Chapter 3: Spatial Distribution of Ecosystem Services, Risks and Opportunities

Ecosystem services

Derbyshires' land and the water deliver many different ecosystem services, from providing food, minerals and timber through to supporting wellbeing and other cultural services. Ecosystem services can be valued; measuring and reporting these values facilitates production of natural capital accounts (Chapter 4: The Natural Capital Accounts).

The 25-Year Environment Plan for England outlines a future where the net gain approach is expanded to include wider natural capital benefits when planning development activities or changes to land management. So rather than require only a biodiversity net gain, the projects should also result in a gain for features such as carbon capture, water regulation and control of water pollution. This is being termed environmental net gain. The key ecosystem services in Derbyshire were considered to allow the natural capital strategy for Derbyshire to report the complete set of relevant environmental net gain indicators, when considering opportunities for enhancing the environment and risks.

A crucial output of the ecosystem service analysis is the spatial data and maps identifying where in the county ecosystem service provision is strong or, conversely, weak. When the value of the land is mapped in this way, decision-makers have a more complete picture of the current value of the environment in terms of the wide range of ecosystem services it provides, and how land management decisions will impact on these. The maps and data are part of the evidence base that inform the Natural Capital Strategy, helping to identify what needs to be protected, and where enhancements can be made. The ecosystem services of most importance were chosen in a workshop held with key stakeholders from the county. Nine ecosystem services were considered key for the county and these have been grouped according to the main type of ecosystem service delivered:

Provisioning services

- Agricultural production

Supporting services

- Biodiversity

Regulating services

- Water regulation (Natural Flood Management)
- Water quality regulation
- Carbon storage (the total amount of carbon contained in vegetation and soil)
- Carbon sequestration (the amount of carbon being removed from the atmospheree and stored in anotherr form that cannot immediately be released)

Cultural services

- Recreation
- Tourism
- Contribution of agriculture to landscape character

The spatial distribution of these services has been mapped using SENCE (Spatial Evidence for Natural Capital Evaluation), an established natural capital tool developed by Environment Systems. SENCE is a modelling process that provides place-based information on natural capital and identifies:

- the stock of ecosystems services that the land is currently delivering
- where environmental risks or issues are located
- the most advantageous locations for changing land management to enhance ecosystem services.

SENCE uses a rule-based approach to map and combine individual environmental variables of the ecosystem service in question. This provides a stepped approach to building a representation of the whole, or part of, a complex ecosystem interaction.

Factors that influence ecosystem services

The main factors that influence the spatial distribution of the Natural Capital and the delivery of ecosystem services in Derbyshire are:

- The habitat type: Habitat type is the main driver for the delivery of biodiversity and other ecosystem services. For example, broadleaved woodlands intercept rainfall, absorbing the energy of the rain, and slowing surface runoff; which means the rainfall infiltrates into the ground more easily. The tree roots are deep; they carry water, and often also organic matter rich in carbon, down into the soil profile to be stored. In contrast, an arable field with emerging crops has much bare ground, the crop does not intercept rainfall as effectively as woodland and the plant roots are shallower. The reduced ability of the crop to intercept rainfall and help it get into the soil, leads to the rain running off the land surface potentially picking up pollutants and transferring them to watercourses, as well as potentially speeding up flood events.
- Habitat management and condition: The condition of habitats and their management also plays an important part in the delivery of ecosystem services, for example drained, actively eroding upland blanket bogs will not be effective at storing water and will be losing greenhouse gasses to the atmosphere, whereas an intact blanket bog will store water contributing to natural flood management and will also sequester carbon.
- Soil type: The soil type and condition are also important. In terms of carbon storage, organic soils store more carbon than mineral soils. Clay and silt rich mineral soils hold more carbon than sandy mineral soils. It is not possible in a county wide strategic survey to represent individual site soil conditions, but good soil management will always enhance ecosystem services.
- Landform: Slope will affect the role of habitats in certain ecosystem service delivery, for example on steep slopes the water will flow over the surface more rapidly, potentially carrying soil particles and causing soil erosion.
- Hydrology: Land close to rivers will be more impacted by river levels and flooding events, and have more influence on water quality than those areas more remote from rivers and channels. There is less opportunity for pollutants to be filtered by vegetation or soil in land that is closest to rivers.

The SENCE rule base is built around a series of key factors which interact together in different ways for the ecosystem service under consideration. As an example, the key factors can be used to describe how the biophysical properties of a parcel of land can be applied, as shown in Figure 10. By understanding these characteristics, it is possible to infer the functions that each parcel of land provides and therefore identify the societal benefits and dis-benefits.

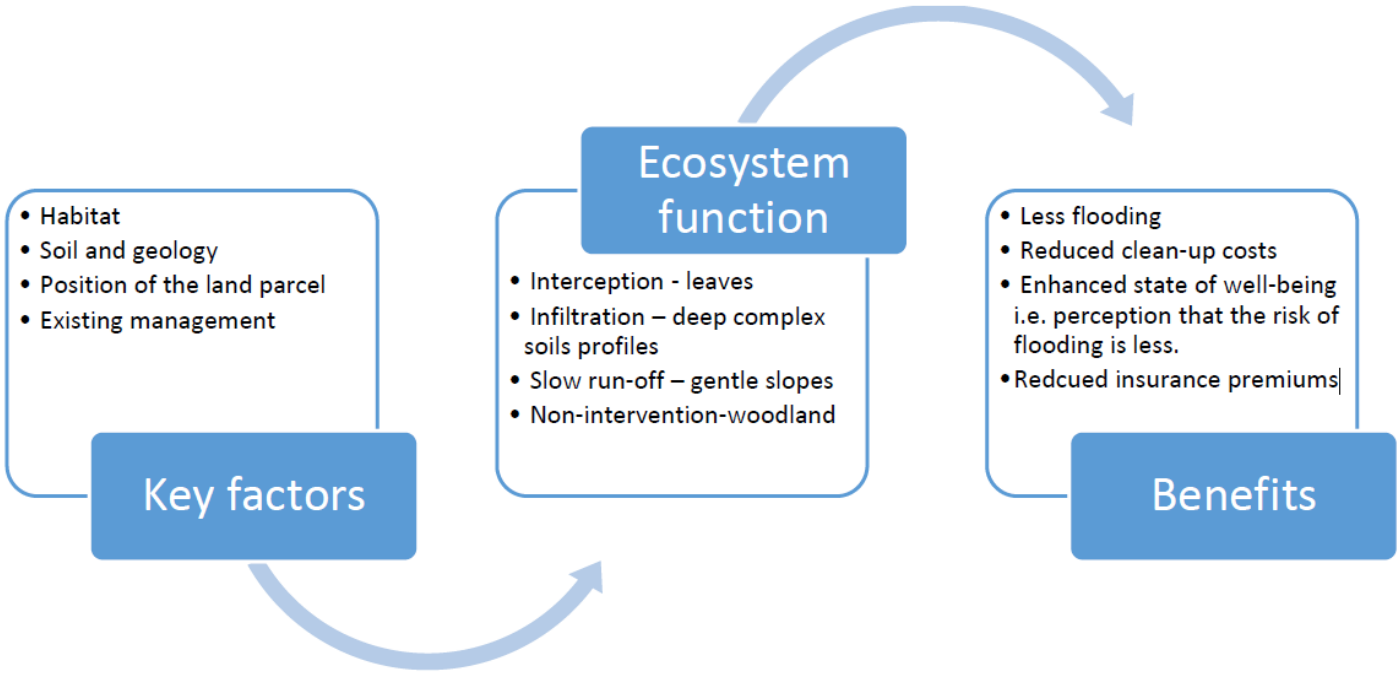

Figure 10: Identification of living systems, their management and the flow of ecosystem service for detention time of overland flow

Additional spatial datasets were sourced for modelling the ecosystem services and these are listed in Appendix 4. Information on the methodology used to produce each ecosystem service map is provided in Appendix 5.

Nature-based solutions

The best way to enhance ecosystem services and address risks and issues is to restore native habitats and species in locations that would naturally support their biophysical requirements. This is known as nature-based solutions. The existing land cover and soil types are the features of primary importance when considering where the opportunities to restore natural habitats. For example, habitats which have the requirement for a nutrient poor soil environment such as native woodland, or species-rich acid grassland, cannot be established well on land that is currently under arable land management, which has a higher pH and nutrient loading, without drastic action to ameliorate the soil environment. If the land is currently an old improved ley for permanent grazing pasture, with a lower pH and nutrient load then the woodland is likely to establish more quickly and is more likely to support the full range of species associated with the native habitats; this will enable a functioning ecosystem to form quickly. In addition, if the restoration area is within the ecological network for woodland, then there are likely to be features such as seeds and pollinators which will move into the woodland and increase the genetic diversity and in turn, its resilience.

The topography and hydrology of areas are also significant in prioritising the optimum areas to develop nature-based solutions. Some species prefer shadier locations, other sunnier ones, some will thrive on exposed ridges, while others prefer sheltered, wet hollows. Wetland creation must consider aspects such as soil drainage, slope and hydrological connectivity; attempting to establish a natural wetland on a naturally freely draining site would face many challenges.

Climate change

Climate change is an important emerging risk to all ecosystem services due to its impact on the underlying key factors of habitat, soil and land management. However, spatially mapping climate change impacts on ecisystem services at the county scale is difficult because the level of risk varies according to local site resilience, which itself is dependent on multiple contributing factors that are difficult to quantify.

As a general rule of thumb, habitats that are currently in favourable condition, are connected through a strong ecological network, and are surrounded by a range of topographic niches, are considered to be more resilient to the impacts of climate change than habitats that are currently in poor condition and more fragmented, with limited opportunities for species migration as the climate changes. A freshwater habitat may become stressed due to reduced summer water levels as a result of climate change; the level of stress and the ability of the habitat to recover will depend on its starting condition and the frequency and magnitude of the stress events that occur. A habitat that is already stressed by pollution levels and invasive non-native species is likely to be less able to recover than a habitat that is in a better starting condition.

The complexity and local variability of these interactions means that climate change has not been considered as a standalone risk factor in the ecosystem service modelling. However, actions to enhance the condition and local resilience of habitats will also enhance climate change resilience.

The predicted trends in climate change in Derbyshire are discussed on Chapter 8: The impacts of climate change.

Irreplaceable habitats

Some species-rich priority habitats within Derbyshire contain native species that are irreplaceable, because these habitats cannot be reconstructed in a different place. In these cases, the particular combination of soil, geology and hydrology is very closely attuned to the habitat that has developed over centuries at that place. An example is the calcareous grassland Priority Habitat. Irreplaceable habitats are defined as:

> *"habitat that cannot be recreated within a specified timeframe because it would be technically very difficult or impossible to recreate taking into account their age, uniqueness, species diversity, rarity and environmental or historical context. These habitats are also likely to be particularly vulnerable to threats such as degradation, fragmentation or loss. In the UK, there is no definitive list of irreplaceable habitats … the full range of factors affecting irreplaceability should be taken into account when determining the status of a particular habitat."*[3]

Natural England is in the process of developing a more comprehensive definition for 'irreplaceable habitats' together with a 'high level' list of habitat types that are considered likely to fall within the revised definition in England. Natural England will retain control of the list and definition and may provide additional evidence and guidance to define irreplaceable habitats and to make additions or deletions to the list.

[3] British Standard BS8683:2021 – Process for Designing and Implementing Biodiversity Net Gain – Specification (BSI, 2021)

Conceptually, individual stands of habitat need to be assessed to determine whether they are irreplaceable or not due to the variation that is likely to occur within particular stands of Priority Habitat. In order to assist practitioners and stakeholders with identifying irreplaceable habitats, Natural England is regularly reviewing its habitat inventories[4]. The national inventories of priority habitats provide a reasonable starting point for identification of irreplaceable habitats, however considerable work is required to maintain and update these inventories. There should be a clear mechanism to add to, and subtract from, the inventories to correct errors, with a right to appeal that is transparent for all stakeholders involved.

Irreplaceable habitats are vulnerable to misidentification by ecologists and degradation through management changes. Therefore, all irreplaceable habitat stands (or those potential to be irreplaceable) should be subject to independent verification as part of any development-related process to ensure that they have been correctly identified.
Work to update the inventories should be undertaken soon, as there is a substantial risk that stands of habitat that are not on the current lists will be subject to poor management or deliberate degradation to render them less likely to meet irreplaceable habitats thresholds.

Outputs and analysis: ecosystem services – stock, opportunity and risk

Agricultural production

The stock of the most highly productive agricultural areas is located in the Southern Magnesian Limestone and in valley bottom areas, particularly in the catchments of the Melbourne Parklands, and Mease/Sense Lowlands (Figure 11 & f
Figure 12). Productivity is highest where the soil and topography are most suited to agriculture. This is defined as the 'Best and Most Versatile (BMV) land measured using the Agricultural Land Classification (BMV is ALC Grades 1, 2 and 3a).

Risk to agricultural production is currently driven by new market forces which are taking the ALC BMV land out of production. This is an issue as this land supports the widest range of crops and losing this land may affect food security. As well as affecting agricultural production these market driven changes will affect the landscape character; particularly in those areas where agriculture plays a significant role in the landscape character.

Maps have been produced to show high quality agricultural land that may be targeted for woodland for carbon schemes and making a distinction of whether the areas are within or outside of the woodland network (Chapter 2: Natural Capital Baseline Assessment: Mapping for Nature Recovery). The highest concentration of risk is in the south of the county. Areas which may be suited for solar (Figure 14) or wind energy generation (Figure 15 and Figure 16) have also been mapped and have similar locations. Areas have been classified as a higher risk of a loss of agricultural production if there are deemed to be fewer constraints to establishing renewable energy projects. Risks to a loss of

[4] Priority Habitat inventories are published by NE and are regularly updated. Current dataset (09/08/2022) is available here: https://www.data.gov.uk/dataset/4b6ddab7-6c0f-4407-946e-d6499f19fcde/priority-habitat-inventory-england

agricultural production have been based on assessments from the Derbyshire Spatial Energy Strategy[5].

The risk maps consider all scales of renerable energy generation (micro to very large), and identify areas where applications for renewable energy are most likely to be lodged and approved. The maps do not identify the level of risk to productivity associated with each scale of generation; therefore it has not been possible to classify the level of risk to agricultural production according to generation scale (for example, small wind schemes would lead to lower impacts on productivity than larger schemes).

Where point data mapping the location of existing energy generation proposals were available, these were included only for schemes proposing significant scales of development (>1MV; medium to very large schemes). It is important to note that while the Spatial Energy Strategy considered agricultural land quality and landscape character sensitivities in its assessment of site suitability for energy generation, it did not consider grid connection costs; therefore the mapped areas are likely to be an overestimation of what is currently technically feasible in terms of energy generation, or planned improvements to grid connections.

Key points and recommendations for nature-based action: Agricultural Production

- **Change management practices** to increase resilience to climate change; for example, altering the types of crop grown and cropping cycles.
- **Agroforestry:** integration of trees and shrubs into crop and animal farming systems to create a range of environmental, economic, and social benefits, including climate change adaptation by way of providing shelter from extreme temperatures, benefiting animal welfare.
- **Embrace regenerative agriculture:** supported by innovative technologies this approach reduces the use of water and other inputs. Through preventing land degradation and deforestation, this approach also protects and improves soil, biodiversity, climate resilience and water resources, while making farming more productive and profitable in the face of climate change.
- **Renewable Energy:** changing land use to support renewable energy generation can support income generation and provide other environmental benefits.

[5] Scene Connect (2022) Derbyshire Spatial Energy Study. Evidence base for policy makers. Derbyshire County Council

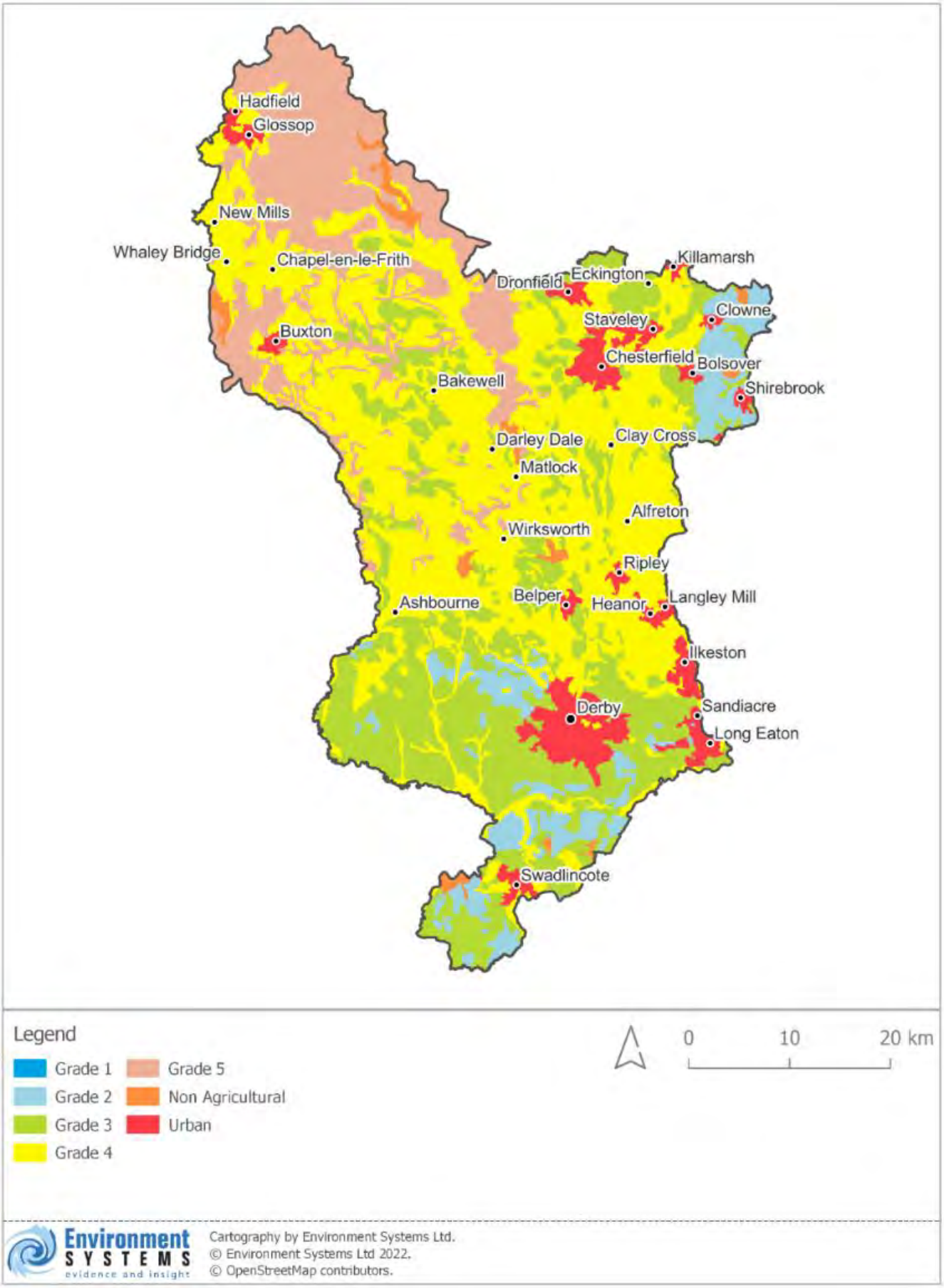

Figure 11: Agricultural Land Classification

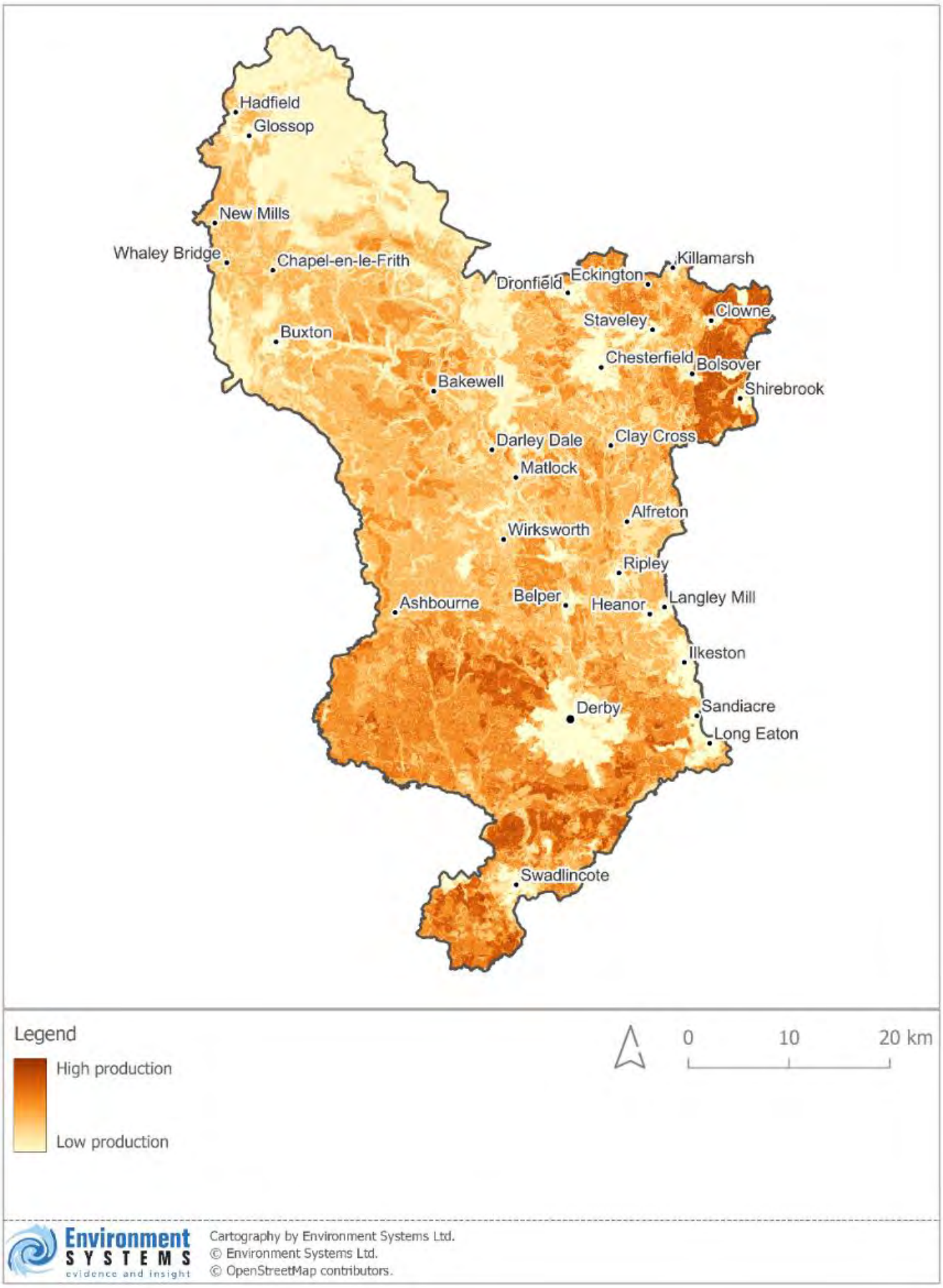

Figure 12: Agricultural production: current provision (stock)

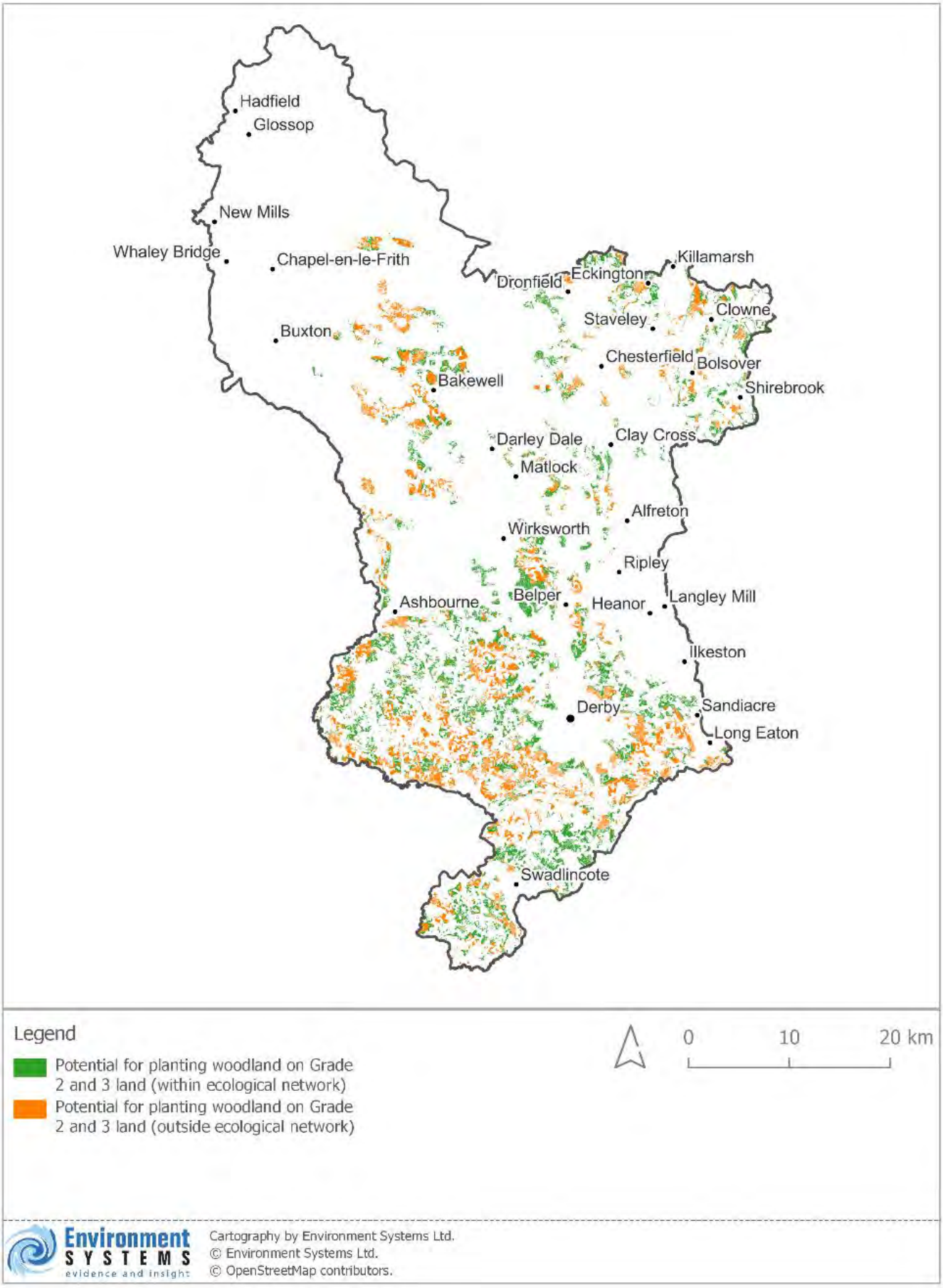

Figure 13: Risks to agricultural production: potential conflicts with woodland objectives

