

Warton Crag Quarry LNR Management Plan 2020 - 2025



Compiled by

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Appendix 1: Warton Crag Quarry map of existing habitat and features

Appendix 2: Warton Crag Quarry map of required management

Appendix 3: Warton Crag LNR By-laws

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Responsibility for the management of Warton Crag Quarry falls under the direction and supervision of the Arnsdale & Silverdale Area of Outstanding Natural Beauty, led by the Nature Reserve Warden in conjunction with the Countryside Officer and AONB Manager.

Works to achieve the site management objectives will be carried out by the Reserve Warden, the 'Friends of Warton Crag' volunteer group and other agreed AONB staff, volunteer groups and interested parties.

Financial support of the warden's time to support the execution of these works on an annual basis is agreed and supported by Lancashire County Council and the Arnsdale & Silverdale AONB .

1 SITE DESCRIPTION

1.1 General Information

Warton Crag Quarry is a disused limestone quarry (abandoned in 1966) on the south side of Warton Crag, c 500 m to the west of Warton village Main Street and c 1.5 km to the north of Carnforth. The Quarry forms part of a large area of Warton Crag which is managed as nature reserve, covering the southern side of the hill to the south of Occupation Road. The 6.5 hectares of disused quarry was bought by Lancashire County Council in 1991, while 27 ha to the north and west of the quarry was purchased in 1987 by the Royal Society for the Protection of Birds (RSPB), 19.4 ha to the east of the quarry was donated to Lancaster City Council in 1948, and a further 33.6 ha around the hill summit is leased by Lancashire Wildlife Trust (LWT) for 99 years from July 1988.

Site Name	Warton Crag Quarry LNR
County	Lancashire
Local Planning Authority	Lancaster City Council
Civil Parish	Warton
Grid Reference	SD 491 724
Access points	Via car park entrance from Crag Road.
Area	6.5 ha (16.4 acres)
Maps	1:50,000 - 97, 1:10,000 - SD 47 SE 1:2,500 - SD4872 & SD4972
Tenure	Lancashire County Council: 6.5 ha (16.4 acres) purchased in 1991.
Legal rights of access	Public vehicular access is freely available to the car park (subject to restricted head height), from where there is access by foot to the grassland and lower areas of woodland within the Quarry area and paths leading to the adjacent Lancaster City Council and RSPB owned areas of Warton Crag.
Common rights	None.
Bye-laws	Applicable to the Local Nature Reserve (Quarry and adjacent Lancaster City Council owned area of Warton Crag) - see Appendix 3.
Status	1) The land lies wholly within the Arnside/Silverdale Area of Outstanding Natural Beauty (AONB). 2) The Quarry was declared a Local Nature Reserve (LNR) in 1993 (added to the neighbouring Lancaster City Council owned LNR declared in 1984). 3) Warton Crag Quarry and Cliffs Lancashire Biological Heritage Site (BHS). 4) Component of the Warton Crag Local Geological Site (LGS), which covers 330 ha over the whole Crag. 5) Warton Crag Site of Special Scientific Interest (SSSI) lies immediately to the north and east. 6) Warton Crag south of Occupation Road BHS lies immediately to the west. 7) Crag Road Verge BHS lies immediately to the south.
Legal obligations	Occupiers Liabilities Act requires duty of care not to expose visitors to known dangers. This includes provision of fencing and signage at the top and base of the quarry face.

Summary Description

The disused quarry lies on the south-facing side of the natural limestone hill, Warton Crag. Commercial quarrying commenced in 1931 and, by the time the site was abandoned, the quarry works had created a quarry face of up to 51 m high across a width of approximately 275 m.

After abandonment, the bare quarry floor gradually developed a sparse, early succession vegetation, while ephemeral pools supported aquatic plants and provided habitat for palmate newts. The bare quarry face provided a breeding site for kestrels and a colony of jackdaws and, in more recent decades, has also been used regularly by breeding peregrine and raven.

Following acquisition by Lancashire County Council the area beneath the cliff face, including the pools, was fenced to restrict casual access beneath the unstable rock face and has been allowed to continue its slow vegetation development, while the area of the quarry floor nearest to Crag Road was landscaped to create a small car park and a seeded mound of species-rich grassland.

The margins around the sides and top of the quarry support semi-natural vegetation typical of the adjoining undeveloped parts of Warton Crag, including blue moor-grass dominated grassland over thin limestone soils, mixed scrub and mature ash-dominated woodland (though there is also a small larch plantation within this).

Plant species recorded in Warton Crag Quarry include dark red helleborine, bird's-eye primrose, bee orchid, black bog-rush and limestone bedstraw, while lady's slipper has also been successfully introduced as part of a wider species recovery programme.

Outside of the peregrine nesting season, the quarry face is used by climbers, though in smaller numbers than elsewhere on Warton Crag due to the difficulty of the slopes and the instability of much of the rock-face.

1.2 Environmental Information

1.2.1 Physical and Biological Information

Warton Crag Quarry lies within 2km of the Morecambe Bay coast, at the southern end of the Arnsdale & Silverdale AONB. The southern flank of Warton Crag, including all of the exposed rocks in the Quarry, lies within the Park Limestone Formation. Stratigraphic and structural features are revealed within the quarry exposures.

Warton Crag is one of a series of limestone hills around Morecambe Bay, which support important mosaics of limestone grassland, rock, scrub and woodland habitats; with a huge diversity of associated plant and animal species. The Quarry forms a relatively small part of Warton Crag, which has a particularly rich biodiversity over the immediately adjacent 80 ha of land managed by conservation bodies on the southern side of the Crag.

1.2.2 Biological Communities

The following habitats were present at Warton Crag Quarry during a site visit in November 2019.

Lowland calcareous grassland: The NVC community (Rodwell 1991 *et seq.*) **CG9 Blue moor-grass - limestone bedstraw grassland** is present over thin soils around the margins of the quarry, including along narrow ledges on the quarry face.

Lowland meadow: The seeded grassland mound next to the car park appears to be broadly a form of the neutral meadow **MG5 Crested dog's-tail - common knapweed grassland**, though elements of the calcareous **CG2 Sheep's-fescue - meadow oat-grass grassland** are also present.

Open mosaic habitats on previously developed ground: Sparsely scattered vegetation covers the fenced part of the quarry floor, including **S19 Common spike-rush swamp** in the ephemeral ponds (possibly tending towards **S8 Common club-rush swamp** and **S12 Common reedmace swamp** in parts) and sedge-dominated vegetation over damp ground.

Upland mixed ashwoods: Mature ash-dominated woodland covers land bordering the quarried area to its north-west, south-west and south-east. This mostly appears to be the lowland **W8 Ash - field maple - dog's mercury woodland**, though the more fern- and moss-rich upland ash community **W9 Ash - rowan - dog's mercury woodland** may occur over rocky ground and thinner soils. A small part of the south-western woodland block, at the top of the quarry, has been planted with non-native larch trees.

Scrub: A mix of **W21 Hawthorn - ivy scrub**, **W23 Gorse - bramble scrub** and **W24 Bramble - Yorkshire-fog underscrub** is scattered around open margins of the quarry and over parts of the quarry floor.

1.2.3 Cultural/ Historical Information

The quarry was worked between 1931 and 1966 and, in the later working years, much of the quarried material went to construct the M6 motorway.

The British Mountaineering Council (BMC) published a revised 'Lancashire Area Climbing Guide' in 2016, which includes details of routes on Warton Crag Quarry. Climbing on the friable and loose quarry face is restricted and closed during the peregrine breeding period - usually from March to the end of July each year - as the peregrine is a protected species under Schedule 1 of the 1981 Wildlife & Countryside Act.

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2 EVALUATION AND OBJECTIVES

2.1 Evaluation of Features

2.1.1 Size

At 6.5 hectares the site is relatively small but its key function lies in forming a complimentary part of the extensive 86.5 ha Warton Crag nature reserve that covers most of the southern part of Warton Crag; in particular providing habitats which are not present elsewhere in the reserve and so enhancing the overall biodiversity of the reserve. The combined area of nature reserve on Warton Crag is a reasonable size for a lowland habitat, comparable to Arnside Knott but less extensive than Whitbarrow Scar or Hutton Roof Crag and Farleton Fell.

2.1.2 Diversity

Despite being by far the smallest part of the Warton Crag reserve, the Quarry supports several of the key habitats found more extensively elsewhere on the Crag, notably calcareous grassland and ash-dominated woodland, but also includes habitats which are unique to this part of the Crag; particularly the high quarry face and the thinly scattered colonising vegetation and ephemeral pools of the quarry floor.

