



Leicestershire County Council.

**Lutterworth East**

**Feasibility Study: Misterton Marshes SSSI.  
Core Strategy Representations.**

September 2016

**FPCR Environment and Design Ltd**

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Appendix B: Peter Brett Associates. Technical Note. 33277-4001-TN002. Preliminary Hydrogeological Inspection of the Misterton Marshes SSSI

## 1.0 INTRODUCTION & BACKGROUND

- 1.1 Leicestershire County Council commissioned FPCR Environment & Design Ltd. and Peter Brett Associates LLP. to provide additional technical information for Harborough District Council in relation to the Misterton Marshes SSSI. This assessment has been informed by the completion of an Extended Phase 1 Habitat survey of land within the SSSI, a basic habitat assessment of land outside the boundary to the SSSI and review of existing hydrological information.
- 1.2 The document does not provide full technical details, detailed designs or mitigation proposals, as these are not required at this stage. This document does outline the potential constraints to the allocation from the location of the Misterton Marshes SSSI and strategies which are 'technically feasible' to implement to avoid or minimise potential effects from the allocation to the nature conservation value of the SSSI. Whilst further technical assessments / detailed mitigation strategies will be required to support a planning application following allocation, the level of information provided in the following document is adequate to support allocation of the site and is in accordance to the requirements of the Wildlife & Countryside Act 1981 (*as amended*).
- 1.3 The proposals for the Sustainable Urban Extension on the site comprise:
- The development of circa 2960 dwellings and 23ha of employment land with associated infrastructure;
  - A new primary school and local centre; and
  - Extensive green infrastructure comprising approximately 40% of the total development area.
- 1.4 Natural England (NE) provided advice to the Local Planning Authority on 04 April 2016 and 07 July 2016 relating to the proposed allocation and the potential constraints the Misterton Marshes SSSI presents to the allocation. In summary the potential affects to the SSSI identified by NE from allocation of the site include:
- Reductions in the overland hydrological flows to and from the SSSI from the development may affect the conservation status of the SSSI;
  - Development of the site may affect the hydrological regimes of any existing ground water flow to the SSSI;
  - Development may affect the water quality entering the SSSI; and
  - Development of the site may result in increased informal recreational pressure within the SSSI.
- 1.5 The following document reviews the existing available baseline information and provides outline mechanisms through which the potential impacts can be addressed. The mechanisms through which the potential affects can be addressed will be reviewed and agreed with further consultation with NE in September 2016. It is expected the solutions presented will be agreed with NE in September 2016 through use of the Discretionary Advice Service (DAS).

## 2.0 CURRENT CONDITION ASSESSMENT OF THE SSSI & SURROUNDING FEATURES

### Background & Designation of the SSSI

- 2.1 The boundary to the Misterton Marshes SSSI has been defined and designated by Natural England as a SSSI in 1986 through the legal mechanism provided in Schedule 9 of the Wildlife & Countryside Act (*as amended*). This SSSI was designated for 'unimproved wetland habitat' and 'neutral grassland – lowland'. Section 28B of the Act provides additional discretion powers to Natural England to include additional land within a SSSI designation if considered necessary.
- 2.2 The citation attributes development of the marshes to alluvial deposits adjacent to tributary of the River Swift. This citation also reports the marshes supports a diverse bird community.
- 2.3 Figure 1 shows the boundary to the SSSI.

### Current condition assessment of the SSSI

- 2.4 The most recent condition assessment of the SSSI was completed in June 2011. This concluded that it was in 'unfavourable – recovering' condition.
- 2.5 The assessment of 'unfavourable – recovering' condition was provided as parts of the SSSI are being managed in accordance to a Higher Level Stewardship agreement. This assessment does not confirm the SSSI units are not meeting the necessary targets but it is assumed that if appropriate management is continued the units of the SSSI will reach favourable condition in time through the continued application of such management.

### Surrounding features

- 2.6 Immediately adjacent to the boundary of the SSSI are a number of non-statutory designated sites which are not listed within the SSSI designation (Figure 1).
- 2.7 These sites include:
- Marsh by River Swift (a parish level site north of the SSSI);
  - Thornborough Spiney (a parish level site south east of the SSSI);
  - Thornborough Spiney (a district level site south of the SSSI); and
  - An unnamed marsh (a district level site west of the SSSI).
- 2.8 Since designation of the SSSI and subsequent reviews in 2002, 2008, 2009 and 2011 none of these sites have been incorporated within the designation boundary. Therefore, it is reasonable to conclude that none of the habitats within these sites meet the requirement to be designated as a unit of the existing SSSI or a new SSSI.
- 2.9 Furthermore, when considering the of the physical boundaries of a SSSI, NE have the discretion to encompass the special features of the site and all land necessary to ensure protection and sustainability of those features. Examples given include; protection from fertiliser and pesticide drift, inclusion of land for the purpose of maintaining water quality and hydrological processes, and for ensuring there is a clear notifiable boundary. As the land surrounding the SSSI does not conform to the designation requirements and since designation the surrounding land has not been included

within the SSSI boundary it is reasonable to assume that additional land surrounding the SSSI is not required to maintain the conservation status of the site.

- 2.10 Further parish level site including the River Swift, an area of conifer plantation and areas of semi-improved grassland adjacent to the River Swift are situated further south of the SSSI.

### 3.0 HABITAT ASSESSMENT OF THE SSSI AND SURROUND LAND

#### Habitat Assessment of land within the SSSI

- 3.1 On 5<sup>th</sup> August 2016 an extended Phase 1 Habitat Assessment was completed by FPCR. This assessment confirmed the SSSI comprises a complex series of habitats. The following provides a description of the habitats and the locations of the habitats are shown on Figure 2.
- 3.2 A Phase 1 and Phase 2 (National Vegetation Classification) Survey of the SSSI was commissioned by Natural England in 2007 (Peak Ecology Ecological Consultants Ltd, 2007). The findings of the 2016 Phase 1 Habitat Assessment broadly concur with the 2007 assessment, though extents of habitats may have shifted slightly in the interim.

#### Semi-natural Broadleaved Woodland

- 3.3 Centrally within the site, mature alder *Alnus glutinosa* trees flanked either side of the watercourse, forming an area of semi-natural broadleaved woodland. No discernible shrub layer was present and tufted hair grass *Deschampsia cespitosa* dominated the ground layer with soft rush *Juncus effuses* and occasional common nettle *Urtica dioica*, meadow sweet *Filipendula ulmaria* and wild angelica *Angelica sylvestris* with common reed *Phragmites australis* at the peripheries.

#### Coniferous Plantation Woodland

- 3.4 Two areas of larch *Larix decidua* woodland was recorded, which was separated by an area of semi-improved grassland where the power cables passed overhead. No shrub layer was present and ground layer was predominantly leaf litter with occasional common nettle.

#### Broadleaved Plantation Woodland

- 3.5 An established cricket bat willow *Salix alba caerulea* plantation occurred within the SSSI, which had a ground flora comprising common reed, common nettle, rosebay willowherb *Chamerion angustifolium* and hedge bindweed *Calystegia sepium*.

#### Dense Scrub

- 3.6 A section of dense scrub on the eastern boundary of the SSSI was dominated by elder *Sambucus nigra*.

#### Species Poor Semi-improved Grassland

- 3.7 Grassland with abundant Yorkshire fog with frequent perennial rye *Lolium perenne*, creeping thistle *Cirsium arvense* and common nettle and occasional tufted hair grass, crested dog's tail *Cynosaurus cristatus*, black knapweed *Centaurea nigra*, meadow vetchling *Lathyrus pratense*, hairy sedge *Carex hirsutum*, common sorrel *Rumex acetosa* and ladies bedstraw *Galium verum*.

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Improved Grassland

- 3.8 A sward comprising Yorkshire fog, crested dog's tail, creeping bent *Agrostis stolonifera* and perennial rye grass with negligible coverage of herbs, grazed by sheep was recorded in the north eastern part of the SSSI.

Tall ruderal

- 3.9 Areas dominated by common nettle with creeping thistle flanked several areas of *Phragmites australis* reed bed (swamp habitat).

Swamp

- 3.10 Habitats mapped as swamp comprise common reed dominated reed bed (target note Tn1) or are dominated by lesser pond sedge (target note Tn2). In areas of lesser pond sedge *Carex acutiformis* (Tn2) species also occasionally occurring included ragged robin *Lychnis flos-cuculi*, fen bedstraw *Galium uliginosum*, common marsh bedstraw *Galium palustre*, sharp flowered rush *Juncus acutiflorus*, common bird's-foot trefoil *Lotus corniculatus*, marsh thistle *Cirsium palustre*, meadow sweet and wild angelica.

Marshy Grassland

- 3.11 Though classifying as marshy grassland, this habitat distinctly differed either being dominated by hard rush *Juncus inflexus* (Target note Tn3), blunt flowered rush *Juncus subnodulosus* (Target note Tn4) or soft rush *Juncus effuses* (Target note Tn5) (refer to Figure 2).
- 3.12 Target note Tn3 comprised hard rush dominated rush pasture with scattered soft rush and occasional meadow sweet, marsh thistle and water figwort *Scrophularia aquatic*.
- 3.13 Target note Tn4 was almost entirely dominated by blunt flowered rush with occasional lesser pond sedge and meadow sweet.
- 3.14 Target note Tn5 was a permanently moist area dominated by soft rush with frequent tufted hair grass and occasionally occurring Yorkshire fog *Holcus lanatus*, common reed, creeping buttercup *Ranunculus repens* and common figwort *Scrophularia nodosa*.

Running Water

- 3.15 The watercourse runs east – west through the SSSI and though fenced on both banks, is relatively over shaded by the adjacent alder woodland for most of its journey through the site. As such, aquatic vegetation is limited to encroachment of common reed from the banks.

