Review of Pre-river Restoration Monitoring Results on Mileham Common and Meadow

Photo: Grenstein Meadow

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1.0 Introduction

1.1 A river restoration project has been undertaken by the Norfolk Rivers Trust in October 2012, which has been funded by Coca Cola and the Catchment Restoration Fund. The project has restored a stretch of the River Nar site of special scientific interest (SSSI) towards favourable condition by re-meandering sections of the channel. This has created a sinuous shallow channel reconnecting it to the floodplain when the flows are highest. This project at Mileham involved land at Mileham Common and a stretch through a meadow, which is part of Grenstein Farm (Plate 1). Previously the River Nar flowed through a narrow, incised and straight channel where vegetation could not thrive because the channel banks were too steep and was overshadowed by trees.

1.2 Pre-river restoration monitoring of the flora and fauna was completed to record the presents and absence of species that inhabit the site. Monitoring completed included:

2.1 Small Mammal Survey
3.0 Water Vole Survey
4.0 Macro-invertebrate Survey
5.0 Electro-fishing Survey
6.0 Water Quality Survey
7.0 Vegetation Survey on Mileham Common
8.0 Macrophyte Survey

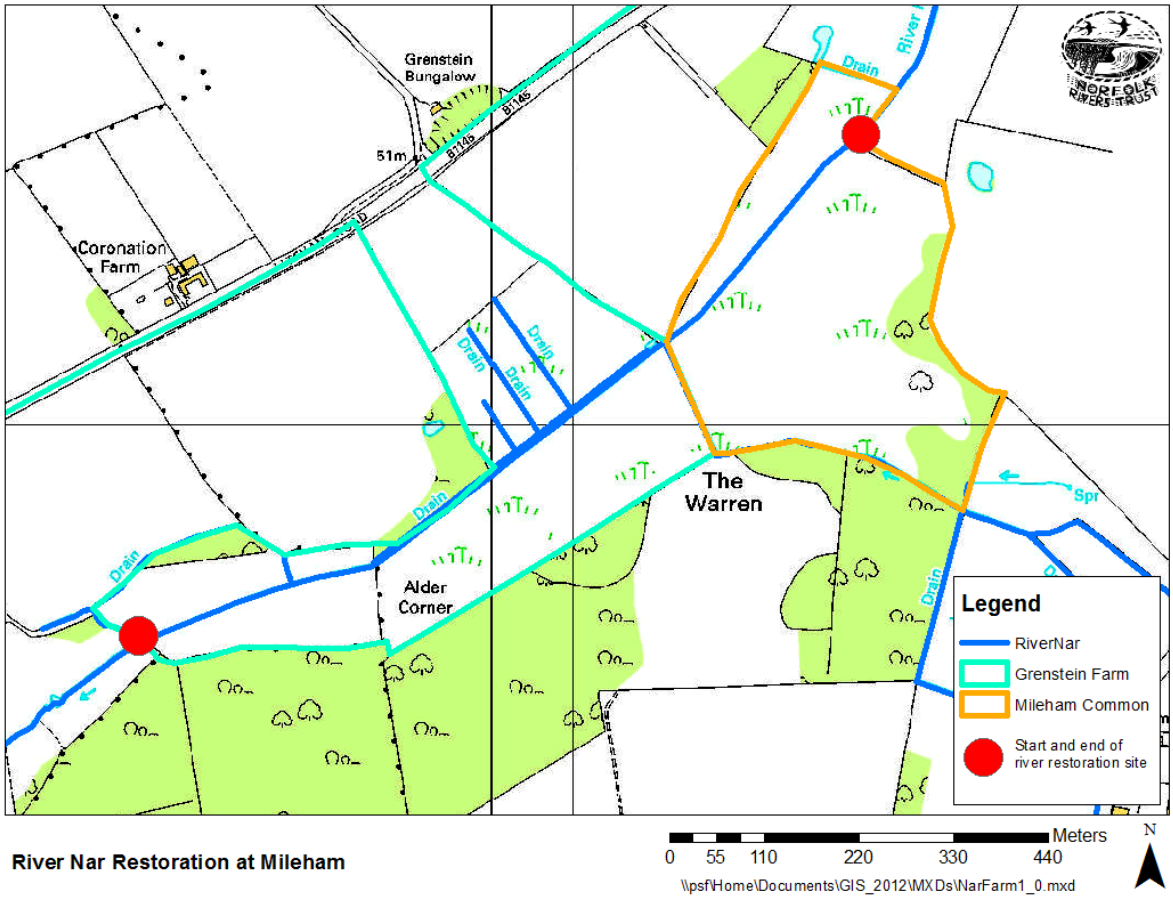


Plate 1: The location of the restoration works and monitoring

2.0 Monitoring Surveys

2.1 Small Mammal Survey

The Hawk and Owl Trust[1] completed a small mammal survey over 15 days in September and October 2012 using grids on three sites (Area 1 = meadow, Area 2 = common, Area 3 = common).

