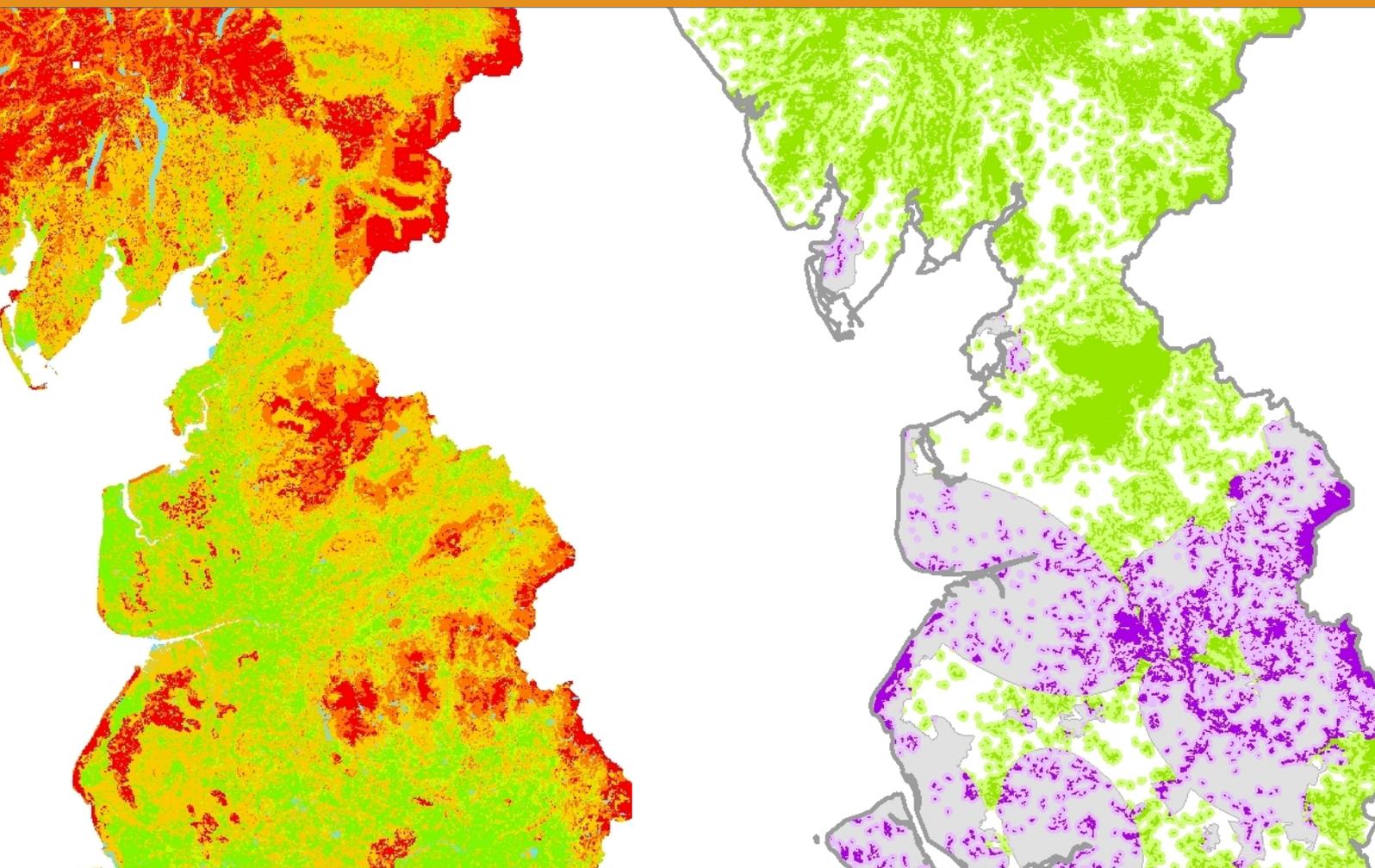


GREEN INFRASTRUCTURE SOLUTIONS TO PINCH POINT ISSUES IN NORTH WEST ENGLAND

How can green infrastructure enable sustainable development?



PREFACE

This report was requested by the NWDA and Natural England, to look at finding and resolving ‘pinch points’ through green infrastructure interventions. Pinch points are localised areas where investment for growth and/or redevelopment is planned but where specific issues (‘pinches’), that may have green infrastructure solutions, manifest themselves most seriously.

The work has been undertaken by the Green Infrastructure Unit, with staff input from ComFor Consult and The Mersey Forest and Red Rose Forest teams, and the support of Natural Economy North West, the Green Infrastructure Think Tank and a wider advisory group.

In addition we have had a great deal of support from the sub-regions, both economic partnerships and local government. Their input has been invaluable in ensuring that the areas of search for pinch points that were selected were the correct ones in terms of where investment is most likely to be targeted over the next 3-5 years.

Green infrastructure as a concept and as a strand of policy has developed rapidly over the last four years in North West England. The role of the Green Infrastructure Unit has been to support and develop this wide range of activity across the region. This study has made use of and has tried to build on the excellent work that has gone on over that period, including the following:

- Strategic Plan for Developing and Funding Natural Economy Projects
- The Economic Value of Green Infrastructure
- The Economic Benefits of Green Infrastructure: The Public and Business Case for Investing in Green Infrastructure and a Review of the Underpinning Evidence
- The economic benefits of Green Infrastructure: Developing key tests for evaluating the benefits of Green Infrastructure
- Developing An Outline Strategy For Linking Green And Grey Infrastructure
- Assessing the Potential for green infrastructure Development Within Projects
- Green Infrastructure Prospectus for the Liverpool and Manchester City Regions
- Regional Spatial Strategy policy EM3

This work along with other NENW information and publications is on our website –

www.greeninfrastructurenw.org.uk and also

www.naturaleconomynorthwest.co.uk.

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ACKNOWLEDGEMENTS

The authors would like to thank the following people for their contribution to this study, plus everyone else who has helped in any way.

Julia Bartens, The Mersey Forest
Malcolm Barton, Natural Economy North West
Christine Bennett, Merseyside Environmental Advisory Service
Ruth Benson, Natural England
Mike Bray, The Mersey Forest
Dr Jeremy Carter, University of Manchester
Dr Roger Catchpole, Natural England
Gina Cavan, University of Manchester
Rory Chisholm, UPM Tilhill
Dr Derek Clarke, University of Southampton
Steve Clarke, Cheshire County Council
Steve Connor, Creative Concern
David Dunlop, The Wildlife Trust for Lancashire, Manchester & North Merseyside
Matt Ellis, Environment Agency
Martin Evans, University of Manchester
Tom Ferguson, St Helens Metropolitan Borough Council
Chris Gibbard, The Mersey Forest
Anna Gilchrist, University of Manchester
Dr Susannah Gill, The Mersey Forest
Professor Douglas Godbold, Bangor University
Pauline Goodridge, Carlisle City Council
Professor John Handley, University of Manchester
Francis Hesketh, The Environment Partnership
David Hodcroft, Bury Metropolitan Borough Council
Debra Holroyd, 4NW
Tony Hothersall, Red Rose Forest
Dr Philip James, University of Salford
Alan Jemmett, Merseyside Environmental Advisory Service
Mark Johnston, Myerscough College
Keith Jones, Forestry Commission
Mark Joslyn, Northwest Regional Development Agency
Helen Lacy, Warrington Borough Council
Garry Legg, Warrington Borough Council
Richard Lord, Natural England
Chris Mahon, Chris Mahon – Environment
Ian Marshall, Cheshire County Council
Bob Massingham, St Helens Metropolitan Borough Council
Chris McGloin, The Mersey Forest

Dr Ronnie Milne, Centre for Ecology & Hydrology
Martin Moss, Natural England
Clare Mumford, Natural England
Richard Newman, Cumbria County Council
Simon Nokes, Northwest Regional Development Agency
Andrea O'Connor, Sefton Metropolitan Borough Council
Penny Oliver, Forestry Commission
Clare Olver, The Mersey Forest
Stuart Pasley, Natural England
Karen Potter, University of Liverpool
Pauline Randall, Randall Thorp Landscape Architects
Kirsty Rhind, GreenSpace North West
Mike Savage, Red Rose Forest
Melissa Short, University of Manchester
Dr Claire Smith, University of Manchester
Helen Sweeney, Government Office North West
Richard Tracey, Northwest Regional Development Agency
Dr Paul Upham, University of Manchester
Paula Vandergert, Commission for Architecture and the Built Environment
Matt Waltho, Northwest Regional Development Agency
Peter Wilmers, Natural Economy North West
Ruth Wood, University of Manchester

CONTENTS

1.	Introduction	6
2.	Overview of method.....	15
3.	Areas of search.....	16
4.	Identification of pinch.....	24
5.	Identification of pinch points	30
6.	How can green infrastructure help to overcome these pinches?.....	38
7.	Identification of potential green infrastructure management actions	48
8.	Further opportunities for sustainable development	75
9.	Policy and pinches	83
10.	Identification of emerging storylines for each sub-region	84
	Appendix 1 Policy	116
	Appendix 2 Sub-regional green infrastructure opportunities	125
	Appendix 3 Actions.....	129
	Appendix 4 The five step process for green infrastructure planning	136
	Appendix 5 Green infrastructure functions	138
	Appendix 6 Datasets.....	139
	Appendix 7 Maps	145

1. INTRODUCTION

1.1. This report was commissioned by the NWDA and Natural England, to look at finding and resolving 'pinch points' through green infrastructure interventions. Pinch points are localised areas where investment for growth and/or redevelopment is planned but where specific issues ('pinches'), that may have green infrastructure solutions, manifest themselves most seriously.

1.2. Funding for the project has been provided by NWDA, Natural England, the Interreg IVb programme ForestClim¹ and The Mersey Forest Partnership.

1.3. This study is a follow up to the work that was undertaken as part of Action 4.3 of the NW Climate Change Action Plan², led by Community Forests North West.

1.4. The focus of that work was to assess where there are 'pinch points' potentially caused by projected climate change, and how green infrastructure planning and interventions could help to overcome these anticipated pinches.

1.5. The initial report was presented in October 2008³. Following on from that work, it was agreed that other benefits of green infrastructure, not just climate change adaptation and mitigation, should also be assessed, again in relation to 'pinch points' to help to inform the emerging North West Regional Strategy 2010.

1.6. This work to look at critical green infrastructure is also seen as complementary to the work being undertaken by SQW Consultants to look at Environmental Considerations for Sustainable Economic Growth (ECOSEG)⁴. That study looked initially at a wide range of potential considerations before focusing on four types of critical infrastructure: energy, water, waste and transport in a second stage of the project.

1.7. This current study supports the idea that green infrastructure should be seen as a fifth critical infrastructure, as critical to sustainable economic growth as any of the other four.

¹ www.forestclim.org.ge

² www.nwda.co.uk/PDF/climatechange.pdf

³ Critical Climate Change Functions of Green Infrastructure for Sustainable Economic Development in the North West (Community Forests Northwest, 2008) www.greeninfrastructurenw.org.uk

⁴ The Environmental Considerations of Sustainable Economic Growth (ECOSEG), NWDA, 2008

1.8. Table 2 below indicates the relationship between the ECOSEG work and this study, in terms of the issues covered.

Table 1 Comparison between issues covered by ECOSEG and green infrastructure pinch point studies

ECOSEG capacity themes	Pinch covered in this study
Climate Change <ul style="list-style-type: none"> • Coastal Erosion • Water Availability • Tourism Patterns 	<ul style="list-style-type: none"> • Risk of inadequate water supply • Risk of coastal storms • Risk of poor tourism, recreation, cultural & heritage
<ul style="list-style-type: none"> • Flood Risk 	<ul style="list-style-type: none"> • Risk of flooding
<ul style="list-style-type: none"> • Air Quality 	<ul style="list-style-type: none"> • Risk of poor air quality
Water Quality and Resources <ul style="list-style-type: none"> • Water Supply 	<ul style="list-style-type: none"> • Risk of inadequate water supply
Landscape <ul style="list-style-type: none"> • Noise Pollution 	<ul style="list-style-type: none"> • Risk of noise
<ul style="list-style-type: none"> • Biodiversity 	<ul style="list-style-type: none"> • Risk of loss of biodiversity
Built Environment <ul style="list-style-type: none"> • Quality of Life 	<ul style="list-style-type: none"> • Risk of poor aesthetic • Risk of urban heat island effect
	Additional pinch issues not covered by ECOSEG <ul style="list-style-type: none"> • Risk of loss of carbon storage • Risk of soil erosion • Risk of little green travel

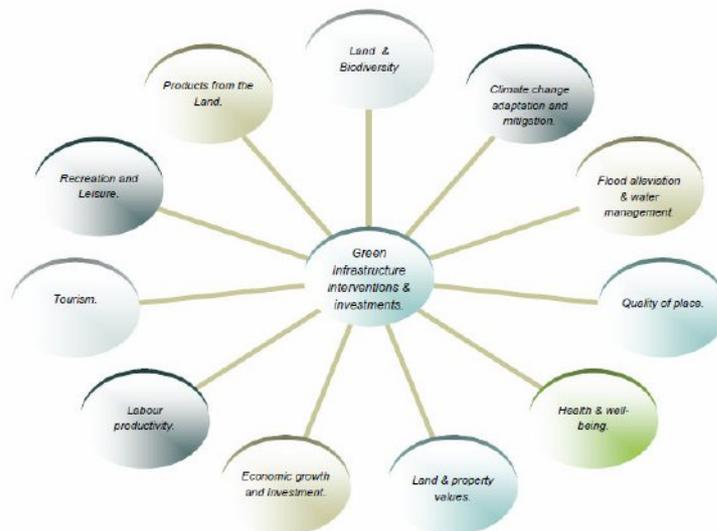
1.9. GREEN INFRASTRUCTURE

1.9.1. The concept of green infrastructure was originally developed in the United States, but is increasingly being adopted and adapted for use in a UK context.

1.9.2. Green infrastructure has been defined as “the region's life support system – the network of natural environmental components and green and blue spaces that lies within and between the North West's cities, towns and villages which provides multiple social, economic and environmental benefits”⁵.

1.9.3. The Natural Economy North West (NENW) project has identified eleven interlinked economic benefits⁶ provided by green infrastructure:

Figure 1 The eleven benefits of green infrastructure taken from NENW report⁷



1.9.4. In the NW Principles and Issues paper⁸ green infrastructure is included as an issue for the sustainable development of the region:

⁵ North West Green Infrastructure Guide (version 1.1). Prepared by the North West Green Infrastructure Think Tank.

www.greeninfrastructurenw.co.uk

⁶ Whilst the list states ‘economic benefits’, it arguably covers the social and environmental benefits as well.

⁷ The Economic Benefits of Green Infrastructure, The Mersey Forest on behalf of NENW, 2008

⁸ RS 2010 Regional Strategy for England’s North West, Principles and Issues paper, NWDA, 2009

“A regionally distinctive natural and marine environment which has rich biodiversity” and “good quality green infrastructure and public open space/parks accessible to all.”

1.9.5. An increasing range of policies and strategies are incorporating green infrastructure. Appendix 1 provides an exhaustive list of the current state of policy and strategy in relation to green infrastructure (courtesy of Helen Sweeney, GONW).

1.9.6. Green infrastructure planning in the UK builds on the legacy of ideas and initiatives going back over 150 years (City Parks, Garden Cities, Green Belt, Community Forest etc.)⁹, but it differs from many conventional land conservation and natural resource protection approaches because it looks at bringing land development, man-made infrastructure planning and the natural environment together¹⁰. Green infrastructure planning seeks to optimise land use to meet the needs of people and nature.

1.9.7. Green infrastructure needs to be planned and managed in the same manner as other types of infrastructure that underpin society.

“For green infrastructure to be truly of value it requires co-ordination and co-operation across political and administrative boundaries. It must be strategically planned, invested in and managed on scales ranging from the local to the regional, and in settings from urban centres to the open countryside. In short, green infrastructure needs to be planned, developed and managed just like all other forms of infrastructure, if society is to thrive and prosper.”

Hazel Blears - Sept 2008

1.9.8. Green infrastructure planning is also based on eight principles:

- Identify and protect green infrastructure before development
- Engage diverse people and organisations from a range of sectors
- Linkage is key: connect green infrastructure components with each other and with people
- Design green infrastructure systems that function at different scales and across boundaries
- Green infrastructure activity must be grounded in good science and planning practice
- Fund green infrastructure up-front as a primary public investment
- Emphasise green infrastructure benefits are afforded to all: to nature and people

⁹ See also presentation by Ian Wray, Head of Planning NWDA, 4th December 2008, www.greeninfrastructurenw.org.uk

¹⁰ Green Infrastructure, Benedict and McMahon. 2006. Island Press ISBN1-55963-558-4

- Green infrastructure should be the framework for conservation.

1.9.9. This study should not be seen in isolation. It builds on the work that has already been undertaken by the Green Infrastructure Unit and Think Tank as well as the Natural Economy North West programme, and is informed by a range of studies and projects¹¹. In particular it helps to deliver three key actions from the NENW study “Developing an outline strategy for linking green and grey infrastructure”¹², an extract of which is presented below in Table 2.

Table 2

Ref	Action	Reasons and further notes
	<i>Strategy</i>	
1	Ensure that sub-regions embed green infrastructure in their investment plans and develop green infrastructure strategies	NENW is already progressing this work but with very limited resources. Sub-regional planning is an essential component of regional strategy development and it is vital that green infrastructure is properly understood and included at this level – particularly because the NWDA looks to sub-regional plans to support applications for Single Programme funding.
2	Ensure that the current development of green infrastructure set out in the draft RSS is carried forward into the proposals for a Single Regional Strategy	A body at a regional level needs to have the responsibility for ensuring that current progress does not suffer in the process of moving to a SRS. This is reflected in PSA 27 paragraph 3.37
3	Investigate the feasibility of retrofitting green infrastructure into grey infrastructure – particularly with regard to sustainable drainage systems.	If the Government opts for a 'polluter pays' system of licensing discharge consents on a volume basis then roads and motorways agencies as well as owners of large developments will be motivated to look at reducing costs. The RSS draft policy EM5 also mentions encouraging the retrofitting of SuDs so there may be a good opportunity to provide guidance in this area.

1.9.10. The approach of this current study is that green infrastructure planning and implementation can be an important element in overcoming pinch issues, that green infrastructure planning should be incorporated into the early stages of proposed investments and that it needs to be linked with grey infrastructure planning.

1.9.11. Increasingly green infrastructure planning is becoming integrated with the ecosystem services approach¹³, for example through joint work with SWIMMER at the

¹¹ See appendix 2

¹² Developing an outline strategy for linking green and grey infrastructure, NENW, 2008

¹³ For example see www.millenniumassessment.org/en/index.aspx

University of Liverpool¹⁴ on a project at Alder Hey, and through the trans-regional work looking at practical methodologies for valuing green infrastructure.¹⁵

¹⁴ www.liv.ac.uk/swimmer/research/research_projects/index.htm

¹⁵ Practical ways of valuing Green Infrastructure and raising awareness of its strategic importance, Genecon, 2009 (work underway, information from NENW)

1.10. This study highlights how and where functions of existing and/or potential future green infrastructure assets are critical to enabling the planned investment that has been identified by the sub-regional partnership as priority, or in regional investment priorities. It is focused at sub-regional/district level where increasingly following the Sub-National Review it is anticipated that decisions about economic development (inter alia) will be taken²².

1.11. In particular, it focuses on development, investment and change that is expected to take place over the next three to five years in the North West. However, some of the issues that green infrastructure can help to address (such as climate change) are much longer term issues that should nonetheless be addressed now. For this reason, some consideration of change beyond the five year threshold has been necessary.

1.12. The term 'pinch point' has been interpreted to mean a place where significant development, investment and/or other change is expected to occur, yet where the investment may not fulfill its full potential due to an issue (the pinch) that green infrastructure can help to solve.

1.13. For example, part of Salford can be seen as a pinch point. It has been identified as a housing market renewal area with significant restructuring and development taking place, yet it is also subject to flood risk – a pinch that may restrict the potential of the planned levels of investment. This study looks at the options for how green infrastructure can help to overcome this pinch.

1.14. Urban areas are already experiencing difficulty in meeting the demand for good air quality, adequate water supply and a sense of place. These and other issues will also be affected by projected climate change. Green infrastructure can play a key role in creating sustainable development and helping to adapt to projected climate change.²³

1.15. Issues that may cause a pinch will often be resolved by a mix of green and grey infrastructure. In the future, if green infrastructure is considered alongside other traditional infrastructure investments, there will need to be plans that integrate these differing, but complementary solutions. We are therefore not looking to appraise these opportunities, but rather to start to identify areas where this integration may be most pressing in terms of securing

²² www.berr.gov.uk/files/file43640.pdf

²³ Royal Commission on Environmental Pollution, Twenty-sixth Report, The Urban Environment, March 2007

economic benefit from investment and growth over the next three to five years. We will also present some possible options for green infrastructure interventions that could help.

1.16. It is particularly important to highlight that this study does not set out a green infrastructure strategy for the region. The remit of the study is focused on specific areas where it is anticipated that investment will be made or a key economic driver needs to be safeguarded from a set of particular issues (pinches) and therefore is limited in its scope.

1.17. The study considers green infrastructure from the perspective of the investor. There is also a need to look at the impact of development itself on the quantity and quality of green infrastructure. This impact could potentially cause pinch elsewhere. For example, creating a large area of impervious surface in place of existing green infrastructure upstream of a flood zone could 'pass on' increased risk of flooding. This would be because the green infrastructure destroyed was previously performing a function that benefited the downstream area in terms of flood risk reduction.

1.18. The sub-regional green infrastructure frameworks and strategies will be important in identifying the functionality of and need for green infrastructure for future development. It is essential that there is continued communication between this work and the emerging green infrastructure plans.

1.19. This exchange can be achieved via the North West Green Infrastructure Forum, which is convened at regular intervals and attracts representatives involved in all of the sub-regional green infrastructure plans. It is also anticipated that further work through Action 4.3 of the NW Climate Change Action Plan will refine aspects of this study, which again will provide helpful data for sub-regional planning.

1.20. A regional green infrastructure framework is likely to be comprised of a compilation of the sub-regional green infrastructure frameworks that are being developed and which have a wider scope than this study. This study will be used to help inform these sub-regional frameworks.

1.21. It must be noted that the work presented here has been undertaken within a short timeframe. As such, it has relied on readily available datasets and input from partners²⁷. However, the methodology that has been developed can continue to be applied as improved data and changing circumstances emerge. The use of Geographic Information Systems (GIS) as the basis for the study means that new data can be incorporated and disseminated relatively easily in the future.

²⁷ This type of caveat also appears as part of the ECOSEG report indicating an emerging theme that we lack the full range of data to enable better decision making. This is discussed in the final section of this report.

1.22. In the study we have indicated the levels of confidence that we are able to place in the data available, and hence the conclusions drawn. The task will be to continue to develop the green infrastructure evidence base, continuing the significant progress made in the last four years and to implement action on the ground.

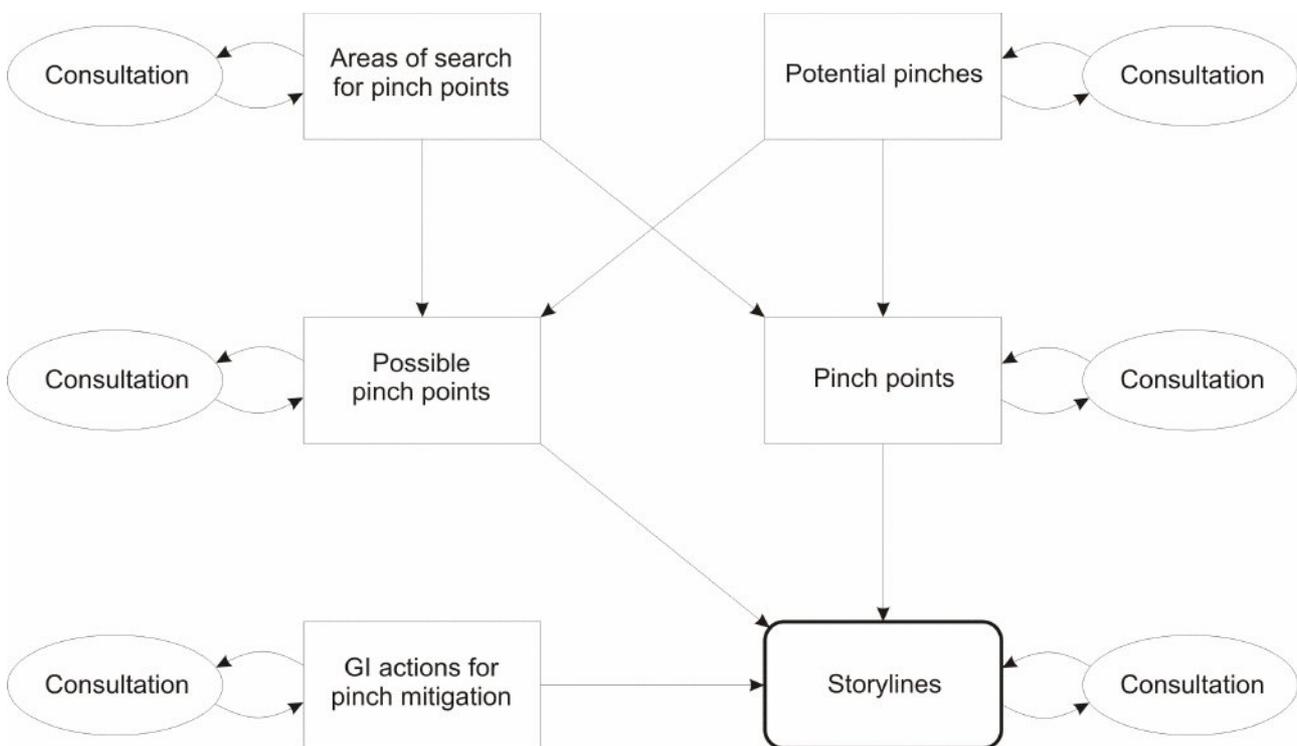
1.23. Much more value, in terms of evidence to aid decision making, can be extracted from the maps in this study with the help of GIS software than can be presented in this document. Therefore it is recommended that anyone who wishes to use evidence from this study to help inform decision making contacts the authors to discuss access to GIS data and/or additional analysis.

2. OVERVIEW OF METHOD

2.1. The method used the following broad stages:

- Identification and mapping of **areas of search** for pinches including:
 - areas identified as targets for investment by sub-regional partners, and also
 - regional economic priorities based on the Regional Economic and Spatial Strategies
- Identification of **pinches** and assessment of methods to map these as accurately as possible
- Identification of **pinch points** by overlaying the pinch maps on to the areas of search
- Identification of potential green infrastructure **actions** to reduce the impacts of pinches
- Identification of emerging **storylines** for each sub-region

Figure 2 Methodology leading to sub regional storylines



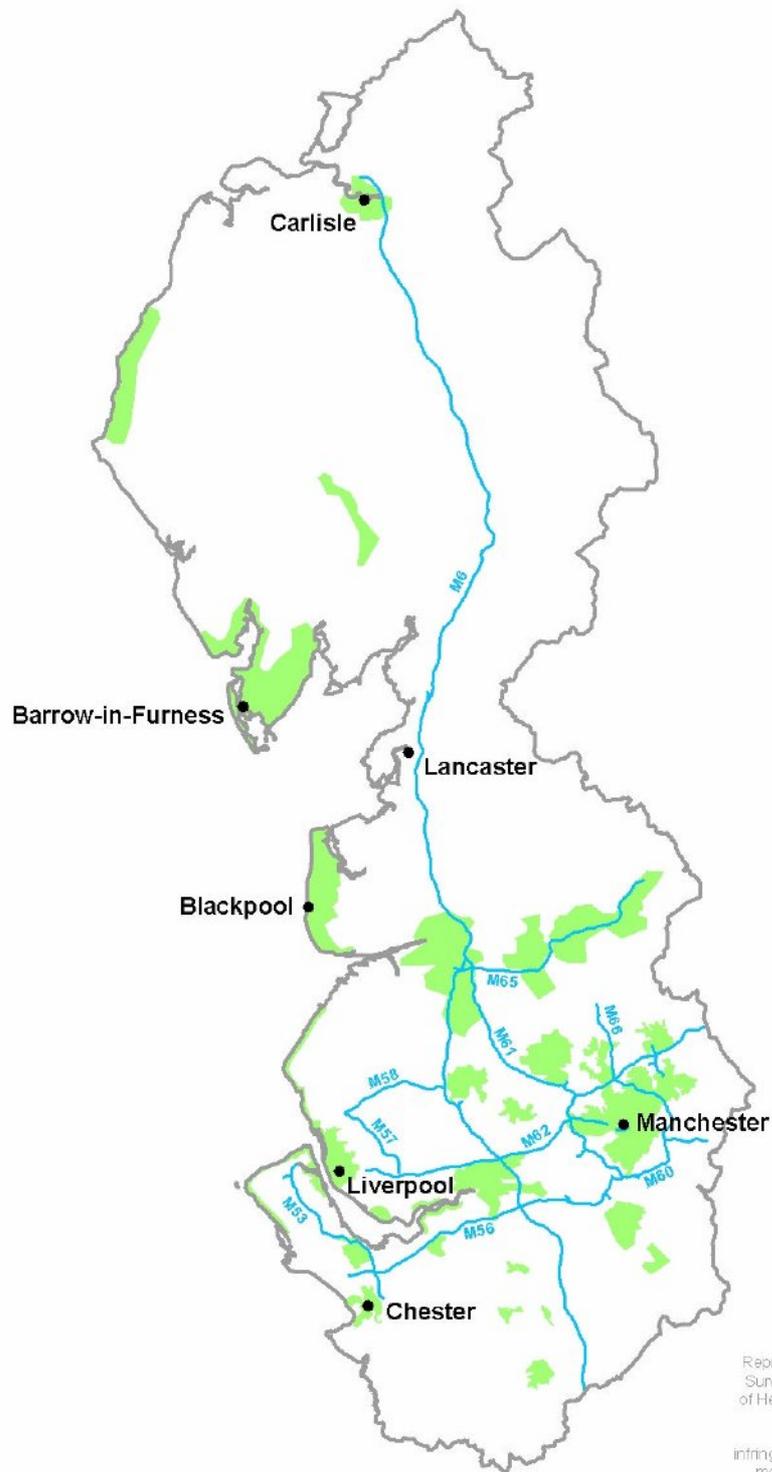
3. AREAS OF SEARCH

3.1. Two methods have been used to identify the areas of search for pinch points.

3.1.1. **Strand 1:** This drew upon the NENW work that identified potential green infrastructure interventions to support priority projects in the five Sub-Regional Economic Strategies³⁴. This work provided a basis for defining definite areas that will undergo change and enabled discussion with each of the sub-regions about their priorities and their assessment of where most change was likely to take place over the next three to five years. These discussions with sub-regional partnerships enabled us to refine the maps and produce Map 1.