**Habitat Assessment of land surrounding the SSSI**

- 3.16 Over the survey the non-designated sites of nature conservation interest were assessed and the following provide a description of the habitats present. These habitats are also shown on Figure 2.
- 3.17 Marsh by River Swift (Parish level value) – this refers to the corridor of the water course directly upstream of the section that passes through the SSSI. This part of the watercourse passes through marshy grassland, with more open conditions and greater light availability allowing a little greater diversity of associated vegetation, including branched bur-reed *Scarganium erectum* and

brooklime *Veronica beccabunga* in the channel with marsh thistle, wild angelica, common bird foot trefoil, hedgerow crane's-bill *Geranium pyrenaicum*, and meadow vetching *Lathyrus pratensis* on its banks.

- 3.18 Thornborough Spiney (Parish level value) – once an area of plantation, this is now a habitat mosaic which still includes some broadleaved plantation (comprising, alder, goat willow *Salix caprea*, guelder rose *Viburnum opulus*, silver birch *Betula pendula* and oak *Quercus robur* amongst a rough grassland comprising false oat grass *Arrhenatherum elatius*, Yorkshire fog, hairy sedge, rosebay willowherb and bramble *Rubus fruticosus* agg.), but now also includes dense scrub, swamp and soft rush dominated neutral grassland.
- 3.19 Thornborough Spiney (District level value) – this is an apparently unmanaged area of dense willow scrub, the section to the east of the water course appearing somewhat more established.
- 3.20 An unnamed marsh (District level value) – this is a field compartment which is currently sheep grazed rush pasture, with abundant hard rush, frequent water figwort, water mint *Mentha aquatic* and brown sedge *Carex disticha* and occasional wild angelica and branched bur-reed.

#### **Wider habitat assessment**

- 3.21 Land use within the wider site surrounding the SSSI is dominated by intensively managed improved grassland and arable land with boundary hedgerows. Given this management the land is likely to be subject to the application of fertilisers and agricultural pesticides.

#### **4.0 POTENTIAL HYDROLOGICAL INFLUENCES**

- 4.1 The designation citation considers the 'tributary to the River Swift' as the likely source of the alluvial deposits within the SSSI. From a review of the current topographical information, OS mapping and FEH catchment descriptors it has been concluded that this tributary and the drains / ditches feeding this tributary are likely to provide the main hydrological input into the SSSI.
- 4.2 The springs found within the vicinity of the site are likely to be emanating from bands of sand located within the glacial till that underlies the site, specifically the Shawell Sand and Gravel that outcrops close to the watercourse flowing through the SSSI. The size and flow from any springs cannot be determined at this stage, however, it could be expected that they have an insignificant contribution as the glacial till that overlays the Shawell Sand group is typically of low impermeability.
- 4.3 The marsh associated with the SSSI could be formed as a result of both springs and surface waters, however, further technical assessment and monitoring is required to determine the primary source.
- 4.4 A preliminary hydrogeological inspection of the SSSI was completed in September 2016. The findings are reported in PBA Technical Note 33277-3501-TN002 in Appendix B. The note provides further commentary on the items discussed above and confirms that further technical assessment is required to determine all the hydrological influences at the SSSI.

#### **5.0 POTENTIAL MITIGATION STRATEGIES TO ELIMINATE, REDUCE AND/OR MITIGATE THE POTENTIAL EFFECTS TO THE SSSI**

- 5.1 To ensure compliance with the requirements of this policy at the detailed application stage environmental assessments will review all current environmental parameters, the potential effects



of the proposals and the potential residual effects of the proposals following the application of appropriate mitigation. At the strategic level the submitted assessment is required to assess the potential environmental parameters of importance to ecological receptors, the potential effects of plan or projects and potential mitigation measures, which can be applied to eliminate, reduce and/or mitigate for the potential effects.

- 5.2 The following section considers the potential effects during the construction / operational phases of the proposed sustainable urban extension and potential mitigation strategies which could be implemented at the detailed design stage to eliminate, reduce and/or mitigate the potential effects to the SSSI. The application of such measures is in accordance to the relevant policies within the NPPF and the requirements of the Wildlife & Countryside Act 1981 (*as amended*).
- 5.3 Further consultation is currently going with Natural England in relation to the mitigation measures required for support the allocation are currently on-going.

### **Design**

- 5.4 The current development design demonstrates the development will not directly affect habitats within the boundary of the SSSI (Drawing Number: 7179-L-02 REVC). The indicative development plan confirms a stand-off of 50 - 174m between the site and the SSSI and green infrastructure will be provided in this area. The design has also incorporated all of the existing district / parish level sites in green infrastructure corridor and adequate connectivity to and from the SSSI has been provided to ensure the SSSI is not isolated during or on completion of the development.

### **Potential Effects**

- 5.5 Potential negative effects to the conservation value of the SSSI could occur both during the construction phase and the operational phase of the development. However, the proposals will not result in land take from the SSSI.
- 5.6 During the construction phase the primary potential negative effects to the SSSI have been identified as:
- Uncontrolled discharge of pollutants from the working area including dust deposition, siltation and pollutant from oils / fuels; and
  - Effects to the current hydrological regime of the SSSI through overland or ground water sources.
- 5.7 Over the operational phase the potential negative effects to the SSSI have been identified as:
- Effects to the current hydrological regime of the SSSI; and
  - Increased recreational pressure.

### **Potential Mitigation Strategies**

#### **Construction Phase**

- 5.8 At the detailed design stage detailed hydrological modelling will be carried out. This modelling will inform the detailed mitigation package, which will be implemented to avoid potential affects the current hydrological regime.

- 5.9 Ground water impacts can be mitigated by ensuring impermeable layers, or similar, are used where necessary (such as in plant cleaning areas) to prevent any potential pollutants suspended within runoff from infiltrating to the ground,
- 5.10 Other potential effects to the conservation value of the SSSI will be mitigated through the application of appropriate environmental management techniques. Such measures will be included within a Construction Environmental Management Plan, which will cover pollution prevention, drainage management, chemical pollution prevention, site waste management and current legislation on site management practice. Additional measures to avoid soil compaction on land within an appropriate zone of influence around the SSSI will be undertaken; such measures could involve the use of temporary road surfaces such as heavy duty road matting. The contents of the plan will be agreed with all relevant stakeholders, as deemed appropriate by the Local Planning Authority, prior to implementation. This package of measures will ensure the nature conservation value of the SSSI will not be adversely affected.
- 5.11 The application of such measures will ensure potential negative effects during the construction phase are avoided or mitigated. Thus compliance with the NPPF and the Wildlife & Countryside Act 1981 (*as amended*) will be achieved.

### Operational Phase

#### Hydrology

- 5.12 Currently, the evidence base relating to the current hydrological regime for the SSSI is minimal. From information provided by NE and evidence collected by Peter Brett to inform this document the main hydrological source is likely to be the unnamed watercourse and associated catchment which enters the SSSI from the north west. At the detailed design stage detailed flood modelling will be carried out to confirm the current hydrological regime. The results of this detailed modelling work will inform the final engineering solution for the development.
- 5.13 Infiltration testing, groundwater monitoring and monitoring of water levels within the watercourse / SSSI could be undertaken, at the detailed design stage prior to the submission of a planning application, to determine the influence of groundwater on the hydrological regime of the SSSI. The level of assessment is to be agreed with all relevant stakeholder prior to the submission of a planning application. The findings of these investigations will inform the final engineering solution for the development.
- 5.14 The Environment Agency will also require the FRA for the development which will also considered the potential risk to the SSSI. This will need to demonstrate:
- an acceptable level of flood risk on-site and no increase in risk elsewhere; and
  - no adverse impacts to third parties (nearby residential properties for example) related to flood flows in the tributary to the River Swift or the River Swift, as a result of the development and surface water run-off rates and volumes from the development.
- 5.15 Mitigation strategies which will be implemented as part of the development will ensure the current flow rates into, through and out of the SSSI will be maintained at current levels. The measures will include designing the surface water drainage system so that existing outfall locations are maintained at the existing greenfield run-off rates. Surface water attenuation will be provided within the development parcels where necessary so that a flow controlled outfall rate can be maintained

to prevent detrimental impact of flows upon the SSSI. These control mechanism will also be used to ensure a continued source of water throughout the year to reduce drying which is currently being experienced within the SSSI.

- 5.16 The development will also ensure ground water flows into, through and out of the SSSI are also maintained on completion of the development by utilising infiltration drainage methods where technically feasible to ensure groundwater levels are continually recharged as per the existing site conditions.
- 5.17 On completion of the development mechanisms for monitoring and management of over land flow and ground water flows will be secured through condition and agreed with all statutory conservation organisations. The monitoring will inform on-going management of the Sustainable drainage system implemented within the development and any necessary alterations to increase or decrease flow rates due to climate change will be implemented in consultation with statutory stake holders.
- 5.18 The technical note provided at Appendix A confirms it is technically feasible to maintain the current hydrological regime with the application of the measure outlined above.
- 5.19 The application of such mitigation will ensure adverse effects to the current hydrological regime of the SSSI are avoided or mitigated. Thus compliance with NPPF and the Wildlife & Countryside Act 1981 (*as amended*) will be achieved.

#### Pollutants

- 5.20 The potential effects of runoff pollutants will be dealt with through the implementation of a SuDS drainage solution, as discussed above and in line with the latest SuDS guidance from CIRIA, which would provide both treatment and attenuation prior to discharge of 'clean' water at controlled rates.
- 5.21 The technical note provided in Appendix A confirms such potential mitigation is technically feasible.
- 5.22 The application of such mitigation will ensure adverse effects from pollutants to the SSSI are avoided or mitigated. Thus compliance with NPPF and the Wildlife & Countryside Act 1981 (*as amended*) will be achieved.

