M42 Junction 6 Development Consent Order

Scheme Number TR010027

8.91 Outline Bickenhill Meadows SSSI Monitoring and Management Plan

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Outline Bickenhill Meadows SSSI Monitoring and Management Plan

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1 Introduction

1.1 Scope of the Document

1.1.1 This Outline Bickenhill Meadows Site of Special Scientific Interest ('SSSI') Monitoring and Management Plan ('the Plan') describes the proposed botanical and hydrological surveys of the Bickenhill Meadows SSSI. These surveys would aim to monitor the changes (if any) as a result of the M42 Junction 6 scheme ('the Scheme') on the SSSI and to inform future decisions about how to manage the mitigation measures being proposed or, if considered necessary, identify the need for additional mitigation measures.

1.1.2 This Plan also describes the establishment and implementation of a Bickenhill Meadows SSSI Monitoring Steering Group, who would be responsible for the setting of trigger levels and subsequent management actions based on the monitored data.

1.1.3 This document comprises a description of the:

- Botanical Monitoring Protocol – including monitoring for the baseline/pre-construction phase, plus the construction and operational phases;
- Hydrological Monitoring Protocol – including monitoring for the baseline/pre-construction phase, plus the construction and operational phases;
- Establishment and Role of a SSSI Monitoring Steering Group; and
- Trigger Points and Action Measures to be used to identify and respond to potentially adverse impacts on the SSSI.

1.2 Development of the full Bickenhill Meadows SSSI Monitoring and Management Plan

1.2.1 Throughout the remainder of the Development Consent Order (DCO) Examination period, and during detailed design, further engagement with consultees including the Natural England, Solihull Metropolitan Borough Council (SMBC) and Warwickshire Wildlife Trust (WWT) will be undertaken, and the Plan reviewed and updated to ensure that all the necessary monitoring requirements have been identified and presented within this document for handover to the relevant organisation(s) when necessary.

1.3 Relationship with other Documents

1.3.1 The Plan should be read in conjunction with the:

- **Chapter 9 Biodiversity [APP-054/Volume 6.1] and Chapter 14 Road Drainage and the Water Environment [APP-059/Volume 6.1] of the Environmental Statement (ES)** and supporting figures and appendices as presented within the DCO Application. These documents present the environmental impact assessment for the Scheme relating to the potential impacts and effects to biodiversity and road drainage and the water environment on the Bickenhill Meadows SSSI, and hence the need for this Plan;

- **Appendix 14.2(a) Bickenhill Meadows Site of Special Scientific Interest – Hydrological Investigation Technical Note (v9.1)** [**REP3-004**] – This document reports the outcomes of a hydrological investigation of the Bickenhill Meadows SSSI, the findings of which were used to develop conceptual models of site functioning. The note then provides a detailed assessment of potential effects on the SSSI resulting from the Scheme, examines various mitigation options and presents the preferred mitigation solution. The monitoring outlined in this Plan is required to ensure the preferred mitigation solution is working adequately;
- **Outline Environmental Management Plan (OEMP) [APP-172/Volume 6.3]** – The purpose of this document is to manage the environmental effects of the Scheme as identified in the ES. Measures within the OEMP include proposed design and construction mitigation which, in part, arise from the technical assessments presented in the ES. The OEMP includes a number of outline Management Plans for key environmental disciplines;
- **Outline Biodiversity Management Plan (OBMP) [APP-8.74]** – This document outlines management prescriptions aimed at ensuring the Scheme delivers biodiversity benefits over the long term. The OBMP includes the habitat monitoring measures that seek to achieve the successful establishment and maintenance of key habitat types, including woodland, scrub, grassland and wetland, and is therefore of relevance to this Plan;
- **The Register of Environmental Actions and Commitments (REAC)** [**APP-172/Volume 6.3**] – This document identifies the environmental commitments to address the potential environmental effects from the Scheme, including commitments to certain key items of embedded mitigation. This includes monitoring of the SSSI as outlined in this Plan; and
- **Position Statement on SSSI Mitigation** [**REP4-006**] – This document outlines the agreed position of Highways England, Natural England, the WWT, and SMBC with regards to the Bickenhill Meadows SSSI. This includes an agreed position on the mitigation solution, monitoring, land access and acquisition, ownership of the mitigation solution and management and maintenance of the mitigation solution. This Plan gives the detail of how the monitoring would be undertaken.

1.4 REAC Commitments and Position Statement of SSSI Mitigation

1.4.1 The REAC [**APP-114/Volume 6.3**] for the Scheme outlines the commitments made by Highways England at the time of the DCO application submission with regard to monitoring and management of the SSSI. These are as follows:

- **Ref G17**: Highways England will continue to refine the mitigation solution using: data obtained from the ongoing dipwell monitoring; and information gathered from further analysis of the local topography and existing water sources. These refinements will seek to identify a sustainable drainage mechanism to mitigate the effects of the Scheme on Bickenhill Meadows SSSI. Highways England will seek to agree any refinements to the mitigation approach with Natural England prior to commencement of the Scheme.

- **Ref G18:** Highways England commits to the ongoing dipwell monitoring associated with Bickenhill Meadows SSSI. This is currently being undertaken on a monthly basis within the SSSI and will continue for a period of two years post-submission of the DCO application in order to record water table levels, the outcomes of which will be shared with Natural England.
- **Ref G19**: A pumped mitigation solution has been developed to mitigate for the loss of surface water catchment at Shadowbrook Meadows South East (SE) unit (site). The design principles of the pumped solution consist of a collection drain on the western slope of the mainline link road cutting to intercept surface water flows that would otherwise have drained towards the SSSI. The collection drain would discharge to a sealed collection sump, from where water would be pumped and/or captured from an alternative water source(s) to an appropriate reed bed/ditch feature in the vicinity of Shadowbrook Meadows SE Unit. This feature would act as a recharge trench, from which water would drain through to the sand, gravel and clay deposits in the upper layers of the substrata within the SSSI. The pumped mitigation solution has been developed in consultation with and agreed in principle with Natural England.

  Highways England will continue to refine the mitigation solution using: data obtained from the ongoing dipwell monitoring; and information gathered from further analysis of the local topography and existing water sources. These refinements will seek to identify a sustainable drainage mechanism to mitigate the effects of the Scheme on Bickenhill Meadows SSSI. Highways England will seek to agree any refinements to the mitigation approach with Natural England prior to commencement of the Scheme.

1.4.2 Further to the above, a more sustainable, gravity fed mitigation solution ('the Passive Solution') has been developed to maintain the hydrological regime of the SSSI, and this has been presented to the DCO Examining Authority (ExA) within the Appendix 14.2(a) Bickenhill Meadows Site of Special Scientific Interest – Hydrological Investigation Technical Note (v9.1) [**REP3-004**] at Deadline 3 of the examination.

1.4.3 A Position Statement on SSSI Mitigation [**REP4-006**] has since been developed as requested by the ExA. this Statement has been discussed, drafted and agreed between Natural England, WWT, SMBC and Highways England.

1.4.4 The Agreed Position has outlined the commitments, based on requests from the Stakeholders, which Highways England agreed to fulfil:

Monitoring:

The Applicant [Highways England] *will be responsible for an on-going monitoring programme (both hydrological and ecological) of the Shadowbrook Meadow SSSI unit. This will continue throughout the construction phase of the Scheme. Subsequently, operational monitoring will continue for five years, commencing from the date on which that part of the Scheme affecting the Shadowbrook Meadow SSSI unit is first opened for use.*

Upon completion of the five years of operational monitoring, the Applicant will discuss with the Stakeholders the necessity of continued monitoring, based upon analysis of data collected as part of the initial monitoring programme. If considered appropriate and necessary, a further duration and scope of monitoring will be agreed by means of voluntary agreement between Stakeholders.

A baseline for the Shadowbrook Meadow SSSI unit from which to monitor thresholds/triggers against will be agreed between the Stakeholders. Additionally, the Applicant will provide quarterly reports of all monitoring (construction and operation) of the SSSI to the other Stakeholders. In the event the monitoring identifies a change to the MG4 habitat[2] that can be attributed to the Scheme, the thresholds/triggers for quantifying and implementing any possible intervention measures will be detailed in a SSSI Hydrological Monitoring and Management Plan which, once completed, will be distributed to the Stakeholders for discussion. The SSSI Hydrological Monitoring and Management Plan will also include a contingency plan for the event that the agreed thresholds are exceeded.

