Natural England Commissioned Report NECR141

New Forest SSSI Ecohydrological Survey Overview

Annex I: Soldier's Bog

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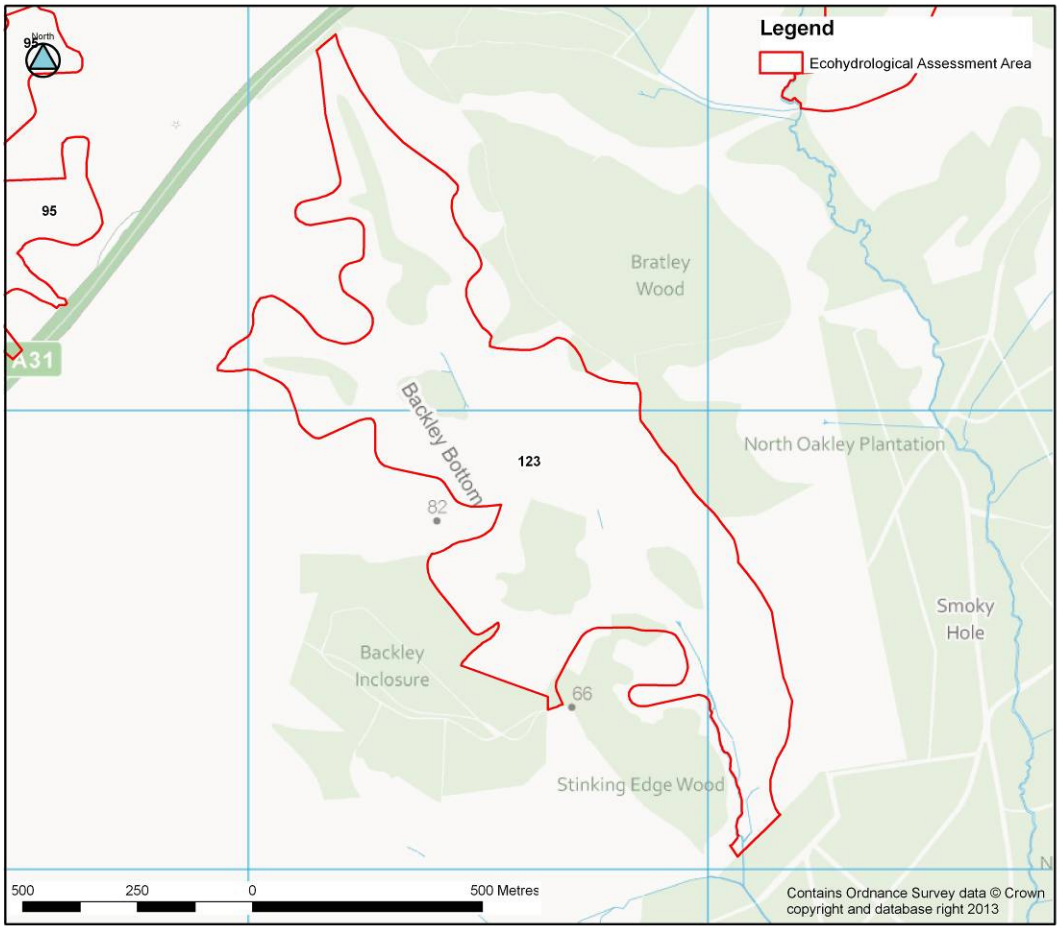
Contents

1 Soldier's Bog

1.1 Introduction

This Ecohydrological Assessment Area (EcoHAA) covers 64.4 ha and is contained within SSSI Unit 123 with its centre at National Grid Reference (NGR) 422626 107886 (see Figure 1-1). Unit 123 is classified as a mire to stream transition unit.

Figure 1-1: Location Map



The site includes a system of flush-dominated valley mires (Backley Bottom) drained by a south-eastward flowing tributary of the Blackensford Brook. The main supply of water is seepage from the base of Quaternary river terrace sand/gravel deposits. The edges of the river terraces form a prominent break in slope, and it is here that seepage occurs. There may also be seepage from bedrock aquifers.

There has been relatively little artificial drainage on the site, although ditches do appear to have modified the mire at the extreme southern end (where valley mire has been replaced by wet dwarf shrub heath and marsh/marshy grassland). Footpath erosion and poaching are an issue locally throughout the unit.

Table 1-1: Ecohydrological Assessment Area Summary Table

Eco-hydrological Assessment Area		**J**
Name		Soldier's Bog
Relative Geomorphology Assessment		
Size (ha)		64.4
SSSI Units		123
Valley Side Wetland	Present	Y
	Wetland Type	Flush Dominated Wetland
	Main Source of water	Seepage from junction of Quaternary river terrace sand/gravel and underlying Tertiary bedrock (Becton Sand Formation, Chama Sand Formation or Barton Clay Formation). There may also be seepage from the bedrock aquifers (Becton Sand Formation and Chama Sand Formation).
	Indicative NVC communities	M16a, M29, M21a, M25a, M23a
	Wetland Types	Wet Heath, Valley Mire, Swamp, Marshy Grassland
	Drainage Damage	N
	Scrub/Tree Encroachment Damage	N
	Poaching and Grazing Pressures Damage	Y (Minor)
Valley Basin Wetland	Present	Y
	Wetland Type	Flush Dominated Wetland
	Main Source of water	Seepage from junction of Quaternary river terrace sand/gravel and underlying Tertiary bedrock (Becton Sand Formation, Chama Sand Formation or Barton Clay Formation). There may also be seepage from the bedrock aquifers (Becton Sand Formation and Chama Sand Formation).
	Indicative NVC communities	M16a, M29, M21a, S4, S12, M25a, M23a, M6
	Wetland Types	Wet Heath, Valley Mire, Swamp, Marshy Grassland
	Drainage	Y - drain at southern end of the site. Weir present adjacent to footbridge where path crosses southern end of site (Minor)
	Scrub/Tree Encroachment Damage	Y
	Poaching and Grazing Pressures	Y - poaching (Minor)
Additional Comments		Soil prone to poaching. OS 1:10,000 mapping shows several disconnected watercourses (each linking "collects" to "spreads") along the bottom of the valley. At the time of the site visit these were connected. In the southern portion of the site a long linear reedbed was present, with a small patch of Reedmace at the southern end.

It should be noted that although this is a standalone report, it is strongly reliant upon the background information provided in section 3 of the JBA (2013) Ecohydrology Survey Overview report, which provides general geology, ecology, hydrogeology, wetland mechanisms and restoration information for the New Forest wetlands surveyed. At the end of the report is a series of maps which support the assessment and indicate the spatial distribution of the features described.

1.2 Topography and Wetland Distribution

The site consists of a system of valley mires drained by a south-eastward flowing tributary of the Blackensford Brook. Ordnance Survey mapping shows several segments of watercourse along the main valley, each segment bounded by a "collects" at its upstream end and a "spreads" at its downstream end. At the time of the site visit these were connected to form a single body of water flowing along the axis of the valley.

There is relatively little artificial drainage. Two small ditches flow into the main watercourse at the southern end of the site (see Figure 1-9), and there are minor ditches associated with a footpath that crosses the northern part of the site and another at the southern end.