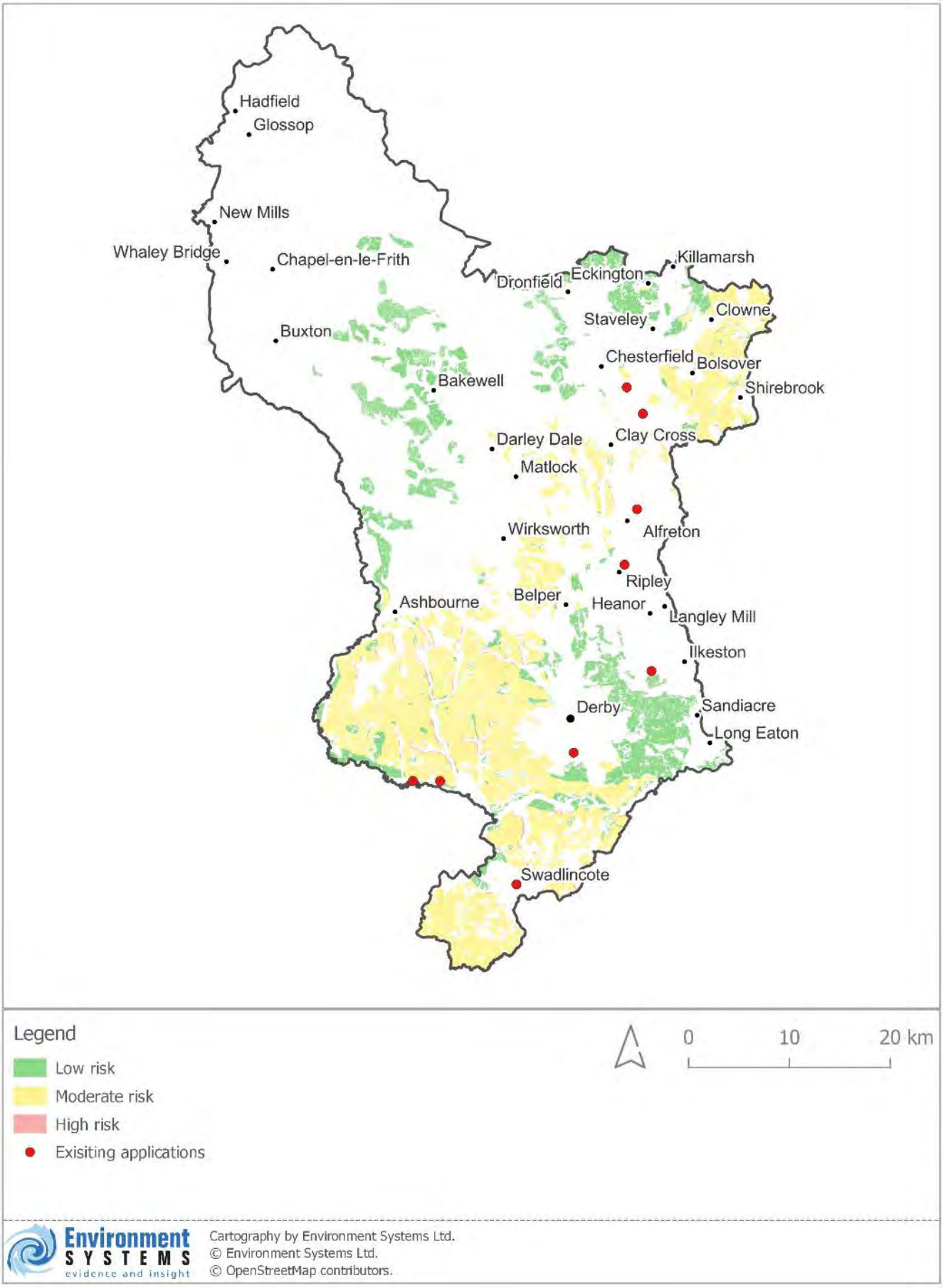

Figure 14: Risks to agricultural production: ground-mounted solar PV

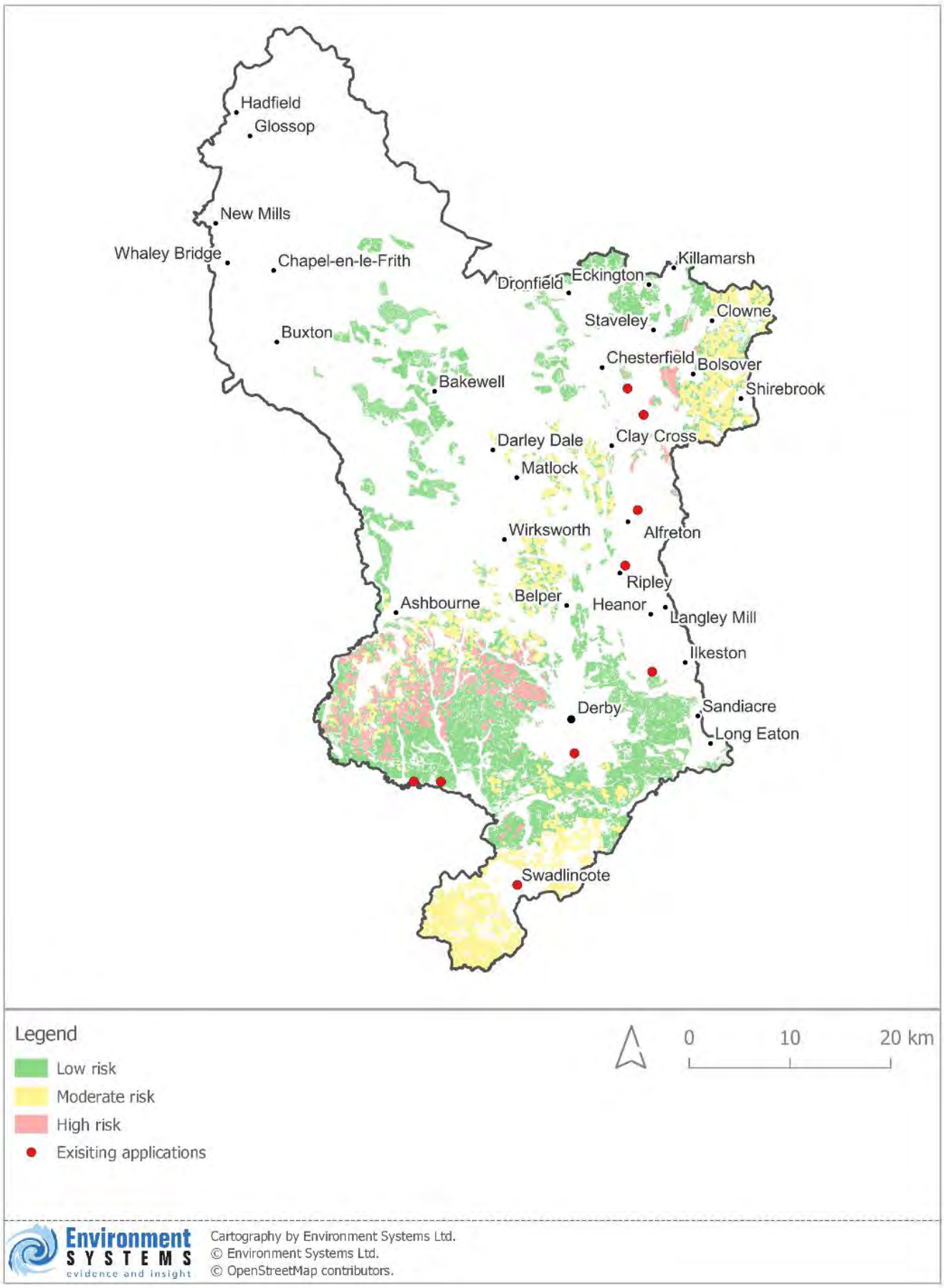

Figure 15: Risks to agricultural production: small wind generation

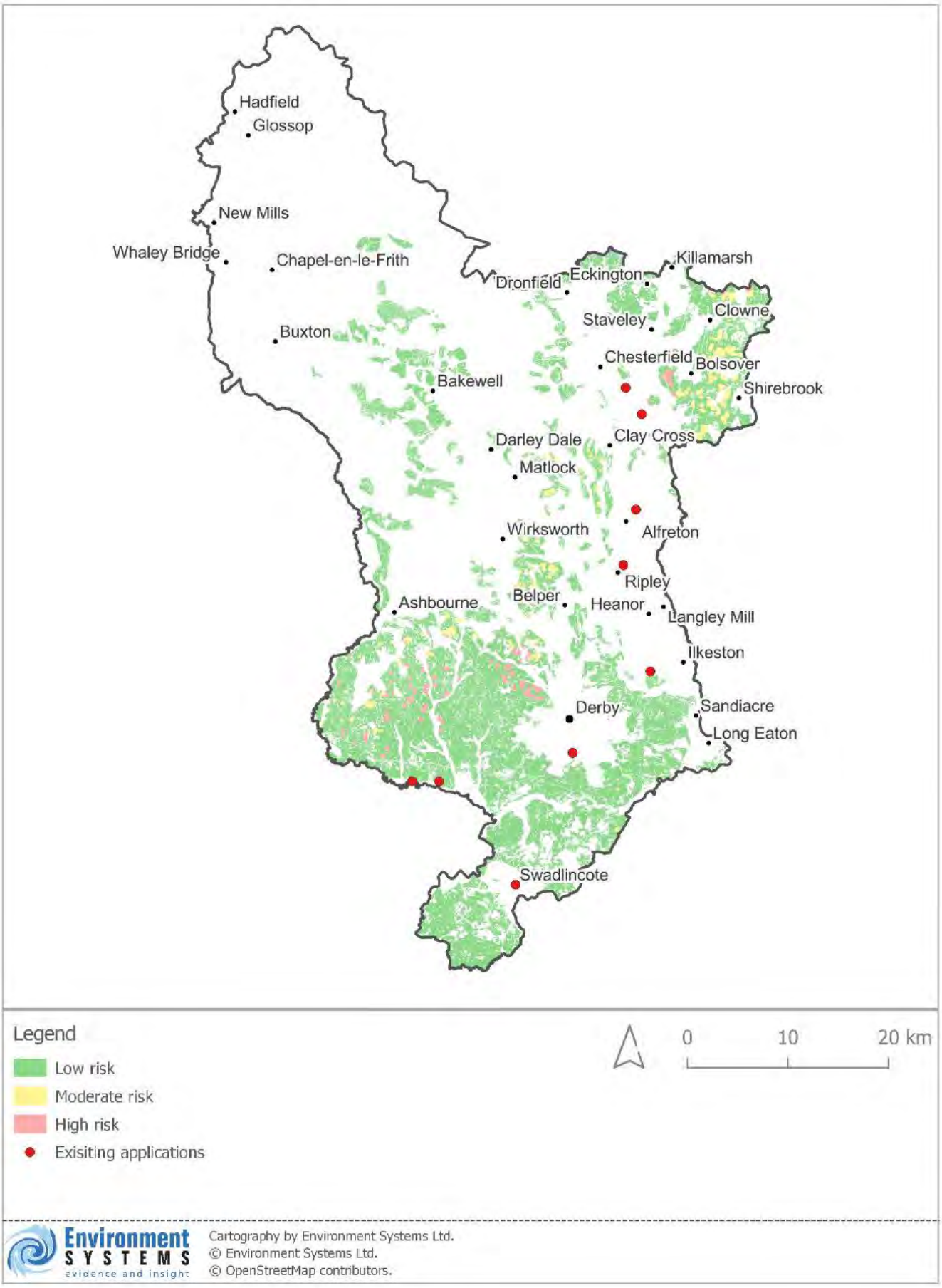

Figure 16: Risks to agricultural production: large wind generation

Biodiversity and irreplaceable Habitats

Very significant areas of biodiversity stock, known as biodiversity hotspots, are located in the northern areas of the Peak District National Park (Figure 17 and Figure 18), which also support the most important heath (Figure 21) and wetland ecological networks in Derbyshire (Figure 23). Other biodiversity hotspot areas that are outside of the National Park are found in White Peak, the Peak Fringe. Lower Derwent, Melbourne Parklands and Southern Magnesian Limestone areas (Figure 18).

There are opportunities for creating new areas of grassland, heath, wetland and woodland habitat (Figures 19-26) which will strengthen the ecological networks in Derbyshire. A comparison has been made between these ecological network maps and the more strategic scale Natural England Nature Recovery Networks (NRNs) which are based on less comprehensive and detailed data. This is informative to the Derbyshire natural capital strategy because where the NRNs coincide, the delivery of natural capital projects will meet both local and national priorities. For example, Figure 19 shows all opportunities throughout Derbyshire for creating species-rich grassland habitat, while Figure 20 solely shows those opportunities that coincide with the Natural England grassland NRNs. Opportunities that coincide with the NRNs will be particularly effective at supporting national biodiversity objectives, but opportunity areas outside the Natural England NRNs maps could be very important at a local scale, and may also provide significant co-benefits in terms of other ecosystem services.

There is widespread opportunity for creating both grassland (Figure 19) and woodland (Figure 25) across Derbyshire, with concentrations of opportunity for grassland creation within the existing grassland network in the Peak District National Park and the Peak Fringe and Lower Derwent. Opportunities for woodland creation lie along the river valleys and other lower lying areas of the county. Through development of the National Forest there is an opportunity to enhance connectivity of large areas of core woodland habitat that are currently relatively isolated, and enhance their resilience.

Opportunities for heath creation are located in the Peak District National Park, as well as in the more southern areas of Derbyshire from the Needwood and South Derbyshire Claylands to the Mease/Sense Lowlands (Figure 21). Opportunities for creating wetland are concentrated in the Trent Valley Washlands (Figure 23). Heath shows a very large potential opportunity space outside the existing ecological network, but these 'outside of network' areas should be treated with caution; due to its exacting mycorrhizal requirements, it is very difficult to establish heath unless it borders, or is in close proximity to, existing heath. An exception to this is areas of coniferous plantation that may have been planted on heath; such areas could revert quickly back to heath habitat.

Key points and recommendations for nature-based action: Biodiversity

- **Maintain and enhance existing biodiversity hotspots:** prioritise areas containing significant stock of irreplaceable habitat; including The Peak District National Park, White Peak, and Derwent valley.
- **Increase the connectivity of existing habitats**: prioritise ecological restoration activities within the ecological networks, to promote nature recovery and increase habitat resilience to pressures including climate change.
- **Consider the size of the habitat:** the size of a habitat patch is important in selecting sites for restoration and habitat creation. For example a woodland site <2ha is considered vulnerable, while a much smaller patch of Calaminarian grassland could be considered resilient.
- **Consider the existing ecology of the site:** habitat restoration is most successful when the soil conditions of the restoration site are similar to those associated with the native habitat. For certain habitats such as heathland, soil mycorrhizal associations are so important that the restoration site will need to either be adjacent to the existing habitat, or an element of soil translocation from a donor site would be needed to improve the success rate of habitat establishment. Coniferous plantations on former heath sites may retain the soil conditions needed for heath establishment, making good candidates for heath restoration.
- **Consider ecosystem multi-benefits:** habitat restoration to support biodiversity can also provide other valuable ecosystem services such as flood management, benefits to agriculture and carbon storage. Consideration of multi-benefit areas can help in the prioritisation of restoration sites.
- **Ensure appropriate mitigation actions are taken by developers**: 'Bespoke compensation' should be required to mitigate the damages potentially caused mitigation of development projects that lead to losses of irreplaceable habitats
- **Establish long-term management agreements:** Habitat restoration and creation projects should be accompanied by a secured agreement for long-term management to ensure success and sustainability

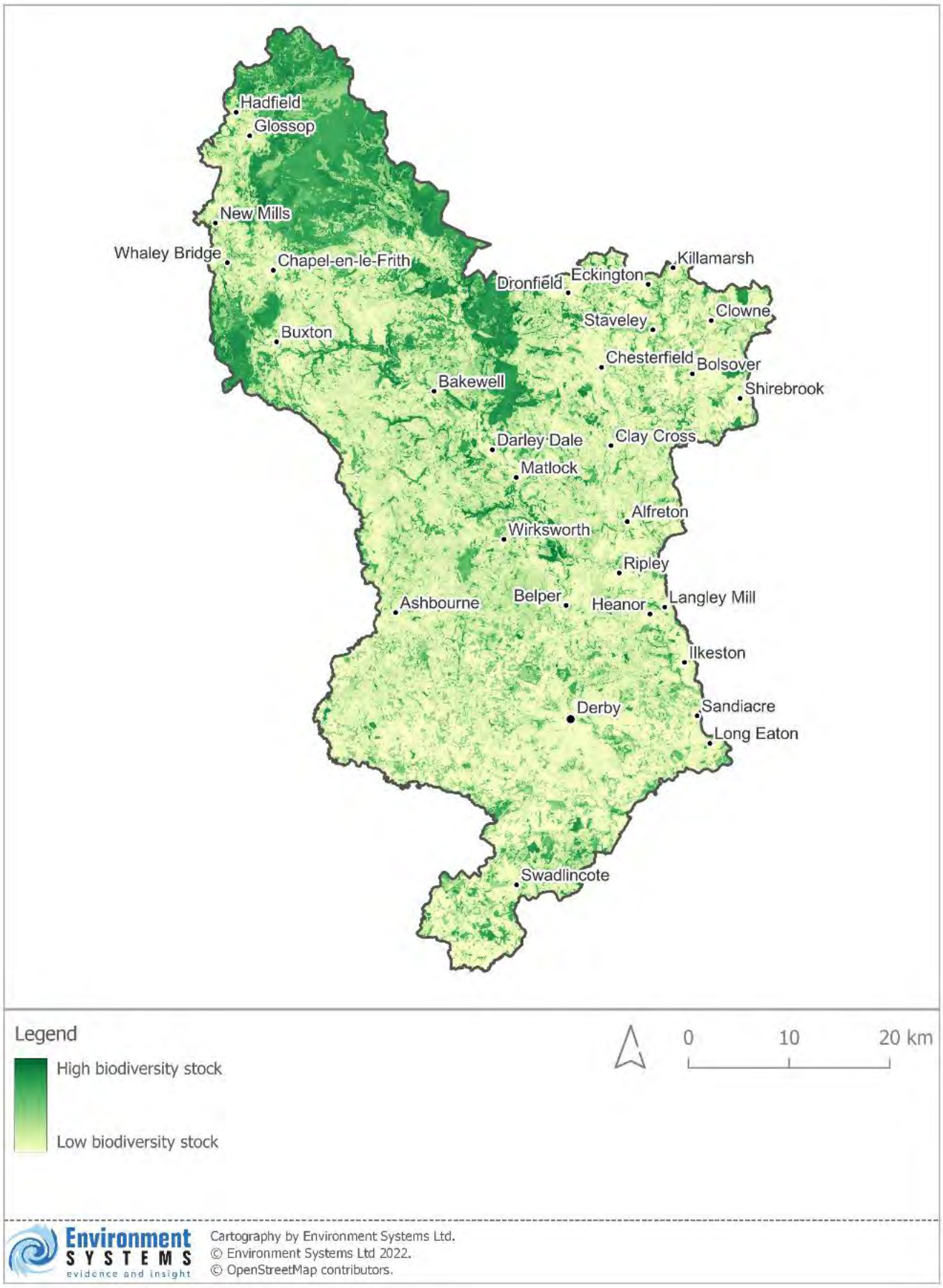

Figure 17: Biodiversity: current provision (stock)

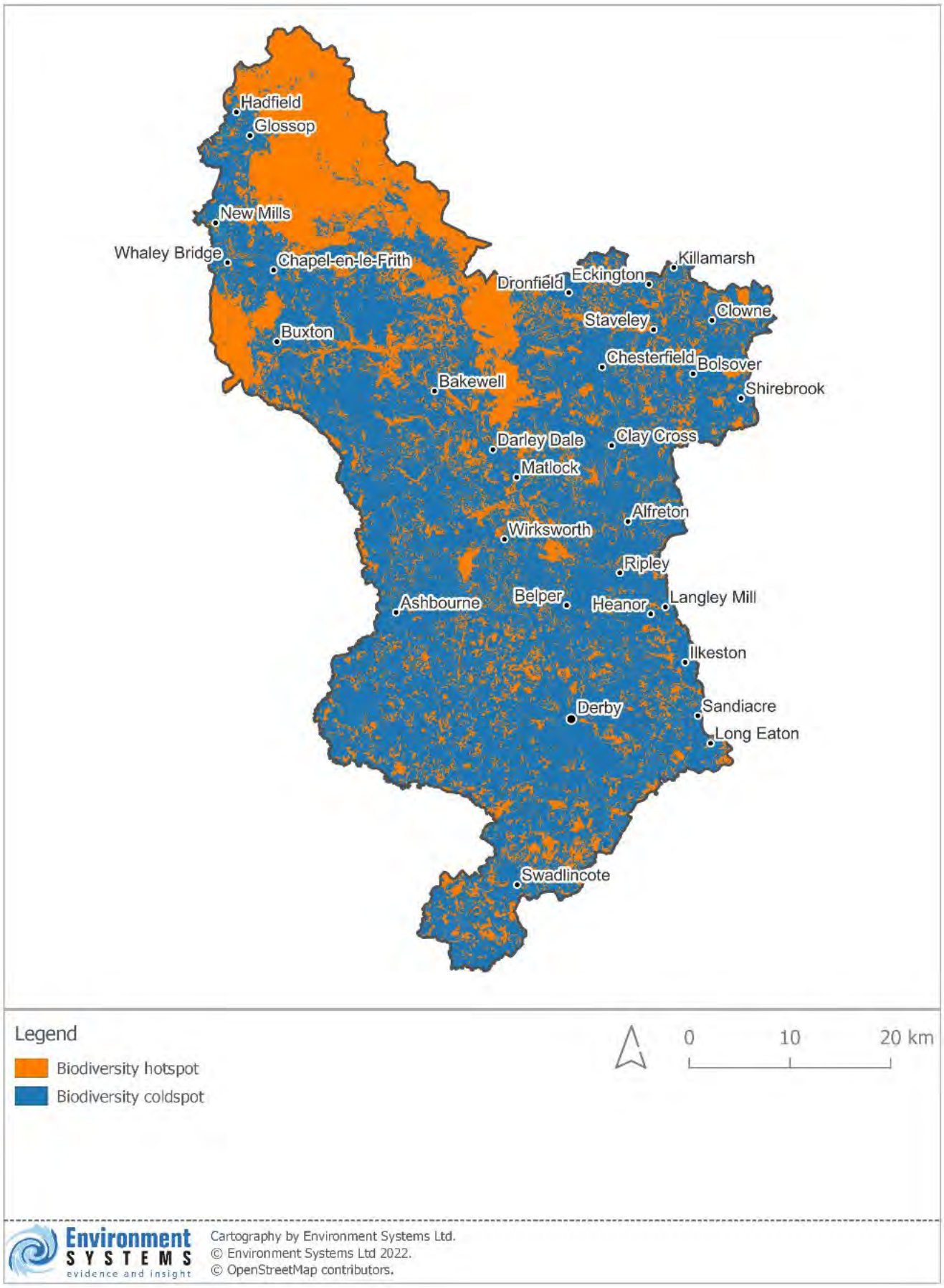

Figure 18: Biodiversity hotspots / coldspots

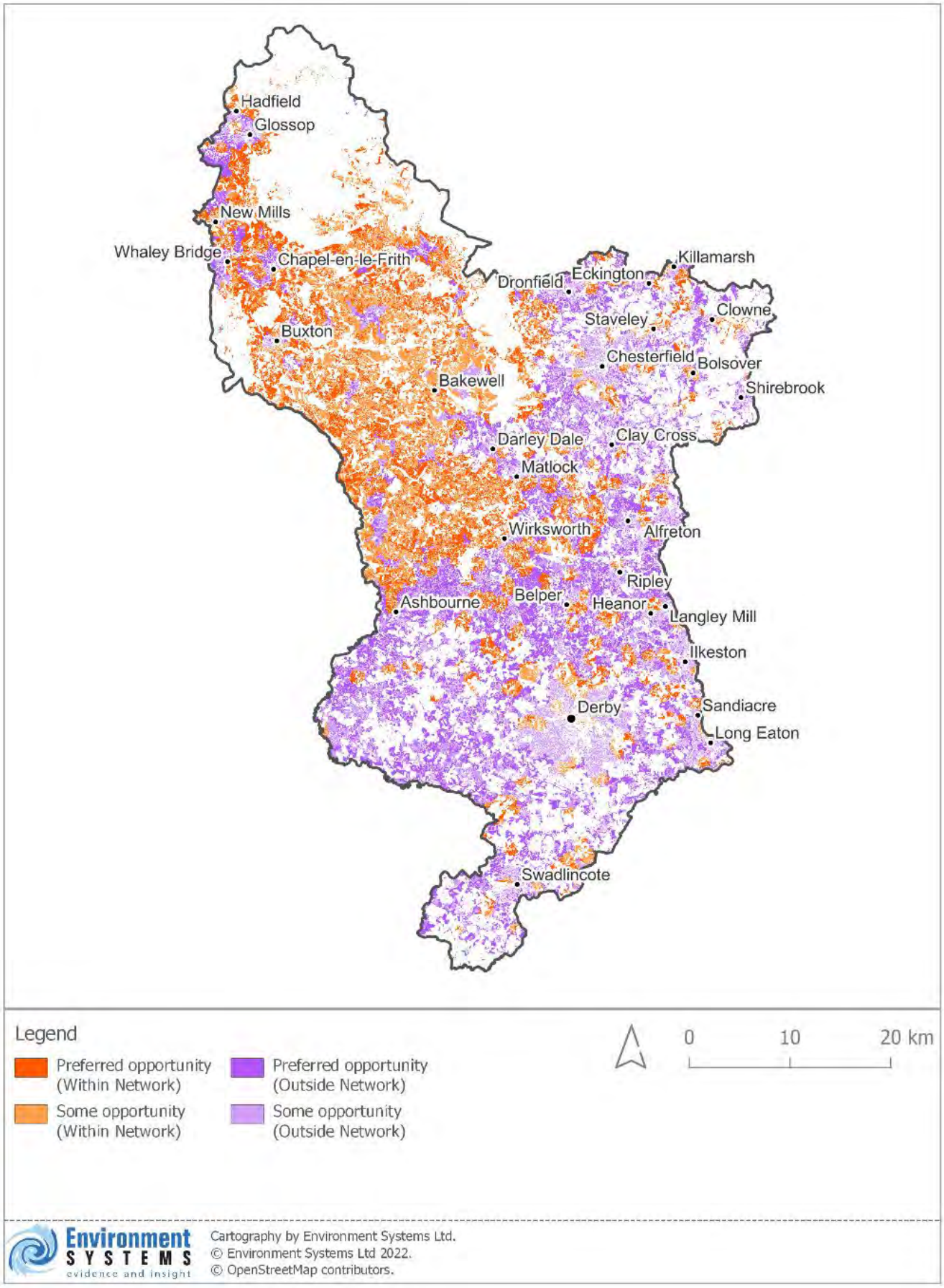

Figure 19: Opportunities for establishing species-rich grassland

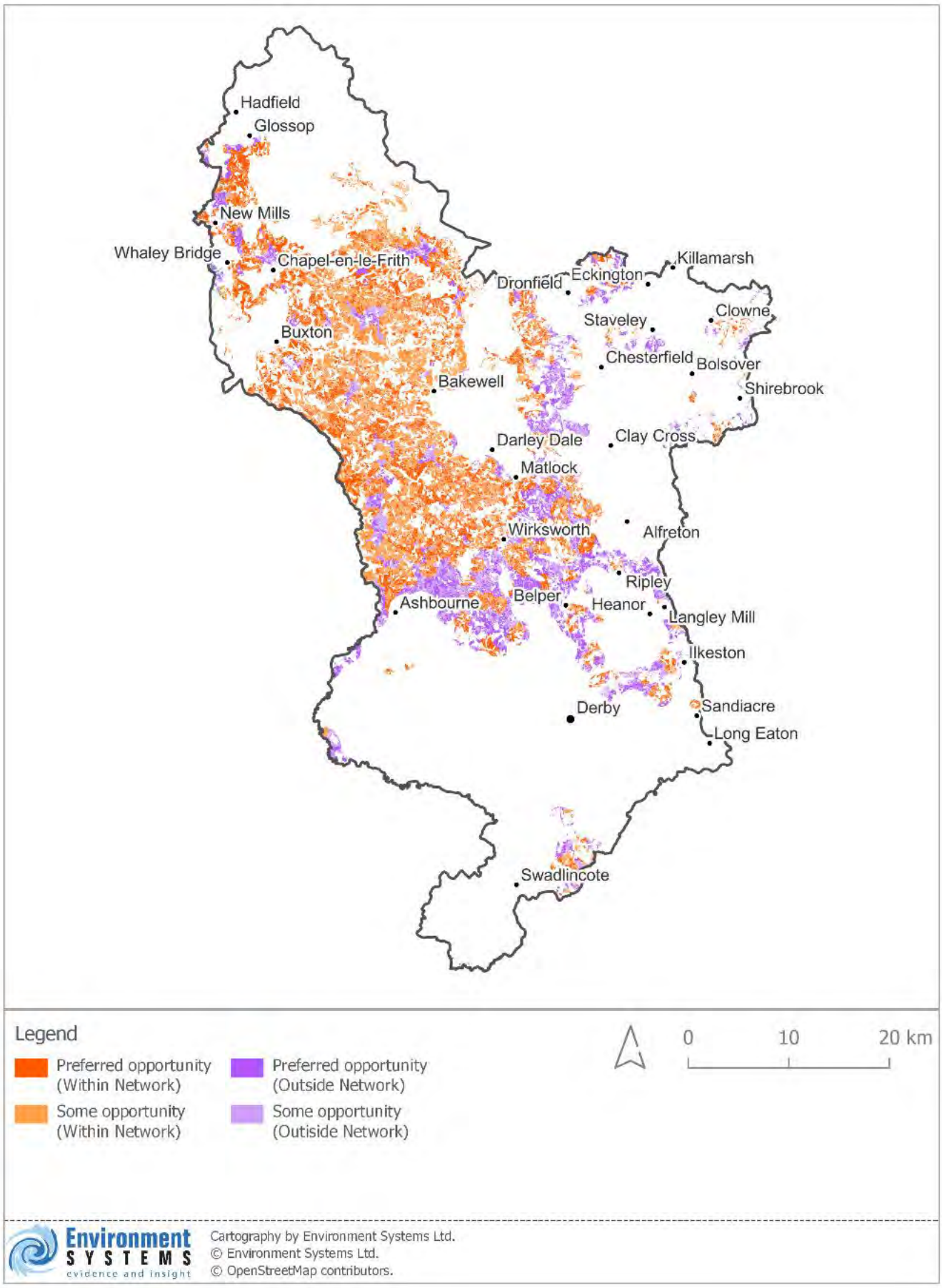

Figure 20: Opportunities for establishing species-rich grassland in relation to Natural England national grassland NRNs