³⁴ Assessment of how green infrastructure can assist sub regional plan delivery, NENW, 2008

Map 1



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3.1.2. The full list of sub-regional opportunities for green infrastructure intervention are listed in Appendix 2 and are a modified version of the opportunities identified in the work carried out by Ecotec based on discussion with sub regional partnerships.

3.1.3. **Strand 2:** Where it was not possible to get well defined areas of investment we identified broader areas of search. For example, six growth points have been identified in the North West. However, the exact boundaries of these areas have not yet been released. We are therefore unable to be specific about the boundaries of the growth points at the moment, but we can identify the Growth Point Partnership Areas and use those as a basis for search for possible pinch points.

3.1.4. We use this second method for four regional priorities:

3.1.4.1. Growth points (Map 2)

3.1.4.2. Areas of planned tourism growth (Map 3) - Identified as a key priority in the Regional Economic Strategy³⁵ and through the Sub-Regional Tourism Strategies - attack brands (the Lake District, Manchester, Liverpool and Chester) and other areas aspiring to attack brand status (Blackpool)³⁶, National Parks and Areas of Outstanding Natural Beauty³⁷, Regional Parks³⁸, Southport³⁹, World Heritage Sites (Hadrian's Wall and Liverpool Waterfront), Lancaster and Carlisle⁴⁰, and English Heritage Historic Parks and Gardens.

3.1.4.3. Areas of high quality agricultural land (Map 4) - 80% of the region is designated as agricultural land. The ability of the region to provide high quality food to local markets may be a key factor in future years, if ideas such as carbon costing/budgeting become reality. In addition over the next 6 years over £1bn of Rural Development Programme England funding will be invested in rural communities. Axis 2 in particular focuses on land management and conservation issues. We have mapped grades 1 and 2

³⁵ Regional Economic Strategy, NWDA, 2006

³⁶ Transformational action 101 in NWDA (2006). Regional Economic Strategy (RES), p.46. Also in NWDA (revised 2007). The Strategy for Tourism in England's Northwest 2003-2010 – Developing the Visitor Economy. Northwest Regional Development Agency: Warrington, p15.

³⁷ Referred to as a regional tourism asset in RES, p.15.

³⁸ Action 116 in RES, p.48.

³⁹ Action 102 in RES, p.46.

⁴⁰ Action 115 in RES, p.48.

agricultural land plus other land deemed to have a ‘high likelihood’ of being amongst the ‘best and most versatile’ agricultural land⁴¹ as the area of search for pinches.

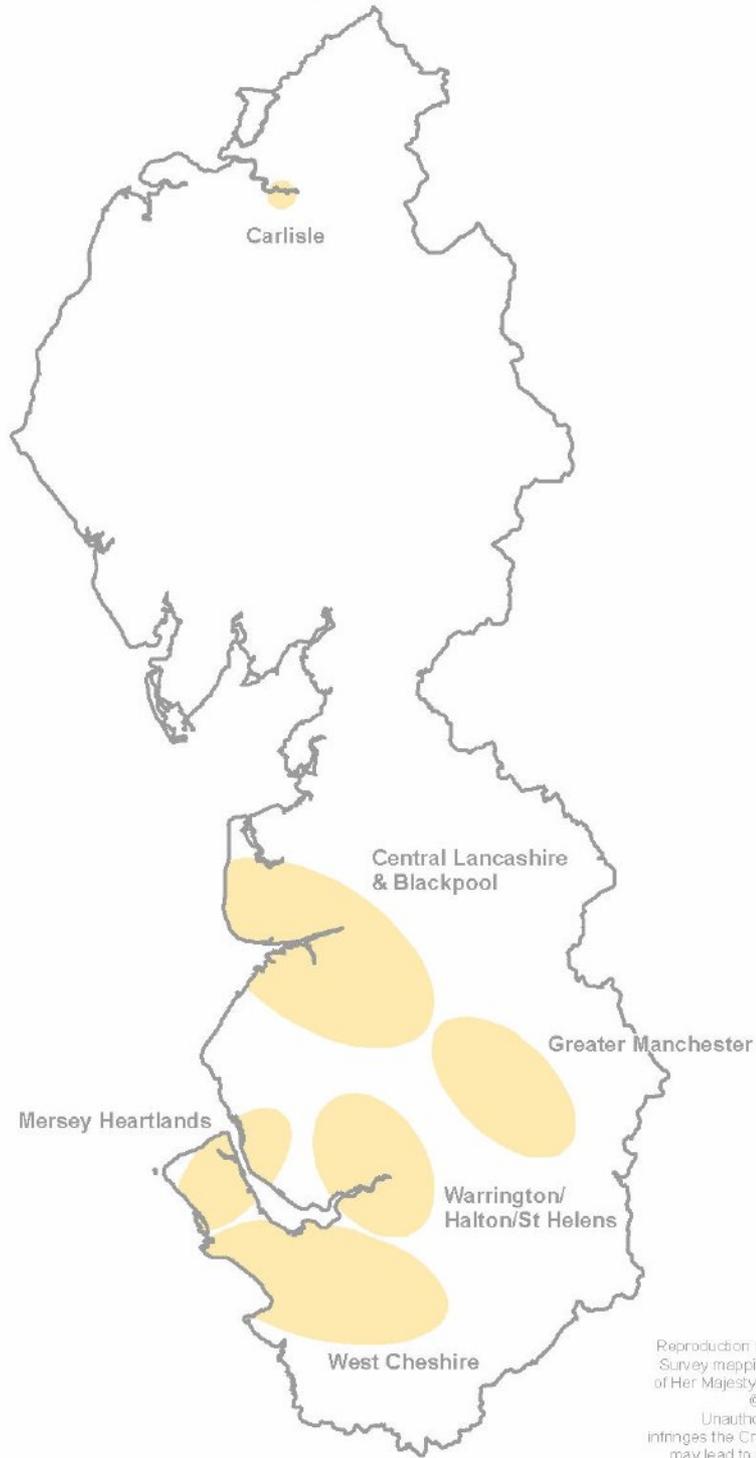
3.1.4.4. The Mersey Corridor is a key area for the North West economy with over 60% of the population and 65% of the region’s GVA⁴². The emergence of the adjacent city regions of Liverpool and Manchester will ensure that there is a continued focus on this corridor to assist ambitions to create a globally significant region.

3.1.4.4.1. In the Mersey Corridor a project tentatively named ‘Atlantic Gateway’ is being assessed based on the Thames Gateway model. However, just as Thames Gateway has a high level green infrastructure plan, Atlantic Gateway should promote sustainable development and enable multiple benefits to be delivered through the implementation of future projects and programmes.

⁴¹ Defra define ‘best and most versatile’ (BMV) agricultural land as grades 1, 2 and 3a. The first two have been mapped definitively, but grades 3a and 3b have not been mapped separately. However, another dataset is available that specifies the ‘likelihood’ of land being amongst the three grades making up BMV land, ie. 1, 2 and 3a. In this study, land categorised as ‘high likelihood’ BMV, but not as grade 1 or 2, has been used as a proxy for grade 3a.

⁴² http://www.nwriu.co.uk/documents/NWDA_Pocket_Databook.pdf

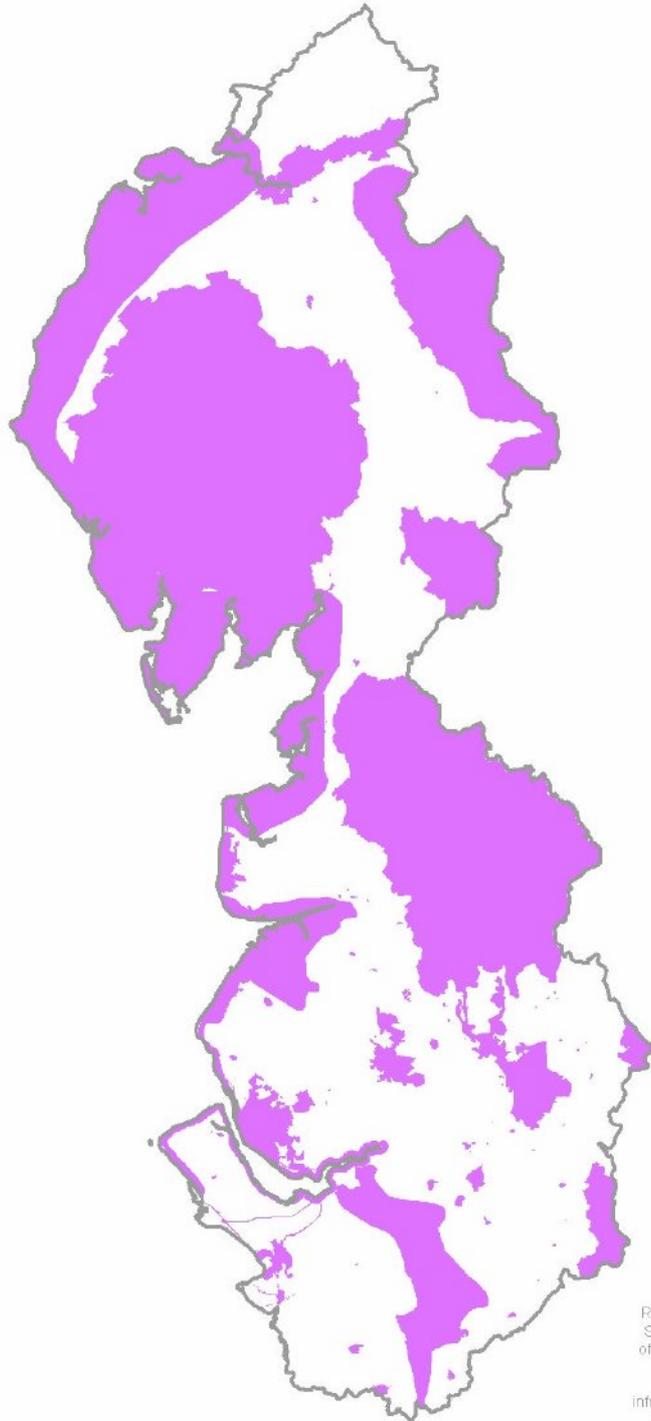
Growth Point Partnership Areas



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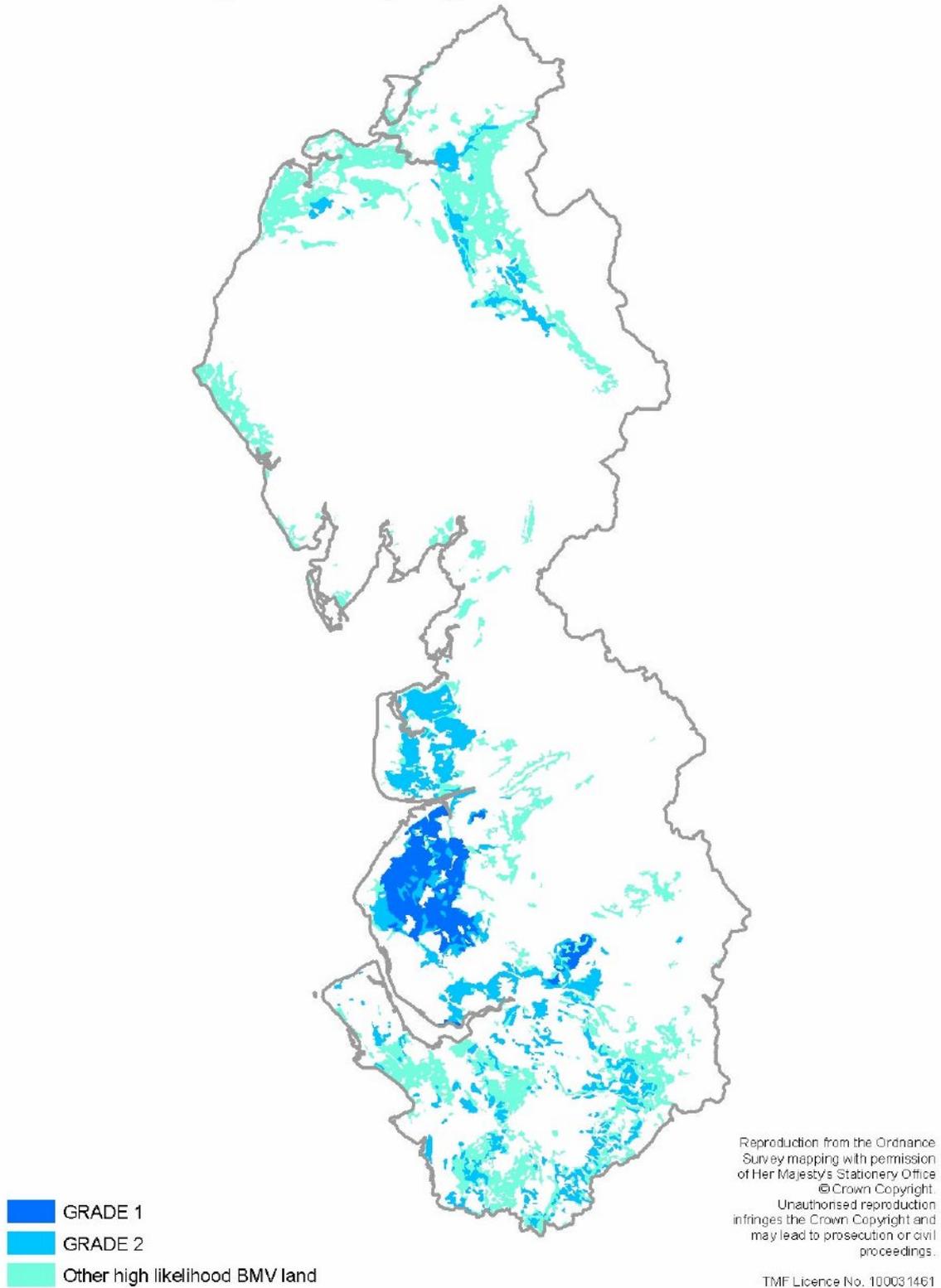
Areas of Tourism Significance



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Areas of High Quality Agricultural Land



Mersey Corridor



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4. IDENTIFICATION OF PINCH

4.1. The basis of this study is to assess how green infrastructure planning could be used to help overcome issues that impede, or could in the future impede, economic development that has been identified as key to the economic growth of strategically important sites across the region.

4.2. The timescale that we have considered is for investments that are planned to be made in the next three to five years, ie. that are within the timeframe of the next iteration of regional and sub-regional economic investment plans.

4.3. The key to this was to be able to identify the specific issues that:

- Could inhibit economic growth
- Potentially have solutions that could be partially delivered through effective green infrastructure planning and implementation. There is a link here to work that has been published through the Natural Economy North West programme on developing grey/green infrastructure strategies.⁴³

4.4. The identification of the pinches was achieved by:

- Using the list of green infrastructure functions developed by the North West Green Infrastructure Unit for previous studies⁴⁴
- Determining for each function whether the lack of its provision could significantly impact on the delivery of a project or programme of economic development. Those that do are the pinches that we are interested in.

4.5. Table 3 below sets out the pinches that have been identified, how they have been mapped in this study and an indication of our confidence in the data available to identify this pinch⁴⁵.

43 Developing an outline strategy for linking green and grey infrastructure, IBIS, Natural Economy NW, 2008

44 Appendix 5 – List of green infrastructure functions

45 See Appendix 6 for more information on datasets used

Table 3 North West pinches that green infrastructure can help alleviate

Pinch Description	Mapping method	Alternative mapping method	Confidence
Risk of flooding	Flood zone 2		High
Risk of inadequate water supply	Carlisle & West Cumbria Water Resource Zones ⁴⁶		Medium
Risk of urban heat island effect	Regional centres, towns & cities		Medium
Risk of loss of biodiversity	Existing ecological network		Medium
Risk of loss of carbon storage	Carbon density > mean		Medium
Risk of poor air quality	IMD air quality index > mean	IMD air quality index > 75 th percentile	Medium
Risk of coastal storms	1km buffer of coast		Medium
Risk of poor tourism, recreation, cultural & heritage	Unable to map effectively: data too widely dispersed		
Risk of soil erosion	Risk is high or very high		High
Risk of poor aesthetic	NEI Landscape & Visual Quality Domain < 0	NEI Landscape & Visual Quality Domain < -90	Low
Risk of little green travel	Unable to map effectively: scale too small for regional scale study		
Risk of noise	500m buffer of main roads & railways, 5km buffer of airports, and urban areas	100m buffer of main roads & railways, and 1km buffer of airports	Medium

⁴⁶ According to “The Environmental Considerations of Sustainable Economic Growth” (NWDA, 2008), “Overall, the capacity of the region to supply water is considered to be sufficient to cope with current and predicted demand for the medium to long-term up to 2035, with planned resource support in particular for the Integrated Resource Zone. The region as a whole has relatively flexible supply routes, although the West Cumbria and Carlisle Resource Zones have less flexibility with regard to capacity for an additional major water user if one appears.”

Two of the pinches (risk of little green travel and risk of poor tourism, recreation, culture & heritage) cannot be mapped in a sensible manner at present because of the nature of the pinch and the availability of data. These two pinches are considered in more detail in Section 10 “

Identification of emerging storylines for each sub-region”.

4.6. For each of three pinches (aesthetic, air quality and noise), two alternative mapping methods have been used. This is because a relatively non-arbitrary threshold applied to the dataset (such as the mean for the region, or a buffer distance justified by anecdotal evidence) gives areas too large to sensibly be called pinch points (eg. the whole of the Manchester conurbation). Maps using this first threshold will be presented, but closer attention should be paid to the ‘alternative’ maps, which use a purely arbitrary⁴⁸ threshold in order to give pinch points of more sensible sizes. This is because all thresholds in this study are necessarily arbitrary, even though they have been consulted on, serving purely to prioritise areas for investment in green infrastructure (ie. to identify pinch points), and hence those thresholds that most tightly focus identification of pinch points are most useful. Except where otherwise specified, all figures and cumulative maps in this document are based on the ‘alternative’ thresholds.

4.7. The confidence placed in the datasets and mapping methods for each pinch is based on several factors:

- Professional acceptance that the dataset(s) represent with reasonable accuracy what they claim to represent
- Assessment of the applicability of the dataset(s) to the task at hand
- Likely professional acceptance of the way in which the dataset(s) have been used
- Assessment of to what extent the threshold(s) are arbitrary
- Age of dataset(s)
- Resolution of dataset(s)
- Assessment of the extent to which the mapping method(s) could be improved given more resources

⁴⁸ In the sense that the thresholds were based purely on the judgement of the authors, without reference to any specific external data or reasoning.

- Assessment of how closely the results of the mapping method(s) resemble what is understood by the term ‘pinch points’.

4.8. The ideal situation would be to have high confidence in the mapping methods that identified pinches that were highest priority. The actual situation we have at present is that we have medium levels of confidence for most of the datasets, with high confidence for one of the high priority pinches (flood) and a mid-range one (soil), and low confidence for one of the low priority pinches (aesthetic).

4.9. Potential pinches are arranged in descending order of priority, as determined by a ‘forced pairs’ consultation with a range of partners. There can be a lot of discussion about the priority list, but the question we asked was specific and focused on the key question for this study: “On average, at a strategic and regional level which pinches (if they were present) would have most effect in slowing or stopping investment?”

4.10. In addition we have also suggested three categories of pinch

4.10.1. Pinches that will cause direct damage to an investment.

4.10.2. Pinches that may not directly damage the investment but will affect the quality of place.

4.10.3. Pinches that are policy driven i.e. they must be considered but will not directly damage an investment.

4.11. Prioritisation properly needs to be a local exercise undertaken with knowledge of the area being assessed: a flood risk or carbon store in a specific area may be the most important pinch. This issue is dealt with in Section 6 below where guidance on developing an intervention plan is set out. The regional priority list does not undermine the need for a more detailed assessment of priority at a local level.

4.12. Figure 3 below shows the result of this regional prioritisation exercise.

Figure 3 North West England pinch prioritisation

Priority	Pinch	Pinch type
HIGH	Risk of flooding	Direct Damage
	Risk of inadequate water supply	Direct Damage
	Risk of urban heat island effect	Direct Damage
	Risk of loss of biodiversity	Policy
	Risk of loss of carbon storage	Policy
	Risk of poor air quality	Quality
	Risk of coastal storms	Direct Damage
	Risk of poor tourism, recreation, culture & heritage	Quality
	Risk of soil erosion	Policy
	Risk of poor aesthetic	Quality
	Risk of little green travel	Quality
LOW	Risk of noise	Quality

4.13. A pinch has been identified as low in the priority list should not be overlooked. The high priority pinches are those that will almost definitely stop a development. For example, water supply is a basic necessity. Risk of inadequate water supply can be managed by investing in new water supply infrastructure (and green infrastructure as part of that), but if the cost is too great, development will not take place.

4.14. However, good aesthetic may not always be seen as a basic necessity. Poor quality developments, in terms of their visual appeal, are still seen across the region (and country). Lack of investment in providing good aesthetic means that the value of the development is not maximized, and often the cost of dealing with poor quality is borne not by the developer, but by other public agencies that eventually have to deal with the social and environmental issues that arise. Particularly in times of economic slowdown it is the areas of poor aesthetic quality that are least resilient, and where economic investment eventually has to be made to try to retro-fit quality.

5. IDENTIFICATION OF PINCH POINTS

5.1. Having identified:

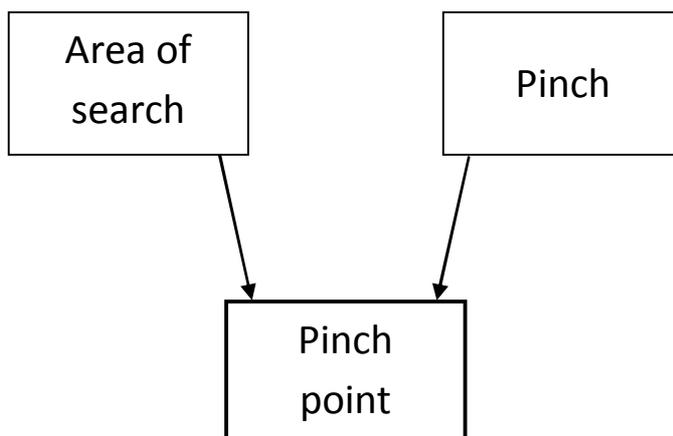
- The areas that are most likely to undergo economic growth and investment over the next three to five years as discussed in Section 3 above and
- The pinches in Section 4 above

5.2. We can identify our pinch points by overlaying these two datasets, giving both:

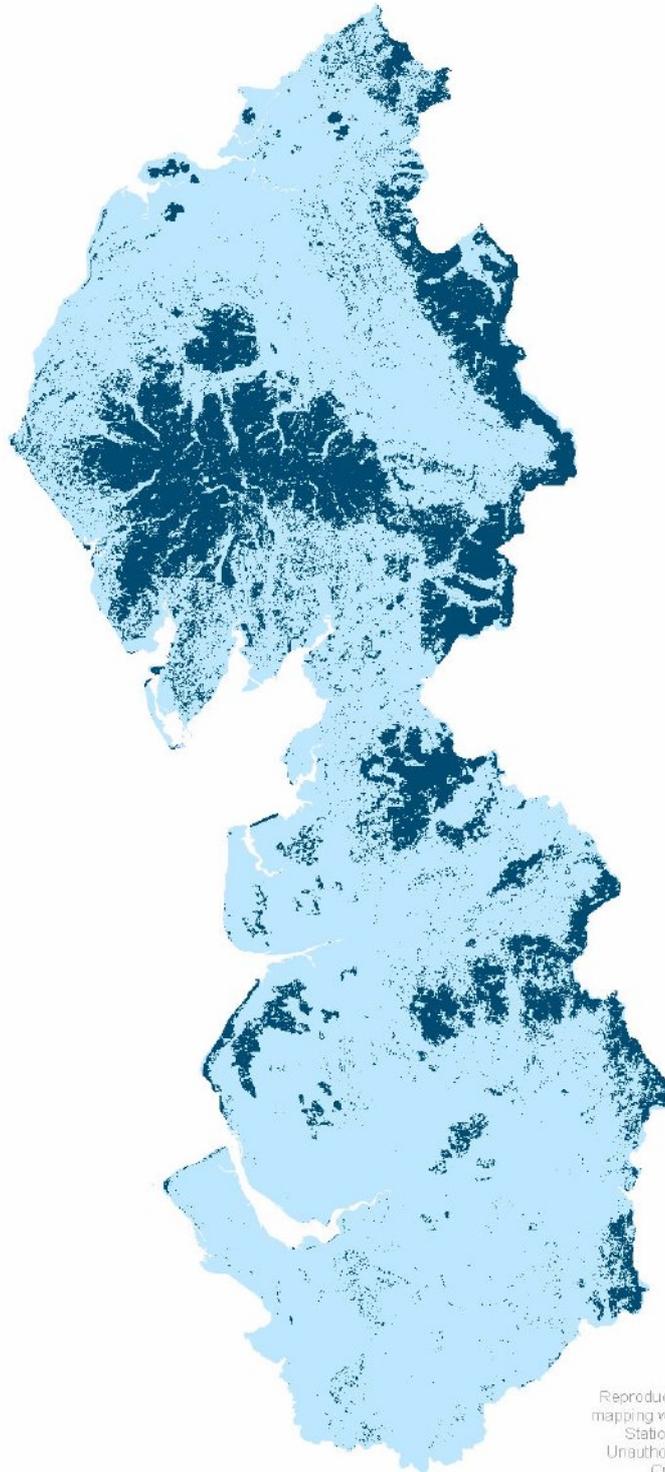
- The locations of types of pinch point – eg. identifying where all the pinch points subject to the pinch ‘risk of poor air quality’ are located in the sub-regions
- The range and regional priority of pinches at each point - eg. what pinches are acting in Carlisle and how important are they at a regional level?

5.3. This assessment can help us in developing storylines for each of the sub-regions, describing the main issues for the sub-region and the range of options available to utilise green infrastructure as part of a grey/green infrastructure plan to overcome the pinches. These storylines can be fed into the developing sub-regional green infrastructure plans and also used as a basis for making evidence based decisions to inform the development of the Sub-Regional Strategy.

5.4. Maps 6, 7 and 8 below show how the soil erosion pinch points were identified, as an example. Map 7 is restricted to Strand 1 areas of search for pinch points, and Map 8 is restricted to Growth Point Partnership Areas as a Strand 2 example. The maps for the remaining pinches are included in Appendix 7.