2.2 Trapping Method: Seven grids of live traps were established in the study area (Plate 2). Each grid consisted of 5x10 trap points at 10m spacing (50 Traps). Traps contained hay bedding, and a seed mix with castors was used for food with the addition of carrot and apple chopped for overnight moisture. Traps were checked twice a day (am and pm) and each mammal was identified, weighed, sexed, aged, body length and tail length measured.

Plate 2: Map of trapping area

2.3 Summary of results:

2.4 Mileham Common (Area 2 and 3): The common is registered as a County Wildlife Site (Ref No: 2177) mainly undisturbed Fen with tall reed, fen vegetation and lesser pond sedge dominating. In area 2 five species were trapped, these included wood mouse *Apodemus sylvaticus*, bank vole *Myodes glareolus*, short tailed vole *Microtus agrestis*, pygmy shrew *Sorex minutus* and common shrew *Sorex aranus.* Common and pygmy shrews comprised of >50% of the trapped specimens with common shrew the most prevalent. Bank vole was the second most recorded species, which fits with the habitat type.

[1] Middleton, 2012.

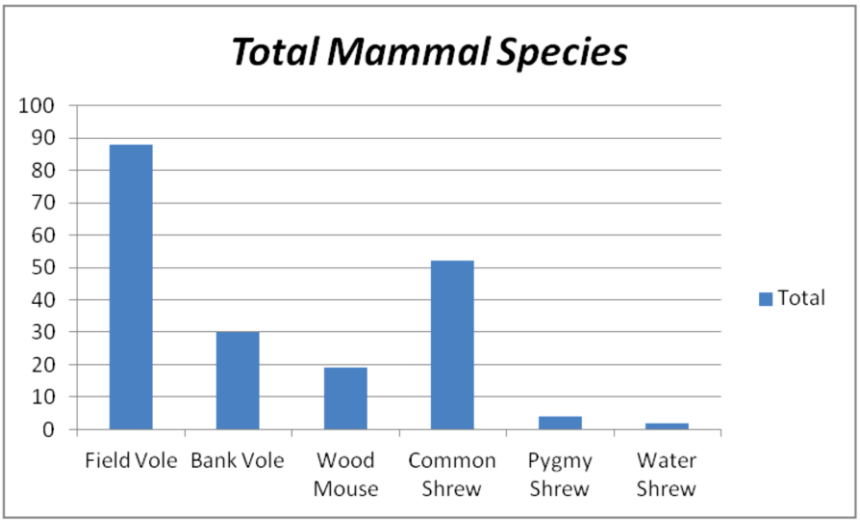
Plate 3: Wood mouse

Plate 4: Common shrew

2.5 In area 3 four species were trapped, these included wood mouse, bank vole, short tailed vole and common shrew. Wood mice were found in the reed dominant areas, a habitat which would not normally be associated with wood mice, which are principally a woodland species. Water shrew *Neomys fodiens* was not recorded in area 2 & 3 and evidence of harvest mice *Micromys minutus* was found in the reedbed areas where summer nests were found.

2.6 Mileham Meadow (Area 1): This is an area of ungrazed rough grassland that had been topped off with a mower on a yearly basis. This type of management had allowed the area to become ideal grassland habitat for short tailed field vole, this species accounted for 83% of species trapped. Other mammal species trapped included bank vole common shrew, pygmy shrew and water shrew. More than 50% of mammals trapped were juvenile voles, which reflects the time of year that trapping took place in the early autumn, showing a good vole year.