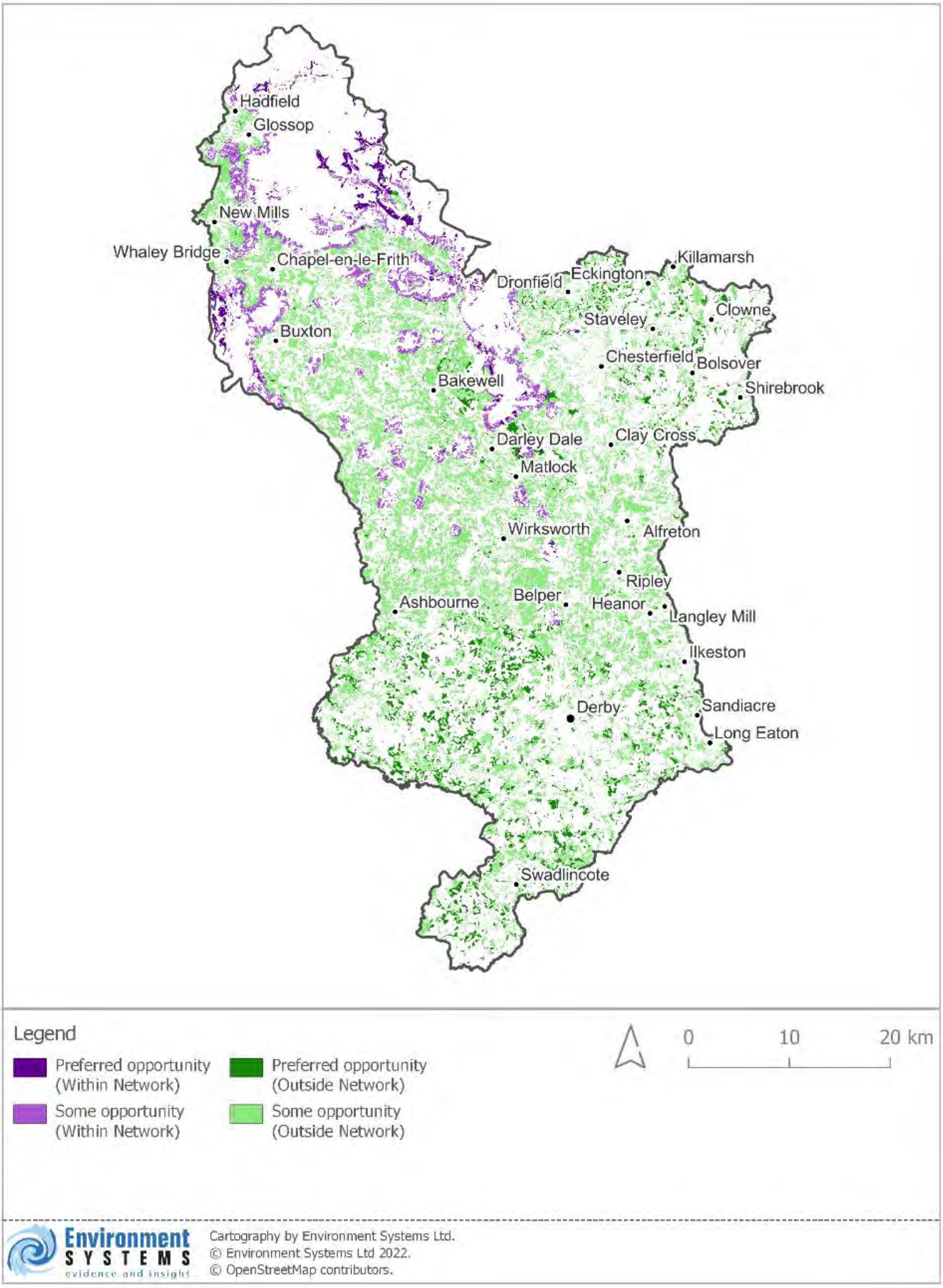

Figure 21: Opportunities for establishing heath

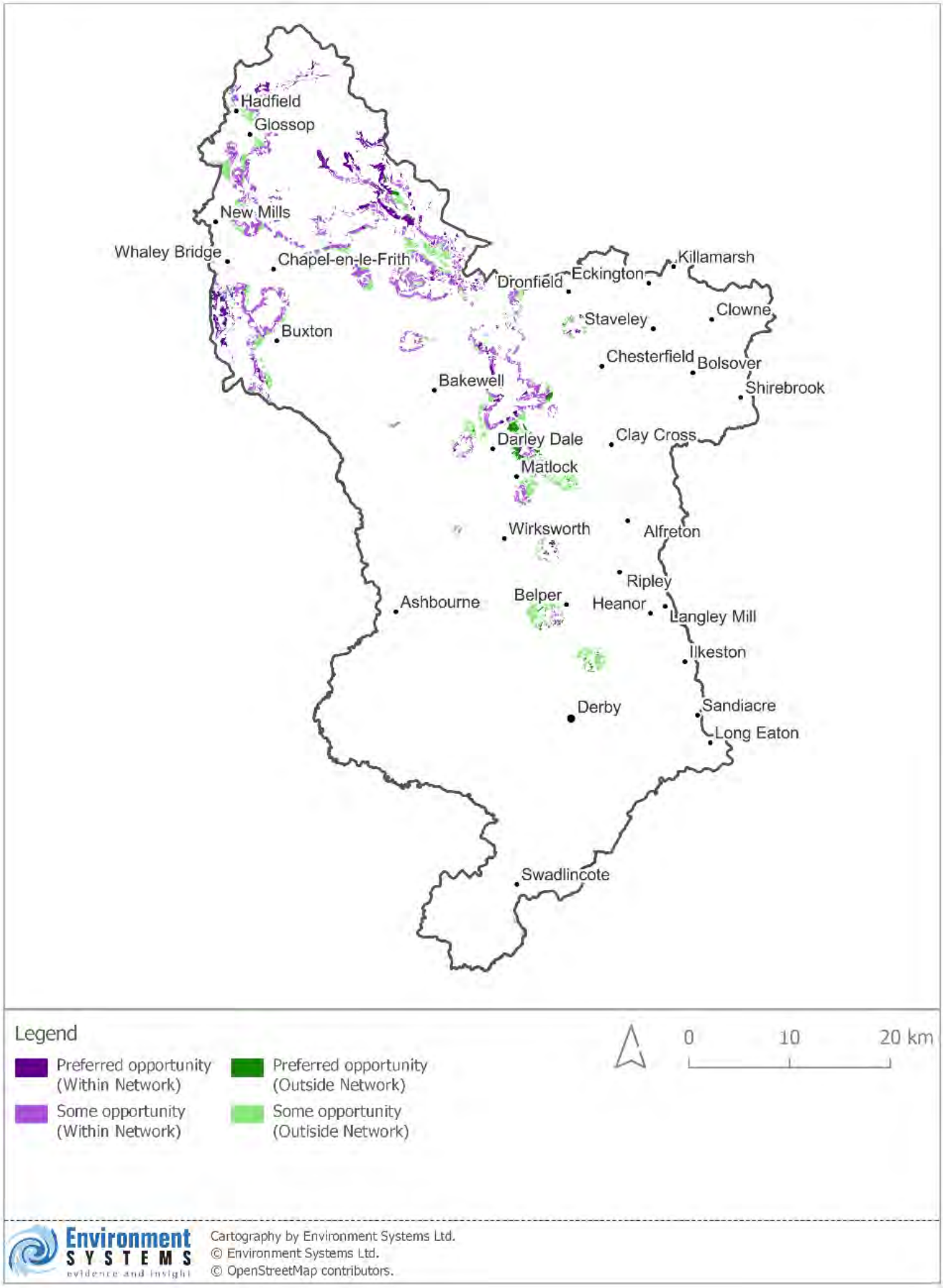

Figure 22: Opportunities for establishing heath in relation to Natural England national heathland NRNs

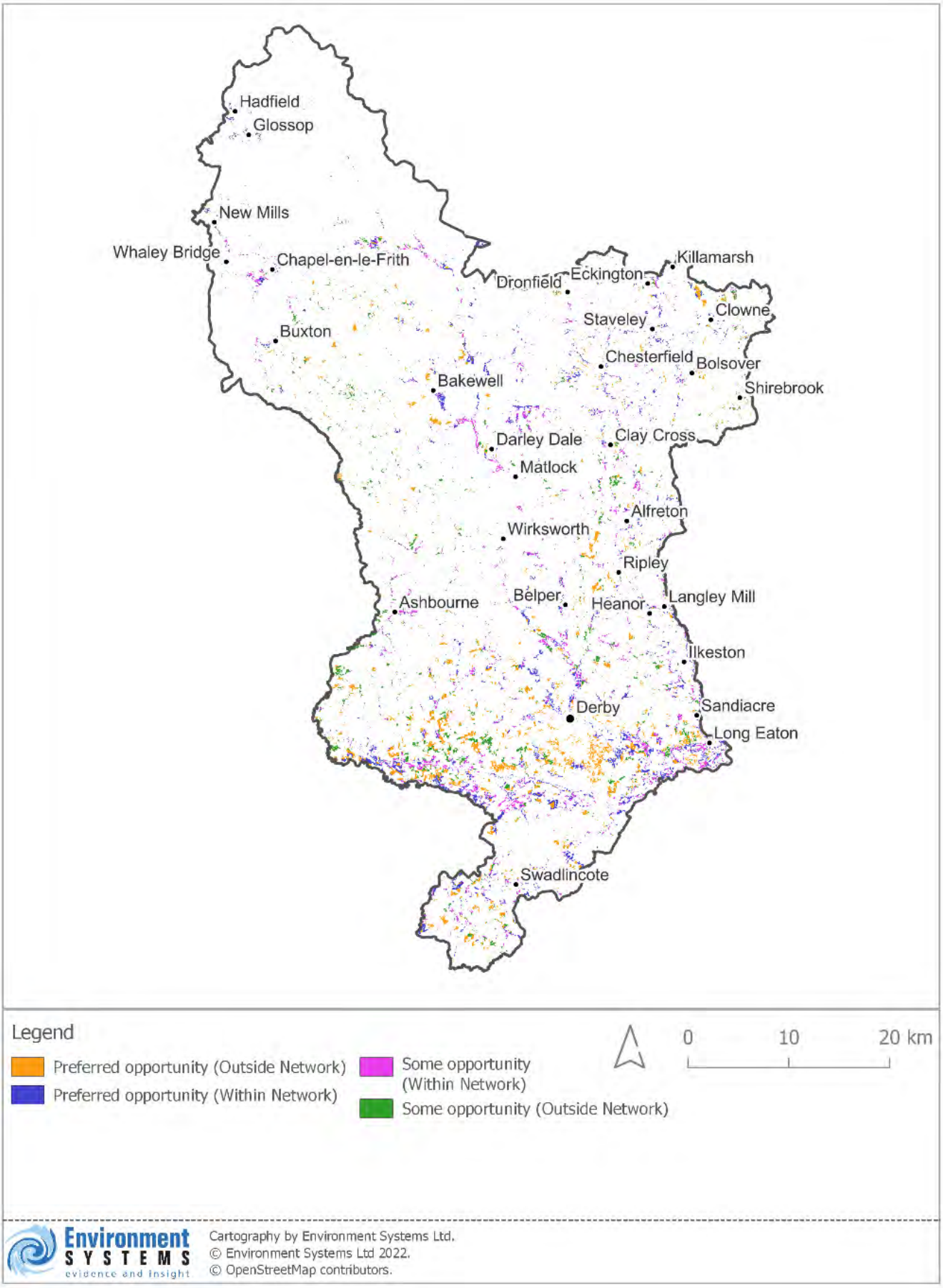

Figure 23: Opportunities for establishing wetland

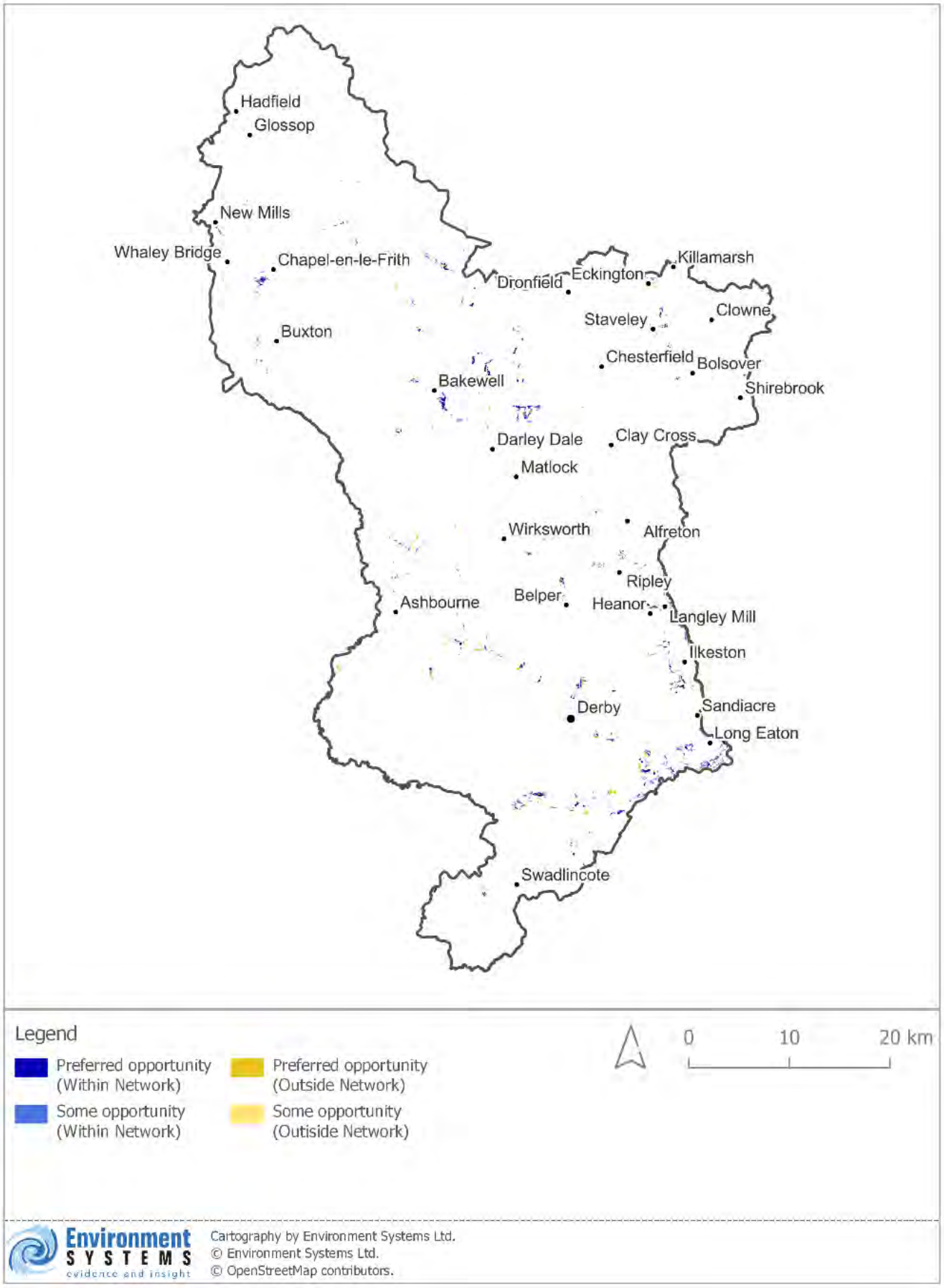

Figure 24: Opportunities for establishing wetland in relation to Natural England national wetland NRNs

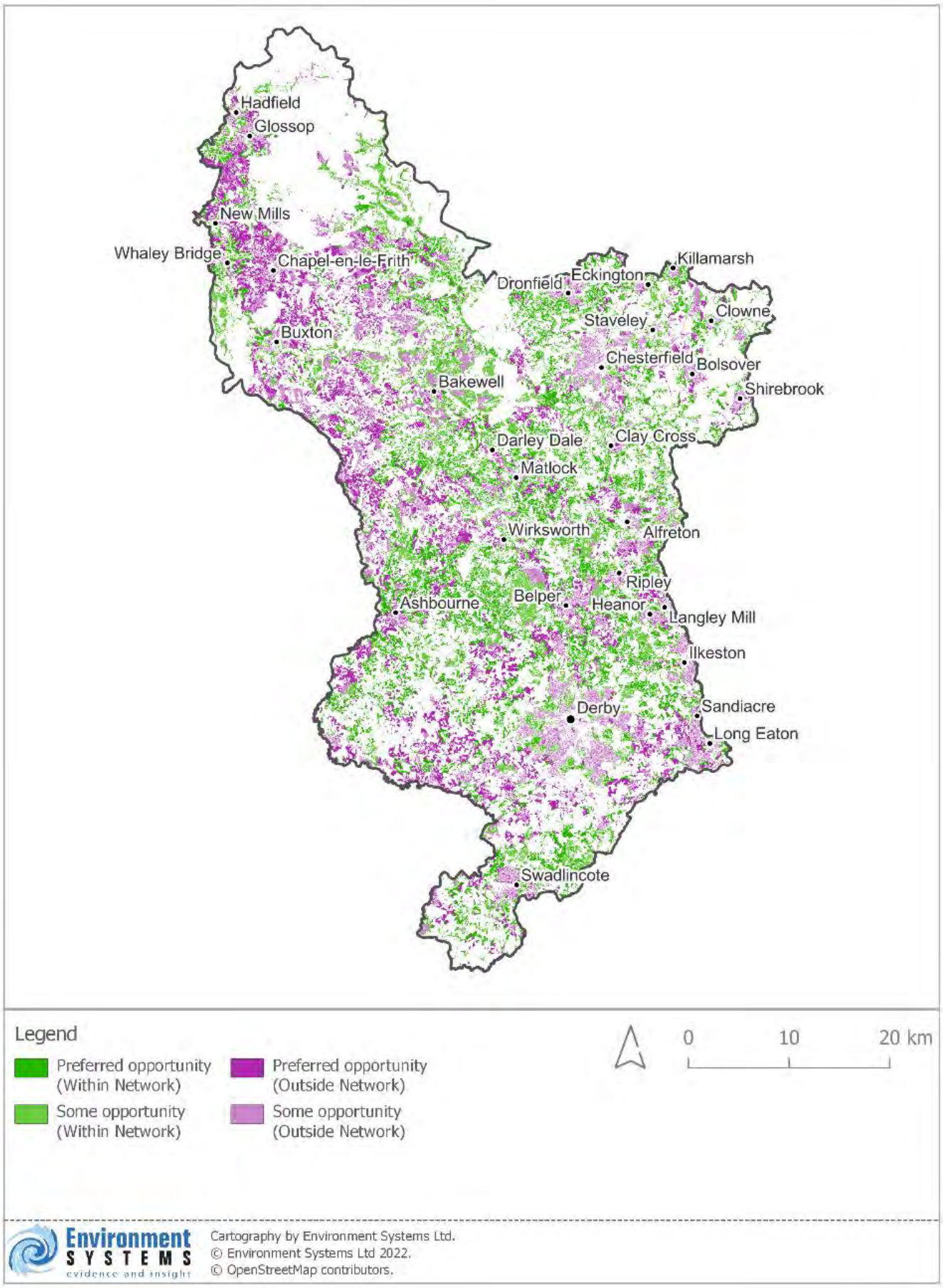

Figure 25: Opportunities for establishing woodland

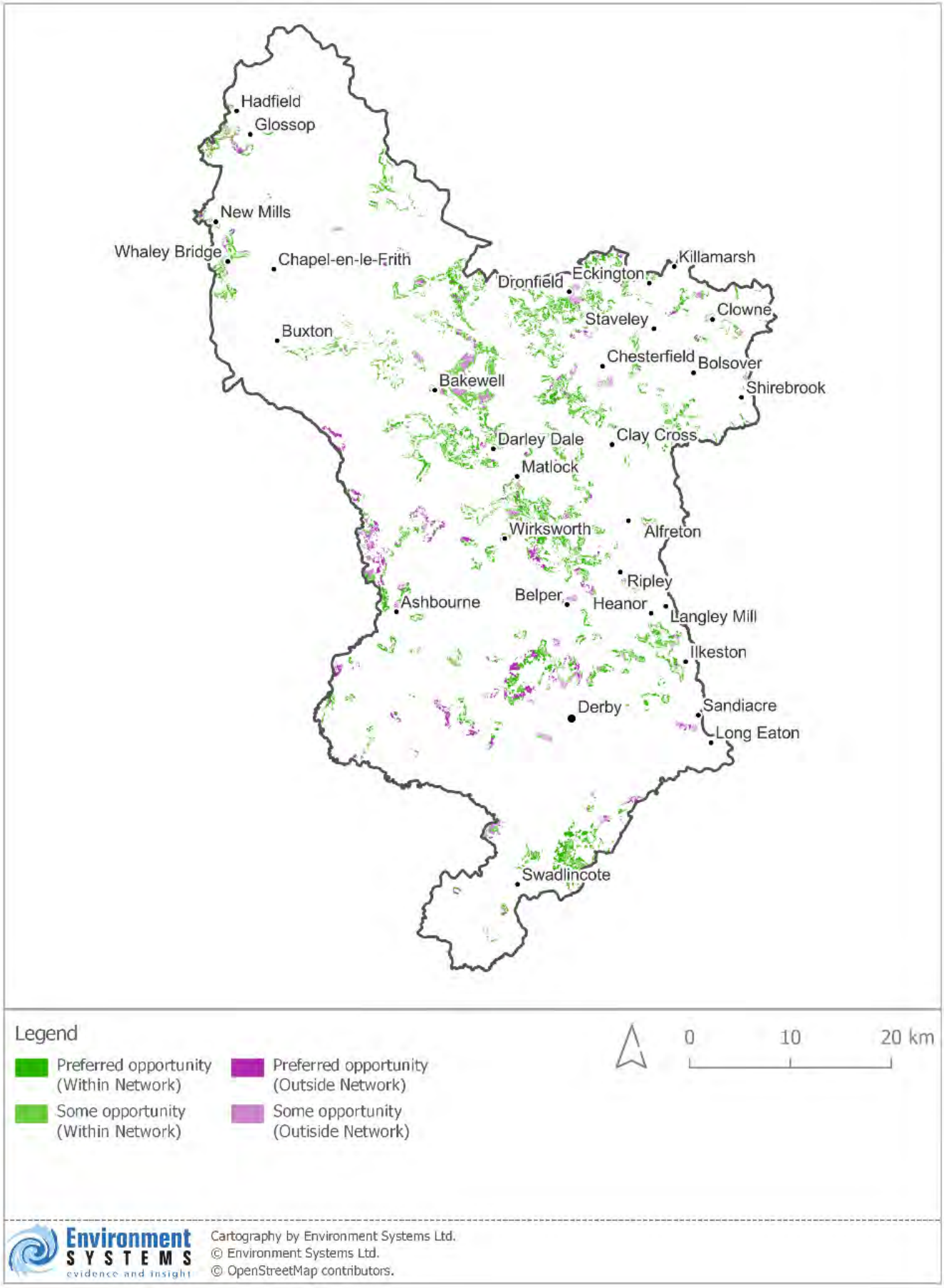

Figure 26: Opportunities for establishing woodland in relation to Natural England national woodland NRNs

Risks to biodiversity have been mapped where native habitats experience pressures from the surrounding land use (Figure 27), as follows:

- Native woodlands less than 2ha in extent, where the surrounding land is under more intensive agricultural use; the risk of fertilisers and herbicide sprays affecting the vegetation in these small woodlands is much higher than for larger woodlands. In this situation, the agricultural management of crops can create unfavourable conditions for some specialist native woodland species and, therefore, poses a risk to the biodiversity these smaller woodlands host.
- Other habitats adjacent to intensive agricultural land are also affected by the same type of risk if they also contain specialist species.
- Where public access is present to woodland, grassland, heath or wetland, there is a risk to species including from disturbance to wildlife, increased pollution (e.g. phosphorus from dog excrement) and littering; this is a particular issue in the Peak District National Park.
- Some Sites of Special Scientific Interest (SSSIs) are recorded as being in 'poor' or 'declining' condition which demonstrates that there is currently a risk to the biodiversity they are designated to support.
- Water bodies with a current 'poor-quality' status.

Development risk: areas that have been identified within local development plans as areas targeted for housing or employment development. The distribution of irreplaceable habitats is shown in Figure 28. These habitats are predominately located within the Peak District National Park and the Peak Fringe and Lower Derwent, and mainly comprise heath, blanket bog and calcareous grasslands.

Local planning policy as determined by Local Authorities, National Park Authorities, City Councils and Natural Capital Strategies must ensure rigorous protection of these habitats. A significant and largely unquantified proportion of irreplaceable habitats occur outside the designated sites network in Derbyshire, and therefore outside protected designated sites, such as National Nature Reserves, SSSIs, Local Nature Reserves and Local Wildlife Sites. Planning authorities should adhere to the protections already granted to designated sites but also ensure through the Natural Capital Strategy and LNRS that the undesignated irreplaceable habitats are not comprised. These unprotected important habitats are often small patches that have been fragmented and degraded by human activity, making them key targets for restoration, as they are stepping stones that can be included in plans for the expansion of existing ecological networks.

