Natural England Commissioned Report NECR140

New Forest SSSI Geomorphological Survey Overview

Annex N: Cowleys Heath Central Restoration Plan - SSSI Unit 423

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1 Cowleys Heath Central Restoration Plan - SSSI Unit 423

1.1 Introduction

Cowleys Heath Central (Unit 423) has mire and stream characteristics and eventually flows into the Stock Water to the south of the unit (Figure 1-1). It is considered to be in unfavourable, recovering condition and is approximately 41.29ha in size.

The unit is predominantly made up of wet heath and valley mire with some areas of broadleaved woodland, scrub, Gorse *Ulex europaeus* and Bracken *Pteridium aquilinum*.

Figure 1-1: SSSI Unit 423 location (flow direction is north to south)

1.2 Current hydromorphic conditions and issues

A summary of the hydromorphic conditions of Unit 423 is given below in Table 1-1.

Table 1-1: Hydromorphic conditions of unit 423

Geomorphological Assessment Area		Cowleys Heath Central
Site name		Cowleys Heath Central
Size (ha)		41.3
SSSI unit(s)		423
Channel Condition	River type (s)	Mire to stream transition - stream is active single thread, spread in upstream mire section with a dominant channel only evident in some locations
	Responsiveness	Moderate - upstream incision propagation from stream could impact mire, some gravel supply to stream, moderate gradient, straightening, tree clearance (historic) in stream section. Mire section robust, providing downstream incision managed in longer term.
	Sediment delivery, type and mobility	Gravels in downstream stream section, supplied from mainly local gravel sources (banks), mainly silty bed (only minor evidence of gravels) in mire section in dominant channel

		where not spread or multi-thread
	Main source of water	Upstream source (Beaulieu Heath) drains and overland flow
	Aquatic vegetation	At the time of the survey the channel was flooded, however Bog Pondweed and Marsh St John's-wort were evident
	Drainage damage	Drains do not appear significantly damaged or deepened (apart from road drains), possibly some minor modifications. No evidence of embankments apart from road drains.
	Morphology	Pools, riffles / glides / runs in stream section, but limited by incision and steep gradient (mainly a transporting section). Gravel features not well developed. Spreads in mire section in some locations. Silty bed in sections where a dominant channel is evident.
	Incision	Observed incision in downstream stream section, could impact mire if not managed. No significant incision in the mire section or drain / flow route network
	Engineering	Stream section possibly straightened and overdeepened (particularly downstream of SSSI unit boundary). Road provides barrier to natural flow routes as do the drains alongside them
	Bank activity	Some lateral activity in downstream stream section, also bank collapse associated to incision. Little activity in mire section as spread
	Flow type (s)	Flows impacted by upstream mire and road drains at upstream end which prevent natural flow paths. Flood peaks concentrated in stream section due to confined floodplain and incision.
Floodplain Condition	Valley type	Wide floodplain (narrowed at stream section)
	Main source of water	Seepage, drains / overland flow, out of bank flows
	NVC communities	M29, M21a, M16a, M25a, W1
	Wetland types	Wet heath, Valley mire, Broadleaved woodland
	Drainage	The flow routes into the main mire section appear in reasonable condition and do not appear to be over-deepened. The road and drains along them do alter natural flow route paths.
	Scrub / tree encroachment damage	Gorse encroachment, some burning has taken place
	Palaeo features	None evident in SSSI unit, possibly some downstream of unit boundary
	Floodplain connectivity	Moderate to high - high in upstream mire section although some improvements could be made. Moderate to low in stream section due to incision
	Poaching and grazing pressures	Significant grazing damage
Generic restoration options		Incision in stream should be managed by channel blocking by debris jams in wooded section, blocking in upstream mire section to raise water levels and / or fill in dominant channel sections where appropriate. Assess whether culverts / pipes under road can be improved / increased in size to allow improved flow passage
Additional comments		Footpath erosion is evident in a number of places

The stream within SSSI Unit 423 is a mainly a passive single thread channel (Figure 1-2), switching to sections of reduced gradient multi branch / spreading networks where floodplain connectivity is improved (Figure 1-3). There are generally low inputs of gravel to the stream locally and from upstream sources, with limited bank erosion. As a result the dominant material on the channel bed is fine sediment / silt (Figure 1-5), with only small sections of exposed gravel (in the single thread sections in upstream mire area). In the downstream section, the stream has a better defined channel and is more active, with evidence of incision (Figure 1-4). The floodplain is also confined in the stream section at the downstream end of the floodplain, limiting floodplain connectivity.

