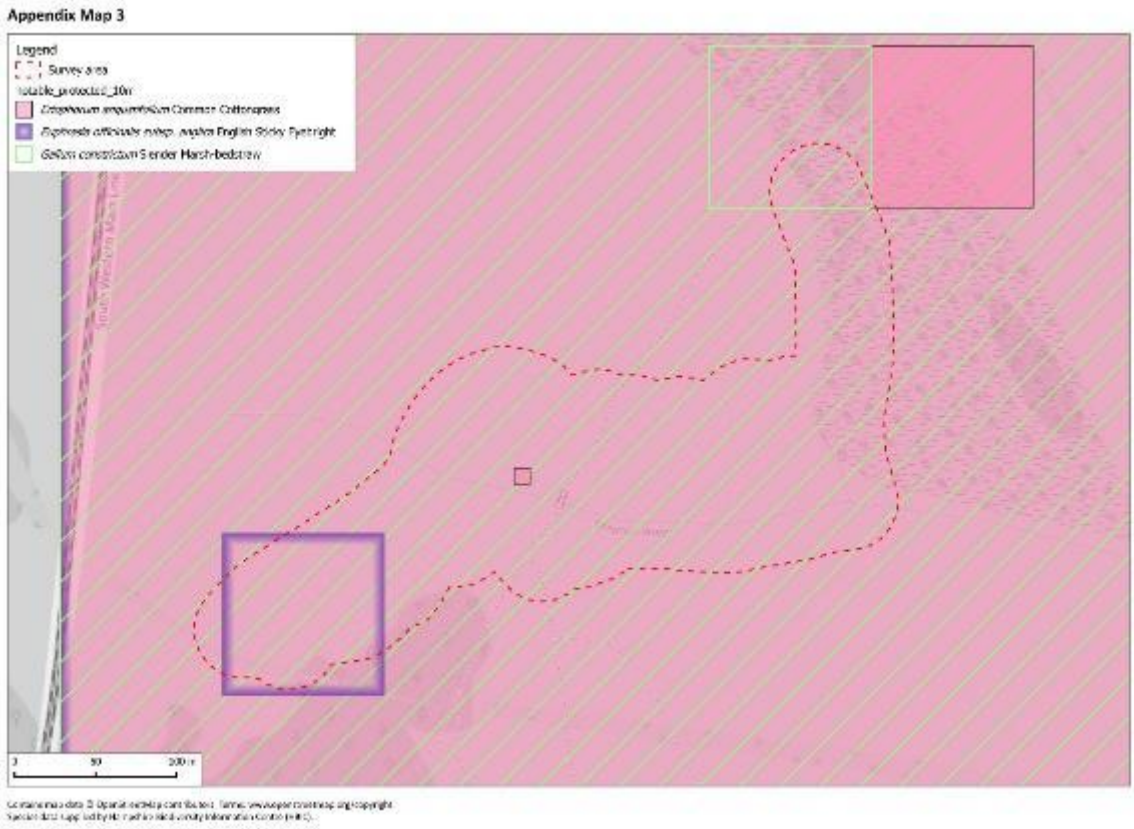
Species	Grid Reference	Record Note
Ludwigia palustris	SU3538604565	
Ludwigia palustris	SU3538104566	
Ludwigia palustris	SU3537504565	
Ludwigia palustris	SU3537204564	
Ludwigia palustris	SU3536904563	
Ludwigia palustris	SU3536604563	
Ludwigia palustris	SU3536304564	
Ludwigia palustris	SU3535804565	
Ludwigia palustris	SU3535404567	
Ludwigia palustris	SU3535004568	
Ludwigia palustris	SU3534704568	
Ludwigia palustris	SU3534104570	
Ludwigia palustris	SU3533604569	
Ludwigia palustris	SU3534004565	
Ludwigia palustris	SU3548204519	
Ludwigia palustris	SU3548004519	
Ludwigia palustris	SU3547604519	
Ludwigia palustris	SU3546604518	
Ludwigia palustris	SU3546804519	
Ludwigia palustris	SU3546204518	
Ludwigia palustris	SU3545904517	
Ludwigia palustris	SU3545704518	
Ludwigia palustris	SU3545004516	
Ludwigia palustris	SU3544504513	
Ludwigia palustris	SU3544204513	
Ludwigia palustris	SU3544104513	
Ludwigia palustris	SU3544004513	
Ludwigia palustris	SU3543604512	
Ludwigia palustris	SU3543504511	
Ludwigia palustris	SU3543204510	
Ludwigia palustris	SU3543104510	
Ludwigia palustris	SU3542804509	
Ludwigia palustris	SU3542404510	
Ludwigia palustris	SU3542204510	
Ludwigia palustris	SU3542004510	
Ludwigia palustris	SU3541604509	
Ludwigia palustris	SU3541804510	
Ludwigia palustris	SU3541404506	
Ludwigia palustris	SU3541104505	
Ludwigia palustris	SU3540904505	
Ludwigia palustris	SU3540604503	
Ludwigia palustris	SU3543904512	