Management and Maintenance of the Proposed Passive Solution:

The Applicant can confirm that the maintenance of the Passive Solution during the first five (linked to monitoring) years of operation will be the responsibility of the Applicant.

It is agreed that the long-term management and maintenance of the installed Passive Solution, including maintenance frequency and access requirements, will continue to be discussed and co-ordinated by the Applicant, WWT and SMBC. Notwithstanding this, the general powers afforded by the DCO (as outlined above) will enable the Applicant to secure the access rights (as per Part 5, Article 27 of the dDCO) [REP3-002/Volume 3.1(a)] needed to maintain the passive solution so that it may operate effectively and as intended until a final agreed position is identified.

1.4.5 These commitments outlined above have been used to inform the outline of the SSSI monitoring and mitigation plans as detailed within this document.

1.4.6 This Plan is a 'live' document and the current outline version collates the applicable information as drafted to date. It will continue to be updated, refined and where necessary added to as ongoing discussions are held with Natural England, WWT and SMBC.

1.5 Structure of the Document

1.5.1 The document briefly introduces the Bickenhill Meadows SSSI site, and outlines the potential for adverse impacts on the SSSI, and the proposed Passive Solution that has been designed to mitigate any adverse impact. The approach for botanical and hydrological monitoring, creation of a SSSI Monitoring Steering Group, and triggers for action are then outlined.

1.5.2 This document is structured as follows:

- Section 2: Overview of the Bickenhill Meadows SSSI, description of the potential effects on the SSSI relating to the Scheme; and presentation of the preferred passive mitigation solution;

- Section 3: Proposed monitoring protocol;
- Section 4: Establishment and role of the SSSI Monitoring Steering Group; and
- Section 5: Trigger points and action measures for action based on monitored data.

[NOTE: All details are subject to further development and stakeholder engagement. The final version of the Bickenhill Meadows SSSI OBMMMP will be re-issued to all stakeholders following the DCO decision.]

2 Bickenhill Meadows SSSI

2.1 Introduction

2.1.1 Bickenhill Meadows SSSI is split between two units (see Figure 2-1), located either side of Catherine-de-Barnes Lane (centered on approximate national grid references SP182822 and SP188816), southwest of the M42 Junction 6. The total area designated covers 7.2 hectares and was notified in 1991. The northwest unit is known as the 'First Castle Meadow Unit' (referred to as 'NW Unit') and the southeast unit is known as 'Shadowbrook Meadows Unit' (referred to as 'SE Unit').

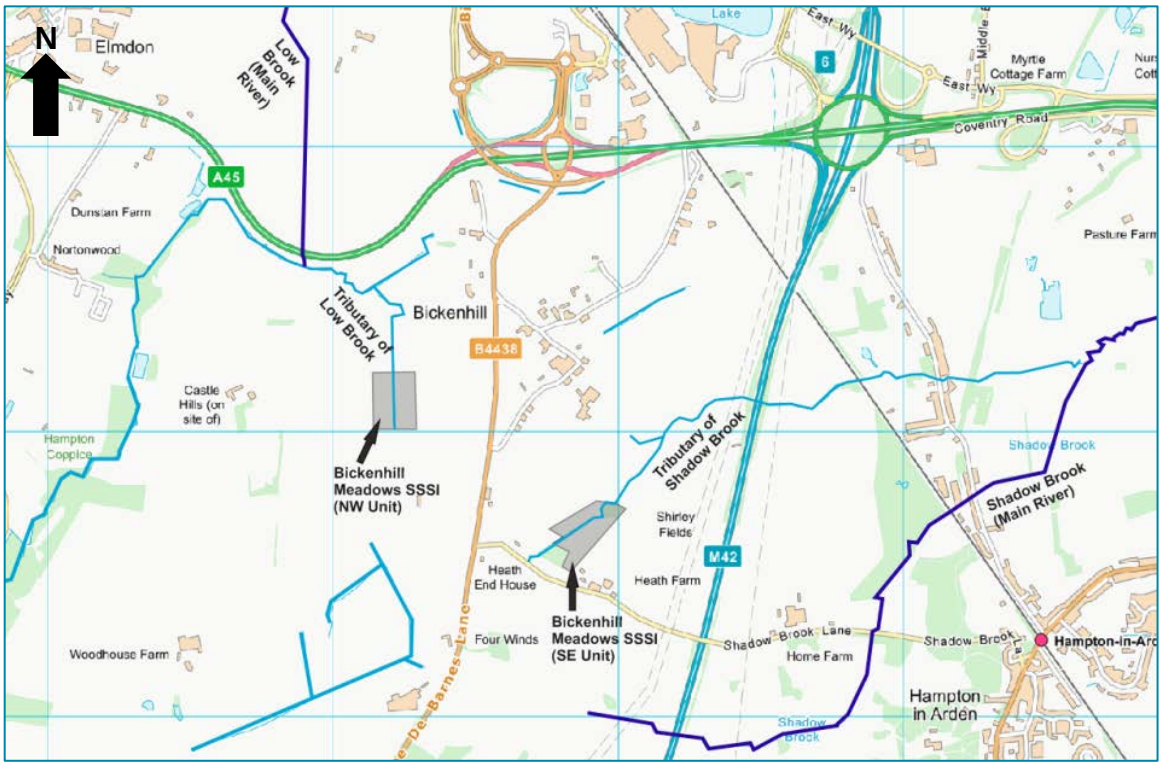


Figure 2-1 - Location of the Bickenhill Meadows SSSI units, to the west of the M42 Junction 6. (source: Ordnance Survey © Crown copyright and database rights 2019).

2.1.2 The Natural England citation for the SSSI is as follows.

"Bickenhill Meadows consists of two groups of fields comprising species-rich grassland situated to the south and west of the village of Bickenhill on predominantly neutral soils overlying Keuper Marl.

The meadows comprise one of the richest grassland floras in the county with good examples of both meadow foxtail (Alopecurus pratensis), great burnet (Sanguisorba officinalis), flood meadow and common knapweed (Centaurea nigra), crested dog's-tail (Cynosurus cristatus) meadow and pasture. Both grassland types have declined very severely nationally in the 20th Century due to agricultural improvement. The West Midlands Region contains a major part of the national resource of the common knapweed – crested dog's-tail grassland type which is typically associated with level topography, loam or clay soils, moderately

free drainage and the retention of traditional farming methods with small fields. There is a complex pattern of vegetation resulting from local variations in topography and drainage, such as the ridge and furrow pattern, evident in some of the fields. This has led to the development of mosaics where the main vegetation types intermingle, as well as to areas where each type can be recognised.

Further interest is provided by wetter areas characterised by rushes Juncus spp., sedges Carex spp. and tall herbs such as meadowsweet (Filipendula ulmaria) and great burnet. Both groups of meadows have streams and there is a good range of tree and shrub species in the hedgerows around the fields".

2.1.3 Both units of the SSSI have a status of 'Unfavourable – Recovering'. However, the Natural England condition notes indicate that the southeastern SSSI shows a good cover of desirable species and may move to favourable in the near future.

2.1.4 From the available information on the SSSI it is clear that the plant species in the wet meadows and woodland areas within the SSSI units require wet ground conditions, although subtle changes in topography and local features (such as the local ditches and spoil heaps from past clearing of them) exert an influence on the botanical communities and distinctive zones of MG4 (wetter) and MG5 (drier) plant communities according to the National Vegetation Classification (NVC).

2.1.5 The ES for the Scheme identified that the new mainline link road has the potential to adversely impact upon Bickenhill Meadows SSSI, either through loss of surface water catchment or due to the need for a cutting and associated works in close proximity (within 300m) of each SSSI unit, which may disrupt groundwater flows to the site.

2.1.6 In order to determine the extent of the potential impact in more detail, a Technical Note was produced reporting the outcomes of a hydrological investigation of the two SSSI units. This considered the soil and geological ground conditions including that derived from the Ground Investigation for the Scheme, the topography around the SSSI, observations made during site visits (including one attended by Natural England), and botanical and hydrological data collected from monitoring of the SSSI. The findings of the investigation were reported and developed into a conceptual model of each SSSI Unit, which are presented in full in the Appendix 14.2(a) Bickenhill Meadows Site of Special Scientific Interest – Hydrological Investigation Technical Note (v9.1) [**REP3-004**] and also included as Annex A to this document. A summary of the findings of potential impacts to the grasslands is described below.

