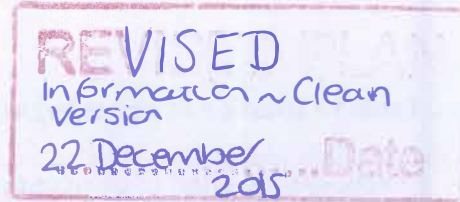


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Technical Appendix C Flyway early warning monitoring scheme



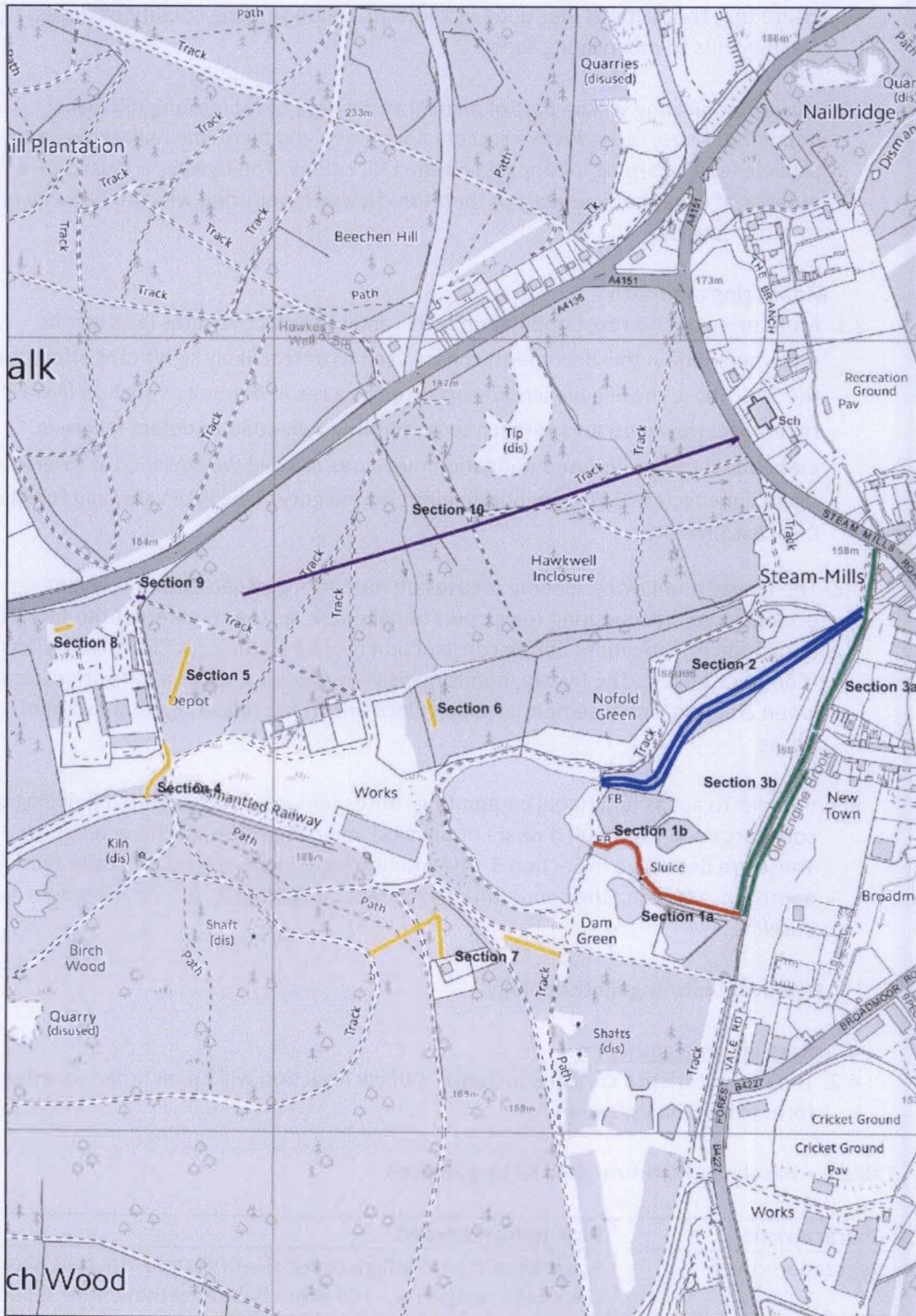
1. Purpose

- 1.1. The purpose of the scheme is to measure the effectiveness of imbedded and imposed measures to protect and maintain ecological corridors which LHBs use to commute along.
- 1.2. Ecological corridors allow many Key Ecological Components (KECs) to migrate and disperse within and beyond the Northern Quarter. They connect resting, breeding, hibernating and foraging habitat for a range of key species including Lesser horseshoe bats (LHBs) which use these corridors as flyways. Interruption of these corridors can result for example in reduced genetic exchange and fragmentation and isolation of habitats, making species less resilient to a wide range of pressures. Development within the Northern Quarter and works within 'off site' mitigation areas has the potential to interrupt important LHB flyways identified through previous studies.
- 1.3. Both the Cinderford Northern Quarter Biodiversity Strategy and the Appropriate Assessment (AA) for planning permission P0663/14/OUT identified this. The AA recognised that embedded measures including retention and protection of vegetation, soft landscaping, set back of development, lighting strategies and outline Construction Environment Management Plans (CEMPs) went a considerable way to reducing the likelihood of LHB flyways being severed. However, it imposed additional measures to provide certainty that such impacts would be avoided. These imposed measures included:
 - Vegetation protection during construction including CEMPs (Conditions 8-12)
 - Soft landscaping (Conditions 27-32)
 - Lighting controls (Conditions 24-26)
 - Submission of a detailed early warning monitoring scheme for LHB flyways 1 & 2 and other ecological corridors (Condition 23)
- 1.4. Previous surveys and the Cinderford Northern Quarter Biodiversity Strategy have identified a number of ecological corridors for a range of species (including LHBs) in and around the Northern Quarter. Some of these ecological corridors are located wholly or partly outside of any development plots or mitigation areas, or are not of particular importance for LHBs and as such must be considered beyond the scope of this monitoring scheme. It is assumed that retention of these ecological corridors would be achieved through Forest Design Plan process as these corridors are almost exclusively under the management and ownership of the Forestry Commission. The Appropriate Assessment ruled out the need to monitor Flyway 3 for vegetation and lighting impacts because of its remoteness from the development and because it did not cross any mitigation areas.
- 1.5. A summary of the specific sections of ecological corridors to be monitored for vegetation and lighting impacts is given in Table 1 below:

Table 1 - Location of points/areas where monitoring will be undertaken

Section/s	Section to be monitored	Notes
1	5m wide strip running from northern bank of the Cinderford Brook lake outlet stream, 130m in length	Occasional LHB flyways
2	5m wide strip running from both banks along the Cinderford Brook late inlet stream (including western Bridge - L2A, L2B), 420m in length	
3	5m wide strip running from the eastern bank of the Engine Brook Bridge (including eastern Bridge L1A and L1B) along its entire length and from its western bank from the Dam Green pools to the edge of the Newtown Settlement to the north, 489m in length	Occasional LHB Flyways
4	Bat culvert west (L2H and L2G). Length 81m.	LHB major Flyway 1
5	10m wide strip running either side of Flyway 1 through mitigation area MP-2(R)B. Length 78m.	LHB major Flyway 1
6	Bat culvert east (L2C & L2D). Length 38m.	LHB major Flyway 2
7	10m wide strip running either side of Flyway 2 through mitigation areas MP-2(R)E, MP-2(R)F, MP-1D,MP-1E, MP-2(R)G. Length 240m.	LHB major Flyway 2
8	Spine road hop over. Length 27m.	LHB minor Flyway 4
9	5m wide strip running either side of Flyway 4 through mitigation area MP-2(F)B. Length 12m.	LHB minor Flyway 4
10	5m wide strip running either side of Flyway 5 through mitigation areas MP-2(R)C, MP-2(R)D. Length 676m.	LHB minor Flyway 5

Figure 1. Flyway monitoring sections



2. Monitoring aims

2.1. The objective of this monitoring is to:

- Ensure that the sections identified in Table 1 provide suitable conditions necessary to allow LHBs to move along them.

2.2. Flyway monitoring will be part of an overall package of monitoring (including populations size, reproductive success and forage and flight line maintenance to provide 'early warning' of impacts on the LHB colony. The flyways are used by a number of other bat species and therefore flyway monitoring will also be relevant to other species.

3. Monitoring approach

3.1. Monitoring of LHB roost population levels and reproductive rates (as describe elsewhere within this document) can be used to detect likely significant effects on the SAC where these have already occurred as a result of impacts such as flyway severance. However, an approach to monitoring is needed to detect failure in embedded and/or imposed mitigation measures to avoid the likelihood of adverse significant effects with the potential to effect the integrity of the Wye Valley and Forest of Dean Bat Sites SAC.

3.2. The flyway monitoring scheme focuses on monitoring of sections of relevant ecological corridors during their operational phase, as the requirement to monitor mitigation effectiveness during construction is secured through CEMP conditions (Conditions 8-11). The flyway monitoring scheme also focuses on mitigation areas when creation/enhancement is taking place and in the following establishment phase.