#### **Informal recreational pressure**

- 5.23 The indicative development proposals include the provision of approximately 40% GI and a significant buffer zone has been provided on land surround the SSSI. The GI surrounding the SSSI will be design and managed in the long term to provide wetland and grassland habitats which complement the existing habitats in the SSSI. The inclusion of wetland habitat in the GI surrounding the SSSI will deter significant increases in informal recreation through the nature of the habitats. To further reduce the potential for increase recreational pressure in the SSSI the long term management strategy will also include other mechanism for controlling informal recreational pressure which will be agreed with relevant stake holders through the submission of a planning application.
- 5.24 Such additional measures to avoid or minimise potential effects from informal recreational pressure are likely to comprise:
- The use of appropriate signage and fencing on land within and surrounding the SSSI;

- The creation of broad walks / defined pathways in areas of the SSSI through which public access is agreed with relevant stakeholders;
- The use of appropriate planting to restrict access to areas of the SSSI; and
- The provision of informative leaflet to new residents informing of the ecological importance of the SSSI.

5.25 The proposals also include the creation of a new community park and the creation of the GI routes throughout the site provide further significant area for both formal / informal recreation outside the SSSI. The inclusion of such areas within the proposals will ensure informal recreation within the boundary of the SSSI is minimised.

5.26 With the application of such management allocation of the site will be in accordance to the requirements of NPPF and the Wildlife & Countryside Act 1981 (*as amended*).

## **6.0 ADDITIONAL ENHANCEMENTS**

6.1 The GI package proposed by the site has included all of the district / parish level site situated adjacent to and distant from the SSSI. The habitats created within these corridors will be complementary to the wetland habitats and improve the overall connectivity to the SSSI, reducing isolation of the SSSI which currently occurs through the existing land management.

6.2 The proposals will also provide suitable management for the district / parish level sites identified within the development boundary, which will be agreed with relevant stakeholders. The appropriate management applied to the district / parish level sites immediately adjacent to the SSSI will improve the overall buffers and complement the management of habitats within the SSSI. Thus with appropriate management the quality of the buffers surrounding the SSSI will be enhanced.

6.3 Appropriate management would be led by Natural England and build upon their existing work, however additional funding brought forward by the proposed development could enable additional proactive management, to speed up the recovery of the condition of habitats within the SSSI. Additional techniques that could potentially be considered if resources were available may include securing more appropriate breeds of livestock to graze some areas of the SSSI, creation of scrapes to break up the homogeneous nature of *Juncus* sp. swards and increase ecotones or manual control of extents of scrub and common reed to ensure diversity of wetland habitats is maintained.

6.4 In addition, the removal of the area of broadleaved plantation woodland within the SSSI, could be implemented to the benefit of the hydrology of surrounding wetland habitats. A reasonable grazing regime within this area, post felling, could see this return to habitat more complementary to the marsh.

6.5 Clearly management efforts have already taken effect on the Parish Level value area of Thornborough Spiney, transforming plantation woodland to a mosaic of neutral grassland, tall herb and swamp. This could be continued through implementing some of the techniques described above to further improve the wetland habitat in terms of extent and condition.

6.6 The area of Thornborough Spiney that is of District level value, to the south of the SSSI, may benefit from thinning, in turn benefitting the water course that passes through it, which is currently only of Parish level value because of its over shading and nutrient enrichment.

6.7 The overall management plan, subject to agreement with relevant stakeholder, and funding of management will all enhancements currently within the boundary of the SSSI. This management

plan, long term funding and monitoring will ensure the conservation status of the SSSI is returned to favourable condition and maintained at a favourable condition.

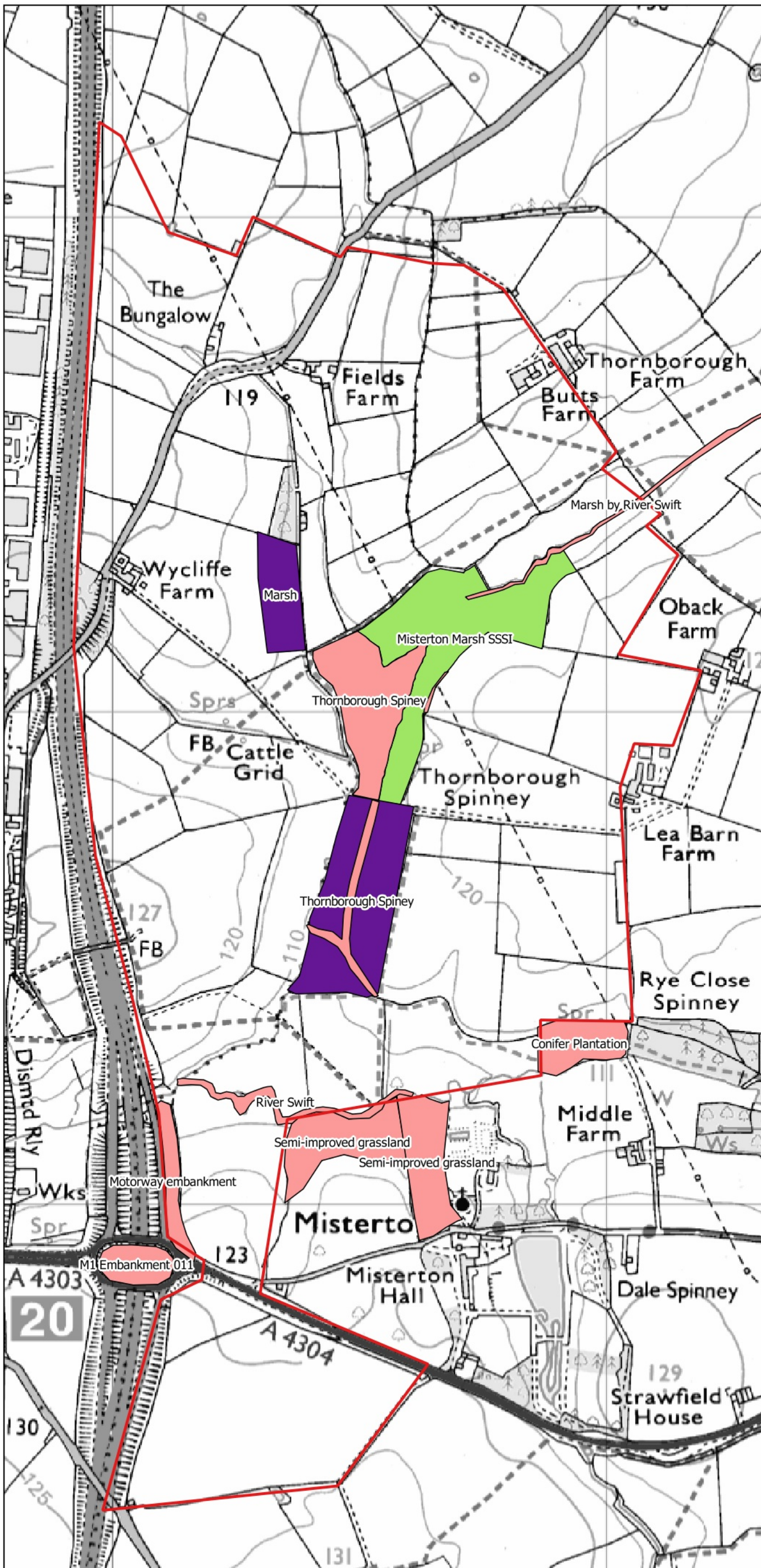
- 6.8 Through the application of these additional enhancements and long term management of all element of GI including the SSSI the proposals are again in accordance to the requirements of NPPF and the Wildlife & Countryside Act 1981 (*as amended*).

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Leicestershire County Council  
Lutterworth East, Lutterworth

Statutory and Non-statutory Designated Sites



Scale: 1:8,718

LFR / KDG

27/9/2016













Figure 1

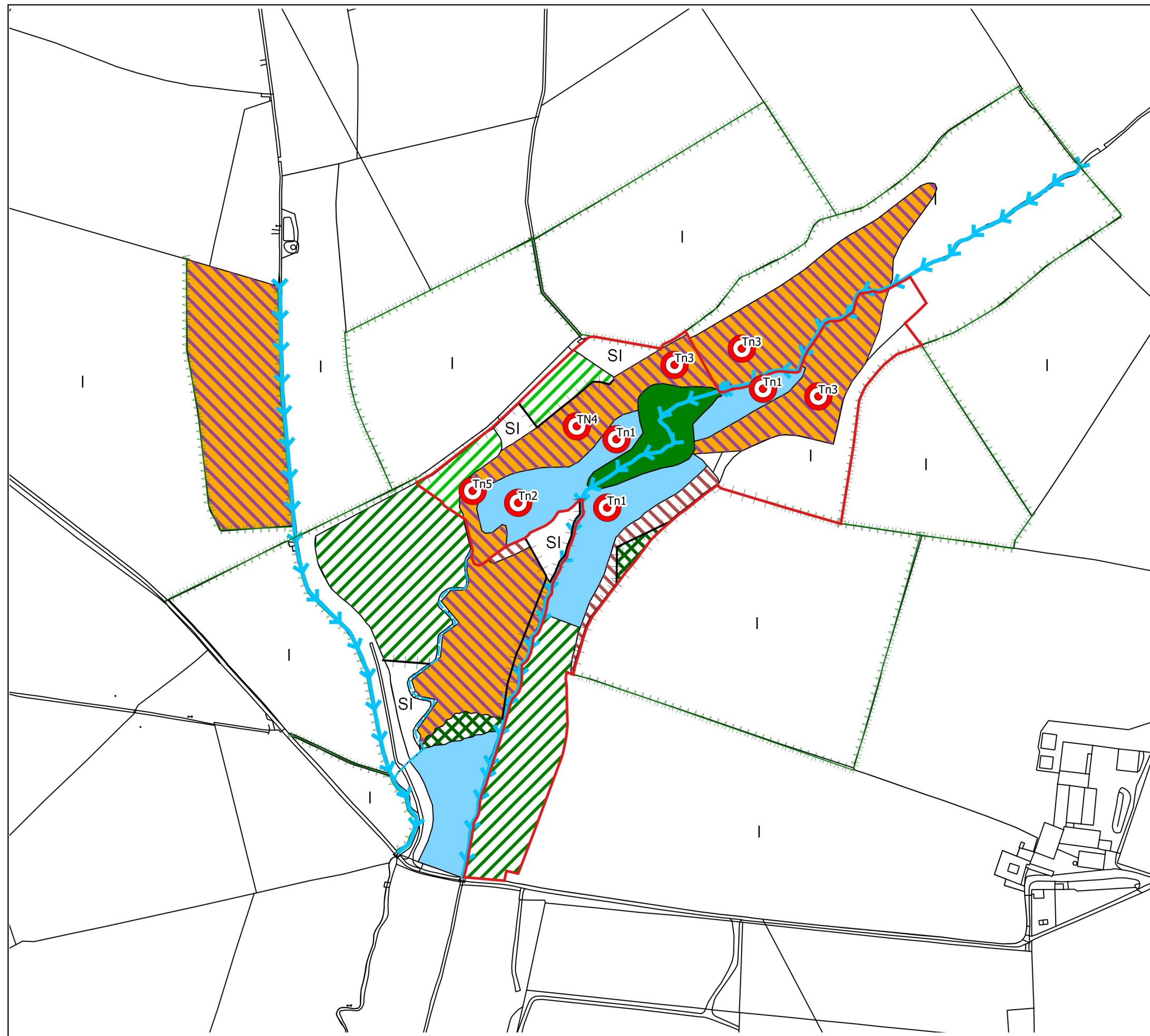
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### Key