2.2 Summary of Potential Impacts on the SSSI

2.2.1 The investigation undertaken in the Appendix 14.2(a) Bickenhill Meadows Site of Special Scientific Interest – Hydrological Investigation Technical Note (v9.1) [**REP3-004**] indicated that the NW Unit appears to be dependent on direct rainwater recharge to maintain its water table at a suitably high level in the winter and spring to support the development of MG4 grass communities. Low permeability Mercia Mudstone is at shallow depth around the periphery of the site and would prevent any significant groundwater flow between the location of the new mainline link road and the SSSI unit. Superficial deposits are also thinner

than across the SE Unit with greater amounts of lower permeability clay and limited sands and gravels, which help to reduce infiltration and maintain surface saturation. Around 5% of the surface water catchment will be cut off by the development but this is considered unlikely to significantly alter the flow in the watercourse that flows occasionally through the NW Unit, as this portion of the catchment is not well connected to the SSSI unit (with the main flow pathway being subsurface flow).

2.2.2 The SE Unit was shown to have thicker and more extensive superficial deposits which stretch out in a wide 'bowl' around the site. There will be groundwater movement within the granular layers in these thicker superficial deposits, which will generally flow into the SSSI from the south, north, and west and then out towards the northeast. The water table at the Site is maintained through winter and spring by a combination of rainwater recharge, infiltration from the northern ditch, limited groundwater flows from elsewhere in the catchment, and potentially some recharge from infiltration from the central watercourse. Analysis of the thickness and spatial extent of the superficial deposits indicates that they thin out towards the new mainline link road cutting. There is no evidence that the proposed cutting will intersect significant thicknesses of sand or gravel in the thin superficial deposits at this location, which could be contributing to groundwater recharge of the SSSI. The majority of the cutting will instead intersect the low permeability Mercia Mudstone, and so it is concluded that the cutting will have negligible impacts on the hydrogeological conditions of the SSSI.

2.2.3 Around 18% of the surface water catchment for the SSSI (drawn from the most downstream point of the central stream as it leaves the SE Unit) to the west of the mainline link road and beneath the Scheme footprint will be lost or cut off. Detailed catchment analysis has demonstrated that most of this catchment loss is to the central watercourse within the site which is thought to have limited importance for recharge of the wet meadow field. The wet meadow field which supports MG4 grasslands would lose 3.6% of its surface water catchment, while the dry meadow field supporting MG5 grasslands has no loss in surface water catchment area. For the wet meadow field, an analysis of rainfall records for the site suggested that the amount of water lost to the 3.6% surface water catchment reduction would be within that expected with natural climatic variability 'year on year'. However, it could not be confirmed that this would not have consequences for the sensitive grassland species in a given year or over a number of consecutive 'drier' years in terms of depressing the water table to the extent that surface conditions become drier, especially in the spring. There was also an inherent uncertainty in this assessment from data limitations. Due to this uncertainty it was proposed that mitigation is provided for the wet meadow in the SE Unit.

2.3 Proposed Mitigation for the SE Unit – Passive Solution

2.3.1 A passive, gravity fed solution has been designed (shown in Annex B) and accepted by statutory consultees during the DCO Examination as the preferred approach to mitigating the loss of surface water catchment for the SE Unit. It is preferred due to it being a sustainable approach with minimal intervention required in comparison to other options (e.g. a pumped solution, potable water supply or borehole pumping).

2.3.2 A design has been produced which uses road run-off from the realigned Catherine-de-Barnes Lane (4,875 m^2 of which 4,086 m^2 is from impermeable surfaces such as the road and 789 m^2 from more permeable areas such as the soft verge) and greenfield runoff from adjacent fields (7,103 m^2), both of which are collected and delivered to the northern ditch of the SSSI via a conveyance swale. The greenfield area is within the control of Highway's England and if required legal instruments could be created to ensure this area is maintained as a contributing area to the SE Unit in perpetuity. The ditch should then act as a recharge trench, enabling replenishment of the wet meadow's water table. If water is not being retained long enough within the ditch it could be reprofiled to create more exaggerated pools or semi-porous log dams could be installed using natural materials, all with the intention of keeping water in the ditch for longer to maximise infiltration. The proposed solution is shown in Appendix 14.2(a) Bickenhill Meadows Site of Special Scientific Interest – Hydrological Investigation Technical Note (v9.1) [**REP3-004/Volume 6.3**].

2.3.3 A design storm analysis of volumetric water loss from the wet meadow due to the Scheme was undertaken using Micro Drainage software (Appendix 14.2(a) Bickenhill Meadows Site of Special Scientific Interest – Hydrological Investigation Technical Note (v9.1) [**REP3-004**]). This indicated that once the gravity-fed mitigation solution is applied there is a surplus of water reaching the wet meadow in comparison to existing conditions. At the 1 in 5-year storm there is an increase in volume of 7.7% reaching the wet meadow, and 7.5% for the 1 in 30-year storm, and 7.0% for the 1 in 100-year storm. Although there remains some uncertainty regarding the contribution of groundwater flow and infiltration from the central watercourse, and some of the water supplied may not infiltrate and might flow along the ditch, there is a buffer in the volumes of water available. Natural England have also previously expressed a preference for excess water to reach the wet meadow rather than too little water, as any water reaching the site can be managed and drained if necessary. However, this itself implies that a degree of 'management' of the mitigation will be required, especially in the short term post-construction. Ongoing monitoring of the mitigation would be necessary for optimisation and to ensure not too much water is being provided. If infiltration needs to be encouraged further, small informal log dams using natural materials could be provided across the northern ditch and the bed deepened in places to encourage water to pool.

2.3.4 Furthermore, it is proposed to include a mechanism within the passive mitigation solution to enable the volumes of water reaching the SSSI to be limited, should the monitoring indicate that delivery of too much water is having an adverse impact on the grassland communities. This mechanism would take the form of a sluice valve within one of the drainage chambers off Catherine de Barnes Lane, which would enable runoff to be redirected back to the main highway network. The sluice valve would need to be manually closed or opened, but would provide a means by which some control over the volume and rate of water being supplied to the Northern Ditch could be achieved.

2.3.5 The Position Statement on SSSI Mitigation [**M42J6/DCO_SSSI_DPS**] describes ongoing responsibilities for the site, "*The Applicant notes the desire of SMBC to own and manage the swale at Shadowbrook Lane and the filter drain system adjacent to the realigned Catherine de Barnes Lane and will work collaboratively with SMBC to this effect as part of the wider transfer of relevant assets from Highways England to SMBC."*

"*The Applicant can confirm that the maintenance of the Passive Solution during the first five (linked to monitoring) years of operation will be the responsibility of the Applicant".*

2.3.6 Crucial to the successful functioning of the mitigation solution will be appropriate ongoing maintenance of the swale in line with guidance in the DMRB HD103/06 Vegetated Drainage Systems for Highways Runoff and CIRIA C753 The SuDS Manual. As new guidance is produced on maintenance of SuDS this should also be consulted. As noted above, it is intended for Highways England to be responsible for maintenance of the passive solution for the period of construction and 5 years into operation, at which point SMBC will take over responsibility. The likely maintenance requirements relate mainly to the swale and include:

- Inspections made monthly to start, then as required or after each major storm of the following – inflow/outfalls for blockages, integrity/erosion and vegetation cover / vigour;
- Undertake half yearly clearance of built up sediment (if deposits exceed 25mm in depth) and invasive weeds. Assess after 6 months whether a more frequent rate of clearance is required;
- Clearance of rubbish and debris monthly or after each major storm;
- Regular mowing of the grass sward to 100mm. Grass should not be mowed when ground conditions are wet and soft as this may compact soils, create ruts and result in erosion. Grass clippings should be disposed of off-site or outside the area of the swale to remove nutrients and pollutants;
- Swales should be inspected at least quarterly for structural repairs, especially to the inlet areas and side slopes were erosion may occur. Repair should include infill, reshaping of the slopes and reinforcement if necessary. Bare areas should be reseeded;
- Remove and dispose of oils or petrol residues as required, following safe standard practices; and
- All vegetation management activities should take account of the need to maximise biosecurity and prevent the spread of invasive species.

2.3.7 Future maintenance and management is not considered to have any adverse effect on the SSSI Unit going forward, given that it consists of standard maintenance measures that are undertaken widely as a matter of routine on the strategic and local road network.

2.4 Requirement for this Plan

2.4.1 The Passive Solution has been designed to provide more water than has been estimated to be lost by the change in catchment area supplying the wet meadow of the SE Unit. However, ensuring that the wet meadow receives the right amount of water is complex and thus it is important that the implementation of the mitigation solution is accompanied by a programme of botanical and hydrological monitoring. The scope of this monitoring is set out within this Plan, and will be agreed with Natural England, WWT and SMBC.