Plate 5: Short tailed field vole being measured



Bar chart 1: Chart showing total mammal species for the Meadow and Mileham Common

3.0 Water Voles

3.1 Naturi[2] completed the water vole survey during September and October 2012.

3.2 Monitoring method: 16 tethered floating polystyrene rafts were installed in the River Nar in and around vegetation (6 on common, 10 on meadow), to provide survey sites for water vole *Arvicola amphibious* activity including feeding and latrines The length of the river was walked and the banks and water margins were checked thoroughly for water vole signs and burrows.

3.3 Summary of Results
3.4 Mileham Common: Four out of the 6 floating polystyrene rafts contained evidence of water voles where they were using the rafts as feeding stations and latrines. There were also natural latrines and there was an estimate of 20 water vole burrows found on the riverbank (please see Plate 3 which shows the location of evidence of water voles).

3.5 Grenstein meadow: There was no evidence of water voles in the meadow.

3.6 Plate 3 shows the location of water vole burrows, latrines and feeding stations found on Mileham Common (red line). The map also shows the proposed route for the new channel, avoiding water vole stretches (blue line).

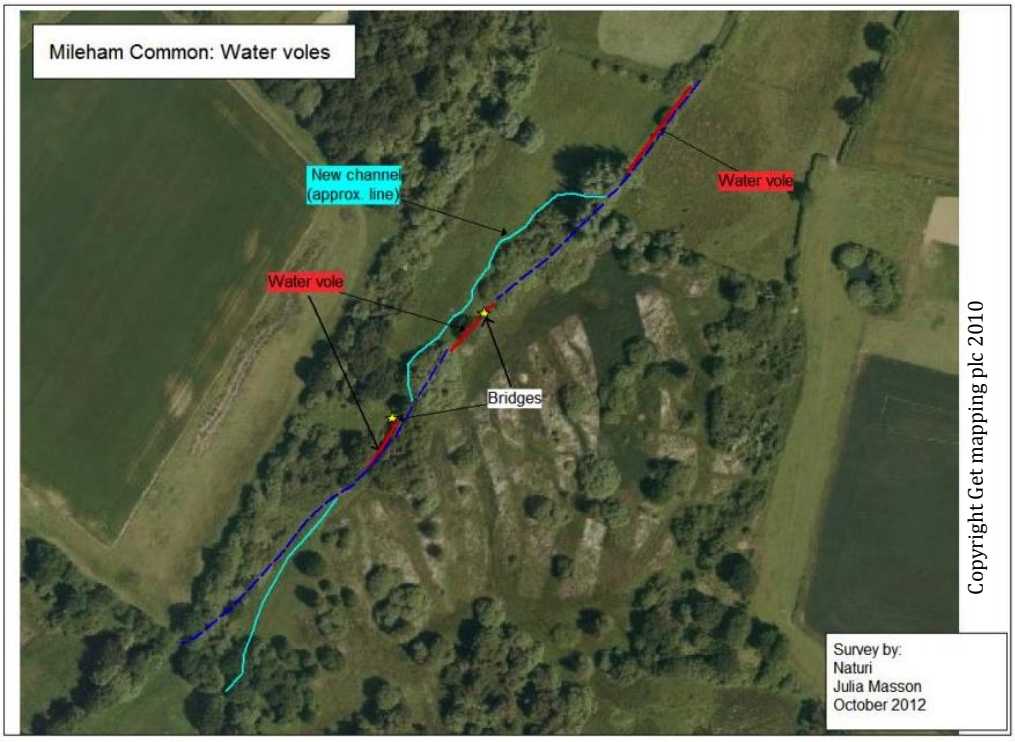


Plate 6: Water Voles on Mileham Common

[2] Masson, 2012a.

4.0 Macro-invertebrate monitoring

4.1 Riverine Ecological Solutions (RES)[3] completed the invertebrate survey during June and September 2012.

4.2 Sampling method: Three sites were chosen within the incised channel of the River Nar where they were visited once a month (Plot 1 = Common, Plot 2 and 3 = meadow). These samples were collected by using a kick sampling technique where the net (1mm mesh) is placed downstream on the riverbed and using your foot to disturb the riverbed just upstream of the net for 3 minutes to dislodge any invertebrates which are then carried by the current downstream into the net.

4.3 Summary of Results

4.4 Mileham Common: Plot 1 had little flow, an abundance of in-stream vegetation, leaf litter and was the most shaded channel. There was an average of 26.8 species at plot 1 over four months. Proportion of sediment-sensitive invertebrate (PSI) scores indicated that Plot 1 had heavily sedimented to sedimented habitats.