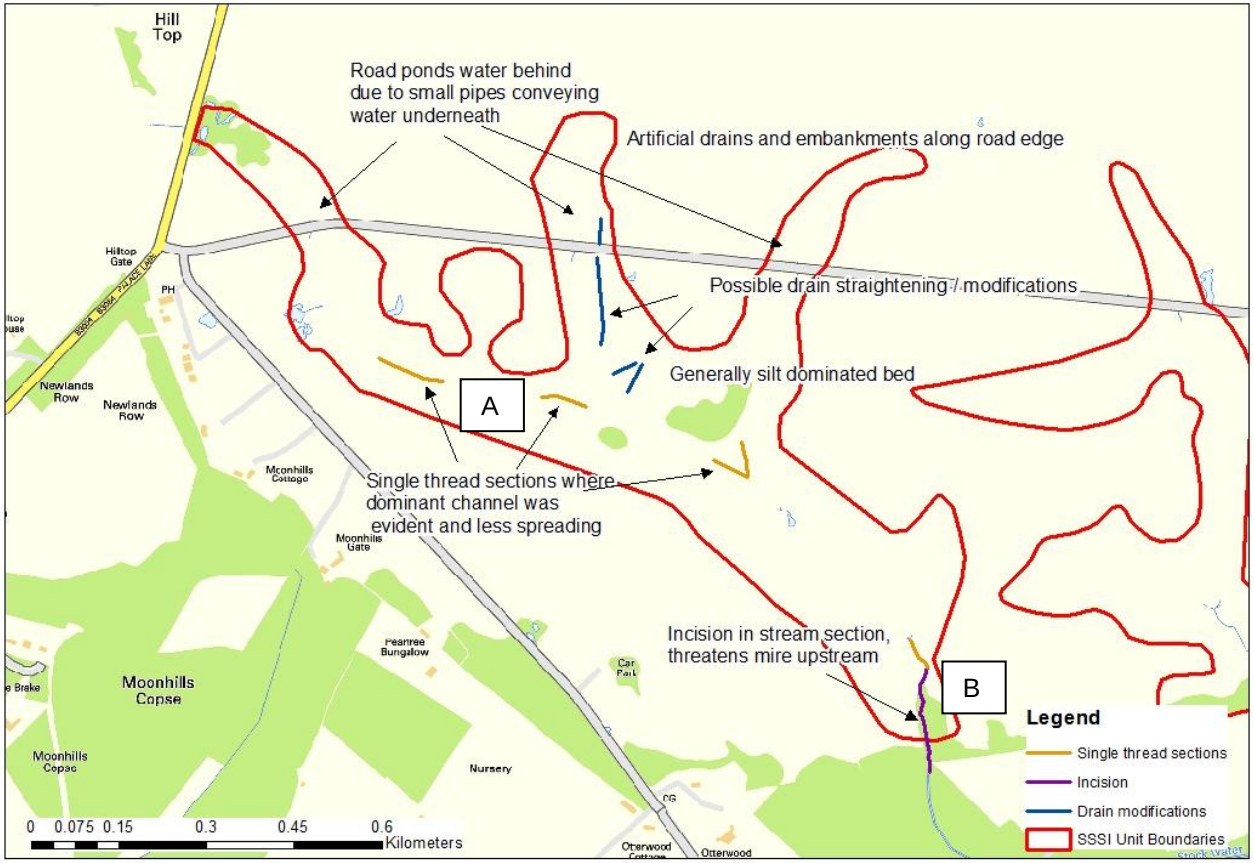
Figure 1-2: Passive single thread channel characteristics in *Molinia* Mire (M25a)

Figure 1-3: Multi branch / spreading sections on wet heath (M16a) and mire (M25a) boundary

Figure 1-4: Active stream section downstream in W10a woodland

The source of the unit is Beaulieu Heath. Figure 1-5 summarises the existing hydromorphology and pressure impacting unit 423.

Figure 1-5: Current hydromorphic conditions and pressures



The unit in the middle to upper reaches has a generally low gradient (Figure 1-5 - A), particularly in the multi-thread / spreading sections where there is no clear dominant channel and water spreads over a wide area. In the single thread sections, the gradient is still generally low (although does steepen downstream), with only minor local increases at riffles where occasional gravel bed sections are exposed (Figure 1-6). Outside of these locally energetic areas, the bed is generally silt dominated due to the low gradients (Figure 1-7). As a result of the generally low gradients and in combination with little incision within the mire section of the unit, bank erosion is limited.

Figure 1-6: Small gravel bed sections downstream

Figure 1-7: Silty and ephemeral vegetation bed channel characteristics

In the downstream reaches of the unit, the channel is more active with possibly some past channel straightening towards the Stock Water outside of the SSSI unit boundary. This will have resulted in some loss of channel length leading to a steeper channel, and resulting in increased flood shear stress levels promoting erosion of the channel bed. This incision is seen at several locations along the downstream reaches (Figure 1-5 - B and Figure 1-8). Incision is enhanced where the channel banks are stronger (due to the presence of more resistant boulder clays rather than fluvio-glacial gravels or where riparian woody vegetation is dense enough to provide a coherent resistant root mat). The major incision point is currently being temporarily prevented from migrating upstream by a live woody debris jam (Figure 1-8).