Few biological records appear to exist that cover the Quarry distinctly from other parts of Warton Crag, so a full indication of the diversity of species present cannot be provided at this point. However, it is clear there are a number of species which are found in the Quarry that do not occur elsewhere on the Crag. These include the cliff-nesting birds of the quarry face (peregrine, kestrel, raven and jackdaw), the palmate newts found in the pools, and the plants lady's slipper, bird's-eye primrose and black bog-rush.

2.1.3 Naturalness

The whole of Warton Crag has been modified to a degree by past activities including small-scale quarrying and grazing, but nevertheless supports a good range of habitats that would naturally occur on its thin soils and rocky landscape; including blue moor-grass dominated calcareous grassland, ash-dominated woodland and limestone pavement (though the woodland all appears to be secondary and of relatively recent origin with no indication of ancient woodland presence, while much of the grassland has been sustained by grazing or has resulted from recent colonisation of quarried rock). The Quarry has clearly been heavily modified through its use over some 35 years in the mid 20th century as a commercial quarry, and would otherwise be expected to look similar to the adjacent lower slopes of the Crag on the City Council and RSPB land. Further artificial development has taken place since the closure of the working quarry, including the creation of the car park and the landscaping to hasten development of a grassland area. However, much of the quarry floor has been allowed to develop naturally, with an interesting range of early successional vegetation, while the quarry face provides an artificial high cliff which has encouraged natural colonisation by bird species that require such inaccessible nesting locations.

2.1.4 Rarity

Lowland calcareous grassland, lowland meadow, upland ashwoods and open mosaic habitats on previously developed ground are all uncommon habitats nationally and are listed as priority habitats for conservation concern in England on Section 41 of the 2006 NERC Act.

Peregrine is protected under Schedule 1 of the 1981 Wildlife & Countryside Act due to a severe decline in its population numbers during the second half of the 20th century associated with pesticide use, though the species has been recovering well in the last few decades. Kestrel is listed as an amber species of medium concern on the 2015 Birds of Conservation Concern, due to recent population decline.

While recently introduced as part of a species recovery scheme, lady's slipper is an extremely rare plant which, prior to this and other introductions, was found only at two UK locations (Silverdale and Yorkshire), and is both protected under Schedule 8 of the 1981 Wildlife & Countryside Act and listed as a priority species for conservation concern in England on Section 41 of the 2006 NERC Act. Two other plant species found at the Quarry, dark red helleborine and bird's-eye primrose, are nationally scarce (i.e. found in less than 100 10 km squares in the UK).

Other Section 41 species of conservation concern or red and amber birds have been recorded on Warton Crag that are likely to occur in the Quarry. These include slow-worm, marsh tit, song thrush, grayling and dingy skipper.

2.1.5 Fragility

The habitats within the Quarry area are generally relatively robust. The quarry floor and grassland areas are vulnerable to scrub invasion, leading to shading of key plant species and eventual loss of habitat through succession to scrub and woodland. Periodic control of scrub may be necessary to maintain open habitats, though spread across the quarry floor appears to be very slow and is unlikely to require major intervention.

Prior to acquisition by Lancashire County Council, the abandoned quarry site had been vulnerable to dumping of rubbish and unauthorised use by vehicles, but formalising the car park area and fencing off the quarry floor beneath the quarry face has largely alleviated these problems.

Peregrine and kestrel would be vulnerable to disturbance from climbers, and the former also to egg collectors, but climbing is restricted only to outside the breeding season and the nest is well monitored by volunteers. The lady's slipper and other more notable plant species all occur in the fenced area, so are not subject to significant public attention.

2.1.6 Typicalness

The Quarry is one of a small number of abandoned quarries within the AONB, including Trowbarrow and Middlebarrow, and each demonstrate geological features typical of their wider area. The vegetative development of each has been slightly different, however, and while there are some similarities in the habitats and species found at these sites, there are also many differences.

While calcareous grassland and upland ashwoods are uncommon in a national context, these habitats are typical of the landscape mosaic of limestone habitats within the Arnside & Silverdale AONB.

2.1.7 Recorded History

The site was worked as a commercial quarry from 1931 until 1966, providing stone for the construction of the M6 motorway during its later years. The site lay abandoned for 25 years until acquisition by Lancashire County Council in 1991; after which the car park was built and the adjacent area landscaped with a mound of seeded grassland, while the quarry floor beneath the quarry face was fenced and use of the quarry face by climbers was controlled. Subsequently, the site has been subject to only very low-key management including limited scrub control and infrequent cutting of the grassland.

The Quarry has not been a focus for collection of biological records to the extent that other parts of the Crag have. Compilation of any existing records and future targeted efforts to record species present in the Quarry would be valuable.

2.1.8 Position in Ecological/Geographical Unit

Warton Crag is the most southerly of a set of limestone hills encircling the head of Morecambe Bay. Warton Crag Quarry lies on the southern side of Warton Crag, near the southern edge of the Arnsdale & Silverdale AONB, and forms part of the extensive mosaic of semi-natural habitats which surround the site and stretch across much of the AONB.

The Quarry lies immediately adjacent to Warton Crag SSSI, within 1 km of Morecambe Bay SSSI, SAC, SPA and Ramsar site, within 2 km of Leighton Moss SSSI, SPA and Ramsar site and within 3 km of Cringlebarrow Wood SSSI (which forms part of the Morecambe Bay Pavements SAC). The Quarry also lies immediately adjacent to the Lancashire Biological Heritage Sites at Warton Crag South of Occupation Road and Crag Road Verge, as well as within 1 km of Warton Crag North of Occupation Road, Barrow Scout, Ings Point Railway Cutting and Ings Point Cliff.

2.1.9 Potential Value

Given the small scale of the site and the nature of its habitats, there is not huge scope for habitat enhancement, so the main target for management will be to maintain existing habitats in optimum condition. There is, however, potential for improving collection of biological records within the Quarry, which then may help guide future tweaks in management practices to provide specific requirements for particular notable species. There is also potential for increasing use of the site as an educational resource, given the good range of habitats and species that are present and that are very easily accessible.

2.1.10 Intrinsic Appeal

As part of the Arnsdale & Silverdale AONB, the landscape value of the site is high. Warton Crag, including the prominent scar of the quarry, is a particularly distinctive feature in the landscape when approaching the AONB from the south along the A6 or M6, and also when viewed from Morecambe across Morecambe Bay. Within the site, the tall quarry face is a striking feature, softened by the surrounding limestone grassland, scrub and woodland habitats.

The small car park and ease of access makes the site an attractive site to visit, both for the Quarry itself (e.g. by families and dog walkers) and as a starting point for visiting other parts of Warton Crag and beyond within the AONB.

2.2 Summary of important features

Feature	Status
Habitat	
Lowland calcareous grassland	S41 2006 NERC Act priority habitat for nature conservation
Lowland meadow	S41 2006 NERC Act priority habitat for nature conservation
Open Mosaic Habitats on Previously Developed Land	S41 2006 NERC Act priority habitat for nature conservation
Upland mixed ashwoods	S41 2006 NERC Act priority habitat for nature conservation
Geological Interest	
Limestone exposure (disused quarry)	Warton Crag Local Geological Site (LGS)
Historical Interest	
Historic quarry	local
Species	
Birds	
peregrine <i>Falco peregrinus</i>	WCA 1981 Schedule 1 (pt1) protected species; BHS qualifying species - Av3 (scarce Lancashire breeding bird)
kestrel <i>Falco tinnunculus</i>	BoCC4 Amber list species - medium conservation concern
raven <i>Corvus corax</i>	BHS qualifying species - Av3 (scarce Lancashire breeding bird)
jackdaw <i>Corvus monedula</i>	colony of local interest
marsh tit <i>Poecile palustris</i> *	BoCC4 Red list species - high conservation concern; S41 2006 NERC Act species of conservation concern
song thrush <i>Turdus philomelos</i> *	BoCC4 Red list species - high conservation concern; S41 2006 NERC Act species of conservation concern
Butterflies	
grayling <i>Hipparchia semele</i> *	S41 2006 NERC Act species of conservation concern
dingy skipper <i>Erynnis tages</i> *	S41 2006 NERC Act species of conservation concern
Plants	
lady's slipper <i>Cypripedium calceolus</i>	Protected under Schedule 8 of the 1981 Wildlife & Countryside Act; S41 2006 NERC Act species of conservation concern; BHS qualifying species - Ff1 (protected Flowering Plant or fern)
dark red helleborine <i>Epipactis atrorubens</i>	Nationally scarce; BHS qualifying species - Ff2 (nationally scarce Flowering Plant or fern)
bird's-eye primrose <i>Primula farinosa</i>	Nationally scarce; BHS qualifying species - Ff2 (nationally scarce Flowering Plant or fern)
black bog-rush <i>Schoenus nigricans</i>	BHS qualifying species - Ff3 ('endangered' Flowering plant or fern in Lancashire)
limestone bedstraw <i>Galium sternerii</i>	BHS qualifying species - Ff4b ('sensitive' Flowering plant or fern in Lancashire)
bee orchid <i>Ophrys apifera</i>	BHS qualifying species - Ff4b ('sensitive' Flowering plant or fern in Lancashire)

Reptiles & Amphibians	
slow-worm <i>Anguis fragilis</i> *	species of conservation concern under Section 41 of the 2006 NERC Act/ UK Priority BAP; Protected under Schedule 5 of the 1981 Wildlife & Countryside Act (Section 9.5 only)
common toad <i>Bufo bufo</i> *	species of conservation concern under Section 41 of the 2006 NERC Act/ UK Priority BAP; Protected under Schedule 5 of the 1981 Wildlife & Countryside Act (Section 9.5 only)
palmate newt <i>Lissotriton helveticus</i>	Protected under Schedule 5 of the 1981 Wildlife & Countryside Act (Section 9.5 only)

* Species marked by an asterisk have been recorded elsewhere on Warton Crag and are likely to be found in the Quarry, but confirmation is required.

2.3 Site Objectives

1. Safeguard the notable breeding birds nesting on the quarry face.
2. Safeguard the lady's slipper and participate in conservation schemes to help the species in the wider area.
3. Enhance the abundance and diversity of notable species present including bird, amphibian, invertebrate and plant populations.
4. Enhance the nature conservation value of the open mosaic habitats over the quarry floor.
5. Enhance the nature conservation value of the Limestone and neutral grasslands.
6. Enhance the nature conservation value of the mature woodland.
7. Safeguard the geological features of interest.
8. Maintain the landscape and amenity value of the site.
9. Promote the site as an educational resource.

3 MANAGEMENT ACTIONS

3.1 Rationale

3.1.1 Nesting birds on the quarry face

In many respects, the most distinctive feature of the Warton Crag Quarry site is the quarry face and the nesting birds that this has attracted; particularly the peregrine. Ensuring that the birds are not disturbed during the breeding season (March to July) is the overwhelming priority and good relations should be maintained with climbing groups to ensure that the closure of the quarry during this time is respected. Encouraging and assisting volunteers to monitor the peregrines and other birds will also be valuable to ensure that the birds progress unhindered through the breeding period and to report any incidents that might arise.

For the most part, the cliff face requires no active management but it should be monitored for spread of scrub, particularly non-native cotoneaster. Specialist advice would be desirable to determine the appropriate balance required for the key bird species of scrub and other vegetation (e.g. providing cover and perching) and open rock and ledges (providing hard-to-access nest sites and allowing good visibility of potential predators). Control of cotoneaster and other scrub from the quarry face is likely to be an extremely difficult and specialist task, but options for control should be investigated if monitoring and specialist advice suggests that this is appropriate.

Effort should ideally be made to gather historic data on the use of the quarry by peregrine, kestrel and raven, particularly to determine dates when the birds first colonised, and future collection of data on breeding attempts and success should be encouraged. Such data will help to guide future management and help to identify any issues which need to be addressed.

3.1.2 Lady's slipper

While the present lady's slipper plant was introduced to Warton Crag, this species would once have been fairly widespread across the limestones of northern England before being reduced to just two individual plants by the early 20th century through over-collection and habitat loss. The introduction at Warton appears to have been more successful than many other attempts, with the plant apparently thriving. A balance of light and dappled shade is required for optimum growth. Growth of scrub in the quarry is very slow, so there does not appear to be any imminent threat from over-shading, but conditions need to be monitored and some small-scale cutting back of scrub may be necessary in future years.

Liaison with others involved in the conservation of this plant is essential to ensure that optimum conditions are maintained and to participate in wider conservation efforts.

3.1.3 Species diversity

The full extent of species present within the Quarry is not known, so collecting together any existing records and initiating future surveys will be a very valuable exercise and will help to guide future management. In particular, compiling lists of plant and bird lists would be useful, along with initiating butterfly monitoring and perhaps organising occasional moth-trap evenings or investigating the palmate newt population and its habitat requirements.

3.1.4 Open mosaic habitats on the quarry floor

Maintaining the fence to limit access to the quarry floor is essential, not just to reduce the risk of injury to visitors from loose rock falling from the quarry face, but also to reduce trampling of pioneer vegetation and limit disturbance to the rare plants and the palmate newt population.

As far as possible, the quarry floor should be allowed to develop naturally and with minimum intervention. While the spread of scrub growth appears to be very slow, this needs to be monitored to ensure open habitats remain (including the pools), and some cutting back of scrub may be necessary occasionally where problems are perceived. In any scrub control, non-native species which are likely to be particularly invasive should be targeted first, including cotoneaster and sycamore.

3.1.5 Limestone and neutral grasslands

The landscaped and seeded grassland holds a good range of herb species and appears to be thriving with very little management intervention. Periodic cutting is likely to be necessary to prevent the grasses from becoming too rank and reducing species diversity, given that grazing management is unlikely to be practical, but current growth suggests this is not an annual requirement. Late August or September mowing (after most of the herbs have set seed) of thirds of the grassland on a three year rotation is likely to be sufficient. This ensures that the whole grassland area is cut once every three years, but two-thirds of the grassland each year remains uncut. Such an approach is beneficial for invertebrates as it avoids the sudden change in habitat across the whole area from long grass to short grass, re-colonisation of species into the short grass from the tall grass is therefore more rapid, and there is a broader range of vegetation heights available for different species requirements. The damp, sedge-rich area in the centre of the seeded grassland area should be excluded from cutting, in part because slow growth in this area appears not to require cutting and in part because this may provide invertebrate habitat which should not be disturbed.

It is essential to remove all cuttings within a few days of mowing to avoid a build up of nutrients in the grassland. Cuttings left to decay would fertilise the area, favouring a few highly competitive grass and herb species over species diversity.

The limestone grassland growing over thin soils is unlikely to require cutting but scrub encroachment over this and over the seeded grassland needs to be monitored and cut back where necessary to maintain all areas that currently support any grassland vegetation.

Monitoring of the grassland vegetation (e.g. recording the presence of lowland meadow and calcareous grassland indicator species within a series of quadrats) will be valuable to ensure that the mowing regime is beneficial and to inform any adjustments to the management regime that may be required.

3.1.6 Woodland

The mature woodland should largely be left to develop naturally with minimum intervention; with much of it being dangerous to access due to its cliff-top location and therefore difficult to manage anyway. Ideally, and if resources allow, effort should be made to thin or remove the larch stand, as well as removing younger sycamore trees. If this is not possible, the larch can be left to die

naturally over time, while regeneration of sycamore should be monitored and controlled where this is limiting regeneration of native trees and growth of woodland herbs.

All standing and dead wood should be left in situ as this provides habitat for a range of wood-boring invertebrates which in turn provide prey for insectivorous birds, while standing dead wood provides opportunities for hole-nesting birds such as marsh tit. Growth of ivy and other climbing plants should also be encouraged as this provides cover and structure for a range of bird nests and may also provide opportunities for roosting bats.

3.1.7 Geological interest

The geological exposures on the quarry face are of local geological interest. Significant damage to the quarry face should be avoided, and this aim will be aided by the current practice of maintaining the fenced-off area beneath the quarry face and liaising with climbing groups to ensure appropriate climbing protocols are adhered to.

3.1.8 Landscape and amenity

The proposed management to achieve nature conservation objectives should also help to enhance the landscape value of the site. However, when undertaking management works, regard should be given to the visual impact of these works and, where appropriate, they should be carried out sympathetically to the landscape.

Ongoing efforts to manage the site for visitors should continue, including maintenance of paths, gates and other structures in a safe condition, removal of litter and encouragement of dog walkers to remove dog-waste or use the dog-waste bin in the car park. Educational and interpretative material provided to visitors about the value of the site should encourage greater respect for the site and reduce incidences of littering and dog excrement.

Maintenance of existing fences and signage is essential to prevent visitor access to the top of the quarry cliff and to discourage unauthorised access to the quarry floor in order to limit danger to the public.

Any noisy or otherwise disturbing activities, to both the wildlife and to other visitors, should be discouraged and appropriate measures taken where this is in contravention of the LNR by-laws (see Appendix 3).

3.1.9 Education

Ease of access and proximity to a wide range of important habitats and species, means that the site has huge potential for educational use. This may include: offering a relatively safe, easy access site for school groups to look at the seeded grassland, see birds and butterflies and discuss the quarry; working with volunteers (e.g. Friends of Warton Crag) to offer training and encourage more systematic recording of a wider group of organisms; and facilitating university/college research projects within the Quarry and on other parts of the Crag.

3.2 Project register

<p>Operational objective 1: Safeguard the notable breeding birds nesting on the quarry face.</p> <ol style="list-style-type: none">1. Liaise with climbing groups and volunteer birdwatchers to ensure that notable cliff-nesting birds are not disturbed each year during the breeding season (March to July) and respond to any incidents reported.2. Maintain the existing fences and signage in good condition to limit access to the quarry face.3. Monitor for spread of scrub on the quarry face, particularly non-native cotoneaster.4. Seek specialist advice on appropriate balance of scrub and other vegetation and open rock and ledges to meet optimum requirements for cliff-nesting birds.5. Investigate options for control of cotoneaster and other scrub from the quarry face if required6. Control cotoneaster and other scrub from the quarry face as required and/or as opportunity arises.7. Collate historic data on the use of the quarry by peregrine, kestrel and raven.8. Collect data on future breeding attempts and success of peregrine, kestrel, raven and jackdaw in the quarry to help guide future management and identify issues which need to be addressed.
<p>Operational objective 2: Safeguard the lady's slipper and participate in conservation schemes to help the species in the wider area.</p> <ol style="list-style-type: none">1. Monitor the condition of the lady's slipper plants and their immediate environment with respect to appropriate balance of light and dappled shade.2. Carry out small-scale cutting back of scrub around lady's slipper plants if deemed necessary to prevent over-shading.3. Liaise with others involved in the conservation of lady's slipper, to exchange knowledge and participate in wider conservation efforts.
<p>Operational objective 3: Enhance the abundance and diversity of notable species present including bird, amphibian, invertebrate and plant populations.</p> <ol style="list-style-type: none">1. Encourage survey and monitoring of birds, amphibians, invertebrates, plants and other biological groups in the Quarry by volunteers or students.2. If feasible carry out or encourage volunteers to carry out weekly monitoring of butterfly populations through the summer months.3. Investigate options for arranging periodic moth trapping evenings; potentially open for volunteer or public attendance.4. Encourage research on the palmate newt population and its habitat requirements by student or appropriately knowledgeable volunteer.
<p>Operational objective 4: Enhance the nature conservation value of the open mosaic habitats over the quarry floor.</p> <ol style="list-style-type: none">1. Maintain the existing fences and signage in good condition to limit access to the quarry floor.2. Allow the quarry floor to develop naturally and with minimum intervention.3. Monitor scrub to ensure this is not depleting areas of open habitats, including the pools.4. Cut back scrub where considered necessary to maintain open habitats. Non-native species which are likely to be particularly invasive should be targeted first, including cotoneaster and sycamore.

Operational objective 5: Enhance the nature conservation value of the Limestone and neutral grasslands.

1. Mow a section of approximately one third of the seeded grassland each year in August or September (after most of the herbs have set seed) on a three year rotation, so that the whole grassland area is cut once every three years but two-thirds of the grassland each year remains uncut. Ensure that the damp, sedge-rich area in the centre of the seeded grassland is excluded from cutting.
2. Remove all cuttings within a few days of mowing to avoid a build up of nutrients in the grassland.
3. Carry out small-scale scrub control as necessary to prevent loss of grassland through shading or encroachment and to open up new areas of grassland where grassland vegetation persists beneath the scrub.
4. Monitor the grassland vegetation, e.g. by annual or biennial recording of presence of lowland meadow and calcareous grassland indicator species within a series of quadrats.

Operational objective 6: Enhance the nature conservation value of the mature woodland.

1. Allow the mature woodland to develop naturally with minimum intervention.
2. If resources allow, and where safe to do so, thin or remove non-native larch trees.
3. Control young sycamore and sycamore regeneration where necessary to prevent shading of native tree regeneration and woodland herbs.
4. Retain all standing and dead wood in situ unless necessary to remove for safety reasons.
5. Encourage growth of ivy and other climbing plants in the woodland and, again, only consider felling such covered trees if absolutely necessary for safety concerns.

Operational objective 7: Safeguard the geological features of interest.

1. Maintain the existing fences and signage in good condition to limit access to the quarry face.
2. Liaise with climbing groups to ensure appropriate climbing protocols are adhered to.

Operational objective 8: Maintain the landscape and amenity value of the site.

1. Ensure all management actions consider landscape and visitor impacts and that any essential adverse impacts are only short-term.
2. Maintain the existing fences and signage in good condition to limit access to the quarry floor.
3. Maintain all paths, gates and other structures in a safe condition.
4. Periodically remove any litter left in the Quarry.
5. Encourage dog walkers to remove dog-waste or use the dog-waste bin in the car park.
6. Provide interpretative material to inform visitors about the value of the site and to discourage littering and dog fouling.
7. Discourage any noisy or otherwise disturbing activities, to both the wildlife and to other visitors, and take appropriate measures where this is in contravention of the LNR bylaws (see Appendix).

Operational objective 9: Promote the site as an educational resource.

1. Encourage educational use of the site including school visits, training for volunteers and research by students.

4 SUMMARY OF WORKS - five-year work programme
(1 = high priority, 2 = medium priority, 3 = low priority)

Project	year in which work to be done				
	20	21	22	23	24
Habitat management					
1. Control cotoneaster and other scrub from the quarry face as required and/or as opportunity arises.	2	2	2	2	2
2. Carry out small-scale cutting back of scrub around lady's slipper plants if deemed necessary to prevent over-shading.	1	1	1	1	1
3. Allow the quarry floor to develop naturally and with minimum intervention.	1	1	1	1	1
4. Cut back scrub where considered necessary to maintain open habitats. Non-native species which are likely to be particularly invasive should be targeted first, including cotoneaster and sycamore.	1	1	1	1	1
5. Mow a section of approximately one third of the seeded grassland each year in August or September (after most of the herbs have set seed) on a three year rotation, so that the whole grassland area is cut once every three years but two-thirds of the grassland each year remains uncut. Ensure that the damp, sedge-rich area in the centre of the seeded grassland is <u>excluded</u> from cutting.	1	1	1	1	1
6. Remove all cuttings within a few days of mowing to avoid a build up of nutrients in the grassland.	1	1	1	1	1
7. Carry out small-scale scrub control as necessary to prevent loss of grassland through shading or encroachment and to open up new areas of grassland where grassland vegetation persists beneath the scrub.	1	1	1	1	1
8. Allow the mature woodland to develop naturally with minimum intervention.	1	1	1	1	1
9. If resources allow, and where safe to do so, thin or remove non-native larch trees.	2	2	2	2	2
10. Control young sycamore and sycamore regeneration where necessary to prevent shading of native tree regeneration and woodland herbs.	2	2	2	2	2
11. Retain all standing and dead wood in situ unless necessary to remove for safety reasons.	1	1	1	1	1
12. Encourage growth of ivy and other climbing plants in the woodland and, again, only consider felling such covered trees if absolutely necessary for safety concerns.	1	1	1	1	1

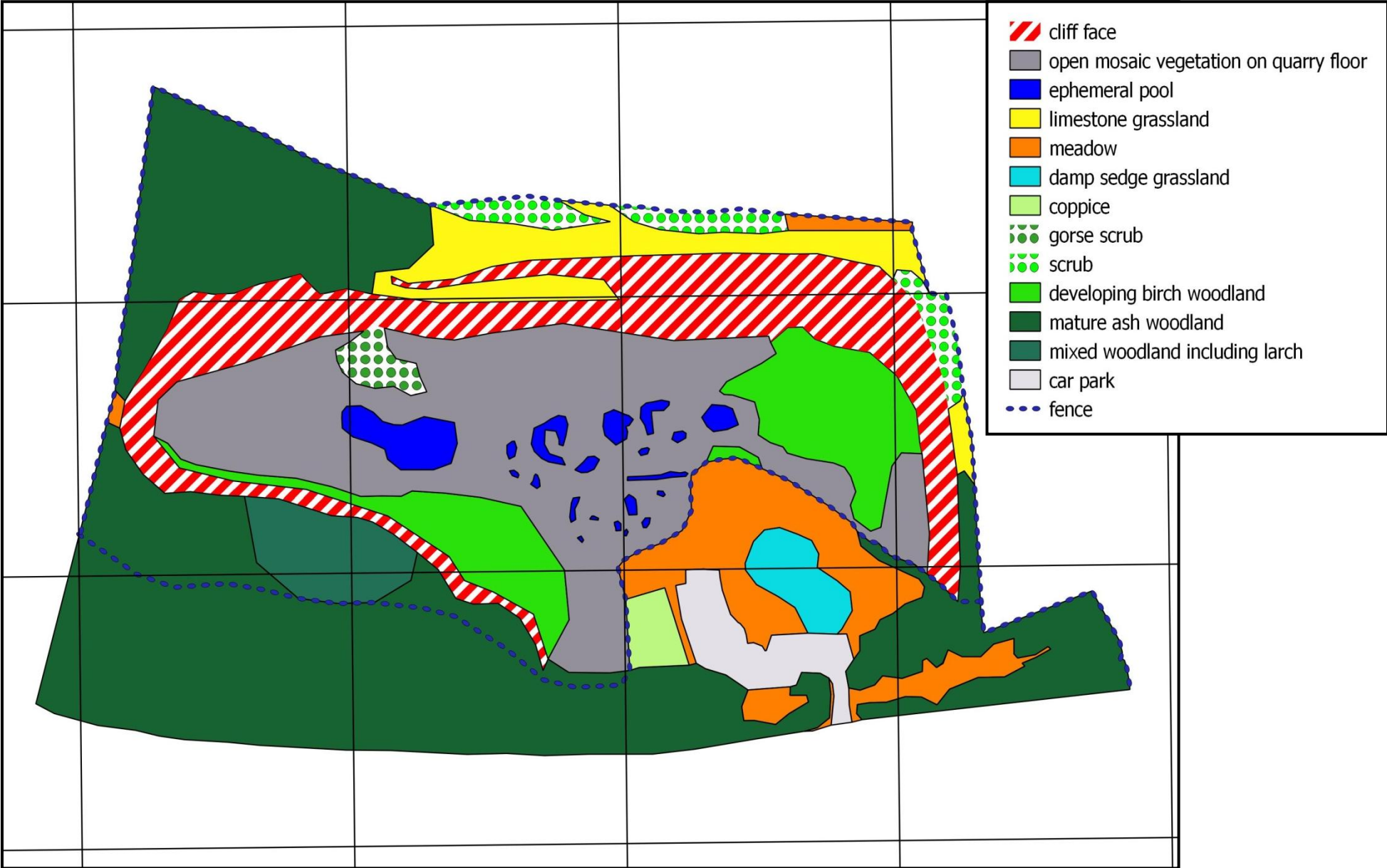
Estate work					
1. Maintain the existing fences and signage in good condition to limit access to the quarry face; both to protect visitors from dangerous areas and limit disturbance to wildlife and habitats.	1	1	1	1	1
2. Maintain all paths, gates and other structures in a safe condition.	1	1	1	1	1
3. Periodically remove any litter left in the Quarry.	1	1	1	1	1
Monitoring					
1. Monitor for spread of scrub on the quarry face, particularly non-native cotoneaster.	1	1	1	1	1
2. Monitor the condition of the lady's slipper plants and their immediate environment with respect to appropriate balance of light and dappled shade.	1	1	1	1	1
3. If feasible carry out or encourage volunteers to carry out weekly monitoring of butterfly populations through the summer months.	2	2	2	2	2
4. Monitor scrub to ensure this is not depleting areas of open habitats, including the pools.	1	1	1	1	1
5. Monitor the grassland vegetation, e.g. by annual or biennial recording of presence of lowland meadow and calcareous grassland indicator species within a series of quadrats.	2	2	2	2	2
Administration and planning					
1. Liaise with climbing groups and volunteer birdwatchers to ensure that notable cliff-nesting birds are not disturbed each year during the breeding season (March to July) and respond to any incidents reported.	1	1	1	1	1
2. Seek specialist advice on appropriate balance of scrub and other vegetation and open rock and ledges to meet optimum requirements for cliff-nesting birds.	1	1	1	1	1
3. Investigate options for control of cotoneaster and other scrub from the quarry face if required	1	1	1	1	1
4. Collate historic data on the use of the quarry by peregrine, kestrel and raven.	2	2	2	2	2
5. Collect data on future breeding attempts and success of peregrine, kestrel, raven and jackdaw in the quarry to help guide future management and identify issues which need to be addressed.	2	2	2	2	2
6. Liaise with others involved in the conservation of lady's slipper, to exchange knowledge and participate in wider conservation efforts.	1	1	1	1	1
7. Encourage survey and monitoring of birds, amphibians, invertebrates, plants and other biological groups in the Quarry by volunteers or students.	2	2	2	2	2

8. Investigate options for arranging periodic moth trapping evenings; potentially open for volunteer or public attendance.	2	2	2	2	2
9. Encourage research on the palmate newt population and its habitat requirements by student or appropriately knowledgeable volunteer.	3	3	3	3	3
10. Liaise with climbing groups to ensure appropriate climbing protocols are adhered to.	1	1	1	1	1
11. Ensure all management actions consider landscape and visitor impacts and that any essential adverse impacts are only short-term.	1	1	1	1	1
12. Encourage dog walkers to remove dog-waste or use the dog-waste bin in the car park.	1	1	1	1	1
13. Provide interpretative material to inform visitors about the value of the site and to discourage littering and dog fouling.	2	2	2	2	2
14. Discourage any noisy or otherwise disturbing activities, to both the wildlife and to other visitors, and take appropriate measures where this is in contravention of the LNR bylaws (see Appendix).	1	1	1	1	1
15. Encourage educational use of the site including school visits, training for volunteers and research by students.	1	1	1	1	1

APPENDIX 1: WARTON CRAG QUARRY MAP OF EXISTING HABITAT AND FEATURES

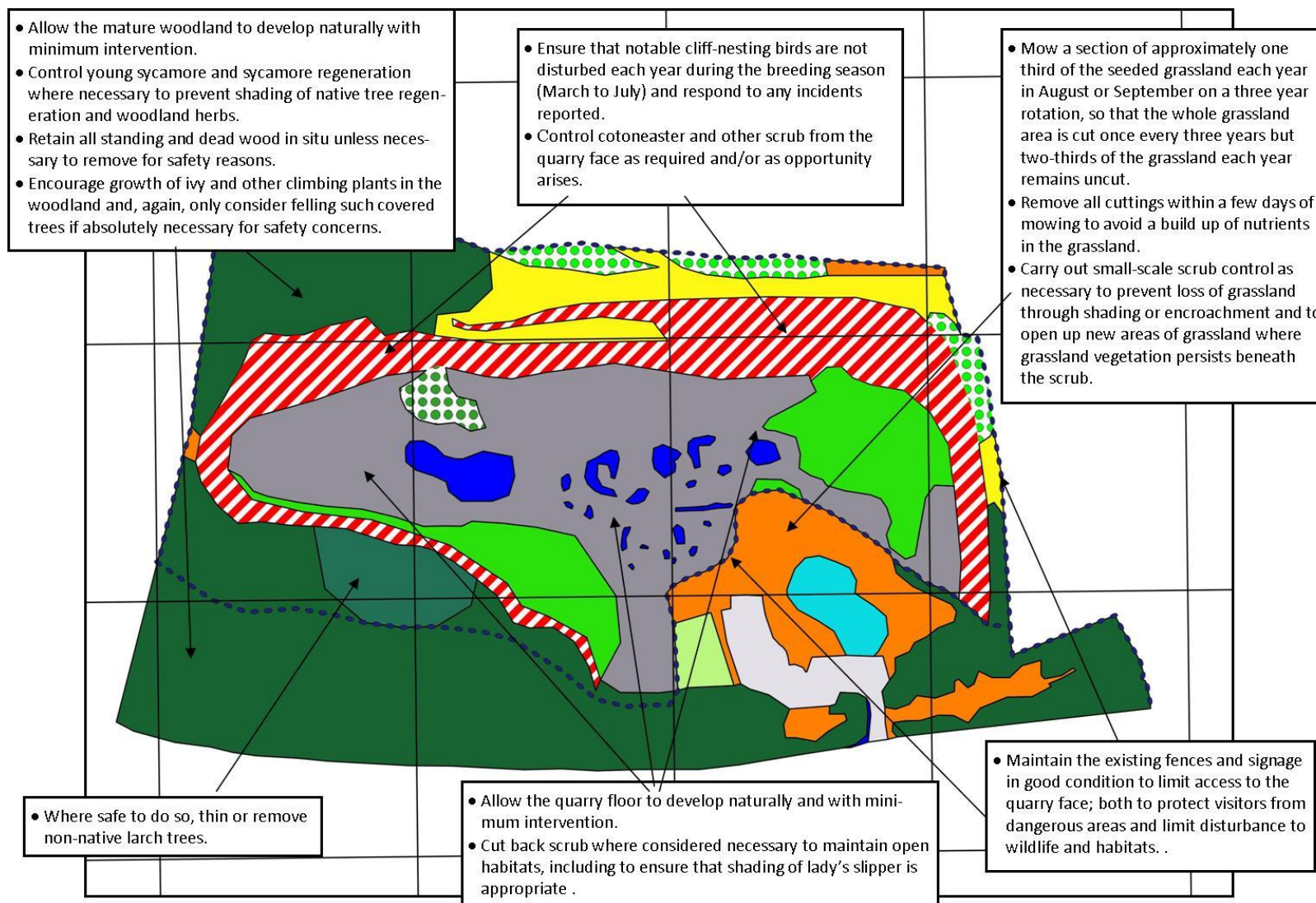
Map drawn by Graeme Skelcher Ecological Consultant, August 2020

Grid lines shown at 100 m intervals



APPENDIX 2: WARTON CRAG QUARRY MAP OF REQUIRED MANAGEMENT

Map drawn by Graeme Skelcher Ecological Consultant, August 2020



APPENDIX 3: WARTON CRAG LNR BYELAWS PROPOSED BY LANCASTER CITY COUNCIL

WARTON CRAG LOCAL NATURE RESERVE

Lancaster City Council in exercise of the powers conferred upon it by Sections 20, 21(4) and 106 of the National Parks and Access to the Countryside Act 1949 in accordance with Section 236 of the Local Government Act 1972 hereby make the following byelaws for the protection of the Local Nature Reserve at Warton Crag in the Parish of Warton in the County of Lancashire.

1. In these byelaws

(1) "The Reserve" shall mean the pieces or parcels of land containing in the whole 19.4 hectares or thereabouts and situated in the Parish of Warton in the County of Lancashire declared to be managed as a Local Nature Reserve by the declaration dated 30 March 1984 made by Lancaster City Council in pursuance of Section 21 of the National Parks and Access to the Countryside Act 1949, and the Reserve, is for the purpose of identification, shown as nearly as may be, on the map annexed to these byelaws and therein coloured pink.

(2) "The Council" shall mean Lancaster City Council.

(3) "Firearm" shall have the same meaning as in Section 57 of the Firearms Act 1968.

2. Within the Reserve the following acts are hereby prohibited unless authorised by a permit issued by the Council in accordance with Byelaw 3, or are necessary to the proper execution of his duty by an officer of the Council or by any person, or servant of any person, employed or authorised by the Council.

RESTRICTION OF ACCESS

(1) Entering at any time those parts of the Reserve where notice has been posted by Order of the Council and shown coloured blue on a map attached to that Notice.

DAMAGE TO OR DISTURBANCE OF THINGS IN THE RESERVE

(2) Spreading or using any net, or setting or using any lamp or other instrument, or any snare or lure, for the taking, injury or destruction of any living creature.

(3) Taking, molesting or intentionally disturbing, injuring or killing any living creature.

(4) Taking or intentionally disturbing or destroying the eggs, larvae, pupae or other immature stages, or the place used for the shelter or protection of any living creature.

(5) Intentionally removing or displacing any tree, shrub, plant, fungus or part thereof, or any unfashioned mineral thing including water.

BRINGING ANIMALS INTO THE RESERVE

(6) Intentionally bringing or permitting to be brought, into the Reserve any living creature, or the egg of any living creature, or any plant, or any seed of any other plant, in circumstances that it is likely that such creature or plant will reproduce or propagate itself, or such egg will hatch, or such seed will germinate.

(7) Bringing into, or permitting to remain within, the Reserve any dog unless it is kept under proper control and is prevented from worrying or disturbing any animal or bird.

(8) Turning out any animal or poultry to feed or graze.

USE OF VEHICLES

- (9) Driving, riding, propelling, or leaving any mechanically propelled vehicle elsewhere than on a highway or on a road, or in a place indicated by a notice as being available for the purpose.
- (10) Landing any aircraft except in case of emergency.
- (11) Launching or landing a hang glider except in an emergency.
- (12) Operating any hang glider at such a height that persons on the ground or in buildings may be inconvenienced or annoyed.

USE OF CERTAIN EQUIPMENT

- (13) Using any camera or apparatus for the transmission, reception, or amplification of sound, speech or images by electrical or mechanical means, except apparatus designed and used as an aid to defective hearing and apparatus used in a vehicle so as not to produce sound audible by a person outside the vehicle.
- (14) Using any device designed or adapted for detecting or locating any metal or mineral in the Reserve.

USE OF FIREARMS ETC.

- (15) Being in possession of a firearm (with ammunition suitable for use in that firearm) otherwise than on a public paved road, or discharging a firearm or lighting a firework.
- (16) Projecting any missile manually or by artificial means.

GENERAL PROHIBITIONS

- (17) Erecting, occupying or using any tent, shed, caravan or other structure for the purpose of camping.
- (18) Flying a model aircraft.
- (19) Erecting any post, rail, fence, pole, booth stand, building or other structure.
- (20) Neglecting to shut any gate or to fasten it if any means of doing so are provided.
- (21) Posting or placing any notice or advertisement.
- (22) Selling or offering or exposing for sale, or letting for hire, any commodity or article, or selling or offering for sale any service.
- (23)
 - (a) Engaging in any activity which is causing or likely to cause a disturbance.
 - (b) Holding any show, performance, public meeting, exhibition or sports or the playing of any organised games and activities.
- (24) Intentionally, or recklessly removing or displacing, any notice board, notice exhibited by order of the Council, apparatus, wall boundary bank, fence, barrier, railing, post or hide.
- (25) Skiing or tobogganing.
- (26) Lighting any fire, stove, heater or any other appliance capable of causing fire, elsewhere than in any area indicated by a notice as being available for camping.
- (27) Letting fall, or throwing any lighted match or lighted substance in a manner likely to cause a fire.
- (28) Intentionally leaving items, in a place other than a receptacle provided by the Council for deposit of litter or refuse.

INTERFERENCE WITH DULY AUTHORISED OFFICER

(29) Intentionally obstructing any officer of the Council or any person, or the servant of any person, employed or authorised by the Council in the execution of any works (including research of scientific work) connected with the laying out, maintenance or management of the Reserve.

3. The Council may issue permits authorising any person to do any act or class of acts within the Reserve or any part thereof which would otherwise be unlawful under these byelaws.

(1) Any such permit shall be issued subject to the following conditions:-

a. That it must be carried whenever a visit is made to the Reserve and produced for inspection when required by a person duly authorised by the Council in that behalf; and

b. that it may be revoked by the Council at any time.

4. These byelaws shall not operate so as to interfere with the exercise:-

(1) by a person of:

a. a right vested in him as owner, lessee or occupier of land in the Reserve.

b. any easement or profit a prendre to which he is entitled.

c. any public right of way.

(2) of any functions of a local authority, statutory under-taking or of a water authority or other drainage authority;

(3) by a constable or a member of the armed forces or any fire brigade or ambulance service of the performance of his duty.

5. Any person who offends against any of these byelaws shall be liable on summary conviction to a fine on level 2 as laid down in the Criminal Justice Act, 1982, or as amended, and in the case of continuing offence to a further fine not exceeding £5 for each day during which the offence continues after the said conviction.

APPENDIX 4: NVC COMMUNITIES LIKELY TO BE PRESENT IN WARTON CRAG QUARRY

National Vegetation Classification communities (NVC, Rodwell 1991 *et seq.*) were briefly assessed during visits in September 2019 and August 2020, with sample vegetation recorded from quadrats in the grassland and quarry floor in September 2019 to aid this assessment. Communities noted are listed below, including a brief description of each community's typical physiognomy and typical habitat. Where appropriate, vegetation data from sampled quadrats is presented immediately below each of these accounts. Much of the vegetation in the Quarry is not a good fit to published NVC communities. This is likely to be due to the artificial nature in which these habitats have arisen; both in the initial quarrying activities and in the subsequent landscaping works.

1 Limestone Grassland

The limestone grassland along the top of the quarry and on quarry-face ledges was not sampled due to inaccessibility, but is likely to be **CG9 Blue moor-grass - limestone bedstraw grassland**; similar to that found on more accessible limestone scars and thin soils in the adjacent City Council LNR.

CG9 *Sesleria albicans* - *Galium sternerii* grassland

Blue moor-grass - limestone bedstraw grassland

Physiognomy: The nationally scarce blue moor-grass *Sesleria albicans* is the most frequent grass, though it can vary in abundance from dominant to sparse. Crested hair-grass *Koeleria macrantha* and sheep's fescue *Festuca ovina* are also usually constant components and can be abundant. There are almost always some sedges in the sward with glaucous sedge *Carex flacca* and spring sedge *Carex caryophyllea* most frequent. Thyme *Thymus praecox*, rockrose *Helianthemum nummularium* and bird's-foot trefoil *Lotus corniculatus* can be locally abundant and limestone bedstraw *Galium sternerii* is a very characteristic species of the community.

Habitat: This is a very local community, confined to the Carboniferous Limestone of the Morecambe Bay Area, the Craven district of North Yorkshire and the borders of Cumbria, Durham and North Yorkshire around Upper Teesdale. It is largely restricted to free-draining but moist calcareous lithomorphous soils over usually drift-free Carboniferous Limestone exposures with a sub-montane or montane climate. It can occur as closed or open swards or, in very rocky situations, can be reduced to fragmentary assemblages in which one or more of the major species of the community attain local prominence.

2 Meadow

The seeded meadow by the car park appeared to be primarily **MG5 Crested dog's-tail - black knapweed grassland**, most likely MG5b Lady's bedstraw *Gallium verum* sub-community (the more calcicolous variant of this community), but also included distinct limestone grassland elements suggesting **CG2 Sheep's fescue - meadow oat-grass grassland**. This intermediate grassland may arise from the artificial creation of this meadow; in part, perhaps, due to importing neutral soils alongside existing limestone rock to form the mound, while the floral composition will subsequently have been influenced by the original choice of seed mix used. Other sections marked on the Appendix 1 map as 'meadow' were not sampled, but may include more natural neutral grasslands that have developed on deeper soils over the underlying limestone rock.

MG5 *Cynosurus cristatus* - *Centaurea nigra* grassland

Crested dog's-tail - black knapweed grassland

Physiognomy: Typically a herb-rich community where the fine-leaved red fescue *Festuca rubra*,

crested dog's-tail *Cynosurus cristatus* and common bent *Agrostis capillaris* are the most frequent grasses. Sedges may be abundant in some stands. Bird's-foot trefoil *Lotus corniculatus*, ribwort plantain *Plantago lanceolata* and white clover *Trifolium repens* are frequently the most abundant herbs, with red clover *Trifolium pratensis* and black knapweed *Centaurea nigra* also common.

Habitat: The typical grassland of traditional, grazed hay-meadows on neutral soils throughout the lowlands.

CG2 *Festuca ovina* - *Avenula pratensis* grassland

Sheep's fescue - meadow oat-grass grassland

Physiognomy: This community comprises rich and intimate mixtures of grasses and herbs in a continuous closed sward, with generally no consistent pattern of dominance in the vegetation. Predominant among the grasses are fine-leaved species, of which sheep's fescue *Festuca ovina* is the most frequent and usually the most abundant. Also constant, though usually less abundant, are meadow oat-grass *Avenula pratensis*, crested hair-grass *Koeleria macrantha* and quaking grass *Briza media*. The only sedges to occur with any frequency are glaucous sedge *Carex flacca*, which is constant and often abundant, and spring sedge *Carex caryophyllea* which is more uneven in its appearance. The most common herbs are those with small rosettes or sprawls of shoots. Salad burnet *Sanguisorba minor*, mouse-ear hawkweed *Hieracium pilosella*, ribwort plantain *Plantago lanceolata*, bird's-foot trefoil *Lotus corniculatus*, rough hawkbit *Leontodon hispidus*, small scabious *Scabiosa columbaria*, self-heal *Prunella vulgaris*, harebell *Campanula rotundifolia*, lady's bedstraw *Galium verum*, thyme *Thymus praecox* and rockrose *Helianthemum nummularium* are frequent throughout.

Habitat: This community is most characteristic of free-draining, calcareous soils in a relatively dry, lowland temperate climate. It occurs on a variety of calcareous bedrocks, mostly over steeper slopes, but also in some artificial habitats. The community is always dependant for its maintenance on a balance of grazing, traditionally by sheep or rabbits.

Meadow Quadrats

	Grid ref E. >	349132	349154	349165	349185	349152			
Species	Grid ref N. >	472422	472416	472423	472388	472386	Freq.	MG5b	CG2c
bird's-foot trefoil	<i>Lotus corniculatus</i>	4	4	2	5	5	V	V	V
quaking grass	<i>Briza media</i>	5	5	4	5	4	V	III	V
glaucous sedge	<i>Carex flacca</i>	1	2	2	4	1	V	II	V
rough hawkbit	<i>Leontodon hispidus</i>	5	6	5	5	7	V	III	IV
crested dog's-tail	<i>Cynosurus cristatus</i>	4	5	5	5	4	V	V	III
lady's bedstraw	<i>Galium verum</i>	5	5	5	1	5	V	V	III
ribwort plantain	<i>Plantago lanceolata</i>	2	2	4		4	IV	V	V
sheep's fescue	<i>Festuca ovina</i>	4	2		4	4	IV	II	V
red clover	<i>Trifolium pratense</i>	2	4	4		4	IV	IV	IV
red fescue	<i>Festuca rubra</i>	4	4	6		5	IV	V	I
salad burnet	<i>Sanguisorba minor</i>	2	2		4		III	II	IV
creeping bent	<i>Agrostis stolonifera</i>	5	4			4	III	II	III
marjoram	<i>Origanum vulgare</i>	4	4		3		III		
Yorkshire fog	<i>Holcus lanatus</i>	4		4			II	IV	IV
cock's-foot	<i>Dactylis glomerata</i>	1				4	II	IV	III
common knapweed	<i>Centaurea nigra</i>			4		4	II	IV	II
red bartsia	<i>Odontites verna</i>	1	3				II		
black sedge	<i>Carex nigra</i>			1		1	II		
bulbous buttercup	<i>Ranunculus bulbosus</i>			2			I	II	II
timothy	<i>Phleum pratense</i>		2				I	I	II
smooth meadowgrass	<i>Poa pratensis</i>		2				I	II	I
carnation sedge	<i>Carex panicea</i>				2		I	I	
slender St John's wort	<i>Hypericum pulchrum</i>				1		I		

3 Sedge Grassland

A lower-lying, damp area within the seeded meadow was dominated by carnation sedge. Elements of MG5 and CG2 grassland persisted in the sampled quadrats, but generally **this area was a poor match to any of the published NVC communities.**

	Grid ref E. >	349149	349152	349167	349163	349168					
Species	Grid ref N. >	472398	472406	472406	472396	472391	Freq.	MG5b	CG2c	M13	M10c
carnation sedge	<i>Carex panicea</i>	8	8	7	8	8	V	I		I	V
sheep's fescue	<i>Festuca ovina</i>	4	4	4	4	2	V	II	V		III
ribwort plantain	<i>Plantago lanceolata</i>	2	3	2	3	4	V	V	V		
creeping bent	<i>Agrostis stolonifera</i>	5	4	4	4	4	V	II	III	V	IV
crested dog's-tail	<i>Cynosurus cristatus</i>	4	4	2	4	4	V	V	III		
lesser hawkbit	<i>Leontodon taraxacoides</i>	2	3	2	2	3	V				
bird's-foot trefoil	<i>Lotus corniculatus</i>		2	2	4	4	IV	V	V		
jointed rush	<i>Juncus articulatus</i>	3	3		1	1	IV			I	IV
quaking grass	<i>Briza media</i>		2	4		3	III	III	V		
common knapweed	<i>Centaurea nigra</i>	2		1		2	III	IV	II		
bulbous buttercup	<i>Ranunculus bulbosus</i>	2		2	1		III	II	II		
lady's bedstraw	<i>Galium verum</i>			1		1	II	V	III		
ryegrass	<i>Lolium perenne</i>	4	2				II				
self-heal	<i>Prunella vulgaris</i>			1			I				I
dandelion	<i>Taraxacum officinale</i>			1			I				
ox-eye daisy	<i>Leucanthemum vulgare</i>					1	I				

4 Open mosaic vegetation on the quarry floor

Open vegetation across the quarry floor mostly comprised a scatter of sedges with creeping bent, mosses and rushes, suggesting a generally damp substrate. **This vegetation did not match any of the published NVC communities.**

	Grid ref E. >	349013	349021	349032	349037	349042					
Species	Grid ref N. >	472430	472431	472437	472429	472437	Freq.	MG5b	CG2c	M13	M10c
carnation sedge	<i>Carex panicea</i>	6	8	9	8	6	V	I		I	V
creeping bent	<i>Agrostis stolonifera</i>	2	3	4	3	4	V	II	III	V	IV
spear-moss	<i>Calliergon cuspidatum</i>	4	4	4	4		IV				
jointed rush	<i>Juncus articulatus</i>	2	1	1			III			I	IV
a yellow sedge	<i>Carex</i> sp.	2	1			2	III				IV
hard rush	<i>Juncus inflexus</i>			2	1		II				
sheep's fescue	<i>Festuca ovina</i>					4	I	II	V		III
willow	<i>Salix</i> sp.				1		I				
silver birch	<i>Betula pendula</i>				1		I				
Compositae sp						1	I				
moss sp.						4	I				
limestone bedstraw	<i>Galium sternerii</i>					1	I				

5 Ephemeral pools

The quarry floor included several sparsely vegetated pools, which regularly become dry during summer months. Where denser vegetation was present, especially in the largest pool towards the western end of the quarry, this appeared overall to be a variant of **S19 Common spike-rush swamp**; perhaps developing very locally towards **S8 Common club-rush swamp** or **S12 Reedmace swamp**.

S19 *Eleocharis palustris* swamp

Common spike-rush swamp

Physiognomy: Dominated by an open or closed cover of common spike-rush *Eleocharis palustris*. No other species are frequent throughout.

Habitat: A community of standing or running waters up to 50 cm deep which occurs around large lakes, small ponds and along streamsides.

S8 *Scirpus lacustris* ssp. *lacustris* swamp

Common club-rush swamp

Physiognomy: Typically has an open cover of common club-rush. No other species is frequent throughout.

Habitat: A swamp of deep water, occurring typically in larger pools and lakes predominantly in the lowlands.

S12 *Typha latifolia* swamp

Reedmace swamp

Physiognomy: Pure or species-poor stands overwhelmingly dominated by common reedmace *Typha latifolia*. Associates are generally of low cover.

Habitat: Most characteristic of standing or slow-moving, moderately to very nutrient-rich, neutral to basic waters with silty substrates. It is tolerant of a wide range of water levels and is frequent around lowland lakes, ponds and reservoirs, along canals and dykes and in sluggish streams.

	Grid ref E. >	348999	349002	349005	349007	349008	349018	349020	349023	349030							
Species	Grid ref N. >	472458	472457	472457	472458	472451	472446	472452	472449	472446	Freq	S19a	S19c	S12b	S12c	S8b	S8c
common spike-rush	<i>Eleocharis palustris</i>	8	8	7	7	8	8	5	7	7	V	V	V	I	II		I
jointed rush	<i>Juncus articulatus</i>	2	3	2	3	4		4	2	2	V	I	II	I	I		
spear-moss	<i>Calliergon cuspidatum</i>	7	5	7	5	6	7		3	4	V			I			
creeping bent	<i>Agrostis stolonifera</i>	4		4	4	4	4	2		4	IV	I	V	I			
common club-rush	<i>Scirpus lacustris</i>	1	7	7	7	3	5	3			IV			I		V	V
carnation sedge	<i>Carex panicea</i>			4				1	1	5	III						
Compositae sp							1	1	2	1	III						
common reedmace	<i>Typha latifolia</i>	5									I	I		V	V	I	
cuckoo flower	<i>Cardamine pratensis</i>				1						I	I					
marsh willowherb	<i>Epilobium palustre</i>				2						I			I			I
quaking grass	<i>Briza media</i>	4									I						
willow	<i>Salix</i> sp									2	I						

6 Scrub and pioneer woodland

On the quarry floor, a patch of gorse-dominated **W23 Gorse-bramble scrub** was present towards to the north-western end, while concentrations of otherwise scattered young birch formed developing woodland in the north-east and south-west. Around the top of the quarry were patches of **W24 Bramble - Yorkshire-fog underscrub**, in parts developing towards **W21 Hawthorn - ivy scrub**.

W21 *Crataegus monogyna* - *Hedera helix* scrub

Hawthorn - ivy scrub

Physiognomy: Dominated by various mixtures of smaller trees and shrubs, although hawthorn *Crataegus monogyna* is usually the most abundant shrub and may be the sole dominant. Bramble *Rubus fruticosus* is often very abundant and roses *Rosa* spp. can be prominent. The field-layer is typically species-poor. A ground carpet of ivy *Hedera helix* is most characteristic while nettle *Urtica dioica* and cleavers *Galium aparine* are abundant in some stands.

Habitat: The typical sub-climax shrub community of neutral to base-rich soils throughout the lowlands including, often planted, hedgerows.

W23 *Ulex europaeus* - *Rubus fruticosus* scrub

Gorse - bramble scrub

Physiognomy: Scrub with a fairly low (1-2 m high) woody cover, generally dominated by common gorse *Ulex europaeus*. Usually, the only other component of the scrubby cover is bramble *Rubus fruticosus*. In dense scrub, there is next to no vegetation beneath the bushes and herbs are limited to areas between the gorse.

Habitat: Characteristic of moderately to strongly acid brown soils, free-draining though not always dry and not markedly nutrient-poor. It is probably a fairly natural colonising vegetation in the lowlands and upland fringes, though its establishment and spread are much encouraged by disturbance and agricultural neglect.

W24 *Rubus fruticosus* - *Holcus lanatus* underscrub

Bramble - Yorkshire fog underscrub

Physiognomy: Typically dominated by mixtures of brambles, rank grasses and tall herbs, sometimes with scattered shrubs. Bramble *Rubus fruticosus* is a constant component but its abundance is variable. The commonest grasses are Yorkshire fog *Holcus lanatus* and cock's-foot *Dactylis glomerata*, but false oat-grass *Arrhenatherum elatius* also occurs quite frequently. Tall herbs, including common nettle *Urtica dioica*, occur as scattered plants or with patchy local abundance.

Habitat: Typical of abandoned and neglected ground in the lowlands where it can be found on a wide variety of neutral and less nutrient-poor soils. It is extremely common on derelict land and in run-down arable, pasture and meadow. It can also figure as a temporary or persistent vegetation type where woodland has been coppiced or cleared.

7 Mature woodland

Mature ash woodland covered much of the site's margins, to the north-west, south-west and south-east of the quarry. Vegetation was not sampled, but most of this appeared to be **W8 Ash - field maple - dog's mercury woodland**, with a high cover of bramble in the field-layer. The more moss- and fern-rich **W9 Ash - rowan - dog's mercury woodland** occurs elsewhere on Warton Crag and this community may also occur locally around the quarry, especially on rockier and perhaps more inaccessible ground. Mature, non-native sycamore were often frequent alongside the dominant ash trees, while a stand of larch trees occupied an area within the ash wood on the south-west edge of the quarry.

W8 *Fraxinus excelsior* - *Acer campestre* - *Mercurialis perennis* woodland

Ash - field maple - dog's mercury woodland

Physiognomy: A diverse community in both the field-layer and tree/shrub component. Ash *Fraxinus excelsior*, field maple *Acer campestre* and hazel *Corylus avellana* provide the general diagnostic character of the woody component. In the field-layer, dog's mercury *Mercurialis perennis* typically occurs with mixtures of bluebell *Hyacinthoides non-scripta*, enchanter's nightshade *Circaea lutetiana*, herb Bennet *Geum urbanum*, lords-and-ladies *Arum maculatum* and dog violets *Viola* spp.. An underscrub, most frequently of bramble *Rubus fruticosus*, is a consistent element of the field-layer although its prominence is very variable.

Habitat: Typically a community of calcareous soils in the relatively warm and dry lowlands of southern Britain.

W9 *Fraxinus excelsior* - *Sorbus aucuparia* - *Mercurialis perennis* woodland

Ash - rowan - dog's mercury woodland

Physiognomy: Typically, this community is dominated by ash *Fraxinus excelsior* with hazel *Corylus avellana* usually the most abundant component of the shrub layer and frequent rowan *Sorbus aucuparia*. Dog's mercury *Mercurialis perennis*, wood sorrel *Oxalis acetosella*, common dog violet *Viola riviniana* and bluebell *Hyacinthoides non-scripta* are all frequent in many stands but the irregular topography over which the community typically develops tends to result in there being no consistent pattern of dominance among the herbs. However, the prominence of ferns and the abundance and variety of bryophytes can be distinctive.

Habitat: Characteristic of permanently moist brown soils derived from calcareous bedrocks and superfcials in the sub-montane climate of north-west Britain.

Note - values for each species in the quadrat tables indicate abundance in each sample on the Domin scale:

DOMIN value	% cover
10	91 - 100
9	76 - 90
8	51 - 75
7	34 - 50
6	26 - 33
5	11 - 25
4	4 - 10
3	< 4, many
2	< 4, several
1	< 4, few