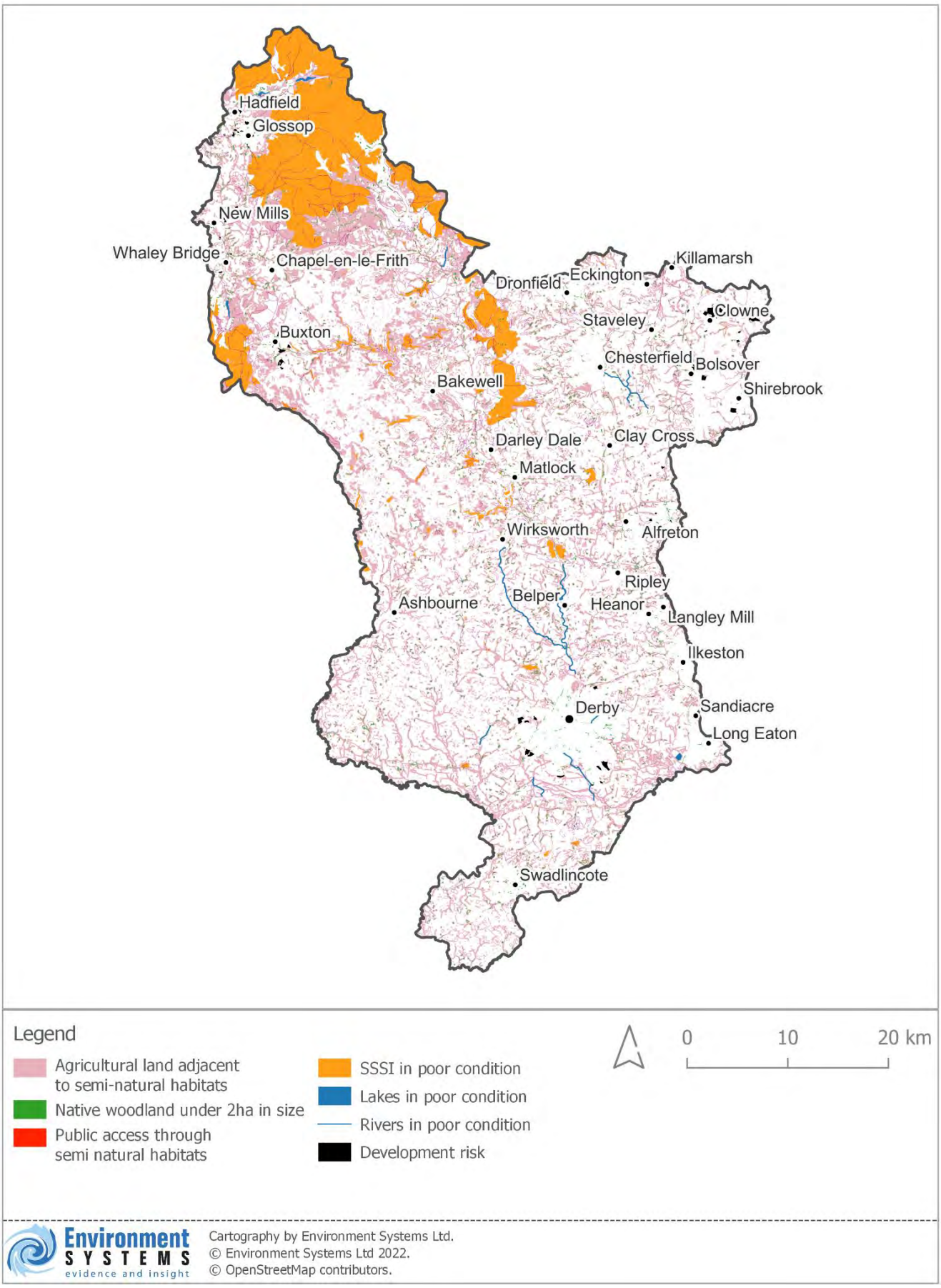

Figure 27: Risks to biodiversity

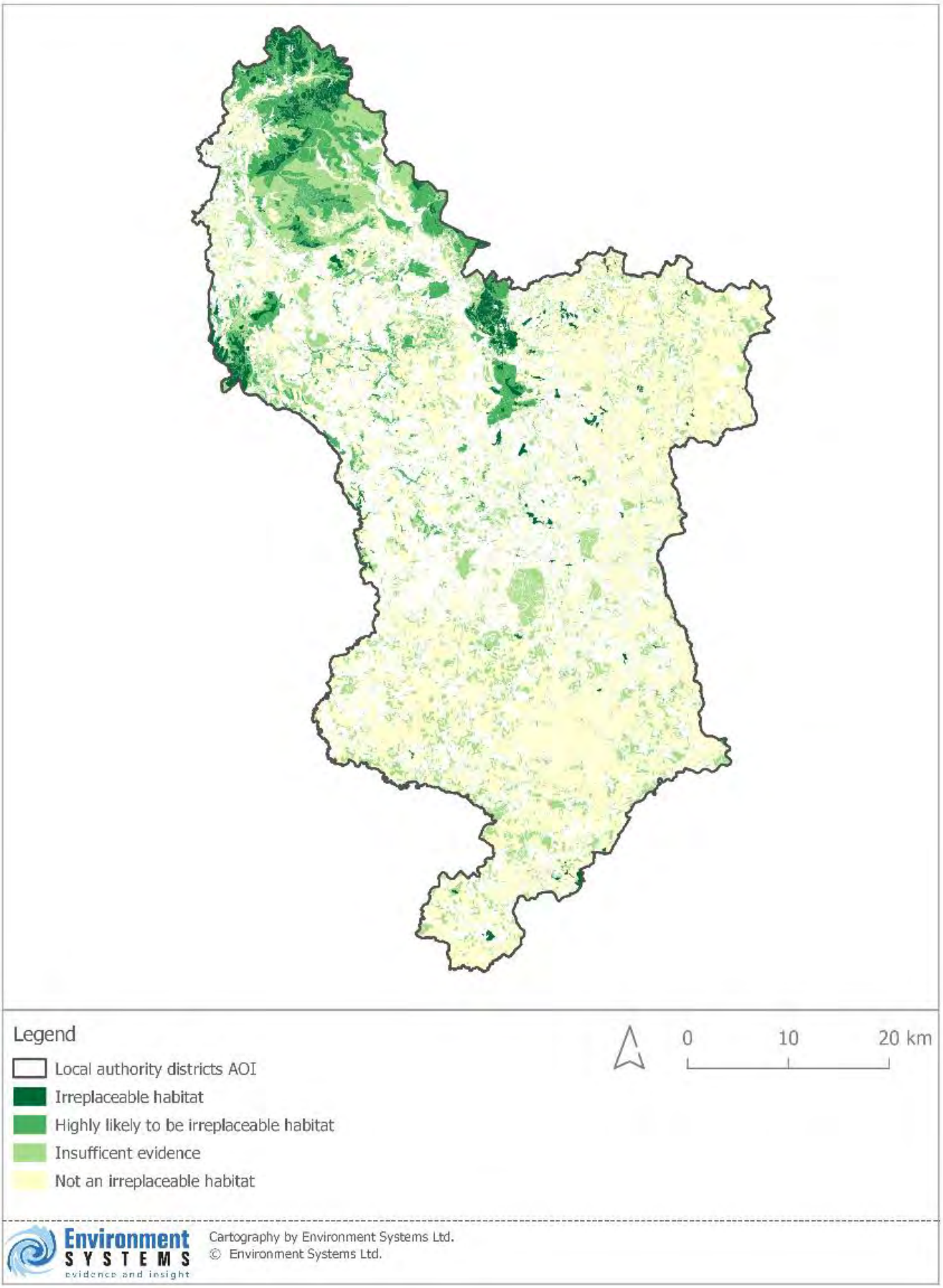

Figure 28: Distribution of irreplaceable habitats

It is a core principle of Biodiversity Net Gain (BNG) that irreplaceable habitats are avoided by proposed development. Figure 29 illustrates a proposed flowchart for the consideration of irreplaceable habitats in the development planning process and for BNG projects.

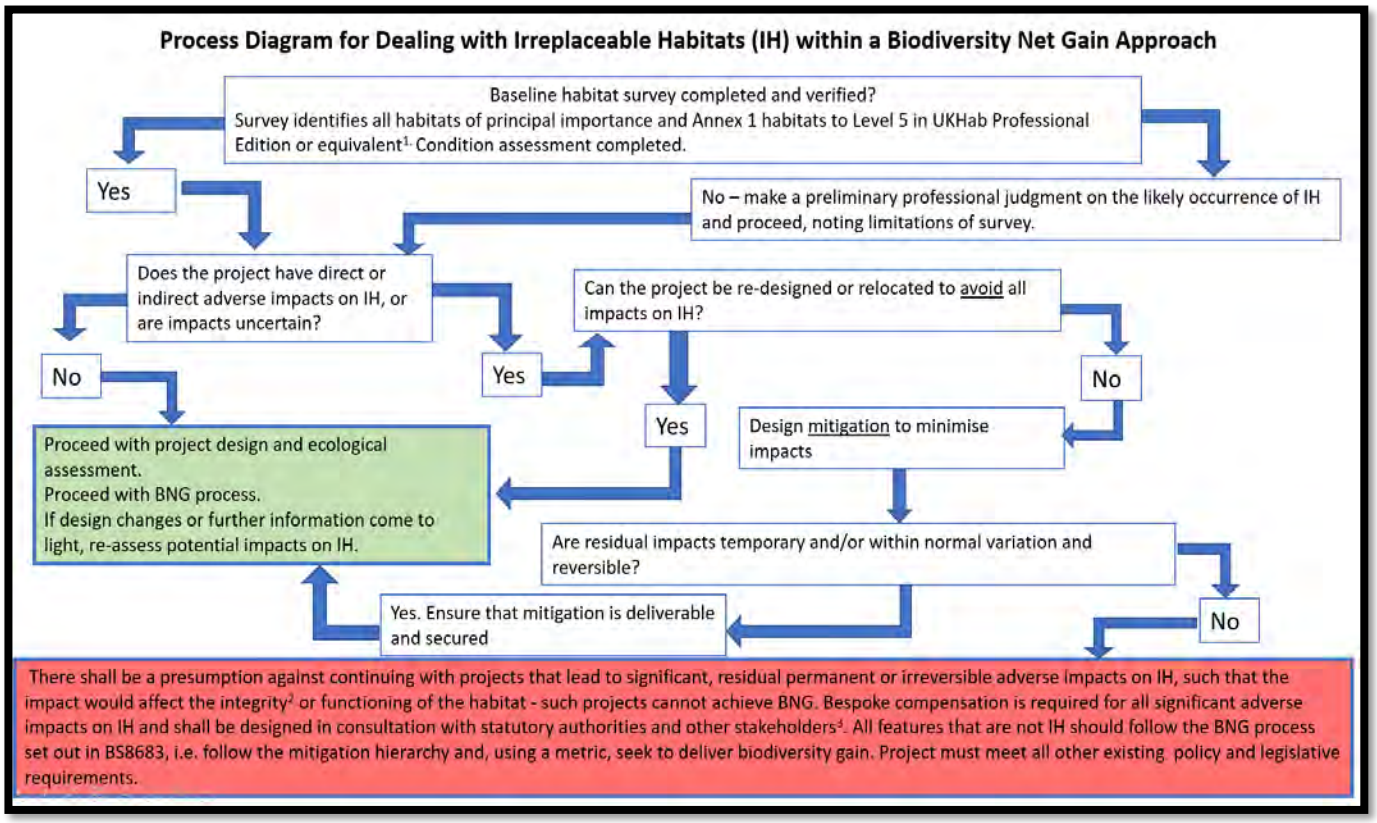

Figure 29: Process Diagram for Dealing with Irreplaceable Habitats in Development Planning and BNG Projects

Figure 29 identifies that 'bespoke compensation' is required for projects that lead to losses of irreplaceable habitats. Currently, there is no national guidance on what form this compensation should take. One approach may be to provide a hierarchy of suitable measures, for example:

1. Compensate for losses of irreplaceable habitats through a habitat translocation, where this is technically feasible and subject to existing guidance[6];
2. Restore existing equivalent habitats, i.e. habitats that are the same type as those being impacted, and secure their long-term management;
3. Create new habitat to enhance network connectivity and buffering to existing equivalent habitats already under appropriate management;

The approach to compensation for irreplaceable habitats must be clearly defined and agreed with relevant stakeholders. Where appropriate, compensation should be quantified using standard and repeatable methods. As a minimum, the quantum of compensatory habitat required should be significantly above the baseline biodiversity units + 10% to account for the relevant risk multipliers and habitat type should be the closest approximation to the habitat type lost as practicable.

[6] https://cieem.net/resource/habitat-translocation-a-best-practice-guide/

A national list of irreplaceable habitats is yet to be published by Natural England. In the absence of a national list a provisional list of habitats of high irreplaceability that are known to occur in Derbyshire has been identified for the Natural Capital Strategy, as follows:

- Ancient woodland
- Wood pasture and parkland
- Ancient and Veteran Trees
- Long-established woodland
- Blanket bog
- Lowland hay meadows and pastures
- Traditional Orchards
- Purple moor grass and rush pasture
- Lowland and upland fens
- Reedbeds
- Inland rock and scree
- Calaminarian grassland

This list should be interpreted with caution and reviewed as soon as the forthcoming Natural England definition and national list is available. The location of these habitats in Derbyshire, their characteristics and how each habitat is mapped in the Natural Capital Strategy is described in Table 1: Irreplaceable habitats in Derbyshire. It is expected that local authorities can build upon this list to ensure it is adequate in the local context.

Table 1: Irreplaceable habitats in Derbyshire

Habitat Name	Habitat Type (UKHab[7] typology)	Description and likely occurrence in Derbyshire
Ancient woodland	All woodland (w) ecosystems identified with Secondary code 33	Current definition of Ancient Woodland is any woodland (including plantations) that has been continuously wooded since 1600AD[8]. Known Ancient Woodlands >2ha are documented on the Ancient Woodland Inventory, although many smaller woods will not be included. In Derbyshire, the majority of recorded ancient woodlands are small and fragmented. Larger fragments remain in the ashwoods of the limestone dales of the White Peak, e.g. Millers Dale, Cressbrook Dale and Lathkill Dale and the Derwent Valley around Matlock and the oak and birch woods on the steeper slopes of the gritstone edges in the Eastern Moors.
Wood pasture and parkland	Habitat features identified with Secondary code 20	Wood-pasture and parkland are mosaic habitats valued for their ancient and veteran trees and are typically characterised by open grown trees in an extensive grazed landscape.

[7] Butcher, B., Carey, P., Edmonds, R., Norton, L. and Treweek, J. (2020). The *UK Habitat Classification Version 1.1* at http://www.ukhab.org/

[8] Ancient woodland, ancient trees and veteran trees: advice for making planning decisions - GOV.UK (www.gov.uk)

Habitat Name	Habitat Type (UKHab[7] typology)	Description and likely occurrence in Derbyshire
		Some sites have origins from Royal Hunting Forests. Anderson (2021)[9] records 3 Royal Forests partially in Derbyshire: The High Peak, Malbanc Frith and Macclesfield Forest, although there are only remnants of wood-pasture habitat retained along the Snake Pass road recorded on the current inventory. Most parklands in Derbyshire are associated with the country estates, including Chatsworth, Haddon Hall, Longshaw, Kedleston and numerous smaller estates. Wiltshire and Woore (2009)[10] provides a useful reference source of other medieval parks of Derbyshire.
Ancient and Veteran Trees	Point features identified with Secondary code 49	Many ancient and veteran trees fall within other ancient habitats, e.g. woodland and parkland. Open grown trees are poorly recorded, but the Woodland Trust has a publicly accessible database[11]. NB – all ancient trees are also veterans, but the terms are not strictly interchangeable.
Long-established woodland	Potentially including all woodland (w) ecosystem types	Long-established woodland is a stand of habitat that has a recorded history of being continuously wooded* >100years. There is no systematic inventory of these woodlands and many have no protection from development pressures. The First Edition Ordnance Survey maps are a useful resource to indicate the presence of long-established woodlands in Derbyshire. *woodland management, including coppice, felling and replanting or felling and regeneration is acceptable and areas of woodland open space and habitats that occur as part of woodland succession, e.g. native scrub, may also count.
Blanket Bog	Degraded blanket bog (UKHab f1a6) and Active Blanket Bog (UKHab f1a5 Annex 1 H7130)	Large blocks of blanket bog, a UKBAP Habitat of Principal Importance and the majority are also an Annex 1 Habitat under the Habitats Directive are present within Derbyshire. The vast majority of blanket bog in Derbyshire has been degraded by a combination of fire, including managed burns, wild fire and arson; drainage, cutting for fuel, over-grazing, air pollution and recreational pressures (Anderson, 2021). There are 3 major areas of blanket bog within Derbyshire: The Dark Peak, including Edale Head and Kinder Scout National Nature Reserve and part of South Pennines Moors Special Area of Conservation. (SAC) The Dark Peak, including the open moors and moorland fringe of Coombs Moss and the Upper Goyt Valley (including part of the Goyt Valley SSSI) to the west of Buxton

[9]Anderson, P (2021) Peak District – A Survey of British Natural History. New Naturalist Library
[10] Wiltshire M. and Woore, S. (2009) Medieval Parks of Derbyshire. Landmark Collectors Library
[11] Ancient Tree Inventory - Woodland Trust

Habitat Name	Habitat Type (UKHab[7] typology)	Description and likely occurrence in Derbyshire
		The Eastern Gritstone Moors, including Big Moor above the Gritstone Edges of Froggatt and Curbar, which include part of the Eastern Peak District Moors SSSI.
Lowland hay meadows and pastures	May include all priority grassland types: g1a lowland dry acid grassland, g2a lowland calcareous grassland and g3a lowland meadows	Grasslands with a long history of continuous management are likely to have high irreplaceability where they meet the following criteria: 1) Presence of designated species or habitats, rare or scarce plants, fungi or invertebrates; 2) Characteristic and appropriately managed areas with evidence of long establishment (>100 years); 3) Presence of characteristic topography, aspect, geology and soils. This includes grassland on all soil types (acid, calcareous and neutral), which are widely distributed throughout Derbyshire. Natural England has published grassland priority habitat inventories[12], although field data should be used to confirm the presence and status of any grasslands outside of the designated sites network. Calcareous grasslands are typically largest in area and are restricted to the limestone dales in the north and west of the county. Acid grasslands are typically smaller and associated with the Gritstone Dark Peak. Neutral grasslands are widespread, but typically in small patches.
Traditional Orchards	Complex habitat features identified with Secondary code 21	Traditional orchards comprise open-grown fruit and nut trees typically including specimens which are >50years old and have veteran features. Typically planted in herbaceous ground layer, this habitat may have fallen out of regular management, leading to encroachment with tall herbs and scrub. Habitat includes traditional orchards within curtilage of domestic properties. Habitat patches are typically very small (typically <1000m^2) and isolated patches, associated with traditional villages and farmsteads throughout the county.
Purple moor grass and rush pasture	UKHab f2b	This grass and rush-dominated wetland community is associated with poorly drained soils on valley sides and spring-lines, especially on calcareous and clay soils. Good examples of this uncommon and difficult to identify community are typically herb-rich and are sometimes confused with considerably more widespread species-poor acidic communities such as Yorkshire fog – soft rush pastures (UKHab g3c8) and many purple moor-grass dominated communities that have arisen through inappropriate management of other bog and fen communities. Very rare in Derbyshire, probably covering <50ha in total, the largest known patch is within Goyt Valley SSSI.
Lowland and upland fens	Lowland fens (f2a) and Upland flushes,	Derbyshire straddles the upland/lowland boundary of the UK and this complicates the differentiation between these two closely allied priority habitat types. The upland moorland of

[12] Priority Habitat Inventory (England) - data.gov.uk

Habitat Name	Habitat Type (UKHab[7] typology)	Description and likely occurrence in Derbyshire
	fens and swamps (f2c)	Kinder and the Dark Peak SSSI, Derwent and the Eastern Moors support a mosaic of blanket bog, wet heath and upland flush communities, with the latter largely associated with streamlines and cloughs[13]. Lowland fens are uncommon and largely confined to river valleys, notably along Bretton Clough near Abney and in the Erewash valley on the border with Nottinghamshire.
Reedbeds	UKHab f2e	Reedbeds are an uncommon habitat in Derbyshire and almost all are a result of the restoration of former mineral workings. Reedbeds in restored mineral working are not irreplaceable.
Inland rock and scree	UKHab s1a	Inland rock and scree and their natural vegetation communities, derived from natural and semi-natural outcrops (as opposed to quarried outcrops) are likely to be irreplaceable. There is no national habitat inventory for this habitat type currently. Natural limestone outcrops (UKHab s1a), base-rich screes (UKHab s1a6) and crevice vegetation (UKHab s1a7), particularly within the Derbyshire Dales NNR, but occurring throughout the dales of the White Peak support fragments of this habitat. It is notably difficult to map these habitats as they occur on steep slopes and so the area shown on two-dimensional spatial projections significantly under-estimates the area of the habitat across the county.
Calaminarian grassland	UKHab u1c	This is a very uncommon and rare habitat within Derbyshire, although the county is a stronghold nationally. This habitat is only associated with the former workings of historic metalliferous surface mining, in particular the lead rakes of the White Peak. Good examples, such as Tideslow Rake SSSI, are protected, but much of this habitat has been subject to grazing pressure and intensification which has led to loss and degradation. It is estimated that only 14ha of Calaminarian grassland remains in the Peak District, with an upper estimate of 41ha[14]. Mapping the current extent, condition and potential for restoration and buffering (through new habitat creation of species-rich grasslands) for this critical habitat resource within the county should be a conservation priority.

[13] a steep-sided ravine
[14] Anderson, P (2021) Peak District, New Naturalist Library.

Surface water regulation (Natural Flood Management)

Surface water regulation is an important ecosystem service with respect to climate change, due to the trend for increased frequency and severity of flood events. Enhancing surface water regulation can reduce peak flows when carried out at scale, in the right locations.

Figure 30 shows the existing level (stock) of Natural Flood Management (NFM) provision. The uplands of the Peak District National Park provide the highest provision for NFM due to the high occurrence of peaty soils that absorb and retain water. Other areas that have a high capacity to reduce flooding are those with shallow gradients and areas that are wooded.

Knowledge of the areas that flood can help us understand where nature-based solution can be targeted to help mitigate flood peaks by slowing the time it takes water to reach rivers during high rainfall events. The position of land in a water catchment is an important consideration; interventions targeted within headwater zones (i.e. upstream) have greatest impact, but can be physically challenging to achieve due to accessibility issues. Interventions in the valley bottoms are least effective at slowing the flow of water through a catchment, but can still be important locally. Figure 31 shows the hydrological catchment zones for Derbyshire from headwaters to valley bottoms.

Hydrological connectivity is an important consideration when targeting interventions to enhance NFM. The existing channel network for Derbyshire, showing rivers and major streams, is shown in Figure 32. From this network and the surrounding topography the hydrological connectivity has been derived. Hydrological connectivity is shown in Figure 33; in areas with high connectivity more of the surface water is funnelled by the topography to join the channel network, which then carries it downstream and these areas are more prone erosion, pollution and pluvial flooding.

Two maps for NFM opportunities have been produced; one showing all possible locations where interventions could be located (Figure 34 and Figure 35) and one showing a range of targeted interventions, which are the locations that have the highest hydrological connectivity, and as such would have the greatest impact on reducing the flow of water into the channel network (Figure 32).

Key points and recommendations for nature-based action: NFM

- **Restoration of peatland** within the Peak District National Park will enhance water holding capacity in the peat, thereby mitigating downstream flooding. It will also alleviate the impact of drought on the surrounding areas, and store carbon.

- **Plant riparian woodlands** along rivers where there is no existing adjacent semi-natural vegetation. This flood management solution will be particularly beneficial in reducing flood risk in the Trent Valley Washlands, and the mid and lower section of the river Derwent.

- **Create and restore floodplains** in the lower reaches of the catchment where the floodplain is larger. Flood mitigation can be enhanced by establishing sacrificial flood areas upstream of major settlements. An example of this is the lower reaches of the River Rother near Chesterfield, where washlands have been created upstream of the town to contain flood water.

- **Enhance integrity of river channels,** particularly the river Derwent, to slow the speed of water and increase its water holding capacity.

- **Creation of wet woodlands and fen** adjacent to rivers to absorb flood waters.

- **Enhance soil infiltration** through the management of existing species-rich pastures, planting deep rooted grasses in agricultural ley grassland, and/or establishing species rich meadows. These actions will have most impact when they are carried out in the higher catchment zones, and on the areas with greater hydrological conductivity.

- **Plant new hedges** or restore older hedges and field margins across slopes. This will help slow the movement of water and mitigate flooding particularly when implemented in the mid-reach catchment zone.

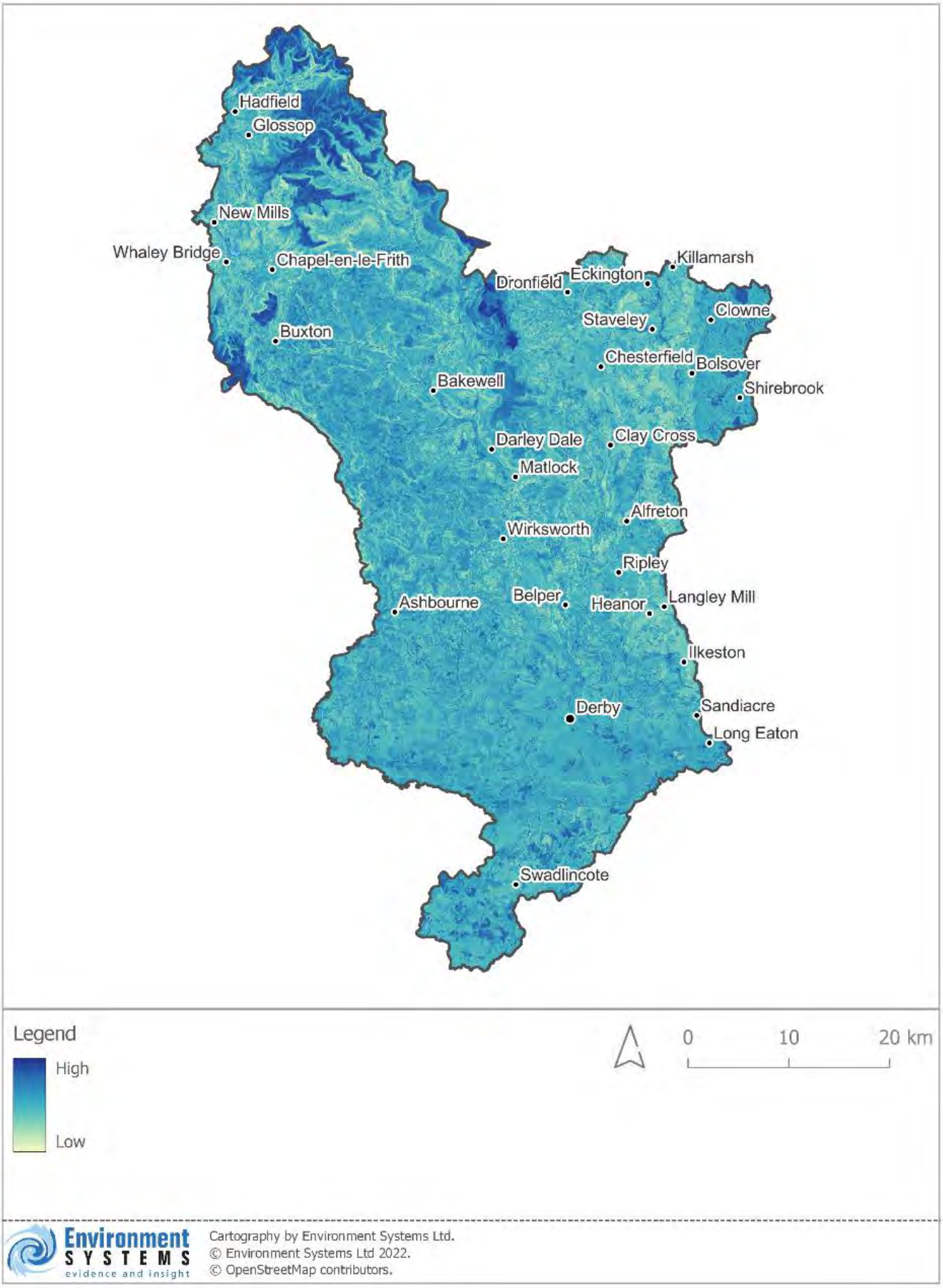

Figure 30: Natural Flood Management: current provision (stock)