Soil Erosion



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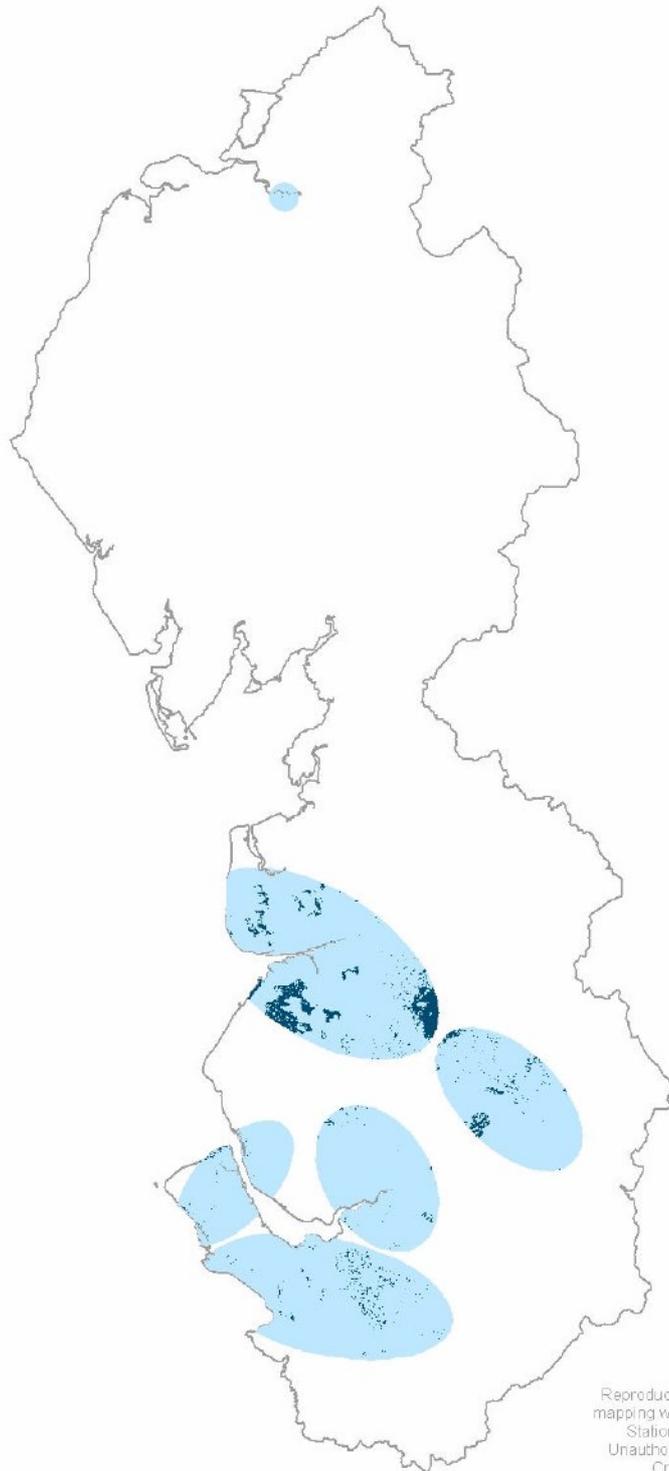
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Soil Erosion



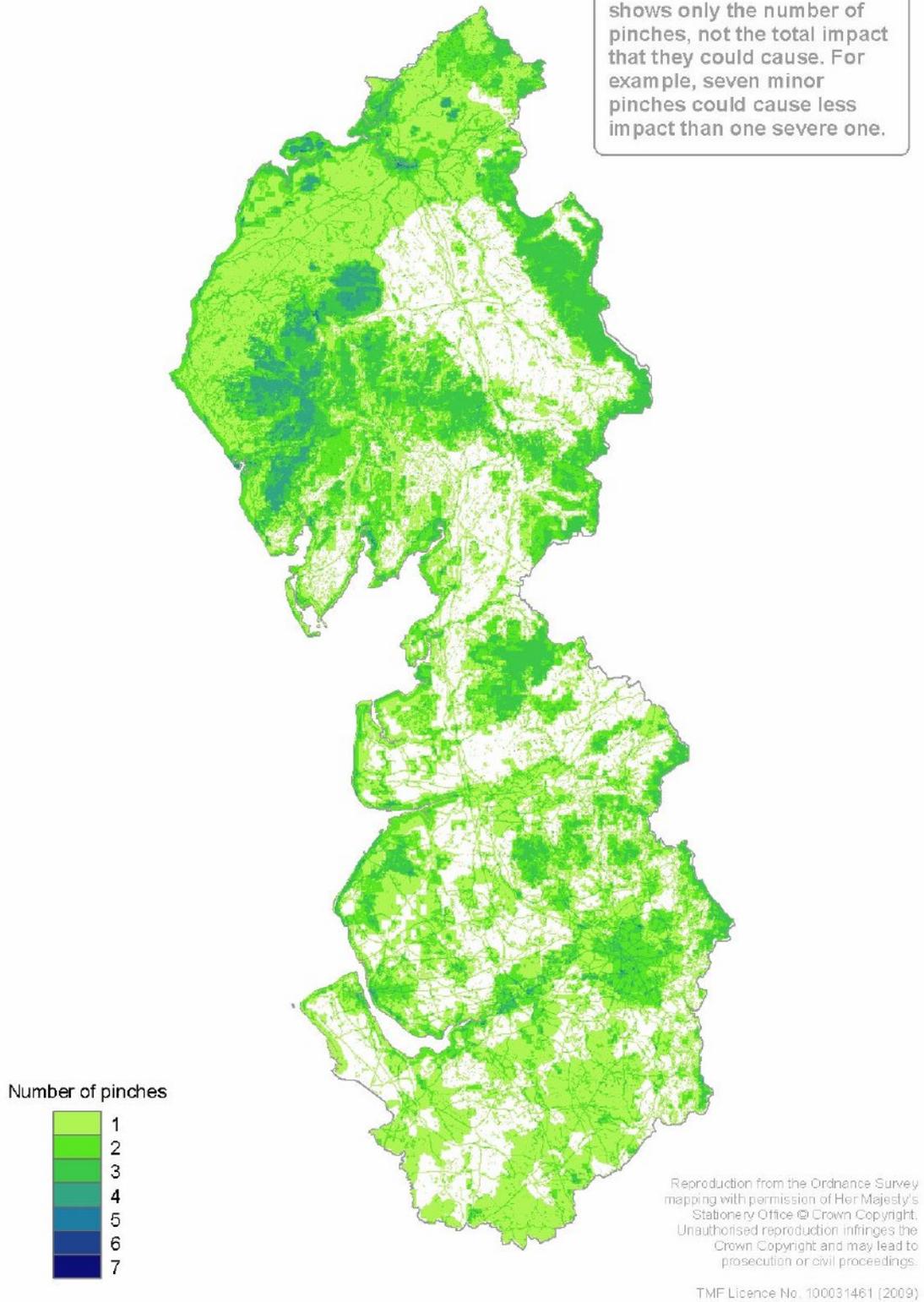
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5.5. Maps 9, 10 and 11 below show the number of pinches acting at each point in the region. Map 10 is restricted to Strand 1 areas of search for pinch points, and Map 11 is restricted to Growth Point Partnership Areas as a Strand 2 example. It is important to note that whilst these maps may be useful for targeting, they don't take into account the relative importance of different pinches in different places. For example, a place with only one pinch may be more in need of investment in green infrastructure than a place with seven if that one pinch is particularly severe. Therefore the maps have a limited use in terms of making decisions about what to do where or where pinches may be most pressing.

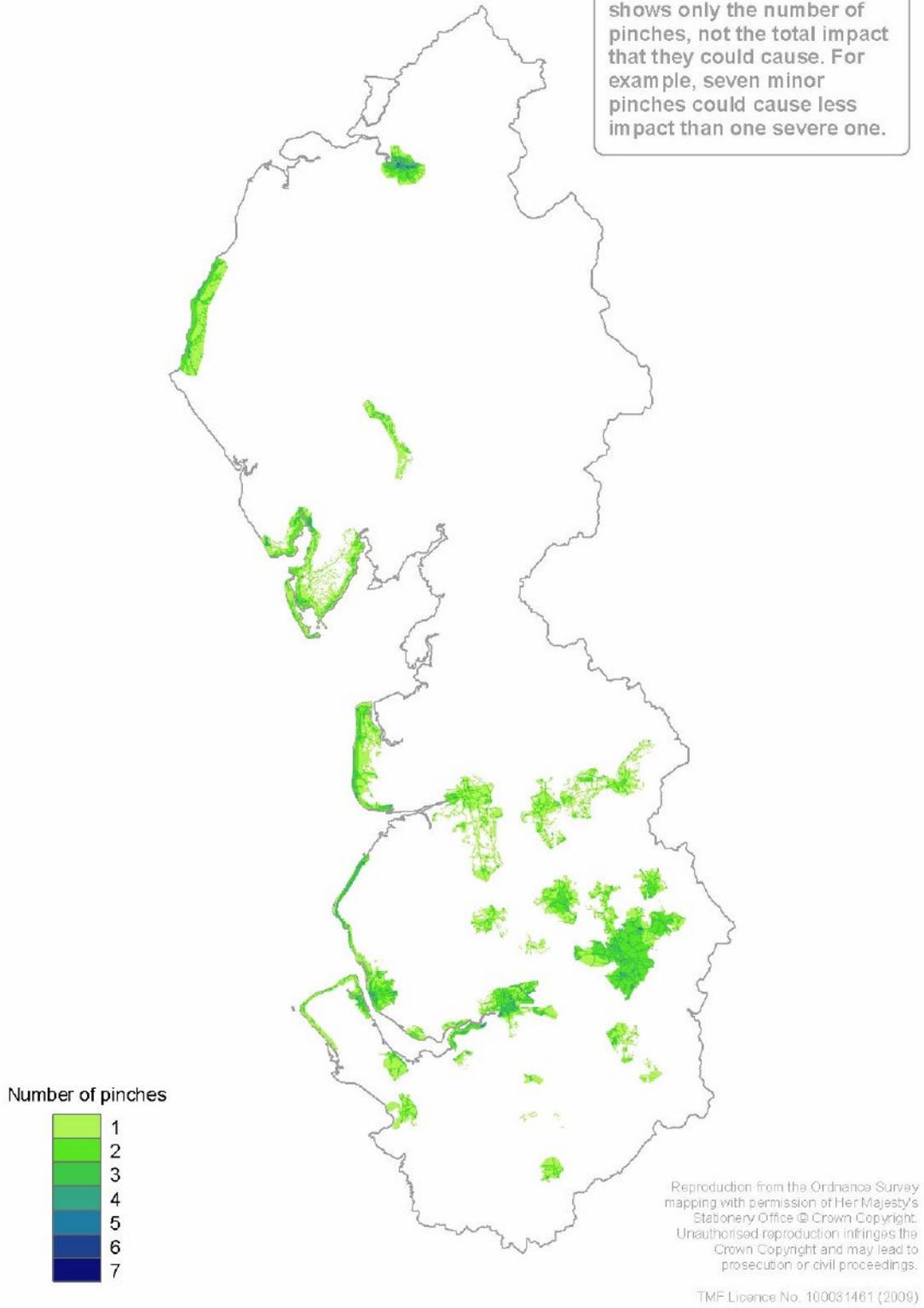
Map 9 Number of pinches

Please note: This map shows only the number of pinches, not the total impact that they could cause. For example, seven minor pinches could cause less impact than one severe one.



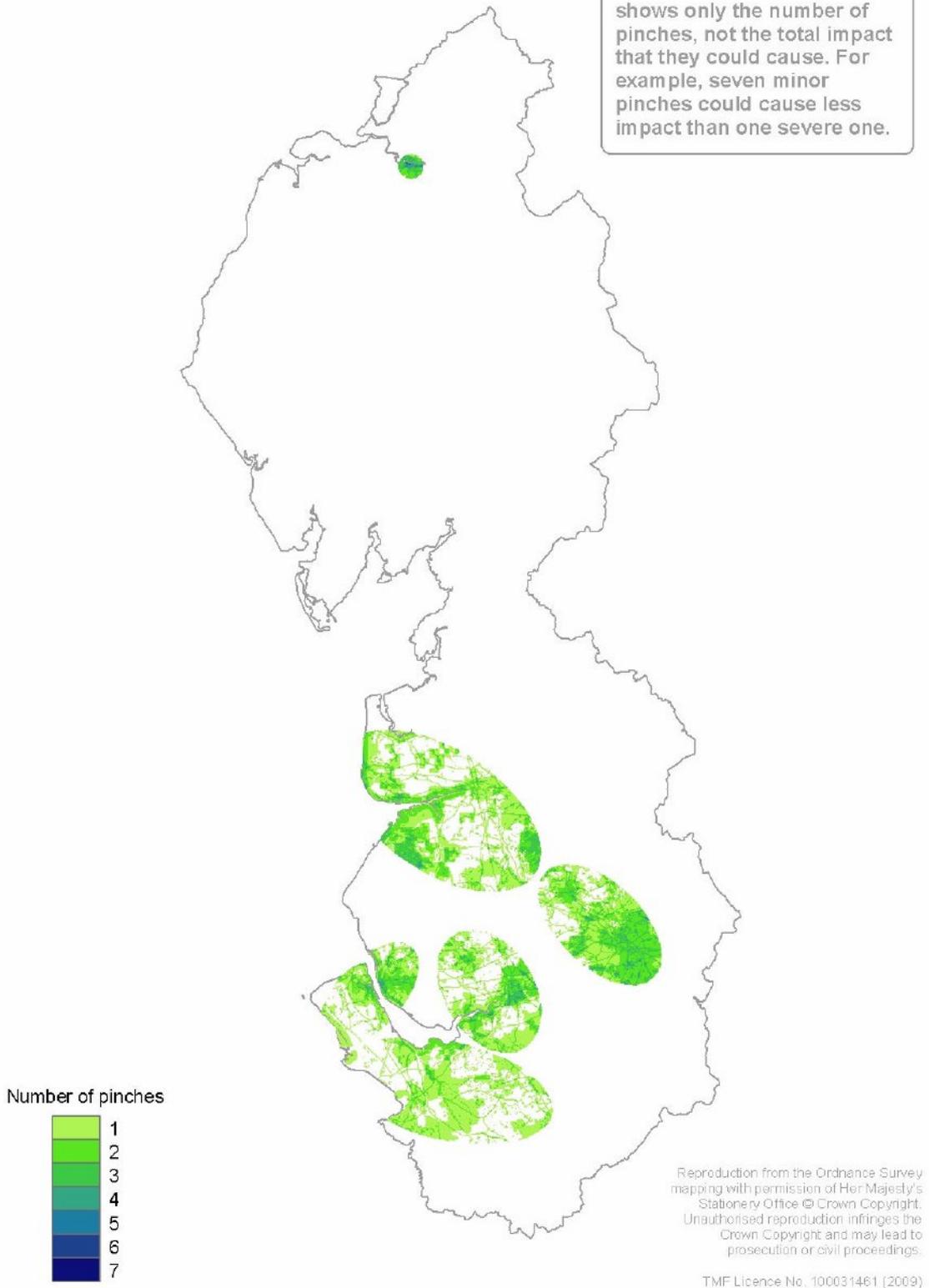
Map 10 Number of pinches in Strand 1 areas of search

Please note: This map shows only the number of pinches, not the total impact that they could cause. For example, seven minor pinches could cause less impact than one severe one.



Map 11 Number of pinches in Strand 2: Growth Point Partnership Areas

Please note: This map shows only the number of pinches, not the total impact that they could cause. For example, seven minor pinches could cause less impact than one severe one.



6. HOW CAN GREEN INFRASTRUCTURE HELP TO OVERCOME THESE PINCHES?

6.1. Work on green infrastructure planning in the North West of England has been based on the relationship between land type, function and finally benefit. This chain can be helpful in determining what action to take to deliver particular functions that will assist in overcoming the pinch or pinches in a specific area.

6.2. In this study we have not identified the green infrastructure land typology. This should be carried out by the sub-regional and/or local partnerships as set out below. Appendix 3 provides information about the types of action that can be delivered to overcome each of the identified pinch issues.

6.3. This study has also not specifically identified what may be termed “social” pinch issues such as areas of poor health, deprivation or low skills. In delivering improved functionality through green infrastructure planning and implementation we can achieve a range of the 11 green infrastructure benefits (1.9.3 above) that will help to address some of these social issues.

6.4. This study can be used in tandem with techniques such as those developed by Forestry Commission (Public Benefit Recording System⁴⁹) to identify areas of social need.

6.5. These actions themselves are elaborated upon in Section 7 ‘Identification of potential green infrastructure management actions’.

6.6. The actions set out in Appendix 3 fall into two categories:

- Safeguard existing green infrastructure to help overcome the pinch issue. This may be policy led and may not need additional investment in green infrastructure above that which is already in place.
- Enhance green infrastructure - modify existing or create new green infrastructure to overcome the pinch issue. This requires specific action on the ground.

6.7. The information in Appendix 3 provides the basis for discussion at sub-regional and local levels on the specific actions to take to overcome a pinch issue.

⁴⁹ <http://www.pbrs.org.uk/>

6.8. More detailed information of the safeguard/enhance categories in relation to pinch issues caused by climate change is included in the previous pinch point study “Critical Climate Change Functions of Green Infrastructure for Sustainable Economic Development in the North West.”⁵⁰

6.9. For example, in Lancashire the Blackpool area of search contains several pinches, including risk of flooding and risk of urban heat island effect. Using Appendix 3 as a basis for discussion with stakeholders we can start to develop suggested green infrastructure actions that play a role in overcoming these pinches. Some of these may involve safeguarding existing green infrastructure, other actions will be about enhancing green infrastructure. Decision making about how green infrastructure can play a role in helping to overcome these two pinch issues can be assisted by the use of the actions table. Table 4 below provides an extract from Appendix 3.

Table 4 Green infrastructure options for the urban heat island and flood risks in Blackpool

Risk	Action	Activity Type
Risk of urban heat island effect	Protect assets such as city/town centre parks, open spaces in built up areas, and areas with vulnerable populations	Safeguard
	Ensure no net loss of green cover and increase it wherever possible	Safeguard
	Undertake creative greening to enhance green cover, with particular attention to town centres, areas with low green cover, and vulnerable populations - 10% rule, use of green roofs	Enhance
	Maintain and increase cover of large canopied trees for shade provision	Enhance
	Where possible, protect green infrastructure assets which encourage air flow into urban areas	Safeguard
	Align new development and restructuring so that it encourages air flow into urban areas	Enhance
	Ensure a water supply for vegetation	Safeguard

⁵⁰ Ibid

Risk of flooding	Protect flood zones from new development	Safeguard
	If development occurs within flood risk areas it should be designed for flood resilience	Enhance
	In urban areas explore opportunities for de-culverting of water courses where this can assist in reducing flood risk	Enhance
	Explore areas upstream of flood risk area where it may be possible to reduce flood risk through green infrastructure, eg. water parks, woodland creation, and take opportunities where they exist	Enhance
	Design all development and restructuring so that it does not pass on flood risk, especially where it is upstream of flood risk areas	Enhance
	Take opportunities through development and restructuring to reduce flood risk downstream, through SUDS, green infrastructure and woodland creation	Enhance
	Development should be avoided, where possible, in areas where the soil has a high infiltration rate, and should not increase the proportion of impervious surface cover on such soils	Safeguard

6.10. In selecting a green infrastructure intervention to overcome the pinch, we should also be mindful of the ability to gain additional functionality and deliver a wider range of benefits to help improve the quality of the investment in sustainable development terms.

6.11. In some cases the green infrastructure intervention may be made away from the pinch point. For example, using green infrastructure to reduce flood risk or improve air quality may mean planning an intervention at some distance from the pinch point, up stream or alongside a major motorway.

6.12. In Section 8 we have also identified a number of additional green infrastructure functions that can further enhance a location. These additional functions are not related to the pinches identified in this study, but they will enable sustainable development of areas and help to address issues related to energy conservation and the development of low carbon economies, key issues that will need to be faced by new investment across the region.

6.13. Within Section 8 we have gathered these green infrastructure functions together under the heading 'Further opportunities for sustainable development'.

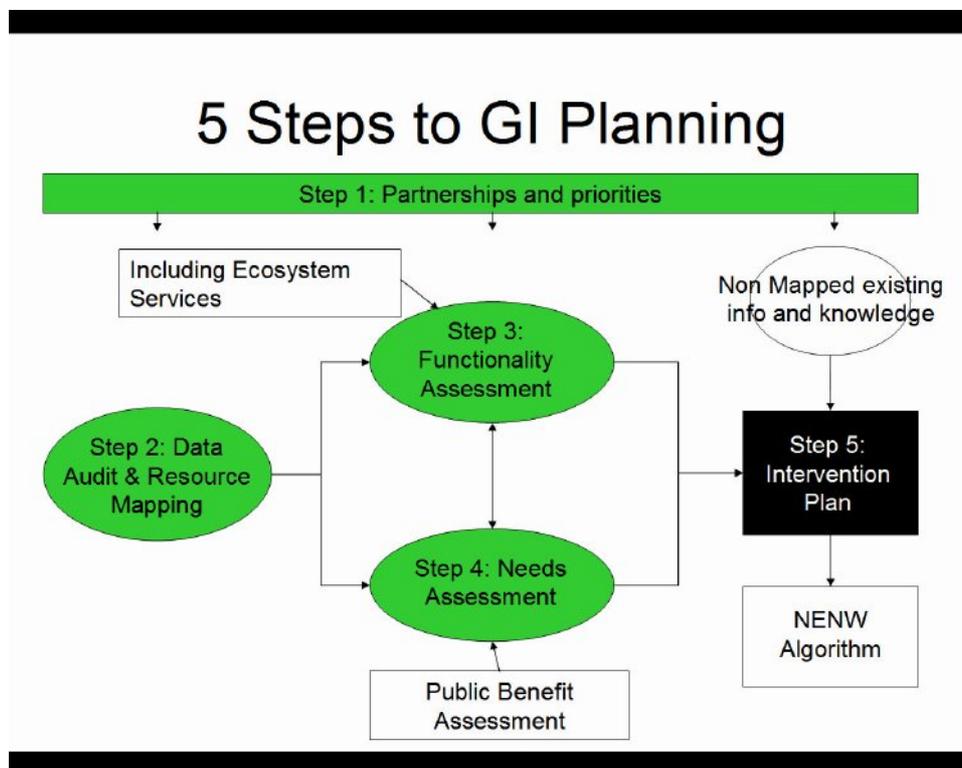
6.14.3. We should not try to be too simplistic in our approach to the system. We should accept that it is a complex system that we do not fully understand, but where we can intervene to improve the system to deliver the benefits required based on our current knowledge.

6.12. DEVELOPING AN INTERVENTION PLAN

6.12.1. The North West Green Infrastructure Guide proposes a five step process for delivering an intervention plan for green infrastructure. We can see how this five step process, set out in Figure 5 below can be used to produce an intervention plan for a pinch point.

6.12.2. The five step process used in relation to pinch points helps to identify how green infrastructure can overcome the pinch issue or issues and therefore enable the benefit and ultimately value to be delivered.

Figure 5 The five step green infrastructure planning process⁵⁵



6.12.3. We have tried to follow the model as best we can at a regional level by engaging partners and identifying priorities, gathering data and assessing aspects of

⁵⁵ North West Green Infrastructure Guide, Green Infrastructure Think Tank, 2007.

need. We have not looked at functionality of green infrastructure due to the scale of the work that would be required, resources available and time allowed. We have also suggested how sub-regions can start to implement aspects of the findings from this study – the intervention plan.

6.12.4. The approach to green infrastructure in North West England has elsewhere been based on the relationship between:

- green infrastructure types – eg. grassland, broadleaf woodland, sports pitch, garden, stream⁵⁶
- green infrastructure functions – what is it doing – intercepting water, reducing noise, etc.
- green infrastructure benefits – what are the benefits that society can derive from the functions provided by the green infrastructure?

Figure 6



6.12.5. The relationships between green infrastructure types, functions and benefits are ‘many-to-many’. Furthermore, there are complex relationships amongst the benefits. So from these relationships it is not a surprise that what develops is a complex system.

6.12.6. There are many way to look at this, but increasingly the eleven economic benefits set out in the NENW study “The Economic Benefits of Green Infrastructure: The Public and Business Case for Investing in Green Infrastructure and a Review of the Underpinning Evidence” are being seen as a good basis for discussing these benefits (see Figure 1 above).

6.12.7. At a sub-regional level, further work has been carried out by NENW to develop guidance for sub-regional green infrastructure planning that builds on the basic model outlined in the regional Green Infrastructure Guide.⁵⁷

⁵⁶ Green infrastructure encompasses all plants, plus water and soil.

6.12.8. At a project level the approach is also being used in conjunction with current work taking place in Liverpool to look at incorporating green infrastructure into the major works to improve the built structures and public realm of Liverpool Knowledge Quarter⁵⁸. More information on how the approach works is provided in Appendix 4.

6.12.9. Section 7 below provides further details of the types of appropriate intervention to assist in overcoming specific pinch issues.

6.12.10. It is anticipated that this data will be used by the sub-regional partnerships as part of their decision making that will eventually lead to the development of the more detailed intervention plan and ultimately to the delivery on the ground of the actions required.

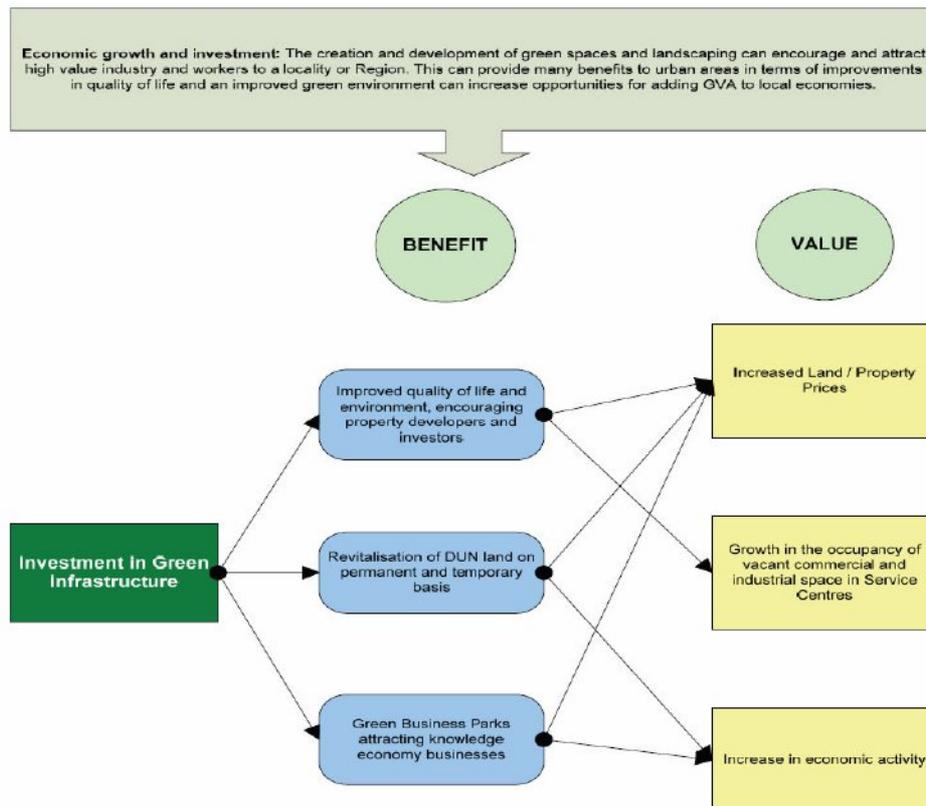
6.12.11. Decision making about which intervention to select is supported by a growing body of evidence. The basis for cost/benefit assessment is complex and again the NENW work on identifying Economic Benefit of Green Infrastructure uses a simplified 'value chain' to set out how green infrastructure interventions deliver value.

⁵⁷ A guide to planning Green Infrastructure at the sub-regional level, Commissioned from IBIS Environmental and Design Consultants by The Mersey Forest on behalf of Natural Economy Northwest, 2009

⁵⁸ www.liverpoolvision.co.uk/keydocs/13126%20LpoolVisionLOWRES.pdf

⁶¹ The Economic Benefits of Green Infrastructure, *ibid*

Figure 7 Value chain for green infrastructure intervention – economic growth and investment example



6.12.12. These values can be delivered in a number of ways:

- direct value - for example jobs created, land brought back into economic use
- downstream value - for example the induced and indirect impacts of investment upon visitor spend, employment in supply chain industries
- cost reduction value - for example in relation to costs to health services, government and employers in managing the effects of ill health
- risk management value – for example through reduced insurance premiums for homes and business where investment has lowered flood risk.⁶¹

6.12.13. The use of green infrastructure to overcome pinches relates to the last two of these bullet points in particular.

6.12.14. There is a great deal of interest at both national and regional level in developing robust valuation models for green infrastructure. Across the Northern

Way⁶² a consortium of organizations are currently working on a major study to devise these models.