Figure 1-8: Incision in downstream riparian woodland stream section

In some locations the single thread channel is more disconnected than others resulting in drier floodplain areas and associated impacts on vegetative assemblages (see section 1.4).

The LIDAR and drainage lines in Appendix A show that there is likely to have been some minor modification to the drainage flow routes, mainly through some drain straightening as shown in Figure 1-5 and possibly an artificially modified drain between units 422 and 423.

There are no significant gravel shoals or features within this unit, with morphologic units limited to riffles and runs where there are minor increases in gradient locally and particularly in the downstream single thread sections where there are more local gravel sources. The stream section of the unit at the downstream end is considered to be a transporting reach to the Stock Water, as a result of the confined floodplain (Figure 1-9) and relatively steep gradient. Therefore, significant stores of gravels are unlikely to be seen in this section under restored conditions and conditions are in line with current processes.

Figure 1-9: Stream section in W10a woodland showing confined floodplain

Fine sediment inputs to the channel are increased due to poaching and grazing within the unit.

There are no natural woody debris features along the channel due to the surrounding vegetation type in the middle and upper reaches. Therefore, restoration options to improve floodplain connectivity further through the single thread sections of the watercourse are likely to involve channel blocking using consolidated silty berms (which naturally occur through the reach) alongside channel infilling. These will create short lengths of impounded watercourse and multi-branched / spreading networks that will improve floodplain connectivity / wetting.

Woody debris jams could be used to manage the incision in the downstream single thread reaches as these would naturally occur in the wooded riparian corridor in this area (Figure 1-10).

Figure 1-10: Natural woody debris jams in downstream reach

The artificial drains along the road (Figure 1-11) do impact the natural flow routes through the SSSI unit (from upstream to downstream), often concentrating flows at certain points into the surrounding drainage network. There is no evidence of this causing significant incision at present, although this may be a risk in the longer term. The structures that convey flow underneath the road (believed to be small pipes) promote ponding of water upstream of the road due to the backwater effects of the structures and their limited conveyance capacity (Figure 1-12).

Figure 1-11: Road drains concentrating flows into the SSSI unit via a Soakway (M29) community

Figure 1-12: Ponding upstream of the road in *Molinia* mire (M25a)

1.3 Probable channel development

The channel in the middle and upper reaches is presently relatively stable as a result of limited incision, straightening, embanking and good floodplain connectivity.

Incision is a continuing process in the downstream single thread reach and threatens to migrate further upstream if not managed. This would threaten the mire areas of this unit through bed and water level lowering, groundwater lowering and consequential floodplain drying.

Otherwise, in the middle and upper reaches, continuing processes are likely to involve further low level silt deposition (some of which will be flushed through during higher flows) that could lead to bed raising in the long term. Fine sediment inputs will remain heightened as a result of surrounding land use and grazing, due to the limited buffer strip between the floodplain and the channel. It is unlikely the nature and distribution of existing features will change significantly over the next decades due to the generally low energy conditions in the upper and middle reaches. The modifications to the drainage network may pose a long term risk of incision.