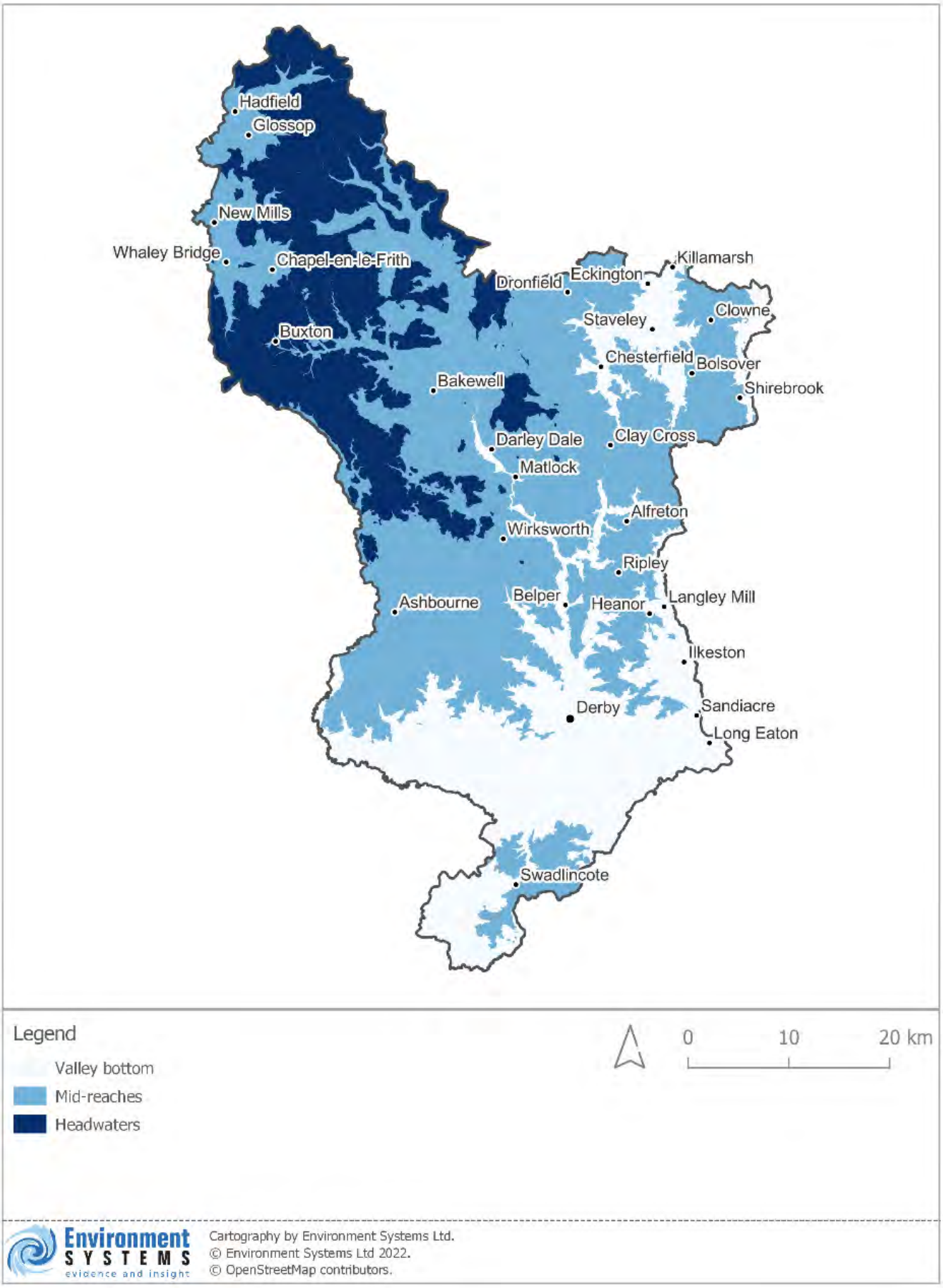

Figure 31: Hydrological catchment zones

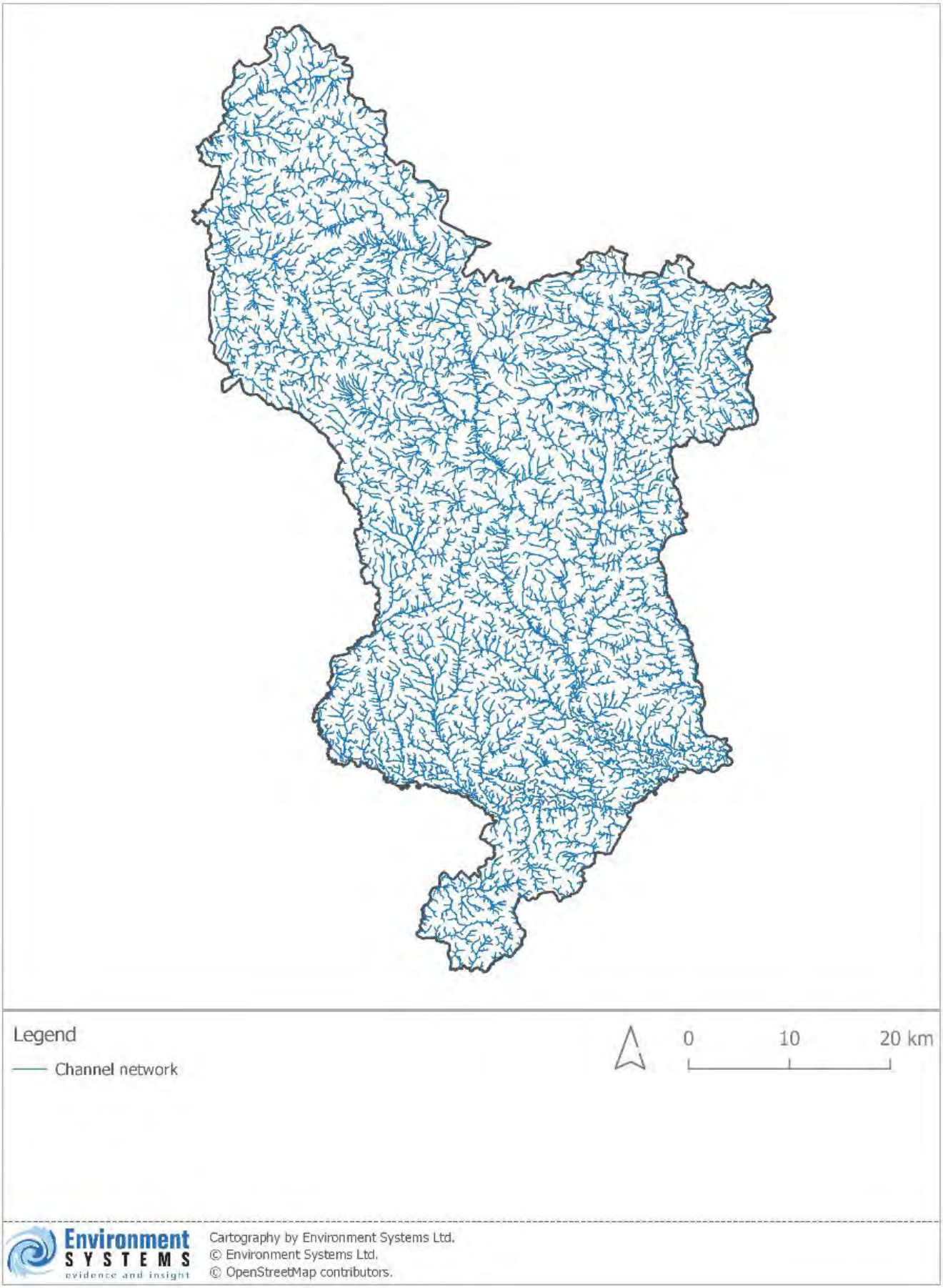

Figure 32: Channel Network

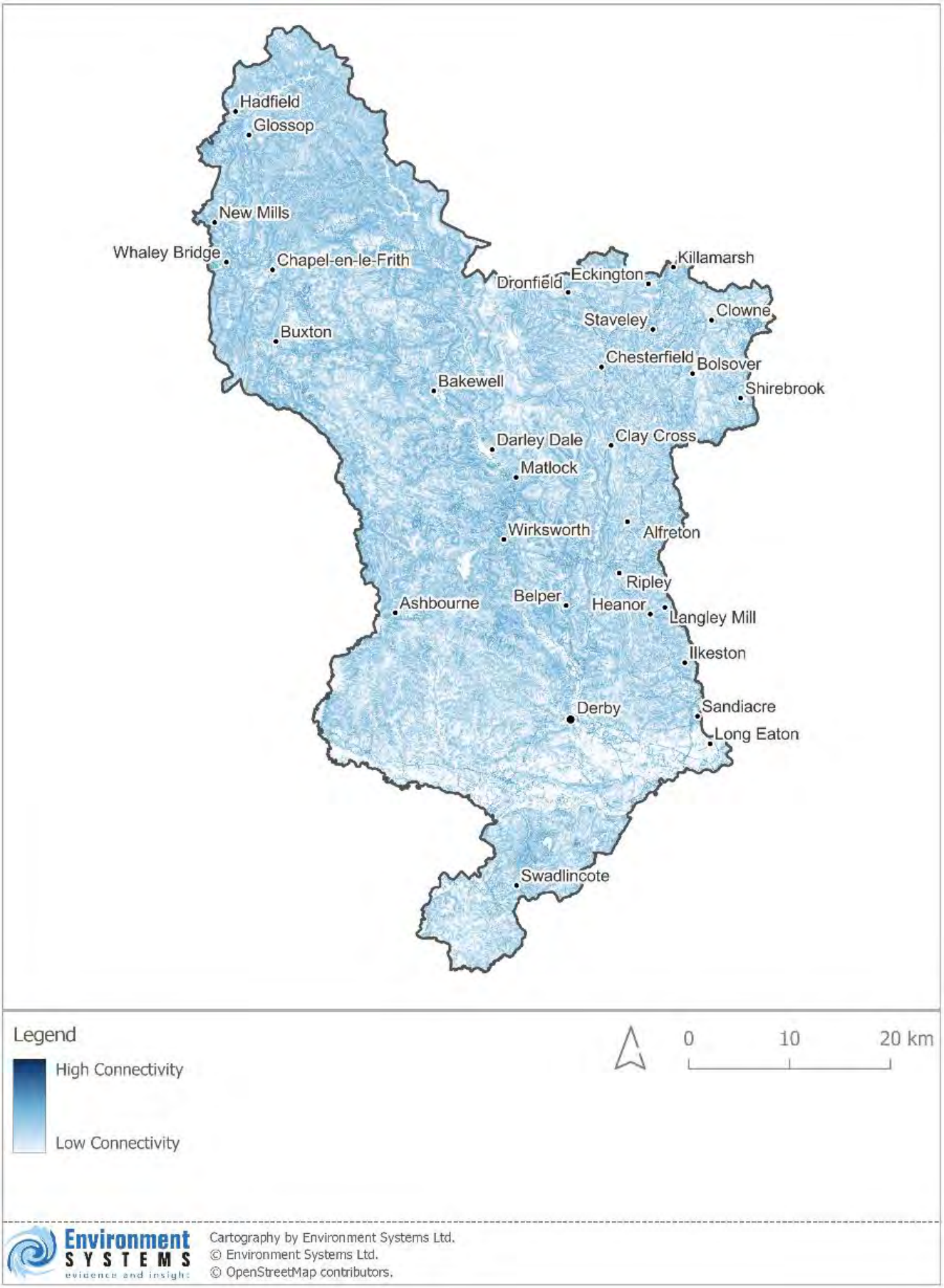

Figure 33: Hydrological connectivity

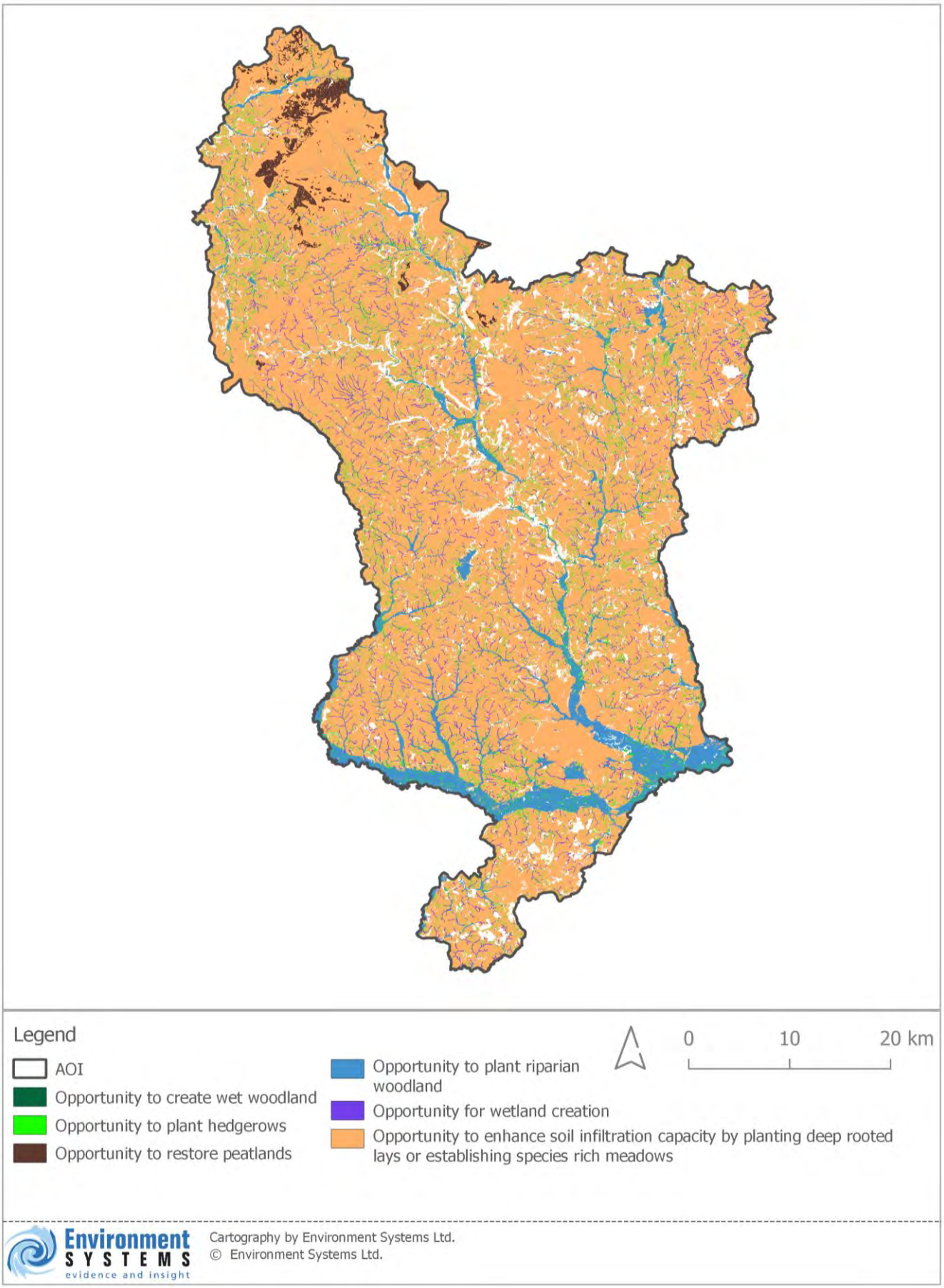

Figure 34: Natural Flood Management: all NFM opportunities

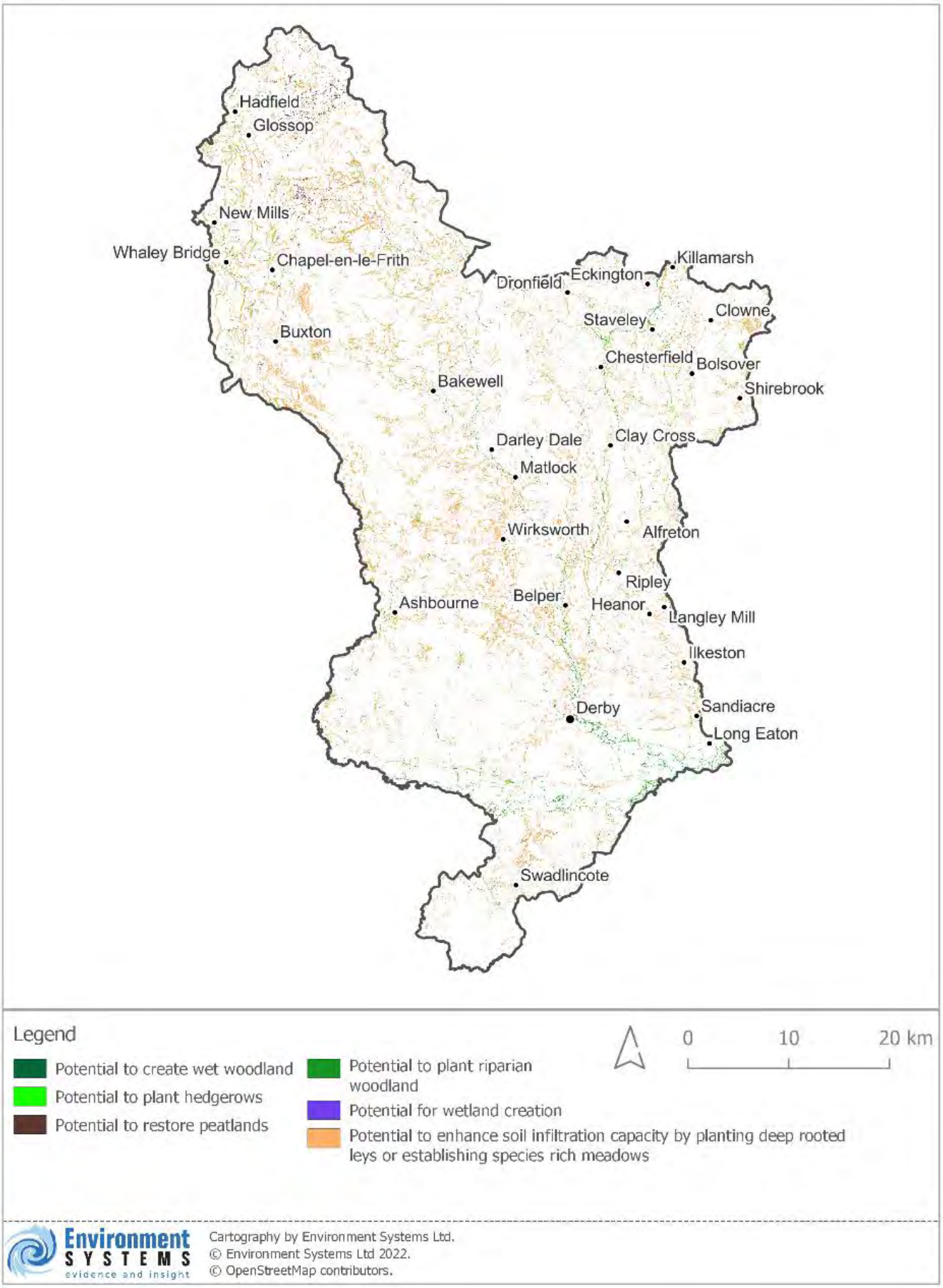

Figure 35: Natural Flood Management: targeted opportunities

Water quality regulation

Slope, soil type, vegetation cover and land management practice all have an impact on maintaining water quality. Figure 36 shows the existing level (stock) of water quality regulation in Derbyshire. Peat habitats located within the Peak District National Park have a high existing provision for maintaining water quality. In contrast, the intensively managed agricultural land in the Trent Valley Washlands currently have the lowest existing provision for maintaining water quality.

The degraded peat within the Peak District National Park is a risk to water quality in the wider catchment (Figure 37). However, the most widespread risk to water quality within Derbyshire that can be tacked by NBS is the potential for agricultural run-off into watercourses, or places where there are livestock directly adjacent to streams and rivers and channels of fast water movement; in this situation run-off can pick up pollutants which then enter the watercourses. This risk is greatest in areas with high levels of agricultural production such as Southern Magnesian Limestone and in the valley bottom areas of the main river catchments, particularly the Trent Valley washlands, the Melbourne Parklands and Mease/Sense Lowlands.

Opportunities for nature-based solutions that will improve water quality throughout the catchment are shown in Figure 38. These land management actions can have a significant, positive impact on water quality.

Key points and recommendations for nature-based action:
Water Quality

- **Restoration of peatland:** peatlands act as a water filter removing dirt, debris and pollutants from water before they flow into waterways.
- **Establish within-field headlands** throughout Derbyshire's agricultural lands to reduce sediment and pollutant run-off.
- **Enhance the woodland network** throughout Derbyshire to reduce soil erosion and pollutant run-off.
- **Improve bankside vegetation:** riparian tree buffers and riverside meadows intercept and immobilise sediment and pollutants before they reach watercourses.
- **Plant new hedgerows or rows of trees** across slopes or adjacent to watercourses, to reduce the sediment and pollutant load reaching watercourses.
- **Prevent erosion and pollution of the River Wye:** this river has specific management needs, as due to the porosity of the underlying limestone it is common for this river to dry up during the summer. Preventing erosion, and pollution of the river bed from animal grazing or visitor pressure, are particularly important during dry periods. Fencing, and establishing more bank-side vegetation along the river bed is recommended.
- **Planting of vegetation around disused mining sites:** bankside vegetation adjacent to mining sites can alleviate heavy metal pollution.

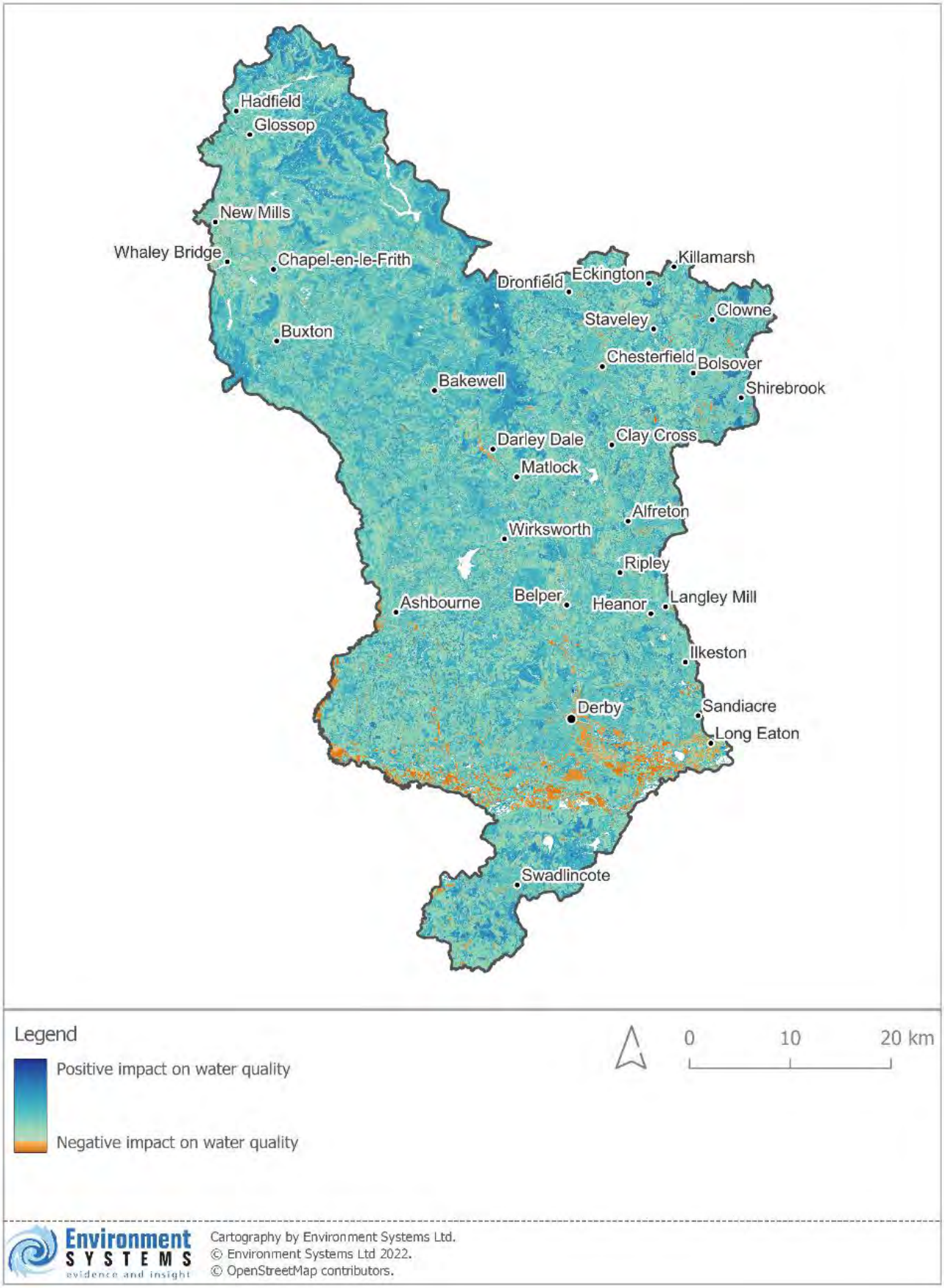

Figure 36: Water quality regulation: current provision (stock)

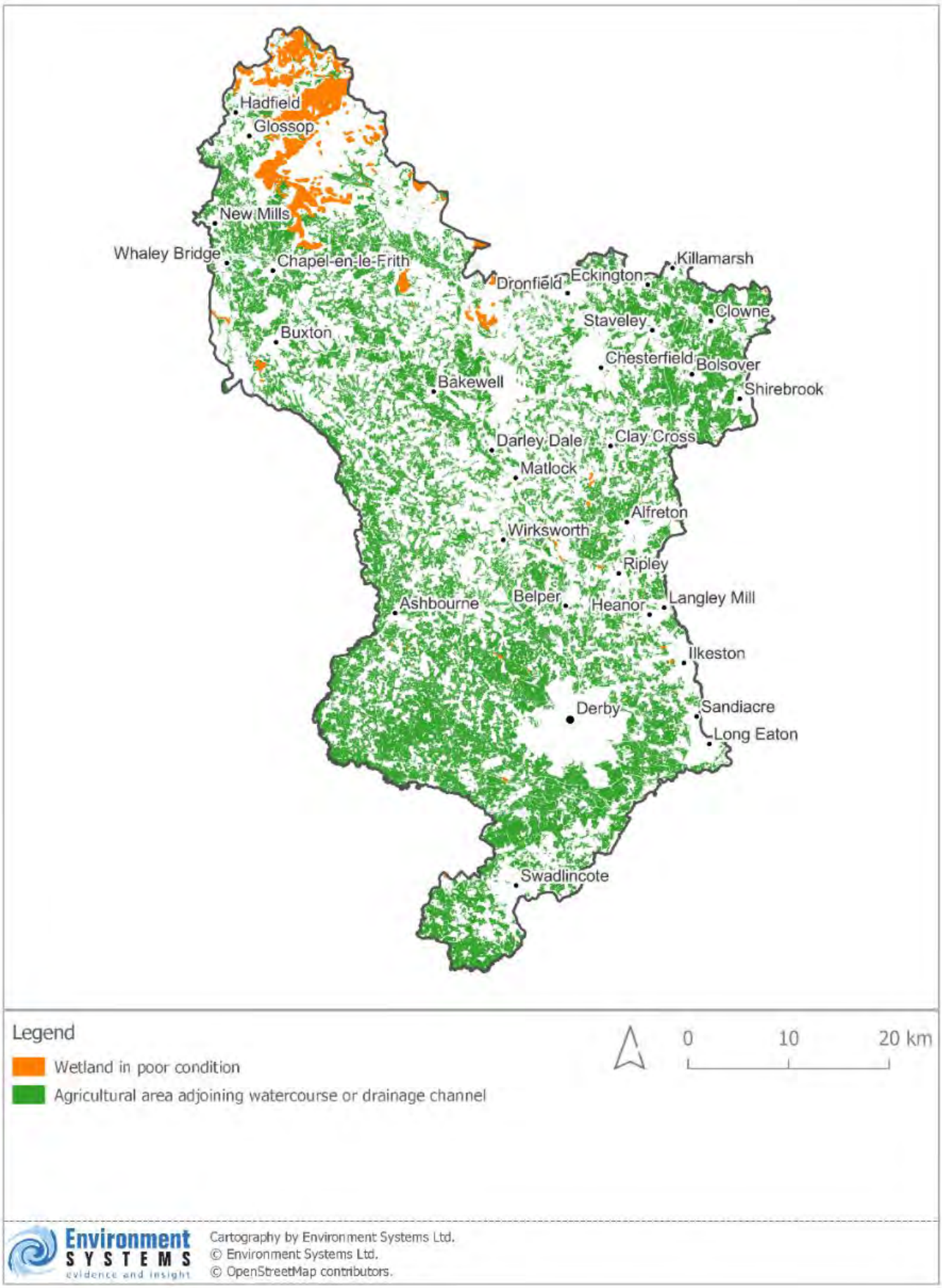

Figure 37: Water quality regulation: risk areas

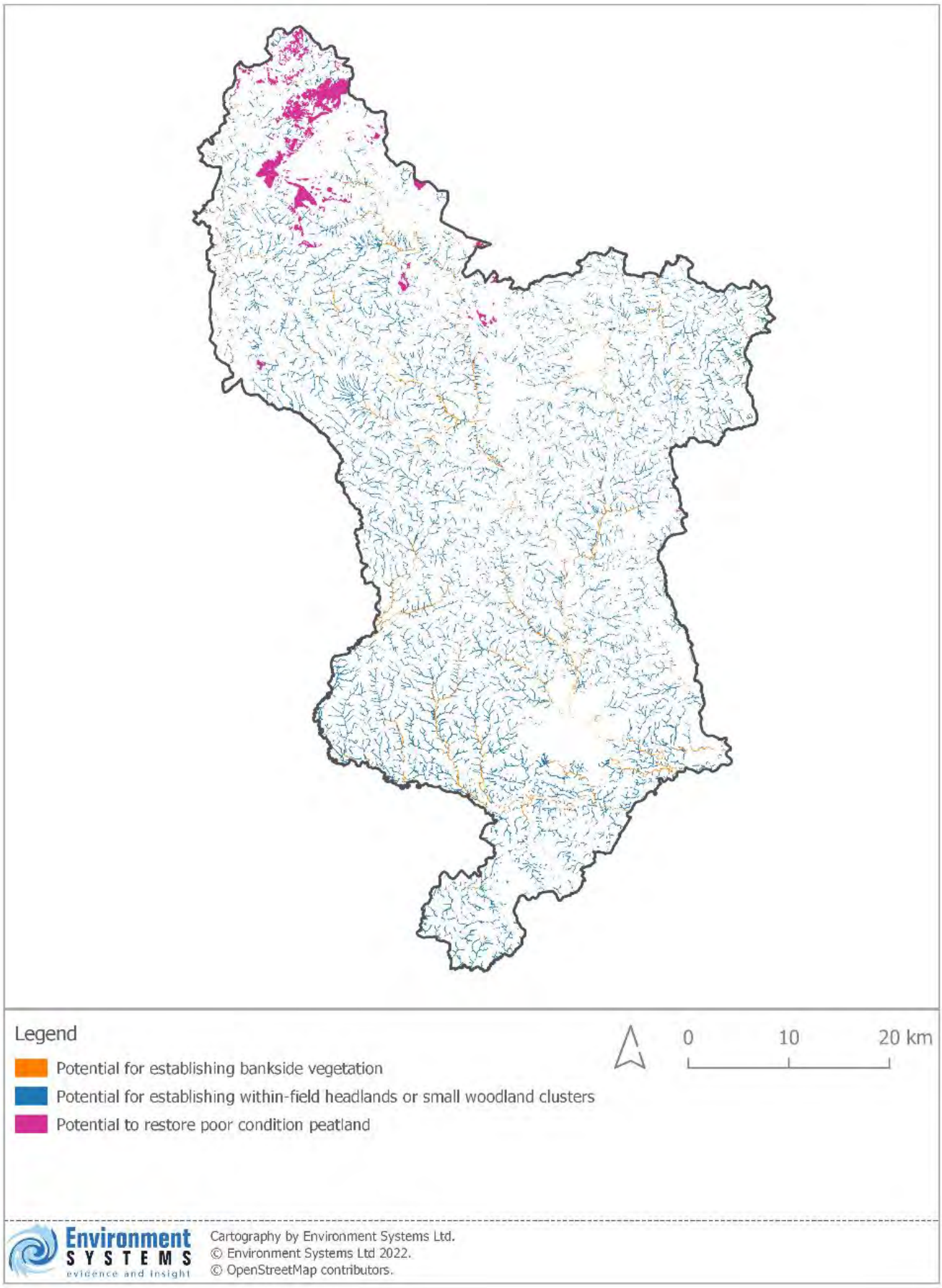

Figure 38: Water quality regulation: areas where nature-based solutions will improve water quality

Carbon storage and sequestration

Areas with the greatest area of carbon storage (stock) are located within the Peak District National Park, the Peak Fringe and Lower Derwent and areas south of the Mease/Sense lowlands (Figure 39) where there is bog on deep peat.