Species	Grid Reference	Record Note
Ludwigia palustris	SU3543304510	
Ludwigia palustris	SU3542604509	
Ludwigia palustris	SU3541504507	
Ludwigia palustris	SU3540604509	
Ludwigia palustris	SU3540304507	
Ludwigia palustris	SU3540204508	
Ludwigia palustris	SU3540004508	
Ludwigia palustris	SU3538804508	
Ludwigia palustris	SU3537604506	
Ludwigia palustris	SU3534704511	
Ludwigia palustris	SU3534404511	
Ludwigia palustris	SU3534004513	
Ludwigia palustris	SU3533404514	
Ludwigia palustris	SU3532904516	
Ludwigia palustris	SU3532804518	
Ludwigia palustris	SU3532304523	
Ludwigia palustris	SU3531704527	
Ludwigia palustris	SU3531804525	
Ludwigia palustris	SU3532704512	
Ludwigia palustris	SU3532904510	
Ludwigia palustris	SU3533604509	
Ludwigia palustris	SU3533804509	
Ludwigia palustris	SU3534104508	
Ludwigia palustris	SU3534404506	
Ludwigia palustris	SU3537404504	
Ludwigia palustris	SU3542904504	
Ludwigia palustris	SU3526904524	
Ludwigia palustris	SU3529904516	
Ludwigia palustris	SU3524804528	
Ludwigia palustris	SU3518904495	
Ludwigia palustris	SU3519304497	
Ludwigia palustris	SU3520004499	
Ludwigia palustris	SU3532804558	
Ludwigia palustris	SU3532404511	
Ludwigia palustris	SU3515104484	continuous to next point
Ludwigia palustris	SU3514404484	
Ludwigia palustris	SU3513804476	
Ludwigia palustris	SU3520604502	
Ludwigia palustris	SU3521104505	continuous to end
Ludwigia palustris	SU3522304516	
Ludwigia palustris	SU3522304516	
Pilularia globulifera	SU3535604565	

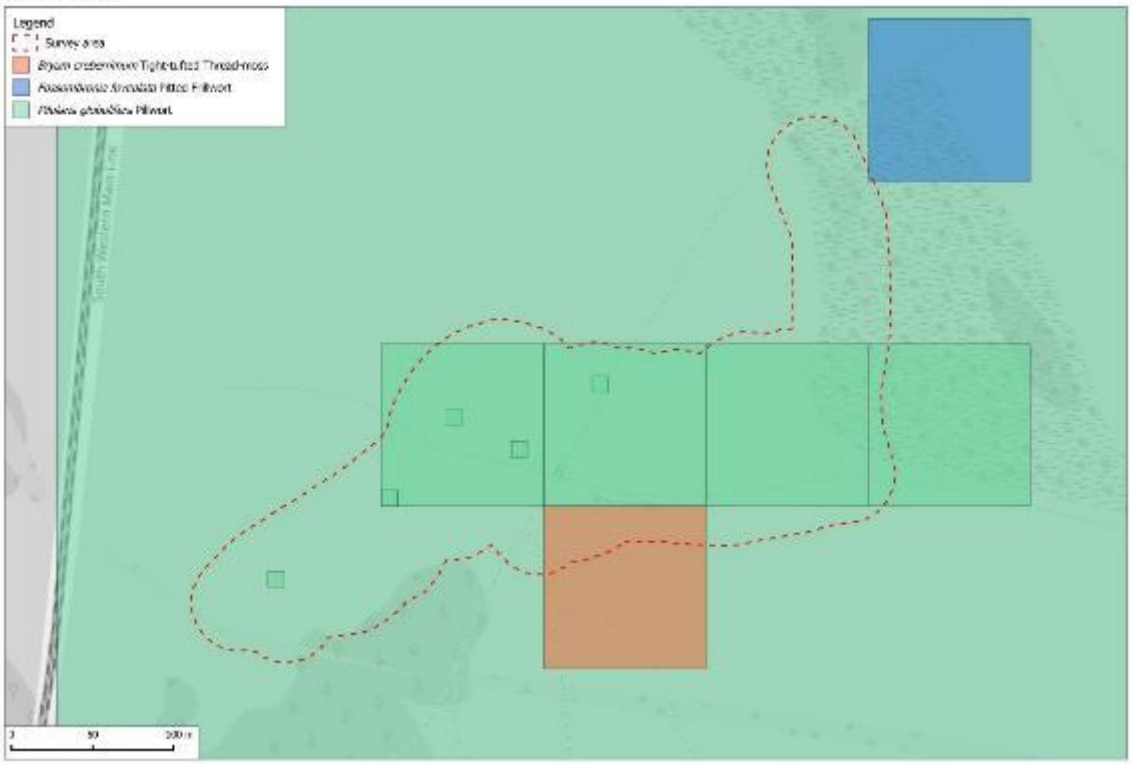
Species	Grid Reference	Record Note
Pilularia globulifera	SU3535904564	
Pilularia globulifera	SU3536204562	
Pilularia globulifera	SU3536404562	
Pilularia globulifera	SU3537804562	
Pilularia globulifera	SU3538104563	
Pilularia globulifera	SU3546704573	
Pilularia globulifera	SU3548504525	
Pilularia globulifera	SU3531904519	
Pilularia globulifera	SU3532604513	
Pilularia globulifera	SU3534904512	
Pilularia globulifera	SU3536404510	
Pilularia globulifera	SU3542004504	
Pilularia globulifera	SU3543104505	
Pilularia globulifera	SU3544604518	continuous to next point
Pilularia globulifera	SU3547704524	
Pilularia globulifera	SU3514904488	continuous to next point
Pilularia globulifera	SU3513904487	
Pilularia globulifera	SU3513504481	
Pilularia globulifera	SU3512804477	
Pilularia globulifera	SU3512704454	
Pilularia globulifera	SU3512804448	
Pilularia globulifera	SU3512204432	
Pilularia globulifera	SU3532604555	
Pilularia globulifera	SU3532904561	
Pilularia globulifera	SU3545204582	
Pilularia globulifera	SU3543404581	
Pilularia globulifera	SU3542504580	
Pilularia globulifera	SU3535404571	
Pilularia globulifera	SU3547704524	
Pilularia globulifera	SU3543904519	
Pilularia globulifera	SU3542304516	
Pilularia globulifera	SU3541604516	
Pilularia globulifera	SU3540704515	
Pilularia globulifera	SU3531404527	
Pilularia globulifera	SU3532304527	
Pilularia globulifera	SU3531604529	
Pilularia globulifera	SU3532804517	
Pilularia globulifera	SU3533004515	
Pilularia globulifera	SU3533504513	
Pilularia globulifera	SU3533904513	
Pilularia globulifera	SU3534304512	
Pilularia globulifera	SU3534504512	continuous to next point