Plate 7: Mark Rylands (RES) kick sampling (Plot 3)

4.5 Grenstein Meadow: Plot 2 and plot 3 had a shallow faster flow with riffle bed habitat. There was an average of 31.5 invertebrate species sampled at plot 3 and an average of 30.5 invertebrate species sampled at plot 2 over four months. PSI scores indicated that Plot 2 and 3 had sedimented to moderately sedimented habitats. The Biological monitoring working party (BMWP) score exceeded the benchmark threshold in Plots 2 and 3 during all surveys indicating a relative ecosystem health and functional response for a moderate to fast flowing headwater stream.

Plate 8: Green Drake mayfly larvae *Ephemera danica.*

4.6 Species commonly associated with slow and sluggish to standing water such as *Notonecta glauca, Phryganea bipunctata* and *Agrypnia pagetana* were charachteristic of the inhibited flow condition at Plot 1. Species such as the case-bearing caddis larvae of the *Sericostomatidae* family; *Sericostoma personatum*, larvae of the *Ephemerellidae* family; *Serretella ignita* and stonefly larvae of the *Nemouridae* family; *Nemoura erratica* were found in Plots 2 and 3. These species are indicative of the pristine and optimal habitat of a headwater stream. However, according to the results (Average score per taxon [ASPT] values), Plots 2 and 3 did not consistently score highly enough to corroborate this inferred finding. This suggests that the Grenstein Meadow reach was potentially being limited or suppressed in its ecological functioning.

[3] Rylands, 2012.

5.0 Electro-fishing Survey

5.1 The Environment Agency[4] completed the fish survey in September 2012.

5.2 Electro-fishing method: This method uses electricity to stun fish before they are caught. It is a common survey method used to sample fish populations to determine abundance, density, and species composition. Electro-fishing causes no harm to the fish when used correctly and after the fish are stunned they return to their natural state in around two minutes.

5.3 The Environment Agency electro-fished 100m stretch in the meadow and 100m stretch where they were able in Mileham Common because of the obstructions made by the vegetation. The species, weight and size were recorded and scales were removed for age analysis for each individual fish caught.

Plate 9: Kye and Justin (EA) electro-fishing in the River Nar

5.4 Summary of Results

5.5 Despite the relatively poor habitat four species were caught during electro-fishing, these included brown trout *Salmo trutta*, 3 spined stickle back *Gasterosteus aculeatus*, 10 spined stickleback *Pungitius pungitius* and stone loach *Barbatula barbatula*.

Plate 10: 3 spined stickleback being measured

Plate 11: Brown trout being measured

Plate 12: Stone loach in the hand

[4] Jerrom, 2012.

5.6 The channel was quite small and offered very little to its channel complexity and variety. The only species that was expected to be present was bullhead *Cottus gobio*, this may have been due to the lack of suitable substrate size and habitat.

5.7 The site may take up to three years to mature after the river restoration works offering more geomorphological features and habitat complexity.

6.0 Water Quality Survey

6.1 Naturi[5] completed the water quality monitoring during July and October 2012. The technical monitoring equipment for turbidity, dissolved oxygen and flow rate was supplied by OTT Hydrometry and the Environment Angency (EA) during July and October 2012.

6.2 Monitoring Method used: A site was selected for sampling mid-way within the section to be restored at Alder Corner in the meadow and the monitoring equipment was installed.

6.3 Water Quality

A water sample was collected once a week in a standard Pete bottle and tested for eight ions (nitrate, phosphate, ammonium, sulphate, calcium, chloride, aluminium and potassium), pH and conductivity. The samples were tested using The Palintest System, which uses a Transmittance-Display Photometer 500; a precision colorimeter with wide application in analytical chemistry.

6.4 A Hannah Instruments pH/Conductivity/Temperature meter (HI98130) was used to test water samples for levels of acidity-alkalinity and electrical conductivity.

Plate 13: The EA flow meter on the riverbank.

Plate 14: Matthew Ellison (OTT) explaining the monitoring sonde.

6.5 Telemetry and Hand-held Equipment

A range of telemetry equipment including a Hydrolab was installed by EA and OTT to provide a period of continuous data for the river restoration project covering river flow, dissolved oxygen (DO) (taken as % saturation), flow velocity, pH, temperature and conductivity. Data was collected at 15 minute intervals and downloaded onto IQ software for analysis.