Figure 40 shows the current likely status of natural carbon sequestration, the process by which carbon dioxide is removed from the atmosphere and held in vegetation or the soil. The map also shows areas where there is likely to be a loss of carbon occurring.

There is widespread risk to carbon sequestration throughout Derbyshire due to the extent of degraded peat and agricultural land that is not under regenerative management.

In general, areas with the highest levels of carbon stock also deliver carbon sequestration. Woodlands provide the highest levels of sequestration and intact bog on deep peat the highest carbon storage. There are notable exceptions though; carbon emissions are occurring on degraded peat in the Peak District National Park.

Land of high agricultural quality throughout Derbyshire has also been identified as a potential carbon emission source rather than emission sink (Figure 41). However, land management practices have a significant role to play in maintaining carbon in arable and intensive grassland systems, for example regenerative agriculture and organic farm systems can sequester carbon. As no information is available on management practices, the map should be interpreted as showing the potential for risk of carbon loss.

There is also widespread opportunity to enhance carbon storage and sequestration (known as carbon abatement). The highest benefits to sequestration can be achieved through bog and heath restoration within the Peak District National Park and the conversion of low productivity grasslands to native woodland, particularly in the Peak Fringe and Lower Derwent (Figure 42).

Key points and recommendations for nature-based action: Carbon storage and sequestration

- **Restore peatlands:** when in poor condition peatlands emit a large amount of greenhouse gases to the atmosphere every year. Restoring peatland and making sure it is sufficiently wet all year round will have the biggest impact on the carbon budget of the county.
- **Establishment of new wetlands:** particularly wet woodlands and fens. This will enhance soil carbon, as well as providing other benefits for water management and biodiversity.
- **Regenerative agriculture** is effective at enhancing soil carbon while retaining agricultural production. Measures taken to increase soil carbon will also increase the resilience of agricultural land to the impacts of climate change.
- **Establishment of deep-rooted leys** across agricultural lands will increase soil structure and stability and crop resilience to drought, as well as increasing the overall carbon storage potential.
- **Mange ancient woodlands:** coppicing / pollarding of individual trees will maintain the ecosystem in a state of carbon sequestration rather than it reaching an equilibrium.
- **Planting new trees** will always enhance carbon sequestration; the planting of native species should be encouraged as native species will better support overall biodiversity.
- **Commercial woodlands:** where a forest operation is sought, trees should be destined for the wood rather than paper market. In order to make a positive impact on carbon sequestration, trees should be in place for at least 40 years prior to harvest.
- **Willow coppice for biofuel** can be a useful carbon market, to enhance the soil carbon while still preserving woodland habitats.
- **Planting shelterbelts, green barns and hedgerows** can all bring carbon sequestration benefits to farms while also benefiting animal welfare.

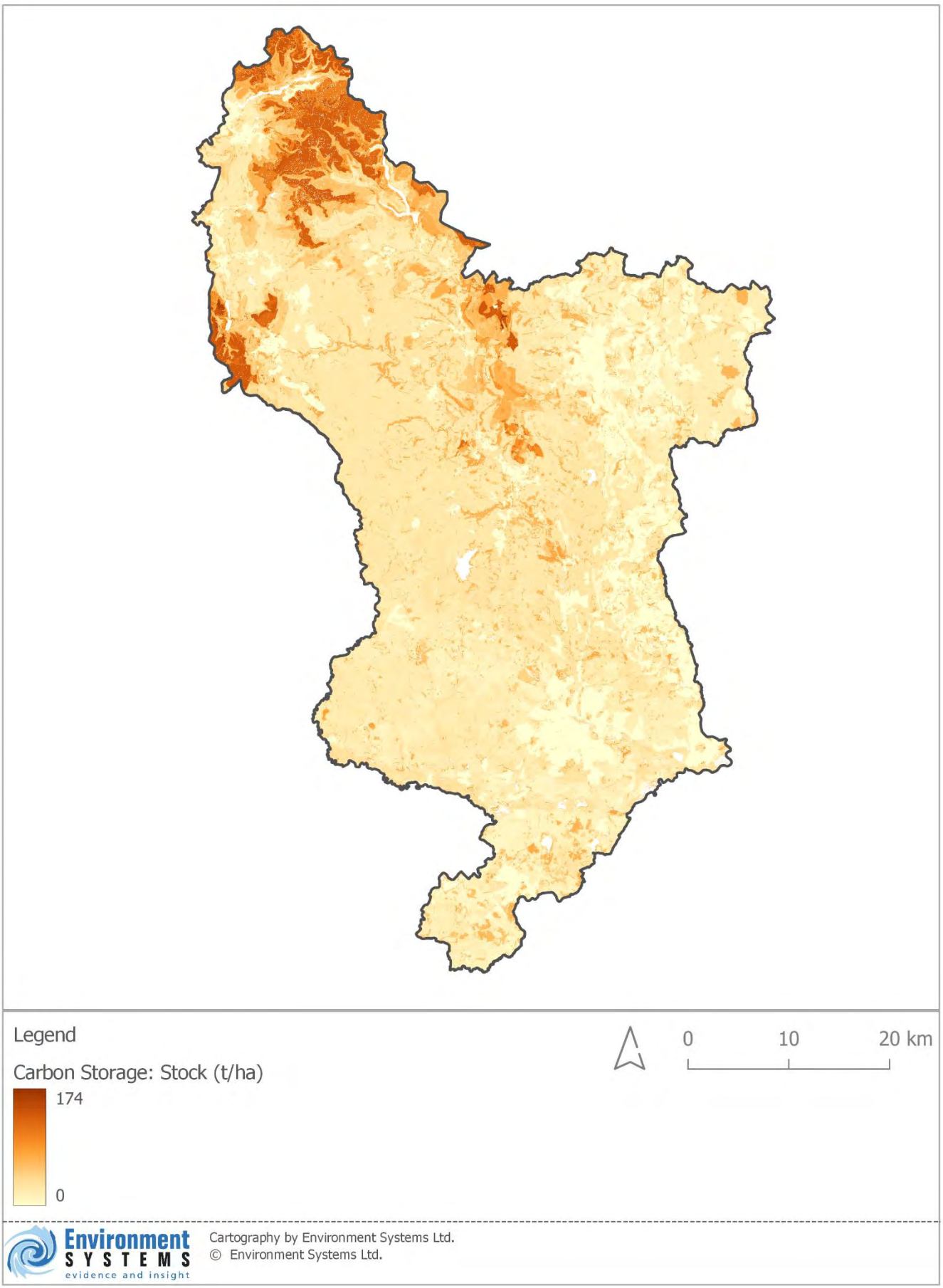

Figure 39: Current carbon storage (stock)

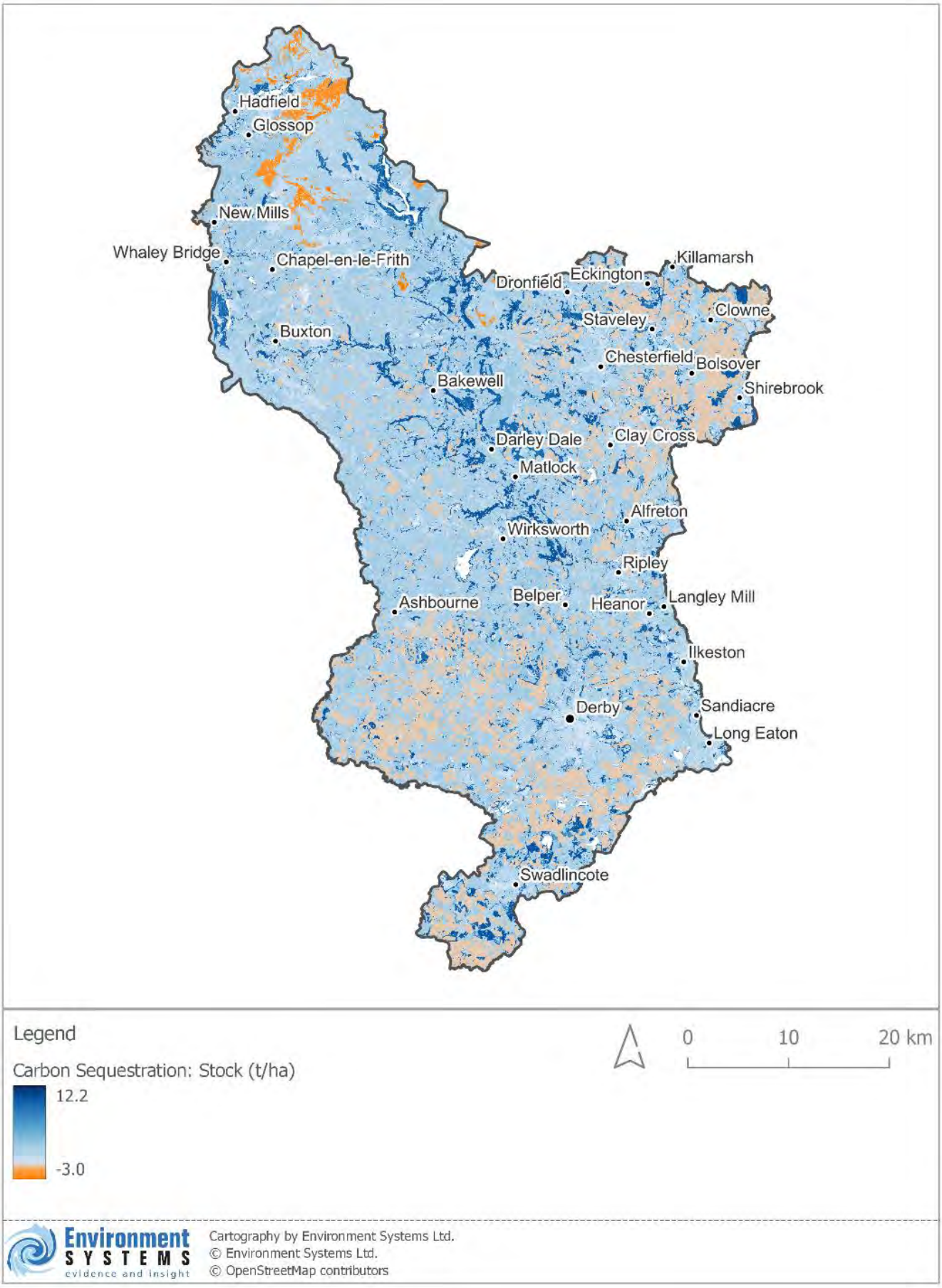

Figure 40: Current carbon sequestration (stock)

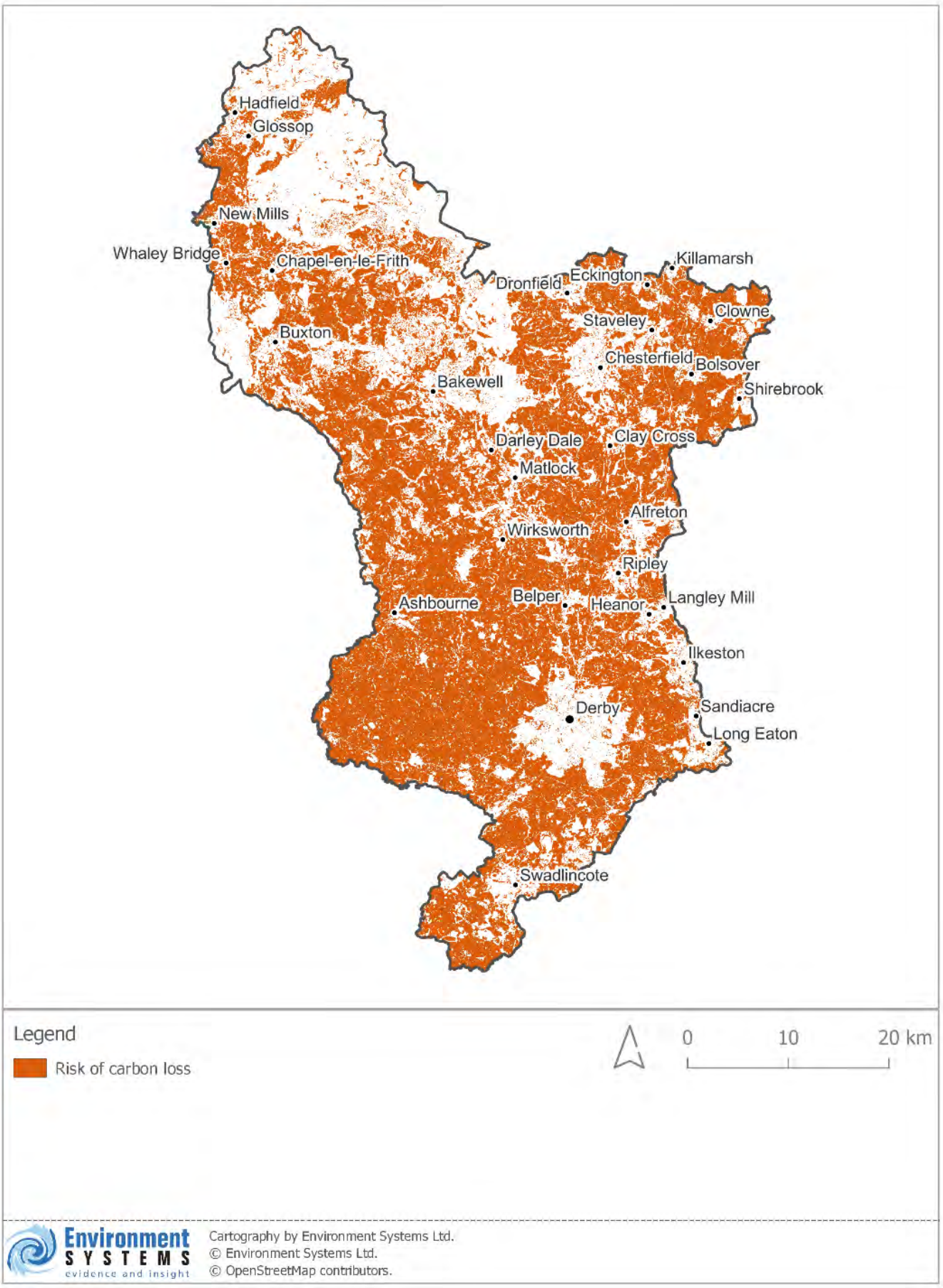

Figure 41: Carbon sequestration risks

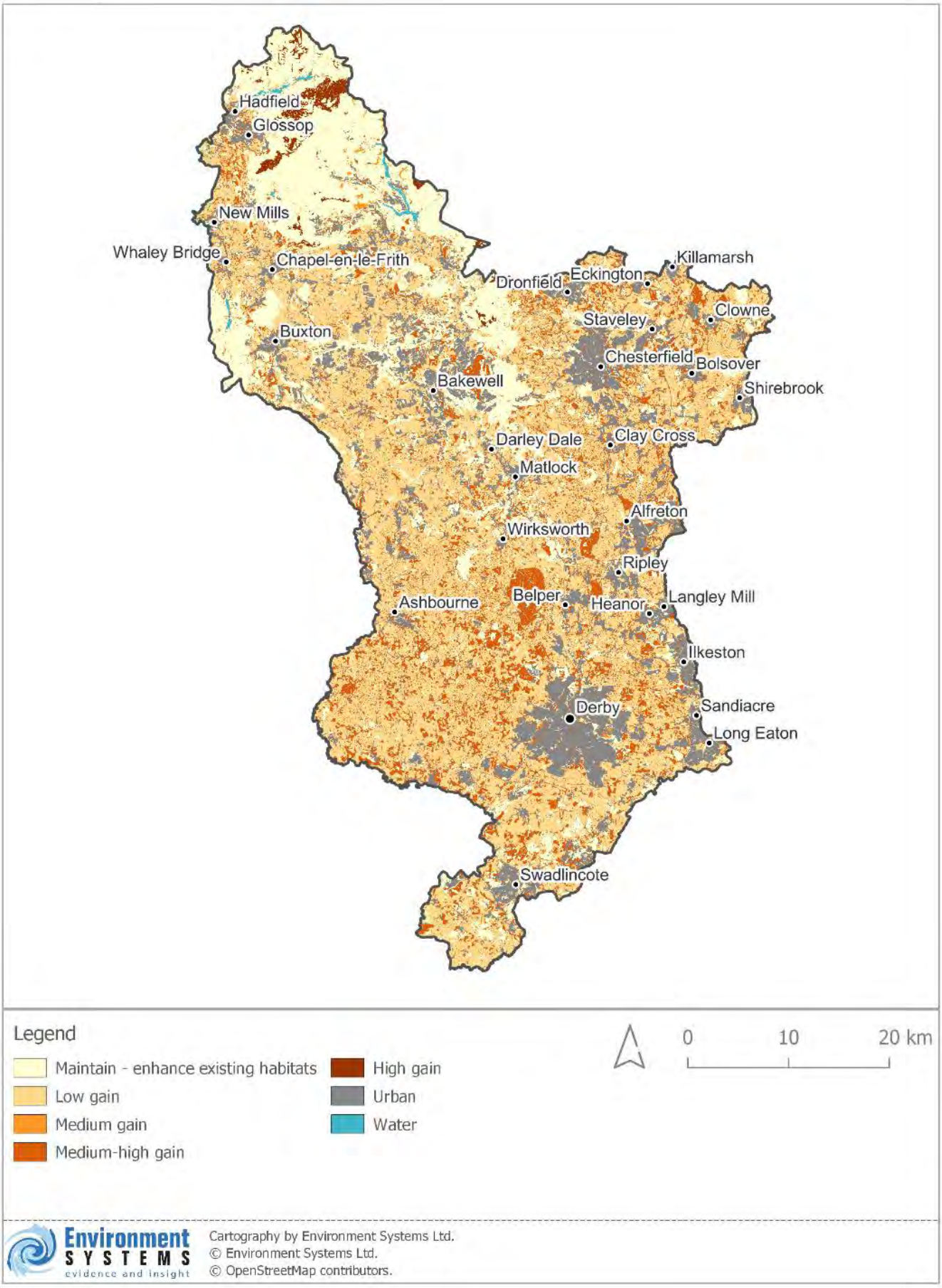

Figure 42: Carbon abatement opportunities: relative gain in carbon storage/sequestration

Recreation

For the purpose of this study recreation was considered as places where local people choose to visit in their spare time, including facilities such as parks, sports pitches and other relatively local greenspaces, as opposed to places that are considered more as a tourism destination, which have been considered as a separate theme in this study. However, there is cross-over between the two, as local people may choose to visit a major tourist honeypot, and tourists may also make use of smaller, more local assets and facilities during the course of their stay.

The input datasets considered in the recreation analysis are shown in Figure 43. These datasets were analysed by ORVal in order to assign the respective visitor numbers and monetary value of each input feature, based on the underlying data from the habitat map. This method for assigning the relative value of the recreational features was chosen in order to maintain parity with the methodology used to produce the baseline Natural Capital Accounts, which also used ORVal for calculating recreational value.

Figure 44 displays the relative value of recreational areas in terms of visitor numbers. The highest visitor numbers are found within the Peak District National Park, where the most extensive recreational spaces are located. In Derby City, Chesterfield, and within the National Forest area there are high visitor numbers in much less extensive recreational areas.

Recreation risk has been mapped by showing residential areas that do not currently have sufficient access to greenspace, based on the ANGSt framework. ANGSt considers how far people have to travel from their homes to access a greenspace area, as well as how large the individual greenspaces are. For the purpose of this study areas of risk have been identified as areas where the current distribution of greenspaces does not meet the ANGSt standard, which states that everyone should have access to all of the following accessible greenspaces meeting the following criteria:

- A 2ha site within 300 m of home (Figure 45)
- A 20 ha site within 2km of home (Figure 46)
- A 100 ha site within 5km of home (Figure 47)
- A 500 ha site within 10km of home (Figure 48)

When using these risk maps, consideration should be given to the fact that recreational assets outside the Derbyshire boundary were not accounted for; the risk areas identified reflect the level of access to accessible greenspace within the county of Derbyshire only, and some areas marked as being at-risk may in fact have access to assets and facilities located outside of the county.

The risk maps identify a disparity in the level of greenspace access between western and eastern Chesterfield. They also reveal large risk areas within Derby City despite the high density of input features considered by the study; this is because although there are a large

number of recreation features included in the modelling, many of these are small and do not meet the ANGSt minimum size standards.

Key points and recommendations for nature-based action: Recreation

- Chesterfield is relatively well-served in terms of access to smaller areas of greenspace, although opportunities should be sought to increase access in to greenspace in the east of the town.
- Derby City has low levels of accessible greenspace when assessed using ANGSt size criteris; opportunities could be sought to increase the accessibility of existing restricted-access sites (for example private sports clubs), in addition to establishing new accessible greenspace areas via habitat creation schemes, in order to create multi-functional greenspaces that provide recreation, biodiversity, and other ecosystem service benefits.
- Many rural toens and villages have poor access to greenspace: in spite of being situated within the countryside, or with the National Park itself. In such areas the surrounding greenspaces may not be accessible due to access restrictions relating to land ownership (e.g. farmland) or infrastructure (e.g. footpath, road and pavement network). Schemes that enhance access to greenspace in these areas should be considered.