6.12.15. Finally, decisions about the type of intervention (grey and/or green) will inevitably require decisions to be made concerning:

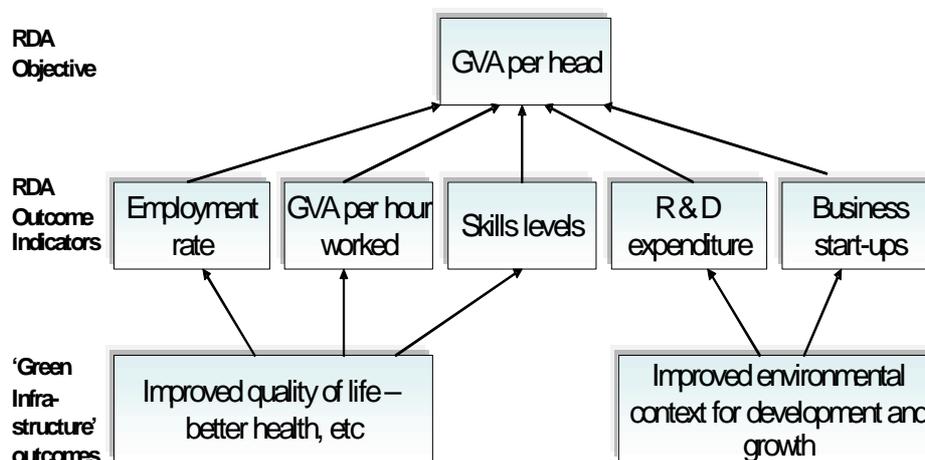
- The evidence that the intervention will overcome the pinch
- The cost/benefit assessment of the intervention.

6.12.16. Where this information is available we have included it in Section 7 against the appropriate green infrastructure function.

6.12.17. In a further NWDA study “The Economic Benefits of Green Infrastructure – an Assessment Framework for the NWDA”⁶³, the link between green infrastructure interventions and increasing GVA (gross value added) was identified. Whilst in future a more balanced framework of economic, social and environmental measures is likely, the ability of green infrastructure to underpin sustainable economic development will still be important.

6.12.18. In the context of this study, the ability to assist in delivery of GVA is in addition to the use of green infrastructure to enable sustainable development in the first place.

Figure 8 Linking green infrastructure interventions to GVA: an example



⁶² www.thenorthernway.co.uk

⁶³ The Economic Benefits of Green Infrastructure – an Assessment Framework for the NWDA. AMION, 2008

7. IDENTIFICATION OF POTENTIAL GREEN INFRASTRUCTURE MANAGEMENT ACTIONS

7.1. In Section 6 ‘How can green infrastructure help to overcome these pinches?’ above, we have identified how it is possible that green infrastructure interventions can help to overcome a pinch by providing the functionality that is lacking and therefore enable sustainable development, delivering one or more of the eleven green infrastructure benefits.

7.2. This section provides detail to enable decisions to be made about the nature of these interventions. In the following sub-sections each aspect of green infrastructure functionality is described and a number of specific green infrastructure interventions are identified that will deliver that function.

7.3. For each function, there is a discussion setting out the context for each function at the regional level. This is then followed by suggested actions.

7.4. It is anticipated that this section is used in conjunction with the storylines set out in Section 10 as the basis for developing both sub-regional and subsequently local green infrastructure intervention plans.

7.5. RISK OF FLOODING

7.5.1. Climate change will alter the seasonality of precipitation, with increased winter and decreased summer precipitation. In addition, precipitation events will be more intense. This could lead to increased flood risk. As well as riverine and coastal flooding, there will also be increased risk from overwhelmed drains. This flood risk will have implications for development and restructuring, tourism and agriculture.

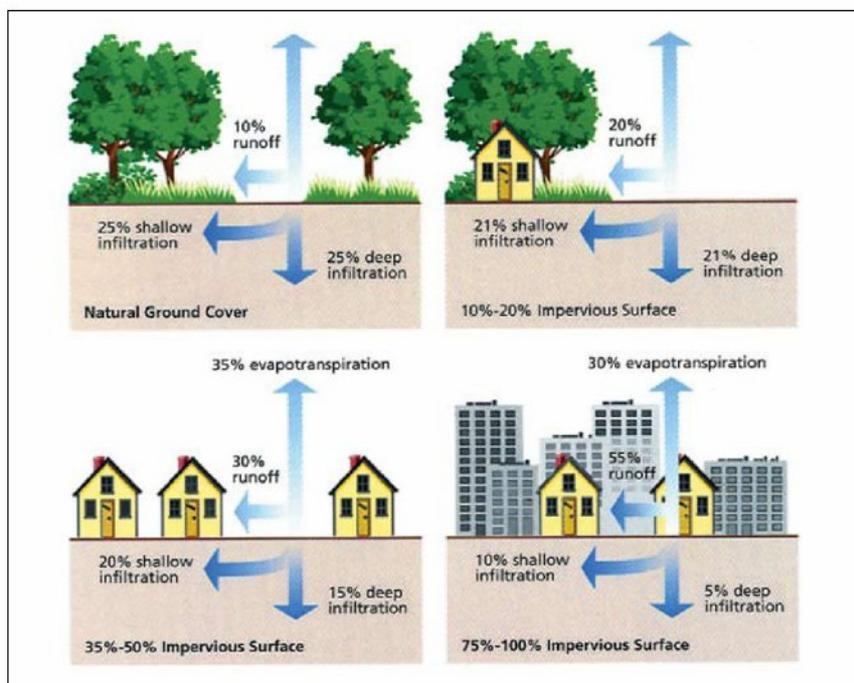
7.5.2. In this instance we have only been able to map fluvial and coastal flood risk using the Environment Agency’s data. Map 12 shows the flood zones in the North West.

7.5.3. In the North West 103,292 ha are within flood zone 3 (1 in 100 year fluvial flood risk, 1 in 200 year tidal risk) and 126,206 ha within flood zone 2 (1 in 1,000 year risk).

7.5.4. Soils with high infiltration capacity are particularly important in reducing flood risk; increasing impervious surface cover on such soils will increase surface runoff (and hence flood risk). It may also decrease water recharge into aquifers, such as under the Sefton sand dunes.

7.5.5. Development should be avoided wherever possible in flood risk areas. Where it does occur within flood risk areas, it should be designed for flood resilience. In addition flood risk reduction opportunities upstream should be taken, for example through green infrastructure interventions such as floodplain restoration and woodland creation. This will require careful hydrological modeling and comparison of the advantages and disadvantages of a green infrastructure solution as opposed to an engineered solution (for example, a green infrastructure solution can have multiple benefits yet is likely to require working across local authority boundaries, whereas an engineered solution is more tried and tested).

Figure 9 Impact of impervious cover on hydrologic cycle – from Urban Forestry Watershed manual



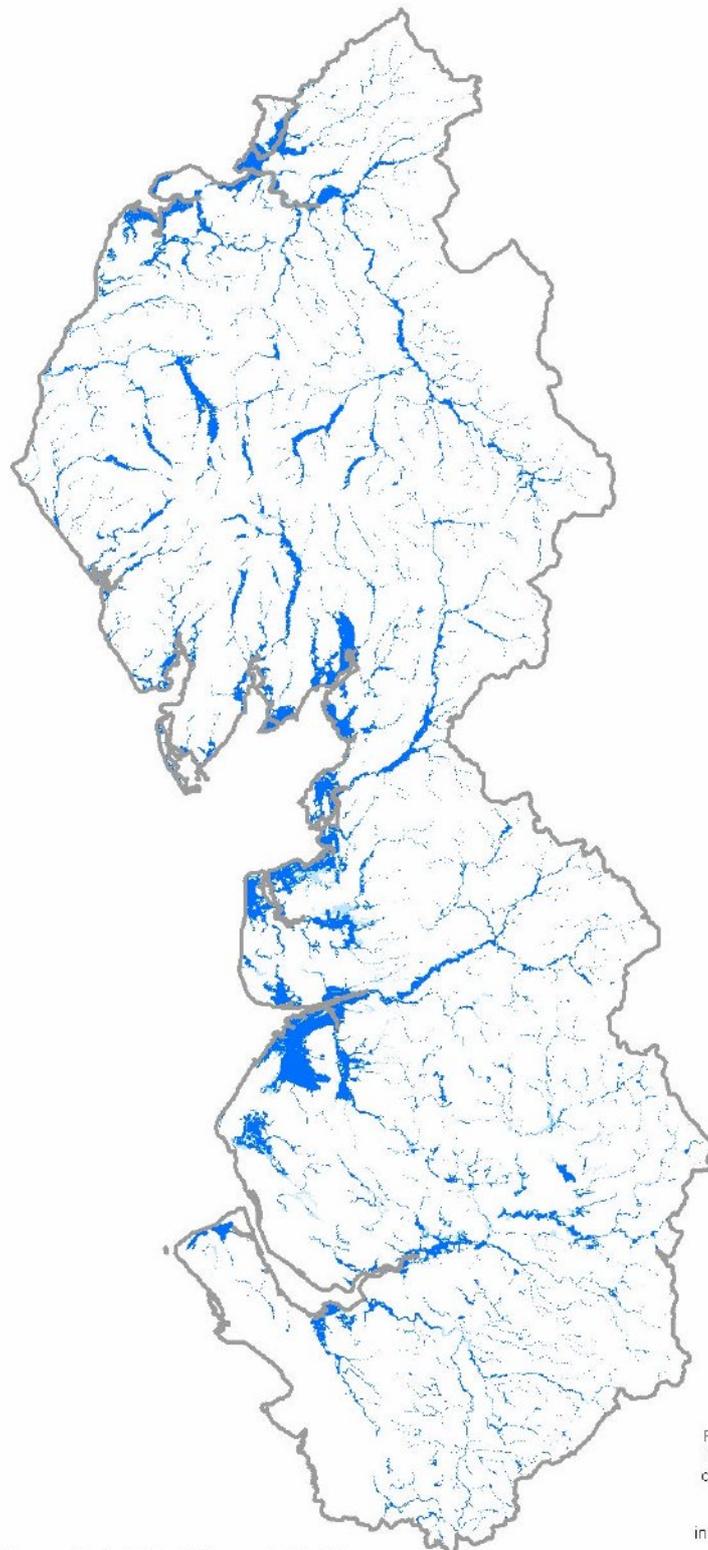
7.5.6. All development and restructuring should be designed so that it does not pass on flood risk to areas downstream. This is especially important upstream of flood risk areas. Opportunities should be taken through development and restructuring to reduce flood risk downstream, for example through SUDS, green infrastructure and woodland creation. This, again, will require careful hydrological modeling.

7.5.7. The predecessor to this study, 'Critical Climate Change Functions of Green Infrastructure for Sustainable Economic Development in the North West', provides more detail on this function of green infrastructure, especially as it relates to climate change.

Table 5 Actions for flood risk

Action	Type
Protect flood zones from new development	Safeguard
If development occurs within flood risk areas it should be designed for flood resilience	Enhance
In urban areas explore opportunities for de-culverting of water courses where this can assist in reducing flood risk	Enhance
Explore areas upstream of flood risk area where it may be possible to reduce flood risk through green infrastructure, eg. water parks, woodland creation, and take opportunities where they exist	Enhance
Design all development and restructuring so that it does not pass on flood risk, especially where it is upstream of flood risk areas	Enhance
Take opportunities through development and restructuring to reduce flood risk downstream, through SUDS, green infrastructure and woodland creation	Enhance
Development should be avoided, where possible, in areas where the soil has a high infiltration rate, and should not increase the proportion of impervious surface cover on such soils	Safeguard

Flood Zones



-  Flood Zone 3 (100 year fluvial risk, 200 year tidal risk)
-  Flood Zone 2 (1,000 year risk)

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7.6. RISK OF INADEQUATE WATER SUPPLY

7.6.1. Water supply is the availability of clean water for householders and businesses.

7.6.2. Water supply has been raised as a potential future difficulty in the northern and western parts of Cumbria. This may hinder the development of industries using high clean water volumes.⁶⁴ United Utilities have integrated water supply across the region as one zone, except for Carlisle, North Eden and West Cumbria.

7.6.3. Projects such as SCAMP⁶⁵ are already underway and focus on the management of water gathering areas in the uplands to improve water quality.

7.6.4. There are established industries using clean water as part of their processes in and around Carlisle. Their expansion and development may be hindered water by resource issues.

Table 6 Actions for water supply

Action	Type
Actions are covered by United Utilities Water Resources Plan ²⁵ .	Safeguard
Support expansion of SCAMP type programmes in uplands	Enhance
Explore opportunities for watershed forestry programmes	Enhance
Develop opportunities for water collection and storage for use in times of drought or water stress for irrigating green infrastructure and maintain evaporative cooling, avoiding use of mains water	Enhance

⁶⁴ www.unitedutilities.com/Documents/Revised_Draft_WRMP_Full_Report_-_January_2009.pdf

⁶⁵ www.unitedutilities.com/AboutSCaMP.htm

7.7. RISK OF URBAN HEAT ISLAND EFFECT

7.7.1. Climate change will bring warmer average temperatures as well as more extreme events such as more heatwaves and of a longer duration. This will be felt particularly in urban areas where the urban heat island is already a recognized phenomenon. The most vulnerable areas will be densely built up areas with a low green (and in particular tree) cover, such as town centres and high density residential areas. The most vulnerable people to heat stress and potentially mortality will be the elderly, the young, those in ill health and the poor.

7.7.2. Green infrastructure has the potential to help adapt urban areas to cope with these increased temperatures by providing evaporative cooling and shading (particularly from trees with large mature canopies), as well as providing opportunities for cold air drainage and air flows. Modelling work has suggested that adding 10% green cover to built up areas in Greater Manchester keeps surface temperatures at a 1961-1990 baseline level up until the 2080s high emissions scenario⁶⁶.

7.7.3. This has implications for development and restructuring in creating places where people will be comfortable to live and work, as well as for tourism in creating comfortable and attractive places to visit.

7.7.4. Map 13 shows the location of vulnerable people in the North West, particularly those in urban areas.

7.7.5. Greater Manchester and Merseyside have the most vulnerable people in urban areas, whilst Lancashire has significant areas.

7.7.6. Investment should seek to protect assets such as city and town centre parks and open spaces in densely built up areas and areas where there are vulnerable populations. It should also ensure that there is no overall loss of green cover and that it is increased wherever possible. Creative greening approaches (such as street trees, green roofs, green facades) will help to enhance green cover, again with particular attention to town centres, areas with low green cover, and areas with vulnerable

⁶⁶ Gill, S.E, Handley, J.F., Ennos, A.R., Pauleit, S. (2007) Adapting Cities for Climate Change: The Role of the Green Infrastructure. *Built Environment*, 33(1), 115-133.

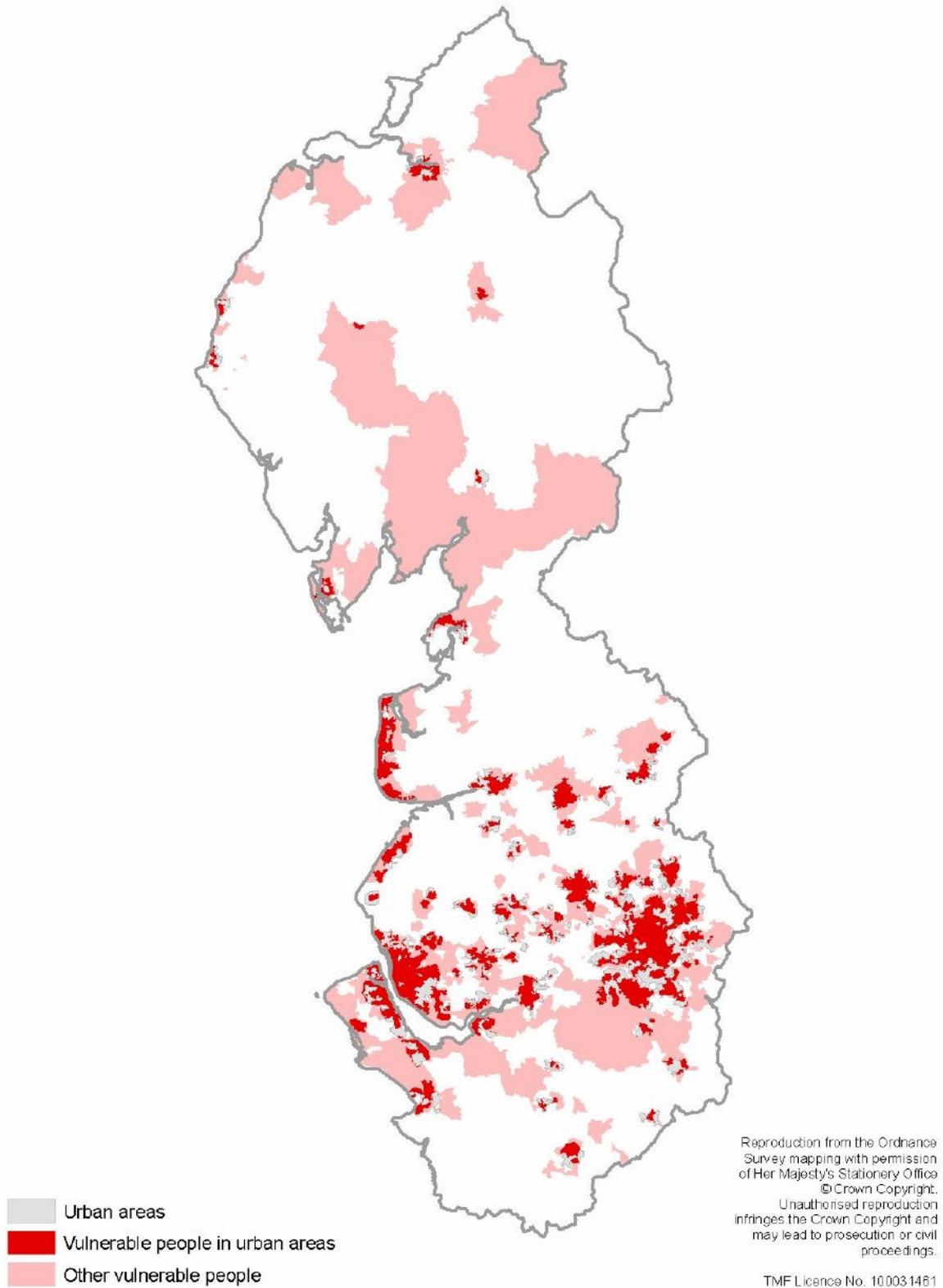
populations. New investment should identify opportunities to ensure a water supply for vegetation, to sustain its functionality during drought.

7.7.7. The predecessor to this study, 'Critical Climate Change Functions of Green Infrastructure for Sustainable Economic Development in the North West', provides more detail on this function of green infrastructure, especially as it relates to climate change.

Table 7 Actions for urban heat island effect

Action	Type
Protect assets such as city/town centre parks, open spaces in built up areas, and areas with vulnerable populations	Safeguard
Ensure no net loss of green cover and increase it wherever possible	Safeguard
Undertake creative greening to enhance green cover, with particular attention to town centres, areas with low green cover, and vulnerable populations - 10% rule, use of green roofs	Enhance
Maintain and increase cover of large canopied trees for shade provision	Enhance
Where possible, protect green infrastructure assets which encourage air flow into urban areas	Safeguard
Align new development and restructuring so that it encourages air flow into urban areas	Enhance
Ensure a water supply for vegetation	Safeguard

Vulnerable People in Urban Areas



7.8. RISK OF LOSS OF BIODIVERSITY

7.8.1. As the climate changes species will need to move northwards and upwards to find new 'climate spaces'. They may be limited in their ability to do this by a number of factors, including the permeability of the landscape for their movement. North-south corridors may aid species movement, whilst east-west barriers could restrict it.

7.8.2. Map 14 shows the ecological network map, with a 500 m buffer, of the North West. This map is taken from work developed by Natural England. In the same way as this study advocates cross boundary working within the North West, it is important to look outside of the region too when planning interventions for biodiversity (and other functions) so as work at the appropriate scale and enable a more coherent approach at a landscape scale.

7.8.3. According to these, ecological networks cover 23.5% of the North West.

7.8.4. If a 500 m buffer is created around all existing ecological networks then 65.4% of the North West is covered. This would increase the total NW ecological network by 178.9%.

7.8.5. This suggests the importance of protecting existing ecological networks and in creating new habitat to buffer and connect the networks, particularly when undergoing new development and restructuring.

7.8.6. The predecessor to this study, 'Critical Climate Change Functions of Green Infrastructure for Sustainable Economic Development in the North West', provides more detail on this function of green infrastructure, especially as it relates to climate change.

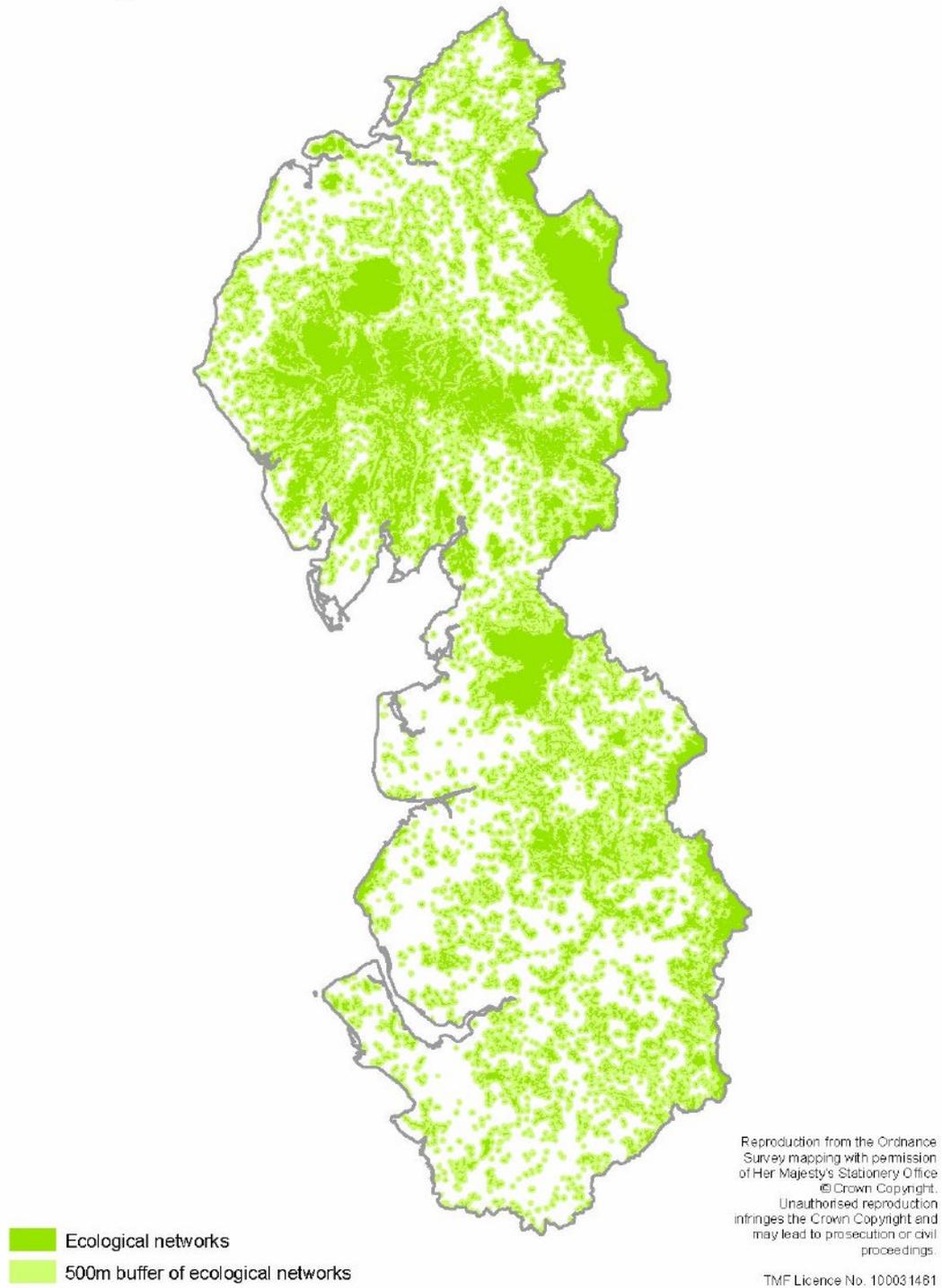
Table 8 Actions for biodiversity

Action	Type
Follow principles set out in "Biodiversity by Design" ⁶⁷	Enhance
Protect existing ecological networks in new development and restructuring areas	Safeguard

⁶⁷ www.tcpa.org.uk/biodiversitybydesign.htm

<p>Maximise opportunities for creating new habitats and filling gaps in ecological networks during new development and restructuring, with particular attention to north-south connectivity. Create the right habitats in the right locations, appropriately managed and delivering priority habitat and species targets in accordance with the relevant UK and sub-regional habit and species action plans.</p>	<p>Enhance</p>
<p>Manage agricultural land to protect existing ecological networks</p>	<p>Safeguard</p>

Ecological Networks



7.9. RISK OF LOSS OF CARBON STORAGE

7.9.1. Carbon is stored in soils and vegetation. In the UK soils contain more carbon than vegetation⁶⁸. However, it must be stressed that different soil types have different carbon contents (eg. peat stores more carbon than sand). Different types of vegetation also store different amounts of carbon (eg. forests generally have significantly higher above-ground carbon reservoirs than other vegetation types⁶⁹). Depending on their nature, changes to land use and/or management practices can lead to increases or decreases in the amount of carbon stored in both soils and vegetation.

7.9.2. In the UK, Defra publishes statistics (for each local authority and region) on CO₂ emissions by end user. This includes net emissions from 'land use, land use change and forestry' (LULUCF) which includes both sources (emissions) and sinks (removals) of atmospheric CO₂⁷⁰. Figure 10 shows the total CO₂ emissions by end user for the North West, with LULUCF activities accounting for only 1% of the total. Figure 11 shows the emissions and removals of CO₂ from LULUCF activities in the North West, with net emissions of 697 kt CO₂ (by end user, 2005). The aim should be for a net removal; in the UK, LULUCF activities lead to a net removal of emissions from the atmosphere. Maintaining this and improving it would involve maintaining existing carbon stores and seeking to sequester carbon where opportunities arise.

7.9.3. Map 15 shows the carbon density of soils and vegetation across the North West. Soils and vegetation in the North West store 2.5 MtC, with a mean density of 178 tC/ha. This ranges from 0 tC/ha to 1146 tC/ha in South Lakeland.

7.9.4. New development should be avoided in areas of high carbon density as it would reduce the amount of carbon stored; such areas should be managed as long term carbon stores. New development should also mitigate any loss of carbon by contributing to carbon sequestration and storage opportunities elsewhere (eg. planting woodland in suitable areas).

⁶⁸ Milne and Brown (1997) Carbon in vegetation and soils of Great Britain. *Journal of Environmental Management*: 49, 413-433.

⁶⁹ Broadmeadow and Matthews (2003) *Forests, carbon and climate change: the UK contribution*. Forestry Commission Information Note 48.

⁷⁰ Emissions are generally from soils due to land use change and liming of soils and removals are through forest growth.

7.9.5. It is important to ensure that agricultural practices maintain this carbon store, and seek to increase it through land and soil management (eg. adding biochar or compost to soils, reduced tillage, managed grazing etc).

7.9.6. The predecessor to this study, ‘Critical Climate Change Functions of Green Infrastructure for Sustainable Economic Development in the North West’, provides more detail on this function of green infrastructure.