-  SSSI Boundary
-  Broadleaved woodland - semi-natural
-  Broadleaved woodland - plantation
-  Marsh/marshy grassland
-  Swamp
-  Scrub - dense/continuous
-  Other tall herb and fern - ruderal
-  Improved grassland
-  Coniferous woodland - plantation
-  Poor semi-improved grassland
-  Running water
-  Intact hedge - native species-rich
-  Fence
-  Dry ditch
-  Target note



client  
Leicestershire County Council

project  
Lutterworth East,  
Leicestershire

drawing title  
PHASE 1 HABITAT PLAN

scale  
1:3,500

drawn  
HET/MPG

issue  
27/9/2016

drawing / figure number  
**Figure 2**

rev  
**7179-E-02**

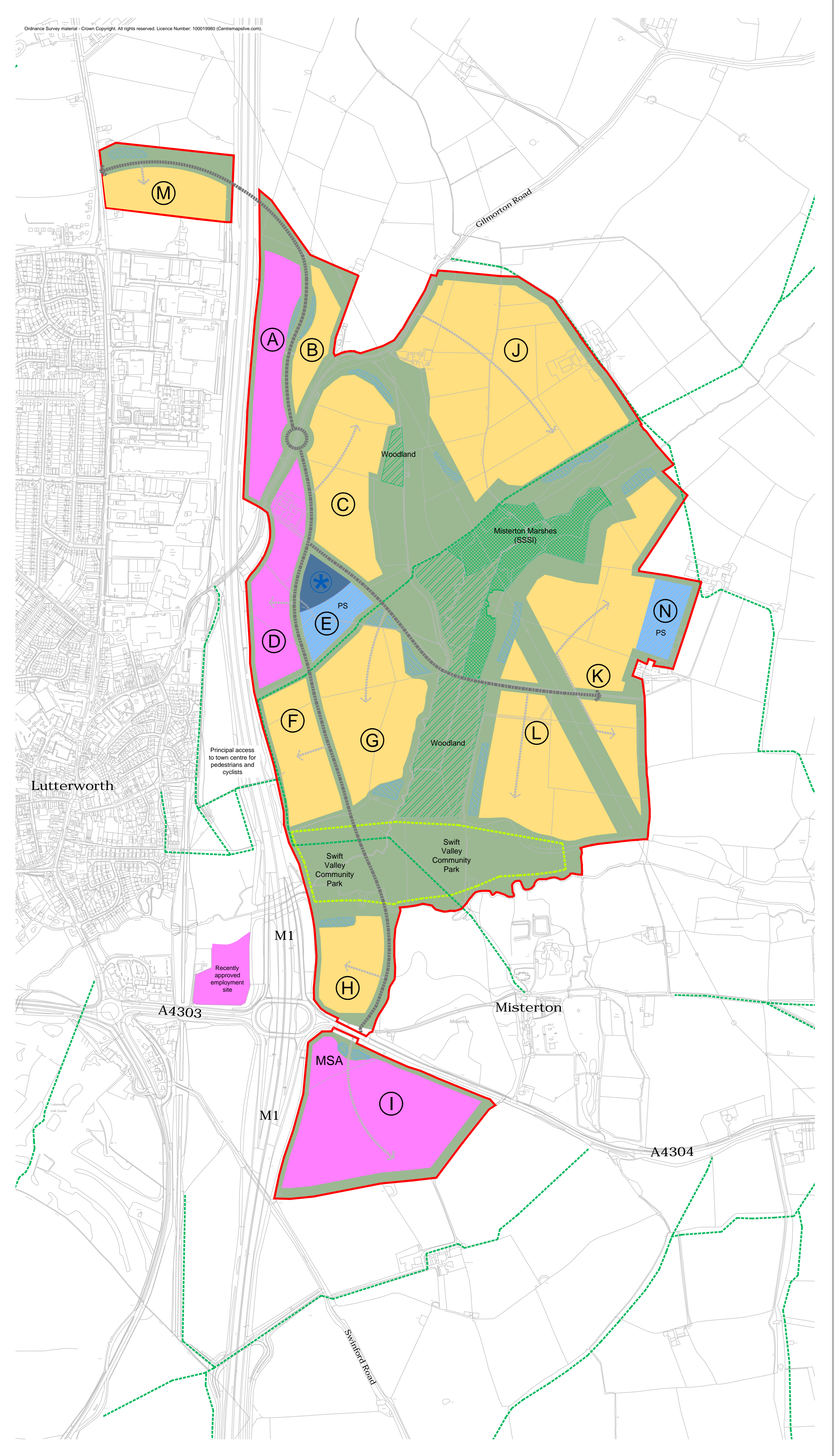


- Proposed red line boundary  
204.76 ha
- Proposed residential areas  
77.62 ha
- Proposed employment areas (within red line boundary)  
23.68 ha
- PS  
Proposed schools  
(2 No. @ 2.00 ha each)  
4.00 ha
- Proposed local centre  
1.19 ha
- Proposed green infrastructure (incl SSSI and existing woodland)  
94.57 ha
- Misterton Marshes SSSI  
6.5 ha
- Existing woodland  
10.1 ha
- Swift Valley Community Park (proposed)
- Potential Attenuation Areas (subject to engineer's recommendations)
- Proposed primary routes
- Proposed secondary routes
- PROW
- MSA Potential Motorway Services

**Individual plots**

Plot	Area	Houses*
A	5.24	81
B	2.12	-
C	8.69	330
D	5.31	-
E	2.00	-
F	4.89	186
G	9.31	354
H	3.90	148
I	13.13	-
J	22.50	855
K	12.47	474
L	9.94	377
M	3.80	144
N	2.00	-
Local Centre	1.19	-
Total	106.49	2949

\* The number of houses are based on a density of 38 houses per hectare applied to the gross residential area.



**DRAFT**

rev	date	description	by
-	27.07.2016	Revised area calcs	LP/CP
-	27.07.2016	Inclusion of second Primary School	LP/CP
-	26.07.2016	Updated housing density	LP/CP
-	25.07.2016	First issue	LP/CP

**fpcr**

- masterplanning
- environmental assessment
- landscape design
- urban design
- ecology
- architecture
- arboriculture

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project  
Lutterworth East  
(Misterton)

drawing title  
**LUTTERWORTH EAST CAPACITY PLAN**

scale  
1:5000 @ A1

drawn  
LP/CP

date  
July 2016

drawing number  
**7179-L-02**

rev  
**C**

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**APPENDIX A:**

**Peter Brett Associates. Technical Note. 33277-4001-TN001.  
Hydrological Impacts of the Lutterworth East SDA upon Misterton Marshes SSSI**

# TECHNICAL NOTE

**Job Name:** Lutterworth East  
**Job No:** 33277  
**Note No:** 33277-4001-TN001  
**Date:** September 2016  
**Prepared By:** Robert Pike – Assistant Engineer  
**Subject:** Hydrological Impacts of the Lutterworth East SDA upon Misterton Marshes SSSI

Item	Subject
1.	<p><b><u>Introduction</u></b></p> <p>This technical note has been prepared to outline the potential interface, interaction and effects of the proposed Lutterworth East Strategic Development Area (SDA) upon the Misterton Marshes Site of Special Scientific Interest (SSSI). The note also outlines how any potential adverse effects will be managed and mitigated so that the SSSI is unaffected by the development.</p> <p>The technical note aims to address the following items:</p> <ul style="list-style-type: none"> <li>▪ Existing hydrology and flood risk</li> <li>▪ Proposed hydrology</li> <li>▪ Water Quality</li> </ul>
2.	<p><b><u>Lutterworth East SDA Proposals</u></b></p> <p>The Lutterworth East SDA is currently seeking an allocation within the new Harborough Local Plan. The site comprises approximately 205ha area of predominantly greenfield land to the east of Lutterworth. As part of the allocation process all relevant stakeholders are being consulted so that any concerns regarding potential development at the site are identified at the earliest opportunity.</p> <p>In this regard, Natural England (NE) has raised concerns of the developments potential impact upon the Misterton Marshes SSSI that is located within the site.</p>

## DOCUMENT ISSUE RECORD

Technical Note No	Rev	Date	Prepared	Checked	Reviewed (Discipline Lead)	Approved (Project Director)
33277/4001/TN001	-	25.08.16	RP	SK	DS	RH
33277/4001/TN001	A	28.09.16	RP	SK	DS	RH