2.4.2 While no adverse impacts are anticipated for the NW Unit and no mitigation solution has been considered necessary, it is proposed to maintain some botanical and hydrological monitoring of this unit as well, due to the uncertainty inherent in the analysis. This data will also provide local geographical context for interpretation of any changes seen at the SE Unit.

2.4.3 Details of the hydrological and botanical monitoring for the site are outlined in the following section.

3 SSSI Monitoring Protocol

3.1.1 This section outlines:

- the botanical and hydrological monitoring to be undertaken to fully understand and establish the baseline (pre-construction) conditions at each SSSI unit, and
- the monitoring that is required during construction and during operation to identify any potential adverse effects on the SSSI.

3.2 Existing Monitoring Commitment

3.2.1 The REAC [**APP-114/Volume 6.3**] stated that monitoring of the Bickenhill Meadows SSSI would continue for 2 years post submission, with Natural England kept informed with data and technical interpretation.

3.2.2 The Bickenhill Meadows SSSI Technical Note (version 9.1) stated that, "*It is further anticipated that monitoring will continue through the construction phase of the Scheme and into the initial years of operation to gather further baseline data and to help evaluate any impacts on the two SSSI units should they occur, subject to continued landowner and Natural England consent*".

3.2.3 A Position Statement on SSSI Mitigation [**REP4-006**] has since been developed as requested by the ExA. With regard to monitoring this states that, "*The Applicant will be responsible for an on-going monitoring programme (both hydrological and ecological) of the Shadowbrook Meadow SSSI unit. This will continue throughout the construction phase of the Scheme. Subsequently, operational monitoring will continue for five years, commencing from the date on which that part of the Scheme affecting the Shadowbrook Meadow SSSI unit is first opened for use. Upon completion of the five years of operational monitoring, the Applicant will discuss with the Stakeholders the necessity of continued monitoring, based upon analysis of data collected as part of the initial monitoring programme*".

3.2.4 These requirements have been incorporated into the proposed monitoring protocol.

3.3 Proposed Monitoring

3.3.1 The criteria for establishing what constitutes a significant change to the interest features (i.e. the grassland communities) should be based upon those that are set by Natural England's Commons Standards Monitoring (CSM) (JNCC 2004)[1]. It is considered that appropriate metrics of change should be based upon a change in the extent of vegetation communities, grass:herb ratio, and / or the frequency of positive and negative indicator species. However, the survey protocol for monitoring of any changes in the grassland in response to altered hydrology will need to go beyond the CSM survey already carried out by Natural England for the purpose of monitoring site condition. The proposed approach will be based upon

[1] JNCC (2004) Common Standards Monitoring Guidance for Lowland Grassland Habitats.

that outlined in Wheeler et al (2004)[2] and will comprise more detailed hydrological and botanical monitoring that are not part of CSM. The hydrological monitoring of groundwater levels is required as this is the aspect of the site that is most likely to be altered by the scheme. This proposed approach is to be implemented prior to construction in order to establish baseline conditions and is currently proposed to be continued for 5 years into operation, before re-evaluating the need for further monitoring thereafter.

Botanical Monitoring Protocol

3.3.2 The protocol for botanical monitoring will be completed in accordance with Rothero *et al* (2016)[3]. The protocol will monitor the composition of vegetation, highlighting transitions in the plant communities (i.e. both dry and wet) that occur across the varied site topography. In order to cover all of the vegetation communities present, the monitoring will be carried out in each field compartment of both the NW and SE Units.

3.3.3 The following outlines the method of botanical survey that will be completed annually throughout the monitoring period:

- surveys will be complete in the period June to August, and will be timed to be completed before grazing or mowing which can reduce suitability of grassland for survey;
- the protocol will comprise transects of 1 m^2 quadrats through each field compartment;
- transects shall be carefully positioned so that they are representative of the varied topography and crosses through the different vegetation communities present in the respective field compartments;
- the quadrats shall be located along the transect at intervals of no less than 10 metres to ensure they are independent of each other;
- each transect shall consist of a minimum of eight quadrats, and preferably between 12 and 16 quadrats as this is the number required for robust statistical analysis of data, for example, correlation with hydrological monitoring (described below);
- within each quadrat all plants present will be recorded along with a measure of their abundance as percentage cover. Sward height and percentage cover of thatch within each quadrat will also be recorded;
- the exact location of the transect start and end points and also the location of each quadrat will be recorded using GPS and photographed. A bearing will be taken between the start and end points so as to effectively locate the end point of the transect and ensure consistency of data. Each location will be used consistently throughout the entire monitoring period.

[2] B.D. Wheeler, D.J.G. Gowing, S.C. Shaw, J.O. Mountford, and R.P. Money, 2004. Ecohydrological Guidelines for Lowland Wetland Plant Communities (Eds. A.W. Brooks, P.V. Jose, and M.I. Whiteman,). Environment Agency (Anglian Region)

[3] Rothero, E., Lake, S. and Gowing, D. (eds) (2016). *Floodplain Meadows – Beauty and Utility. A Technical Handbook*. Milton Keynes, Floodplain Meadows Partnership.

3.3.4 Biennial monitoring of the extent of vegetation communities will also be completed using standard National Vegetation Classification surveys (Rodwell 2006)[4]. This will provide information on type and extent of homogenous vegetation communities present within the SSSI units.

3.3.5 In addition to this monitoring, the data will also be supported by:

- information on the prevailing site management, including key management activities that may also affect vegetation composition, such as timing of cutting & grazing and stock density;
- soil nutrient data collected annually, comprising five representative samples from each field compartment collected in the spring period; and
- fixed-point and aerial photography of vegetation.

3.3.6 The data obtained from monitoring will be used to investigate the occurrence of any changes to the type and extent of vegetation, and to correlate this with the potential causes of any observed change. This will include review of the following variables:

- mean species richness of quadrats;
- percentage frequency of key indicator plant species across transects and at individual locations;
- vegetation community type (as defined by NVC) at fixed locations; and
- overall extent of habitat communities.

3.3.7 Key indicator species would include those that are known to be characteristic of MG4 and MG5 communities present[5], and also those that represent negative indicators typical of poor conditions, such as eutrophication, as described in Crofts & Jefferson (1999)[6].

3.3.8 These factors will provide a picture of the vegetation at the SSSI and that can be analysed alongside and correlated with hydrological and other environmental and site management data. Review of change would include investigation of alteration in habitat extent across the site and the vegetation type and associated species at individual quadrats. This review will consider change within the site at any one location and also any year-on-year change. For example, it will provide in the event that vegetation type shifts.

3.3.9 The baseline of vegetation monitoring data, i.e. quadrat transects, was established in summer 2019.

3.3.10 Botanical monitoring will continue annually throughout the four-year construction period and for five years post-construction.

[4] Rodwell (2006) National Vegetation Classification: Users' Handbook. Joint Nature Conservation Committee
[5] As defined by Common Standards Monitoring guidance (JNCC 2004)
[6] Crofts A & R G Jefferson (eds) (1999) The Lowland Grasland Management Handbook – 2nd Edition. English nature & The Wildlife Trusts

Hydrological Monitoring Protocol

3.3.11 At the SE Unit hydrological monitoring shall focus on both the wet meadow field which supports the more sensitive MG4 grasslands and also the dry MG5 grassland.

3.3.12 At the NW Unit, there are not such discrete areas of wet and dry meadow, and so the hydrological monitoring covers the whole site, including a mix of MG4 and MG5 species.

3.3.13 The baseline monitoring period which is currently underway is described in full in Appendix 14.2(a) Bickenhill Meadows Site of Special Scientific Interest – Hydrological Investigation Technical Note (v9.1) [**REP3-004**], and summarised below. The proposed monitoring protocol for the construction and operation phases is also summarised below.

Baseline period (prior to construction)

3.3.14 It is proposed to continue with the current monitoring regime which commenced in August 2018 until the onset of construction (Q1 2020). This baseline period would therefore extend for 1 year and 9 months. For both the SE Unit and NW Unit of the SSSI this monitoring consists of fortnightly measurement of groundwater levels in 10 dipwells at each site; maintenance and downloading of one water level data logger per site (logging at 15-minute intervals); and fortnightly measurement of pH, electrical conductivity and temperature in three dipwells per site (when there is sufficient water present).