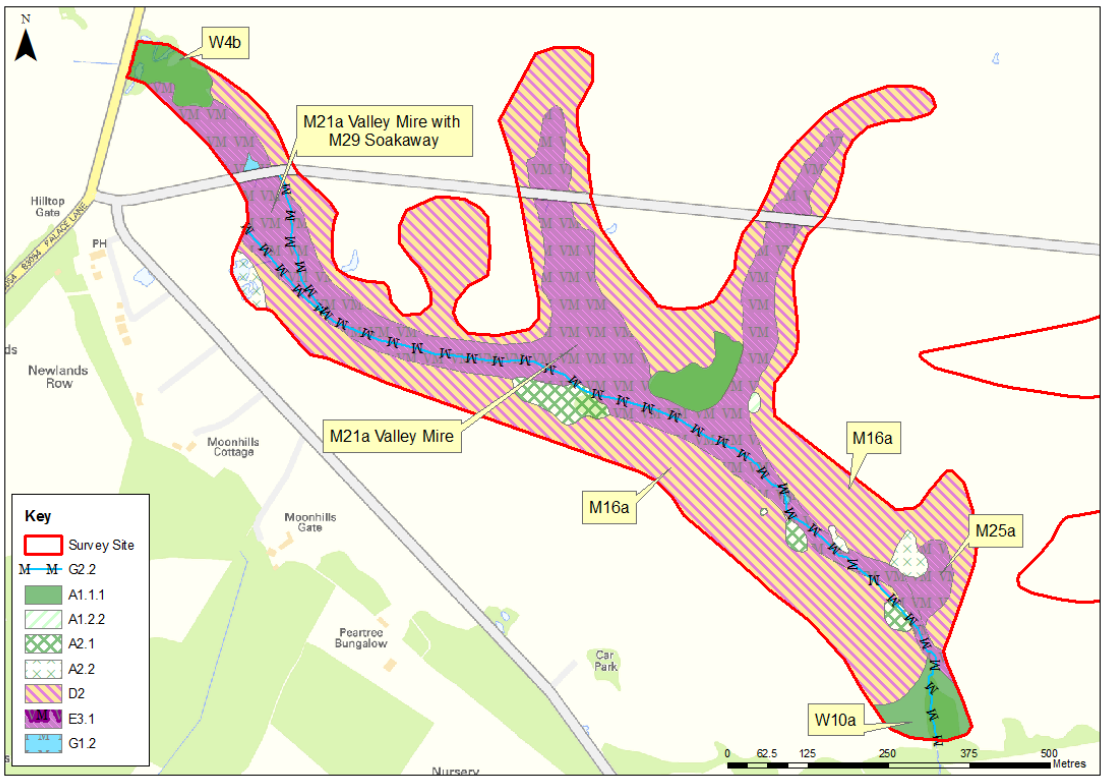
1.4 Current ecological conditions

The unit consists of valley mire which is dominated by Purple Moor-grass *Molinia caerulea* with abundant Cross-leaved Heath *Erica tetralix* and Bog Myrtle *Myrica gale*. In the wetter areas, White Beak-sedge *Rhynchospora alba* and Deergrass *Trichosporum germanicum* are prevalent. The valley mire grades into wet heath, moving away from the central valley bottom, with Cross-leaved Heath more abundant and Heather *Calluna vulgaris* also present. Within the wet heath there are patches of Gorse dominated scrub, some of which have been managed through burning.

The channel, at the time of the survey, was clearly evident due to the prolonged wet weather preceding the site visit. Vegetation within the channel consisted predominantly of Bog Pondweed *Potamogeton polygonifolius* and Marsh St John's-wort *Hypericum elodes*. In the south-east of the unit there is a large area of shallow, standing water where the path crosses the valley. This area is suffering from poaching and footpath erosion was noted.

Figure 1-13 shows the Phase 1 Habitat Map for Unit 423.