Figure 1-2: General view of Soldier's Bog, looking north-westwards from the footpath crossing the centre of the site (NGR 422768 107765)

Figure 1-3: Weir and footbridge near the southern end of the site (NGR 423054 107280)

Figure 1-4: View of main watercourse at southern end of site showing bank erosion (exposing alluvial gravels) and also surface runoff entering the channel (NGR 423063 107176)

Figure 1-5: View of the main watercourse where it leaves the southern boundary of the site (looking upstream - NGR 423076 107041)

1.3 Ecology

Soldier's Bog contains a variety of wetland habitats, including valley mire, soakways, wet heath and bog woodland. In the north of the unit the valley is dominated by bog woodland, with Oak *Quercus robur*., Downy Birch *Betula pubescens* and Grey Willow *Salix cinerea* the dominant species, with Bog Myrtle *Myrica gale* and Purple Moor-grass *Molinia caerulea* frequent in the understorey, along with the mosses *Pseudoscleropodium purum* and *Aulacomium palustre* and a small stand of Common Reed *Phragmites australis*. However, at Bushy Bradley the woodland type appears drier, and is Oak-dominated with a Bracken *Pteridium aquilinum* and heavily grazed Holly *Ilex aquifolium* understorey. There are also some areas of mixed woodland within the centre of the site.

Surrounding the woodland in the north of the unit is very tussocky Purple Moor-grass and Bog Myrtle dominated wet heath. In places there are boggy soakway habitats along preferential flowpaths, which contain numerous *Sphagnum* tussocks, Purple Moor-grass, Bog Myrtle and Carnation Sedge *Carex panicea*.

Upslope beyond the wet heath areas are areas of dry heath dominated by Heather *Calluna vulgaris,* with some extensive areas of closely grazed acid grassland in the north-west that are advancing as the Heather cover retreats. Bracken is also prevalent on the slopes above the mire. Here, beneath bracken-covered scarp faces, there has developed a specialist flora of Deergrass *Trichophorum germanicum*, White Beaked-sedge *Rhynchospora alba* and various species of *Sphagnum (S. cuspidatum, S. auriculatum, S. palustre, S. rubellum and S. magellanicum*) which correspond with the NVC M21a community.

A number of footpaths cross the valley within this unit. Where the northernmost and central footpaths cross the stream, water has ponded significantly with the metalled tracks and the undersized culverts acting as impediments to flow. The ecology of the habitats in these localised ponded areas has been significantly impacted upon, with valley mire and wet heath habitats being locally replaced by pools of standing water (i.e. the mire habitat has been

impacted through inundation). Within these pools, species including Bog Pondweed *Potamogeton polygonifolius*, a Water-starwort *Callitriche sp.,* Floating Sweet-grass *Glyceria fluitans*, Marsh St. John's-wort *Hypericum elodes*, Water Horsetail *Equisetum fluviatile*, Round-leaved Crowfoot *Ranunculus omiophyllus* and Floating Club-rush *Isolepis fluitans* are present and these habitats resemble those of the soakways (M29) Footpath erosion is a localised issue in the unit, often associated with waterlogging, both upstream and downstream of the crossing points

Figure 1-6: Ponding of water around footpath

Just to the south of the central footpath there is a pond, with marginal species including Reed Sweet-grass *Glyceria maxima*, Purple Moor-grass and Common Reed. To the south of this pond the valley bottom contains a relatively large reedbed dominated by Common Reed, with a small Common Reedmace *Typha latifolia* stand at the very southern end. The extent of the reedbed, and the presence of Common Reedmace, is an indicator of silting due to erosion further up the system (Jennifer Thomas, Natural England, pers. comm. 23rd April 2013).

Around the southernmost footpath crossing the valley two distinct watercourses are present, and are relatively incised with a number of gravel deposits (introduced during a partial attempt at restoration - Jennifer Thomas, Natural England, pers. comm. 23rd April 2013), forming bars and islands. In this downstream portion the stream contains a number of aquatic macrophytes, including Floating Sweet-grass, Bog Pondweed, Round-leaved Water-crowfoot and a Water-starwort.

Immediately upstream of the southernmost footpath there is a small stand of Sharp-flowered Rush *Juncus acutiflorus* dominated fen habitat, which grades into small patches of closely grazed marshy grassland moving further south. There are numerous patches of Bracken present within the floodplain in the southern portion of the site.

Overall this Unit is in good condition. The main issues identified on and surrounding the site are the damages being caused to the mire habitats by the footpaths and associated causeways and the loss of Heather at the top of the braes, which is related to the heavy grazing of the (spreading) acid grassland.

1.4 Geomorphology

As noted above, at the time of the site visit a single watercourse was flowing broadly south-southeastwards down the long axis of the site. However, at times of low flow there are likely to be several stream segments bounded by "spreads" and "collects", as shown on Ordnance Survey 1:10,000 mapping. The gaps represent areas where channelized flows become diffuse before becoming channelized again further downstream.

A small knick point (c.0.2 to 0.3 m high) is present within the lower part of the stream system (Figure 1-7). This knick point was not observed during the main site walkover (probably as a result of high water levels) but was noted in a preliminary visit undertaken by JBA and Natural England staff. The eastern side of the channel has a spoil bank running along much of its length (Jennifer Thomas, Natural England, pers. comm. 23rd April 2013), suggesting that artificial drainage activity has been undertaken in the past. On the eastern side there is "extensive tussocky growth of *Molinia*, which is often indicative of rapid changes in water level commonly associated with drainage. By contrast, on the western side...are extensive areas of open water and bare peat indicating erosion of mire vegetation." (Jennifer Thomas, Natural England, pers. comm. 24th April 2013).

The southernmost stream segment has been straightened where it leaves the southern boundary of the site. Where the stream is crossed by a footbridge there is a small weir. The stream is fairly incised close to the southern boundary of the site and there is evidence of localised bank failure (Figure 1-4). It is understood that gravel has been artificially emplaced within the channel as part of restoration works, as discussed above.

Figure 1-7: Eroding knick point (approximate NGR 422960 107490; photograph courtesy of Jennifer Thomas, Natural England)

1.5 Geology and Hydrogeology

Table 1-2 shows the geology at Soldier's Bog. Head deposits are likely to be more widespread than indicated on published 1:50,000 geology mapping, with a thin layer covering much of the Tertiary outcrop. Grey sandy pebbly clay encountered in shallow auger holes made during the site visit is likely to represent head.

Note that the edge of the river terrace deposits shown on published 1:50,000 geology mapping was found to deviate significantly from the actual edge of the terraces as revealed by LIDAR topography and aerial photography.