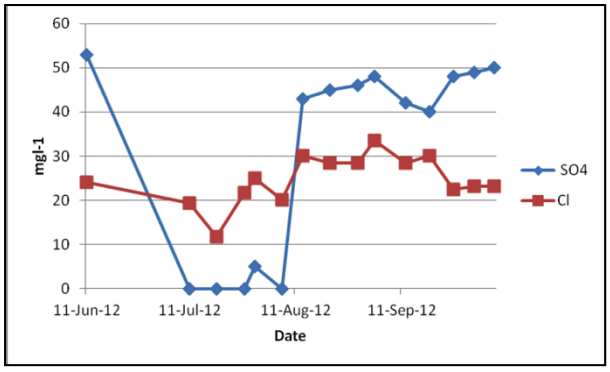
6.6 In addition, DO measurements were taken on a weekly basis from August using a hand-held Hannah Instruments Dissolved Oxygen and Temperature Meter (HI 9146) provided by the Norfolk Rivers Trust.

Plate 15: Hand-held dissolved oxygen meter.

[5] Masson, 2012b

6.7 Summary of results

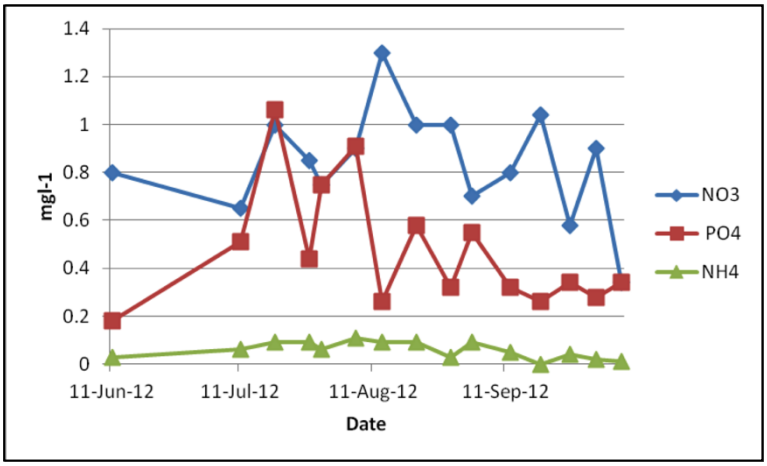
6.8 Water Quality



6.9 A rise in sulphate and chloride levels from low levels were detected in mid-summer through to early autumn, but there is no indication of the cause or effect of this change (Graph 1).

Graph 1: Sulphate and chloride levels (mgl^{-1}) between June and October 2012

6.10 Nitrate, ammonium and phosphate levels are low throughout the reporting time. Ammonium was a constant level below $0.1mgl^{-1}$, nitrate and phosphate had some variance, but were both mainly below $1mgl^{-1}$. Nitrate and phosphate levels were both at $1mgl^{-1}$ in mid July. Phosphate remained below this from mid-July, with nitrate levels falling consistently below $1mgl^{-1}$ in September (Graph 2).

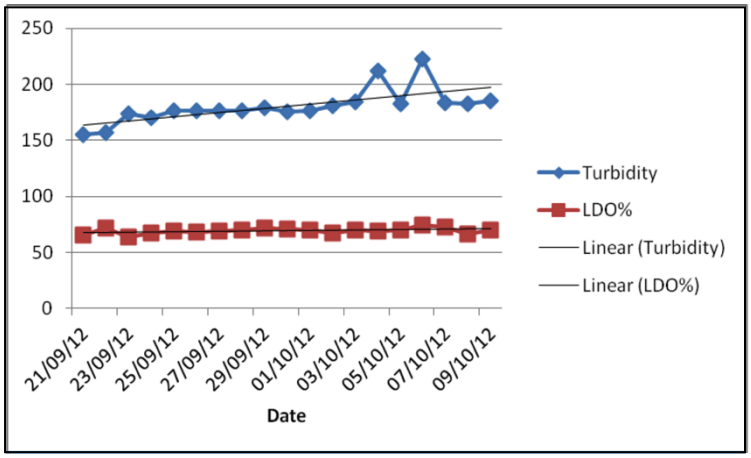


Graph 2: Nitrate, phosphate and ammonium levels (mgl^{-1}) between June and October 2012

6.11 The remaining ions calcium, aluminium and potassium as well as pH and DO were relatively constant throughout the sampling period. The conductivity value peaked towards the end of August and by October had returned back to June levels.