3.3. In order to act as functional commuting routes for LHBs (and other bats) ecological corridors need to exhibit a range of physical and compositional characteristics. These are described in Section 3. The monitoring scheme will adopt a 'site fabric' approach, assessing the condition of each section against its pre-development baseline.

4. Flyway monitoring methodology

4.1. Baseline data gathering

4.2. The characteristics (as listed in Table 2) of each section will be recorded in order to form a baseline as follows:

Table 2 – baseline and future data to be gathered

Characteristic	Data to be recorded
Vegetation cover	Approximate percentage cover of woodland (<5m tall), scrub (>5m tall), hedgerow, and other habitat within entire section
Structure	Average height of mature/emergent vegetation and height of understorey (if present) along each section

Characteristic	Data to be recorded
Species composition	Approximate percentage of native broadleaf versus conifer woody species along each section
Gaps	Number, location and approx. length of any gap greater than 5m in otherwise continuous vegetation (excluding access points) along each section
Artificial light	Number, locations and approx. length subject to light spill from an artificial source along each section

4.3. In addition representative photographs of each section should be taken and their location and direction recorded on as OS base map in order to provide additional information.

4.4. Sections may be split into further sub-sections for ease of recording where they are particularly long or where there is a significant change in vegetation cover for example. The extent of any subsection should be shown on an OS base map.

4.5. All baseline data will be gathered through field survey. Surveyors should walk the entire length of the section recording the position of gaps, artificial lighting etc. as they go and record more generalised information such as vegetation type, structure and composition at the end of the section.

4.6. When baseline data is to be collected is detailed in Table 3:

Table 3 – when baseline data will be collected

Baseline data collection schedule	Section/s
Prior to commencement of Phase 1 of development	1,2,3
Prior to commencement of Phase 2 of development	4-8
Prior to commencement of Phase 3 of development	9,10

4.7. Whilst not required as part of the Condition baseline data for Sections 1 and 2 are included as Annex A.

4.8. Future data gathering and analysis

4.9. Following completion of each Phase of development monitoring of the relevant sections shall commence. Relevant sections will be visited biannual, once between January and March and once between July and September. The same type of data will be gathered during the site visit as for the baseline. Each section will be monitored for a period of 10 years.

4.10. Future data will be gathered in the same way as for baseline data. It will be analysed against its corresponding pre-development baseline data. Significant negative changes between the two will be identified and will trigger adaptive management actions (as set out in Table 4 below). Examples of the type of changes and corresponding adaptive management options that could be used are given in Technical Appendix D.

Table 4 – Significant negative change triggers

Characteristic	Trigger level
Vegetation cover	Decrease of 5% or more in woodland, scrub or hedgerow cover from baseline for each section.
Structure	Reduction of 20% or more in average height of mature or understorey vegetation from the baseline for each section. Where average height of mature vegetation is recorded as below 2m in height.
Species composition	Increase of 20% or more in conifer composition from baseline for each section.
Gaps	Increase of 1 or more in the number of gaps equal to or exceeding 5m in length along otherwise continuous vegetation from the baseline for each section.
Artificial light	Increase in the number of locations subject to light spill of 1 or more from the baseline for each section. Increase of 5% or more in length of section subject to light spill from an artificial source above the baseline for each section.

Annex A Baseline data for Section 1 & 2

Flyway early warning monitoring scheme – field survey form

Section number	Section: 1a (see map). Length 135m	
Name of surveyor	Sarah Ayling	
Date of survey	30/10/2015	
Vegetation cover	Approximate percentage cover of woodland, scrub, hedgerow, water and open habitat within entire section	Woodland: 100% Scrub: Hedgerow: Other habitat:
Structure	Average height of mature/emergent vegetation along section Average height of understorey (if present) along section	Mature/emergent veg: 12m Understorey: 1m
Species composition	Approximate percentage of woody broadleaf versus conifer species along each section	Broadleaf: 100% Conifer: 0%
Gaps	Number gaps greater than 5m in otherwise continuous vegetation (excluding access points) along each section. Show location and extent on map.	# of gaps: 0
Artificial light	Number of areas subject to light spill from an artificial source along each section and length affected. Show location and extent on map.	# of light spill areas: 0

Representative photo/s:



Flyway early warning monitoring scheme – field survey form

Section number	Section: 1b (see map). Length 95m.	
Name of surveyor	Sarah Ayling	
Date of survey	30/10/2015	
Vegetation cover	Approximate percentage cover of woodland, scrub, hedgerow, water and open habitat within entire section	Woodland: Scrub: 80% Hedgerow: Other habitat: 20%
Structure	Average height of mature/emergent vegetation along section Average height of understorey (if present) along section	Mature/emergent veg: 4m Understorey:>1m
Species composition	Approximate percentage of woody broadleaf versus conifer species along each section	Broadleaf: 100% Conifer:
Gaps	Number gaps greater than 5m in otherwise continuous vegetation (excluding access points) along each section. Show location and extent on map.	# of gaps: 0
Artificial light	Number of areas subject to light spill from an artificial source along each section and length affected. Show location and extent on map.	# of light spill areas: 0

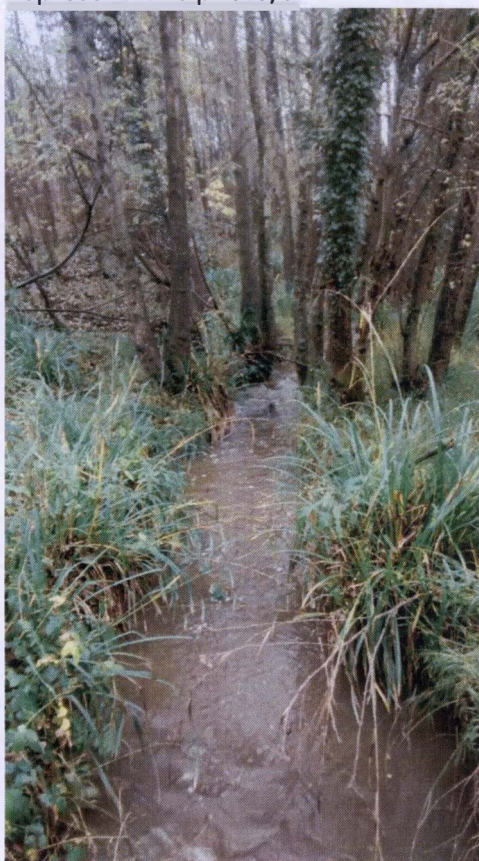
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Flyway early warning monitoring scheme – field survey form

Section number	Section: 2 (see map). Length 420m.	
Name of surveyor	Sarah Ayling	
Date of survey	30/10/2015	
Vegetation cover	Approximate percentage cover of woodland, scrub, hedgerow, water and open habitat within entire section	Woodland:100% Scrub: Hedgerow: Other habitat:
Structure	Average height of mature/emergent vegetation along section Average height of understorey (if present) along section	Mature/emergent veg: 15m Understorey: 1m
Species composition	Approximate percentage of woody broadleaf versus conifer species along each section	Broadleaf: 80% Conifer: 20%
Gaps	Number gaps greater than 5m in otherwise continuous vegetation (excluding access points) along each section. Show location and extent on map.	# of gaps: 0
Artificial light	Number of areas subject to light spill from an artificial source along each section and length affected. Show location and extent on map.	# of light spill areas: 0

Representative photo/s:



Flyway early warning monitoring scheme – field survey form

Section number	Section: 3a (see map) eastern side of watercourse only. Length 244m.	
Name of surveyor	Sarah Ayling	
Date of survey	30/10/2015	
Vegetation cover	Approximate percentage cover of woodland, scrub, hedgerow, water and open habitat within entire section	Woodland: Scrub: 5% Hedgerow: Other habitat: 95%
Structure	Average height of mature/emergent vegetation along section Average height of understorey (if present) along section	Mature/emergent veg: 2m Understorey: 1m
Species composition	Approximate percentage of woody broadleaf versus conifer species along each section	Broadleaf: 100% Conifer:
Gaps	Number gaps greater than 5m in otherwise continuous vegetation (excluding access points) along each section. Show location and extent on map.	# of gaps: 1
Artificial light	Number of areas subject to light spill from an artificial source along each section and length affected. Show location and extent on map.	# of light spill areas: 0

Representative photo/s:



Flyway early warning monitoring scheme – field survey form

Section number	Section: 3b (see map). Length 245m.	
Name of surveyor	Sarah Ayling	
Date of survey	30/10/2015	
Vegetation cover	Approximate percentage cover of woodland, scrub, hedgerow, water and open habitat within entire section	Woodland: Scrub: 60% Hedgerow: Other habitat: 40%
Structure	Average height of mature/emergent vegetation along section Average height of understorey (if present) along section	Mature/emergent veg: 2m Understorey:1m
Species composition	Approximate percentage of woody broadleaf versus conifer species along each section	Broadleaf:100% Conifer:
Gaps	Number gaps greater than 5m in otherwise continuous vegetation (excluding access points) along each section. Show location and extent on map.	# of gaps: 0
Artificial light	Number of areas subject to light spill from an artificial source along each section and length affected. Show location and extent on map.	# of light spill areas: 0

Representative photo/s:

