Moorland Survey
Wemmergill Estate, County Durham

Summary and recommendations

Grip survey:

- Total – 820km drains have been identified
- Active – 18.5km. Recommended to block using peat dams.
- Active down to the mineral layer – 3.2km. Recommended for re-profiling only.
- Naturally regenerating – 191km. No intervention needed.
- Already blocked – 592km. No intervention needed.

Bare peat survey:

- High priority – 32ha. Restoration recommended using the North Pennines AONB Partnership's five steps as a guide (see page 4 & 5).
- 660 bags of brash required.
- 100 units of stone (each unit consists of 750kg) to build 95 dams.
- 380 coir rolls or heather bales are required.

Survey details

The North Pennines AONB Partnership (NPAP) was commissioned to complete this report along with a grip blocking and bare peat restoration specification for Wemmergill Estate Ltd in July 2016. This survey will inform the new Countyside Stewardship Scheme to restore internationally important blanket bog habitat.

A boundary map was provided by Wemmergill Estate Ltd and this boundary has been used as a basis for the area surveyed, approximately 6000ha (Map 1).

At the start of the Peatscapes project the NPAP commissioned a consultant in 2006 to digitise all of the grips and bare peat in the AONB. This identification was based on aerial photography from 2002 and this data has formed the basis of this survey. For this report, a desk based survey was initially carried out by the Partnership using 2015 aerial photos. Blocked grips could be easily identified (Fig 1) and anything that could not be confirmed by aerial photography was visited by NPAP staff.

Fig. 1: 2015 aerial photography showing blocked moorland grips.

Open drains are classified as drains that are void of vegetation and have water running along them. In some cases vegetation, mainly heather (*Calluna vulgaris*) has grown over the grip so that it appears to be naturally re-vegetating however water is still running underneath the heather. These open drains are affecting the conservation value of the heath or bog habitats and may also be causing environmental problems elsewhere in the catchment. In these circumstances blocking the drains with peat dams would slow rainwater run-off from the fell, allowing the blanket bog to rewet which will help to restore floral diversity.

Along with the grips, areas of bare and eroding peat were also identified from aerial photography. A walk over survey of the site was carried out on the 21st, 22nd, 26th & 27th July 2016 (see Map 2 for survey points). The ground truthing survey was carried out by an experienced member of the Peatland Programme team (over 4 years' experience) along with a NPAP trainee.

Grip Survey

Active drains are classified as drains that have no vegetation in the bottom of them, have flowing water along them and still have peat at the base (Fig 2).

Each drain network was visited and characterised to determine:

- The state of the drains (open and active/revegetated and inactive).
- The size of the drains
- The depth of the soil in which the drains sit – this helps to determine if the drains can be blocked using peat dams.

A total of 18.5km of active drains were found. These are marked in red on Map 3.
Drainage rods were used at each survey point to measure whether the peat was greater than 50cm. All of the active drains can be blocked using peat dams from either within the grip or using peat from borrow pits around the grip. This will slow the water running through the drain, reduce erosion caused by the running water and also lead to sedimentation and colonisation of the pool by bog mosses. This will stop the drying effect the drain has on the surrounding area and promote the growth of healthy bog plants.

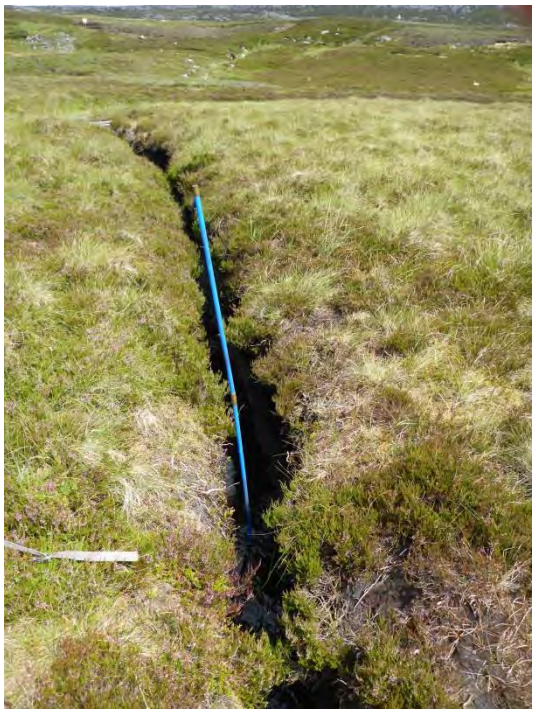

Fig. 2: Open grip on the north side of Wemmergill Estate

A number of drains on Wemmergill Estate have either been cut into shallow peat or have eroded down to the mineral soil (Fig 3). These grips are not suitable for blocking with peat dams. Peat dams do not bind with the mineral layer and there is a high chance of water undercutting the dam causing the dam to fail. The amount of peat in the surrounding area also has to be considered as blocking large drains with peat dams require multiple borrow pits which affect the surrounding land. For these types of drains we would recommend that they are re-profiled only. This can be done in a number of ways with the same outcomes, slowing water running along the drain, allows more light into the drain promoting vegetation growth and removes steep sides which can be hazardous to livestock and wildlife including red grouse.

Fig. 3: A moorland drain that has eroded down to the mineral

There is 3.2km of grips that are recommended to be re-profiled. These are highlighted in purple on Map 3.

A large portion of the grips on Wemmergill Estate were found to be either naturally regenerating or have been already blocked in 2007/2008. These drains no longer have running water through them and have been colonised by bog mosses and common and hares-tail cottongrass (Fig 4). A total of 191km of drains were found to be naturally regenerating and 592km have been previously blocked. With sustainable land management in place, drain infilling will continue. These drains do not require any intervention. These are marked in green and blue respectively on Map 3.

Fig. 4: A naturally regenerating grip full of *Sphagnum* moss.

There is 32ha of bare peat identified using 2002 aerial photography that is high priority. This is split over 10 sites, all but one of which is on the north side of Wemmergill Estate (Map 4). It is recommended that the bare peat sites be restored using the North Pennines AONB Partnership's five steps (see below). The aim of this work is to slow running water through the bare peat sites, stabilise the water table to prevent large fluctuations throughout the year and stabilise the peat surface to prevent it being washed into nearby watercourses. The NPAP have successfully restored a

number of similar sites (Fig 5) with heather, other dwarf shrubs and a good cover of moss (including *Sphagnum sp.)* being present after 2 years.

There is 4ha of actual bare peat within the eroding sites that will require 660 dumpy bags of brash to cover it all (Map 5, 6, 7, 8 & 9). To slow water movement through the sites stone dams and either coir rolls or heather bales will be used. 100 units of stone are needed to build 95 dams (Map 5, 6, 7, 8 & 9) and 380 coir rolls/heather bales will be required (Map 5, 6, 7, 8 & 9). There is also 3km of hagg edges to re-profile to aid re-vegetation (Map 5, 6, 7, 8 & 9).

Fig. 5: A site in Northumberland 3 years after restoration work started.

North Pennines AONB Partnership's Five Steps to Restoration

1. Fence – A fence would be to exclude livestock grazing and reduce/remove vehicle traffic through the site (if any). Fences would be temporary, with the view to removing it after 10 years or when the restoration is completed. This is not required on Wemmergill Estate.
2. Hydrology – Sediment traps and barriers are used to prevent running water causing further or new erosion within the site. Techniques such as stone dams (Fig 5), coir rolls (Fig 6), heather bales and peat dams can be used.

Fig. 5: Stone dam used as a sediment trap.

Fig. 6: Coir roll in amongst heather brash used to slow water movement across the bare peat surface.

3. Slopes – Steep slopes can be re-profiled to speed up colonisation from the base of the slope (Fig 7). Slopes that can be re-profiled depends on access as re-profiling is done using a low ground pressure digger.

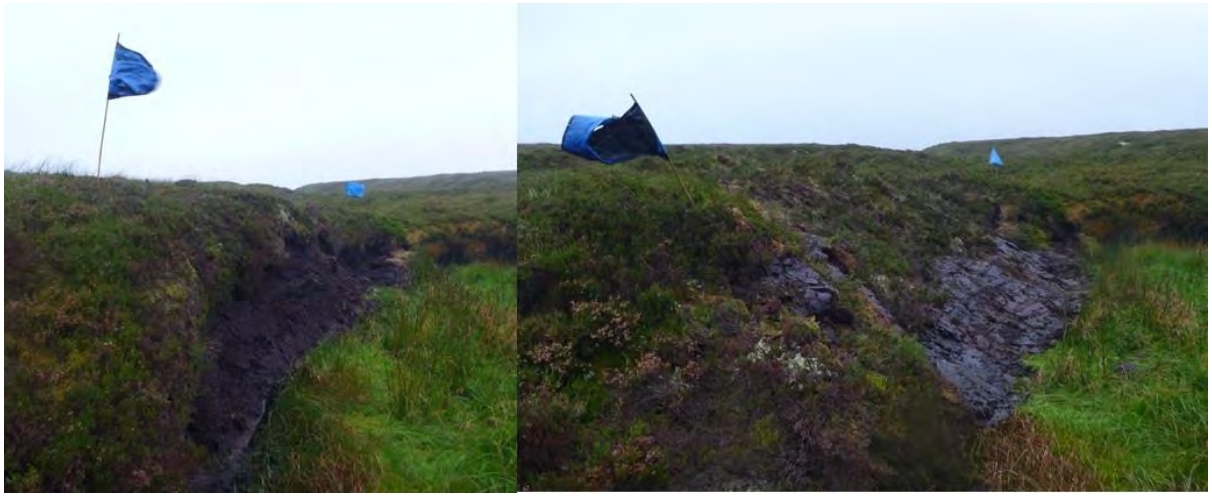

Fig. 7: Re-profiled slope that will revegetate from the base.

4. Heather brash – Bare peat is covered with heather brash. This prevents frost heave, drying and wind erosion and also provides seeds and moss that speeds up the re-vegetation.
5. Re-vegetation techniques – This is to encourage and speed up re-vegetation. Small amounts of lime and fertiliser can be applied along with moorland seed. *Sphagnum* can be translocated which helps stabilise the hydrology and promote other species to grow.

Report drafted by [redacted]
Field Officer – North Pennines AONB Partnership's Peatland Programme
July 2016

Map 1

Wemmergill Estate Boundary

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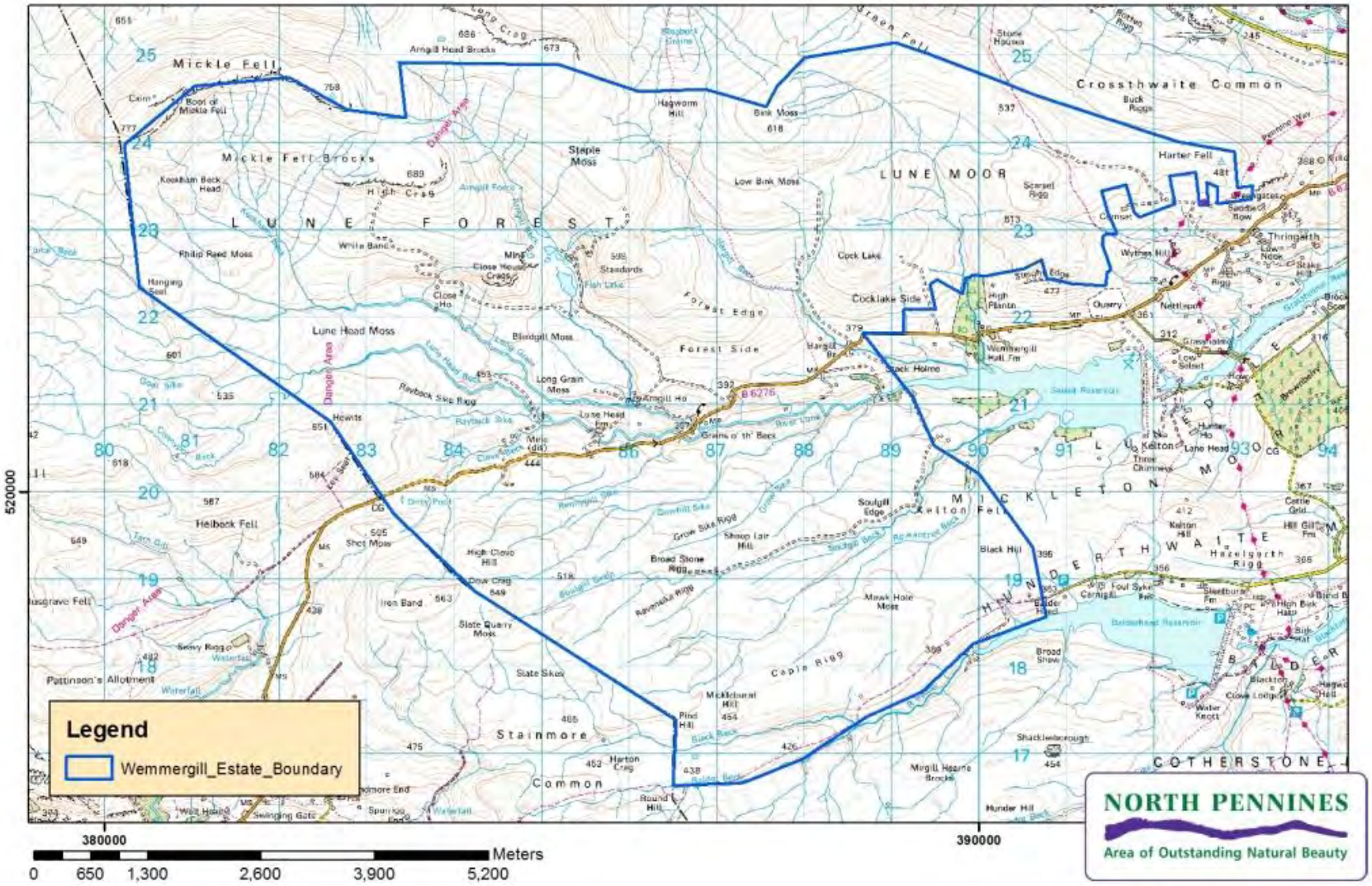

Map 2

Wemmergill Estate Survey Points

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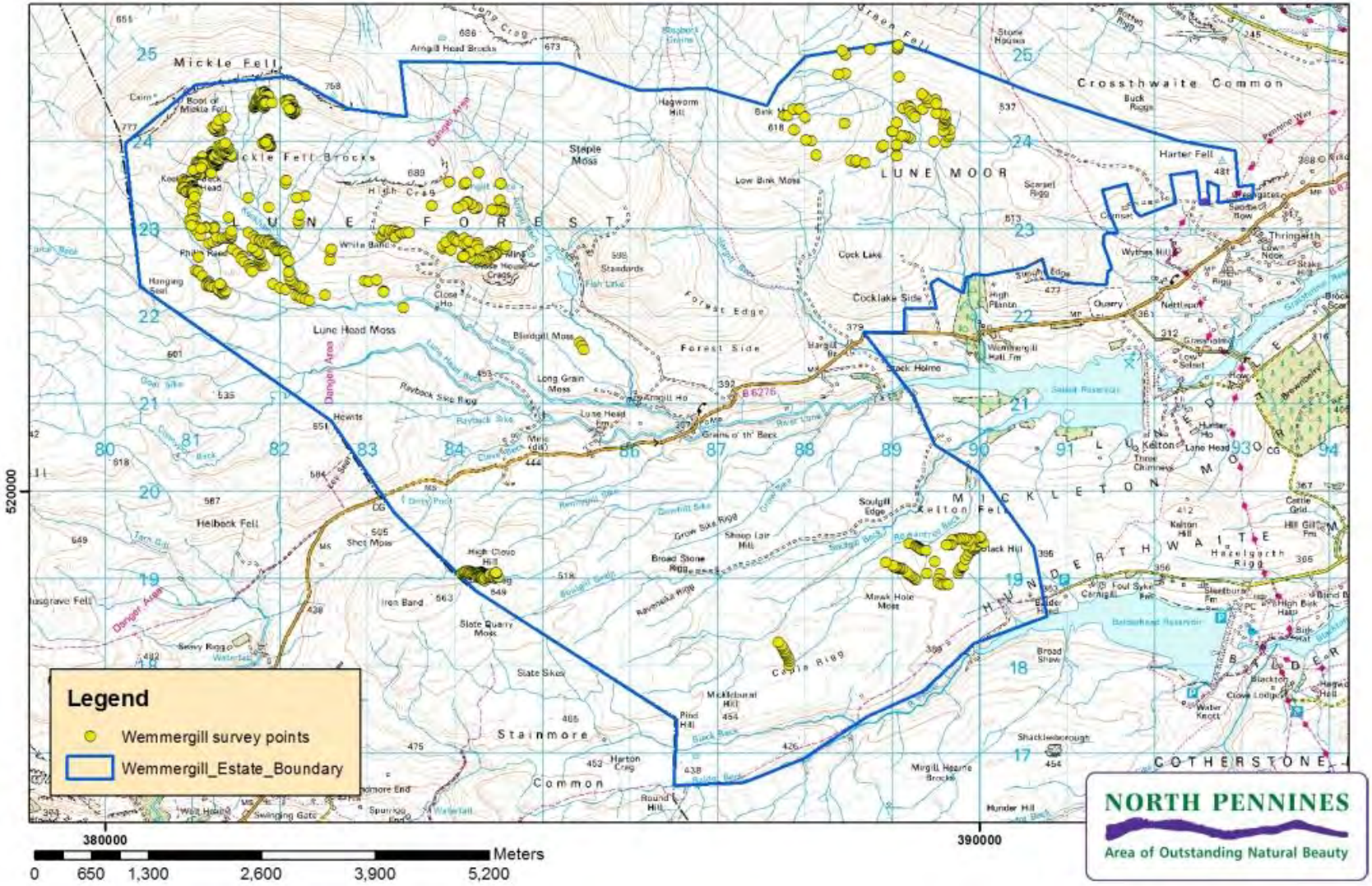

Map 3

Wemmergill Estate Grip Survey

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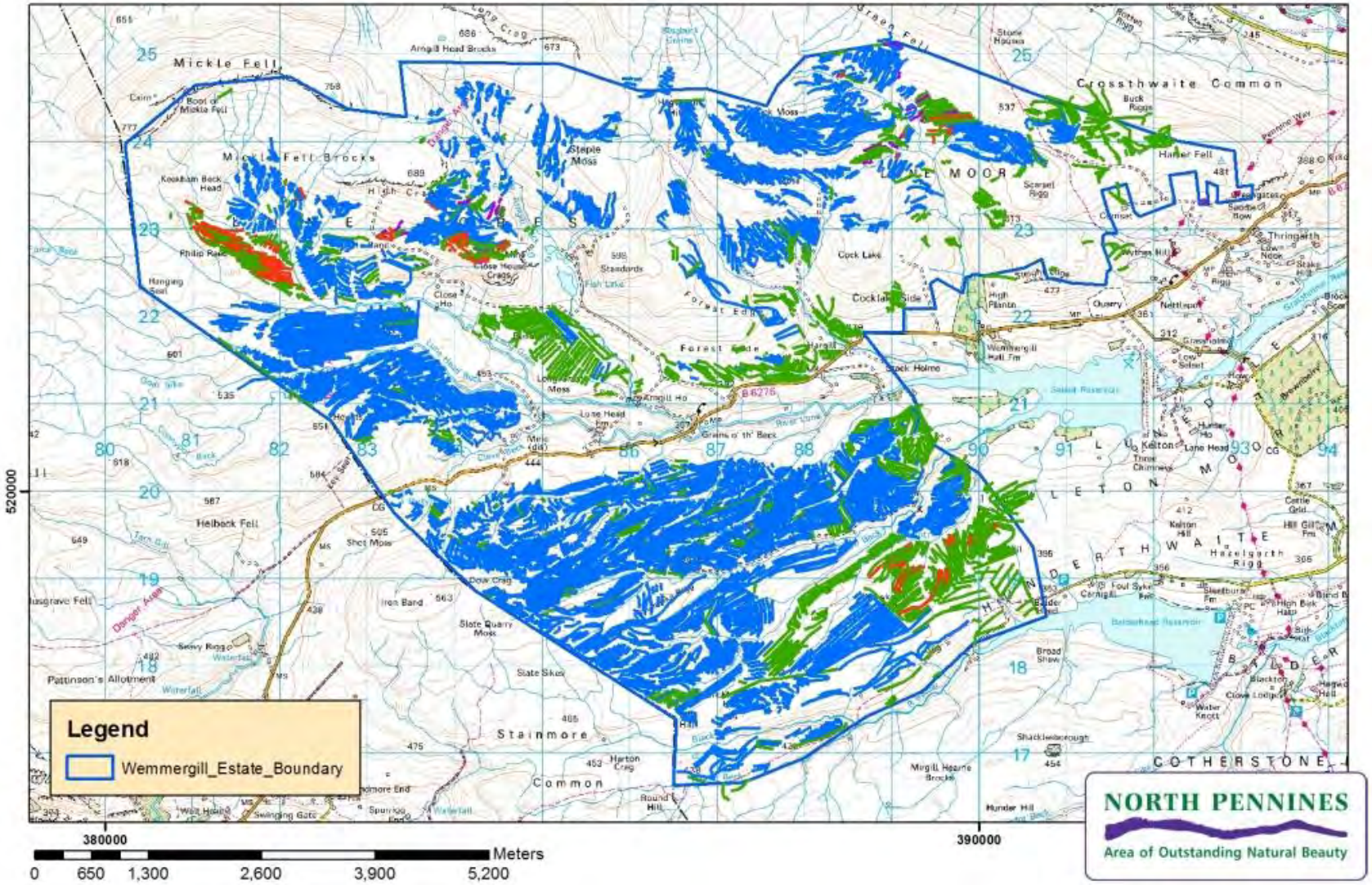

Map 4

Wemmergill Estate Bare Peat Restoration Sites

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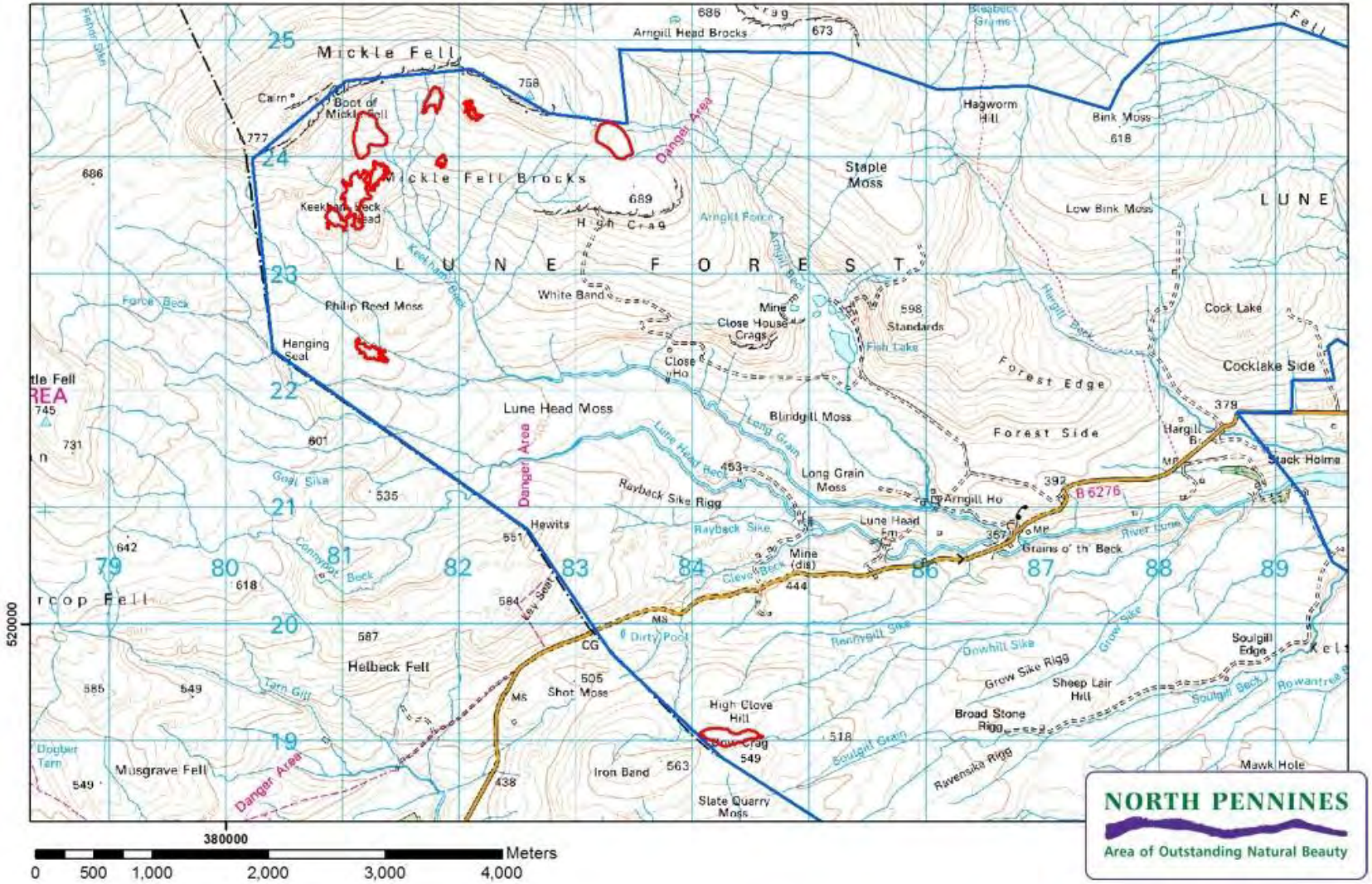
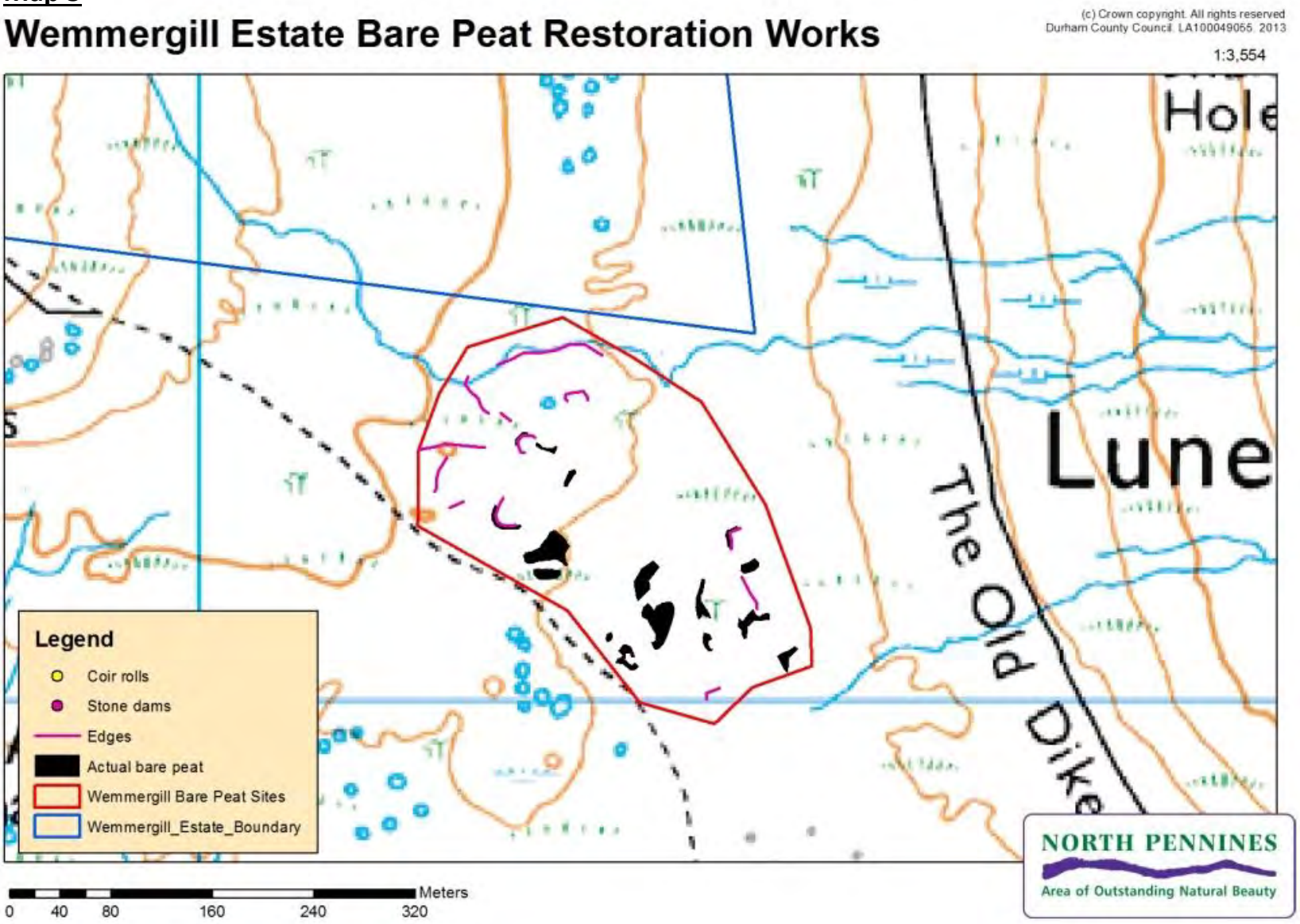


NORTH PENNINES
Area of Outstanding Natural Beauty

Map 5

Wemmergill Estate Bare Peat Restoration Works



Map 6

Wemmergill Estate Bare Peat Restoration Works

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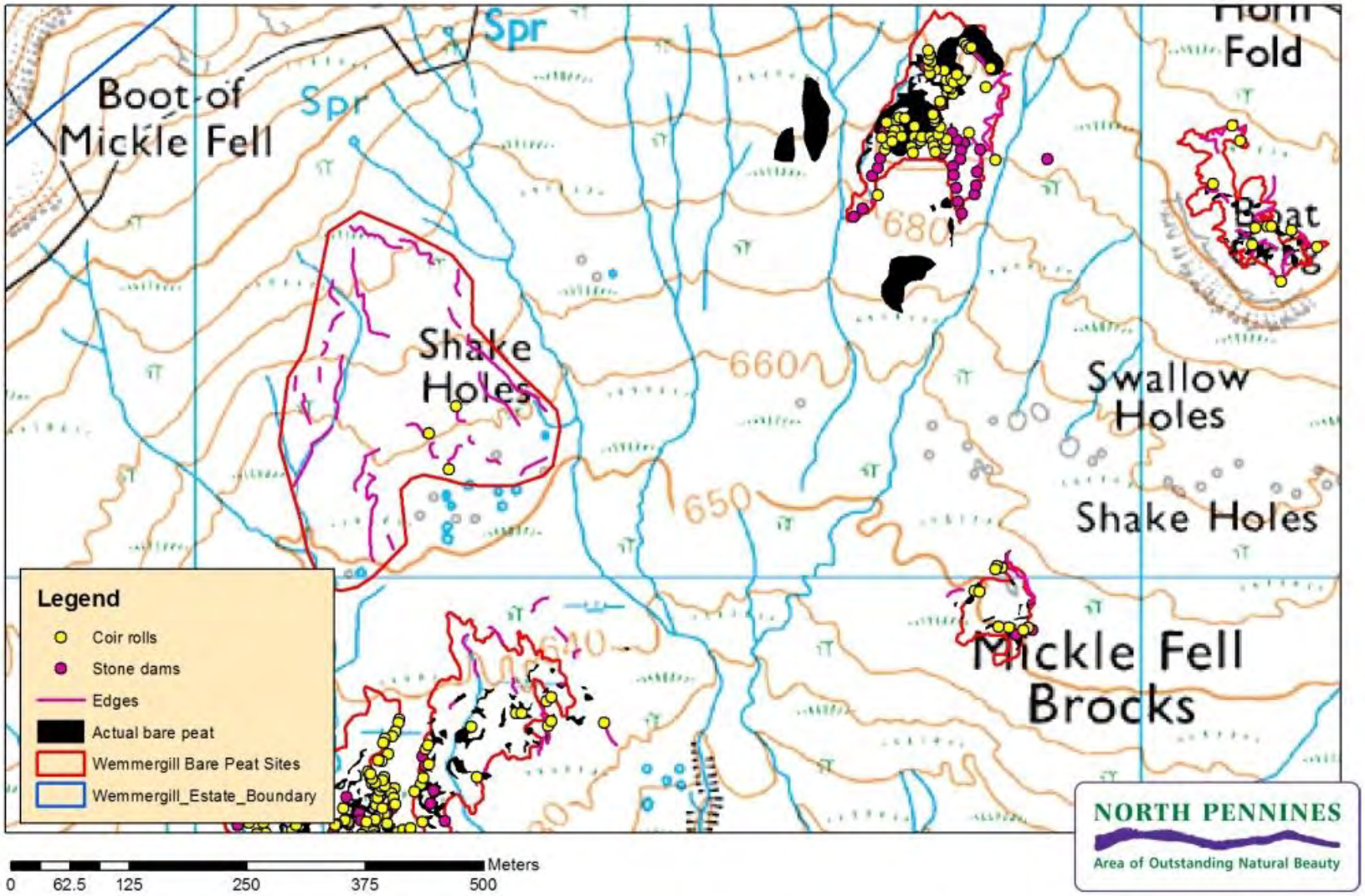

Map 7

Wemmergill Estate Bare Peat Restoration Works

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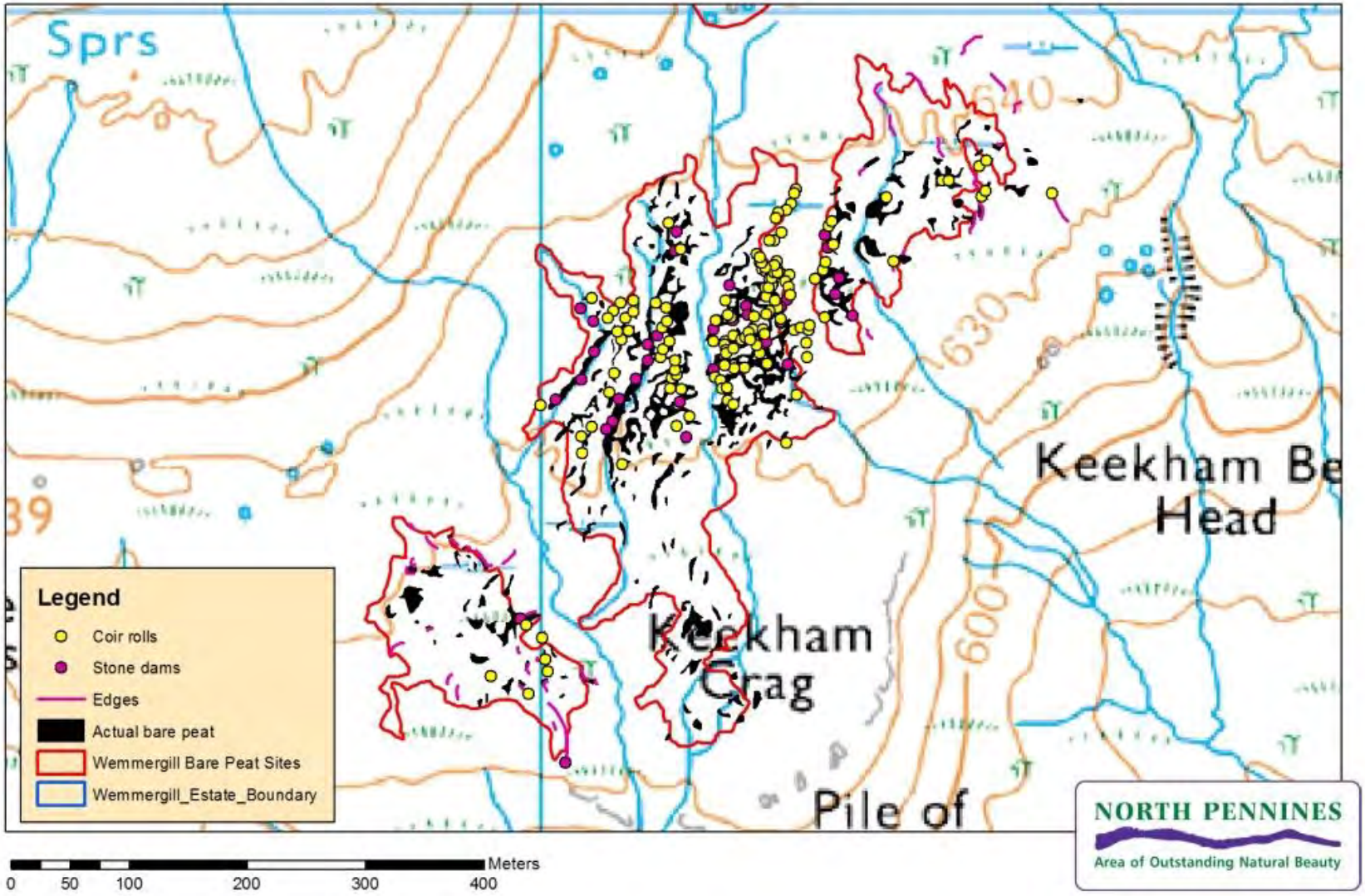

Map 8

Wemmergill Estate Bare Peat Restoration Works

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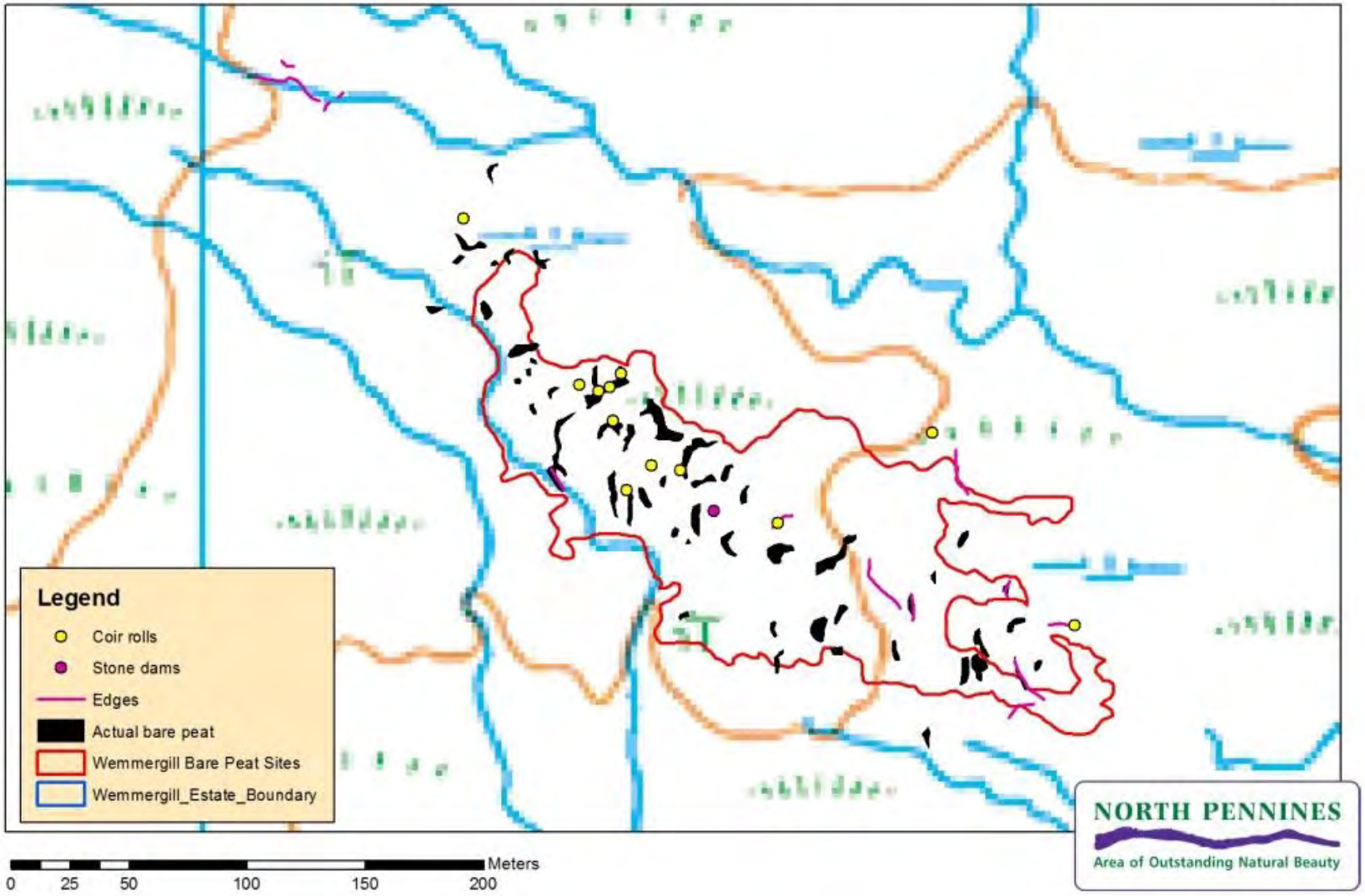

Map 9

Wemmergill Estate Bare Peat Restoration Works

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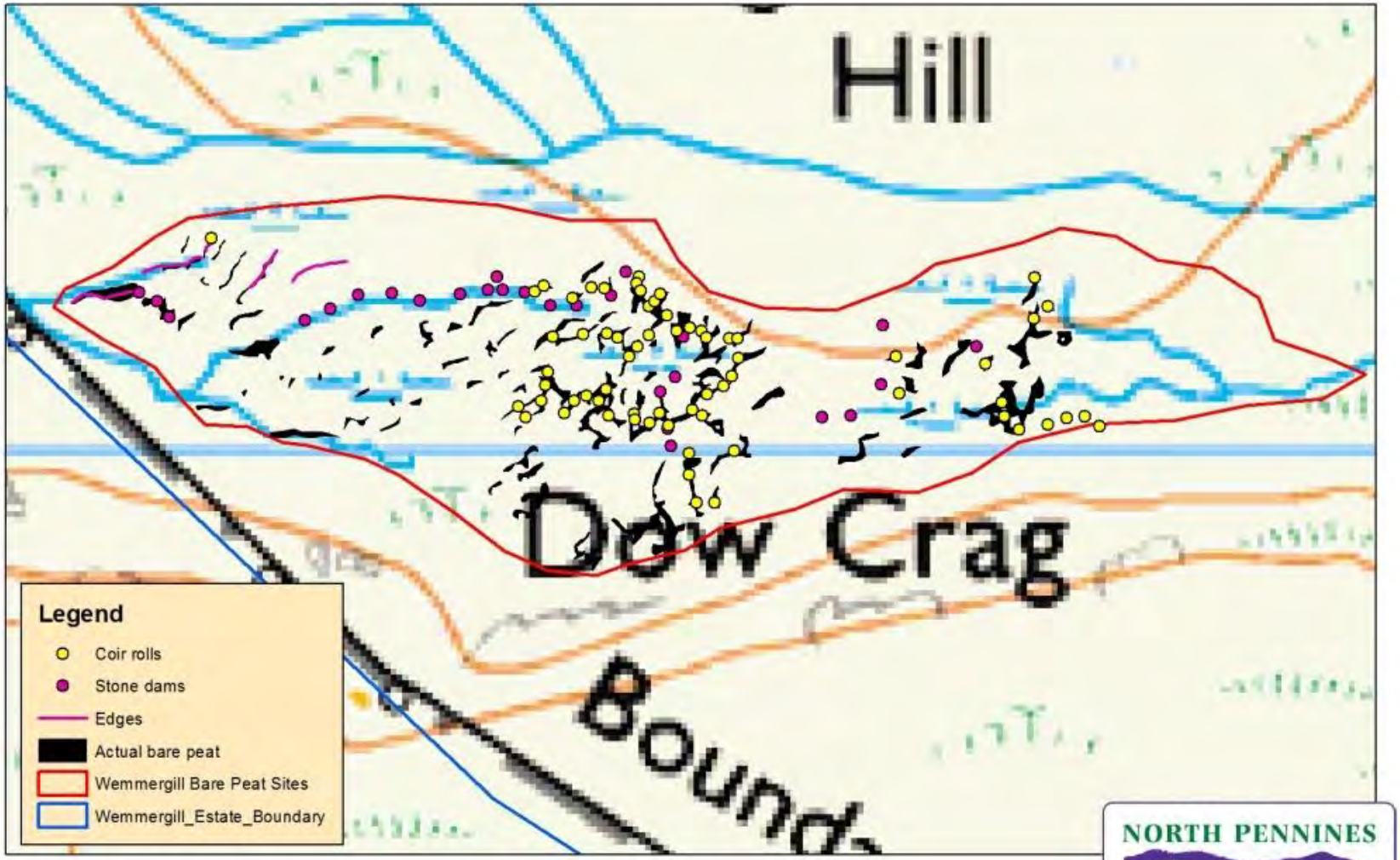

Grip Blocking Specification
Wemmergill Estate, County Durham

This specification outlines proposals for peatland restoration work on Wemmergill Estate as part of a new Countryside Stewardship scheme.

Project location

The grip blocking work lies on Wemmergill Moor, which is to the South West of Middleton-in-Teesdale in County Durham (Map 1 & 2). The site lies within the North Pennines Area of Outstanding Natural Beauty and is designated as a Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC) & Special Protection Area (SPA).

Fig. 1: Typical active grip on Wemmergill Estate

Aims

The project requires:

- 18.5km of active grips (Fig. 1) to be blocked using peat dams (Map 3, 4, 5, 6 & 7).

Grip blocking

All drains blocked with peat dams must also be re-profiled.

These drains lie on blanket bog soils.

The restoration of a peat building habitat such as blanket bog involves the restoration of the active peat accumulation process on a permanent basis. *Sphagnum* moss abundance is a key attribute of active peat accumulation on blanket bog and in general the water table must be within 8cm of the bog surface for most of the year for successful *Sphagnum* growth. For sites where blanket bog occurs (implying sufficient precipitation inputs for peat accumulation) the main restoration objectives are to:

- Reduce and delay the loss of water from the system.
- Elevate the water table within the peat
- Encouraging revegetation of bare areas and maximising the height of vegetation on the bog surface (to reduce the speed of surface runoff water)
- Restoring original depths of watercourses where artificial deepening has occurred through increased water flow from grip drainage
- Arresting the process of peat oxidation (drying) by rewetting the peat.

Methods of Working

A grip system and each individual grip should be blocked from uphill working down slope. Thus any water in the grip is limited during construction. All of a grip system should be dammed if possible, with priority given to working on feeder grips and upstream grips that lead into main grips even if these are not particularly eroded in order to reduce water supplies to main grips where the potential for erosion is highest. Some small sections of

drains may need to be left unblocked to ensure infrastructure (e.g. tracks and grouse butts) remain serviceable.

For dam location, avoid cracked or eroded peat banks. Water backing up behind the dam could enter a crack and bypass the dam, forming a new watercourse. Minimise the gradients along the grip/gully. Aim to flatten off sharp changes in gradient which will encourage scouring by infilling with non-erodible material-stones, turves, bales, brash.

Peat Dams (Impounding water)

The intention with impoundment dams is to completely prevent the flow of water along an artificial drain immediately restoring open water to the system; aiding rewetting and improving dispersal of the water across the mire expanse via lateral overflows from the drainage channel (see section 7).

Block Spacing

The ultimate aim of dam construction is to raise water levels to the bog surface all along the grip. There are three main reasons for requiring a high water table and therefore closely spaced dams:

- If water levels in blocked grips are lower than the ground surface then the water table has not been raised to the critical height required for all the peat to become saturated and probably the critical height required for the survival of most *Sphagnum* species.

- Where water is impounded behind peat dams, the dams must be kept as wet as possible all year round. If allowed to dry the peat will shrink, crack and cease to be watertight. As a rough guide the water level on the uphill side of every dam should not drop below 20cm of the dam top in dry weather. Dams **must** be spaced so that the water level at the top of one dam should **at least reach to within 20 cms of the top of the next uphill dam**. For all dam materials to remain securely anchored, adjacent bog vegetation should also be kept as wet as possible.

- Flowing water will be slowed down when it meets stationary water in a pool and by using frequently placed dams plenty of pools are made. This avoids water flowing along the base of an empty grip with sufficient erosive force to breach the next downhill dam.

It is important to minimise the change in height between dams by using the maximum number of dams practicable. For this project, there should be **at least 1 dam/10m on flat ground and 1 dam/6m on slopes**. This spacing is taken to mean the maximum distance between the mid-point of adjacent dams. To protect the dam and minimise scouring the overflow point should be as wide as possible.

Block Construction

- A pre-requisite for peat dams is that there is sufficient depth of peat on the site where the grip is situated to provide material to construct the dam; it is impractical to haul over long distances. If the peat depth is less than 0.5m a borrow pit will be required.

- It is suggested that peat dams should be a maximum of 2m wide x 1m deep and thus small grips are best suited to peat dams. Although this is a useful guide, it is possible to construct larger dams but extreme care must be taken and generally they should have a composite structure with a material of high cohesive strength in the middle.

- Ideally unoxidised, highly humified, pristine 'black' peat with a low hydraulic conductivity should be used for peat dams. Poorly humified peat or oxidising peat is unable to hold much water and is liable to drying out. Such peat also tends to be permeable and insufficiently dense hence it is difficult to achieve a watertight dam. Similarly, 'spoil' peat, or peat with wood and debris should be avoided as it can weaken the dam. At the dam location the turf and surface oxidised peat should be dug off and set aside. If there is abundant oxidising peat this should be put aside for eventual placement in the pool or can be used as outer layers of the dam provided that the core of the dam is comprised of pristine peat.

- The dam site should then be dug out ensuring that all unconsolidated peat is gathered up. The excavation should cut into the sides of the grip by at least 0.5m on either side and at the base by 0.2m. This ensures that the dam will be fully keyed into the surroundings and is vitally important. The breadth of the dam from front to back should be a minimum of 2x the original width of the grip at the dam site. A common fault is that dams are too small. When extracting peat for dams, do not dig so deep as to expose the underlying mineral layers. Contact with a mineral substrate will elevate the pH and increase nutrient availability and may reduce the quality of the seal between the dam and the underlying substrate. Where the grip has eroded into the mineral this contact cannot be avoided but should not be exacerbated.

- Ideally material is then taken from the grip sides immediately upstream of the point of dam construction. This creates a pool above the dam wider than the original grip which serves to slow the rate of water flow. Elsewhere the grip sides should be left undisturbed. Vegetation and surface peat should be set to one side. The underlying peat can then be excavated and placed at the base of the dam. If this does not supply sufficient material additional pristine peat can be taken from borrow pits by removing a turf excavating the peat underneath and replacing the turf right way up in the borrow pit. Pits should be ideally sited on flat ground for maximum water retention and a series of pits should be randomly located not in a line as this can form a new drain.

- On placement, the material is dropped from a height to the base of the dam to compact it thoroughly. It can then be further compacted with the excavator bucket. However care is required not to overwork the peat otherwise the peat structure will be destroyed and the peat will become a semi-liquid mass with no strength.

- The height of the peat dam should extend **at least 30cm** above the bog surface (before turves are replaced) to allow for a loss in height during settling.

- Cover all exposed pristine peat with poorer surface peat and saved turves installed the right way up. The roots will serve to bind the dam and protect peat from being washed away. This aspect is important.

- Pools can be left to fill with water but will be slow to revegetate if deep. Pools can be filled with any absorbent woody material such as brash, woodchips or *Calluna.* Thrown into the pool these materials will act as rooting substrates, they will reduce wave action and cushion the dam against moving water. Pools should be a **maximum of 50cm deep**.

Dispersal of excess water

Any means of holding back water needs to be coupled with a means of dispersing water away from the dam and laterally over a broad area. Dispersing excess water also plays an important positive role in evening out the rewetting by spreading the available water across the mire surface.

Excess water should be encouraged to seep out of the pool upstream of the dam. Dispersing excess water can be engineered if the land does not naturally lend itself to water draining away from the dam. i.e. on very flat ground. An overflow should be as wide as possible and formed by making a shallow depression as far back from the dam as possible. It must not result in any concentrated flow of water through a narrow point.

Frequently, grips occur within a wider depression caused by the peat shrinking. In such cases, although the grip itself may be water filled, the flooded grip still lies in the wider depression which will serve as a channel for water. Therefore any dispersal methods must have a means of taking water beyond the associated depression. This can be achieved by constructing a vegetated depression to allow water to disperse. The turf should be stripped of the required area, a small amount of peat excavated and the turf replaced and tamped down into position. The depression should be wide and shallow and only of sufficient depth to allow water to seep across the depression.

Re-profiling

All drains will be re-profiled by pushing the grip edges into the centre of the grip using either a digger bucket, or a tractor-mounted rolling ball. The purpose of this is to help speed-up re-vegetation across the grip surface and adjacent bog, and prevent stock and grouse falling into the grip itself.

Machinery and access

The machinery employed in this work must not damage the delicate vegetation and underlying peat. Vehicular access to the sites will be limited to tracked excavators or other necessary low ground pressure vehicle, generally with ground pressure of less than 3lbs per square inch. Any vehicle that becomes bogged down must be removed (after discussion with the landowner and necessary agencies) by the contractor and at the contractor's expense. Access routes and timings must be agreed with the landowner prior to commencement and adhered to at all times.

Some of the moorland grips on the North side of Wemmergill Estate are in the Ministry of Defence (MOD) Danger Area (Map 5). This area has 'over firing rights' which means that the area is inaccessible to members of the public however Wemmergill Estate staff and contractors are able to access the area under an exemption. However the MOD can restrict access to this area if they are using certain types of larger guns on the range. During these occasions' access and restoration work will be completely restricted. It will be up to the contractor to ensure they know when restrictions apply to this area.

Please note, although this area is only in the extended firing area it is still within the MOD Danger Area and therefore care should be taken when working in this area. There is a risk that ordnance could be found, if this is the case all work must stop and the contractor must inform the Warcop Military Range on 017683 43227. Work will only continue after the MOD has deemed it safe.

Project timing

The project will start from 1st January 2018 and run until the 31st December 2019. No works will take place in the bird breeding season which is between 1st April to the 15th July.

Work must be completed by December 2019.

Shapefiles can be made available to the contractor by Wemmergill Estate.

Management

The contractor will need will to gain all of the relevant permissions for the grip blocking work. Please note these may have charges connected to them.

The contractor will be required to take photos of every dam once installed along with a GPS location for each picture. The contractor will provide all of the photos to the client once the work is completed in a useable format. This will include either mapinfo or shapefiles of all of the dam locations. This is to fulfil the requirements of the Countryside Stewardship agreement.

Map 1

Wemmergill Estate

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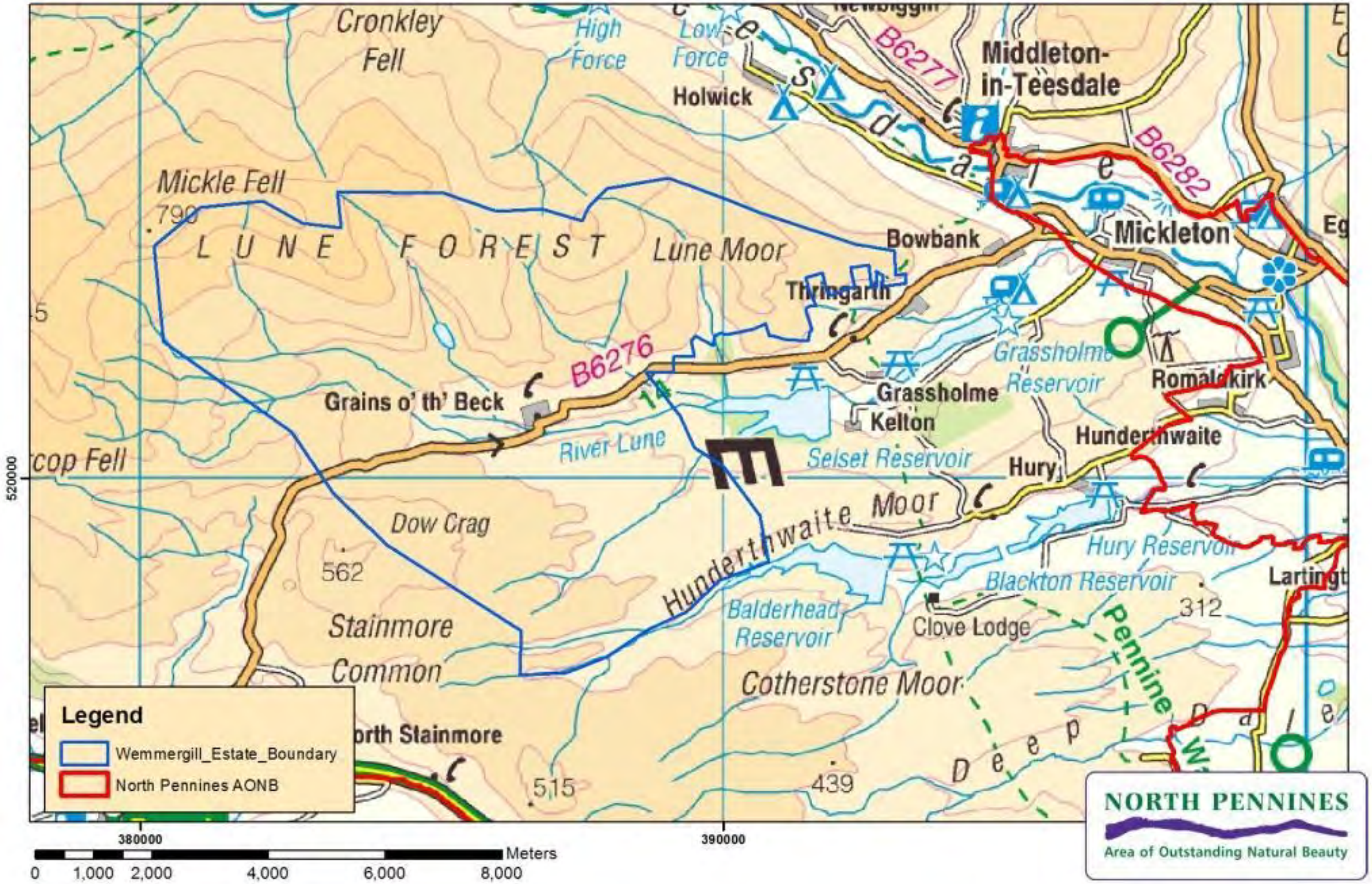

Map 2

Wemmergill Estate Boundary

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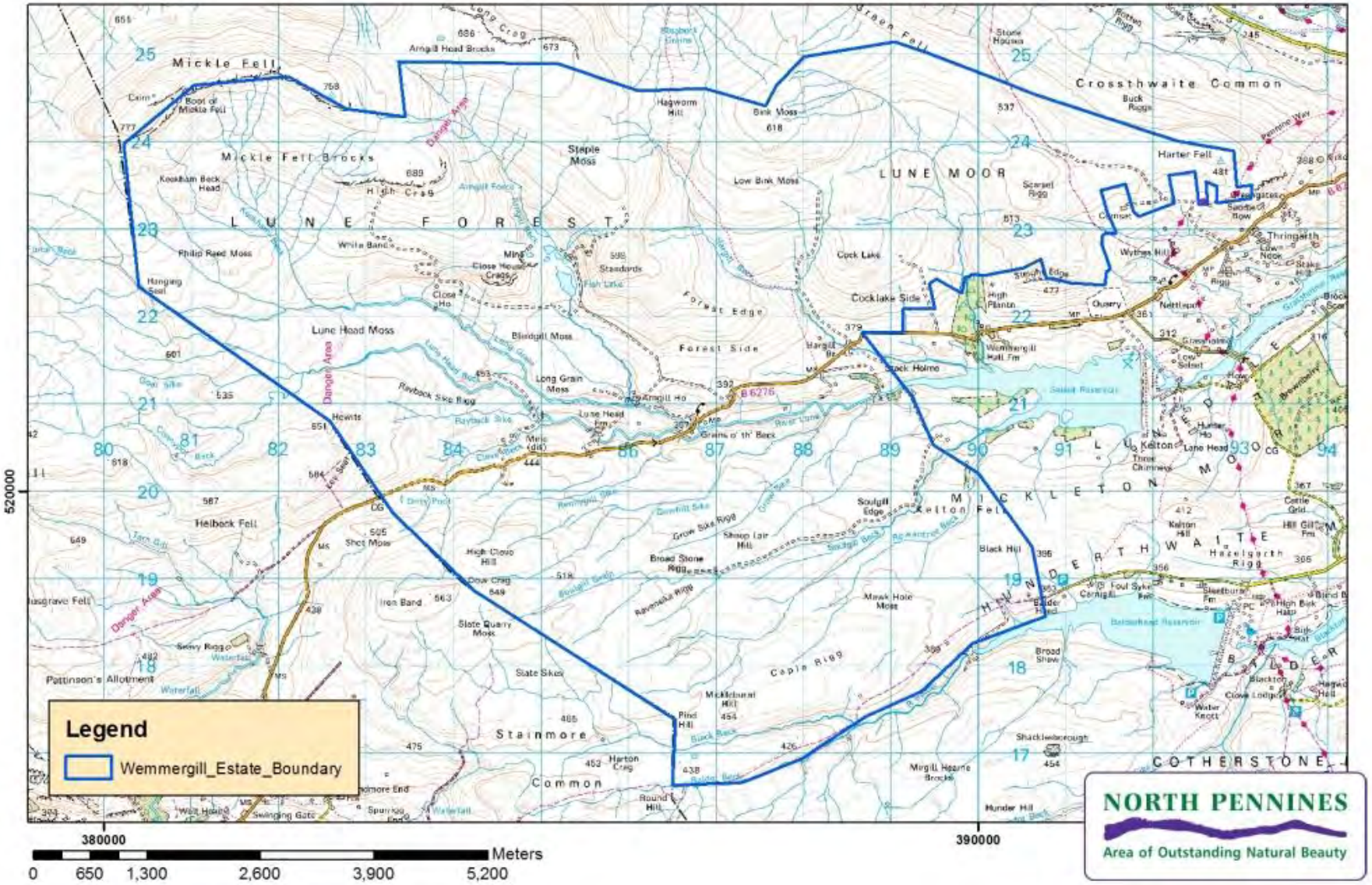
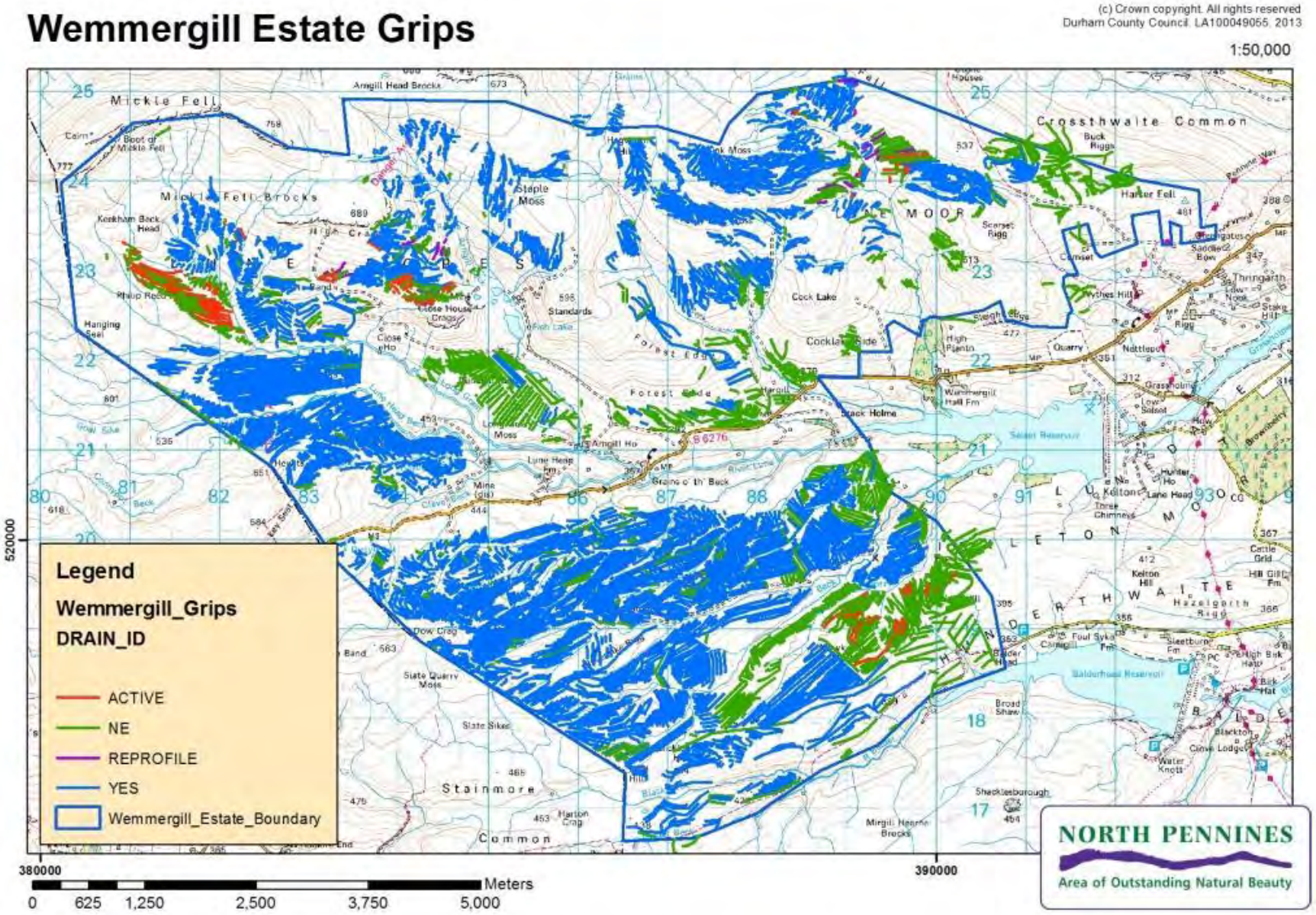


Map 3


Wemmergill Estate Grips
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Durham County Council. LA100049055. 2013
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380000
390000
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625
1,250
2,500
3,750
5,000
Meters
NORTH PENNINES
Area of Outstanding Natural Beauty

Map 4

Wemmergill Estate Grips

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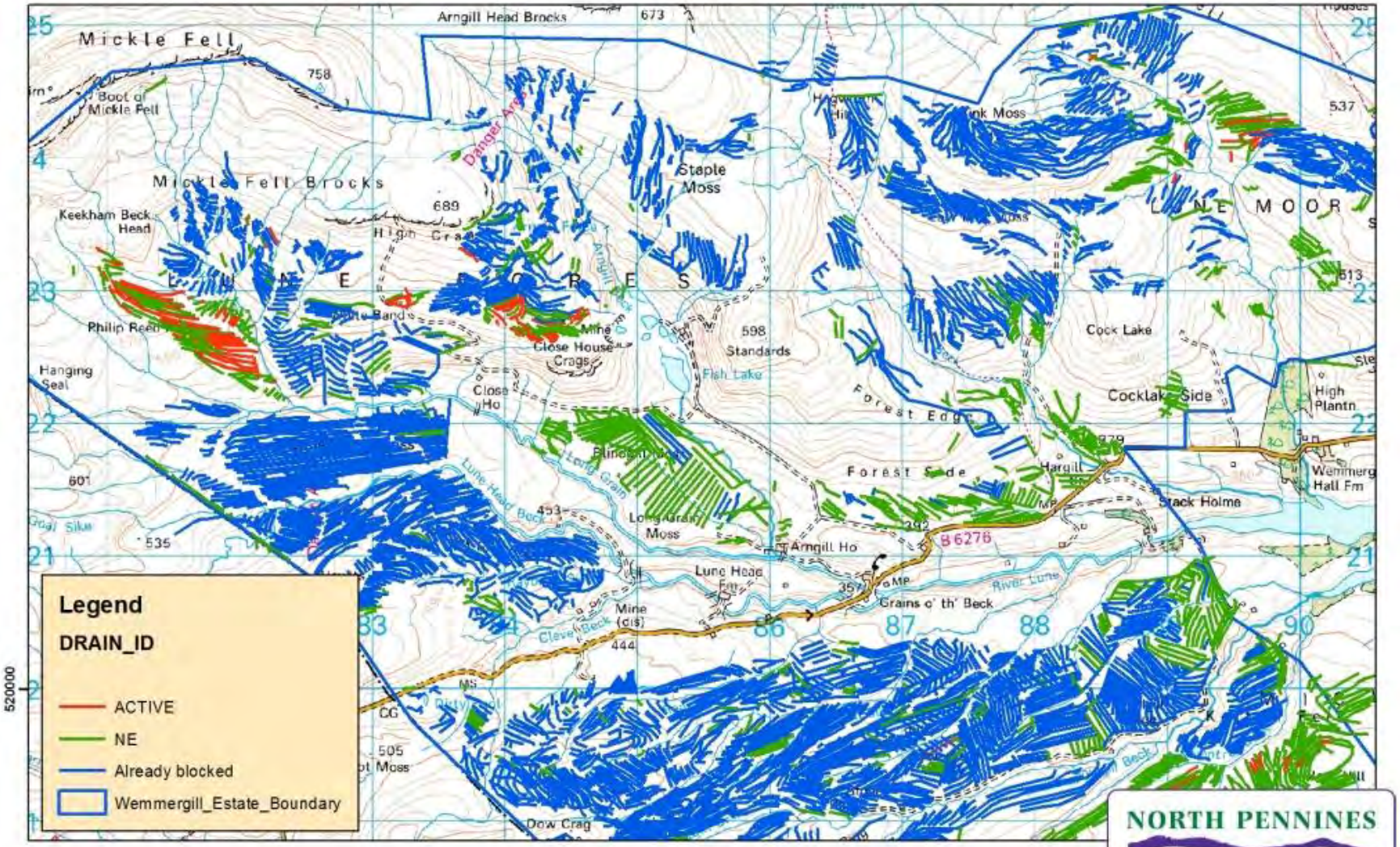

Map 5

Wemmergill Estate Grips

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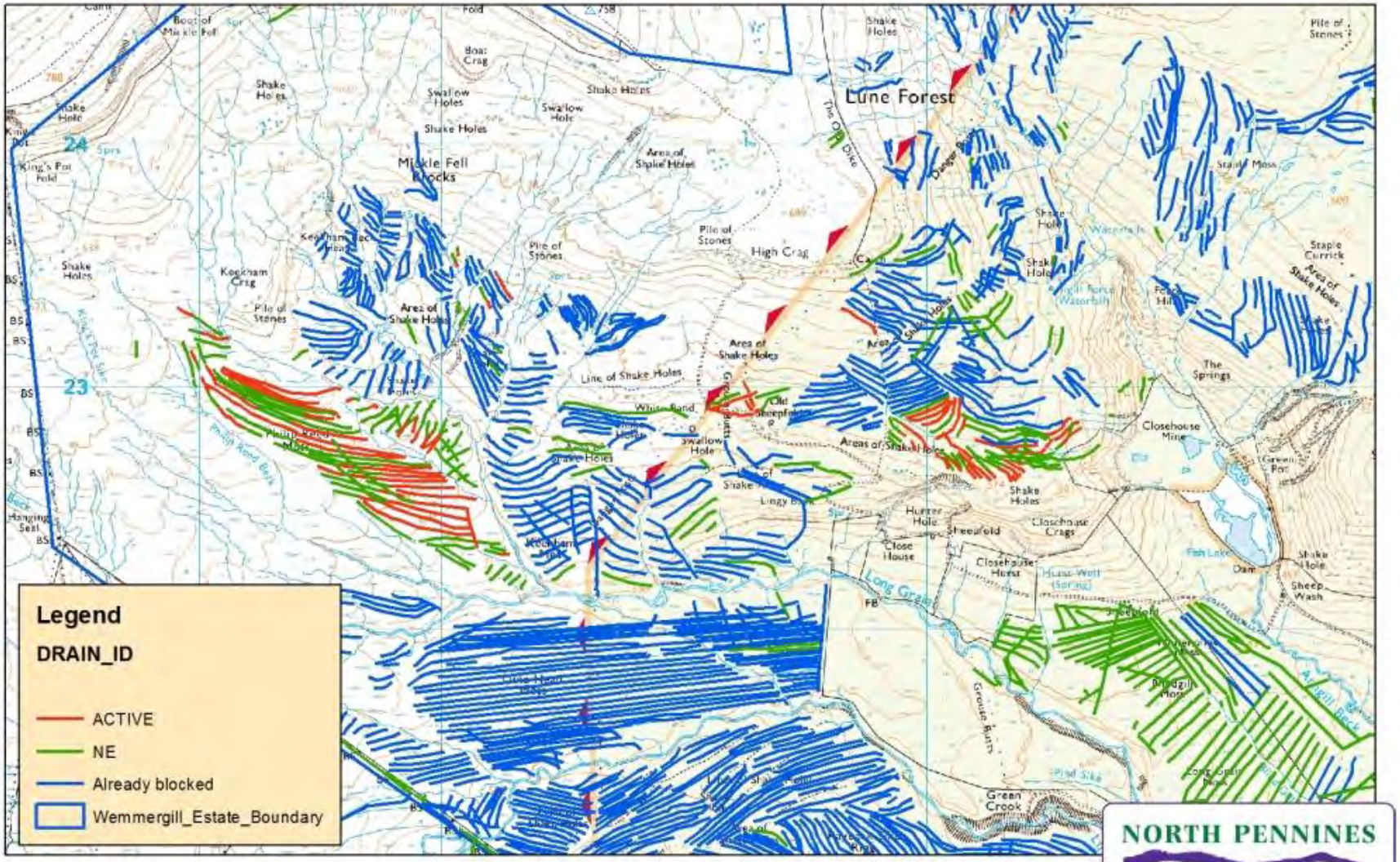

Map 6

Wemmergill Estate Grips

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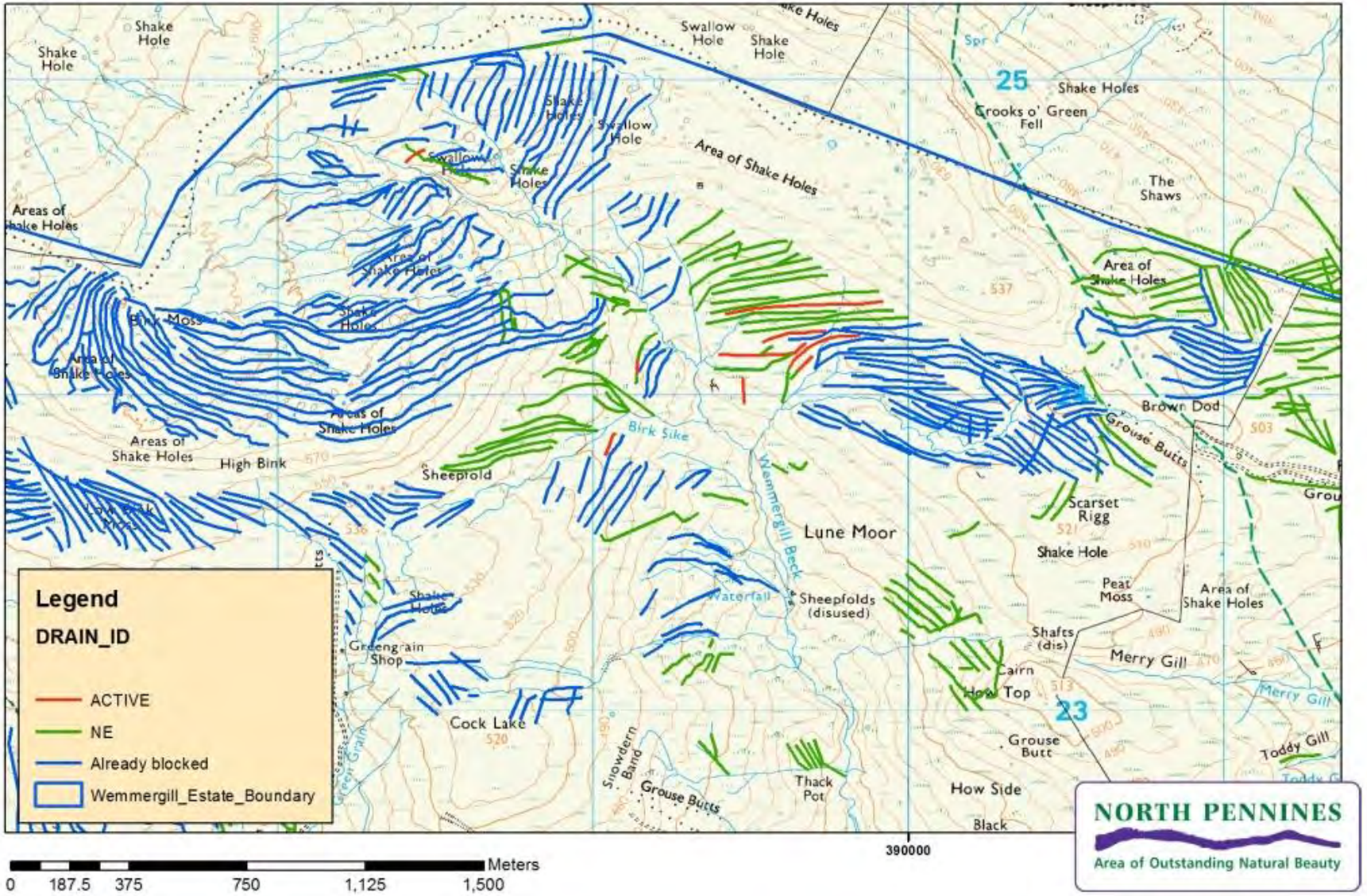

Map 7

Wemmergill Estate Grips

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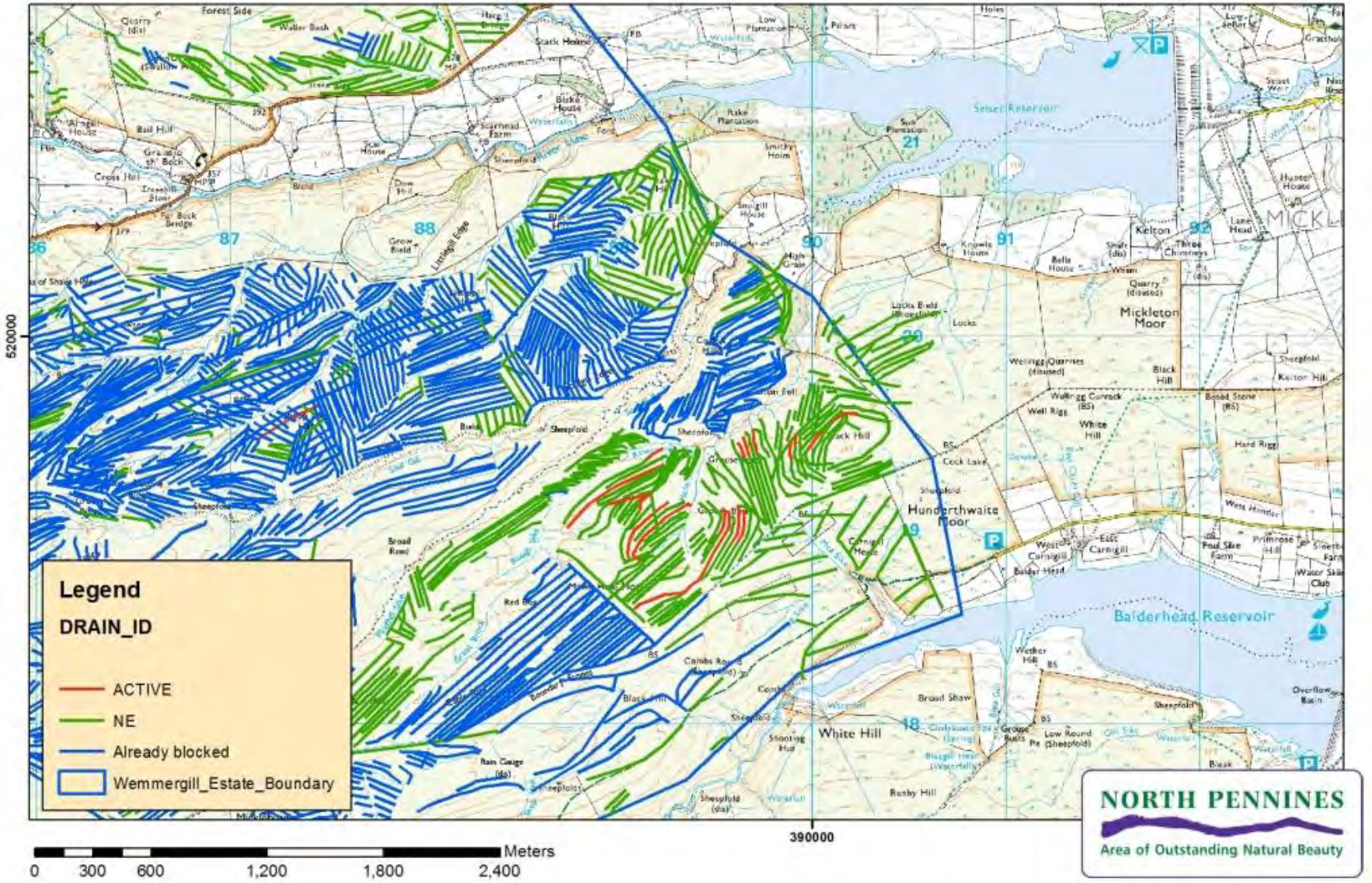


Peatland Restoration Specification
Wemmergill Estate, County Durham

This specification outlines proposals for peatland restoration work on Wemmergill Estate as part of a new Countryside Stewardship scheme.

Project location

The work lies on Wemmergill Estate, which is South West of Middleton-in-Teesdale in County Durham (Map 1 & 2). The site lies within the North Pennines Area of Outstanding Natural Beauty and is designated as a Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC) & Special Protection Area (SPA).

Aims

The project requires:

- 3.2km of grips to be re-profiled (Map 3).
- 32ha of bare peat restoration (Maps 4, 5, 6, 7, 8 & 9) which includes:
    1. 3000m of hagg edges to be re-profiled
    2. 100 units of stone (sandstone/gritstone) to build 95 dams (each unit consists of 750kg)
    3. 660 bags of brash
    4. 380 coir rolls + 2280 wooden stakes

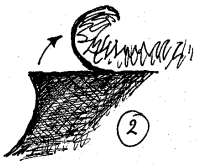
Grip re-profiling

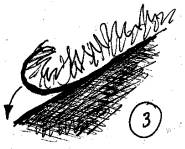
Deep drains that have eroded down to the mineral soil will be re-profiled by pushing the grip edges into the centre of the grip using either a digger bucket, or a tractor-mounted rolling ball. The purpose of this is to help speed-up re-vegetation across the grip surface and adjacent bog, and prevent stock and grouse falling into the grip itself. This technique may not be used in every location, but will be used where feasible on the more severe grips.

Bare peat restoration

This project requires: 32ha of bare peat restoration which will include blocking active gullies, stabilising the water table and covering the area with heather brash.

Hagg re-profiling





- Eroding edges that are overhanging should be re-profiled using appropriate machinery.
- A 2m length of vegetation on the top of the hagg should be 'rolled' back or undermined far enough to enable the underlying peat to be re-profile to create a 33° sloping bank.
- The existing vegetation should then be rolled back to cover the top of the slope.
- Vegetation that is rolled back should be done so with a depth that retains the root structure of the vegetation (approximately 50cm).
- If the existing vegetation does not cover the newly re-profiled slope heather brash should be spread on the exposed peat to protect it from the elements.
- No edge is greater than 2m are to be re-profiled.
- There is 3000m of edges to be re-profiled (maps 5, 6, 7, 8 & 9).

Gully blocking with stone (marked on Maps 5, 6, 8 & 9)

- Stone dams will be constructed at the same interval rate as peat dams which is 6-10m
- Gritstone or sandstone should be used.
- Gabion stones between 150-400mm in length/width
- Stone will be flown to site using a helicopter. There are companies that are capable of installing stone dams that have successfully completed work for both Moors for the Future and the RSPB.
- Stone will be placed into a skip/bucket using a digger. It will then be flown up to site, positioned above the gully (approximate locations marked on maps 5, 6, 8 & 9) by helicopter grounds crew and then the helicopter will dump the stone into the gully. The contractor will then rearrange the stone if necessary so that is measures no more than 1 meter high and approximately 1-1.5meters in length (Fig. 1).
- Dams should be built so that they are steeper on the down slope edge and have a notch in the middle to allow excess water to drain down the gully.
- Each dam should consist of approximately 750kg of stone (1 unit). More than one 750kg load will be needed in the bigger gullies.
- Coordination between the delivery of stone to the lift site will be the responsibility of the contractor
- 95 stone dams are needed, 5 of which will require two units of stone.

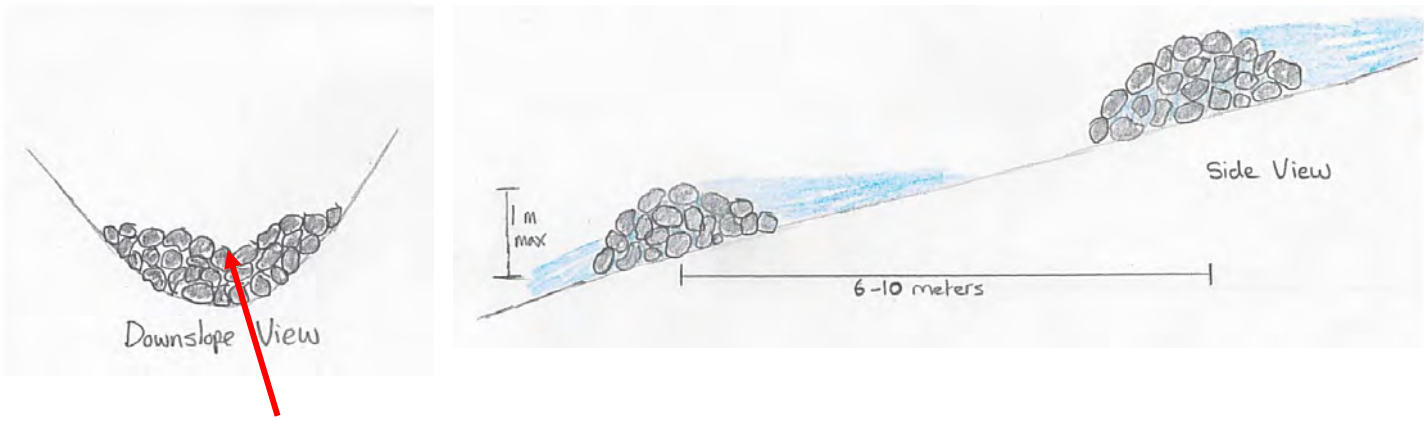


Fig. 1: Notched to allow water to flow down the middle rather than the sides.

Cutting, collecting and transporting heather brash

The objective of the brash is to not only introduce heather seed and to stabilise the ground surface, but also provide a microclimate of more favourable conditions for seeds to germinate and survive.

In total there is 4ha of actual bare peat that requires heather brash. As a rule of thumb the same area of heather needs to be collected as the bare peat.

Due to the distance from the heather cutting sites the bags of brash will be airlifted from an appropriate lifting site.

Heather brash should ideally come from the same estate to prevent the transfer of tick, heather beetle and other diseases. Cutting will be approved by the landowner and Natural England and should be checked for the issues above by the contractor.

Heather to be cut should be leggy (approximately 1ft, 30cm tall) from areas that have abundant mosses, cottongrass and other dwarf shurbs. It should also be in line with the moorland management plan associated with the Countryside Stewardship scheme.

The contractor will:

- Cut and collect 660 dumpy bags of heather brash
- Cutting should mimic typical patterns of traditional heather burning – strips approximately 30m by 50m should be mown in an appropriate distribution.
- Harvest as much of the sward as possible collecting mosses as well as vascular plants but without exposing the soil.
- Transport bags from the cutting sites to the airlifting site.
- Use cutting equipment appropriate to the sensitive moorland landscape. Duel wheeled tractors may not be an option depending on the cutting ground.
- Depending on the cut sites, bags may be able to be flown directly to the restoration site.
- Cut sites will need to be negotiated with the estate.

Spreading heather brash

- Brash should be spread over the bare peat areas by hand using pitch forks to minimise the ground disturbance.
- Spreading should leave a thin carpet of brash, approximately 5cm thick, evenly across the bare peat. Bare peat should still be slightly visible through the brash carpet. This prevents the formation of mulch which would prevent vegetation growth.
- Heather brash should be spread within 2 weeks of harvesting.
- Areas of existing bog vegetation should not be covered unless it is colonising Common cottongrass.

Coir rolls

Small active channels within the hagg system will be causing sediment movement and erosion. Coir rolls should be used to slow the water running along these channels, this will stabilise the hydrology and promote re-vegetation. Coir is a biodegradable and sustainable waste product from the husk of coconut shells.

- Coir rolls should measure 300mm in diameter and be 3m long.
- Coir rolls should be placed no more than 10 meters apart.
- 380 coir rolls will be required.
- They should be secured in places using at least 6 timber stakes (suggested dimensions are 600mm long and 30mm thick). 2280 stakes in total.
- Coir rolls should be dug into the peat surface by 100mm to ensure water does not undercut the roll.
- The middle of the roll should be the lowest point to allow excess water to drain over the roll rather than cutting around the sides.
- If the gully is adjacent to vegetated peat the coir rolls should be placed at an angle to divert water into surrounding vegetation.

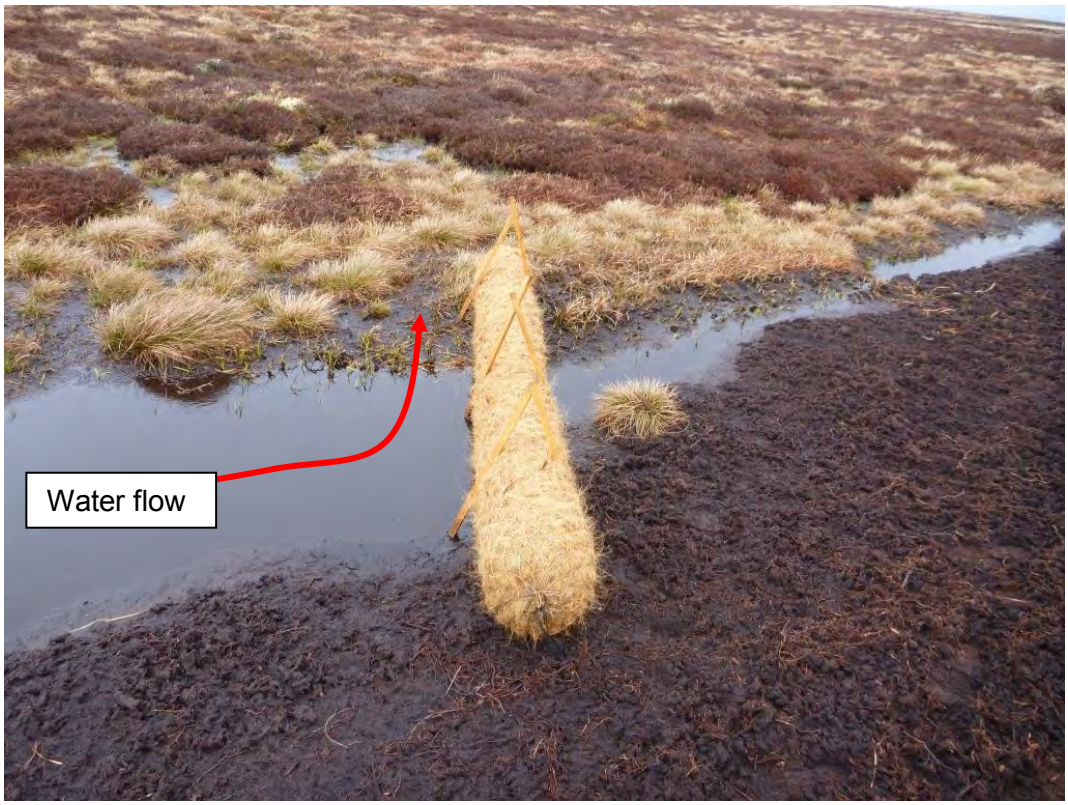


Fig. 2: Coir roll secured into place to divert water into existing vegetation

Airlifting materials

Brash and materials will be transported over land by the contractor to an appropriate life site. This will prevent damage occurring to the fell from tracking multiple loads over the same route.

Contractors will need to organise

- Airlifting 660 bags of heather brash from the lift site to the restoration site. Bags should meet helicopter company standards and be bound together in either 4s or 6s using suitable grade rope.
- Airlifting 380 coir rolls and 2280 stakes to site. It is the contractor's responsibility to ensure that all materials are ready and safe to lift.
- 100 units of stone (750kg per unit).

This includes hiring an appropriate helicopter company, organising dates with the estate, organising materials ready to be lifted and also ensuring that materials are lifted to the correct positions within the bare peat site.
The contractor will provide a minimum of 1 person at the drop site, 2 people at the lift site and 2 people on site to re-build the dams where necessary. If the helicopter will be flying close to the road the contractor will also need to provide 2 marshals on the road so that they can stop traffic and then direct it when safe.

Lime, fertiliser and seed

Heather grows best at pH 4.5 and *Sphagnum* species will now grow on restoration sites below pH 3.4. In general if the pH is below 4 most vascular plants and bryophytes will suffer from aluminium and acid toxicity levels.

Typical pH on bare area in the North Pennines range from 3.7 to 3.9, therefore lime will be added to the bare peat.

- Lime should be applied as granulated (prilled) lime (e.g. Calciprill) at a rate of 1 tonne/ha.

- 4 tonnes of lime is needed in total
- Lime should be applied in February or March however if this is not possible then it should be applied after the heather brash has been spread.
- Lime should be spread with small spreaders mounted on ATVs or very low ground pressure vehicles and only spread onto bare peat, not existing vegetation.

Studies have shown that phosphate is a limiting factor for vegetation growth. Therefore phosphate based fertiliser should only be added to the brashed area.

- P_2O_5 should be added at least two weeks after the lime has been spread.
- P_2O_5 should be added at a rate of 19.5kg/ha. Total weight will depend on fertiliser compositions. For example Triplesuperphosphate (TSP phosphate) is 46% phosphate therefore would need to be added at a rate of 42kg/ha.
- P_2O_5 should be spread with small spreaders mounted on ATVs or very low ground pressure machinery. In some cases spreading material by hand will be needed to minimise damage.

Moorland seed typical of the North Pennines should be added to the brashed areas. This will boost the current seed source and act to stabilise the bare peat once the vegetation has started to grow.

- Seeds should be suitable for North Pennines blanket bog. Species will include *Calluna vulgaris (60% max), Descampsia flexuosa, Eriophorum vaginatum, Eriophorum angustifolium and Festuca ovina*.
- Seed should be heat treated.
- Seed should be added at a rate of 10kg/ha
- Seed should be applied with the fertiliser application.
- Seed should be spread with small spreaders mounted on ATVs, very low ground pressure vehicles or by hand.

There is 4ha of bare peat to be treated with lime, seed and fertiliser (maps 5, 6, 7, 8 & 9).

Machinery and access

The machinery employed in this work must not damage the delicate vegetation and underlying peat. Vehicular access to the sites will be limited to tracked excavators or other necessary low ground pressure vehicle, generally with ground pressure of less than 3lbs per square inch. Any vehicle that becomes bogged down must be removed (after discussions with the landowner and necessary agencies) by the contractor and at the contractor's expense. Access routes and timings must be agreed with the landowner prior to commencement and adhered to at all times.

Some of the bare peat restoration sites on the North side of Wemmergill Estate are in the Ministry of Defence (MOD) Danger Area (Map 10). This area has 'over firing rights' which means that the area is inaccessible to members of the public however Wemmergill Estate staff and contractors are able to access the area under an exemption. However the MOD can restrict access to this area if they are using certain types of larger guns on the range. During these occasions' access and restoration work will be completely restricted. It will be up to the contractor to ensure they know when restrictions apply to this area.

Helicopters carrying out restoration work **must not** fly beyond Wemmergill Estate boundary and over the MOD owned land (map 10). This is restricted airspace unless the work is being carried out during a non-firing day and even then it will need pre-approval from the MOD.

Please note, although this area is only in the extended firing area it is still within the MOD Danger Area and therefore care should be taken when working in this area. There is a risk that ordnance could be found, if this is the case all work must stop and the contractor must inform the Warcop Military Range on 017683 43227. Work will only continue after the MOD has deemed it safe.

Project timing

The project will start 1st January 2018 and run until the 31st December 2019. Negotiations with the landowner will determine whether any work can be completed between 15th July and the 12th August.

No works will take place in the bird breeding season which is between 1st April to the 15th July.

Shapefiles can be made available to the contractor by the estate.

Management

The contractor will need will to gain all of the relevant permissions for the bare peat restoration work. Please note some may be charged for permissions.

The contractor will be required to take photos of the work along with a GPS location for each picture. The contractor will provide all of the photos to the client once the work is completed in a useable format. This will include either mapinfo or shapefile of all of the photo locations so that they can be re-visited. This is to fulfil the requirements of the Countryside Stewardship agreement. Photos required are:

- Photo of each stone dam
- 5 photos of each bare peat site to show what work has been done

The contractor will need to manage the entire project with an experienced person/people:

- Carry out further survey work on the bare peat sites to determine brash drop locations.
- The contractor will need to work with the estate to find appropriate airlifting sites and cutting sites.
- Checking the work every 3 days throughout the entire works to ensure mistakes or issues can be identified and resolved quickly.
- Keep the estate up to date with works on a regular basis

<u>Quotation completion</u>

Contractors must provide:

- A short method statement for each part of the work:
  1) Grip re-profiling
  2) Hagg re-profiling
  3) Stone dams
  4) Heather brash
  5) Coir rolls
  6) Transport
  7) Lime, fertiliser & seed

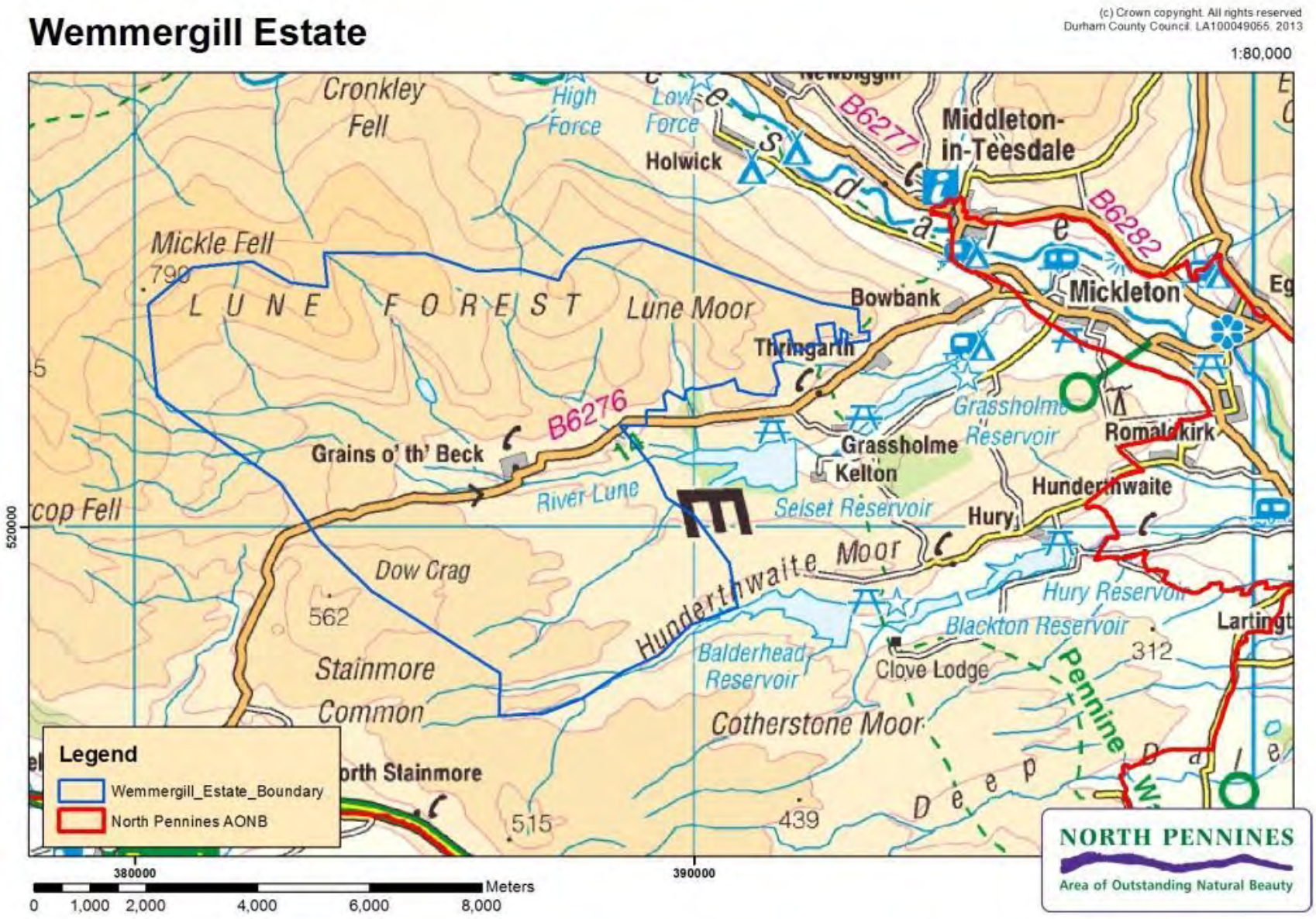
The method statement will include: methods of transport for materials, day to day access, construction methods. Full details of contractor experience restoring bare peat in the North Pennines and how the contractor intends to manage the work and complete it to the deadlines should be submitted together with:

- A health and safety statement detailing compliance with the relevant legislation and site specific issues.
- A completed bill of quantities – see below

Bill of Quantities

Restoration works on Ousby Common				
Item		Quantity	Rate	Total Cost £
1	Grip re-profiling	3200m		
2	Hagg re-profiling	3000m		
3	Stone Dams Supply and installation of stone dams. 600kg of stone per dam unit.	100 units		
4	Heather brash Cutting, collecting, transporting and spreading heather brash as per specification.	660 bags		
5	Coir Rolls Supply and installation of coir rolls. Using at least 6 stakes per coir roll.	380 coir rolls & 2280 wooden stakes		
6	Transport Airlifting all materials to site, including packing all materials ready for lifting using appropriate means, organising lifting materials to site in appropriate locations			
7	Application of lime, fertiliser and seed To spread lime, seed and fertiliser across all of the bare peat on site (4ha in total)	4 tonnes of lime, 19.5kg/ha of P_2O_5 40kg of moorland seed mix		
7	Management of works To manage all of the works above including carrying out further survey work, applying for any necessary permissions, ensure work is completed to a high standard and work is documented with the aid of photos.			
8	**TOTAL COSTS**			

Map 1


Wemmergill Estate
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Durham County Council. LA100049055. 2013
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Cronkley Fell
High Force
Low Force
Holwick
B6277
Middleton-in-Teesdale
B6282
Mickle Fell
799
L U N E F O R E S T
Lune Moor
Bowbank
Mickleton
Thringarth
B6276
Grains o' th' Beck
River Lune
Grassholme Reservoir
Grassholme
Kelton
Romaldkirk
Hunderthwaite
Selset Reservoir
Hury
Hunderthwaite Moor
Dow Crag
562
Hury Reservoir
Blackton Reservoir
Balderhead Reservoir
Clove Lodge
312
Stainmore Common
Cotherstone Moor
Pennine
Deep
515
439
Legend
Wemmergill_Estate_Boundary
North Pennines AONB
380000
390000
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NORTH PENNINES
Area of Outstanding Natural Beauty

Map 2

Wemmergill Estate Boundary

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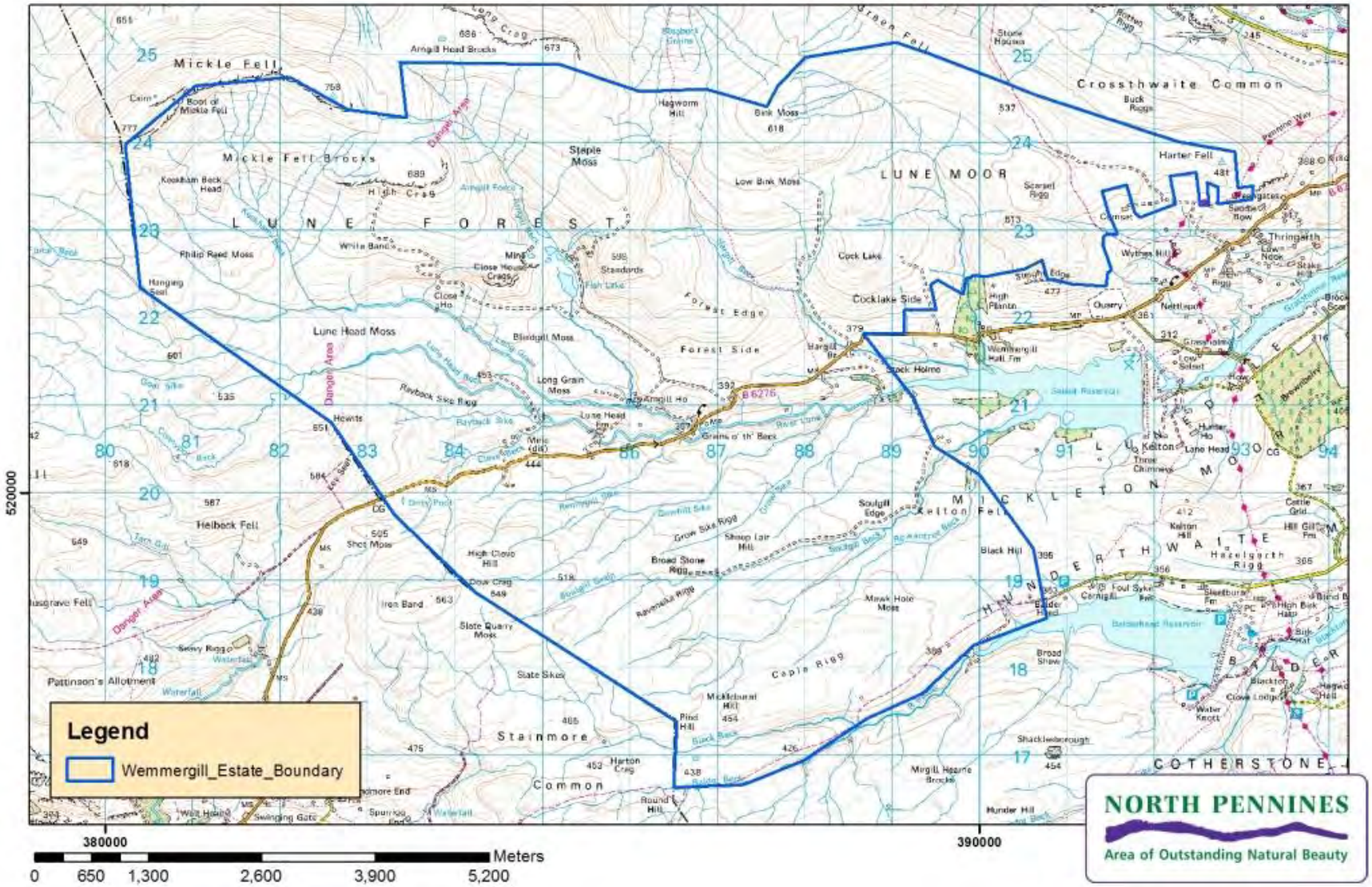

Map 3

Wemmergill Estate Bare Peat Restoration Works

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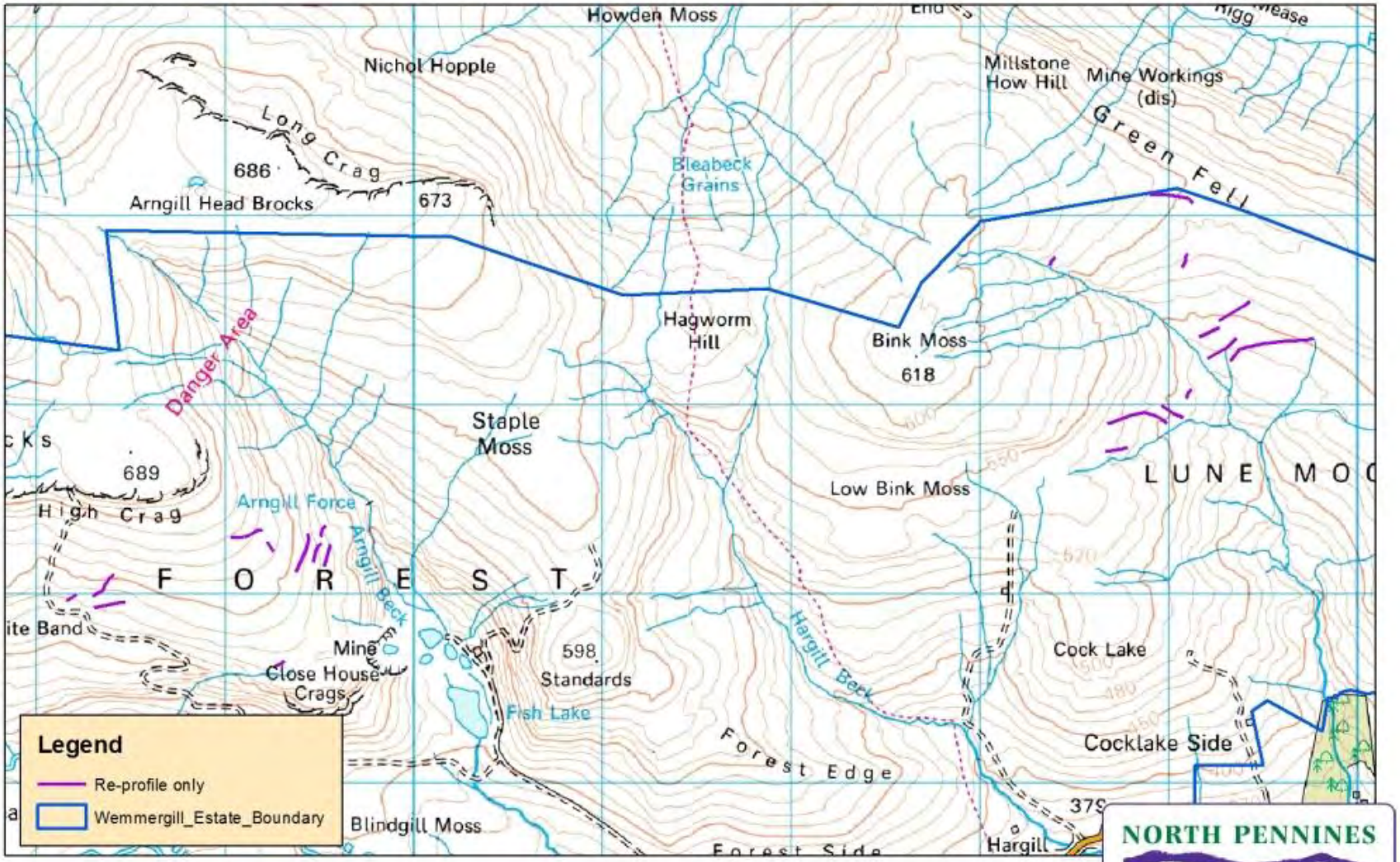
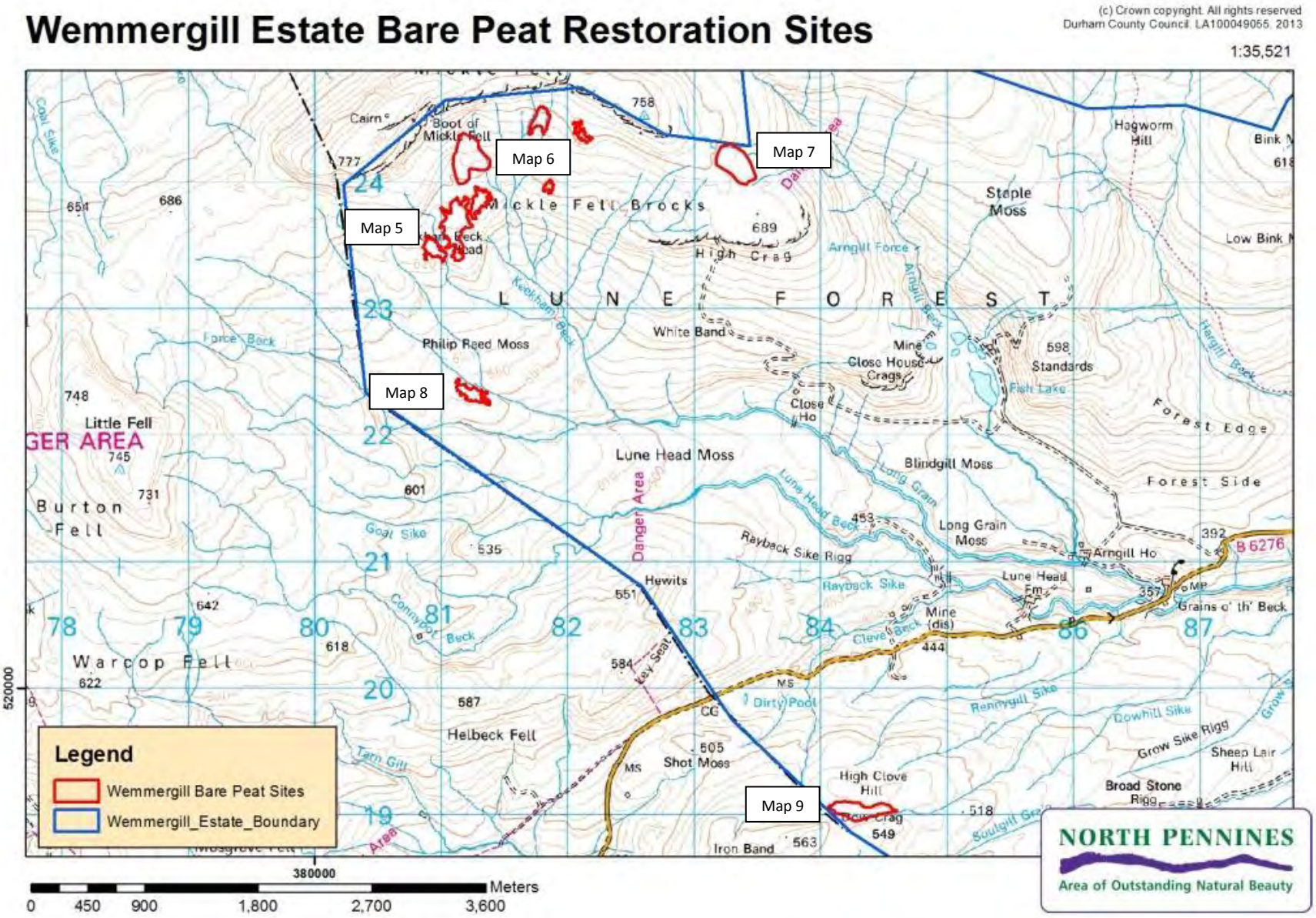


Map 4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Map 5
Map 6
Map 7
Map 8
Map 9
Legend
Wemmergill Bare Peat Sites
Wemmergill_Estate_Boundary
380000
520000
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NORTH PENNINES
Area of Outstanding Natural Beauty

Map 5

Wemmergill Estate Bare Peat Restoration Works

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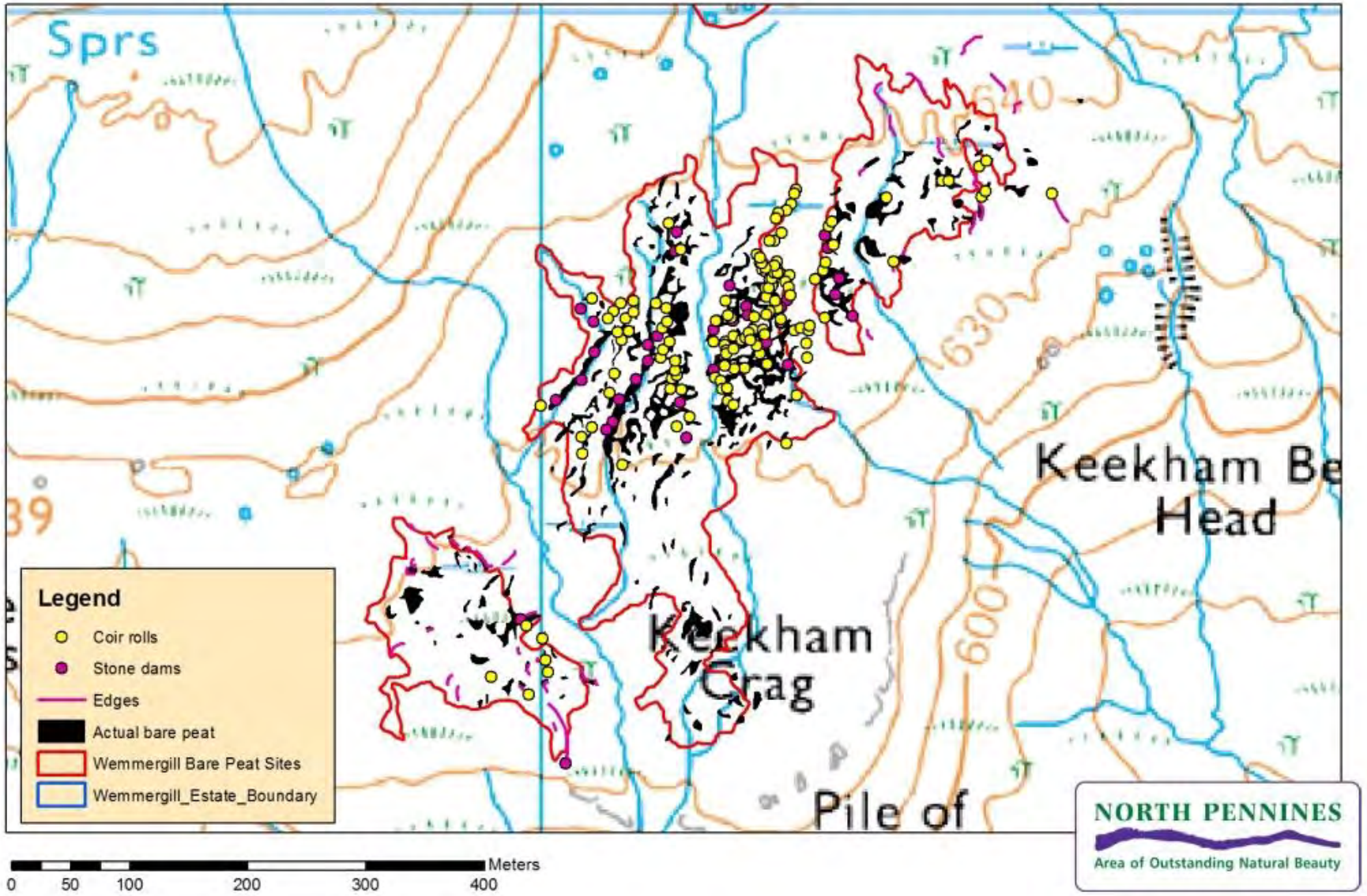

Map 6

Wemmergill Estate Bare Peat Restoration Works

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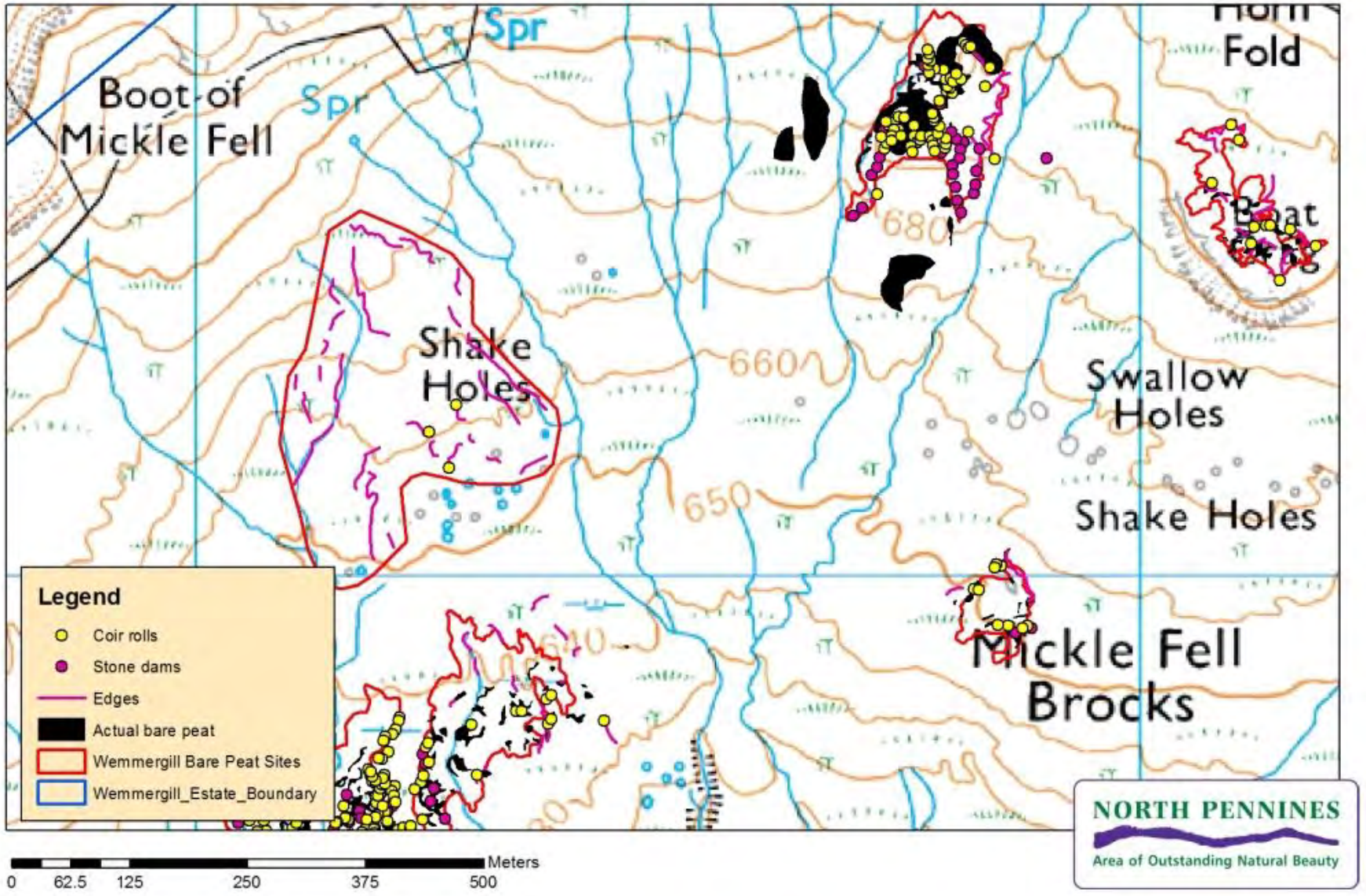
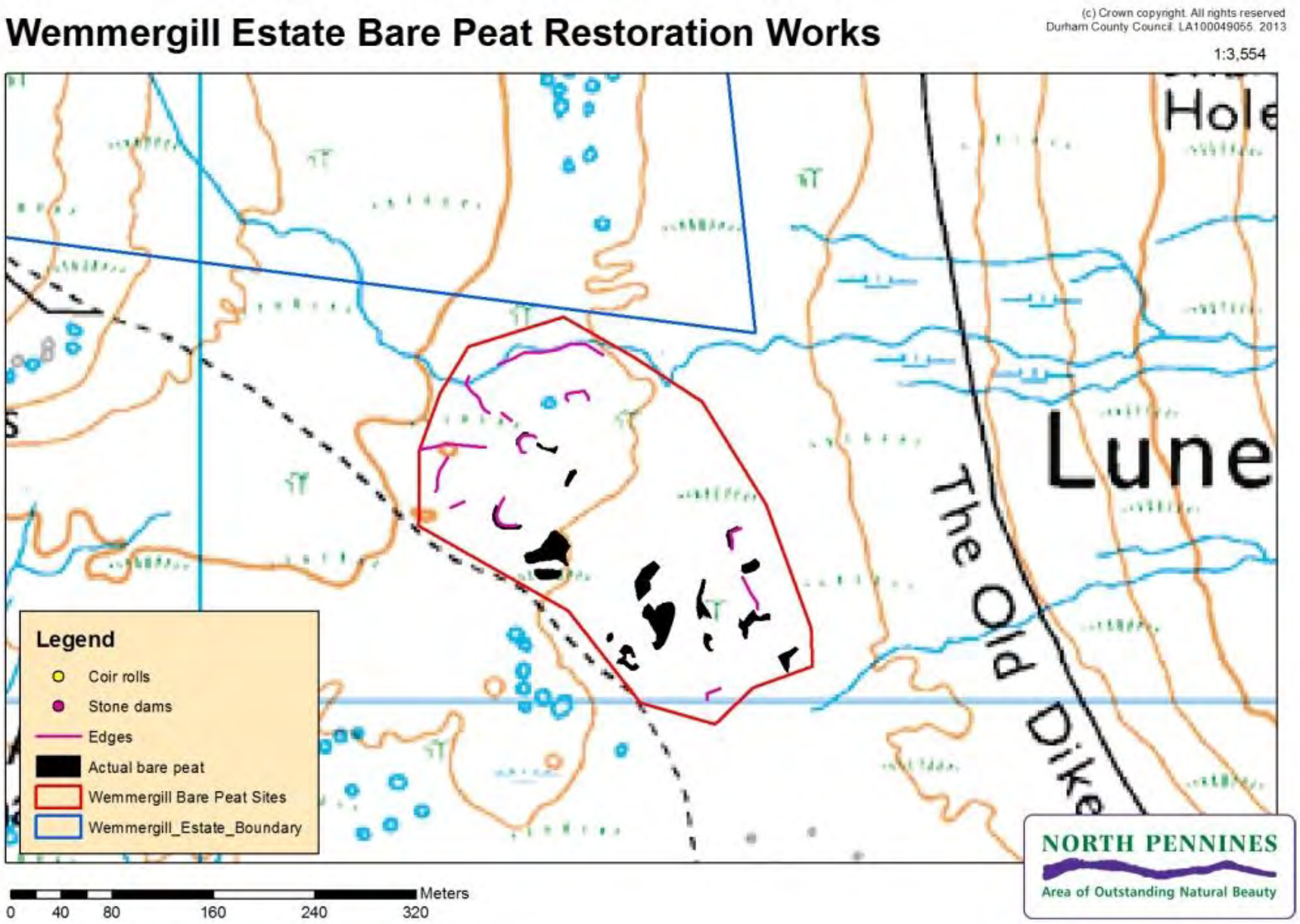


Map 7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Hole
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Legend
Coir rolls
Stone dams
Edges
Actual bare peat
Wemmergill Bare Peat Sites
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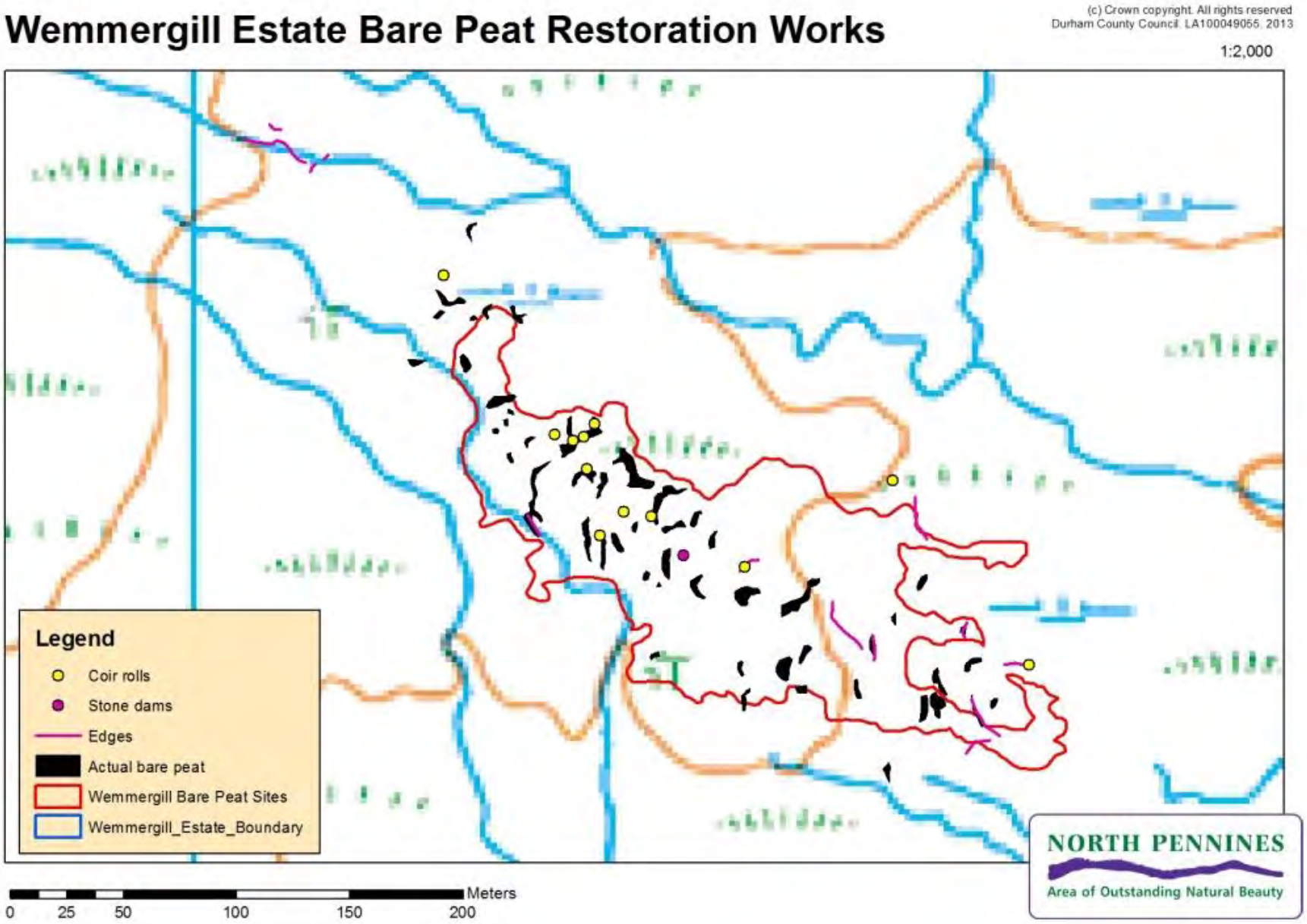
NORTH PENNINES
Area of Outstanding Natural Beauty

Map 8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Legend
Coir rolls
Stone dams
Edges
Actual bare peat
Wemmergill Bare Peat Sites
Wemmergill_Estate_Boundary
Meters
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NORTH PENNINES
Area of Outstanding Natural Beauty

Map 9

Wemmergill Estate Bare Peat Restoration Works

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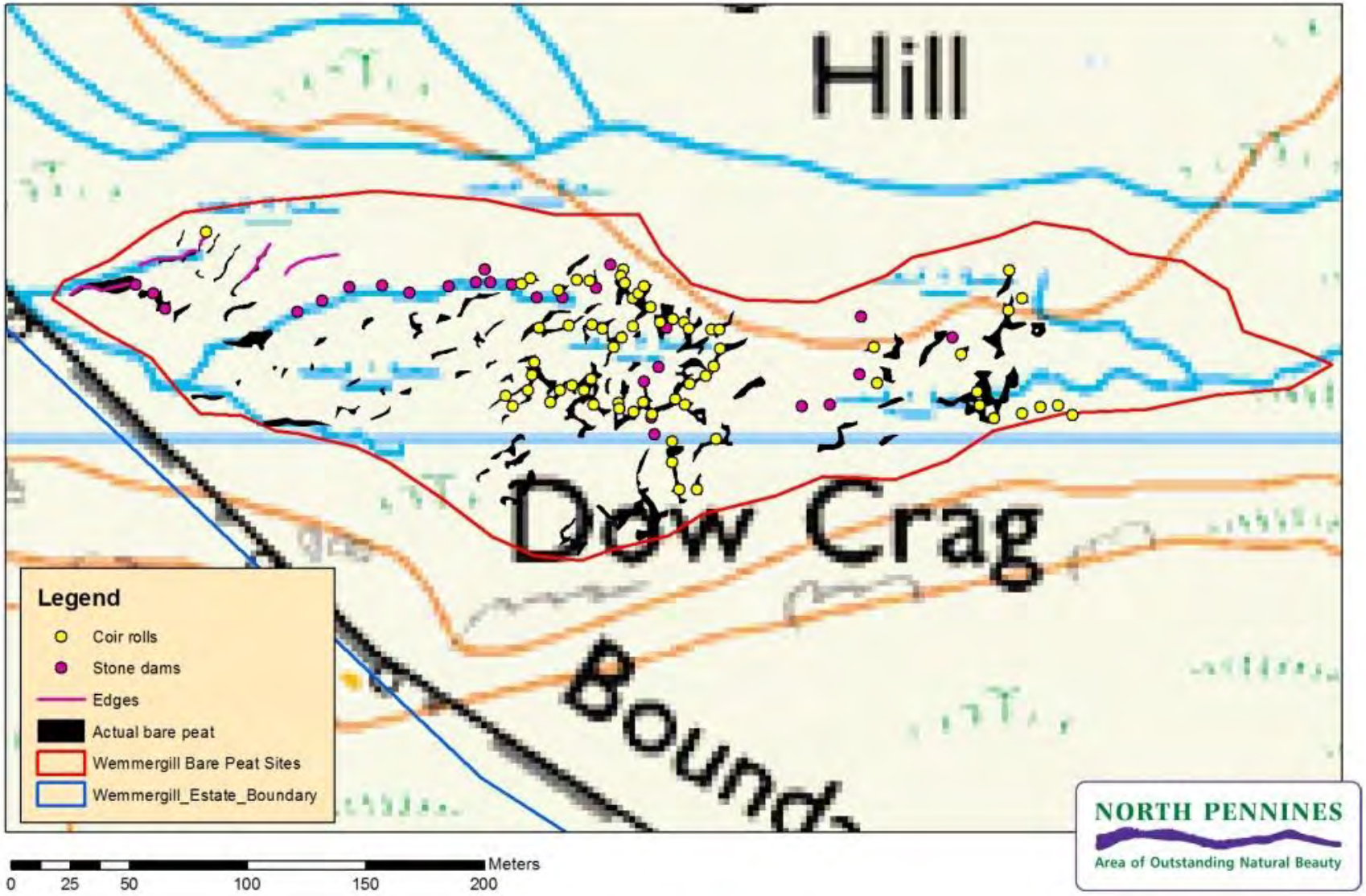
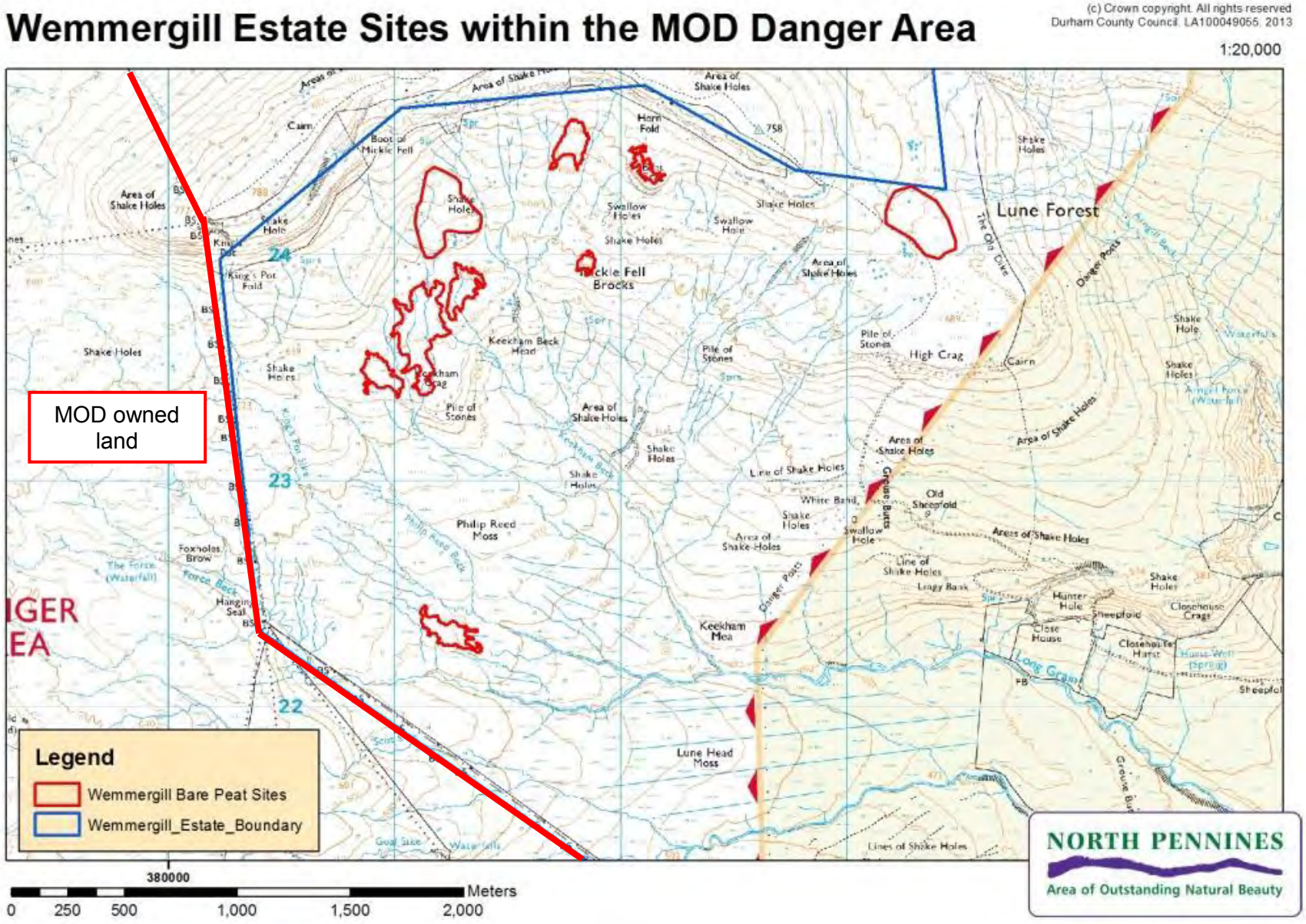


Map 10


Wemmergill Estate Sites within the MOD Danger Area
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1:20,000
MOD owned land
Lune Forest
Legend
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NORTH PENNINES
Area of Outstanding Natural Beauty