Construction period

3.3.15 It is proposed to extend the current baseline monitoring unchanged throughout the four-year construction period at both SSSI units, subject to landowner consent. During this period, fortnightly measurement of groundwater levels in 10 dipwells at each site will be maintained, the existing data loggers will continue to measure water levels throughout construction (at 15-minute intervals), and there will also be fortnightly measurement of pH, electrical conductivity and temperature in three dipwells per site (when there is sufficient water present).

Operation (3 years post construction)

3.3.16 It is proposed to maintain the baseline and construction water level monitoring regime throughout the first three years of operation at both SSSI units, but at a frequency of monthly visits. As such, monthly measurement of groundwater levels in 10 dipwells at each site will be maintained and the existing data loggers will continue to measure water levels throughout construction (at 15-minute intervals). Monthly measurement of pH, electrical conductivity and temperature in three dipwells per site would also be continued.

Operation (3-5 years post construction)

3.3.17 After three years of operation and presuming no adverse impact on the SSSI units had been identified in the previous monitoring data, it is proposed to reduce the monitoring regime to a minimum of one dipwell per botanical transect, with the final number required informed by previous monitoring data. The data loggers would be maintained at each site for continuous logging of water level at 15-minute intervals. It is proposed to visit site once per month to download and service the equipment.

4 Establishment and Role of the SSSI Monitoring Steering Group

4.1.1 It is proposed to set up a SSSI Monitoring Steering Group ('the Steering Group') to oversee the monitoring programme and to make collective decisions on what (if any) actions need to be undertaken/ implemented in response to the outcomes of monitoring.

4.1.2 At this stage, it is envisaged that the Steering Group will consist of Highways England, Natural England, SMBC, WWT and Birmingham Airport, as the main parties involved in the project, management of the SSSI, and landowners. Highways England's appointed Principal Contractor will initially be responsible for the monitoring and will also need to attend. The organisation, purpose, and procedures of the Steering Group (for example, how meetings will be chaired, meeting frequency, scope of monitoring, action triggers, action hierarchy, and general conduct and decision-making capacity) will be agreed between all parties and set out in a Memorandum of Understanding prior to construction of the Scheme.

4.1.3 At this stage, it is proposed that an initial meeting of the Steering Group will take place prior to the start of construction to agree the Memorandum of Understanding. Once construction of the Scheme has begun, it is proposed that the Steering Group will meet twice a year. These meetings will continue throughout construction and for a minimum of five years post opening of the Scheme.

4.1.4 For the construction period and initial three years of operation of the Scheme the Steering Group would need to meet in November and then again in the early-mid Spring (i.e. March/April). This is to consider periods when groundwater levels will be recharging (autumn) and when the SSSI grasslands are most sensitive to hydrological changes (i.e. the spring).

4.1.5 Following two years of operation, it is proposed that the frequency of meetings would be reduced to once a year, coinciding with the critical spring period. These annual meetings would continue for a minimum of three further years. As such, the Steering Group would be regularly meeting for five years after scheme opening. In the final year, the Steering Group would review whether there would be any need to continue the monitoring, meetings and mitigation review process and if so, for how long and what scope.

4.1.6 At each meeting, the monitoring data collected since the last meeting will be presented together with an interpretation of the results in the context of baseline data, standards, climate, management and any other factor that may reasonably be considered to influence the conservation status of the SSSI. The Steering Group will then consider what action to take, with reference to predefined criteria agreed when setting up the Memorandum of Understanding. It is hoped that consensus can be reached on the decisions that can be made, but if not the Memorandum of Understanding should describe in detail the decision-making process of the Steering Group in the event of disagreement between parties.

5 Trigger Points and Action Measures

5.1 Triggers and Actions

5.1.1 In order to assess whether any adverse impacts are occurring to the botanical and hydrological regime within the SSSI units, it is proposed to outline indicators, or "trigger points", which would identify to the Steering Group that there is a potential negative impact to the SSSI occurring and that a course of action needs to be identified. This section outlines how these trigger points and actions would be derived.

5.1.2 The aim of the monitoring is to confirm with reasonable certainty that a change in vegetation for which the SSSI is designated may be attributed to the impacts of the Scheme. If there is no significant hydrological change, then by default any alteration in the vegetation that may be observed cannot be attributed to the Scheme. Where there is hydrological change then the significance of this change will be evaluated further together with any observed vegetation changes and the influence of all environmental (or other) variables. To do this fully, the Steering Group will require detailed information from the land owners and site managers on any changes to the management of the site.

5.1.3 The trigger points would be broadly based on the pre-construction baseline monitoring and Ecohydrological Guidelines[7] for MG4 grasslands. The optimum water depths for MG4 grasslands from these guidelines are shown in Table 5-1. However, these are both 'guides' and all available data should be presented and discussed at the Steering Group meetings before a collective decision on how to proceed is made (e.g. differences in climate when compared to baseline years; changes in land management practices). This is to reflect the natural variability that would be expected in the site, but also uncertainty in the guidance and data sources. For example, significant changes in vegetation extent or condition may occur from year-to-year as a result of natural climactic variation. It is therefore essential that sufficient time is given to establish if any observed changes is the result of such variation rather than a result of the impacts of the Scheme. Overall, a continuous, flexible and adaptive monitoring, mitigation and management approach informed by the best available data is required.

5.1.4 Analysis of vegetation will be reviewed both within the site and year-on-year. Triggers for vegetation may include one or a combination of the following:

- shifts away from the prevailing vegetation community at specific locations or across the site;
- reductions in species richness at specific locations or across the site;
- reductions in the extent of key vegetation communities; and
- changes in the abundance of key indicator species (both positive or negative).

[7] Environment Agency (2004) Protective and Enhancing Wetlands: Ecohydrological Guidelines for Lowland Wetland Plant Communities.

Table 5-1 - MG4 Grassland: Optimum, amber range and red threshold water level values for Spring and Autumn

MG4: Water Level Criteria	Spring	Autumn
Optimum Mean Water Depth (m)	0.45	0.6
Amber Range – Maximum Water Table (i.e. the range of values, which if experienced most years will result in a change to the community) (m)	0.65 – 0.8	1.0
Amber Range – Minimum Water Table (i.e. the range of values, which if experienced most years will result in a change to the community) (m)	0.2 – 0.3	0.2 – 0.3
Red threshold – Maximum Water Table (i.e. the threshold that if breached in 1 year, a change is likely to be experienced) (m)	>0.8	-
Red threshold Minimum Water Table (i.e. the threshold that if breached in 1 year, a change is likely to be experienced)	<0.2	<0.2

Note: Further comment is given in the Ecohydrological Guidelines to values in the 'red zone' as follows, "If a mean value based on three consecutive readings, each at least 14 days apart, falls within the red zone, then there is a high likelihood that the composition of the community will be affected. If they fall in the top red zone the effect may be noticeable within a year, in the lower red zone, it may not reveal itself for several years".

5.1.5 Prior to the Steering Group meeting a report detailing new monitoring data, anecdotal information, and an interpretation of the results will be provided to all parties by the Consultants responsible for the monitoring. It is envisaged that key monitoring metrics (e.g. average groundwater levels, number of days of rain above 10 mm, degree of vegetation change and any correlation with environmental variables) will have been graded with reference to baseline conditions and the Ecohydrological Guidelines. There are many ways in which this may be achieved, which needs to provide a status and direction of change. A simple method might be to use the following 5-point scales (see Table 5-2):

Table 5-2 - Potential metrics and direction of metric for grading SSSI monitoring data

Metric Status	Direction of Change of Metric from last Report
Bad	Large negative (--)
Poor	Negative (-)
Neutral	No change
Good	Beneficial (+)
Excellent	Large beneficial (++)

5.1.6 Should a negative direction of change be recorded, that could not be reasonably explained by reasons other than hydrological changes caused by the Scheme, then that would be a 'trigger' for the Steering Group to consider what action to take.

5.1.7 The status and direction of change of all the monitoring metrics should be evaluated in the context of the SSSI and any other factors that may explain the observed patterns. In light of this it is recommended that the Steering Group can make recommendations for action as follows:

- **Action Level 1:** Do nothing - Continue to monitor.
- **Action Level 2:** Recommend changes to monitoring (that could be temporary) and review need for action at next planned Steering Group meeting.
- **Action Level 3:** Recommend changes to monitoring (that could be temporary) and review at additional meeting in advance of next planned Steering Group meeting.
- **Action Level 4:** Make recommendations for immediate action to adapt existing mitigation measures to improve performance and continue to monitor.
- **Action Level 5:** Make recommendations for immediate action to deliver additional mitigation to reduce any negative trends and ensuring conservation status is maintained.