Table 1-2: Geology and Hydrogeology

Age	Group	Formation - member	Description	Thickness	Hydro-geological Role	Water Resources
Quat-ernary		Alluvium	Flint GRAVEL exposed in stream bed and banks		Aquifer	
		Head deposits	GRAVEL, SAND, SILT and CLAY		Aquitard	
		River terrace deposits (lower terrace)	CLAY and SILT		Aquifer	
		River terrace deposits (upper terrace)	CLAY, SILT, SAND and GRAVEL.		Aquifer / Aquitard - Spring lines may be present at the base of high level river terraces.	
Tertiary (Eocene)	Barton Group	Becton Sand Formation	Yellow/buff fine- to very fine-grained well sorted SAND.	6 – 70 m	Aquifer - The most permeable and reliable aquifer within the Barton Group.	Yields up to 600 m^3/d in the south; in the north they rarely exceed 200 m^3/d.
		Chama Sand Formation	Greenish grey fine- to very fine-grained and rather clayey/silty SAND; slightly glauconitic. Also sandy CLAY.	6 – 15	Aquifer	May yield small supplies
		Barton Clay Formation	Greenish grey to olive grey, glauconitic	26 – 80 m	Aquitard	Little useable groundwat er

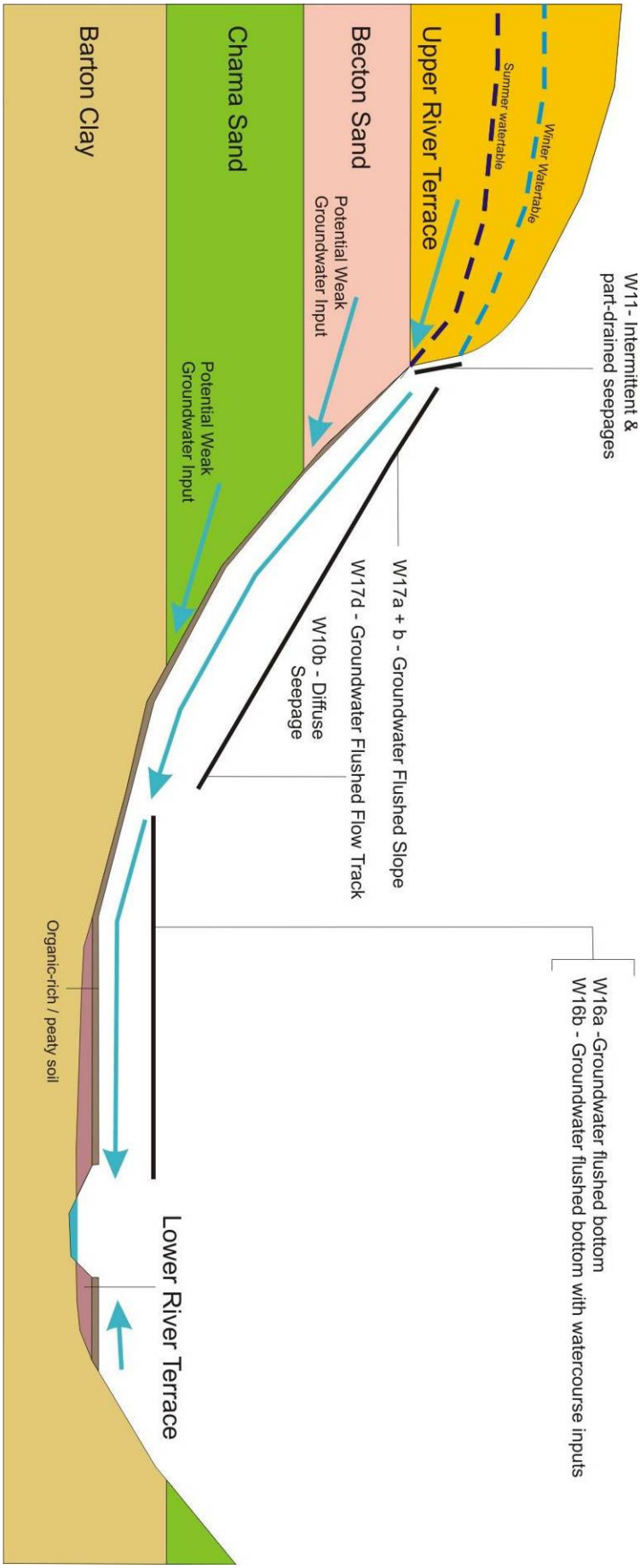
Age	Group	Formation - member	Description	Thickness	Hydro-geological Role	Water Resources
			CLAY; may contain fine-grained sand and shells (mainly bivalves and gastropods).			

Local BGS borehole logs (available at http://www.bgs.ac.uk/GeoIndex/) describe the Barton Clay Formation as dark grey, slightly sandy, silty clay with rare partings of fine sand, and the Chama Sand Formation as brown/orange/grey clayey/silty fine sand interbedded with sandy silty clay.

1.6 Water Supply Mechanisms

The wetlands on site are flush-dominated (see Figure 1-8) and receive water from a seepage face at the junction between river terrace deposits (upper terrace) and the underlying bedrock. There may also be more diffuse seepage from underlying bedrock aquifers: the Becton Sand Formation and Chama Sand Formation. On the lower slopes, water tends to flow over the surfaces of the lower permeability Barton Clay Formation (clay) and lower river terrace deposits (silt and clay).

Figure 1-8: Conceptual Model Diagram



1.6.1 WETMECS identified

WETMECs are ecohydrological classifications of how water can be supplied to a wetland to create distinguishable habitats WETMECS were developed in partnership between the Wetland Research Group at the University of Sheffield, the Environment Agency, English Nature (now Natural England) and Countryside Council for Wales (now Natural Resources Wales). For each Ecohydrological Assessment Area WETMECS have been identified.

The WETMECS identified include:

Valley side wetlands - narrow areas of W17a+b and W17b with small areas of W11 above. Also potential (more diffuse) seepage (W10b) from bedrock aquifers.

Valley bottom wetlands - W16a+b.

1.7 Damage and Restoration

1.7.1 Damage

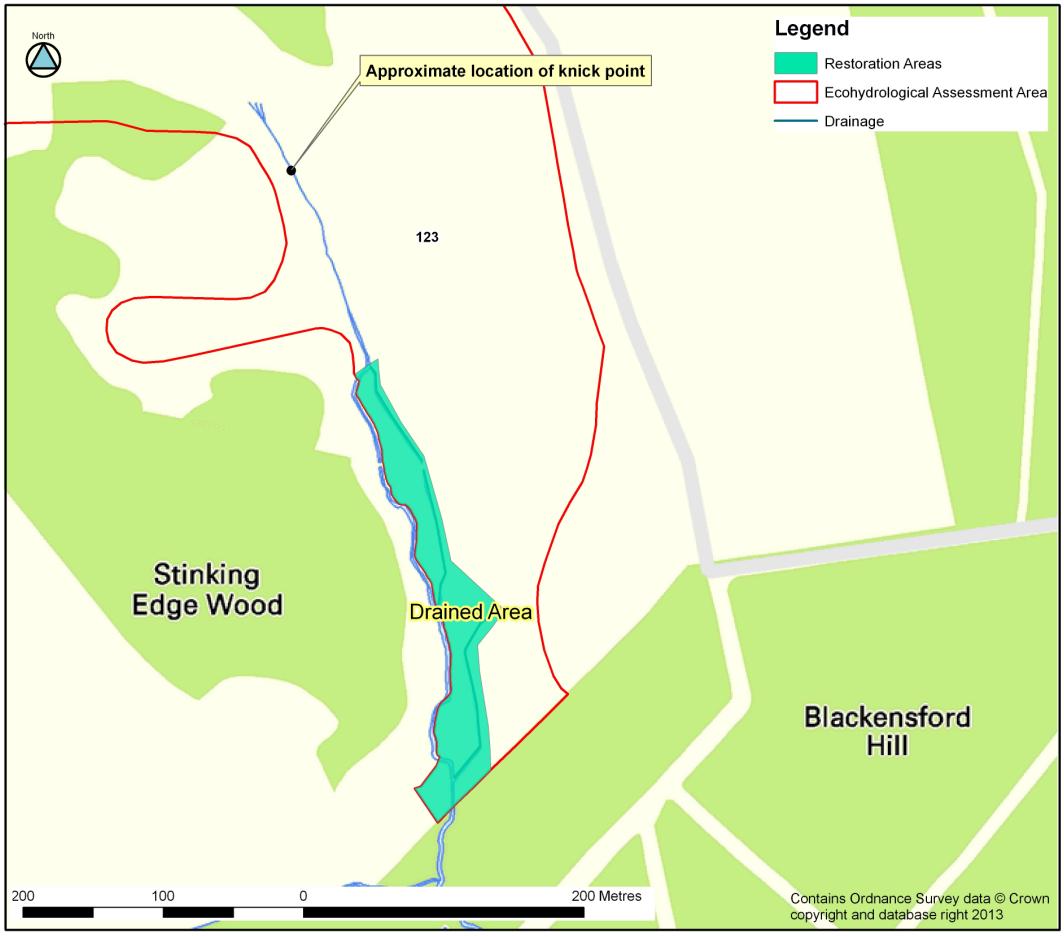
As noted in Section 1.4, the existence of a spoil bank along part of the main watercourse is indicative of artificial drainage activity. The habitats on each side of the modified watercourse are different (Section 1.4), suggesting that the drainage activity has had an impact on the ecology. The spoil bank could be removed, thereby helping to restore a more natural hydrological function to the watercourse.

There is one area in the southern part of the site in which straight drainage channels have been cut, probably to improve the land between the drains and the main watercourse for grazing (see Figure 1-9). Here valley mire is replaced by wet dwarf shrub heath and marsh/marshy grassland. The area is still wet (i.e. the drains are not very effective), and represents only a small proportion of the total area of the site. However, blocking or infilling of the drainage ditches could be considered as a means of restoring wet heath or valley mire in this location, through increasing ground water levels locally.

The small knick point described in Section 1.4 cuts into an area of swamp (with fringing mire) in the southern part of the site (see Figure 1-9 for location). It is a small feature and has thus far done little damage. However, it would be prudent to take measures to prevent it from growing in size and extending upstream. Such measures could take the form of staked heather bales within the channel and/or channel infilling/re-grading.

In localised areas around the two most northern footpaths in the unit (not shown in Figure 1-9), the tracks and current culverts appear to be causing an impediment to water movement down the valley. This has led to ponding of water on the ground surface up and downstream of the foothpaths, leading to a replacement of wet heath and valley mire habitat with standing water and a bog pool-type community. In order to remove this impediment to flow and allow the wet heat or mire habitats to redevelop, consideration should be given to modifying the footpaths and culverts, for example through creating boardwalk sections or by upsizing the culverts.

Figure 1-9: Restoration Areas Map (N.B. footpath modification areas not shown - see text)



1.7.2 Restoration

Table 1-3 summarises the restoration proposed for Soldier's Bog. Note that pine clearance (mentioned in the Forestry Commission's restoration programme) is not proposed. This is because pine encroachment is slight and restricted to areas outside the unit boundary.

Table 1-3: Restoration Area Summary Table

Restoration Area	Damage Type	Restoration Proposals	Improvement	Constraints and Issues
Drained Area	Drainage	Blocking or infilling of drainage ditches	Encourage the re-establishment of a valley mire community.	Only a small portion of the site, so not a large gain. The area is marshy, but not a valley mire.
Knick point in central watercourse	Erosion	Staking of heather bales within the channel and/or use of channel infilling/re-grading.	Protection of the mire from headward erosion and upstream migration of the knick point.	The erosion protection measures would be small in scale and relatively inexpensive. However, they would need to be monitored to ensure that they weren't being compromised over time (e.g. through the washing away of heather bales).
Spoil bank along main watercourse	Artificial modification of bank morphology	Remove bank	More natural hydrological function.	
Two most northern footpaths	Ponding of water from inappropriate footpath and crossing points	Modification of footpaths (e.g. boardwalks) and/or culverts (e.g. upsizing) to remove impediment to flow	Localised restoration of valley mire and wet heath habitats	Footpaths are an important amenity resource which could suffer from short-term disruption

1.8 Monitoring requirements

1.8.1 Water Monitoring

The site contains flush dominated wetlands with thin peats or peaty soils - groundwater monitoring is unlikely to be appropriate for such a site. The surface water features are small and appear stable which limits the need for monitoring.

1.8.2 Vegetation

Monitoring of vegetation is recommended prior to restoration to assess the localised areas of ponded water around the footpaths and to ascertain the extent of this problem. Following implementation of restoration measures it is recommended that monitoring be undertaken to assess the vegetation communities that redevelop. This should also be carried out for any restoration undertaken in relation to the knick point, drainage and spoil bank.

Table 1-4: Monitoring Requirements

Eco-hydrological Assessment Area	SSSI Units	Site Name	Requirements for monitoring: ecology	Requirements for monitoring: hydrology (number of installations estimated)
J	123	Soldier's Bog	Fixed point camera survey (specifically focussing on areas where footpaths are impeding flows, areas of footpath erosion and other proposed areas of restoration). Fixed point quadrat survey (specifically to monitor redevelopment of valley mire and wet heath habitats where restoration is implemented)	Flush dominated wetland –little peat – no monitoring recommended.

2 Maps

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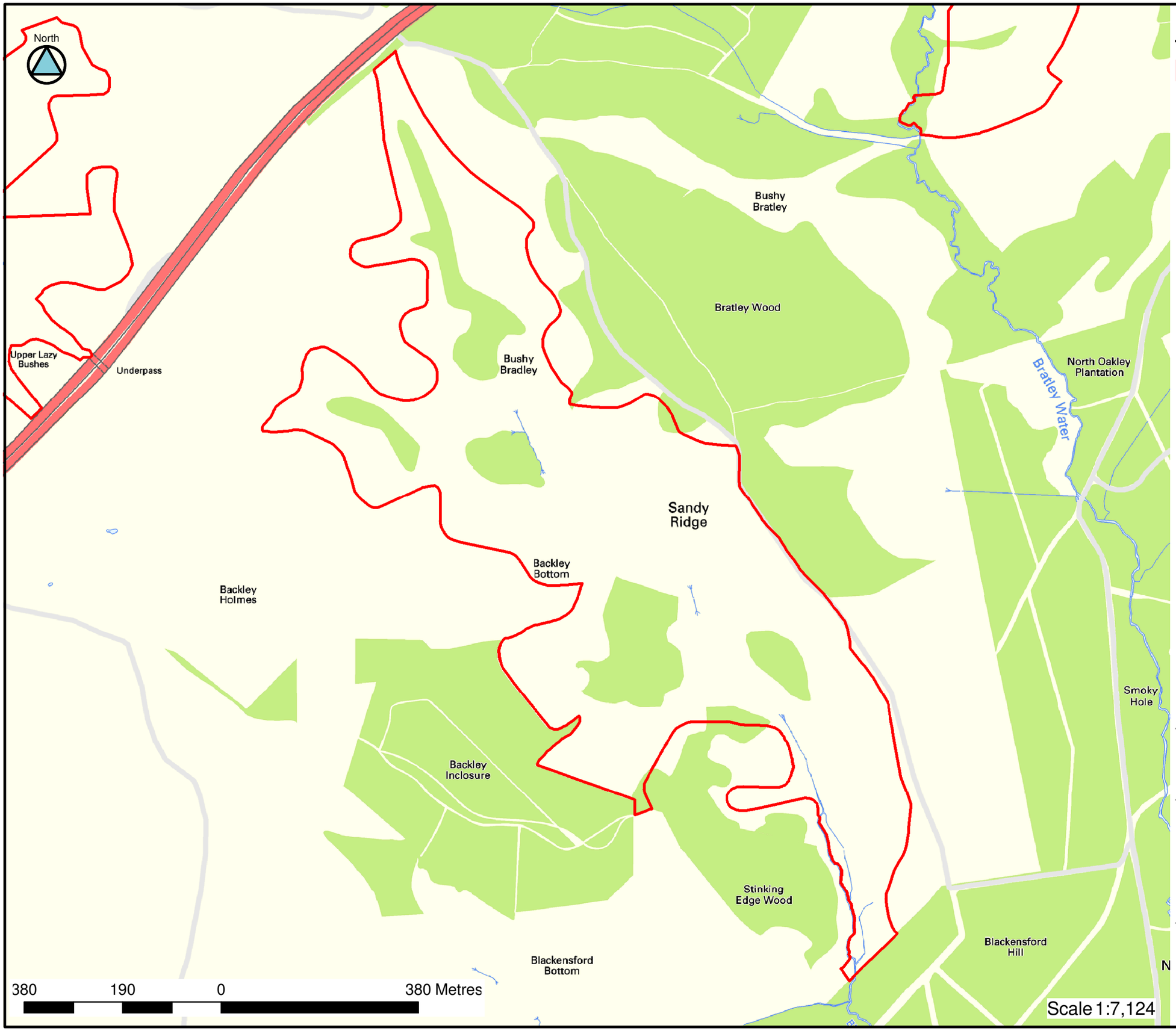
Map 5: Drift Geology
Map 6: Bedrock Geology
Map 7: Eco-Hydrology Map
Map 8: Restoration Plan



LEGEND

Ecohydrological Assessment Area

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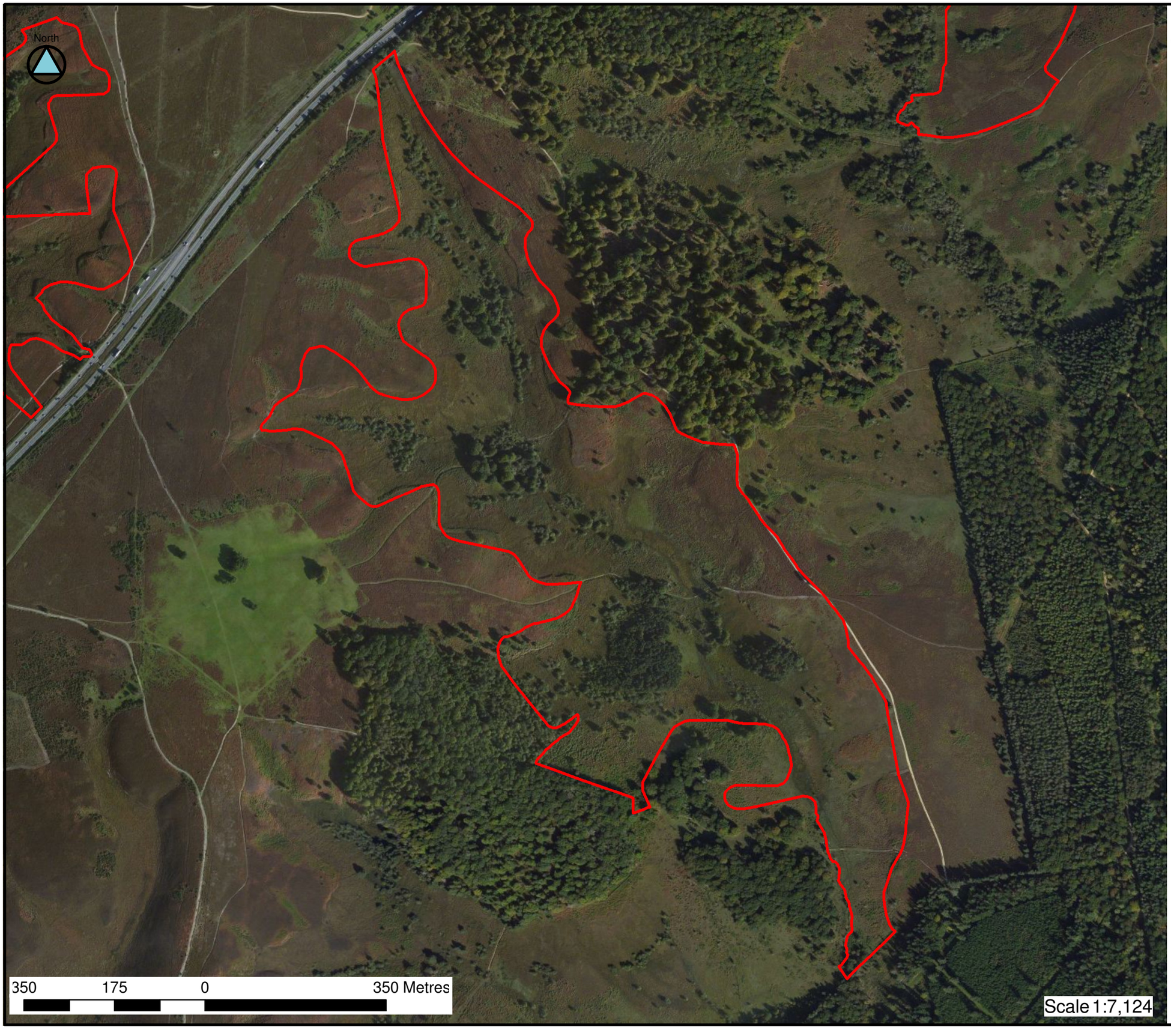
MAP 1

Site Location



LEGEND

Ecohydrological Assessment Area

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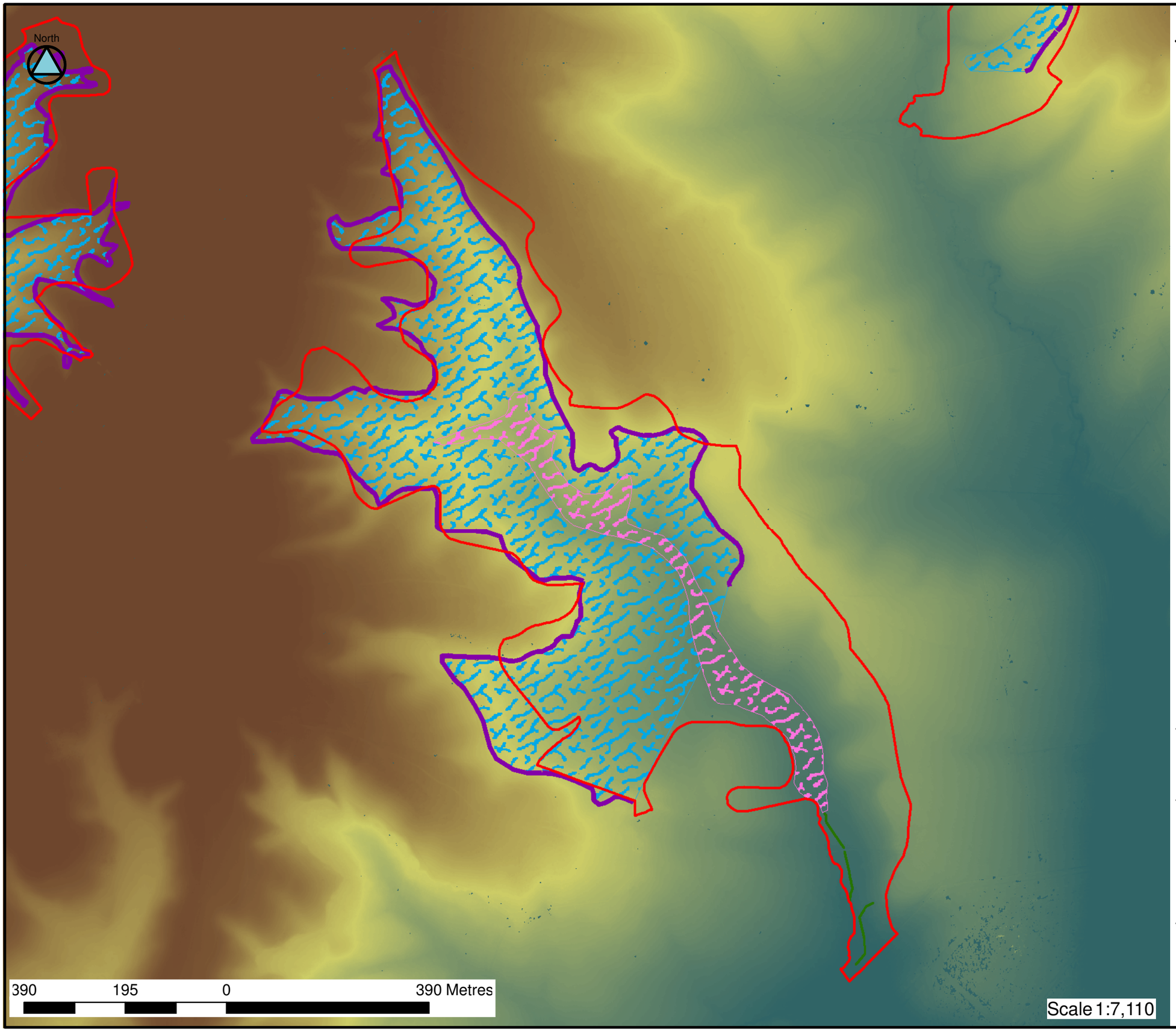
MAP 2

Aerial Photography



LEGEND

- Ecohydrological Assessment Area
- Seepage face
- Drainage
- Valley Bottom Wetland
- Valley Side Wetland

LIDAR

mAOD

High : 100

Low : 55

Scale 1:7,110

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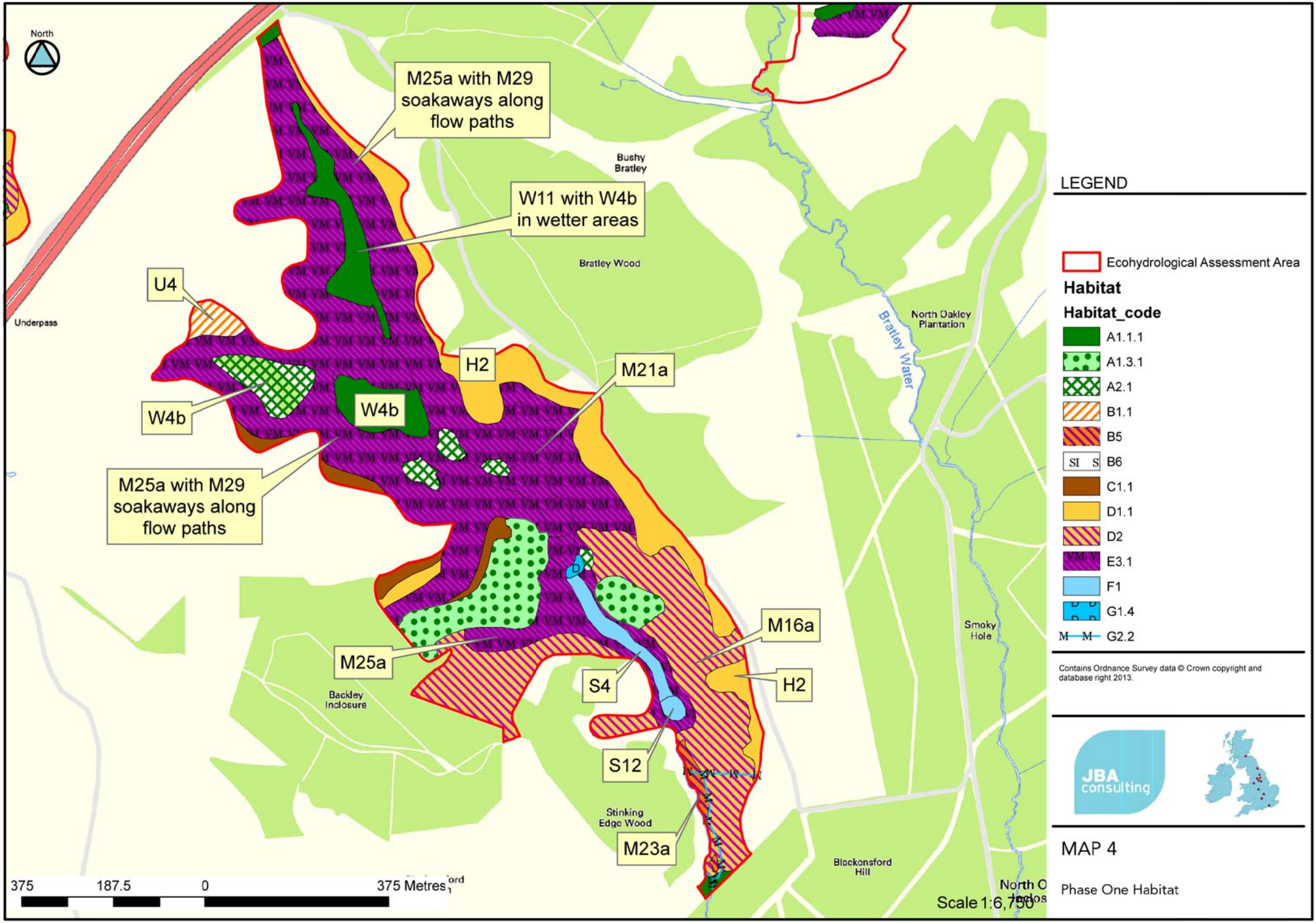
MAP 3

Topography, Hydrology and Wetland Distribution


North
M25a with M29 soakaways along flow paths
W11 with W4b in wetter areas
U4
W4b
W4b
H2
M21a
M25a with M29 soakaways along flow paths
M25a
M16a
H2
S4
S12
M23a
Underpass
Bushy Bratley
Bratley Wood
North Oakley Plantation
Bratley Water
Smoky Hole
Backley Inclosure
Stinking Edge Wood
Blackonsford Hill
375
187.5
0
375 Metres
Scale 1:6,750
LEGEND
Ecohydrological Assessment Area
Habitat
Habitat_code
A1.1.1
A1.3.1
A2.1
B1.1
B5
B6
C1.1
D1.1
D2
E3.1
F1
G1.4
G2.2
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MAP 4
Phase One Habitat

North

Upper Lazy Bushes

Underpass

Bushy Bratley

Bratley Wood

Bushy Bradley

North Oakley Plantation

Bratley Water

Sandy Ridge

Backley Bottom

Backley Holmes

Backley Inclosure

Smoky Hole

Stinking Edge Wood

Blackensford Bottom

Blackensford Hill

320 160 0 320 Metres

Scale 1:7,124

LEGEND

- Ecohydrological Assessment Area
- No Drift
- Other Deposits
- Alluvium - Clay, Silt, Sand and Grave
- Head - Clay, Silt, Sand and Gravel
- Head - Gravel, Sand, Silt and Clay
- Head - Silty Clay
- Head - Gravelly Sand
- Peat
- River Terrace Deposits - Clay and Silt
- River Terrace Deposits - Sand and Gravel
- River Terrace Deposits - Sand, Silt and Clay

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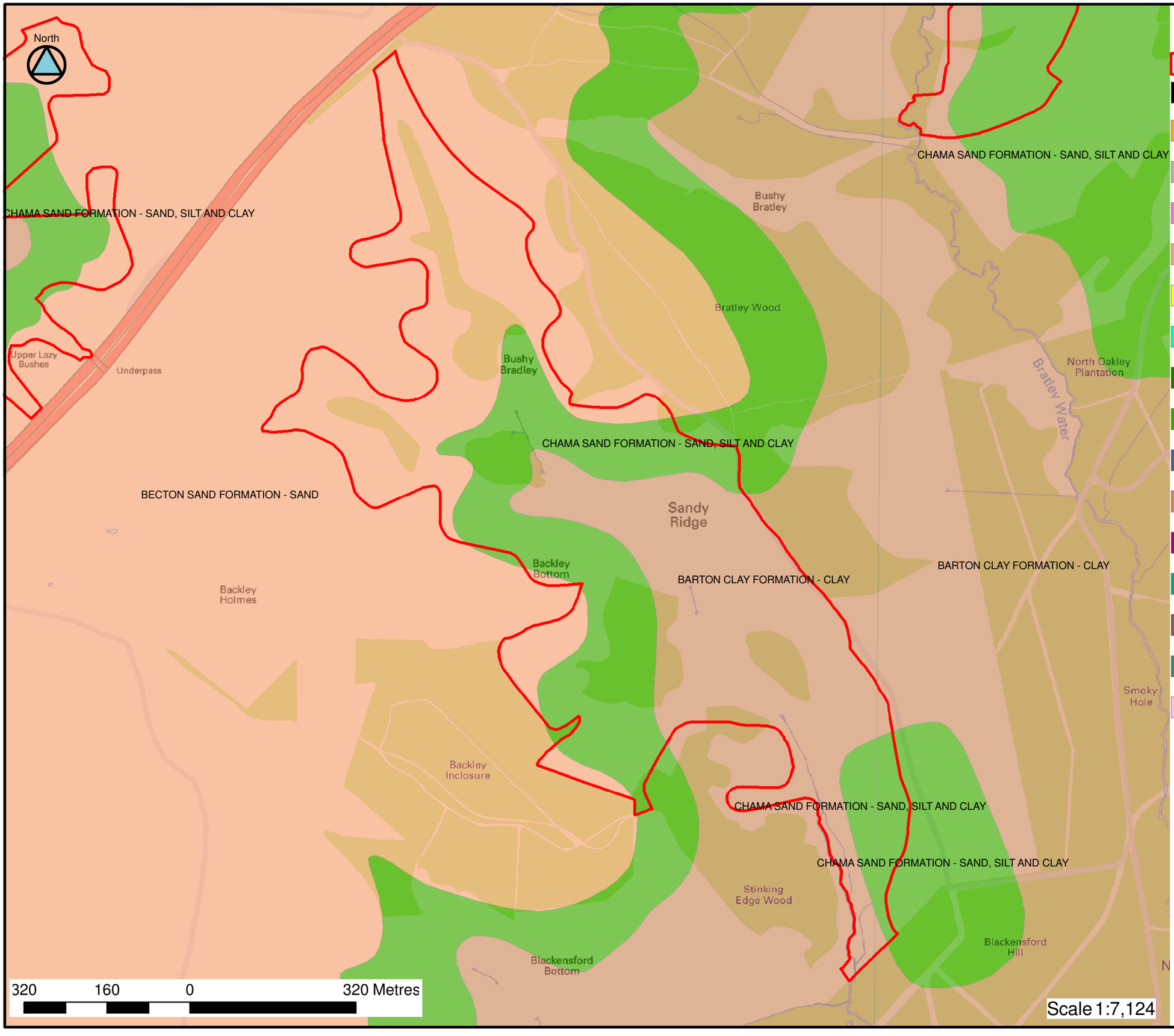
MAP 5

Drift Geology



LEGEND

- Ecohydrological Assessment Area
- Other Rock Types
- Headon and Osbourne Beds - Clay, Silt and Sand
- Headon Formation - Clay, Silt and Sand
- Lyndhurst Member - Sand, Silt and Clay
- Becton Sand Formation - Sand
- Becton and Chama Sand Formation - Sand, Silt and Clay
- Becton Bunny Member - Clay
- Chama Sand Formation - Sand
- Chama Sand Formation - Sand, Silt and Clay
- Chama Sand Formation - Silty Clay
- Barton Clay Formation - Clay
- Barton Clay Formation - Sand
- Selsey Sand Formation - Sand, Silt and Clay
- Marsh Farm Formation - Clay, Silt and Sand
- Poole Formation - Sand, Silt and Clay
- London Clay Formation - Clay, Silt and Sand

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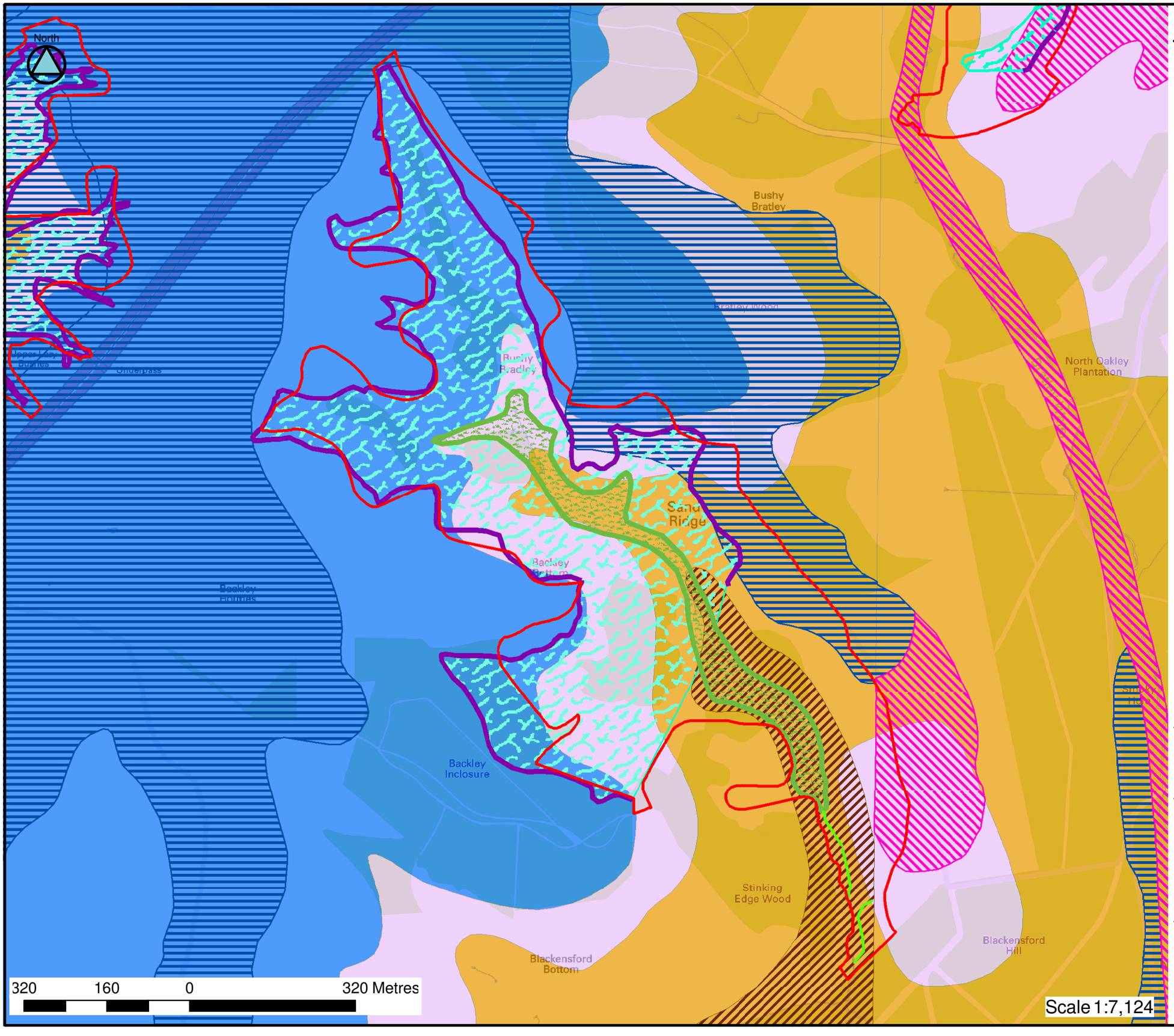
MAP 6

Bedrock Geology



LEGEND

- Ecohydrological Assessment Area
- Seepage face
- Drainage
- Valley Bottom Wetland
- Valley Side Wetland

Drift Hydrogeology

- Aquifer
- Aquifer/Aquitard
- Aquitard

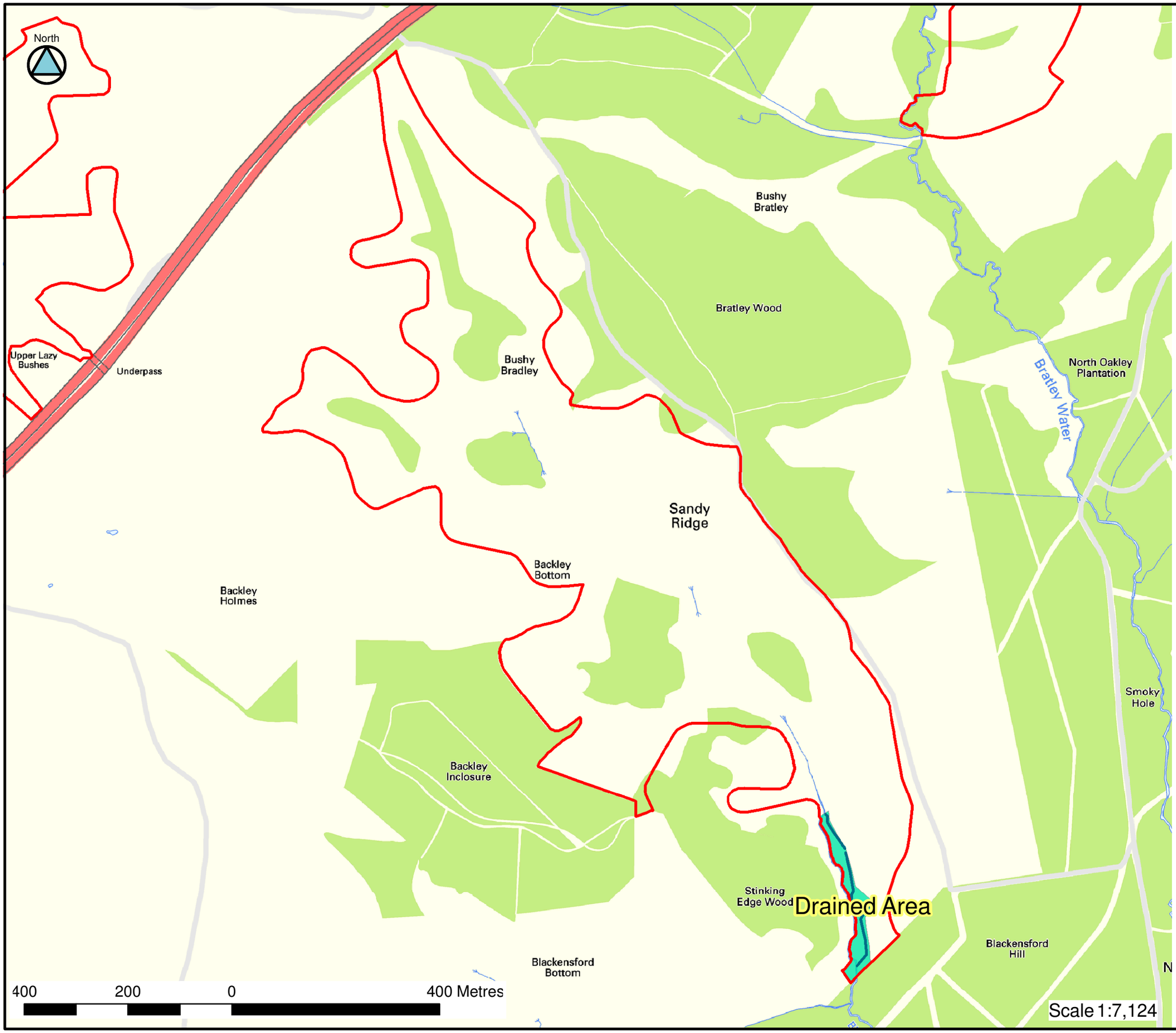
Bedrock Hydrogeology

- Aquifer
- Aquifer/Aquitard
- Aquitard

JBA consulting

MAP 7

Eco-hydrology



LEGEND

- Ecohydrological Assessment Area
- Drainage
- Restoration Areas

JBA consulting

MAP 8

Restoration Plan