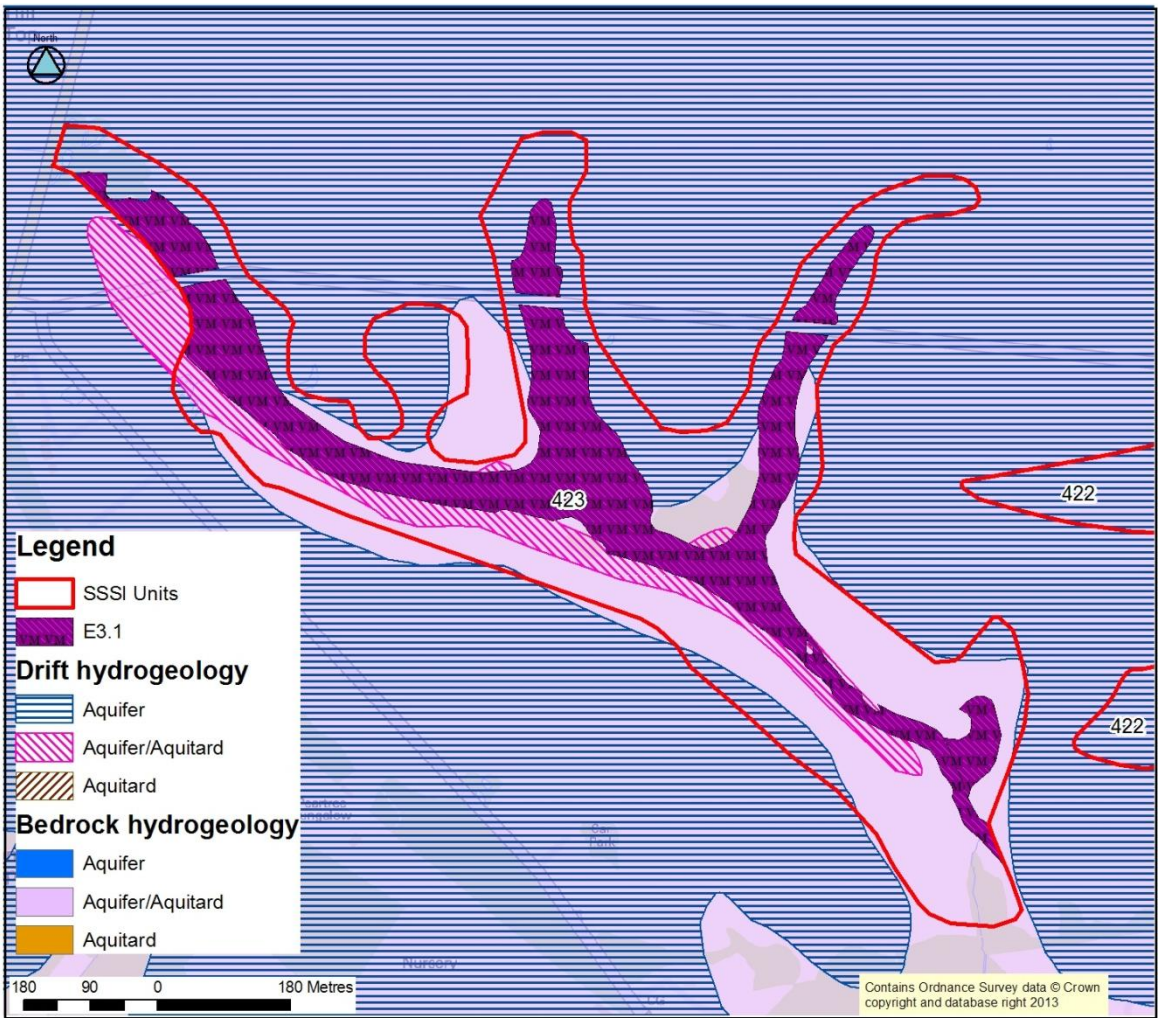
Figure 1-13: Phase 1 Habitat Map



1.5 Ecohydrology

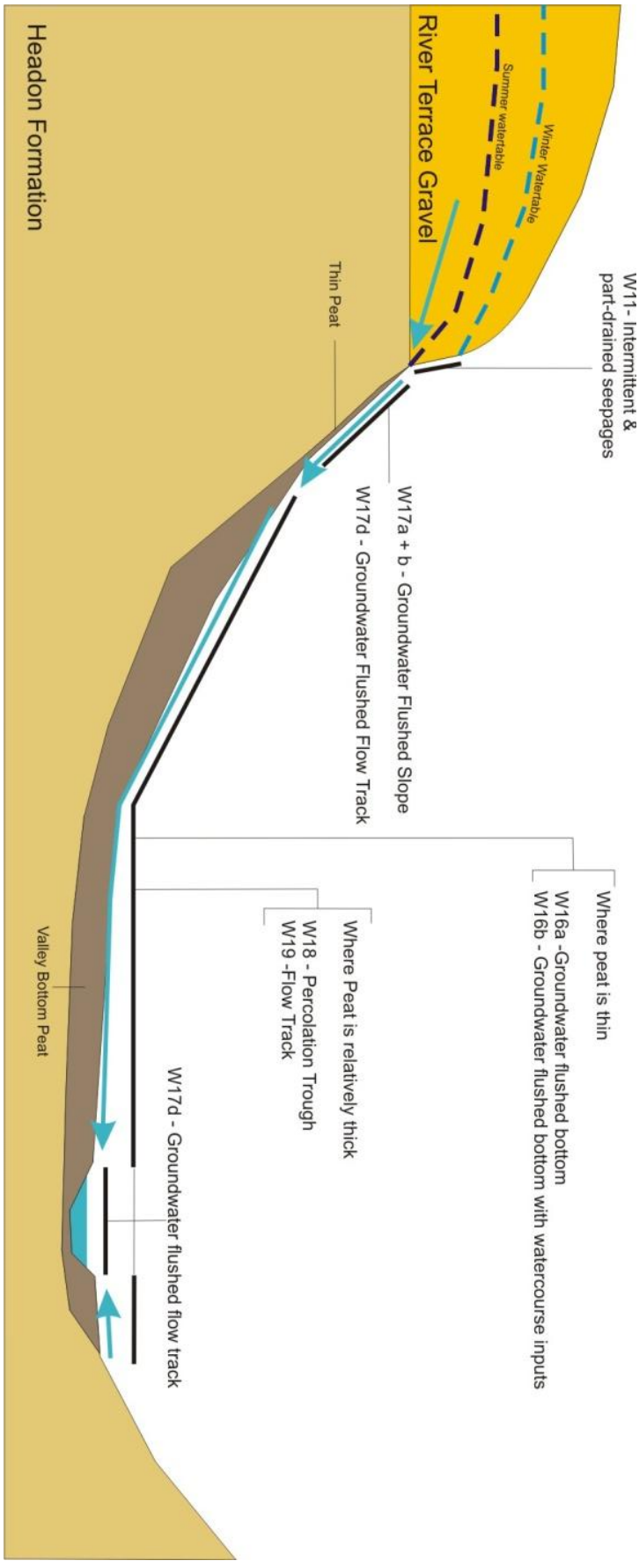
The site is underlain by the Headon Formation which BGS borehole logs (available online) show is locally formed from Clay (likely to act as an aquitard). The plateau above and surrounding the mires is covered by river terrace deposits which are formed of sandy gravels (likely to act as an aquifer). The mires are likely to be flush dominated, supported by a seepage face at the junction between the river terrace gravels and Headon Formation.