5.1.8 A flow chart to summarise the process of monitoring through to identifying a potential 'trigger' and then deciding action levels is shown in Figure 5-1.

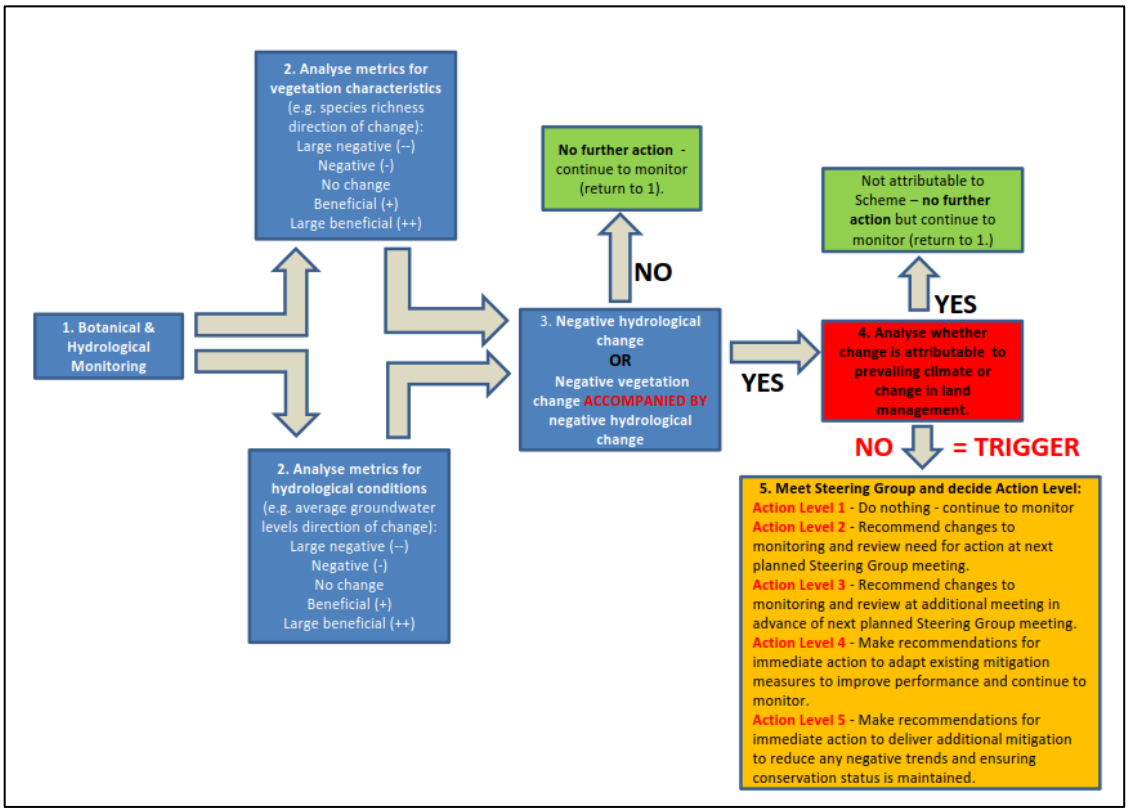


Figure 5-1 - Flow chart showing the process from monitoring to initiation of a 'trigger' and requirement to determine Action Level of response.

5.1.9 A worked example of how this might work is as follows:

- At the Spring and Autumn meetings of the Steering Group, if mean water tables had reduced to the 'red zone' having been in the 'amber zone' the previous year, then this would indicate a negative direction of change and a 'Poor' metric, and may be accompanied by change in vegetation monitoring metrics.
- This would act as a trigger for the Steering Group to consider the necessary actions that might be required to resolve the negative trend.
- The necessary action would depend on analysis of the monitoring data in the context of climatic conditions and management practices to determine whether changes are needed to the proposed mitigation to improve its effectiveness or if (as a worst case) further mitigation measures were needed.
- For example, an exceptionally dry winter or spring could result in water table levels in the 'red zone' which may be unrelated to construction or operation of the scheme.
- A suitable action might be to update the monitoring approach to provide a more detailed assessment of the change and to review again at the next Steering Group meeting.
- Over time, as more data and understanding of the site is developed, it should become easier to make informed decisions about how to respond to any observed changes in the monitored metrics.

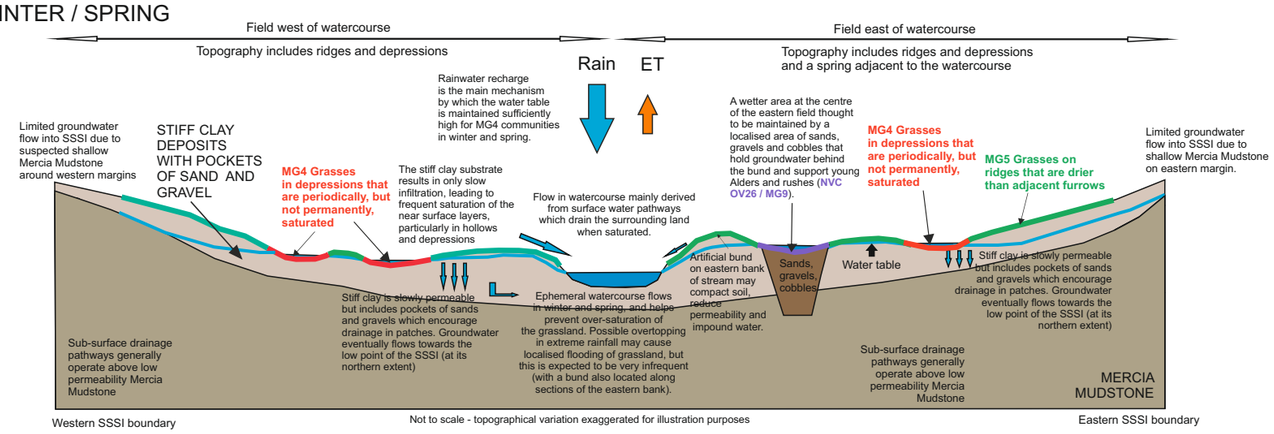
5.2 Mitigation

5.2.1 Should the need be identified, then the Steering Group would discuss options to adapt the preferred mitigation option to improve performance (e.g. to improve water supply, retention and soakaway along the northern ditch, or to hastening removal of water from the site if there was an issue with waterlogging), or if needed, to make recommendations for additional mitigation as already set out in Appendix 14.2(a) Bickenhill Meadows Site of Special Scientific Interest – Hydrological Investigation Technical Note (v9.1) [**REP3-004**] (e.g. to pump treated highway runoff from the new road to augment the existing compensation supply). It would be for the Steering Group to decide the preferred approach if and when it was required, as such it is not possible to provide further detail at this stage.