6.12 Telemetry and Hand-held Equipment

6.13 The river depth gradually dropped during the course of the monitoring period from c.250cm to c.100cm. Over a sampling period of 3 months the depth and velocity of the flow decreased.



Graph 3: Turbidity and DO (Hydrolab)

6.14 The OTT data for turbidity and DO shows a steady DO reading and an increase in turbidity towards the end of the sampling period (Graph 3). The results from using a hand-held Hannah Instruments DO meter show that DO reduces throughout the sampling period.

7.0 Vegetation survey on Mileham Common

7.1 Naturi[6] completed the vegetation survey on Mileham Common during September 2012.

7.2 Survey Method used: Aerial photographs from 2010 were used to aid navigation around the site, which was dominated by tall, largely unmanaged vegetation amongst tree and shrub scrub. They were also used for mapping the vegetation community types across the common using the British Plant Community coding, National Vegetation Community (NVC).

7.3 The site was walked, noting vegetation change and undertaking quadrat sampling within distinctive vegetation blocks. The quadrats recorded were 2x2 metres and all species present were recorded, including prominent bryophytes. An approximation of percentage cover of each species was recorded and then converted to a score of 1-10 using a Domin scale.

7.4 Summary of results

Table 1: Six vegetation types that were recoded in Mileham Common (Plate 11).

NVC Standard	Vegetation Type
M22	*Juncus subnodulosus* – *Cirsium palustre* (blunt-flowered rush – marsh thistle) fen meadow
M27	*Filipendula ulmaria* – *Angelica sylvestris* (meadowsweet – angelica) mire
S7	*Carex acutiformis* (lesser pond-sedge) swamp
S26	*Phragmites australis* – Urtica dioica (common reed – common nettle) tall-herb fen
S28	*Phalaris arundinacea* (reed canary-grass) tall-herb fen
OV26	*Epilobium hirsutum* (great willowherb) community

7.5 A total of 95 plant species were recorded in this 2012 NVC vegetation survey. In a previous plant species recording survey in 2009 by the Norfolk Wildlife Trust[7], 125 plant species were recorded.

7.6 The presence of species-rich M22 vegetation in the meadow reflects the complex management history of the site, which is likely to have involved mowing, gazing and cutting. This is a species-rich community indicated by the highest species count per quadrat. As management practices are reinstated, the common has the potential to reveal greater coverage and range of M22 vegetation. M27 vegetation is associated with wetter areas such as reed beds and fen.

[6] Masson, 2012c
[7] Walmsley, 2009

7.7 The S7 community is influenced by periodic river flooding, and perhaps has developed partly due to lack of regular cutting and removal of arisings at Mileham Common causing localised mulching. The presence of dense tall herb fen vegetation (S26) can relate to drying and disturbance of fen surfaces or spring mires and although this vegetation is species-poor, it provides variation in the overall structure of the vegetation, creating habitat diversity for other species. S28 and OV26 vegetation communities were identified as vegetation types in small patches within larger areas of other vegetation types. Both types respond to levels of soil waterlogging with S28 marking the upper limit of water level fluctuations.