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## TECHNICAL NOTE

Item	Subject																																		
3.	<p><b><u>Natural England Concerns</u></b></p> <p>NE's primary concern relates to the hydrological effects upon the SSSI from potential new development in the surrounding area. The SSSI contains hydrologically sensitive species and it is therefore paramount that the existing hydrology is not altered so as to threaten the ecological diversity at the SSSI.</p> <p>NE requires confirmation as to how the existing hydrological regime within the SSSI is maintained. Specifically whether water levels in the marsh are maintained through river and surface water flows, or whether groundwater plays a role. In any instance, NE requires details of the measures that will be employed as part of any development to ensure the existing hydrological regime remains unchanged.</p> <p>The SSSI is currently under a Higher Level Stewardship (HLS) agreement between Leicestershire County Council (LCC), the Environment Agency (EA) and NE.</p>																																		
4.	<p><b><u>Existing Hydrological Context</u></b></p> <p>An unnamed watercourse flows through the Misterton Marshes SSSI in a south-westerly direction. This watercourse is a tributary of the River Swift. The head of the watercourse is at Gilmorton, approximately 2.8km north-east of the marshes. The confluence with the River Swift is approximately 1.25km south-west of the SSSI.</p> <p>Another watercourse flows from the north-west of the site and conflues with the unnamed watercourse at Thornborough Spinney, immediately downstream of the SSSI.</p> <p>OS mapping indicates there are a number springs located in the vicinity of the site.</p> <p><b><u>Contributing Catchment &amp; Existing Flows</u></b></p> <p>Hydrological assessment of the watercourse catchment at the SSSI has been completed using Flood Estimation Handbook (FEH) and Revitalised Flood Hydrograph (ReFH) statistical analysis. The unnamed watercourse that flows through the SSSI is ungauged and therefore, there are no records from which to estimate the flows.</p> <p>FEH indicates the catchment at the upstream extent of the SSSI is approximately 5.76km<sup>2</sup>. At the downstream extent of the SSSI the catchment area is approximately 6.09km<sup>2</sup>. Table 1 summarises the estimated flows at both the upstream and downstream extents of the unnamed watercourse flowing through the SSSI for a variety of return periods.</p> <table border="1" data-bbox="300 1554 1401 1868"> <thead> <tr> <th rowspan="2">Return Period (yrs)</th> <th colspan="2">Flows into the SSSI based on upstream catchment area of 5.76km<sup>2</sup>.</th> <th colspan="2">Flows at the downstream extent of the SSSI based on catchment area of 6.09km<sup>2</sup>.</th> </tr> <tr> <th>FEH Stats (m<sup>3</sup>/s)</th> <th>ReFH (m<sup>3</sup>/s)</th> <th>FEH Stats (m<sup>3</sup>/s)</th> <th>ReFH (m<sup>3</sup>/s)</th> </tr> </thead> <tbody> <tr> <td>2</td> <td>1.42</td> <td>1.78</td> <td>1.49</td> <td>1.87</td> </tr> <tr> <td>20</td> <td>3.03</td> <td>3.20</td> <td>3.19</td> <td>3.37</td> </tr> <tr> <td>100</td> <td>4.59</td> <td>4.54</td> <td>4.83</td> <td>4.78</td> </tr> <tr> <td>200</td> <td>5.46</td> <td>5.34</td> <td>5.75</td> <td>5.62</td> </tr> <tr> <td>1000</td> <td>8.16</td> <td>8.08</td> <td>8.59</td> <td>8.50</td> </tr> </tbody> </table> <p><i>Table 1: Estimated existing flows in unnamed watercourse</i></p>	Return Period (yrs)	Flows into the SSSI based on upstream catchment area of 5.76km <sup>2</sup> .		Flows at the downstream extent of the SSSI based on catchment area of 6.09km <sup>2</sup> .		FEH Stats (m <sup>3</sup> /s)	ReFH (m <sup>3</sup> /s)	FEH Stats (m <sup>3</sup> /s)	ReFH (m <sup>3</sup> /s)	2	1.42	1.78	1.49	1.87	20	3.03	3.20	3.19	3.37	100	4.59	4.54	4.83	4.78	200	5.46	5.34	5.75	5.62	1000	8.16	8.08	8.59	8.50
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## TECHNICAL NOTE

Item	Subject
	<p>A more thorough assessment of flows in the watercourse will be undertaken as part of the planning application. The estimated flows could be validated through flow monitoring at the SSSI.</p> <p><b><u>Geology and Groundwater Flows</u></b></p> <p>The near surface geology is mostly glacial till which comprises predominantly clay, but within the till is a Glaciofluvial Deposit called the Shawell Sand and Gravel (SSG). The SSG outcrops on the site because the watercourses have cut down through the till, exposing the SSG in the sides of the valley. Alluvium has been deposited on top of the till or SSG by the watercourse.</p> <p>Any groundwater springs are likely to be emanating from the SSG or from thin sand and gravel bands within the till. OS mapping indicates there are a number of springs located in the vicinity of the SSSI. To confirm what features may be present at the site, a hydrogeological inspection has been completed and the findings reported in PBA technical note 33277/3501/TN002.</p> <p>At this stage it is difficult to gauge the size and flow from any springs that may be contributing to flows within the watercourse. The surrounding geology suggests that the springs may have an insignificant contribution to the flow as the SSG is overlaid by the low impermeability clay till. However, the site survey identified areas of waterlogged ground which suggests a groundwater source is present.</p> <p>The marsh associated with the SSSI could be a result of both springs and surface waters, especially as it coincides with the SSG outcrop. However, further technical assessment is required to determine the primary source.</p> <p>Leicestershire County Council (LCC) has provided a drainage plan of a historic Municipal Public Water Supply scheme (Appendix A) at the site. The system is shown to follow the watercourse corridor associated with the SSSI.</p> <p>The system was decommissioned in the 1980s but the infrastructure remains in place. On decommissioning, the system was diverted to discharge into the River Swift. Further details of this system will need to be determined through technical assessments undertaken for any planning application. As the system is still in place, albeit non-operational, it is possibly affecting flows into and out of the SSSI.</p> <p>It is also possible that farmers have installed their own land drainage systems that may be diverting or contributing to flows at the SSSI. It is recommended that any plans of these systems are obtained from the relevant landowners where possible.</p>
5.	<p><b><u>Site Survey and Observations</u></b></p> <p>A site survey was undertaken on 20<sup>th</sup> September 2016 to determine the hydrogeological regime at the SSSI. The survey identified some of the main groundwater sources and how the surface water system and tributary branches interact within the vicinity of the SSSI. The findings of this survey are reported in PBA Technical Note 33277/3501/TN002.</p> <p>Given the time of year, many of the streams and ditches were covered by dense vegetation and the surrounding fields were in crop. The site conditions limited the observations and findings of the survey and it is therefore recommended that further surveys are undertaken throughout the year to improve and qualify the findings and determine the ephemeral conditions.</p> <p>In reference to the LCC drainage plan (Appendix A) the thick blue lines and blue dots are the</p>



## TECHNICAL NOTE

Item	Subject
	<p>outline of a water harvesting and supply system that was once used for PWS for Lutterworth.</p> <p>During the survey, some of the cast iron manhole covers we found outside the SSSI to the south, and others are visible on satellite image where there is arable, but nothing in the SSSI itself, (that area is overgrown wetland pasture).</p> <p>The current status of this system is being confirmed with LCC. If it remains, or part of it remains not properly decommissioned, then it is possibly having an effect on the hydrology of the SSSI.</p> <p>The SSSI condition is listed as Unfavourable / Recovering.</p> <p>Going forward as part of any planning application, a baseline monitoring plan would be prepared (see further work section in Item 7).</p>
6.	<p><b><u>Flood Risk</u></b></p> <p>A preliminary assessment of flood risk has been completed by reviewing EA online flood maps and relevant information gathered from local flood risk studies.</p> <p><b><u>Fluvial Flood Risk</u></b></p> <p>The EA online <i>Flood Map for Planning (Rivers and Sea)</i> indicates there are areas of Flood Zones 2 and 3 associated with the watercourse that flows through the SSSI. The flooding extent is limited to the watercourse corridor. The SSSI is situated within the valley feature associated with the unnamed watercourse.</p> <p>Flood Zone 2 is defined as <i>land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% - 0.1%) in any year</i>. Flood Zone 3 is defined as <i>land assessed as having a 1 in 100 or greater annual probability of river flooding (&gt;1%) in any year</i>. Details of the hydraulic model used to determine these flood extents are not known at this time.</p> <p><b><u>Surface Water Flood Risk</u></b></p> <p>The EA online Flood Map for <i>Risk of Flooding from Surface Water</i> indicates there are areas within the SSSI at risk of surface water flooding. These areas generally coincide with the watercourse corridors as overland flow paths and immediately adjacent low lying areas.</p> <p><b><u>Groundwater Flood Risk</u></b></p> <p>The 2011 Leicestershire County Council Preliminary Flood Risk Assessment (PFRA), includes a map of <i>Areas Susceptible to Groundwater Flooding</i>. The map indicates the Misterton Marshes SSSI is located in an area with a 50%-75% probability of groundwater flooding. The PFRA states that the majority of Leicestershire is underlain by non-permeable or low permeability geology. Where groundwater exists it flows through strata very slowly and in limited quantities.</p> <p><b><u>Other Sources</u></b></p> <p>Flooding as a result of reservoir inundation or surcharged sewers is not understood to affect the SSSI or the wider site.</p>