Figure 1-14: Ecohydrology Map



Derived from 1:50,000 scale BGS Digital Data under Licence, DEFRA IPR/139-2DY British Geological Survey. ©NERC.

Figure 1-15: Ecohydrology Conceptual Model



1.6 Restoration plan proposals

A summary of the current pressures, unmitigated impacts and restoration proposals is given in Table 1-2 and shown in Figure 1-16.

The key hydromorphological and ecological gains associated to the proposed restoration measures are:

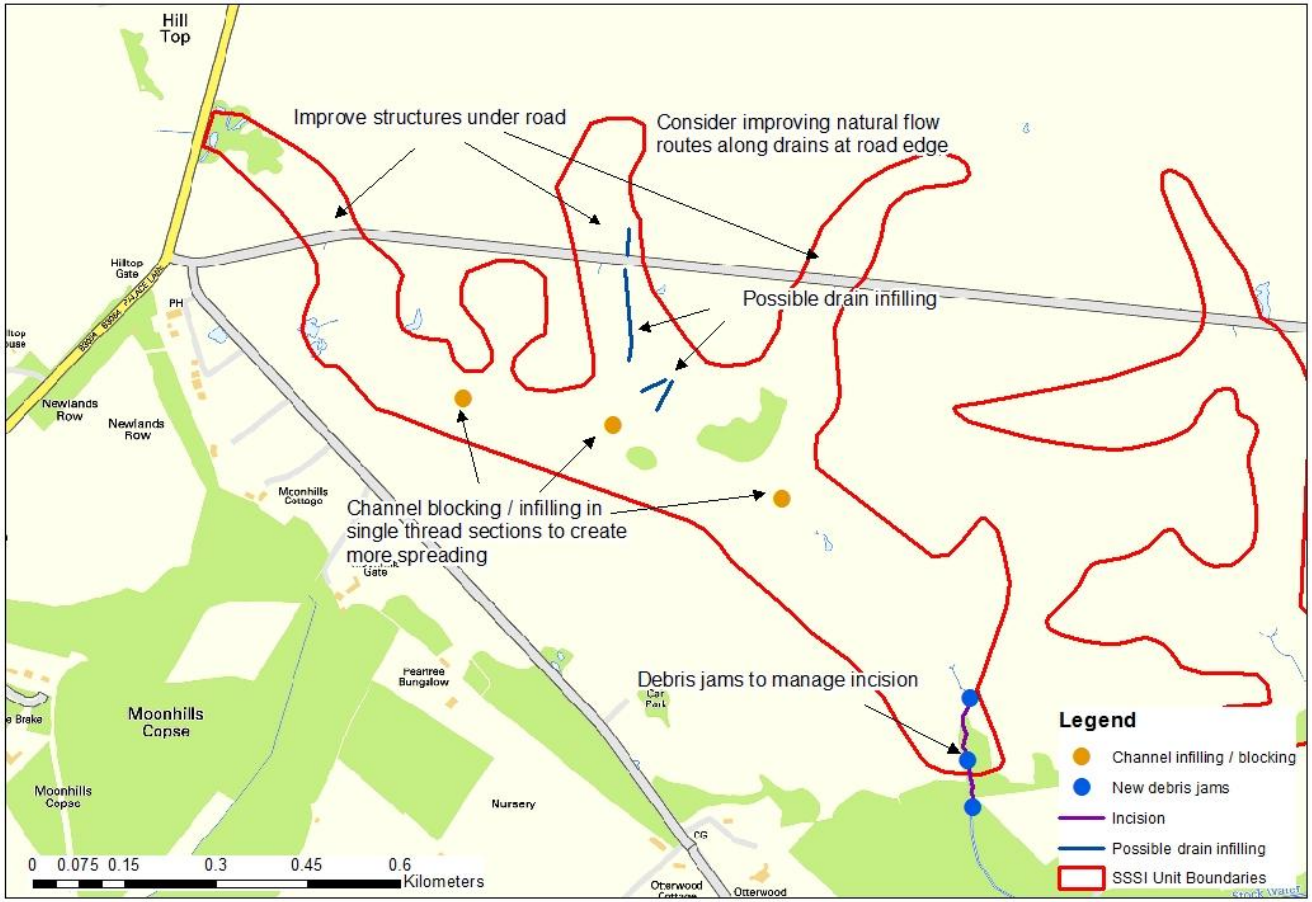
- Bed and water level raising through channel infilling and blocking to create more spreading sections of channel (where it is currently more single thread) and to improve floodplain diversity;
- Water level raising will improve groundwater levels locally;
- Natural flow regime reinstated as a result of artificial drain infilling and possible works to improve conveyance underneath the roads;
- Incision management in the downstream single thread reaches will raise bed and water levels. This will also manage the risk of incision propagation upstream into the mire areas;
- Improved extent and quality of valley mire habitat.