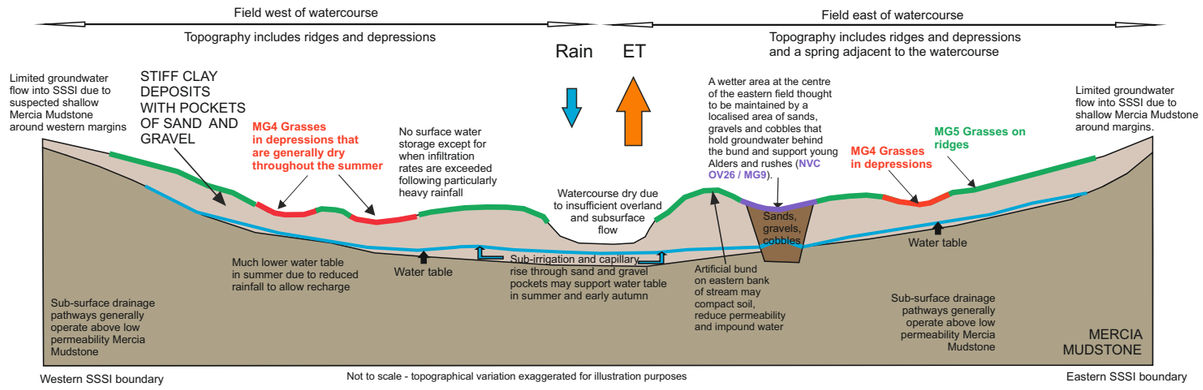
Annex A: SSSI Conceptual Models

A. NW SSSI CONCEPTUAL MODEL

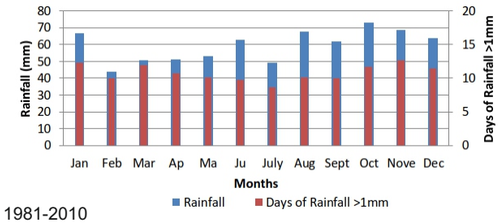
WINTER / SPRING



SUMMER / AUTUMN



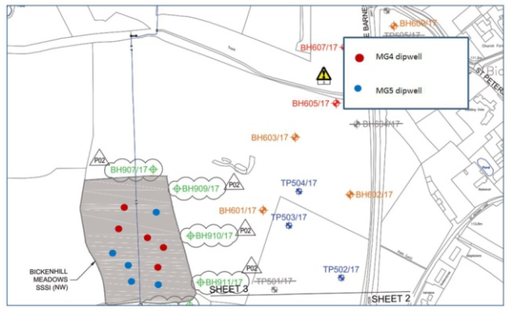
C. COLESHILL RAINFALL



1981-2010

D. CATCHMENT LOSS

E. DIPWELL MONITORING LOCATIONS



NW SSSI - EASTERN FIELD

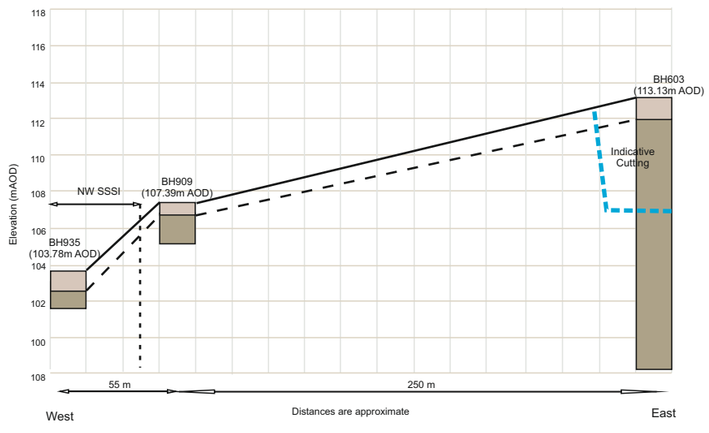
NW SSSI - CENTRAL DITCHCOURSE

CONCEPTUAL MODEL & CROSS SECTION LEGEND

- Mercia Mudstone
- Superficial Clays
- Wetter Area Supported by Sands and Gravels
- MG5 Community
- MG4 Community
- MG9/OV26 Community
- Flow Direction
- Water Table

B. NW SSSI GEOLOGY CROSS SECTIONS

Transect 1



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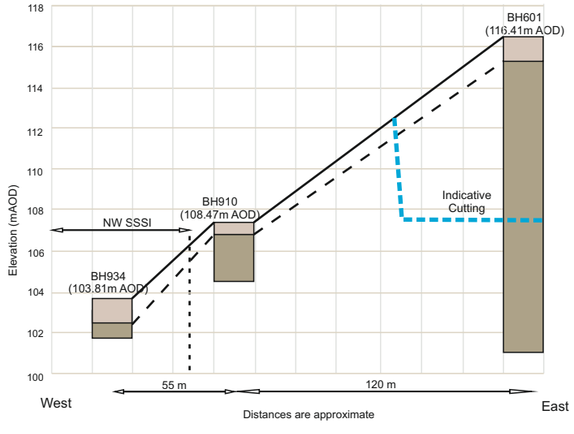
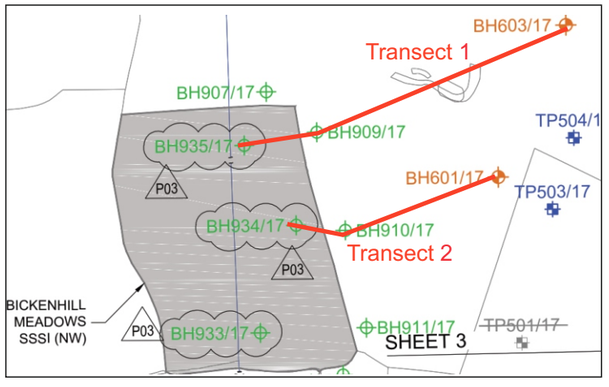


GI & TRANSECT LOCATIONS



Purpose of Issue: PURPOSE OF ISSUE	Project Title: M42 JUNCTION 6 IMPROVEMENT	Drawing Title: ANNEX C: BICKENHILL MEADOWS NW SSSI UNIT CONCEPTUAL MODEL	Designed: TJ	Drawn: TJ	Checked: OT
			Approved: GC	Date: 03/10/18	
			Internal Project No: 60543032	Suitability:	
			Scale @ A3: NA	Zone: X	

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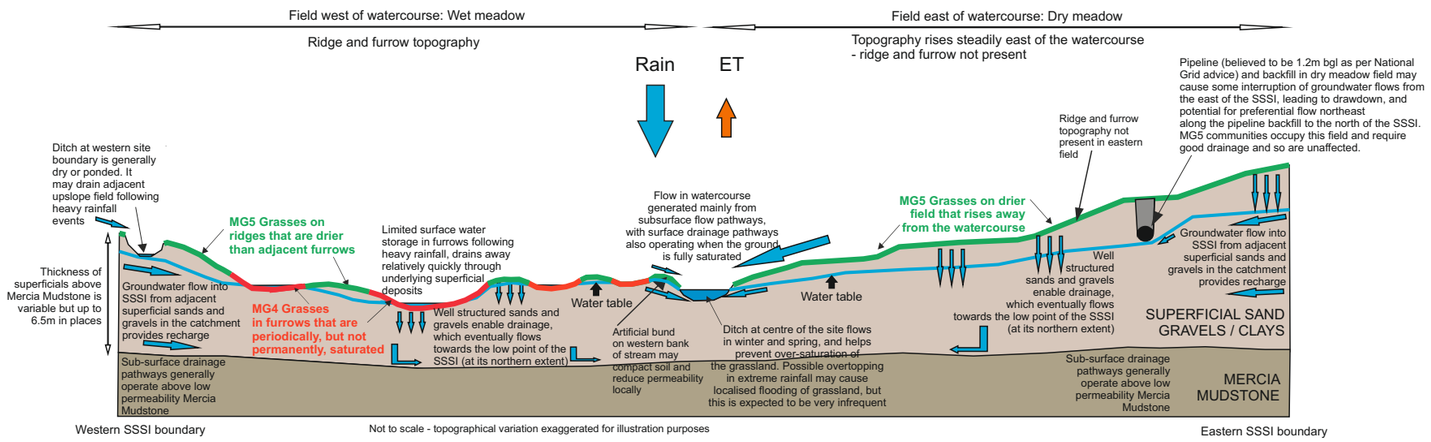
Drawing Number: Highways England Pin HE551485 | Originator -ACM | Volume -EGN | Location M42_SW_ZZ_ZZ | Type DR | Role HD | Number 002