Species	Grid Reference	Record Note
Pilularia globulifera	SU3537404504	
Pilularia globulifera	SU3542704512	
Pilularia globulifera	SU3530104497	
Pilularia globulifera	SU3531404527	
Pilularia globulifera	SU3518904500	
Pilularia globulifera	SU3519404501	
Pilularia globulifera	SU3521104510	continuous to end
Helosciadium inundatum	SU3522904529	
Helosciadium inundatum	SU3521504513	
Helosciadium inundatum	SU3520804514	
Helosciadium inundatum	SU3544004521	
Helosciadium inundatum	SU3542004500	
Helosciadium inundatum	SU3534304517	
Helosciadium inundatum	SU3513004466	
Helosciadium inundatum	SU3518504501	
Helosciadium inundatum	SU3541704576	

Appendix 3: Records of plants of conservation concern from HBIC

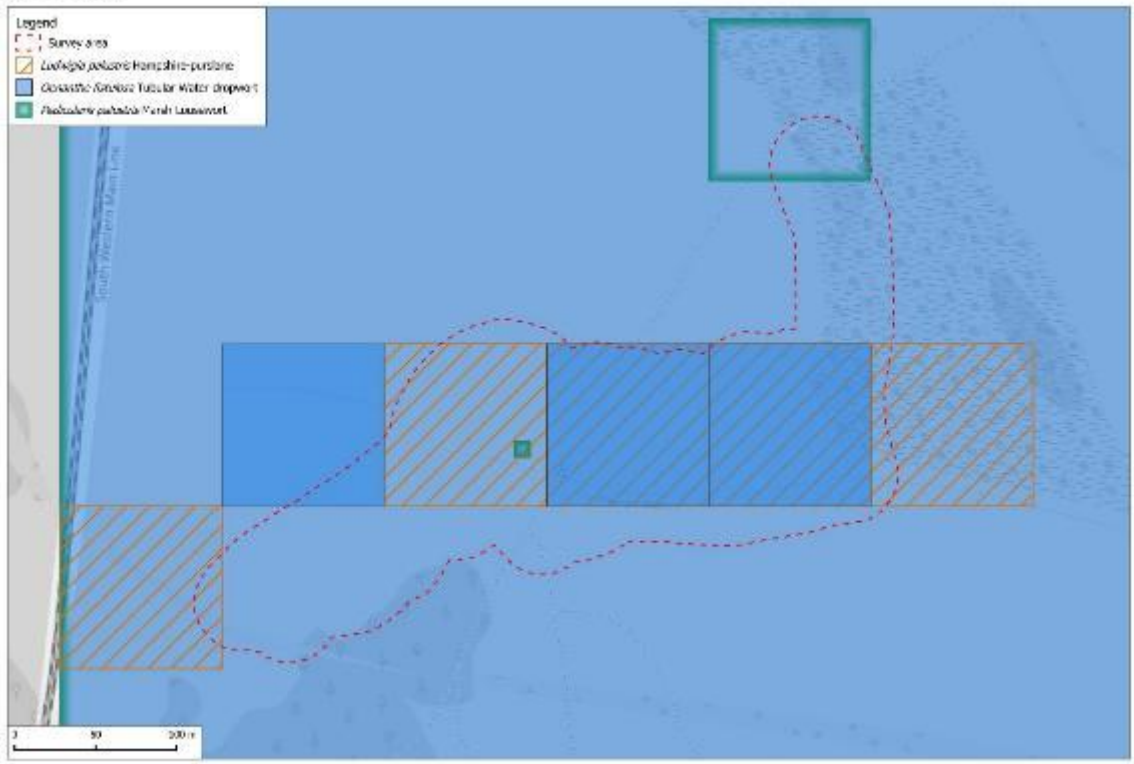


Appendix Map 1



Appendix Map 2

Appendix Map 4



Appendix Map 5

Appendix Map 6

Appendix Map 7