Table 1-2: SSSI Unit 423 proposed restoration measures

Pressure	Impact	Restoration proposal	Hydromorphic improvement	Ecological improvement	Constraints / issues
Historic dredging Straightening - in downstream reaches	Long term river response, cut and fill activity. Enhanced in-channel energy levels. Disconnected sub-channels. Loss of in-channel features. Incision knickpoint.	Incision management - debris jams, morphological restoration, floodplain works. Infill. Restore connectivity. Manage incision knickpoint through either debris jams (reinforcing existing live debris jam), wooden dams and/or heather bailing.	Improving connection to the floodplain will improve in-channel hydromorphic condition and will reduce incision. Debris jams would naturally occur along the downstream reach, use local materials. Morphological enhancement to raise bed and water levels will help improve floodplain connectivity. Reduces fine sediment inputs. Slows gravel movement (although this should not starve downstream reaches of sediment).	Increase flood frequency in the riparian zone and promote the recolonisation of degraded habitats by M25a valley mire. Debris dams will help this process by concentrating out of bank flows in Soakways with the M29 community. All will improve connectivity between the stream and the adjacent riparian strip. Bars and sediments will become vegetated over increasing the diversity of the habitat mix	Debris jams may form a barrier to fish, a fish pass may be required. Large amounts of material are likely to be required. Cost Cultural acceptability
Artificial drainage	High flows impacted. Sediment transfer impacted. Water table lowered locally.	Artificial drain infilling.	Restore a natural flow and sediment regime. Reduces flood peaks.	Promote in-stream habitats with a varied flora that can support a wide range of invertebrate species.	May require import of material with risk of introducing invasive species.
Floodplain drying	Reduction in wetland habitat (quality and quantity)	Channel blocking using berms and channel infilling	Further multi-branch / spreading sections. Improved floodplain connectivity / wetting.	Raise water table in riparian strip and encourage recolonisation of the area by *Molinia* mire. Protect areas of valley mire in the headwaters,	May require import of material with risk of introducing unwanted species Cost

Pressure	Impact	Restoration proposal	Hydromorphic improvement	Ecological improvement	Constraints / issues
River Crossings - road structures	Natural flow path disruption.	Replace with more suitable structures e.g. larger capacity, concrete circular culverts Deter animals from grazing wetlands in the vicinity possibly with fencing	Reinstates natural flow routes / paths Reduces sediment input	Improve quality of surrounding valley mire and reduces poaching and overgrazing. Allowing existing community to re-establish	Structures will need to be fit for the purposes of vehicle crossings Culturally unacceptable
Riparian grazing	Fine sediment production. Disruption to woody species recruitment.	Exclude livestock	Encourages riparian hydromorphic diversity	Increased floristic diversity of ground flora on floodplain. Restoration of over-grazed mire and wet heath habitats. Reduction in poaching	Some grazing is likely to be maintained. Culturally unacceptable Loss of grazing land

Figure 1-16: Proposed restoration measures for SSSI Unit 423



1.7 Design considerations

The current hydromorphic condition of the channel is considered to be reasonable given existing processes and controls. Further improvements could be made through improved floodplain connectivity, which is likely to improve vegetative diversity associated to a wetter environment in the upper and middle reaches. The downstream incision needs to be managed to ensure this does not propagate further upstream.

Channel infilling / blocking should use measures suitable to existing conditions. Heather bale dams have been tried previously elsewhere but have failed progressively due to undercutting and outflanking in these steep, high energy systems. As such similar approaches should be avoided as they are unsustainable here. Successful sensitive restoration on such high energy systems has not been reported.

It is suggested that an alternative design be considered that mimics the naturally stable seepage mire transitions zones present elsewhere. Breaches in glacially derived mineral barriers should be repaired to recreate the lower energy peat forming conditions behind the obstruction. Flows exiting past the barrier are naturally diffuse with the majority of the discharge occurring as throughflow. This should be mimicked with the upstream section and upper layer of the breach repair being unfilled with heather bales to encourage internal flow and occasional diffuse surface flow.

Control of knick points along the incised lower reaches where the channel flows through mineral deposits is equally problematic and requires alternative techniques to staked heather bales used previously. Complete or substantive channel infilling with an organic porous base and mineral top layer could be attempted in the most severely eroding areas. This would be a radical approach and requires detailed design which is outside of the scope of this report.

Woody debris jams must extend into the adjacent banks to ensure longer term functioning.