## TECHNICAL NOTE

Item	Subject
7.	<p><b><u>Post-Development Hydrology</u></b></p> <p><b><u>Policy Requirements</u></b></p> <p>The requirements for any new development are set out in the Harborough District Council Watercycle Study (December 2015). The Watercycle study reviews the Lutterworth East Strategic Development Area (SDA) and states the following:</p> <p><i>“At the heart of this development is the Misterton Marshes SSSI, where a tributary of the Swift runs through. The marshes are a wetland area and have a status of unfavourable recovering. Any development would need to be designed to protect the integrity of the SSSI and if possible bring improvements to the status.</i></p> <p><i>The site for the SDA has a large area of wetland that is prone to flooding and waterlogging. The EA has indicated this is an area where they would like to see additional storage of water to relieve flood risk downstream. In addition development would need to be designed to improve water quality, if feasible. It is particularly important to ensure that sustainable drainage is in place during construction, as the run-off from construction sites can carry large quantities of silt, which increases flood risk.</i></p> <p><i>Careful consideration of water management is essential and any plans should also ensure that the integrity of the Misterton Marshes SSSI is maintained and that the status of the SSSI is improved as part of the conditions for the development. Opportunities for additional rainwater storage to protect downstream urban areas should be included in the site planning.”</i></p> <p>The National Planning Policy Framework (NPPF) and accompanying Planning Practice Guidance (PPG) requires proposals for greenfield sites to ensure that the surface water run-off regime prior to development is maintained. The 2009 Harborough District Council Strategic Flood Risk Assessment (SFRA) states the following:</p> <p><i>“As a minimum there should be no increase in the peak discharge / volumes from any greenfield site.”</i></p> <p><b><u>Effects on flows</u></b></p> <p>The surface water drainage system of the proposed development will be designed such that the run-off rates into the watercourse flowing through the SSSI are maintained as per existing conditions. The equivalent to existing greenfield run-off rates will be maintained from all areas of the proposed development.</p> <p>Flow controls will be added to the outfall of the surface water drainage system and the preferential location for any outfall determined in consultation with all relevant stakeholders. Complex flow controls can be installed so that surface water can be discharged from the site at a variable rate depending on rainfall volume and intensity.</p> <p><b><u>Proposed Run-Off Rates</u></b></p> <p>There are a number of factors that affect the run-off rate of surface water including:</p> <ul style="list-style-type: none"> <li>- Rainfall</li> <li>- Infiltration potential</li> <li>- Land use (Impermeable surfacing)</li> <li>- Artificial drainage systems</li> <li>- Slope / Gradient</li> </ul>



## TECHNICAL NOTE

Item	Subject
	<p>For design purposes existing run-off rates are typically calculated using a combination of annual rainfall and soil characteristics. At this preliminary stage the existing mean annual greenfield run-off rate has been calculated using the Interim Code of Practice (ICP) SuDS method in Micro Drainage WinDes Software, as 4.1 l/s/ha (QBAR).</p> <p>Given the geology of the site, discussed in Item 4, the site is effectively 'capped' by clay till. This generally significantly reduces water entering the ground.</p> <p>To account for the increased impermeable areas associated with the new development, surface water attenuation will be provided to restrict discharge of surface water to the watercourse to greenfield runoff rates, and at a controlled rate during extreme rainfall events. Attenuation will be sized to account for increased rainfall as a result of climate change, in accordance with the latest EA guidance.</p> <p><b><u>Construction Phase</u></b></p> <p>During the construction phase, activities across the site will include earthworks and excavation, construction of below and above ground structures and temporary works.</p> <p>All construction activities will be mitigated against by the provision and implementation of a robust Construction Environmental Management Plan (CEMP) which is a requirement under planning conditions. Mitigation measures included in the CEMP will ensure the prevention of creating pathways to sub-surface water bodies.</p> <p>Examples of mitigation measures that could be employed at the site are as follows:</p> <ul style="list-style-type: none"> <li>▪ Siting of concrete, cement and other hazardous materials a satisfactory distance from on site ditches and drains.</li> <li>▪ Plant cleaning within designated washing areas with an impermeable layer or similar.</li> <li>▪ Locating activities likely to give rise to sediment a satisfactory distance away from watercourses.</li> <li>▪ Silt fencing.</li> <li>▪ Settlement tanks or lagoons to treat water containing suspended particles prior to its release to watercourses.</li> </ul> <p>It is envisaged that NE will be consulted on the CEMP, and provide input as required. We would also envisage that NE become part of the 'site monitoring team' to ensure, as far as practical, activities on site are controlled during construction.</p> <p><b><u>Further Work</u></b></p> <p>During the planning application process a number of further assessments may be required so that the proposed development can respond to the requirements of the SSSI. These assessments are as follows:</p> <ul style="list-style-type: none"> <li>▪ Site surveys will need to be undertaken throughout the year to better understand the springs, seepages, groundwater inputs, surface waters and ephemeral conditions.</li> <li>▪ In order to accurately assess the groundwater effects long term monitoring may be required. This may include boreholes, gauge boards and watercourse levels. It should also be noted that to accurately understand the hydrogeological regime monitoring will be required, prior to the submission of any planning application.</li> <li>▪ Infiltration testing should be carried out to determine the infiltration rates of the soil. The surface water management proposals can then be designed such that infiltration is effective and sustainable, with groundwater recharged as per the existing site conditions.</li> </ul>





## TECHNICAL NOTE

Item	Subject
	<ul style="list-style-type: none"> <li>▪ Boreholes and groundwater monitoring can be implemented to determine the role groundwater has in maintaining flows within the watercourse.</li> <li>▪ Intrusive ground investigation will be undertaken to determine the nature of the underlying geology across the site.</li> <li>▪ Sampling of groundwater, spring water and surface water chemistry can be undertaken to determine the baseline scenario, and any nutrient and pollutant inputs at the SSSI.</li> <li>▪ Investigation of the old water harvesting system would need to be completed to assess any impact it may be having on the hydrological regime at the SSSI.</li> <li>▪ Assessment of any existing land drainage systems including liaison with existing landowners to determine what systems may be in place and what effect they may have on flows in the SSSI.</li> <li>▪ Flows within the watercourse, and its branches and tributaries, could be monitored to determine what flow rate needs to be maintained. This can be assessed alongside any groundwater and spring flow monitoring to determine the location and volume of groundwater and spring water flows into the watercourse. The surface water management proposals can then be designed to ensure any outfalls from the development do not adversely affect flows.</li> <li>▪ Hydraulic modelling of the watercourse to determine the flows in the watercourse at the SSSI for a number of different storm events and determine what measures may need to be implemented to protect the SSSI from flooding.</li> <li>▪ Ecological and hydro-ecological survey at the SSSI to determine the species and sensitivities and ensure appropriate mitigation measures to protect the SSSI are implemented as part of the development proposals.</li> </ul> <p>Given the current SSSI status as unfavourable / recovering the aim of the further technical work would be to ensure the development has no detrimental impact upon the SSSI, and where feasible, improve the conditions at the SSSI.</p> <p><b><u>Stakeholder Engagement</u></b></p> <p>Given the sensitive nature of the SSSI PBA understands NEs concerns regarding potential changes of flows into and through the SSSI. We would therefore expect that liaison with NE, EA, Harborough District Council and Leicestershire County Council would be necessary to determine their requirements with regards to surface water and to determine an agreed approach. Given the sensitivity of the SSSI we would expect that there may be more onerous requirements for the surface water management proposals and the developer will need to liaise closely with all relevant parties to ensure the design meets all the necessary criteria.</p>
8.	<p><b><u>Water Quality &amp; Pollution Risk</u></b></p> <p>The land use at the site and upstream is currently agricultural and therefore water quality within the watercourses in the vicinity of the site and SSSI may be at risk from pollution sources with high levels of nitrogen and phosphorus. The development of the site will result in a reduction in these potential pollutants, but there is aa potential for an increase in pollutants from urban runoff, such as increased sediment loads and hydrocarbons.</p> <p>The SSSI and wider Lutterworth East SDA is not located in an EA designated Groundwater Source Protection Zone and therefore, there are no onerous requirements from the EA with regards to infiltration drainage, where this is technically feasible.</p> <p>The SuDS measures included within the surface water drainage strategy will be designed in accordance with The SuDS Manual (CIRIA C753) and will adhere to the SuDS treatment train with appropriate levels of treatment provided for each type of runoff (i.e. roof, road, car parking areas). This is to ensure that surface water runoff is sufficiently treated to ensure no</p>

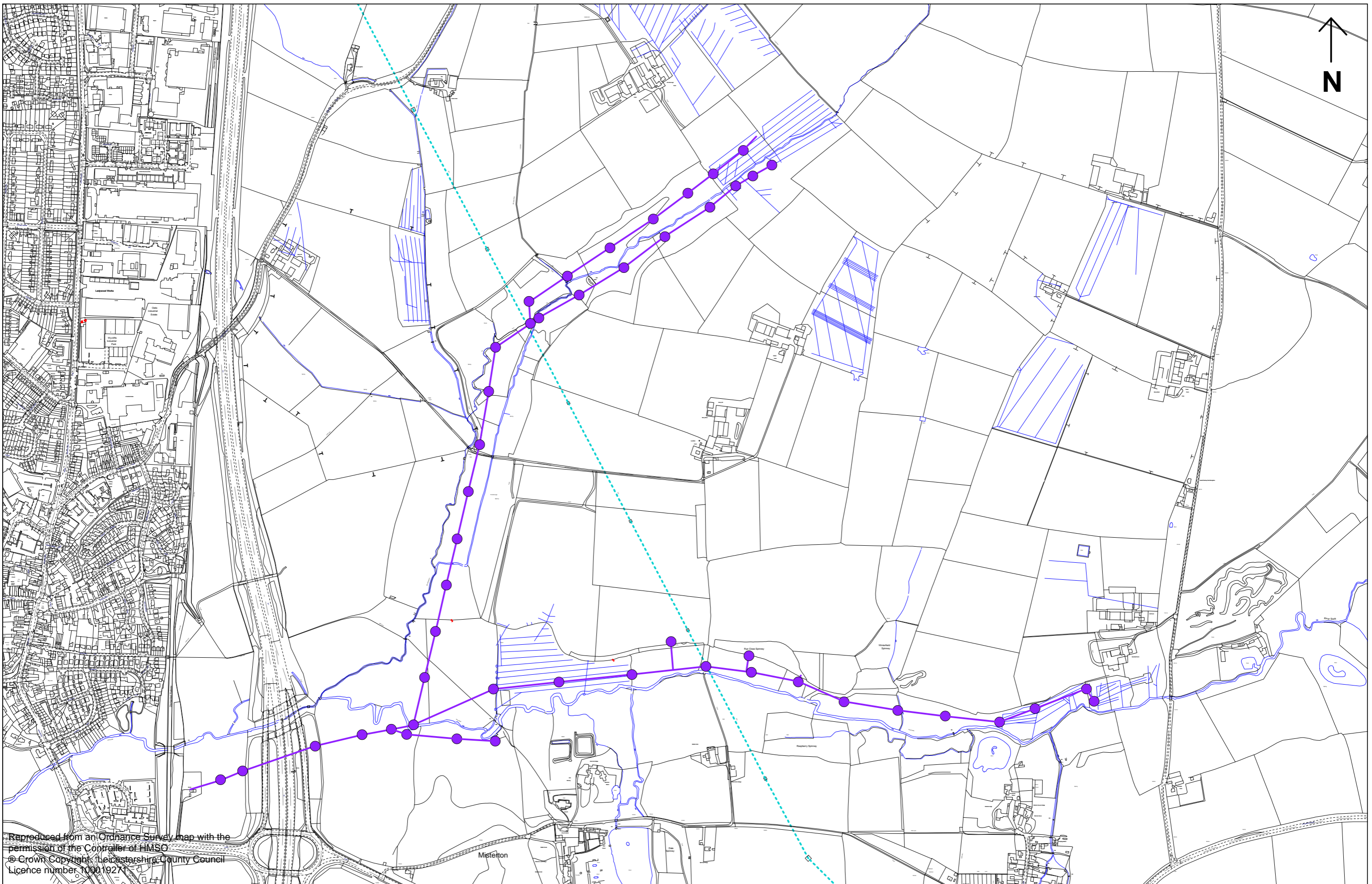
## TECHNICAL NOTE

Item	Subject
	<p>detrimental impact on water quality within the receiving systems. It is anticipated that water quality within the Misterton Marshes will improve due to the implementation of these measures.</p> <p>Such measures would include:</p> <ul style="list-style-type: none"> <li>▪ Proprietary methods of catching and retaining sediment, even under storm flow conditions</li> <li>▪ Provision of sediment forebays at the entrance to swales and attenuation facilities</li> <li>▪ Provision of reeds / planting in swales and attenuation facilities to provide further pollutant removal</li> </ul> <p>Water quality monitoring will be undertaken as part of the planning application process to determine the specific requirements and sensitivities of the watercourse and ensure the surface water management strategy adequately responds to these.</p>
9.	<p><b><u>Summary and Conclusions</u></b></p> <p>This technical note has been prepared to summarise the existing hydrological conditions and the potential hydrological effects of development adjacent to the Misterton Marshes SSSI. The SSSI is located within the proposed Lutterworth East SDA.</p> <p>The findings of this assessment have been used to inform the preliminary masterplan. The note confirms that the sensitivities of the SSSI can be accounted for in the design of any development that comes forward. The note also confirms that the scheme is feasible without adverse impact upon the hydrological and hydrogeological regime within the SSSI.</p> <p>Future detailed technical assessments may be undertaken as part of any planning application to ensure the development will have no long-term detrimental impact upon the SSSI.</p>



**Appendix A LCC Drainage Plan**





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**Lutterworth East, Leicestershire**

N.T.S @ A3 Landscape

by Vanessa Hughes  
September 2016



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**APPENDIX B:**

**Peter Brett Associates. Technical Note. 33277-4001-TN002.  
Preliminary Hydrogeological Inspection of the Misterton Marshes SSSI**

# TECHNICAL NOTE

**Job Name:** Lutterworth East Strategic Development Area  
**Job No:** 33277  
**Note No:** TN002  
**Date:** 28/09/2016  
**Prepared By:** Federico Tromboni – Hydrogeologist  
 Richard Thomas – Senior Consultant  
**Subject:** **Preliminary Hydrogeological Inspection of the Misterton Marshes SSSI**

Item	Subject
1.	<p><b><u>Introduction</u></b></p> <p>This technical note has been prepared to present the findings of a preliminary Hydrogeological inspection of the area of the Misterton Marshes Site of Special Scientific Interest (SSSI) and its surroundings that form part of the Lutterworth East Strategic Development Area.</p> <p>This note should be read in conjunction with Peter Brett Associates Technical Note TN001 dated 25<sup>th</sup> August 2016: “Hydrological Impacts of the Lutterworth East SDA upon the Misterton Marshes SSSI”.</p>
2.	<p><b><u>Lutterworth East SDA Proposal</u></b></p> <p>The Lutterworth East SDA is currently seeking an allocation within the new Harborough Local Plan. The site comprises approximately 205ha area of predominantly greenfield land to the east of Lutterworth. As part of the allocation process all relevant stakeholders are being consulted so that any concerns regarding potential development at the site are identified at the earliest opportunity.</p> <p>In this regard, Natural England (NE) has raised concern about the potential impact of development on the Misterton Marshes SSSI that is located within the site.</p>

## DOCUMENT ISSUE RECORD

Technical Note No	Rev	Date	Prepared	Checked	Reviewed (Discipline Lead)	Approved (Project Director)
33277/3501/TN002	-	28.09.16	FT	RHT	GEO	

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## TECHNICAL NOTE

Item	Subject
3.	<p><b><u>General Aims and Constraints</u></b></p> <p>Current and historical Ordnance Survey mapping suggests there are a number of groundwater springs in the area around the SSSI wetland. The hydrogeological inspection survey was undertaken to provide a preliminary understanding of the presence and location of any groundwater features such as springs, groundwater issues and seepages within the area that could be important in maintaining the hydrological regime in the marshes and wetlands forming the SSSI.</p> <p>The inspection survey also aimed to provide a greater understanding the surface water drainage regime in the area and to assess the potential significance of groundwater in the water balance of the marshes.</p> <p>Historical maps of the site were also obtained to inform the survey and locate any additional historical groundwater sources that might be absent in the latest Ordnance Survey map.</p> <p>The site layout with selected site photography is presented as the accompanying <b>Figure TN002/1</b>.</p> <p>It should be noted that spring flow is generally influenced by the seasonal variation of the groundwater water levels and the availability of groundwater recharge. The site walkover was carried out at the end of summer when water levels are expected to be generally low and some water features may be obscured by vegetation. Additional groundwater sources and possibly higher spring flow rates may be encountered during the winter period when the groundwater levels are likely to be significantly higher.</p>
4.	<p><b><u>Hydrogeological Inspection and Hydrological Observations</u></b></p> <p>A site walkover was carried at the Misterton Marshes SSSI out on the 20<sup>th</sup> September 2016 by a Hydrogeologist from Peter Brett Associates.</p> <p>The Misterton Marshes SSSI is accessed off Gilmorton Road through a track leading to the main access gate. The Misterton Marshes SSSI comprises an area covered in dense, hydrophilic vegetation with a number of mature trees mostly located alongside the eastern and western boundaries. The area surrounding the SSSI generally comprises agricultural land on the valley sides and on the plateaux to the north, east and west, with a number of farms scattered through the area. The ground within the marshland is flat and at the time of the visit it was observed being generally dry with no visible evidence on the surface of a high standing water level or any of the recorded historical groundwater springs.</p> <p>Streams and drainage ditches generally running in a north to south direction are present within the SSSI and in its immediate vicinity. They join the River Swift which is present approximately 700m to the south of the marshes and that runs in an east to west direction. With the exception of River Swift to the south of the SSSI, the water courses are generally unnamed and their locations are shown in <b>Figure TN002/1</b>.</p> <p>At the time of the site visit the volume of flow along the main north to south running stream, Stream A that flows through the centre of the SSSI, was noted as being low as illustrated in Inset 4 of <b>Figure TN002/1</b>. No increase in flow was apparent along its course through the SSSI between points A1 and A2. Given the time of year and the rainfall in the period before the inspection it is likely that most of the low flow observed is groundwater baseflow.</p> <p>The flow of water in Stream B immediately to the west of the marshland was also low.</p>