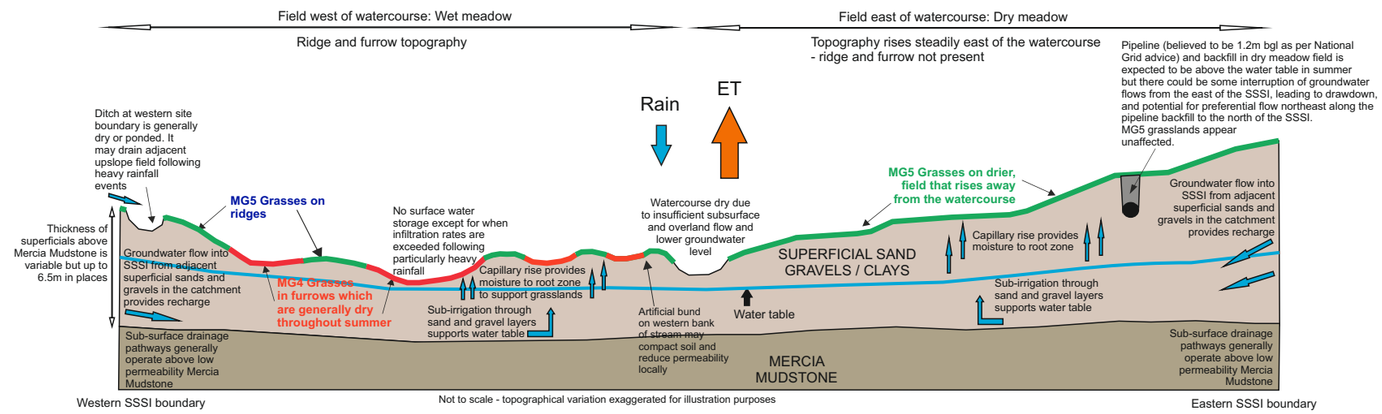
Rev: P01

A. SE SSSI CONCEPTUAL MODEL

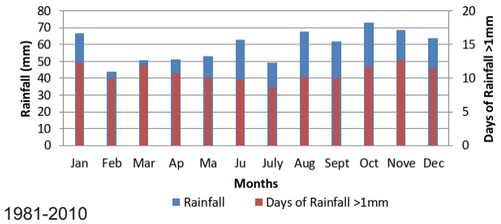
WINTER / SPRING



SUMMER / AUTUMN



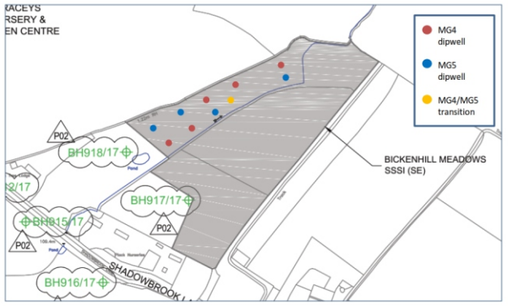
C. COLESHILL RAINFALL



1981-2010

D. CATCHMENT LOSS

E. DIPWELL MONITORING LOCATIONS



WET MEADOW - SE SSSI

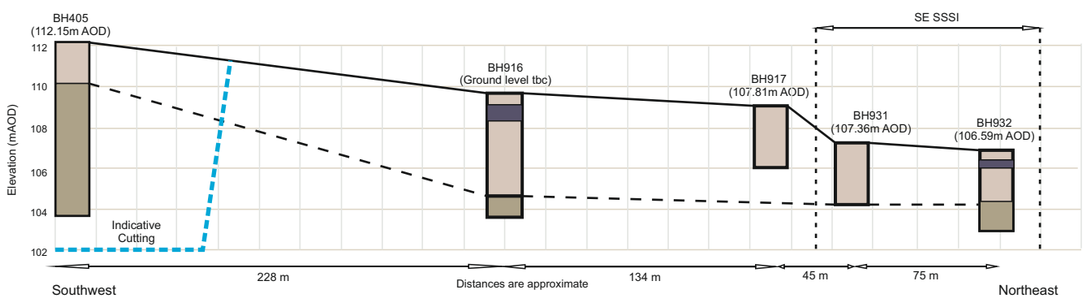
CENTRAL DITCHCOURSE - SE SSSI

CONCEPTUAL MODEL & CROSS SECTION LEGEND

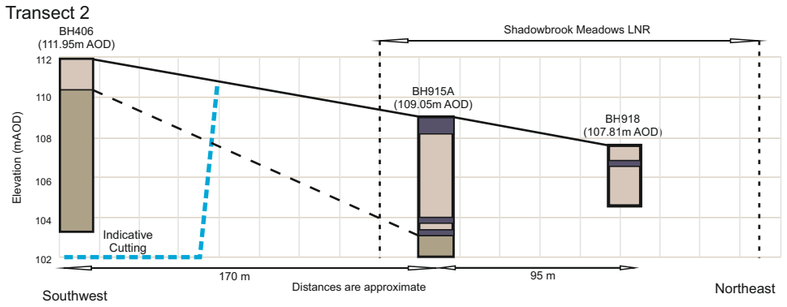
- Mercia Mudstone
- Superficial Clays, sands and gravels (clay dominated)
- Superficial Sand Layers
- Flow Direction
- Water Table
- MG5 Community
- MG4 Community

B. SE SSSI GEOLOGY CROSS SECTIONS

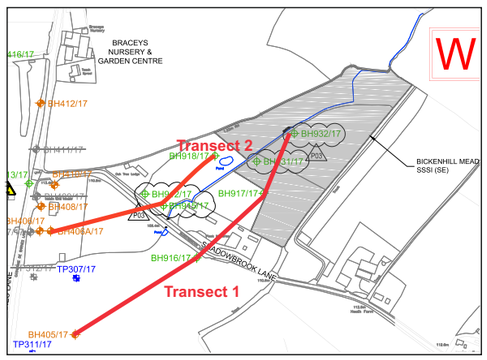
Transect 1



Transect 2



GI & TRANSECT LOCATIONS



Purpose of Issue: PURPOSE OF ISSUE	Project Title: M42 JUNCTION 6 IMPROVEMENT	Drawing Title: ANNEX C: BICKENHILL MEADOWS SE SSSI UNIT CONCEPTUAL MODEL	Designed: TJ	Drawn: TJ	Checked: OT
			Approved: GC	Date: 03/10/18	
			Internal Project No: 60543032	Suitability:	
			Scale @ A3: NA	Zone: X	

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Drawing Number
Highways England Pin | Originator | Volume
HE551485 -ACM -EGN
M42_SW_ZZ_ZZ DR_HD_001
Location | Type | Role | Number

Rev P01

Annex B: Passive Mitigation Solution

ACCESS TO DOG HOME

REALIGNED CATHERINE DE BARNES LANE

CATHERINE DE BARNES LANE OVERBRIDGE

REPROFILE GREEN RECHARGE AREA TO FALL TOWARDS CATHERINE DE BARNES LANE

PROPOSED DUAL CARRIAGEWAY MAINLINE LINK

DOUBLE PIPE SYSTEM FILTER PIPE INSTALLED AT A HIGHER LEVEL ABOVE THE CARRIER PIPE

BICKENHILL ROUNDABOUT

BARBER'S COPPICE ROUNDABOUT

REALIGNED CATHERINE DE BARNES LANE

ST PETERS LANE

REALIGNED CATHERINE DE BARNES LANE NORTH OF BICKENHILL ROUNDABOUT

PROPOSED DUAL CARRIAGEWAY MAINLINE LINK

SHADOWBROOK LANE

ENTRY LEVEL TO EXISTING DITCH = 108.405m

PROPOSED ACCOMMODATION BRIDGE

ST PETERS LANE

N

0 50 100 m

1:2000

LEGEND

- EXTENT OF SCHEME
- EXTENT OF SSSI
- ASSUMED SSSI DRAINAGE CATCHMENT
- APPROXIMATE CATCHMENT AREA CUTOFF BY NEW ROAD
- EXISTING DITCH
- SWALE
- FILTER DRAIN
- CARRIER PIPE / CULVERT
- EXISTING ROAD
- GREEN RECHARGE AREA
- ROAD/FOOTWAY RECHARGE AREA
- HEADWALL
- CHAMBER
- PARTITION HEADWALL WITH WEIR AND ORIFICE

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION BOX

IT IS ASSUMED THAT ALL WORKS ON THIS DRAWING WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROPRIATE METHOD STATEMENT.

THIS DRAWING IS TO BE USED ONLY FOR THE PURPOSE OF ISSUE THAT IT WAS ISSUED FOR AND IS SUBJECT TO AMENDMENT.

EXCEPTIONAL RISKS RELATING TO THE WORKS ASSOCIATED WITH THIS DRAWING ARE IDENTIFIED BELOW.

CONSTRUCTION

MAINTENANCE / OPERATION / DECOMMISSIONING / DEMOLITION

NOTES

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2. DO NOT SCALE FROM THIS DRAWING, USE ONLY PRINTED DIMENSIONS.
3. ALL DIMENSIONS IN METRES, ALL CHAINAGES, LEVELS AND COORDINATES ARE IN METRES UNLESS DEFINED OTHERWISE.

KEYPLAN

SUDS AND PIPEWORK ADDED	OM / ME	25-04-19	P02
Revision Details	By / Check	Date	Suffix

Purpose of issue

FOR INFORMATION

Client
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Working on behalf of highways england

Project Title

M42 JUNCTION 6 IMPROVEMENT

Drawing Title

ANNEX H: SE SSSI UNIT GRAVITY MITIGATION SOLUTION

Designed	Drawn	Checked	Approved	Date

Internal Project No. 60543032	Suitability S2
Scale @ A1 1:2000	Zone M42

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Drawing Number
Highways England PIN | Originator | Volume | Rev
HE551485 - ACM - HGN - P01
M42_GEN_ZZ_ZZ - DR - SK - 0100
Location | Type | Role | Number

Plot Date: 21 June 2019 12:04:59
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