Table 9 Actions for carbon storage

Action	Type
Aim for net removal of CO ₂ in the North West from land use, land use change and forestry	Enhance
Avoid new development in areas with highest carbon densities	Safeguard
Maintain the carbon storage in high density areas, such as areas with a higher density than the NW mean of 178 tC/ha	Safeguard
Increase carbon stored – eg. through agricultural practices, woodland creation, managing mosslands	Enhance
Offset carbon lost through new development by increasing carbon stores and/or maintaining the carbon stored in other areas	Safeguard
Target areas to maintain and increase carbon stored – eg. managing peat and mossland areas, woodland creation in lower quality agricultural areas where it has potential to be multi-functional, management of areas of significant carbon stores; this could be delivered through the newly launched North West Climate Fund	Enhance

Figure 10

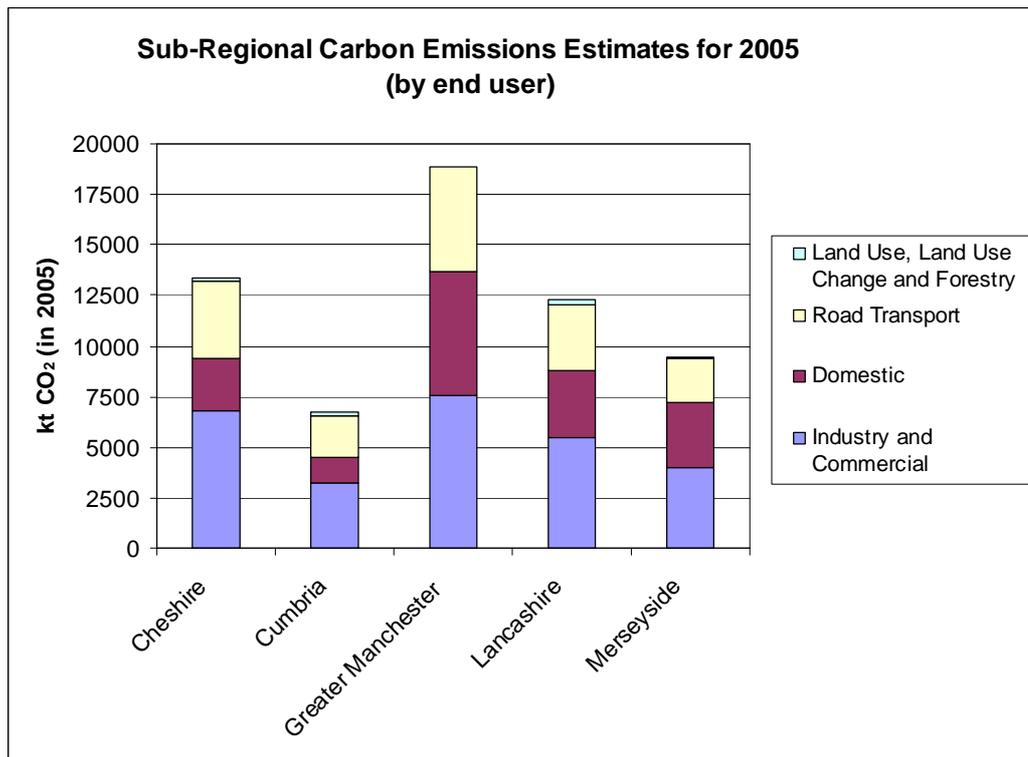
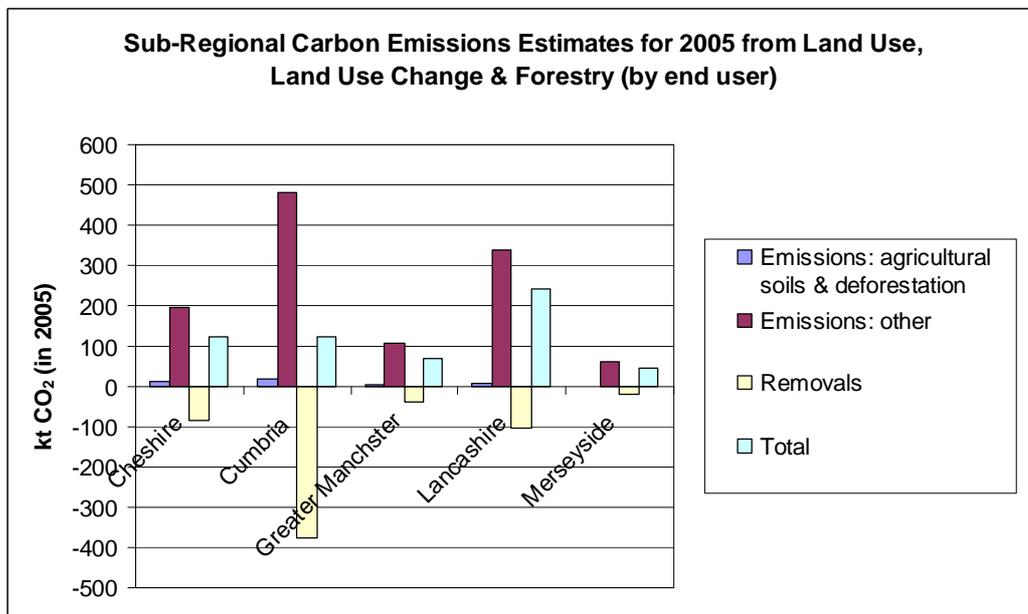
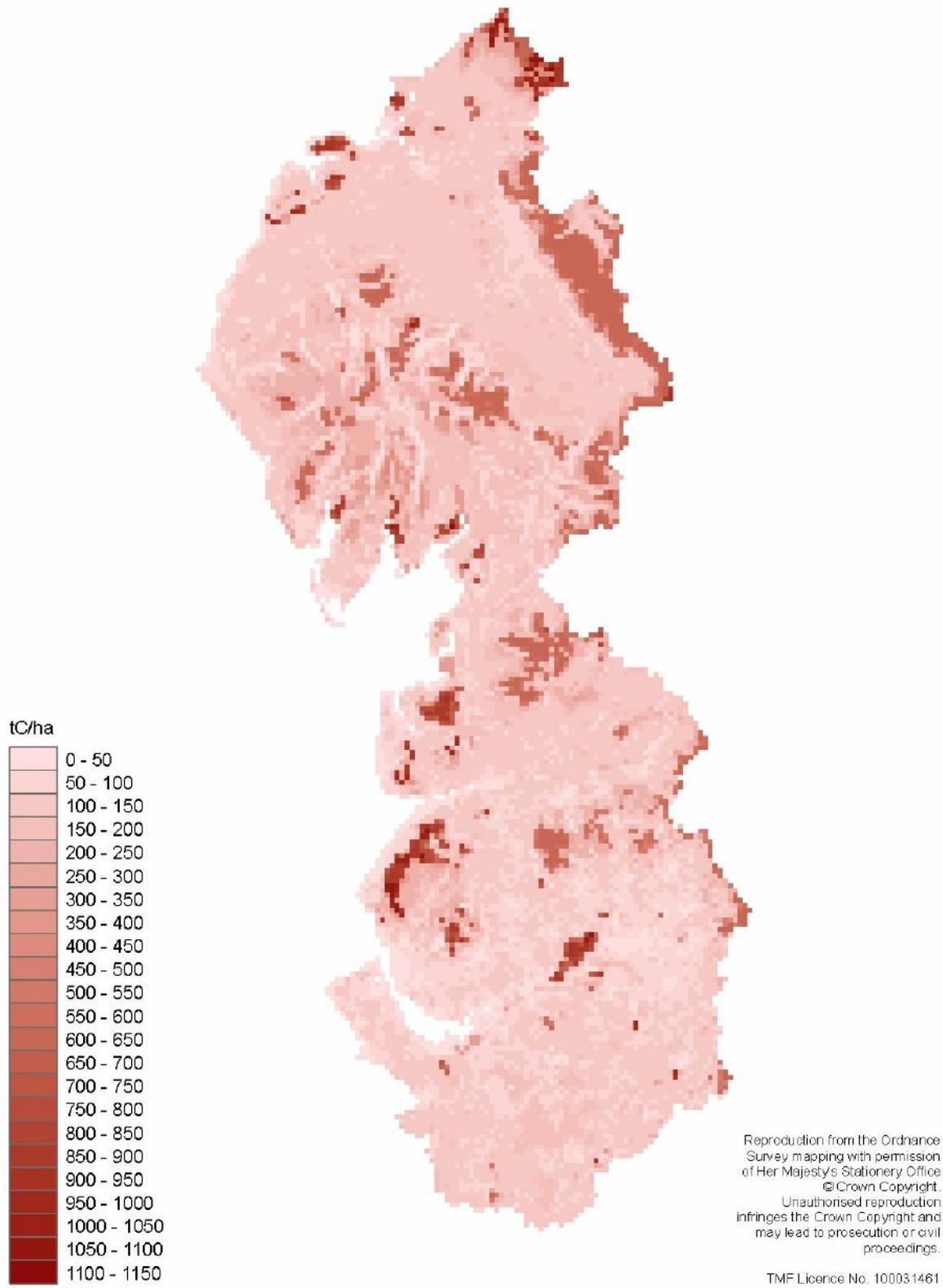


Figure 11



Carbon Density



7.10. RISK OF POOR AIR QUALITY

7.10.1. Trapping pollutants in our urban areas contributes towards the health and well being of citizens. These pollutants may be solid or gaseous. Urban air quality is monitored through Air Quality Management Zones. The air quality index from the Indices of Multiple Deprivation gives an indication of where the negative effects of air pollution may have most impact on health, well being and socio-economic outputs and outcomes.

7.10.2. While the air quality of our towns and cities has improved since the middle of the last century, there remains particulate and gaseous pollution in the air. Our society has generally been reducing the use of domestic coal fires (one of the causes of smog) and replaced it with the ever increasing use of internal combustion engines.

7.10.3. Trees are known for their ability to trap particulate pollutants (eg. PM₁₀) and gaseous toxins by reducing air flow or taking in gases through leaf stomata. The intake of CO₂ helps with the urban heat island affect and climate change issues. For urban woodlands, the greater the length of woodland edge the better for trapping pollutants, as leaf area and foliage proportion is greater. This increased surface area allows the tree to be up to three times more effective at trapping pollutants than grass areas. Individual street trees clearly have an opportunity to maximise their leaf area.

7.10.4. The ability trees have of trapping pollutants may also lead to some health benefits, particularly with the occurrence of asthma and other respiratory health issues⁷¹. Reducing health risk is a saving in not only medically based costs but also helps to increase productivity. It is important that the right species are selected, in particular for urban tree planting, to avoid species that may in certain climatic conditions produce volatile organic compounds that can increase levels of ozone.

7.10.5. While trees can trap pollutants they may also be affected through loss of sunlight and the type of airborne pollutant present. Species choice is as important in the urban setting as in the rural one, although by looking around most cities it is clear which trees serve this function effectively: sycamore, oak, beech and plane being the more resistant species.

⁷¹ jech.bmj.com/cgi/content/abstract/jech.2007.071894v1

Table 10 Actions for air quality

Action	Type
Increase woodland edge effect around and within urban areas	Enhance
Develop street tree opportunities	Enhance
Develop Community Forests and woodland initiatives to increase or at least maintain woodland cover	Enhance
Design woodland pockets within development master plans	Enhance
Allow street tree opportunities within smaller scale development proposals	Enhance

7.11. RISK OF COASTAL STORMS

7.11.1. Coastal storm protection is simply expressed as the coastal boundary with a 500m buffer. The reality is very complex with an array of habitats and landscapes that require careful management.

7.11.2. There are key conurbations and industrial areas that occur within this zone: Chester, Birkenhead, Liverpool, Southport, Blackpool, Barrow-in-Furness and Carlisle to name the larger areas. One major airport (Liverpool John Lennon Airport), two minor airports (Blackpool and Formby) and two aircraft factories (BAE Systems Harwarden and BAE Warton) occur within or close to the buffer.

7.11.3. Chemical complexes occur at Birkenhead, Ellesmere Port, Widnes and Runcorn with other major industries occurring at Liverpool, Shotton, Heysham, Sellafeld and Barrow.

7.11.4. Aside from these areas there are some of the more important designations that occur along these coastal fringes including the estuaries Solway, Morecambe Bay, Duddon Sands, Lune, Ribble, Mersey and Dee, in addition to sands and dunes at Southport, Birkdale and Ainsdale⁷⁴.

7.11.5. Owing to the dynamic nature of both weather and sea, coastal storm protection requires a wide range of skills to manage these areas. Solutions may be hard or soft engineered, some may be time critical, others may not. The management of coastal zones to enhance and retain investment and communities is becoming increasingly critical if models of global warming are proved to be correct. For these reasons the accounting for coastal storm protection is critical in coastal zones.

7.11.6. Green infrastructure can provide the soft engineering solutions such as sand dune stabilization, demarcation and safeguarding of salt marshes, and monitoring cliff erosion. Green infrastructure can also assist in the planning and design of sustainable urban drainage schemes (SUDS).

7.11.7. Cliff and sand dune environments and habitats are unlikely to be lost. However, the piecemeal claiming of salt marsh has occurred in the past for developments and agriculture. This very gradual loss of salt marsh leads to the loss of the buffering benefit that salt marshes provide.

7.11.8. The integrated approach of the Sefton Coast Partnership to the management of the coast provides an example of what can be achieved by a wide range of organisations working together. Similarly joint work between Lancashire Wildlife Trust Fylde Borough Council, the Botanical Society of the British Isles, Blackpool Borough Council, Lancashire Country Council and Natural England is looking to restore dune functionality as far as is practicable and may provide a further model the region.

7.11.9. To date coastal storm protection has been an area of little study in relation to green infrastructure. Future work is needed (and is underway) to bring this key issue up to the same level of integration with green infrastructure thinking as other functions.

⁷⁴ The North West has the longest length of coast in England with important dune systems at the mouth of the Duddon Estuary (including Sandscale Haws and Haverigg Dunes), Drigg Estuary (Ravenglass and Eskmeals Dunes) and between Silloth and Maryport.

Table 11 Actions for coastal storms

Action	Type
Carry out dune protection through partnership working to increase the functionality of the dune systems	Enhance
Ensure no loss of salt marsh through agriculture and development	Safeguard
Create braided river channels or other opportunities for flood areas	Enhance
Encourage appropriately stocked grazing to allow sward and therefore salt marsh integrity	Enhance

7.12. RISK OF POOR TOURISM, RECREATION, CULTURE & HERITAGE

7.12.1. Tourism, recreation, culture and heritage (TRCH) is a group of functions that bring architecture and the environment alive in people’s minds. The assets, both qualitative and quantitative, are difficult to map but they are important within the planner’s or investor’s mind. TRCH is also a largely subjective matter.

7.12.2. The pinch issue can be overcome by ensuring that resources for recreation are provided close to where the new investments, particularly for housing and business are being made.

7.12.3. High quality green infrastructure can also provide an attractive backdrop to key tourism destinations, providing additional places to visit and increasing the overall quality of the tourism offer. The NENW programme has a specific strand of activity that focuses on developing natural tourism⁷⁶. Planning for these resources at a regional and sub-regional level can help improve quality of life and provide a more attractive offer for new investment.

7.12.4. Culture and heritage also have a key role to play in creating sense of place and local distinctiveness and can add value to the quality of investment in green infrastructure by providing a framework for appropriate types of intervention, to guide the development of the implementation plan.

⁷⁶ www.naturaleconomynorthwest.com

7.12.5. There is a clear link between poor quality environment and deprivation. There is a role for green infrastructure planning and implementation to help to overcome the disparities in an area in terms of environmental quality.

7.12.6. In 1997 the spending value of tourism to North West England was estimated at £994 million, approximately 9% of spending for all English regions⁷⁷.

7.12.7. Green infrastructure allows TRCH assets to be enhanced or protected by providing places to relax, reflect, learn and enjoy. Well planned urban landscapes and environmentally considered design can build new or bring new meaning to TRCH assets.

7.12.8. Tourism is an important part of the regional economy and the safeguarding of this resource can help to attract investment and possibly open up new opportunities where previously not possible.

Table 12 Actions for tourism, recreation, culture & heritage

Action	Type
Ensure that assessment of landscape and cultural heritage have been factored into the development of priorities for the green infrastructure plan	Safeguard/enhance
Promote good design in areas that have a TRCH asset	Enhance
Use environmental space such as street trees, pocket parks to safeguard assets or build new interest or interpretation	Safeguard/enhance
Manage water courses and water features as part of the infrastructure that can enhance and safeguard areas of TRCH interest	Safeguard/enhance
Allow green infrastructure to be interpreted as appropriate to build understanding of TRCH assets	Safeguard

⁷⁷ www.defra.gov.uk/ERDP/docs/nwchapter/section14/NW148.htm

7.13. RISK OF SOIL EROSION

7.13.1. Climate change could increase soil erosion through increased precipitation events. Land cover and management can help to reduce soil erosion. Therefore agriculture has the potential to have a positive and/or negative impact on soil erosion. In high quality agricultural areas it is important to protect the soils.

7.13.2. Map 16 shows the soil erosion risk across the North West. Soil erosion risk here combines soil erodability (taking into account soil texture and slope), soil erosivity (taking into account precipitation and temperature), and land cover vulnerability⁷⁸.

7.13.3. It is apparent that the Lake District, as well as other upland areas, have a high or very high soil erosion risk. Lowland areas tend to have a lower risk. The main high quality agricultural areas with a very high or high soil erosion risk are in West Lancashire, Fylde and Wyre in Lancashire, and Salford in Greater Manchester.

7.13.4. This suggests the need to ensure that agricultural practices in these areas reduce soil erosion risk.

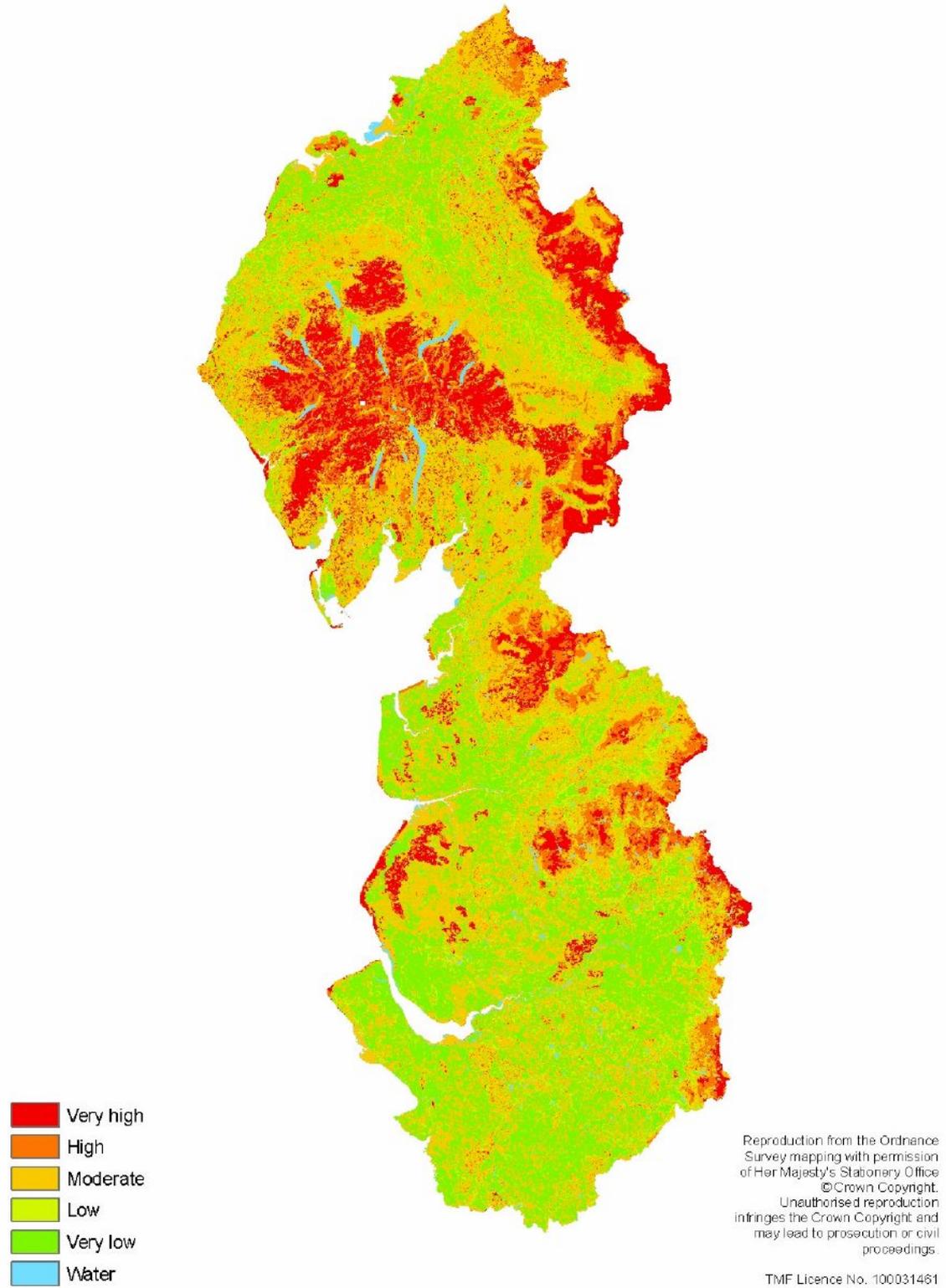
7.13.5. The predecessor to this study, 'Critical Climate Change Functions of Green Infrastructure for Sustainable Economic Development in the North West', provides more detail on this function of green infrastructure, especially as it relates to climate change.

Table 13 Actions for soil erosion

Action	Type
Encourage agricultural practices to reduce soil erosion, particularly where there is a high or very high risk	Safeguard
In other areas where there is a high or very high risk of soil erosion use land cover change and management techniques to reduce the risk	Enhance

⁷⁸ Cavan, G., Handley, J. and Lindley, S. Climate change, tourism and landscape impacts: a regional analysis. Presentation.

Soil Erosion Risk



7.14. RISK OF POOR AESTHETIC

7.14.1. Creating or maintaining attractive places to live, work and visit is not an optional extra. High quality surroundings, including green infrastructure within or in close proximity to areas of investment will safeguard and enhance the investment. In particular CABE⁸¹, have carried out extensive research providing clear evidence of the value of green infrastructure underpinning the value of investments.

7.14.2. Allowing development without adequate investment in the green infrastructure can often mean that other agencies have to intervene at a later date to overcome some of the issues and try to improve the green infrastructure provision by retro-fitting as higher cost than if it were designed into the development.

7.14.3. Defining aesthetics is clearly a subjective and personal matter. However, for the purposes of this report and in the absence of better quality data, we have used the Landscape & Visual Quality Domain of the Natural Environment Index. This dataset is intended to represent the overall quality of the natural environment resource across the region, and is based on many indices which are grouped into domains. The Landscape & Visual Quality Domain correlates fairly well with common subjective assessments of aesthetic quality, but there are many anomalies due to the indices and parcel system used. For example, the Strand 1 area of search near Speke is subject to surprisingly little aesthetic pinch according to this mapping method. This is partly because the area of search is coastal and is focused on the airport rather than the centre of the suburb, but also partly because the dataset is not a very good proxy for the true pinch.

7.14.4. Aesthetics in pinch point areas should be assessed and safeguarded or enhanced. Methods to judge any enhancement may include house valuation which may be a sound approach but does not incorporate the integrative function of individual perception of place, landscape or tree-scape. The importance of a good neighbourhood and landscape seem to be key in house purchasing decisions, along with other considerations such as employment, services and house attributes as just some amongst many variables⁸². Green infrastructure cannot influence all of the factors but can contribute towards the sense of aesthetic in services provided and the sense of landscape at varying levels.

7.14.5. Sense of scale, diversity and continuity, visual accessibility and coherence are important to citizens in subjectively valuing visual aspects of urban semi-natural habitats⁸³. Construction of the built environment should also add to the aesthetic and this is included within Regional Economic Strategy action 120.

7.14.6. The role of townscape and landscape character assessments as part of the initial development of green infrastructure priorities is crucial.

Table 14 Actions for aesthetic

Action	Type
Integrate green infrastructure into design and ensure that design takes into account landscape character if appropriate, or that the green infrastructure elements of the design are appropriate for the site and enable other functionality	Enhance
Target gateways and key transport corridors as well as civic areas and improve quality of green infrastructure as part of the public realm	Enhance
Work with CABE, English Heritage, HMR initiatives and Sustainable Development Commission to achieve good design	Enhance
Ensure local authorities integrate green infrastructure into development proposals	Enhance

7.15. RISK OF LITTLE GREEN TRAVEL

7.15.1. Reducing the need to travel by car will help to decrease the amount of CO₂ emitted. There are two main mechanisms through which green infrastructure can reduce the need to travel by car: by providing high quality local recreation areas, and by providing green walking and cycling routes for both recreation and daily commuting.

7.15.2. Here we have used open access land, open access woodlands, and Sustrans cycling routes, as a proxy for local recreation areas. We have not in this instance mapped green walking and cycling routes in relation to daily commuting. Whilst this issue needs to be highlighted at a regional level, it may be best dealt with at a local to city/sub-regional level, using locally available datasets. It is likely that local authorities will have better datasets on recreation, walking and cycling opportunities (and how these link to residential and employment neighbourhoods) in their areas.

7.15.3. Map 17 shows open access land near to urban areas in the North West.

7.15.4. In the North West there are 363,266 ha of open access land⁸⁴, of which 79,117 ha (21.8% of the North West total) is within 5 km of urban areas and 134,649 ha (37.1% of the North West total) is within 10 km of urban areas. This means that the majority of the resource, located primarily in Cumbria, is not that near to the urban areas.

7.15.5. As new development takes place and areas are redeveloped there is a need to preserve open access land as well as taking the opportunities to provide high quality local recreation areas. Local green routes for walking and cycling, thereby reducing the need to travel by car on a daily basis, have not been mapped here. However, it is important that this is included in plans and as development and restructuring takes place.

7.15.6. Whilst a lot of the National Parks and Areas of Outstanding Natural Beauty are covered by open access land providing significant tourism and recreation opportunities, there may be a need to improve access in some of the other areas of tourism significance. This mapping would need to be repeated using more localised datasets in order to determine the access in these areas.

7.15.7. Additional open access land becoming available on the coast if the Marine & Coastal Access Bill, currently before Parliament, is enacted.

7.15.8. The predecessor to this study, 'Critical Climate Change Functions of Green Infrastructure for Sustainable Economic Development in the North West', provides more detail on this function of green infrastructure, especially as it relates to climate change.

Table 15 Actions for green travel

Action	Type
Protect and create high quality network of recreation areas and local walking and cycling routes (for recreation and commuting) in and near to urban areas	Safeguard
Protect and create local walking and cycling routes (for recreation and commuting) connecting services within rural areas, as well as rural to urban areas	Enhance
Highlight this as an issue to be addressed in local, city/sub-regional transport and statutory rights of way plans	Safeguard

Open Access Land Near Urban Areas



7.16. RISK OF NOISE

7.16.1. With a vibrant economy, increasing population density and the squeeze on land resource there has been an inevitable increase in noise and this has been well researched. Controls have come in to place for machinery and vehicles over a number of years.

7.16.2. Defra describe neighbourhood noise as all industrial and commercial activity along with public, recreation and entertainment noise, but exclude transport noise. Transport noise is discussed in this document⁸⁵. EC Directive (2002/49/EC)⁸⁷, the Environmental Noise Directive, does consider transport noise along with industrial sources.

7.16.3. Under the Environmental Protection Act 1990 local authorities are required to monitor and act on unreasonable noise levels. This has worked towards reducing noise levels in many of our urban areas, although most legislation is European led and is focused not in built or green environmental design but on the noise source itself. Nevertheless the use of trees and green screens are effective. One company in the UK has developed acoustic and non-acoustic green barriers, using living interwoven willow to achieve the sound attenuation in urban areas⁸⁸. Acoustic green barriers achieve the highest categories for CEN Standards EN-1793-1 and EN-1793-2, both relating to road traffic noise⁹⁰.

7.16.4. In North West England there are areas of considerable tranquility, but the main towns and cities centres have heightened noise level with peaks of noise forming corridors along transport corridors, especially the motorways and major A roads. The major airports also produce noise levels that may extend well beyond the vicinity.

Table 16 Actions for noise

Action	Type
Promote green noise barriers and other noise shelter planting in high noise areas	Enhance
Protect existing green infrastructure that can play a role in reducing noise or perception of noise	Safeguard
Add street trees to urban settings to further dampen noise levels	Enhance

8. FURTHER OPPORTUNITIES FOR SUSTAINABLE DEVELOPMENT

8.1. The following sub-sections identify additional functionality that needs to be considered in areas of investments and growth. They provide additional benefits, in particular around areas of energy efficiency and developing a low carbon economy.

8.2. FOOD PRODUCTION

8.2.1. Food production in proximity to markets can help to reduce ‘food miles’, thereby helping to decrease the amount of CO₂ emitted as a result of the transportation of food. Grade 1 and 2 agricultural land is the highest quality land and is the most versatile in terms of food production.

8.2.2. The key issue of food production close to where people live and work is highlighted in the RS 2010 Principles and Issues paper⁹²: “...a strong agricultural and forestry sector could help to protect our landscape and could offer other benefits such as food security, reduced food miles and improved health from fresher food...”

8.2.3. Map 18 shows agricultural land in the North West in relation to urban areas.

8.2.4. In the North West there are 29,109 ha of grade 1 agricultural land and 73,791 ha of grade 2 agricultural land. Most of this is close to urban areas, especially in West Lancashire, Fylde, Salford, Trafford, Warrington, St Helens and Knowsley. 85% of grade 1 land in the North West is within 5 km of urban areas, whilst all of it is within 10 km; 59% and 88% of grade 2 land is within 5 km and 10 km of urban areas, respectively. Within 10 km of urban areas there are also 349,444 ha, 149,148 ha and 102,741 ha of grade 3, 4, and 5 land, respectively.

8.2.5. It is important to avoid new development on this high quality land. However, there is also a significant resource in terms of local food supply to be tapped into, making these potentially attractive and sustainable places to live.