## TECHNICAL NOTE

Item	Subject
	<p>Areas of waterlogged ground with high standing water were observed approximately 250m to the north west of the SSSI. The location of the boggy areas and photographs are presented in Inset 1 and 2 on <b>Figure TN002/1</b>. The presence of waterlogged ground at the end of summer suggests that a probable groundwater source is present in the area and this may be providing baseflow to Stream B at point B1 upgradient of the SSSI.</p> <p>Evidence of a second probable groundwater source was also observed along Stream C approximately 300m to the west of the SSSI and this is presented in Insets 7 and 8 on <b>Figure TN002/1</b>. The stream flow within Stream C at point C2 was observed being significantly larger in volume than the section immediately upgradient at point C1. The sudden increase in stream flow over a short distance suggests a probable ingress of groundwater into Stream C. Two historical springs are recorded adjacent to point C2, however at the time of the visit the locations could not be investigated owing to the dense vegetation along the stream course and a tall crop of maize in the fields.</p> <p>A number of valley features were observed immediately to the east and south of the SSSI and their locations are presented in <b>Figure TN002/1</b>. While no groundwater sources were identified at these locations at the time of the visit, groundwater discharge may be occurring during periods of high groundwater level.</p>
5.	<p><b>Land Drainage and Public Water Supply</b></p> <p>As part of the study land drainage details for the area were requested from Leicestershire County Council. They provided a plan showing the layout of a former Municipal Public Water Supply scheme running along the stream beds and river valleys of the area. This has been transposed on to <b>Figure TN002/1</b>.</p> <p>Two twin branches of the water collection infrastructure are shown running through the SSSI from north to south, and appear to be collector drains harvesting water from the ground along the stream bed in the valley. The various collector and carrier components of the system join up near the confluence of Stream A and the River Swift some 600m south of the SSSI and continue as a single pipeline to the former waterworks off Lutterworth Road, near M1 Junction 20.</p> <p>Further communication with Leicestershire County Council suggests that the construction date is uncertain but that the waterworks was decommissioned at some date before the late 1980s and that the collection infrastructure remains in place. They also reported that it has been diverted and modified on decommissioning to discharge into River Swift near where the pipework crosses the River Swift.</p> <p>It is also understood that the water collection system is not being maintained and that parts of it are reportedly clogged with brown ochre. The site visit identified no obvious signs of the infrastructure inside the SSSI, however one of its inspection manholes was observed immediately to the south of the SSSI and this is presented in Inset 6 of <b>Figure TN002/1</b>.</p> <p>It is unclear at present whether this groundwater harvesting system is continuing to underdrain the SSSI, or whether its condition has fallen into such a state of disrepair that it has no effect on the hydrological system of the valley and the SSSI.</p> <p>The reference to clogging with brown ochre in parts suggests the presence of at least some iron rich groundwater in the area that precipitates iron oxides when exposed to the air.</p>





## TECHNICAL NOTE

Item	Subject
6.	<p><b>Discussion</b></p> <p>The hydrogeological inspection visit undertaken suggests that groundwater baseflow from springs and issues on the valley sides, together with a high groundwater table in the valley floor may be important in maintaining the hydrological regime of the SSSI marsh, especially during the Summer period. Further inspection work during a more appropriate time of year will be necessary to improve our understanding of where the more significant spring sources are located.</p> <p>A greater understanding is required of the effect of the former municipal groundwater harvesting system on the hydrogeological and hydrological regime of the SSSI and the wider area.</p> <p>The inspection has advanced our understanding of the hydrogeology and hydrology of the area to a stage where it will be possible now to design a long term baseline groundwater and surface water data collection and monitoring scheme for the site, This will be used to inform the appropriate risk and impact assessments that will underpin the drainage strategy and design for the SDA, and the Environmental Impact Assessment for the development,</p> <p>The hydrogeological inspection undertaken has not revealed any hydrogeological or hydrological characteristics for the SSSI that would suggest that it will not be possible to provide a suitable drainage strategy and design for Lutterworth East SDA, which does not have any adverse impact on the SSSI.</p> <p>Suitably sympathetic Sustainable Drainage Systems (SuDS) designed to maintain the status quo in the SSSI would appear likely to be feasible. Indeed, it may be possible to include features designed to improve its presently unfavourable condition, particularly if the redundant water harvesting system is having an adverse under-draining effect.</p>





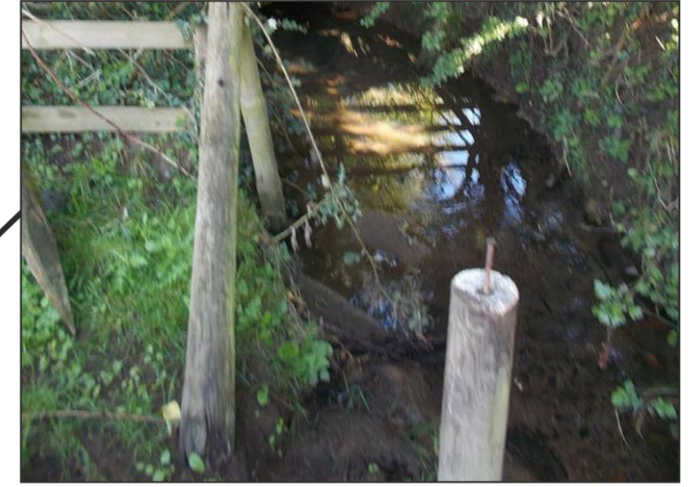
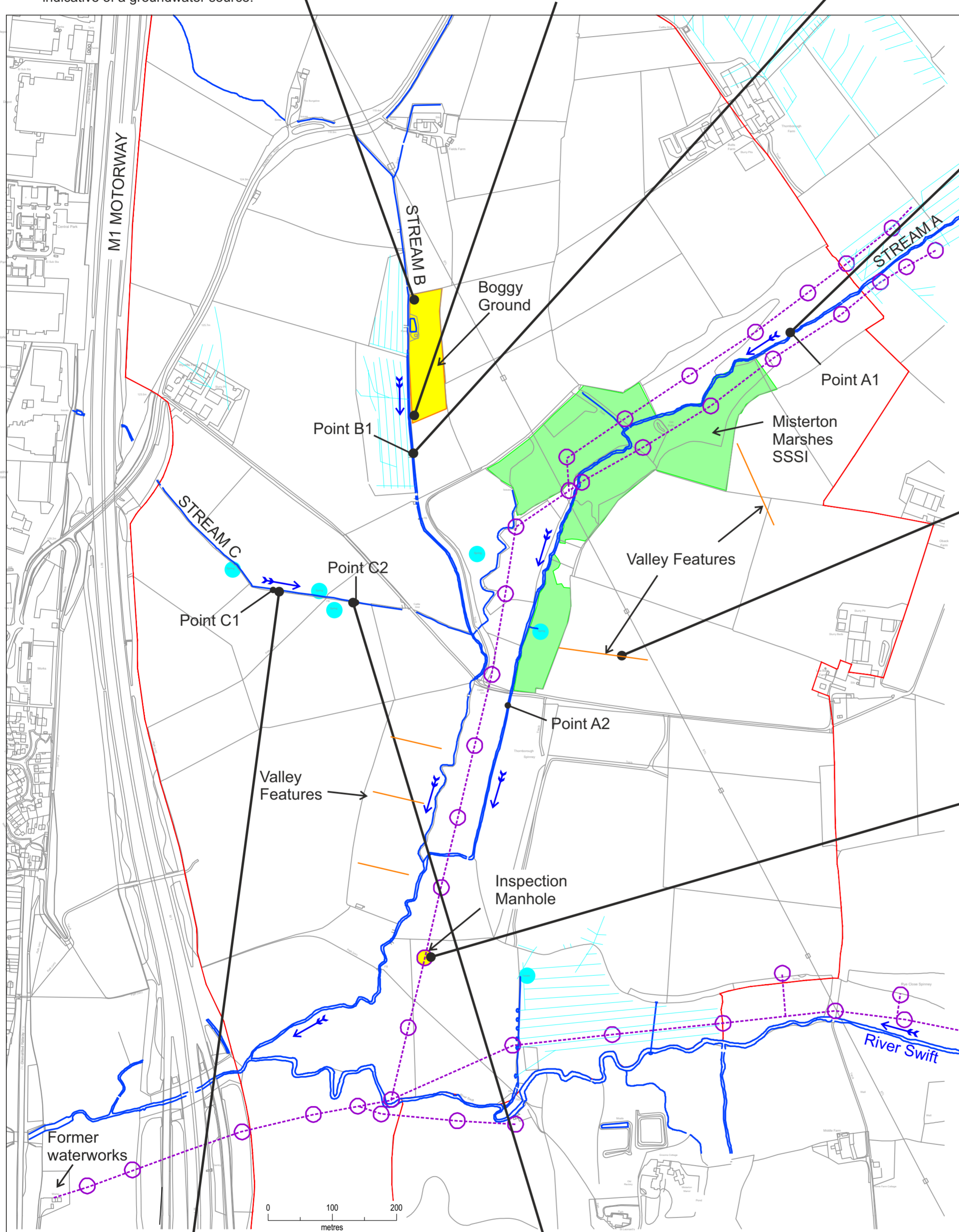
Inset 1 - Buggy ground observed to the north of the SSSI near point B1 and standing water indicative of a groundwater source.



Inset 2 - Hydrophilic vegetation near the boggy ground to the north of the SSSI.



Inset 3 - Stream B at point B1. Very sluggish flow emanating from upstream wetland.



Inset 4 - Stream A at point A1.



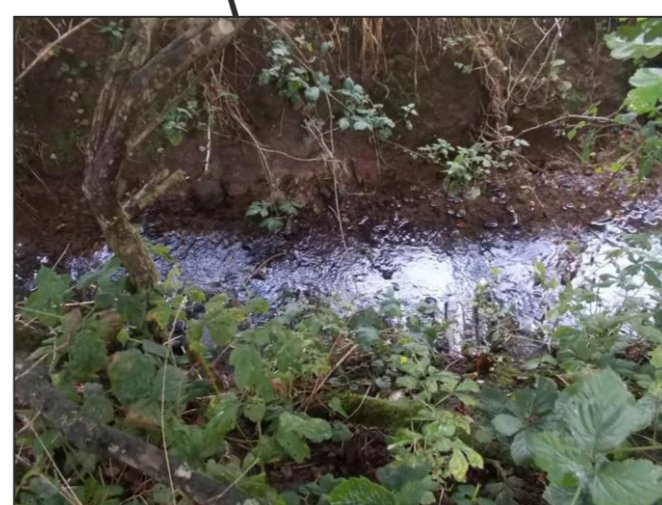
Inset 5 - Valley features immediately to the east of the SSSI. Groundwater issues may be occurring from this area during periods of high groundwater level.



Inset 6 - Inspection manhole located along the decommissioned water collection infrastructure.



Inset 8 - Stream C immediately upgradient of point C1.



Inset 7 - Stream C immediately downgradient of point C2.

LUTTERWORTH EAST STRATEGIC DEVELOPMENT AREA

MISTERTON MARSHES SSSI  
PRELIMINARY HYDROGEOLOGICAL INSPECTION  
KEY FEATURES

Client  
**HALLAM LAND MANAGEMENT**

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