Targeted restoration of natural drainage paths should refer to Appendix A and Figure 1-5.

An engineering assessment would be required for modification to any structures under the road.

1.8 Restored channel and monitoring requirements

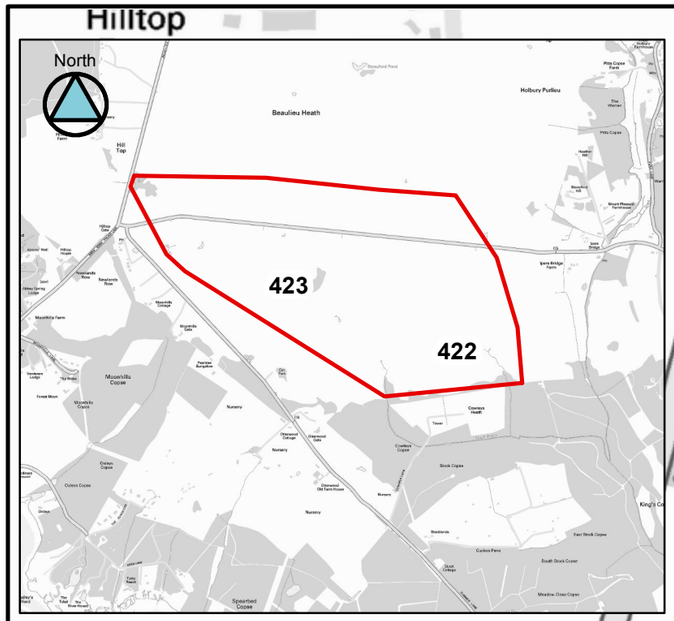
It is anticipated that the proposed restoration works will improve floodplain connectivity. Morphologic change is likely to involve bed raising and the creation / improvement of a multi-branched / spreading channel network. This pattern of development is difficult to document accurately due to the complex nature of the river network and the difficult surveying conditions. This could be monitored qualitatively with automated time lapse photography at key restoration point to record daily images of flow types, morphology and vegetation character. This could be undertaken alongside two-yearly reconnaissance audits to determine hydromorphological change over the entire reach, which fixed point photography will not cover. The daily photographic records should be analysed to estimate and record the parameters detailed in Table 1-3.

Table 1-3: Monitoring parameters, frequency and suggested approaches for the Unit 423.

Parameter	Approach	Frequency	Approximate cost
Morphologic unit change	Time lapse camera / audit	Daily (Annual statistical summary)	Capital 4 x £200 Half yearly downloading £200 Annual summary £300 Two - yearly reconnaissance audit £500
Flow change	Time lapse camera / audit	Daily (Annual statistical summary)	
Sedimentology	Time lapse camera / audit	Daily (Annual statistical summary)	
Vegetation change	Fixed point camera survey	Biennially	
	Fixed point quadrat survey	Biennially	Survey £350 Analysis £500
	Fixed point aquatic macrophyte survey		

Parameter	Approach	Frequency	Approximate cost
NB. Costs assume downloading and site visits as part of wider field campaign.			

Appendix A - Artificial drains and flow lines - SSSI Unit 423



SSSI 422/423: Cowleys Heath East and Central

Hilltop Gate

B3054 PALACE LANE

PH

Hilltop House

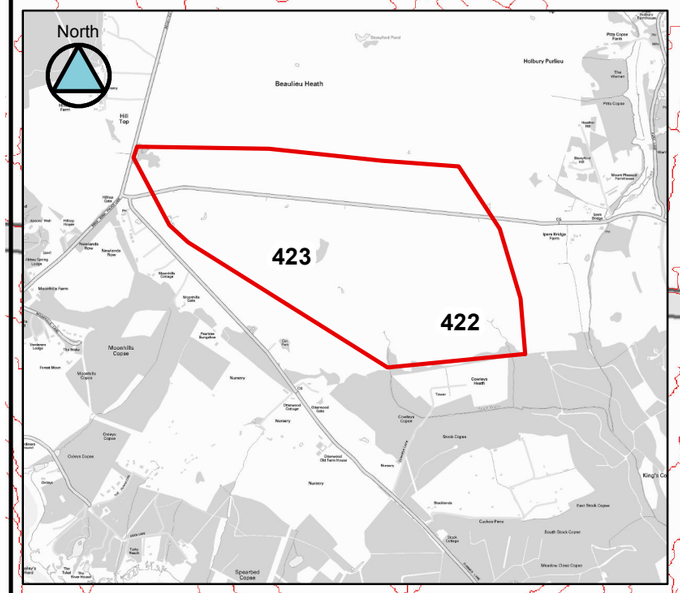
Newlands Row

Newlands Row

Moonhills Cottage

Moonhills Gate

0 50 100 200 300 Metres



SSSI 422/423: Cowleys Heath East and Central

0 50 100 200 300 Metres