8.2.6. It should be noted that the agricultural land classification does not pick up the quality of urban and urban-fringe soils. These could potentially be very productive, as older settlements were often at the centre of good farmland. They are also subject to planning policies and development pressures leading to their cumulative loss.

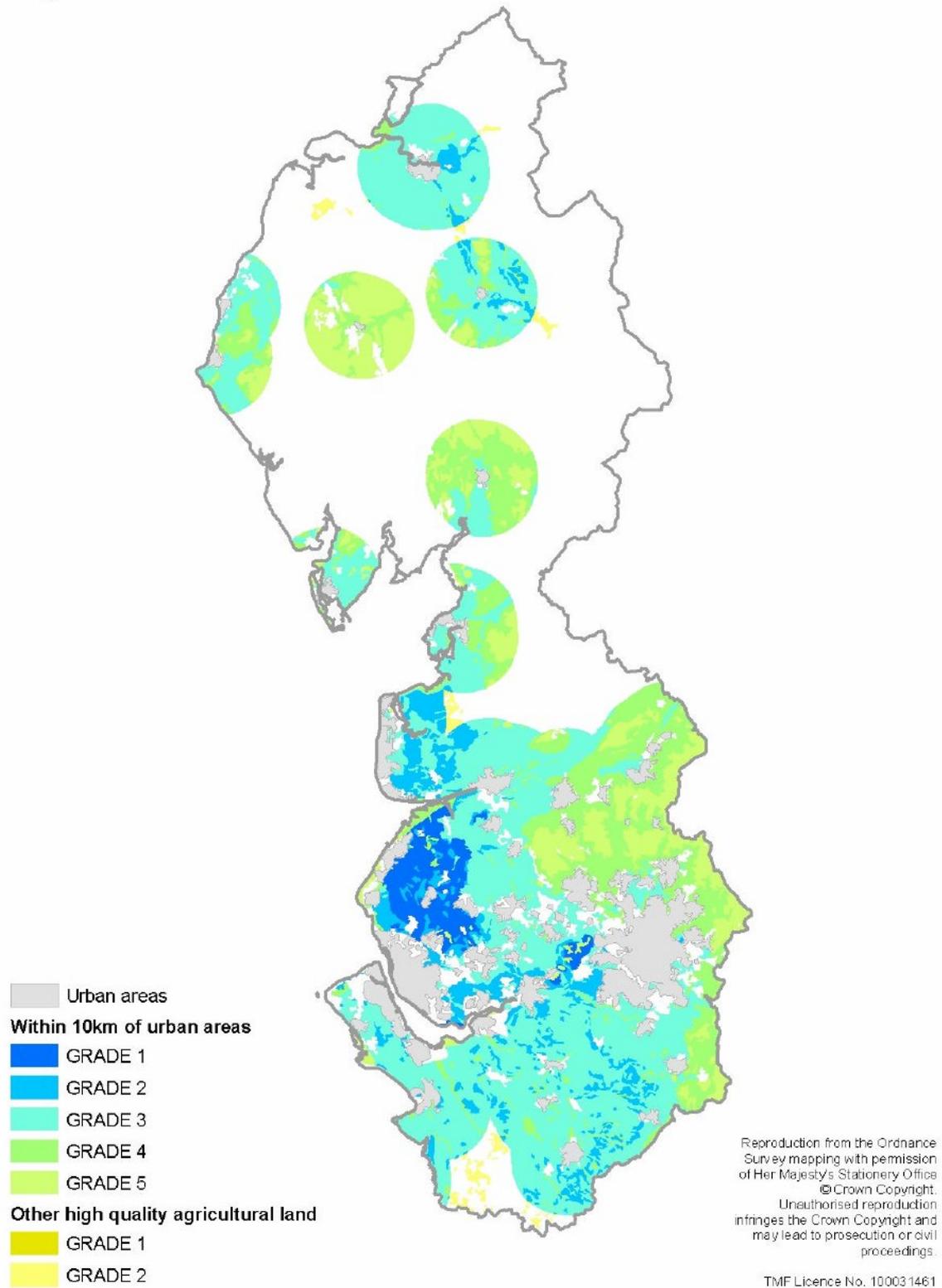
8.2.7. Many of the areas of high grade agricultural land is “reclaimed” land that may require significant input to maintain productivity. There will be decisions to be made about how land can be managed so as to satisfy the basic needs for food whilst also seeking to reduce CO₂ emissions and safeguarding the soil resource.

8.2.8. The predecessor to this study, ‘Critical Climate Change Functions of Green Infrastructure for Sustainable Economic Development in the North West’, provides more detail on this function of green infrastructure, especially as it relates to climate change.

Table 17 Actions for food production

Action	Type
Protect highest quality agricultural land from development and restructuring	Safeguard
Enhance quality of grade 3 land, particularly where it is in proximity to markets	Enhance
Link agricultural land to local markets, including in development and restructuring areas	Enhance
Promote agricultural practices which reduce greenhouse gas emissions and soil erosion (e.g. organic, low tillage, etc)	Enhance

Agricultural Land Near Urban Areas



8.3. REDUCING VISITOR PRESSURE ON VULNERABLE LANDSCAPES

8.3.1. A report on 'Climate Change and the Visitor Economy'⁹⁵ found that the relationship between climate and visitor demand is complicated. However, warmer drier summers and an extended season in the UK, combined with a decline in the popularity of Mediterranean locations and increasingly hot conditions in urban areas, could stimulate a boom in visitor numbers for outdoor based recreation, with a focus around water based activities. Some landscapes, such as the rural uplands, will be vulnerable both to climate change itself, as well as to the increased visitor pressure placed on them. Careful management of the adverse effects on valuable landscapes will be needed to avoid tensions between sustaining their integrity and continuing to allow recreational opportunities.

8.3.2. Map 19 shows the landscape capacity across the region. Landscape capacity⁹⁶ here is concerned with the ability to accommodate use by walkers⁹⁷ (as a proxy for increased visitor pressure). It combines:

- Landscape character sensitivity – using soil erosion vulnerability, which in turn combines soil erodability (taking into account soil texture and slope), soil erosivity (taking into account precipitation and temperature), and land cover vulnerability
- Visual sensitivity – using tranquillity
- Landscape value – using designated sites.

8.3.3. By creating more robust areas for visitors and looking to avoid putting pressure on vulnerable landscapes, green infrastructure planning and implementation can provide for more visitors and tourists, whilst not damaging key green infrastructure that is providing a wide range of other benefits.

8.3.4. Much of the National Parks and Areas of Outstanding Natural Beauty have a low or very low landscape capacity. Areas with a higher landscape capacity include the urban areas of Blackpool, Carlisle, Chester, Lancaster, Liverpool and Manchester.

8.3.5. The Regional Parks tend to include areas with a higher landscape capacity, yet there are significant areas of lower landscape capacity in parts of East Lancashire, Ribble Coast and Wetlands, Morecambe Bay and Duddon, and the West Cumbria Energy Coast, as well as along the Northwest Coastal Trail.

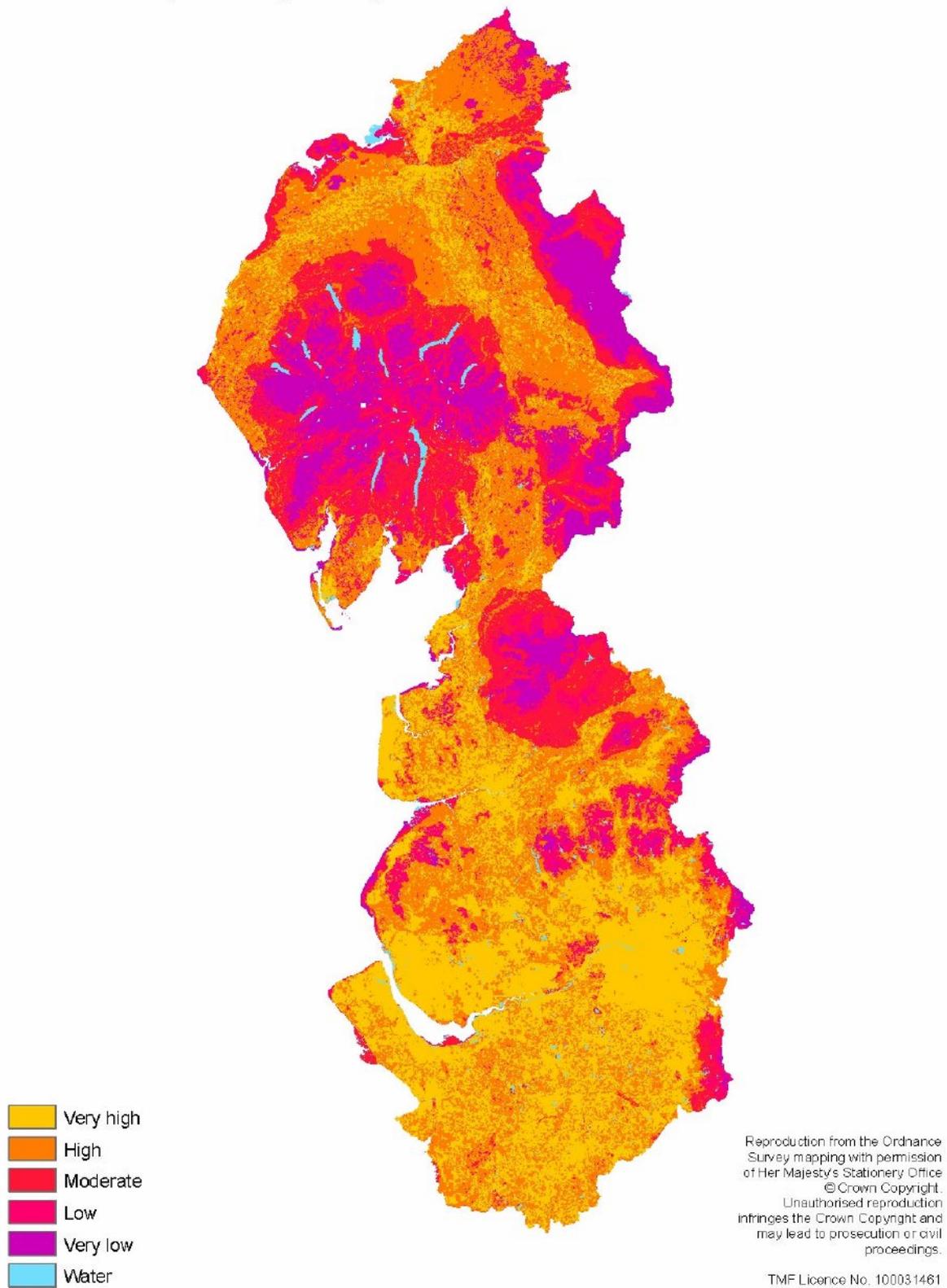
8.3.6. This suggests that visitor pressure will need to be very carefully managed in the National Parks and Areas of Outstanding Natural Beauty, and especially where these correspond to high urban populations. In creating the tourism resource as part of the Regional Parks, attention should be paid to the landscape capacity.

8.3.7. The predecessor to this study, 'Critical Climate Change Functions of Green Infrastructure for Sustainable Economic Development in the North West', provides more detail on this function of green infrastructure, especially as it relates to climate change.

Table 18 Actions for reducing visitor pressure on vulnerable landscapes

Action	Type
Manage visitor pressure in lower capacity areas – eg. maintain footpaths, change to less vulnerable land cover such as woodland (where appropriate), etc	Safeguard
Create tourism resources in high capacity landscapes, particularly near to urban areas, to divert pressure from lower capacity landscapes	Enhance

Landscape Capacity



8.4. BIOMASS ENERGY

8.4.1. The North West has a history of industry that has attracted a large workforce demanding dwellings. These two aspects combine to create a high energy demand, particularly throughout the Mersey Belt and Central Lancashire. The North West is also well placed with the supply of biomass from a number of sources including arboriculture arisings, forest residues, post-consumerism wood by-products and purposefully grown biomass crops. The biomass potential in the North West should be recognized as a low carbon source of energy, as it is not carbon neutral owing to the processing and transport involved.

8.4.2. The six major processing industries, chemicals, textiles, paper and board, food and drink consume around 13,000 GWh/year, the equivalent of the total annual energy consumption for Manchester⁹⁸. A switch from fossil to biofuels would contribute towards managing climate change given that oil achieves 0.25 Kg CO₂ per kWh while biomass is 0.025 Kg CO₂ per kWh¹⁰⁰.

8.4.3. For the transport sector Government has established the Renewable Transport Fuel Obligations (RTFO)¹⁰², that seek to reduce carbon emissions from transport by 0.7-0.8 million tones by 2010, largely through the increased supply of biodiesels.

8.4.4. Aside from transport, biofuels for homes and business provide opportunities for sustainability and landscape improvement. Woodfuel and energy crops can provide alternative agricultural enterprises, enhanced landscape and habitats. The North West is thought to be a good location for energy crops owing to climate. However constraints are common including the value, margin and need for agricultural land, restrictive designations, urban extent and upland areas.

8.4.5. Careful planning of biomass production and usage has supporting infrastructure to allow this sector to develop.

8.4.6. It is estimated that there is a resource of 25,000 ODT/yr of timber in the North West from existing woodland sources that is capable of providing over 80 GWh of energy. Under management of woodlands and a poorly developed supply chain means that this sustainable resource is not being utilised effectively.

8.4.7. In addition where it is appropriate in terms of landscape and biodiversity, the conversion of high forest to coppice may also provide a source of renewable

energy, particularly suited to off grid gas locations. A study looking at this issue is currently underway in Cheshire.

Table 19 Actions for biomass

Action	Type
Integrate biomass energy as a consideration for planners and developers	Enhance
Ensure that planners and developers are aware of the support mechanisms (Envirolink, Biomass Energy Centre and the planning portal where developers can utilise resources such as “Approved Document J - Combustion Appliances and Fuel Storage Systems”)	Enhance
Encourage biomass planting where there are no other constraints	Enhance
Use biomass as a contribution to local authority carbon targets	Enhance
Ensure grants are fully utilised ¹⁰⁴	Enhance

9. POLICY AND PINCHES

9.1. The NENW study “Developing an Outline Strategy for Linking Grey and Green Infrastructure” cited previously provides a comprehensive assessment of how policy reinforces and supports the need to act on the types of pinch described throughout this document.

9.2. Appendix 1 also provides a comprehensive list of policy that supports a green infrastructure approach

9.3. There is a clear policy framework that requires action to be taken to overcome issues such as flood risk, poor air quality etc, all identified as pinch issues. Whilst the policy may not stipulate that a green infrastructure approach has to be taken, it is clear that a grey/green infrastructure approach should be considered.

9.4. The RCEP study states “...if we are to respond to the environmental and social challenges that our urban ecosystems face, while avoiding the short-term solutions of the past, then we contend that the most urgent need is for integrated policies that take as long-term a view as possible and build in flexibility.”

9.5. Green infrastructure planning can help deliver sustainable long term and cost effective solutions that integrate activity and provide robust multifunctionality to tackle the pinches that have been identified in this study.

10. IDENTIFICATION OF EMERGING STORYLINES FOR EACH SUB-REGION

10.1. The information gathered in this study can present a complex picture of risks from pinches and opportunities for green infrastructure interventions.

10.2. At a regional level this study has identified that each sub-region has a distinct 'signature' in terms of the range and extent of the pinches that exist. Figures 12-16 below set these out and each is discussed in more detail below within the individual sub-regional storylines.

Figure 12 Cumbria pinch signature

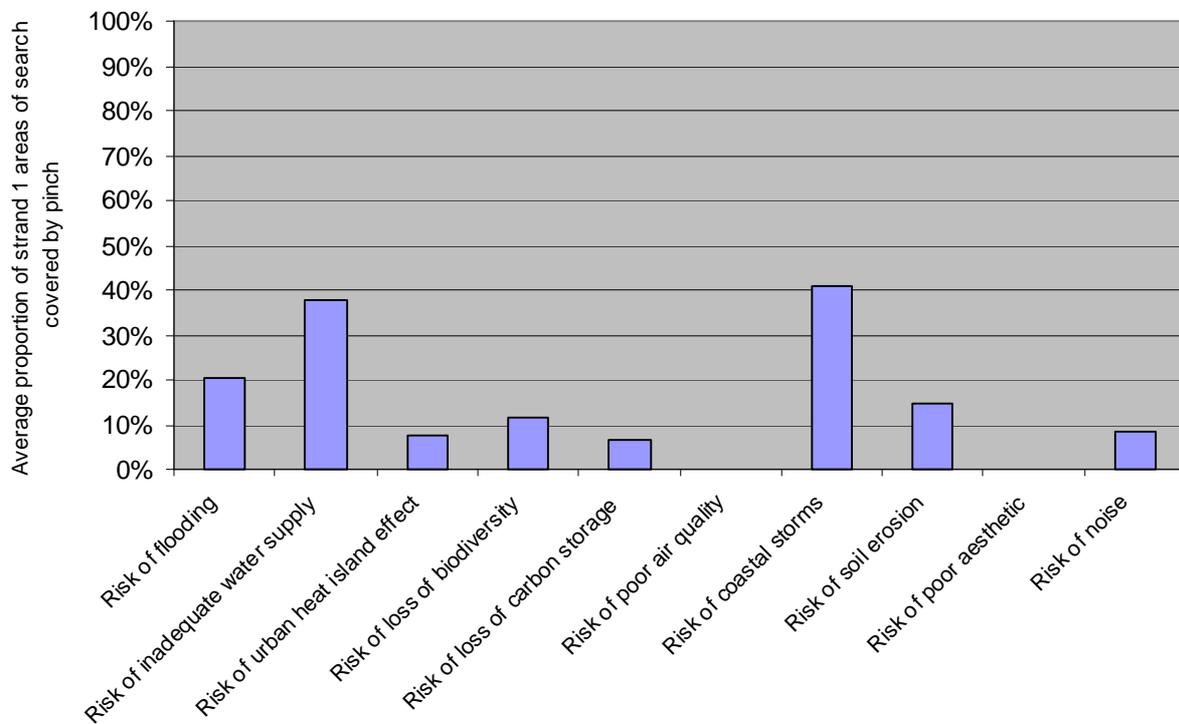


Figure 13 Lancashire pinch signature

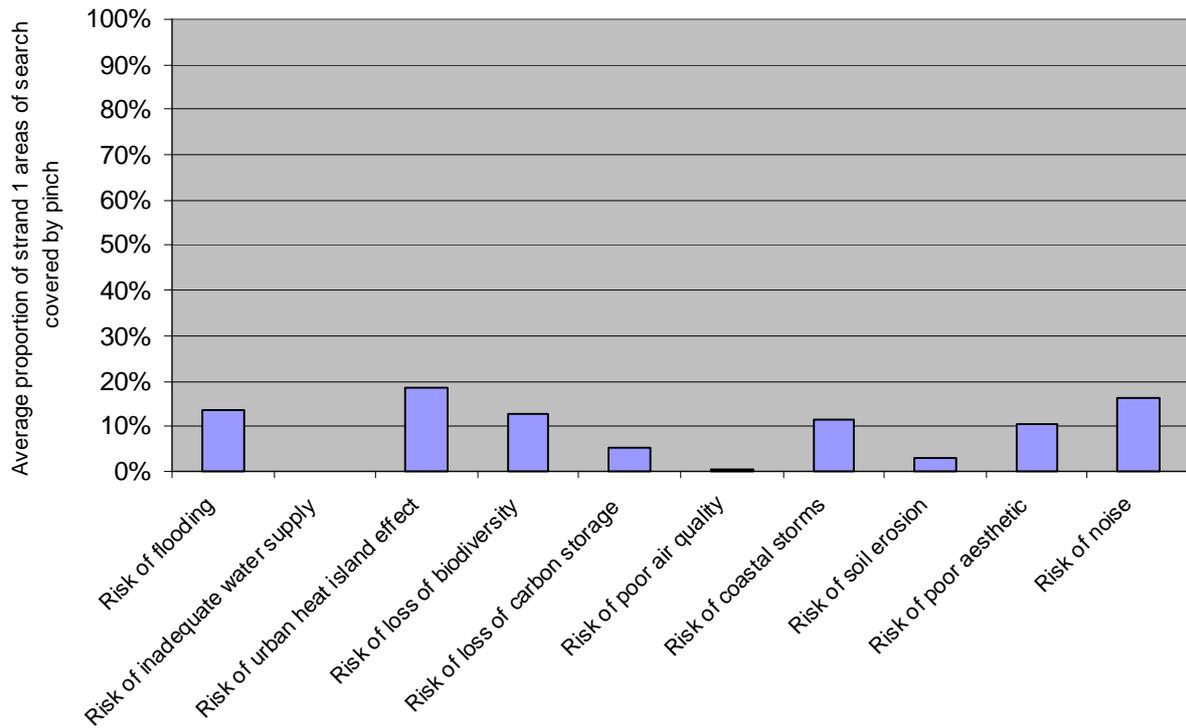


Figure 14 Greater Manchester pinch signature

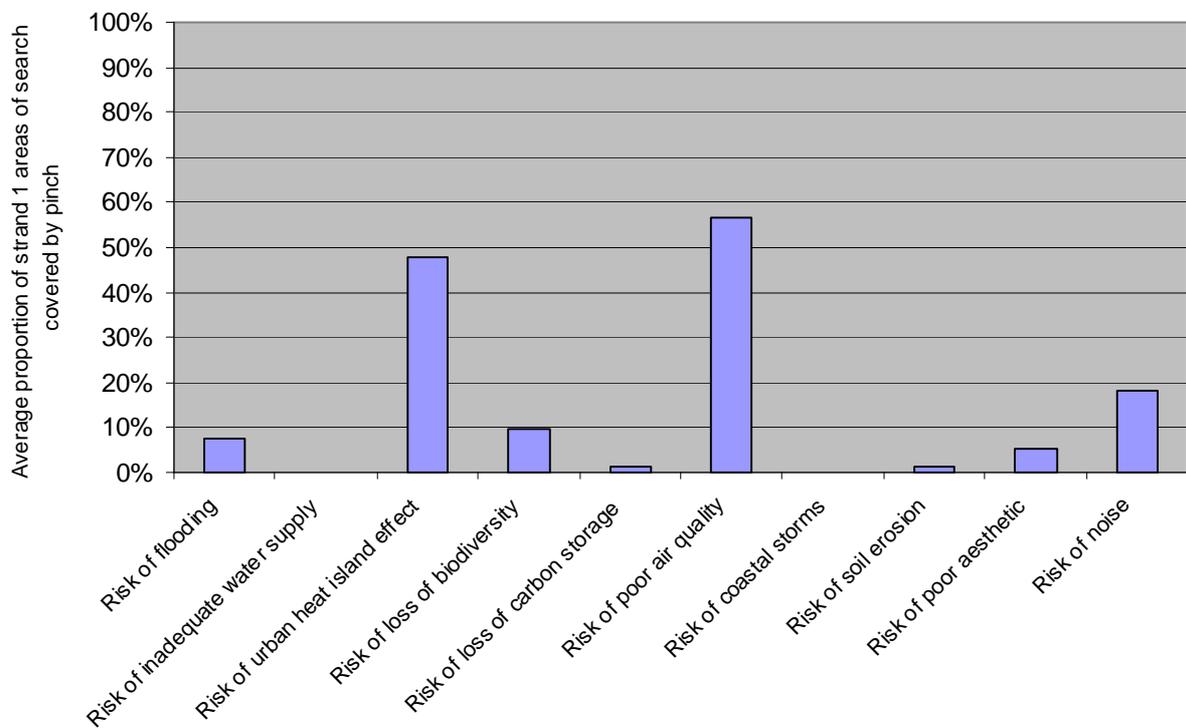


Figure 15 Merseyside pinch signature

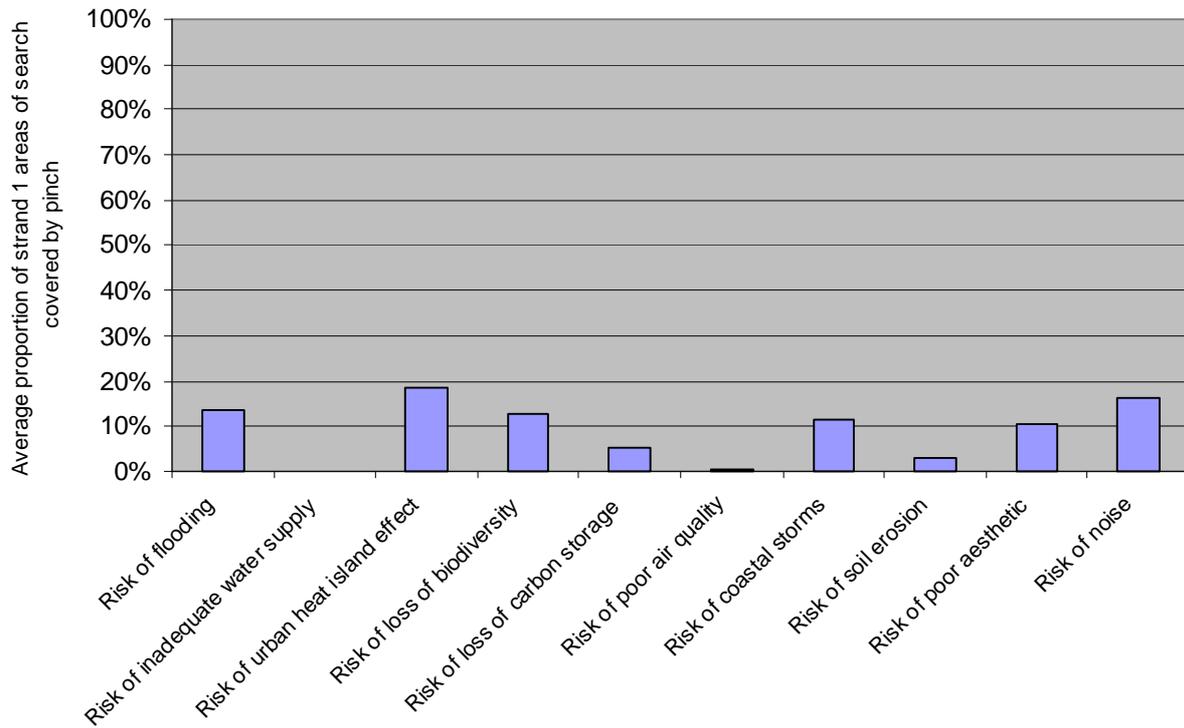
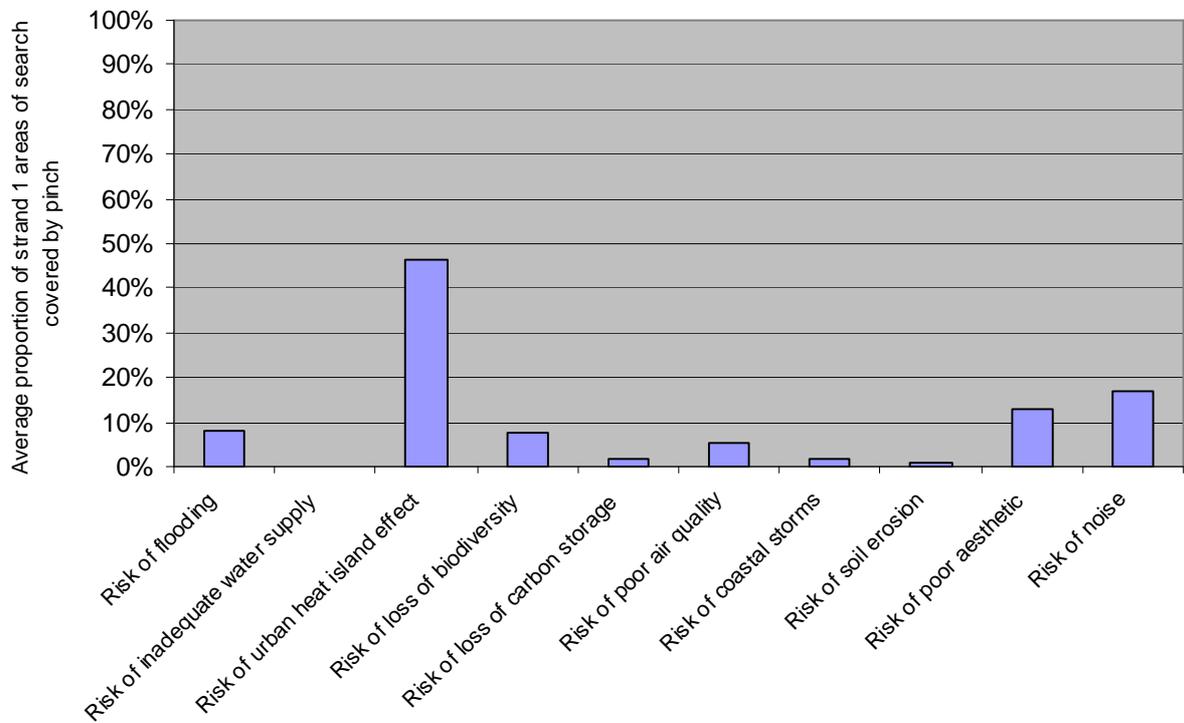
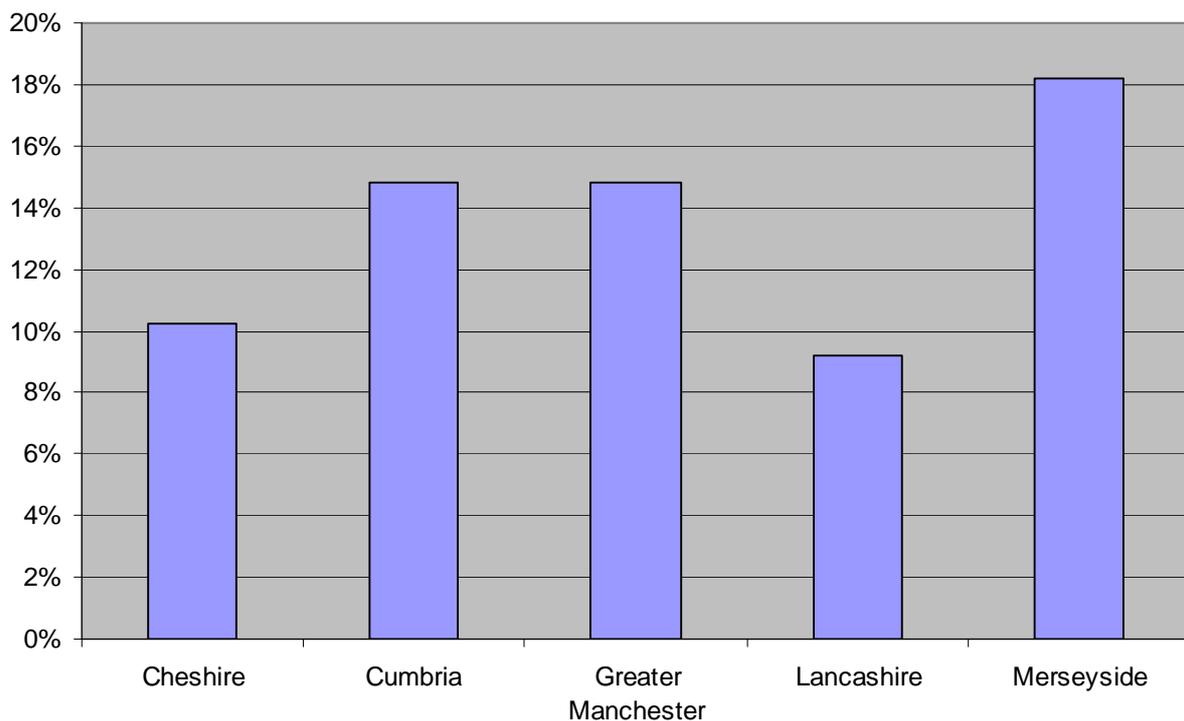