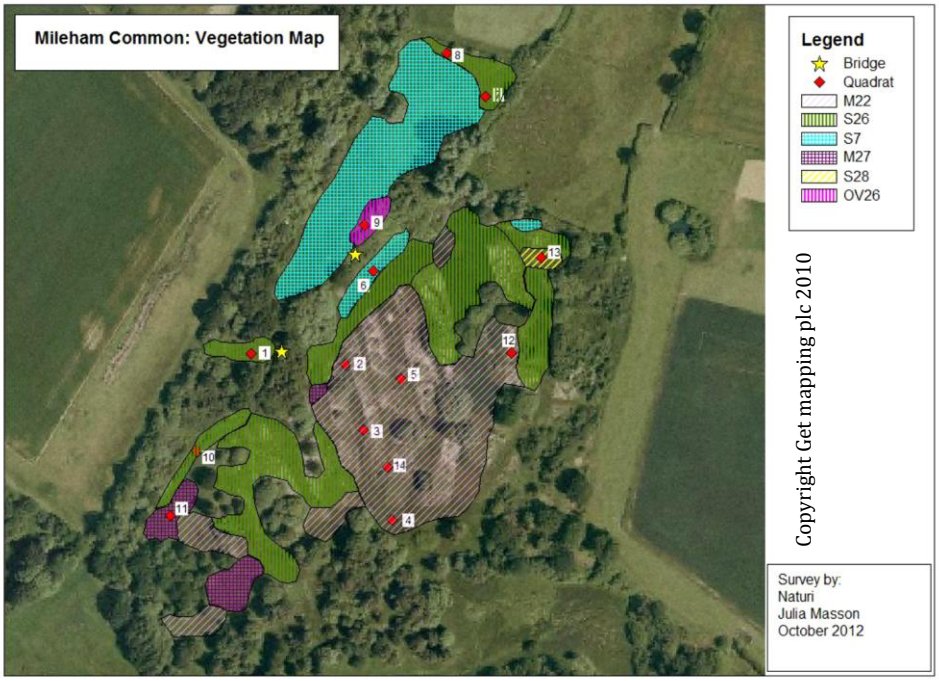


Plate 16: The vegetation survey map of Mileham Common.

8.0 Macrophytes of the River Nar, Mileham

8.1 Alconbury Environmental Consultants[8] completed the pre-river restoration macrophyte survey in July 2012.

8.2 Survey methods: Six survey sites were chosen (3 located in Mileham Common [1 = control, 2, 3], 3 located in the meadow [A, B, C = control) along the stretch of the River Nar to be restored. Two methods were used to collect the data. 1. The LEAFPACS WFD protocol used by the EA (based on the Mean Trophic Rank protocol). 2. The conservation agency's site characterisation of the river plant communities method (known as the JNCC methodology).