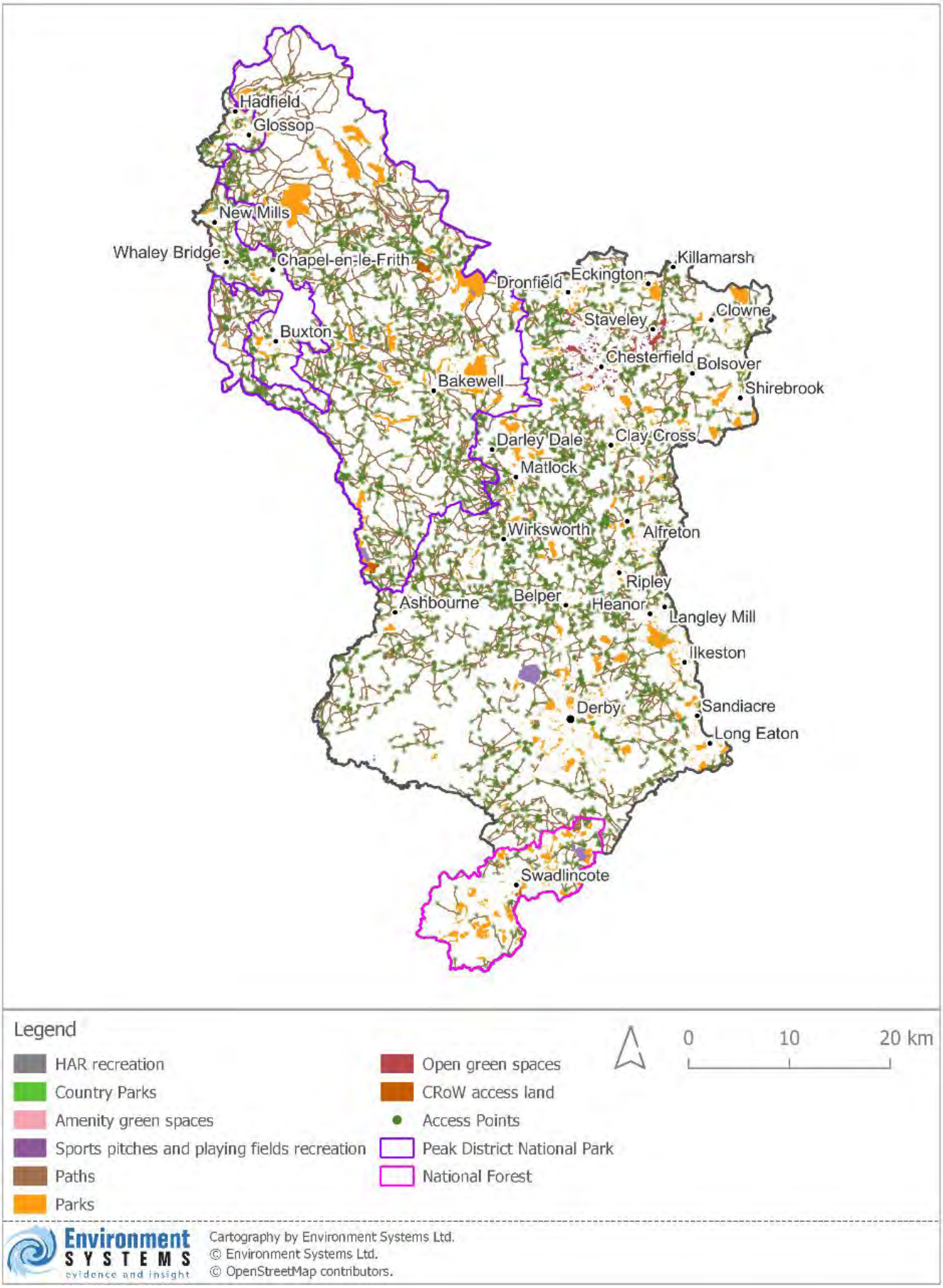

Figure 43: Areas of high importance for recreation: input datasets

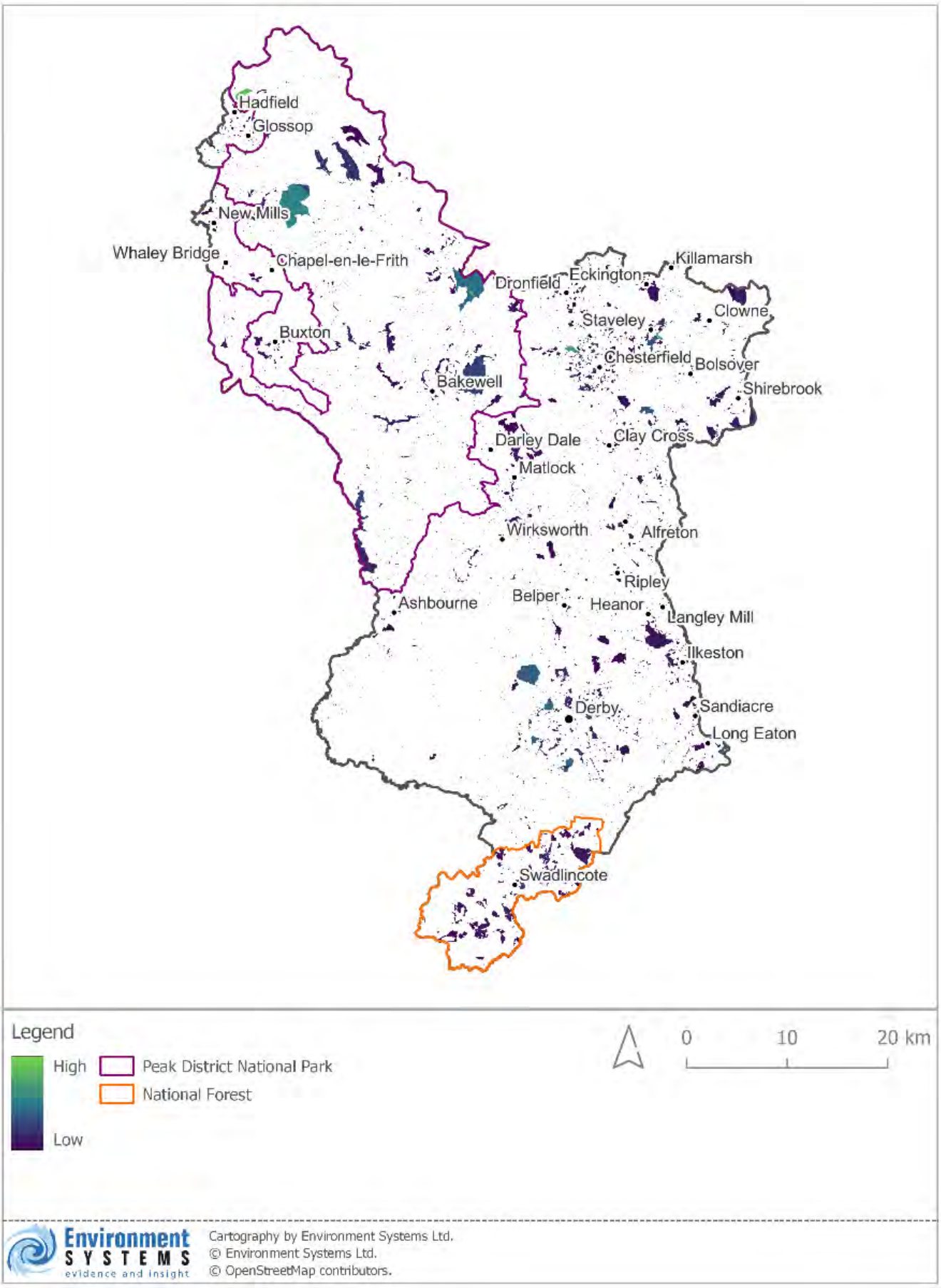

Figure 44: Areas of high importance for recreation in terms of visitor numbers

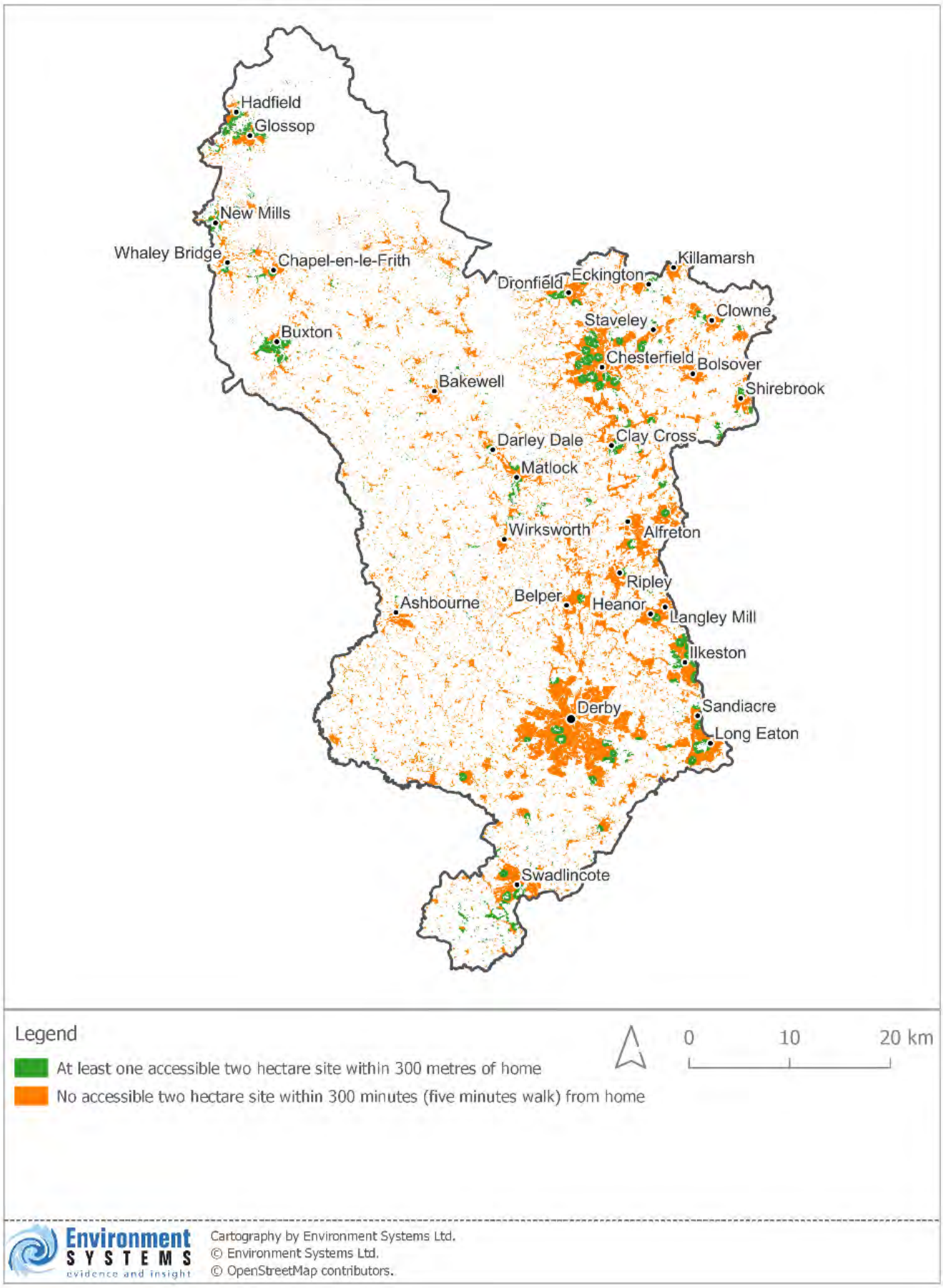

Figure 45: Recreation risks: urban areas with and without access to a 2ha recreational site

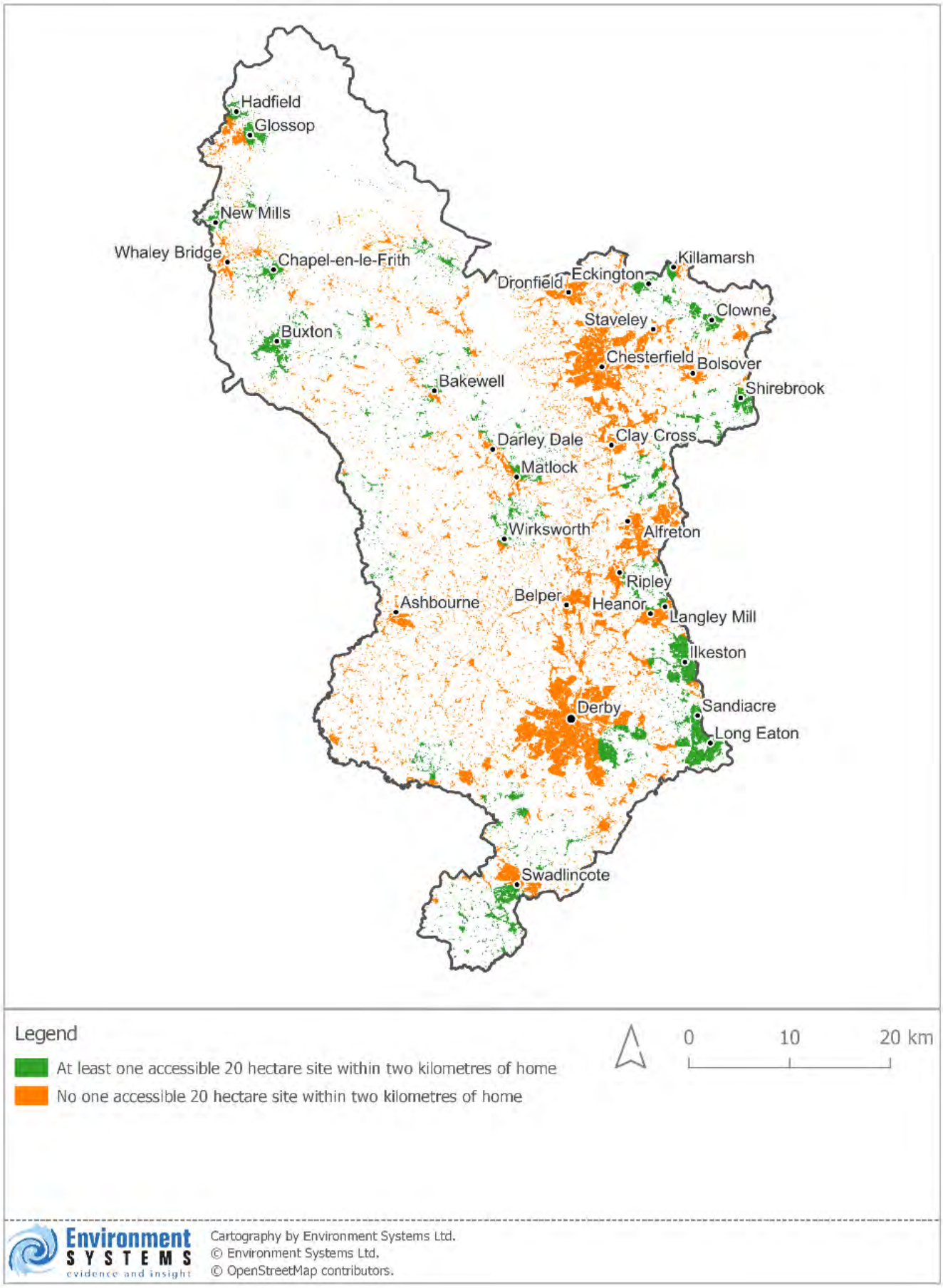

Figure 46: Recreation risks: urban areas with and without access to a 20ha recreational site

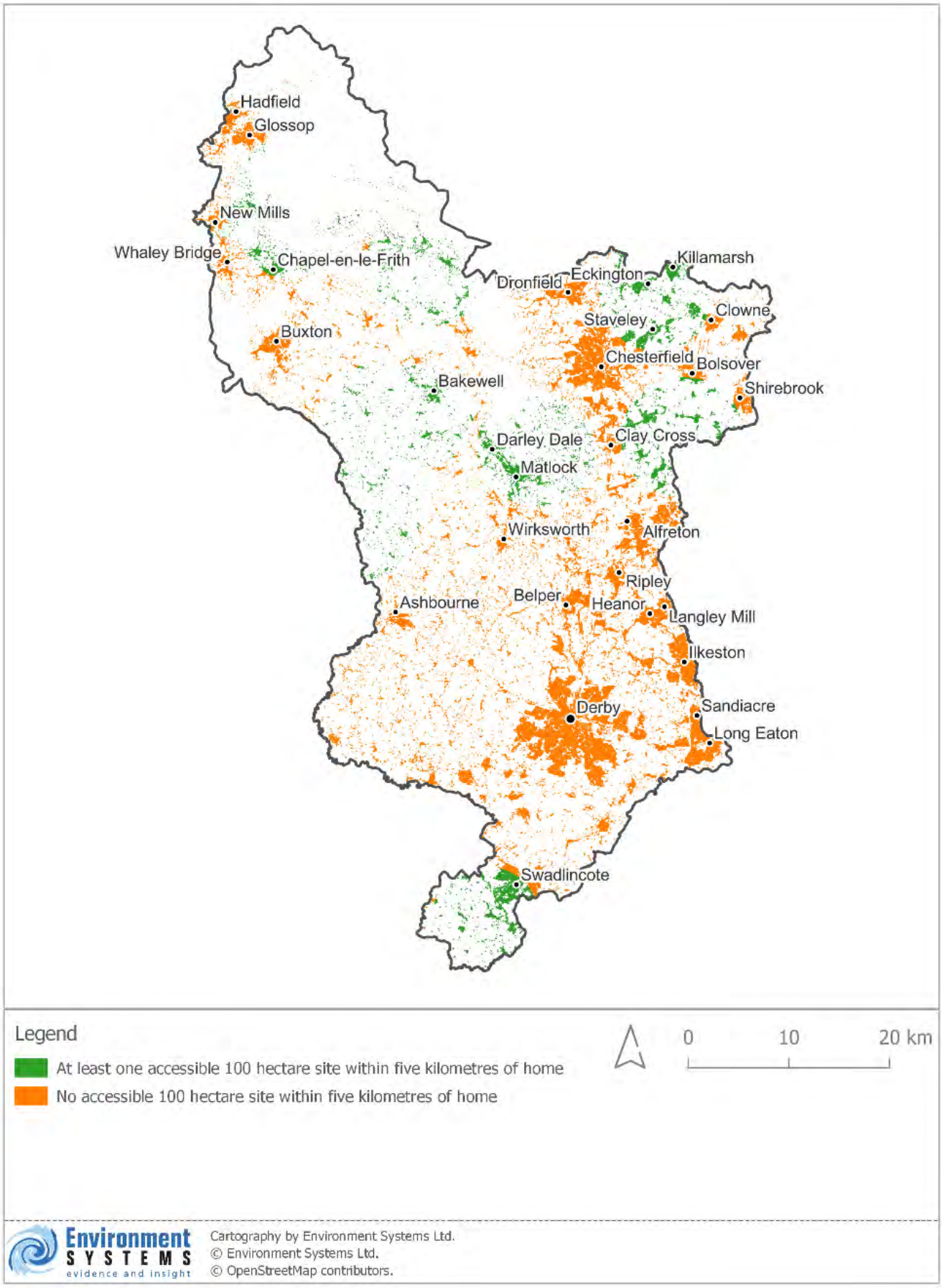

Figure 47: Recreation risks: urban areas with and without access to a 100ha recreational site

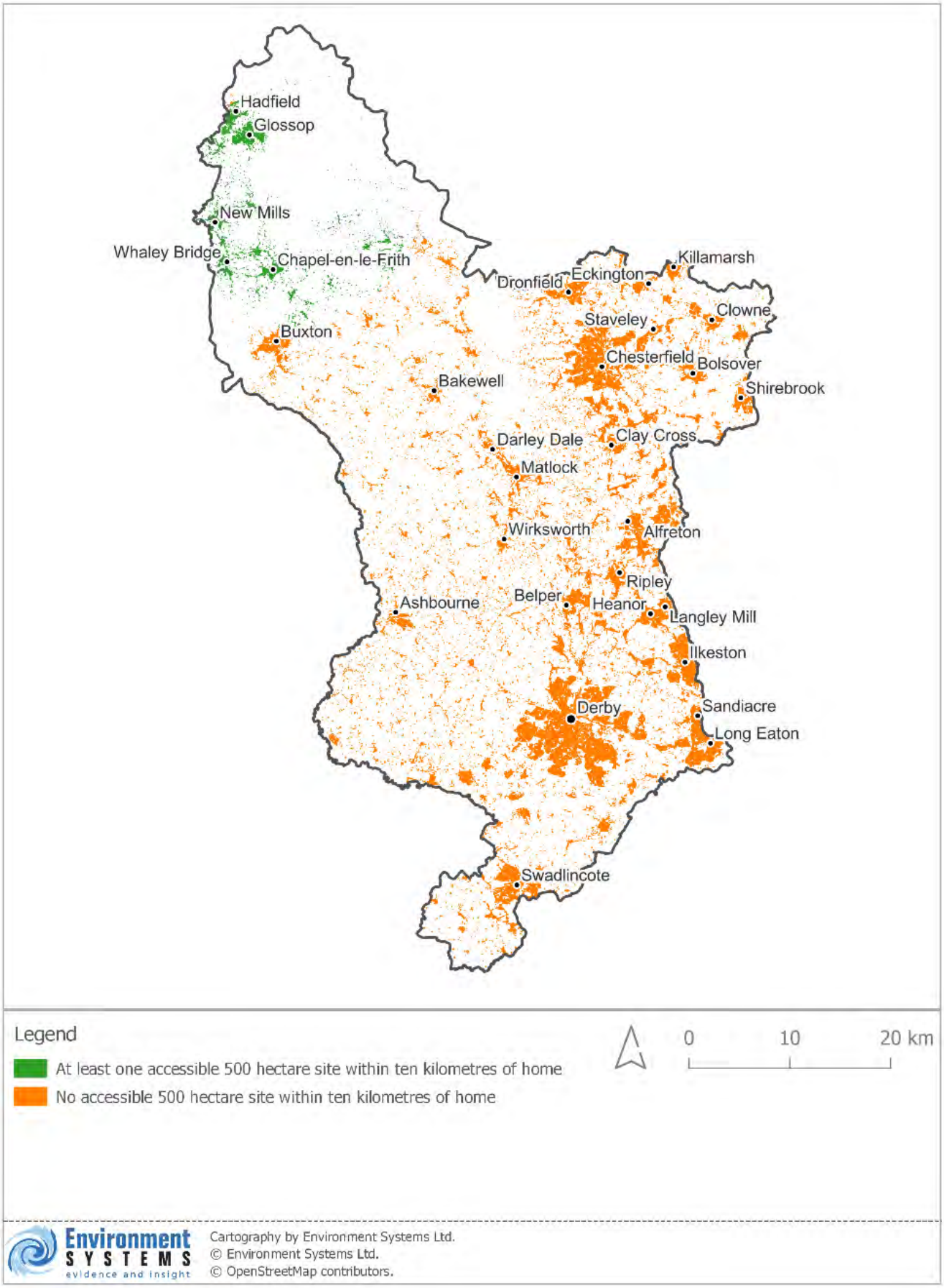

Figure 48: Recreation risks: urban areas with and without access to a 500ha recreational site

Tourism

The input datasets used to identify areas of importance for tourism are shown in Figure 49, and the relative value of individual features is shown in Figure 50. Clusters of sites important for tourism are shown in Figure 51 and it can be seen that a high density of important sites occurs within the Peak District National Park. This map also shows the significance of the National Forest, and Chesterfield, a town which is richly dense in small-footprint tourism assets, such as listed buildings. The Derwent Valley is also identified as a region of high tourism value.

Key points and recommendations for nature-based action: Tourism

- Peak District National Park, via its extensive path network, is an important tourist destination but this popularity can create problems for example through peat erosion. Peat restoration, particularly on Kinder Scout, is a high priority in order to protect these vulnerable soils and the carbon they store, and preserve enjoyment of the landscape for generations to come.
- The National Forest region is important for providing a high density of tourism destinations in southern Derbyshire, offering potential to alleviate excessive tourism pressure in other parts of the county. Numerous cycling routes and forest trails are located in the region; woodland and heathland restoration could be designed to complement the creation of new paths.
- The Trent Valley region currently provides relatively low levels of tourism value, but partnership working under the Transforming the Trent Valley project[15] creates opportunities for tourism to be significantly enhanced in this area.
- A number of stately homes and historic sites are important sites for tourism in Derbyshire, including Hardwick Hall, Chatsworth House, Bolsover Castle and Calke Abbey. This presents opportunities to work with large-scale landowners such as National Trust and English Heritage, to co-ordinate action for nature recovery in line with the Natural Capital Strategy, on a landscape scale; the existing landscape partnership between the National Trust, RSPB, The Wildlife Trusts and Woodland Trust is one such example.
- Reservoirs such as Carsington Water and Ladybower are important locations for watersport tourism and trail walking; actions to protect and enhance water quality would benefit these areas. Working with landowners such as Severn Trent Water, new habitat resoration schemes could be realised in the surrounding areas that extend the existing options for public access, while also benefitting nature recovery and other ecosystem services.
- The Derwent Valley is a significant area for tourism, and the riverine and native woodland habitats are an important part of this, which should be protected and enhanced. Upstream actions to mitigate flood risk would benefit this area.