Figure 16 Cheshire pinch signature



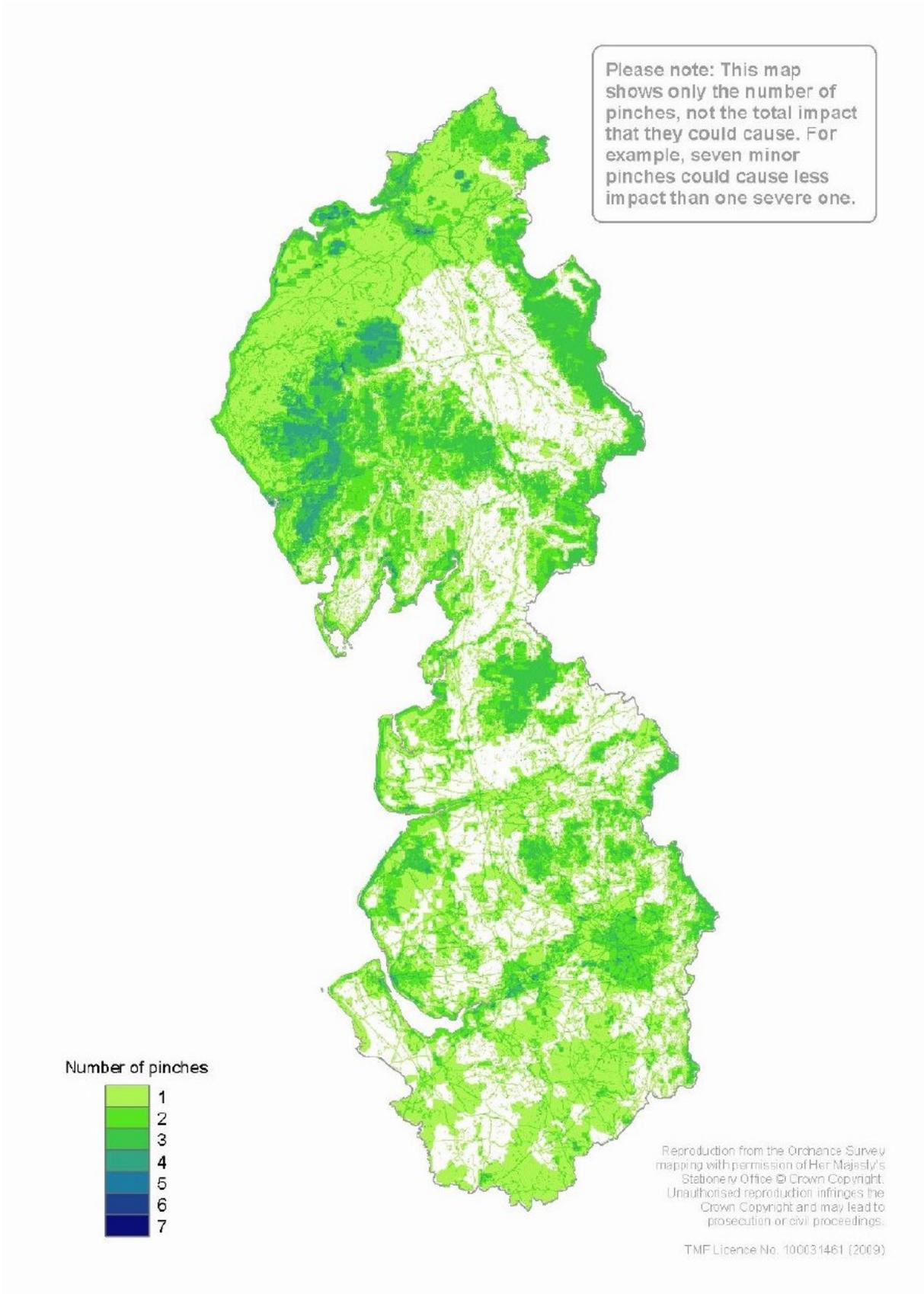
10.3. We can also assess in a somewhat crude manner the degree of pinch within each sub-region by calculating the total proportion of land in the areas of search that is subject to pinch. Figure 17 sets this out. The y-axis is a measure of the extent of coverage of the areas of search by pinch issues.

Figure 17



10.4. The range and extent of pinch can also be mapped at each pinch point to identify perhaps where most work is required to ensure that effective grey/green infrastructure plans are produced (map 20). The areas with few or small extent of pinch should not be ignored as even a single pinch over a small area may have significant bearing on the sustainability of a project if that is a key area for investment. There is a danger in relying on this type of data aggregation map too heavily; they should be used to understand the possible range of pinches rather than the impact or priority of the pinches in each location.

Map 20



10.5. In order to make this information as accessible as possible to the decision makers and others who will be involved in prioritizing actions we have distilled it into a series of narratives or storylines, one for each sub-region. Sub-regional partnerships are at different stages in their production of sub-regional green infrastructure plans and this work can help in the identification of key issues to address in pinch points.

10.6. The information on Strand 1 and 2 areas of search for each sub-region is laid out in a series of 'menu cards' that appear after the executive summary. These provide an at-a-glance indication of the pinches in each sub-region in terms of:

- The range of pinches - with the pinches ordered as set out in Section 4 above from high to low regional priority
- The extent of each pinch in each area, based on the percentage of an area of search for pinch that is covered by the pinch, eg. in the Cumbria sub-region 41% of the area of search around Millom is covered by the flood pinch.

10.7. For each of the five North West sub-regions and for each we answer the following questions:

- What is the range of pinches within each area of search?
 - Are there any trends within the sub-region?
 - What is the area extent of impact by the pinch in area terms?
- Potential lead organizations
- Links to existing activity, in order to embed the green infrastructure work and also maximize opportunities for joint working.

10.8. Risk of little green travel and risk of poor tourism, recreation, culture & heritage could not be mapped in an appropriate way for this study. However they will be key issues to consider at a project level.

10.9. Green travel routes can help to reduce congestion, air pollution and noise, contributing to a low carbon economy. The issue is best dealt with at the local level, but does need support in sub-regional plans.

10.10. Tourism, recreation, culture & heritage will again be a key issue for local projects, and we should learn lessons from previous investments in some new towns across the country where low provision of recreation and culture opportunities have reduced the quality of the investment, with subsequent knock on effects to the image of the area as an attractive place to live.

10.11. CUMBRIA

- 10.11.1. Seven out of the ten pinches are present in the Cumbria sub-region.
- 10.11.2. Unsurprisingly, high levels of noise and poor aesthetic are not issues. Urban heat island is also generally not an issue and it only appears at a high level (in area terms) in Carlisle.
- 10.11.3. Loss of carbon storage is generally not a pinch, but it does appear significant in three areas: Millom, Ulverston and Broughton-in-Furness.
- 10.11.4. The main pinch issues are the two types of flood risk, with large areas of coastal flood risk in seven of the eight areas of search. Broughton-in-Furness has 82% coverage of coastal flood risk. As described in Section 7 the relationship between coastal flooding and green infrastructure interventions is poorly understood at present. We need to gain better understanding if we are to play a significant and worthwhile role in developing grey/green infrastructure plans to help alleviate coastal flooding.
- 10.11.5. Fluvial flood has to be considered by investments in all but the Workington and Maryport areas of search given the extent of coverage of this pinch.
- 10.11.6. Water supply is identified as a pinch for future development in the north of the sub-region. The ECOSEG¹⁰⁵ report identified that water supply may be inadequate for a large scale development in the area.
- 10.11.7. It is worth noting that biodiversity only appears as a significant pinch (in area terms) at Windermere. It may be the case that other areas also contain significant issues, but given their extent it should be possible to avoid damage. This type of pinch issue is best assessed at local level in many cases.
- 10.11.8. Soil erosion is a moderate level pinch in the sub-region, but again around Windermere and Grasmere it covers a large proportion of the area of search.
- 10.11.9. From the sub regional economic strategy 8 key green infrastructure opportunities were identified. These are areas or projects where it is felt green infrastructure can play a key role in assisting the planned investment or development.
- 10.11.10. These opportunities include the proposals for the Derwent Forest as a regional park, Energy Coast, business parks and the possible extension of the national park to form one of the largest areas of protected landscape in Europe.

10.11.11. The flooding of Carlisle is often cited as being an issue where perhaps green infrastructure planning could have reduced the impact. One event has been well documented and reported on:

“On the night of Friday 7 / Saturday 8 January 2005, severe storms and unprecedented rainfall on already saturated ground fell across Cumbria. Over the Friday night and into Saturday, this caused extensive flooding and storm damage particularly in the Carlisle area.

The impacts of this included:

- *3 deaths*
- *1,925 homes and business flooded - to 2 metres*
- *3,000+ people homeless for up to 12 months+*
- *40,000 addresses without power*
- *3,000 jobs put at risk.*¹⁰⁶

10.11.12. However, it is unlikely that green infrastructure can play a major role in events such as this where in essence the entire system is overloaded, ie. waterlogged already, and heavy rainfall rather than infiltrating into the land will run off immediately into water courses¹⁰⁷.

10.11.13. The impact of interception due to different land uses will also play a minor role in these extreme events. The difference between the interception from trees and grassland is not sufficient to reduce the impact. But having green infrastructure in place is better than having a hard surface.

10.11.14. Engineering solutions will always be required for these extreme events to protect areas at risk of flood. Green infrastructure may play a role in these engineering solutions by providing places that can be flooded, areas of open green infrastructure that are perhaps themselves engineered to act as water basins that can be flooded when required, but for most of the time are used as leisure/recreation/biodiversity spaces. There are many examples of this type of grey/green infrastructure across the region¹⁰⁹.

10.11.15. Green infrastructure can play a role in reducing the impacts of less extreme events as the role of green infrastructure as set out in Section 7 above can be both to slow the conveyance of flood, reduce waterlogging through transpiration, intercept rain water and store water.

10.11.16. In Cumbria therefore, whilst Carlisle is the area of greatest priority for flood management, green infrastructure is unlikely to have a major role to play.

10.11.17. For the Strand 2 issues where we are unable to identify the pinch point we can identify issues that occur within the area of search.

10.11.18. Tourism and agriculture are at the heart of the Cumbria sub-regional economy and are interrelated sectors. The pinches for tourism include risk of loss of carbon storage, loss of biodiversity and soil erosion. These are all critical factors in safeguarding the quality of the tourism offer. In addition water supply in the north of the sub-region may be an issue if large scale tourist development is anticipated.

10.11.19. Pinches in the agriculture area of search include areas of risk of flood and loss of carbon storage in South Lakeland and areas identified as being at risk from soil erosion.

10.11.20. In terms of actions to overcome the pinches specific intervention plans need to be made at a local scale. Section 7 above provides detail about the types of local action that may be appropriate. Table 20 below identifies sub-regional actions that can assist either by developing cooperation on cross boundary issues or by identifying possible solutions to generic issues for the sub-region.

Table 20 Key Green Infrastructure Planning Actions in Cumbria

Pinch	Sub-regional activity	Lead body	Existing activity that could assist in delivery
Risk of flooding	Assess key green infrastructure assets and the need to manage and create new green infrastructure to reduce risk of flood. Focus on creating grey/green infrastructure plans.	Cumbria County Council, Natural England, Local Authorities, Forestry Commission, UU and EA	NW Flood Risk Plan, Surface Water Management Plans Strategic Flood Risk Plans Catchment Area Management Plans Cumbria SR Green Infrastructure Plan

Risk of inadequate water supply	Assess applicability of SCAMP ¹¹¹ type programmes in Cumbria	United Utilities, Environment Agency, Cumbria County Council	United Utilities Water Management Strategy Cumbria SR Green Infrastructure Plan
Risk of loss of biodiversity	Ensure robust protection in place for protected species in and around pinch points. Use green infrastructure planning to identify opportunities to safeguard and enhance biodiversity around new investment.	NE, FC, EA, Biodiversity Action Plan Partnerships, local sites partnership and Cumbria Strategic Partnership (LAA Indicator 197 in particular)	Sub-regional BAP Cumbria Strategic Plan Cumbria SR Green Infrastructure Plan
Risk of loss of carbon storage	Ensure robust protection for stores of carbon and effective policy in place to mitigate any loss of storage capacity	Defra	Cumbria SR Green Infrastructure Plan
Risk of coastal storms	Assess key green infrastructure assets and the need to manage and create new green infrastructure to reduce risk of flood from coastal storms. Focus on creating grey/green infrastructure plans. In particular look at the areas of interface between coastal storm flood and fluvial flood.	Defra, EA, Local Authorities, NW Coastal Forum	Integrated Coastal Management Plans, NW Coastal Strategy, Shoreline Management Plans

Strand 1

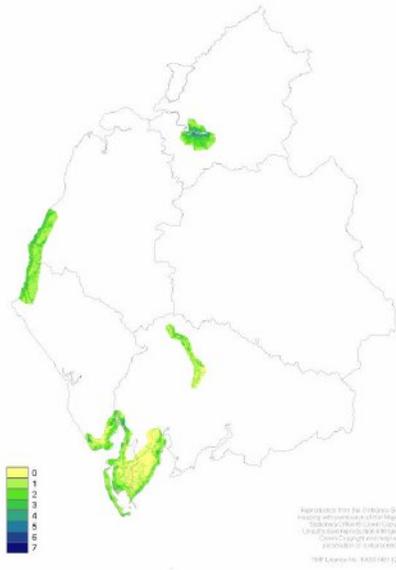
Strand 2

Growth Point Partnership Areas

Areas of Tourism Significance

Areas of High Quality Agricultural Land

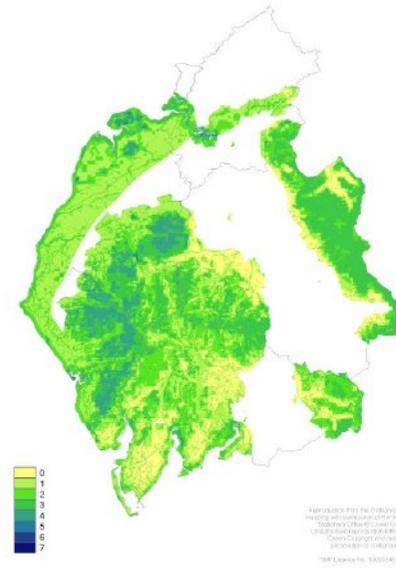
Number of Pinches (alternative)



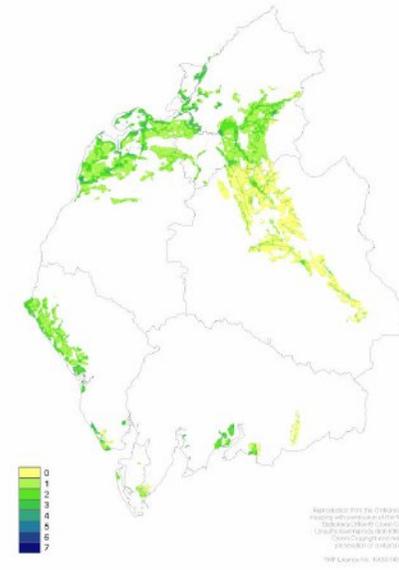
Number of Pinches (alternative)



Number of Pinches (alternative)



Number of Pinches (alternative)



10.12. LANCASHIRE

10.12.1. Nine of the ten pinches are present in Lancashire, with only water supply not present as a pinch. However, air quality is only an issue where the M6, M61 and M65 converge near Bamber Bridge.

10.12.2. Lancashire is the most varied of the sub-regions. Whilst in the other four sub-regions it is possible to identify some general patterns of pinch, Lancashire has more variety. Biodiversity, soil erosion and fluvial flood pinches are all moderate in extent in the areas of search. Urban heat island and poor aesthetic vary significantly in extent, from 0% to 55% for poor aesthetic and 75% for urban heat island.

10.12.3. Loss of carbon storage is a key issue to consider in the Simonstone area of search.

10.12.4. Lancashire has the largest number of areas of search and this may reflect Lancashire's polycentric model for its City Region proposals¹¹². The area has a number of discrete, important towns rather than one or two main centres.

10.12.5. The tourism area of search for pinches revealed potential pinches that in many ways were similar to Cumbria in that the pinches were risk to biodiversity, carbon stores and risk of soil erosion. As with Cumbria, this indicates that green infrastructure has a role to play in safeguarding functionality that can be seen to be the basis of tourism development.

10.12.6. From the sub regional economic strategy 7 key green infrastructure opportunities were identified. These are areas or projects where it is felt green infrastructure can play a key role in assisting the planned investment or development.

10.12.7. These opportunities include the proposed new growth points as well as the regional parks. Blackpool UDC have also indicated that they see green infrastructure playing a key role in the continued improvement being made in that area to increase the attractiveness for tourism.

10.12.8. In terms of agriculture issues of flood again arise as well as risk of loss of biodiversity.

10.12.9. The Lancashire growth points face pinch issues around risk of flood and risk of loss of carbon storage in the South Ribble and Blackburn and Darwen Growth Point Partnership Areas.

Table 21 Key Green Infrastructure Planning Actions in Lancashire

Pinch	Sub-regional activity	Lead body	Existing activity that could assist in delivery
Risk of flooding	Assess green infrastructure assets and the need to manage and create new green infrastructure to reduce risk of flood. Focus on creating grey/green infrastructure plans.	Lancashire County Council, Natural England, Local Authorities, Forestry Commission, UU and EA	Lancashire SR Green Infrastructure Plan Surface Water Management Plans Strategic Flood Risk Plans Catchment Area Management Plans
Risk of urban heat island effect	Assess areas of greatest impact, based on likely future development and presence of vulnerable communities	LAs, link to LAA 188 - Adaptation to Climate Change	Climate Change Strategies Lancashire SR Green Infrastructure Plan

Risk of loss of biodiversity	Ensure robust protection in place for protected species in and around pinch points. Use green infrastructure planning to identify opportunities to safeguard and enhance biodiversity around new investment. Prudent use of RDPE to improve land management practices.	NE, FC, EA, Biodiversity Action Plan Partnerships	Sub-regional BAP
Risk of loss of carbon storage	Ensure robust protection for stores of carbon and effective policy in place to mitigate any loss of store	LAs, link to LAA 188 - Adaptation to Climate Change LWT	Lancashire SR Green Infrastructure Plan Climate Change Strategies
Risk of coastal storms	Assess key green infrastructure assets and the need to manage and create new green infrastructure to reduce risk of flood from coastal storms. Focus on creating grey/green infrastructure plans. In particular look at the areas of interface between coastal storm flood and fluvial flood.	Defra, EA, Local Authorities, NW Coastal Forum	Integrated Coastal Management Plans, NW Coastal Strategy, Shoreline Management Plans

Strand 1

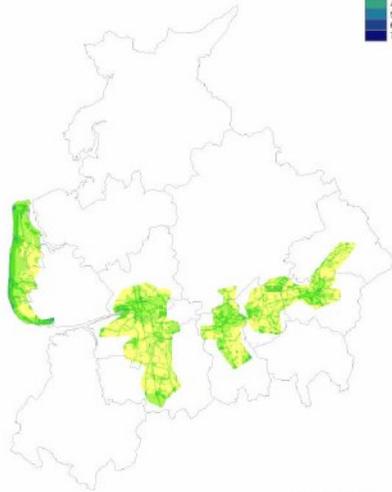
Strand 2

Growth Point Partnership Areas

Areas of Tourism Significance

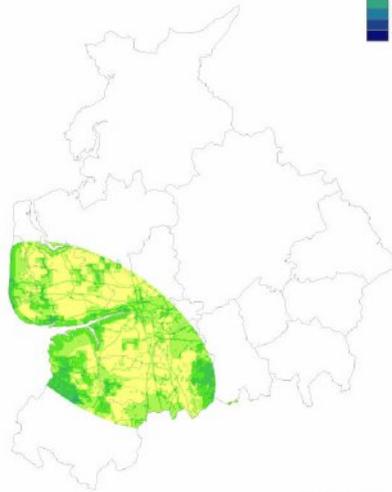
Areas of High Quality Agricultural Land

Number of Pinches (alternative)



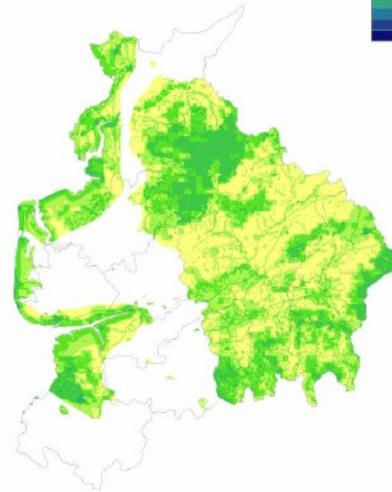
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Number of Pinches (alternative)



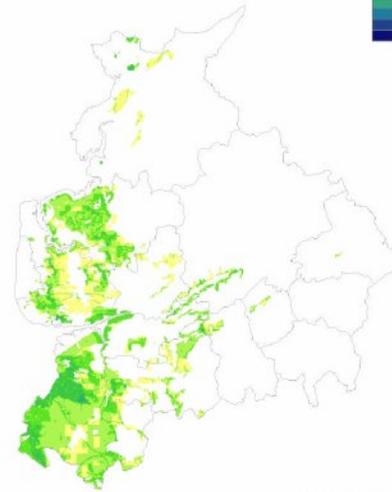
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Number of Pinches (alternative)



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Number of Pinches (alternative)



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10.13. GREATER MANCHESTER

10.13.1. Eight of the ten pinches are present in Greater Manchester areas of search. Unsurprisingly coastal flooding is not an issue: this is the only sub-region where this is the case. Inadequate water supply also is not an issue, whilst soil erosion is present as a pinch in 60% of the pinch areas of search; however, it is at low levels of area coverage, less than 3%.

10.13.2. Urban heat island, fluvial flood, loss of biodiversity and air quality are all moderate or high in extent of area coverage. Greater Manchester has perhaps the most consistent set of pinches and perhaps the most complex in that there appear to be many pinches in each area of search that cover significant proportions of their areas. The challenge for Manchester is to develop a green infrastructure framework that can effectively deal with this complexity of high priority pinches.

10.13.3. Risk of increasing urban heat island effects and risk of poor air quality are the pinches to consider for development of tourism in Greater Manchester. In Oldham risk of loss of carbon storage and biodiversity are significant pinches.

10.13.4. From the sub regional economic strategy 10 key green infrastructure opportunities were identified. These are areas or projects where it is felt green infrastructure can play a key role in assisting the planned investment or development.

10.13.5. The opportunities identified include green infrastructure as a key component of new business parks planned for the area. Growth points will require green infrastructure planning and implementation to provide attractive setting and as a mechanism to improve the environmental sustainability of these programmes.

10.13.6. Further opportunities in Gtr Manchester were identified for increasing green travel routes, through green infrastructure implementation and also for increased urban tree cover to combat urban heat island and increased risk of surface water flooding with projected climate change.

10.13.7. In terms of agriculture, risk of loss of carbon storage and biodiversity are the key sub-regional issues.

10.13.8. The growth points in Greater Manchester face pinches related to flood (the Salford example of pinch being highlighted as a real issue in this study). Also significant are risk of increasing urban heat island, loss of biodiversity and reduced air quality.

Table 22 Key Green Infrastructure Planning Actions in Greater Manchester

Pinch	Sub-regional activity	Lead body	Existing activity that could assist in delivery
Risk of flooding	Assess green infrastructure assets and the need to manage and create new green infrastructure to reduce risk of flood. Focus on creating grey/green infrastructure plans.	Natural England, Local Authorities, Forestry Commission, UU and EA	Gtr Manchester SR Green Infrastructure Plan Surface Water Management Plans Strategic Flood Risk Plans Catchment Area Management Plans
Risk of urban heat island effect	Assess areas of greatest impact, based on likely future development and presence of vulnerable communities	LAs, link to LAA 188 - Adaptation to Climate Change	Climate Change Strategies Greater Manchester SR Green Infrastructure Plan
Risk of loss of biodiversity	Ensure robust protection in place for protected species in and around pinch points. Use green infrastructure planning to identify opportunities to safeguard and enhance biodiversity around new investment.	NE, FC, EA, Biodiversity Action Plan Partnerships	Sub-regional BAP
Risk of loss of carbon storage	Ensure robust protection for stores of carbon and effective policy in place to mitigate any loss of store	NE, LAs	Gtr Manchester SR Green Infrastructure Plan

Risk of poor air quality	Assess how in addition to measures to reduce emission of pollutants, GI can play a role in further improving air quality around specific areas of poor quality through for example woodland planting close to motorway interchanges	HA, EA, LAs, FC	Air Quality Plans, Sub-Regional Green Infrastructure Plans
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10.13.9. There are several issues that will require cross boundary working, particularly control of flood risk where part of the solution may lie in changing the green infrastructure typologies or increasing functionality in areas upstream of, for example, Salford, which has 18% of the area of search in a flood risk zone.

Strand 1

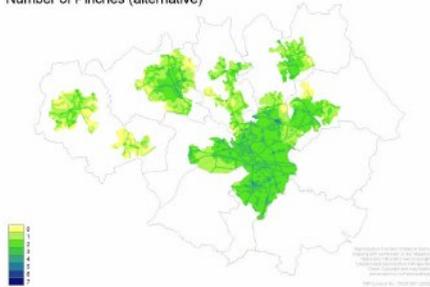
Strand 2

Growth Point Partnership Areas

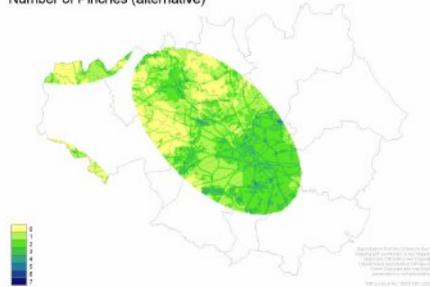
Areas of Tourism Significance

Areas of High Quality Agricultural Land

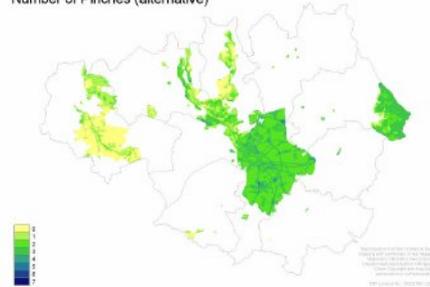
Number of Pinches (alternative)



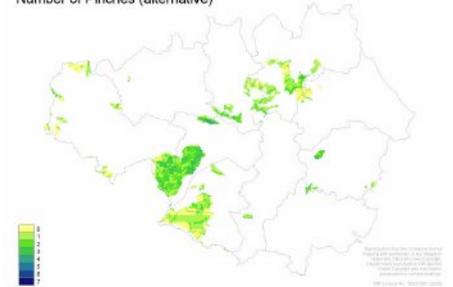
Number of Pinches (alternative)



Number of Pinches (alternative)



Number of Pinches (alternative)



10.14. MERSEYSIDE AND HALTON

10.14.1. Nine of the ten pinches are present in the Merseyside sub-region with only water supply not an issue. However, risk of loss of carbon storage is only a pinch in one of the areas of search and there it extends to only 4% of the total area.