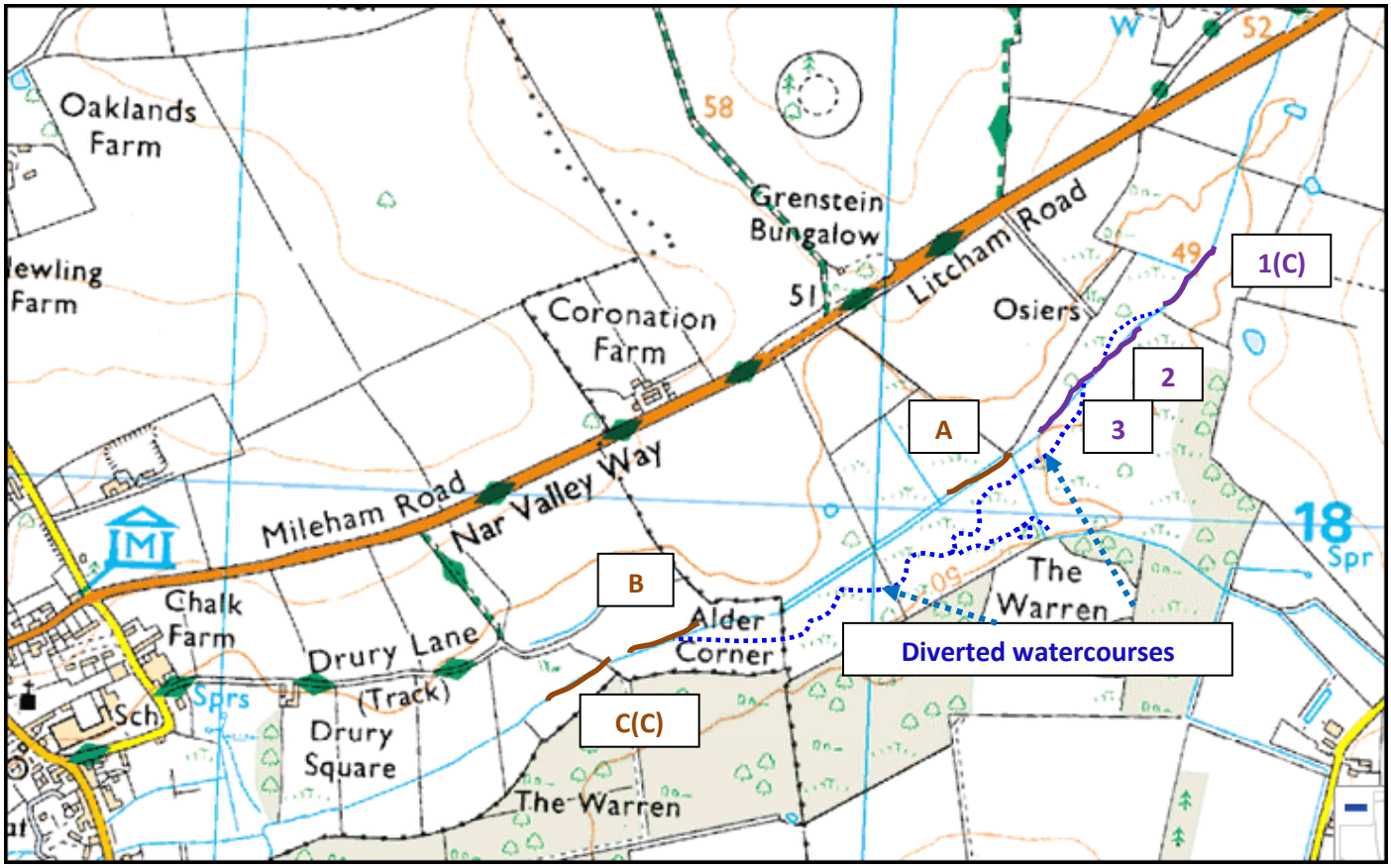


Plate 17: Site locations of the macrophyte survey

8.3 Summary of results

8.4 Throughout the site 12 species of macrophyte were identified, these included liverwort *Pellia endiviifolia,* moss *Leptodictyum riparium,* fool's water-cress *Apium nodiflorum,* lesser water-parsnip *Berula erecta*, blunt-fruited water-starwort *Callitriche obtusangula*, water-cress *Rorippa nasturtium-aquaticum*, water-speedwell *Veronica anagallis agg.*, lesser pond-sedge *Carex acutiformis*, yellow-flag *Iris pseudacorus*, lesser duckweed *Lemna minor*, common reed *Phragmites australis* and branched bur-reed *Sparganium erectum*.

8.5 These species have a Mean Trophic Rank score range (MTR) of between 1-6 (mean = 4.1) which indicates that most of these macrophytes are tolerant of eutrophication, with the moss being the most tolerant and the liverwort being the least tolerant of the list above.

[8] Holmes, 2012.

8.6 All six sites had few species recorded. This is typical for headwater streams that have been converted into ditches. MTR ranged from 40-50, the typical MTR scores (Mean) for other recorded sites is 40.2 and the Mean for the top 10% of sites in this Community Type was 47.3. The results suggest that the river quality (based on nutrient enrichment) is at least average for this type of stream, and the data provides a good baseline for future monitoring.

9.0 Conclusion

9.1 These monitoring surveys have been very beneficial to this project and they have provided background knowledge of the ecology of the site pre-river restoration. These results will help identify positive and negative changes after the river restoration work is completed and the site settles and establishes. These changes will enable us to improve river restoration techniques and ascertain the baseline needed for similar projects in the future.

9.2 The knowledge of the presence of different species before restoration work will have a good chance of recovery, recolonising the floodplain and channel after the site improves from the temporary disturbance caused by the machinery.

9.3 The water quality on the River Nar at Mileham shows that it has good ecological status under the Water Framework Directive. It would classify as a Type 7 calcareous lowland river, with good ecological status for dissolved oxygen, Good to High ecological status for nutrient conditions (as measured by phosphorus), and high ecological status for ammonia.

9.4 The reintroduction of a regular management regime is planned on Mileham Common. The instigation of active management such as grazing will enhance the overall vegetation condition in terms of dominance of some species, enabling less vigorous, and perhaps more uncommon, species to thrive. It is recommended that low density grazing is carried out on the meadow, which will allow the tussock structure that has been established to continue. This structure is ideal for short tailed field voles and is one of the best examples of rough grassland pasture in Norfolk.

9.5 The River Nar restoration will promote an ecologically healthier and better functioning river, which should theoretically support a potentially richer and more abundant community than that of a straight and incised channel.

9.6 If you would like to read the individual monitoring reports please get in touch with Helen Mandley, Norfolk Rivers Trust, Unit 3 Stody Hall Barns, Stody, Norfolk, NR24 2ED, Tel: 01263 862657, email: helenmandley@norfolkriverstrust.org.

10.0 References

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All the photos in this report are taken by Helen Mandley, Norfolk Rivers Trust, unless otherwise stated.