[15] Transforming the Trent Valley: https://www.thetrentvalley.org.uk/

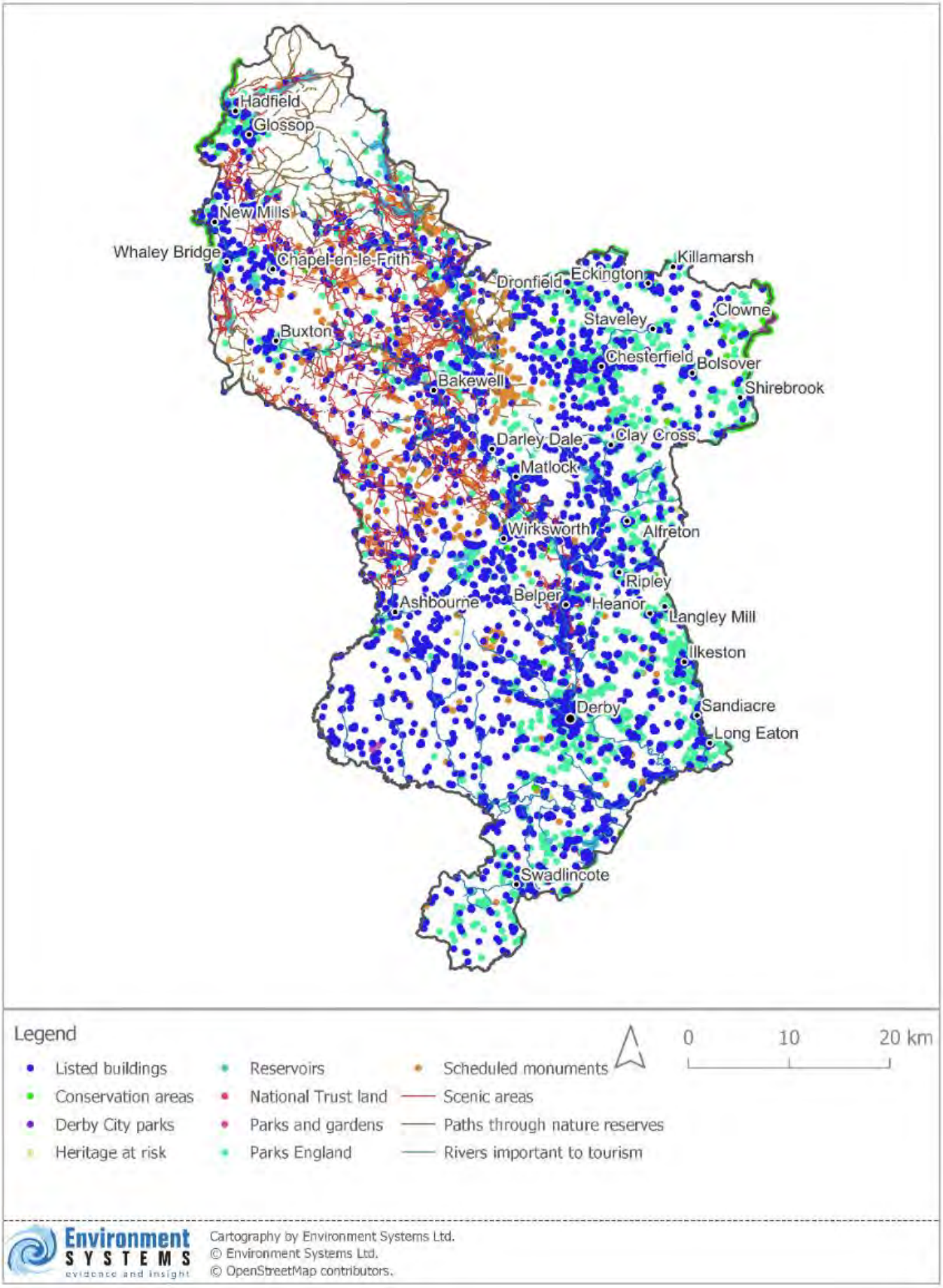

Figure 49: Areas of high importance for tourism: input datasets

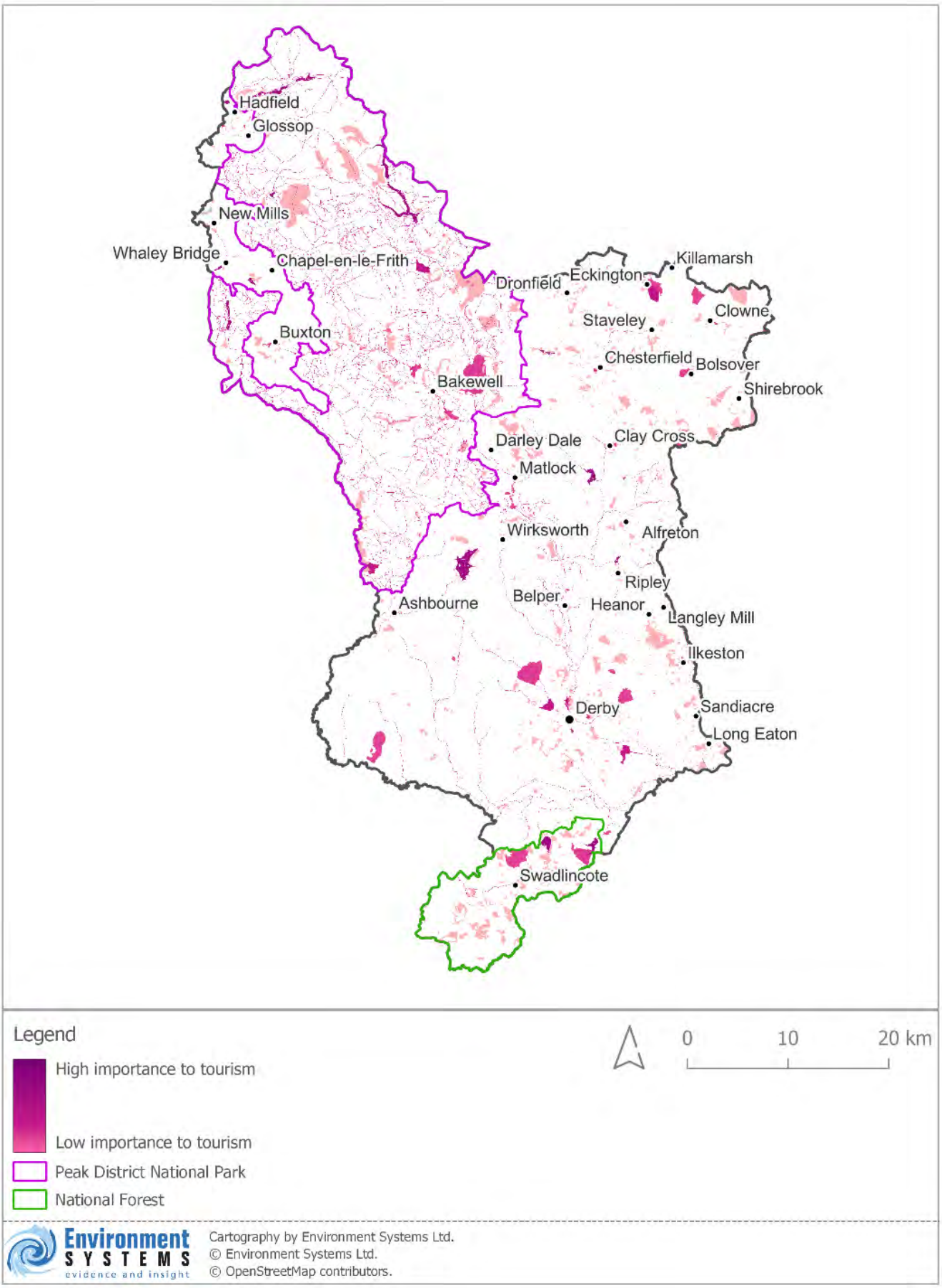

Figure 50: Areas of high importance to tourism: current stock

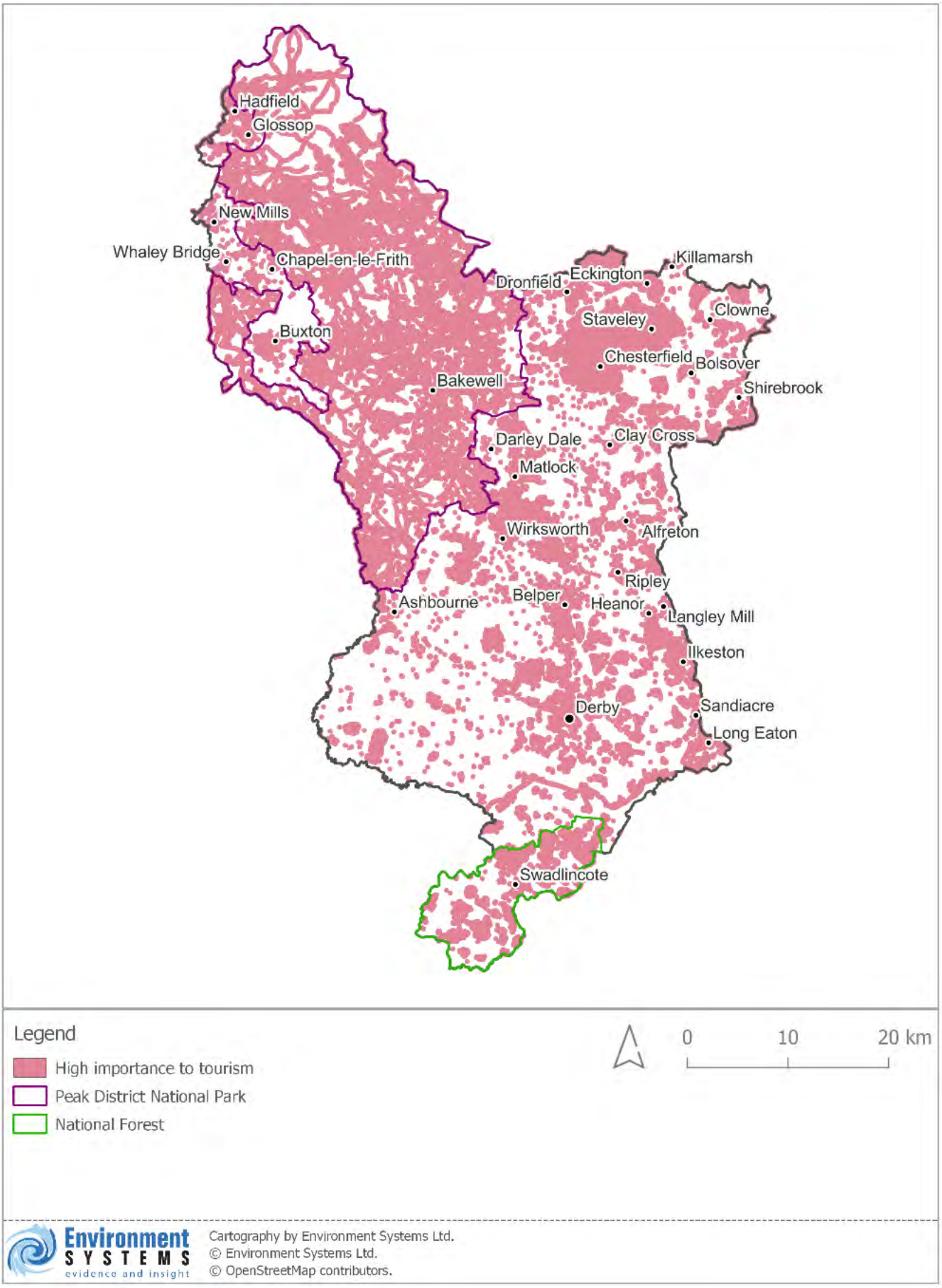

Figure 51: Clustered tourism sites; groupings of sites of high importance for tourism

Contribution of agriculture to landscape character

Agriculture is an important component of Derbyshire's landscape character; centuries of agricultural enclosure and land management practices have crafted the distinctive landscapes people value today. Figure 52 displays the relative contribution of the agricultural areas of Derbyshire, in terms of the current level of visual intactness of the area, and the presence of important cultural and historic assets on agricultural land.

An emerging risk to the existing agricultural aspect of landscape character is the drive for woodland planting for climate change mitigation. Figure 53 identifies areas where the visual intactness of the agricultural landscape may be particularly at risk, due to the presence of woodland opportunities within the ecological network; the highest risk to landscape character from woodland establishment is concentrated within the White Peak and the border separating the Peak District National Park and the Peak Fringe and Lower Derwent. This does not necessarily mean that woodland planting could not be considered in these places, but that sensitivity should be given to the size and location of any planting, and how the landscape character can be maintained. In some places the agricultural component of landscape character may be judged to be more significant than others, but the cumulative impact of woodland planting should be considered, in addition to the impact of individual planting sites.

Another risk to the agricultural aspect of landscape character could come from renewable energy generation; Figure 54 identifies places where the landscape character could be significantly degraded by solar and wind developments. The highest risk to landscape character from the development of renewable energy is concentrated within the areas of Southern Magnesian Limestone, Peak Fringe and Lower Derwent and the Needwood and South Derbyshire Claylands, Melbourne Parklands and the Mease/Sense Lowlands.

Key points and recommendations for nature-based action: Contribution of agriculture to landscape character

- Changes in agricultural practices, driven by market forces, are changing the landscape character of agricultural areas. Agricultural areas are a particularly important component of the landscape in parts of Derbyshire Peak Fringe and Coalfield Estatelands, and parts of South West Peak. The baseline landscape character assessment and associated habitat priorities analysis (Chapter 5) and cultural historic assessment (Chapter 6) provide insights into the areas where agriculture is a key component of the landscape.

- Extensive woodland planting could significantly alter the contribution of agriculture to landscape character, particularly where the chosen tree species do not reflect the local native species mix. Derbyshire County Council's woodland planting strategy identifies the relative scale and type of woodlands suitable for each landscape character area; when considering new planting schemes, the cumulative impacts of existing and proposed plantations on landscape character should be considered.

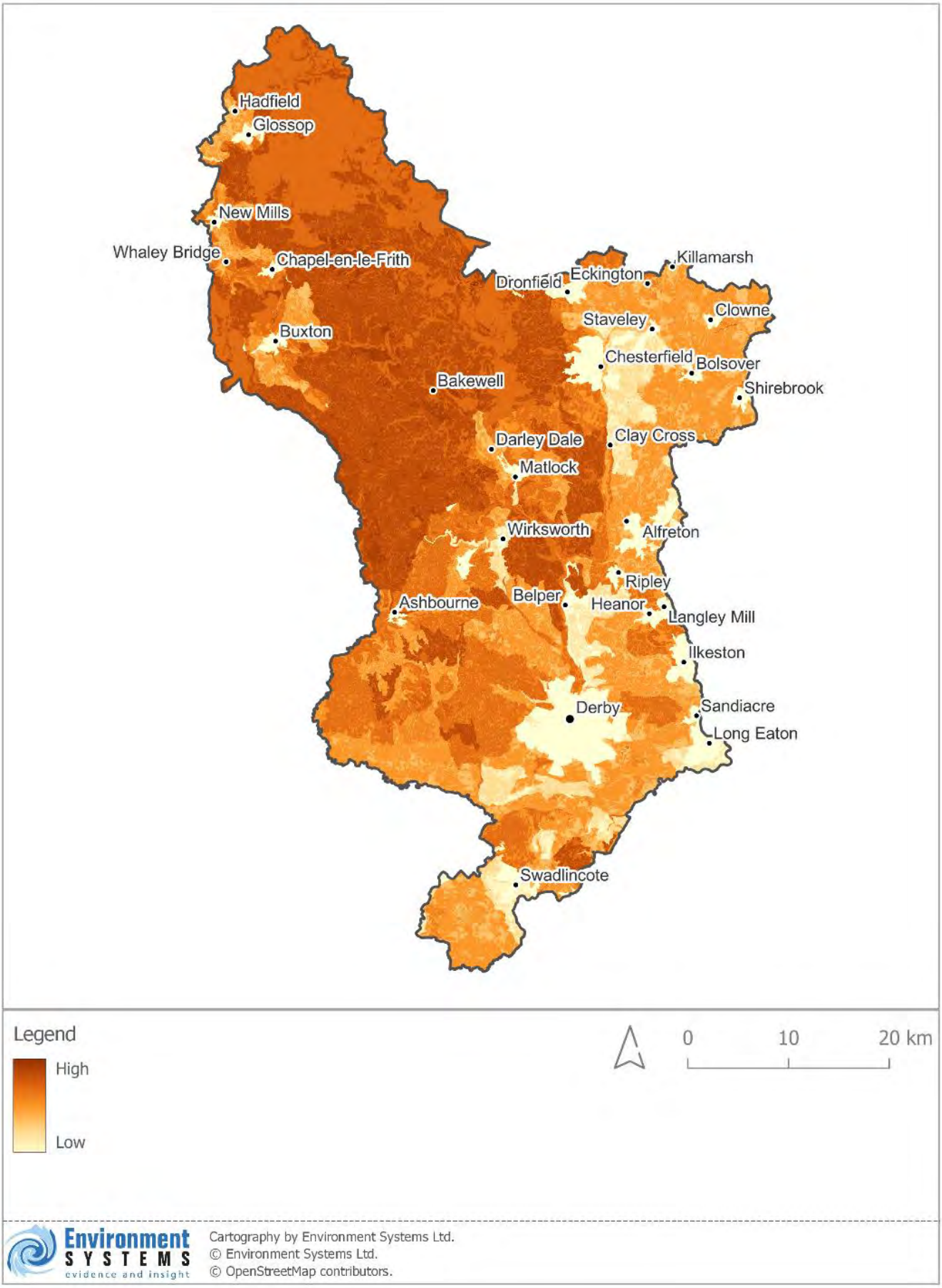

Figure 52: Relative contribution of agriculture to landscape character

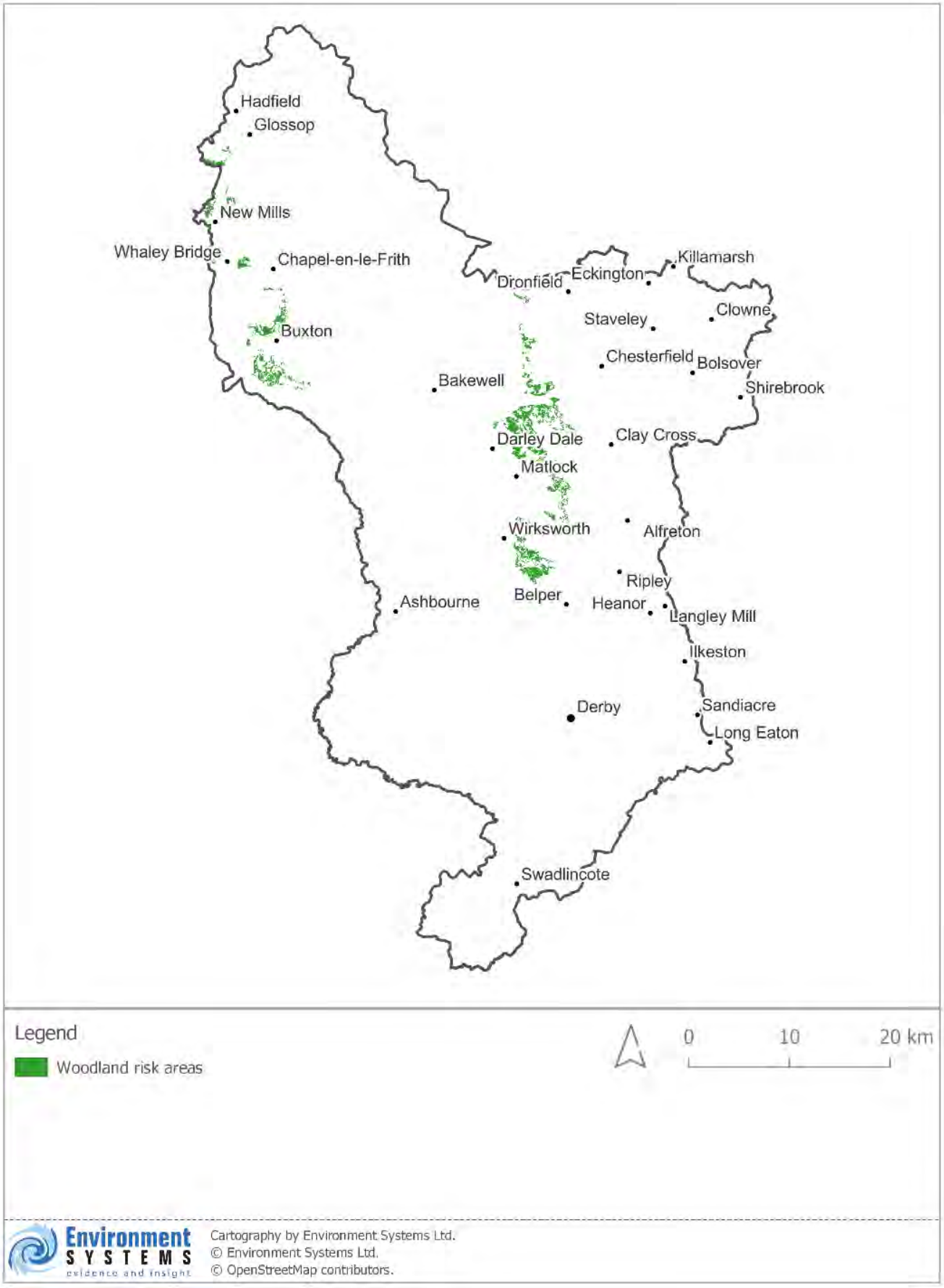

Figure 53: Potential risks to landscape character from woodland planting within the ecological network

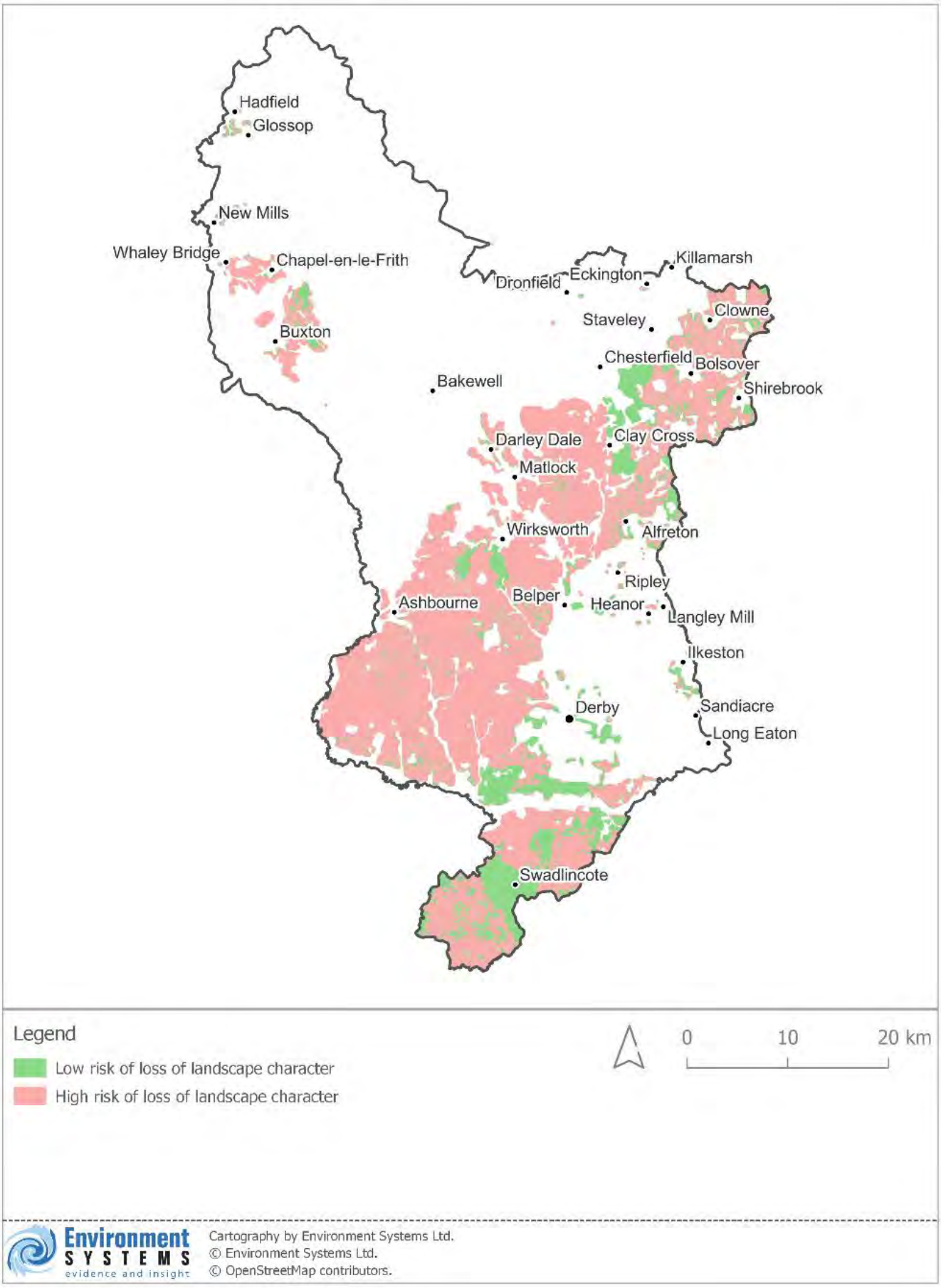

Figure 54: Potential risks to landscape character from solar and wind renewable energy projects Provision of multiple ecosystem service benefits for effective targeting of land management action

In a world of conflicting land use pressures, limited financial resources, and limited time in which to achieve our goals, effective means of targeting land management action are needed in order to maximise the level of benefits realised from nature-based solutions. When considering sites for habitat restoration the full range of priority ecosystem service themes should be considered to address related questions such as:

- Where are the most effective sites for enhancing biodiversity?
- Do any of these align with areas identified as a priority for Natural Flood Management or water quality regulation?
- Do the proposed actions secure or enhance existing carbon stocks?
- Are there opportunities for creating habitats that can address the needs of residents that currently have poor access to greenspace?

Examples of places where there are opportunities to deliver multiple ecosystem service opportunities including for biodiversity and to improve water quality regulation are shown in Figure 55 and for Natural Flood Management in Figure 56. In both cases, the multi-benefits can be met by a land management actions that are appropriate to the particular habitat type. For example, an opportunity for both biodiversity and water quality regulation would be the creation of riparian (grassland / woodland) buffer strips alongside rivers.

These maps identify that there are extensive areas where water quality regulation opportunities can be realised in the Peak District National Park and in west Derbyshire through enhancing the grassland and heathland ecological networks by restoring heath and species-rich grassland. In eastern and southern Derbyshire, water quality benefits can be achieved by targeted woodland planting initiatives (making consideration to landscape character sensitivities) which also strengthen the existing woodland network and development of the National Forest.

In terms of delivering Natural Flood Management (NFM) opportunities, there is a lot of scope for enhancing the grassland ecological network in the upland and mid-reach areas of river catchments. There are significant opportunities for enhancing the wetland network in the lowland valley areas to benefit NFM. It is notable that there were few opportunities for woodland creation that would meet the dual benefits of enhancing NFM and improving the woodland network connectivity; this is a reflection of the current distribution of the woodland network, and the extent of land clearance for agriculture. It highlights the fact that most of the areas with high hydrological connectivity in Derbyshire are currently unwooded.

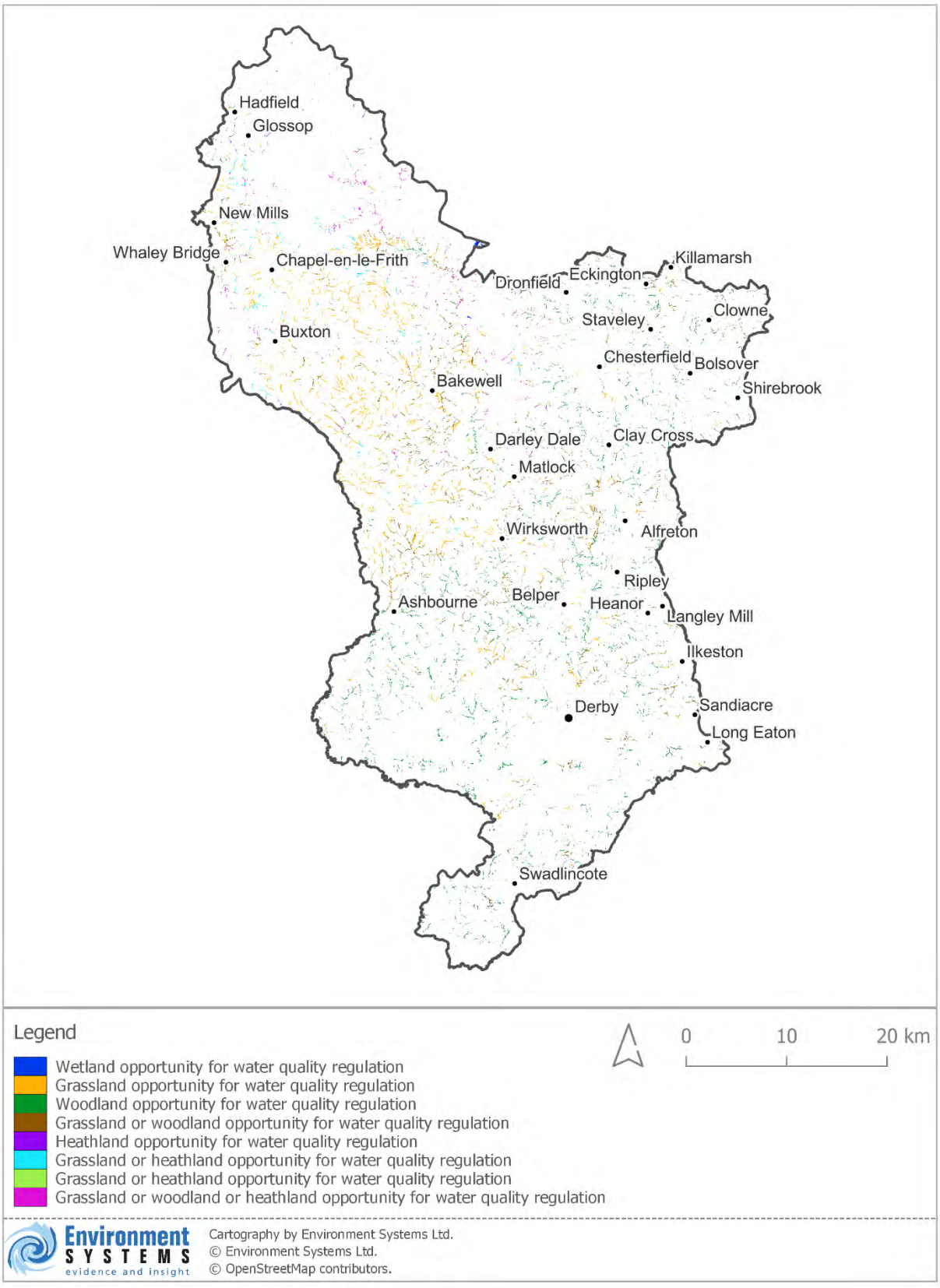

Figure 55: Biodiversity and water quality regulation multi-benefits

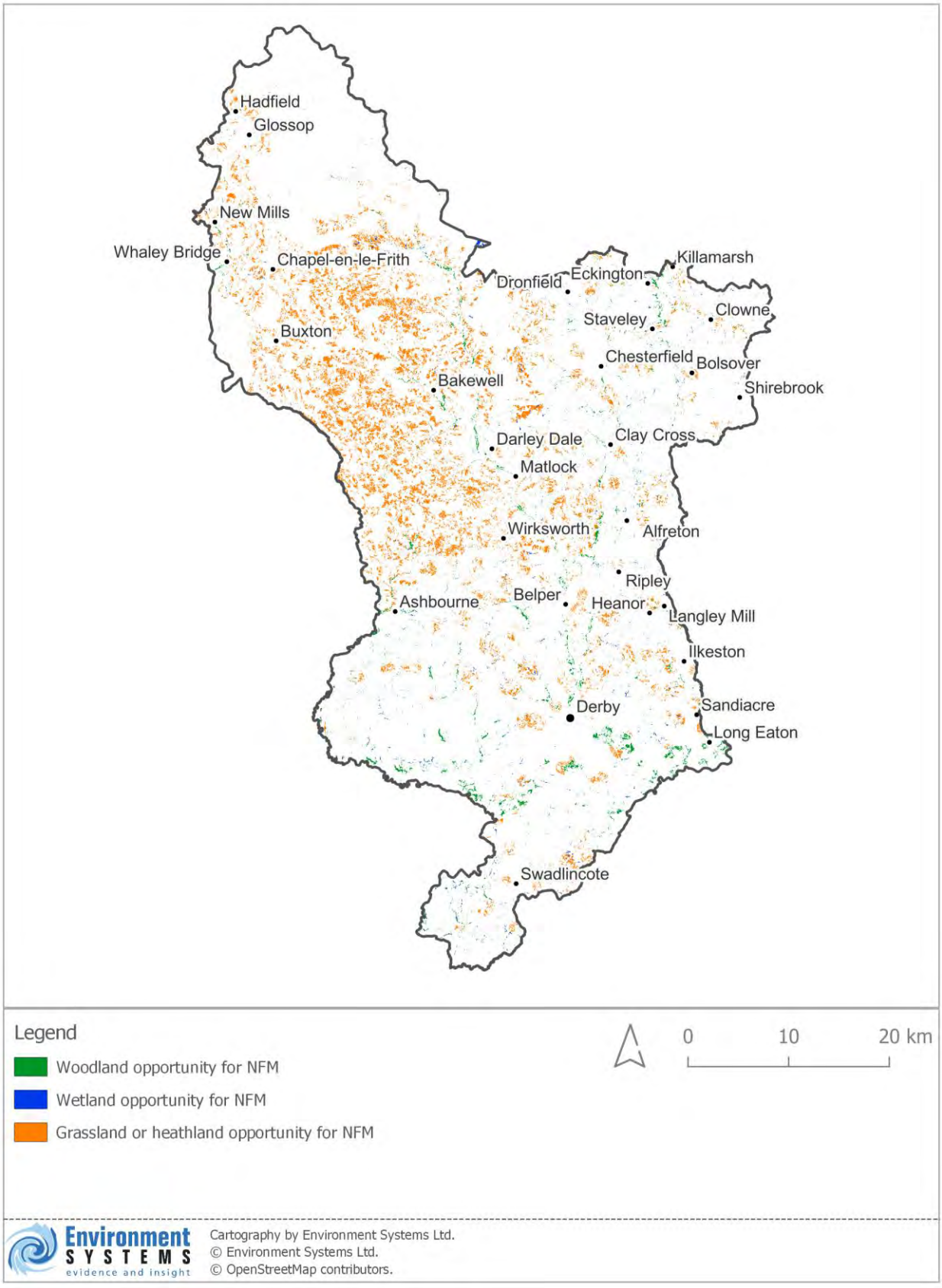

Figure 56: Biodiversity and Natural Flood Management multi-benefits