10.14.2. The extent of areas of pinch are lower than for Manchester, but the impact of this is wholly dependent on where development is most likely to take place. Coastal flooding is the main pinch with the lowest extent being 26% of the area of search (Liverpool), whilst in the upper Mersey it is 97%. As stated in Section 7 “Identification of potential green infrastructure management actions” above, the relationship between coastal flooding and green infrastructure is an area that requires urgent work to improve our understanding of the possible contribution that green infrastructure can play.

10.14.3. Fluvial flood is varied being greatest again (and unsurprisingly) in the upper Mersey. Similar to Manchester, increased noise levels is a pinch across moderately large parts of the areas of search. Other pinches vary significantly between the areas of search.

10.14.4. Objective data for aesthetic is perhaps the most difficult to obtain. All areas in this sub-region do have low to moderate areas of coverage of poor aesthetic. However, Speke is generally seen as being an area in need of environmental/public realm investment and yet our data indicates that it has a low extent of poor aesthetic.

10.14.5. The result is partly due to the proximity of some attractive estuarine landscape to the area of search. However, the result does indicate the need to examine results at a local level and also that we need to have improved and agreed data for assessing aesthetic if we are to include it in a meaningful way in this type of assessment.

10.14.6. From the sub regional economic strategy 13 key green infrastructure opportunities were identified. These are areas or projects where it is felt green infrastructure can play a key role in assisting the planned investment or development.

10.14.7. As with other sub regions growth points and planned business parks were identified as potential opportunities. However, Merseyside was the only sub region to have specifically mentioned local food production. There is a great deal of high grade agricultural land to the north of the sub region, and this does offer great opportunities for local food sourcing with concomitant benefits of reducing food miles, improving diet (amount of fresh produce) through use in local schools and hospitals etc.

10.14.8. In addition the use of green infrastructure to improve image, in particular through improvements to key gateways was identified.

10.14.9. The tourism areas of search for pinch points have increased risk of urban heat island, risk of flood and coastal storms as the most significant pinches. The urban heat island effect may not be an issue in the areas close to the Mersey as on/offshore breezes due to differential heating of the land and water will help to cool them. However, shade and shelter may still be a concern and urban tree planting and maintaining existing coverage should be considered as a way to improve comfort in the city centres, where radiant heat in times of extreme high temperature will make them uncomfortable places to live, work and visit.

10.14.10. Agriculture faces areas of pinch associated with risk of flood and carbon loss, with areas of risk of coastal storm too.

10.14.11. The Growth Point Partnership Areas face pinch point issues of risk of flood (Sefton), increased urban heat island (Liverpool), and also risk of carbon storage loss, risk of biodiversity loss and risk of increased noise.

Table 23 Key Green Infrastructure Planning Actions in Merseyside

Pinch	Sub-regional activity	Lead body	Existing activity that could assist in delivery
Risk of flooding	Assess green infrastructure assets and the need to manage and create new green infrastructure to reduce risk of flood. Focus on creating grey/green infrastructure plans.	Natural England, Local Authorities, Forestry Commission, UU and EA	Surface Water Management Plans Strategic Flood Risk Plans Catchment Area Management Plans EA Flood Plans, Merseyside SR Green Infrastructure Plan

Risk of urban heat island effect	Assess areas of greatest impact, based on likely future development and presence of vulnerable communities	LAs, link to LAA 188 - Adaptation to Climate Change	Climate Change Strategies Merseyside SR Green Infrastructure Plan
Risk of loss of biodiversity	Ensure robust protection in place for protected species in and around pinch points. Use green infrastructure planning to identify opportunities to safeguard and enhance biodiversity around new investment.	NE, FC, EA, Biodiversity Action Plan Partnerships	Sub-regional BAP
Risk of loss of carbon storage	Ensure robust protection for stores of carbon and effective policy in place to mitigate any loss of store	NE, LAs	Merseyside SR Green Infrastructure Plan
Risk of poor air quality	Assess how in addition to measures to reduce emission of pollutants, GI can play a role in further improving air quality around specific areas of poor quality through for example woodland planting close to motorway interchanges	HA, EA, LAs, FC	Air Quality Plans, Merseyside Green Infrastructure Plan
Risk of coastal storms	Assess key green infrastructure assets and the need to manage and create new green infrastructure to reduce risk of flood from coastal storms. Focus on creating grey/green infrastructure plans. In particular look at the areas of interface between coastal storm flood and fluvial flood.	Defra, EA, Local Authorities, NW Coastal Forum	Integrated Coastal Management Plans, NW Coastal Strategy, Shoreline Management Plans

10.14.12. The particular types of pinch described in the table above can all be taken forward through joint work. The emerging City Region structures will provide the basis for this joint work. The Environment and Waste Board has green infrastructure as one of six priorities identified for its work. Organisations such as Merseyside Environment Advisory Service and Merseyside Policy Unit as well as the sub-regional partnership can assist in taking these key sub-regional actions forward.

Strand 1

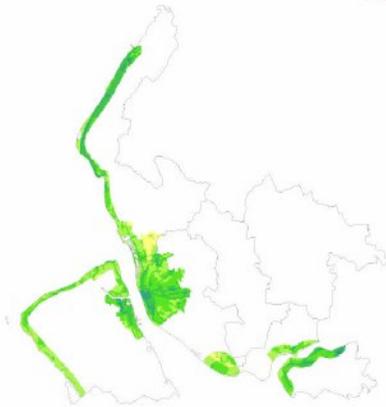
Strand 2

Growth Point Partnership Areas

Areas of Tourism Significance

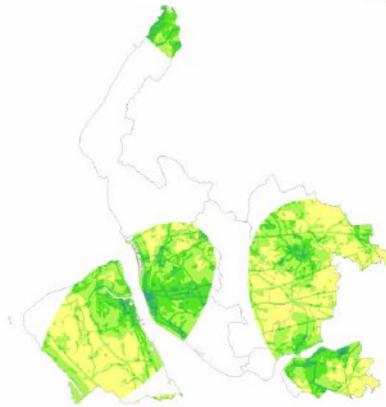
Areas of High Quality Agricultural Land

Number of Pinches (alternative)



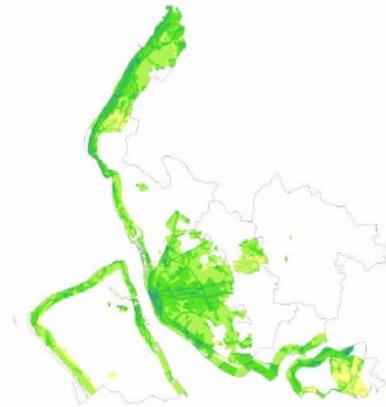
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Number of Pinches (alternative)



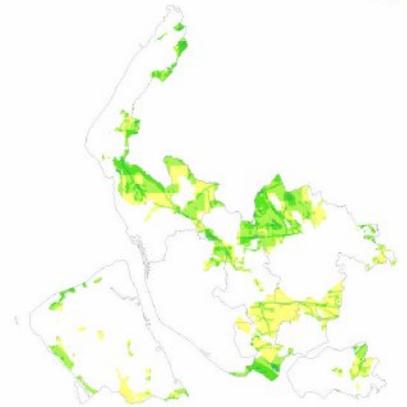
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Number of Pinches (alternative)



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Number of Pinches (alternative)



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10.15. CHESHIRE AND WARRINGTON

10.15.1. Cheshire and Warrington appears just behind Merseyside sub-region in terms of the average extent of pinches. The reason for this appears to be the consistent level of pinch across the sub-region rather than any one single large scale pinch issue.

10.15.2. Again the sub-region has nine of the ten pinches present, though air quality is only a pinch for Warrington and coastal flood for Warrington and Ellesmere Port (Warrington because the Mersey is tidal up to Howley Weir). Loss of carbon storage has low coverage (maximum 9% of area in Wilmslow area of search) in three of the nine areas of search.

10.15.3. Risk of increased noise, loss of biodiversity and poor aesthetic are all fairly consistent and moderate in extent in the areas of search. Fluvial flood risk is variable with Warrington having the greatest area of pinch coverage, followed by Northwich and Frodsham. The other areas have very low extent of coverage. However even in these areas with low extent of coverage the pinch needs to be considered in order to avoid flood damaging future investment. The extent only provides information on how much of an area is at risk from a pinch. If a development is situated in an area where the pinch is present it will suffer exactly the same damage no matter what the extent of coverage of the pinch may be.

10.15.4. Urban heat island is a pinch across large areas of five of the areas or search (100%) and across a moderate area of Macclesfield and Warrington (30% and 35% respectively).

10.15.5. Chester has an identified pinch of risk of increasing urban heat island. In addition for the areas of search for tourism pinches, risk of poor aesthetic is identified as a pinch. The image and quality of the towns and city in the sub-region are a key component of the tourism offer; it is perhaps worth contrasting this to the situation in Cumbria where the pinch is associated with landscape issues. In both cases we highlight that green infrastructure has a role to play in safeguarding and enhancing the key elements of the tourism offer.

10.15.6. From the sub regional economic strategy 7 key green infrastructure opportunities were identified. These are areas or projects where it is felt green infrastructure can play a key role in assisting the planned investment or development.

10.15.7. As with other sub regions growth points and planned business parks were identified as potential opportunities. However local food production was not identified. There is a great deal of high grade agricultural land in the sub region, and this does

offer great opportunities for local food sourcing with concomitant benefits of reducing food miles, improving diet (amount of fresh produce) through use in local schools and hospitals etc.

10.15.8. Using green infrastructure to improve the image of the area, particularly in the Weaver Valley, Warrington Interchange and Crewe Gateway was highlighted. Opportunities to tackle areas of dereliction through were identified.

10.15.9. Flood is also identified as a pinch in the tourism area of search, particularly in Ellesmere Port and Warrington.

10.15.10. Poor aesthetic also appears as a pinch in both the agriculture and growth point areas of search.

10.15.11. Within the sub-region the Weaver Valley has already started to develop a green infrastructure plan to support planned investment. In addition a climate change action plan has also been written for the Valley; this suggests a range of green infrastructure solutions for climate change adaptation and mitigation in the Valley¹¹³.

Table 24 Key Green Infrastructure Planning Actions in Cheshire and Warrington

Pinch	Sub-regional activity	Lead body	Existing activity that could assist in delivery
Risk of flooding	Assess green infrastructure assets and the need to manage and create new green infrastructure to reduce risk of flood. Focus on creating grey/green infrastructure plans.	Natural England, Local Authorities, Forestry Commission, UU and EA	Surface Water Management Plans Strategic Flood Risk Plans Catchment Area Management Plans Merseyside SR Green Infrastructure Plan
Risk of urban heat island effect	Assess areas of greatest impact, based on likely future development and presence of vulnerable communities	LAs, link to LAA 188 - Adaptation to Climate Change	Climate Change Strategies, SR Green Infrastructure Plan

Risk of loss of biodiversity	Ensure robust protection in place for protected species in and around pinch points. Use green infrastructure planning to identify opportunities to safeguard and enhance biodiversity around new investment	NE, FC, EA, Local Biodiversity Action Plan Partnerships	Sub-regional BAP
Risk of loss of carbon storage	Ensure robust protection for stores of carbon and effective policy in place to mitigate any loss of store	NE, LAs	SR Green Infrastructure Plan
Risk of coastal storms	Assess key green infrastructure assets and the need to manage and create new green infrastructure to reduce risk of flood from coastal storms. Focus on creating grey/green infrastructure plans. In particular look at the areas of interface between coastal storm flood and fluvial flood.	Defra, EA, Local Authorities, NW Coastal Forum	Integrated Coastal Management Plans, NW Coastal Strategy, Shoreline Management Plans

10.15.12. As per the other sub-regions the most important issue to tackle on a cross boundary basis will be flooding (coastal and fluvial). Ensuring that new development also provides opportunities for species movement will also require that the area beyond the boundary be considered.

Strand 1

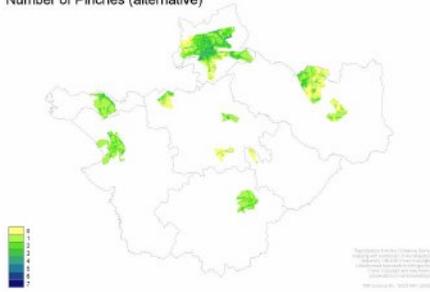
Strand 2

Growth Point Partnership Areas

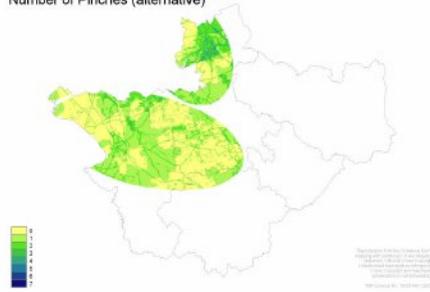
Areas of Tourism Significance

Areas of High Quality Agricultural Land

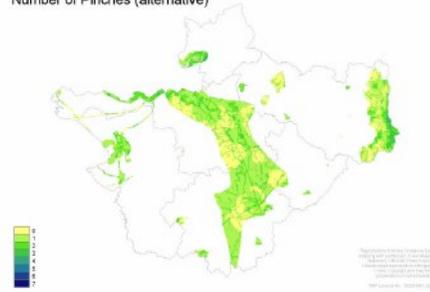
Number of Pinches (alternative)



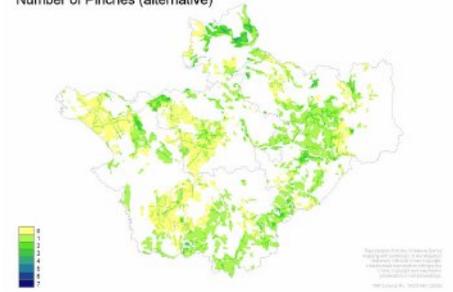
Number of Pinches (alternative)



Number of Pinches (alternative)



Number of Pinches (alternative)



10.16. MERSEY CORRIDOR

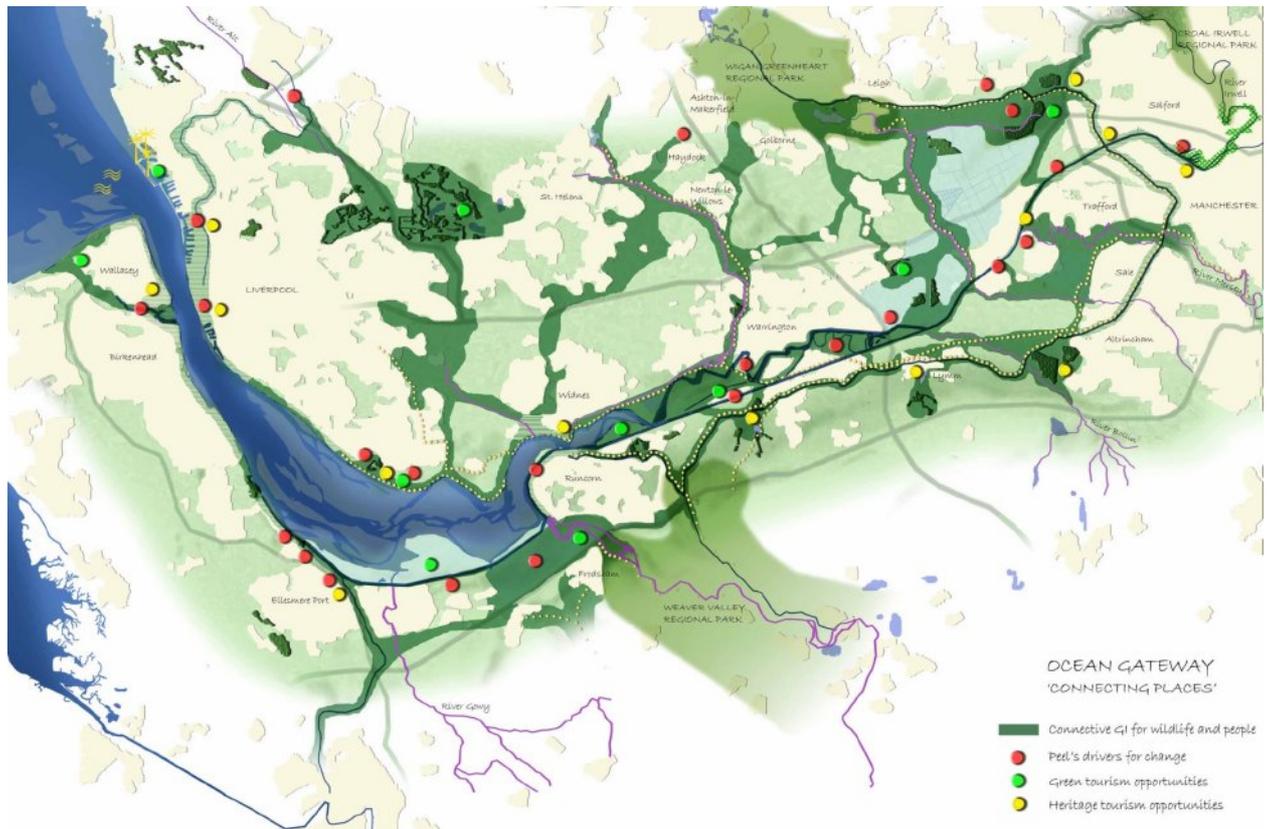
10.16.1. The Mersey Corridor is a key area for the North West economy with over 60% of the population and 65% of the region's GVA. The emergence of the adjacent city regions of Liverpool and Manchester will ensure that there is a continued focus on this corridor to assist the ambitions to create a globally significant region.

10.16.2. The Mersey Corridor area was used as an area of search for pinch points in this study in order to show how this type of approach may be useful in identifying key pinch issues, whilst remembering that a full green infrastructure plan will be required in order not just to assess how green infrastructure can assist in overcoming pinch points but also what other green infrastructure provision will be required to safeguard or enhance green infrastructure functionality and delivery of the eleven benefits.

10.16.3. Some elements of this green infrastructure planning have already been started by Peel for their proposals around the 'Ocean Gateway', and early maps showing potential green infrastructure assets in the Ocean Gateway area have been developed (see Figure 18 below by Peel).

10.16.4. The area is also covered by the two North West Community Forests, with long term (30-40 year) plans for environmental regeneration, providing a delivery mechanism for many aspects of green infrastructure implementation.

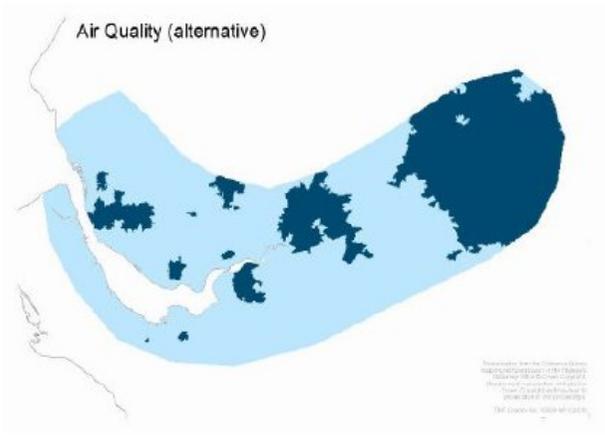
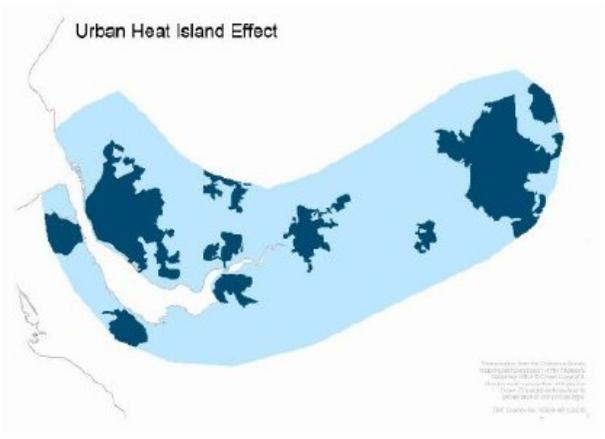
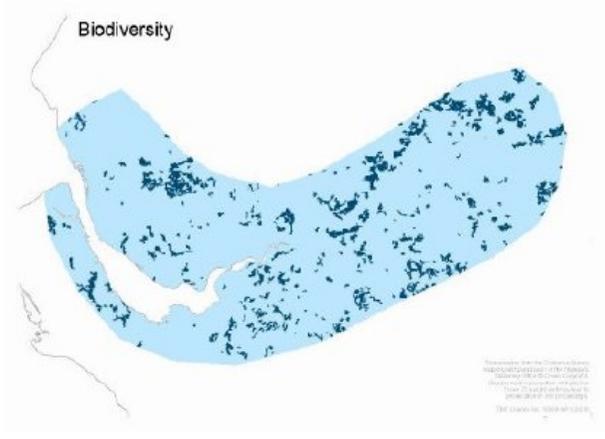
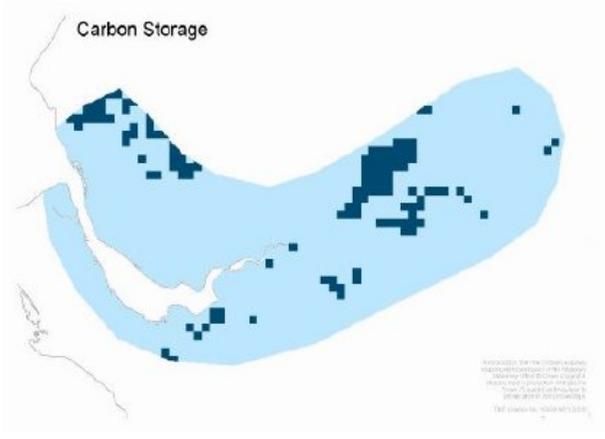
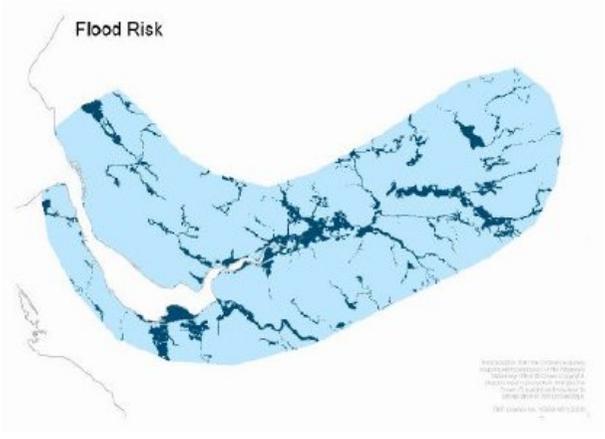
Figure 18 Outline of green infrastructure assets along Mersey Corridor (courtesy of Peel and Randall Thorp Associates)



10.16.5. Whilst all ten pinches have been mapped in this area of search, the main pinch points identified across the area of search were:

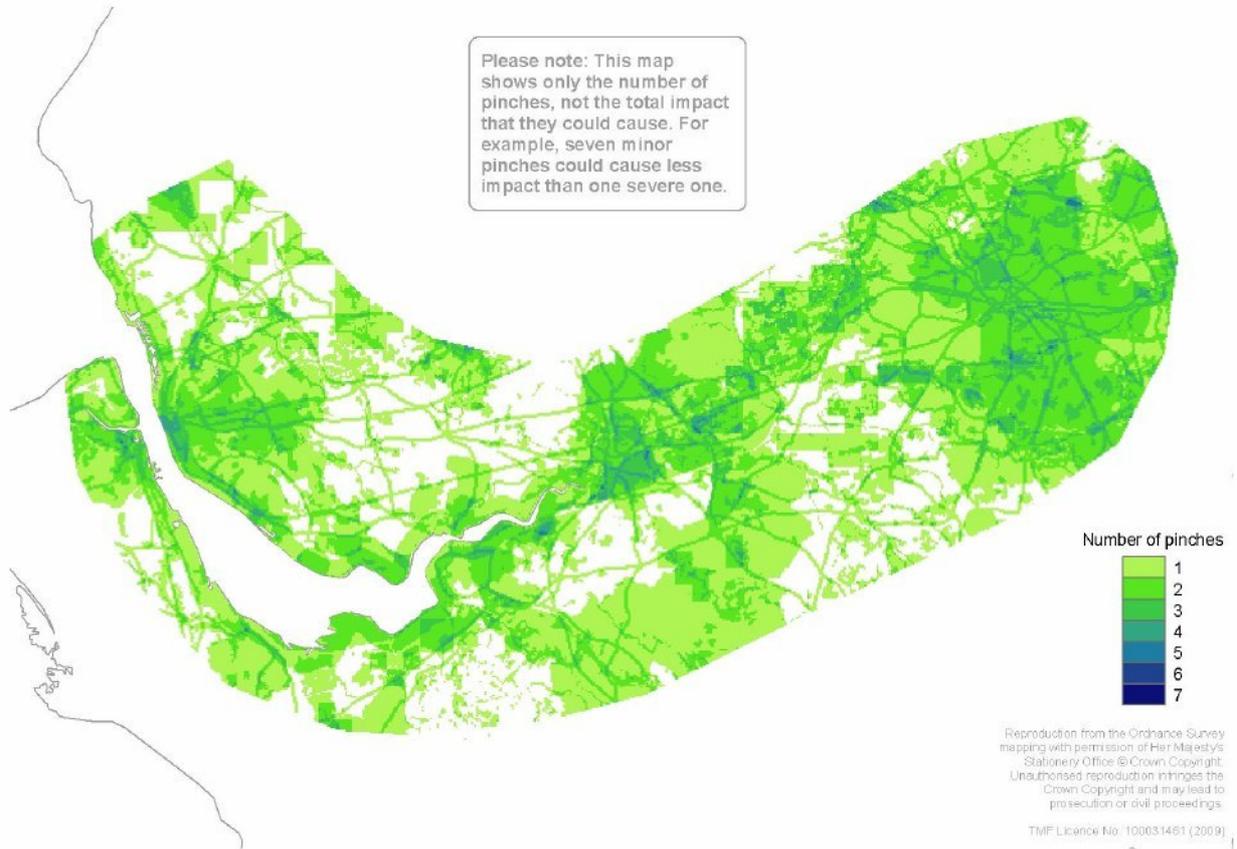
- Risk of flooding
- Risk of poor air quality
- Risk of loss of carbon storage
- Risk of loss of biodiversity
- Risk of urban heat island effect.

10.16.6. These issues are shown in maps below.



10.16.7. The map below shows the number of pinches (all ten pinches are mapped) across the area of search.

Map 21



APPENDIX 1 POLICY

Table 25 below has been prepared by Helen Sweeney of Government Office North West and provides a comprehensive assessment of policies that support green infrastructure planning approaches.

Table 25 Green Infrastructure and Policy

National		
Defra PSA	<p>Public Service Agreement 28 Secure a Healthy Natural Environment</p> <p>Reference to greenspace and Greenspace Infrastructure – thereby covering all eventualities</p>	<p>PSA 28: Secure a healthy natural environment for everyone’s well being, health and prosperity, now and in the future www.hmtreasury.gov.uk/d/pbr_csr07_psa28.pdf</p> <p>Below PSA 28 sit the Defra Priorities.</p> <ul style="list-style-type: none"> • Secure a healthy natural environment for us all and deal with environmental risks • Promote a sustainable, low-carbon and resource-efficient economy • Ensure a thriving farming sector and a sustainable, healthy and secure food supply <p>These are supplemented by 8 Departmental Strategic Objectives (DSO)</p> <ol style="list-style-type: none"> 1. A society that is adapting to the effects of climate change. 2. A healthy, resilient, productive and diverse natural environment. 3. Sustainable, low carbon and resource efficient patterns of consumption and production. 4. An economy and a society that are resilient to environmental risk 5. Championing sustainable development. 6. A thriving farming and food sector with an improving net environmental impact 7. A sustainable, secure and healthy food supply 8. Socially and economically sustainable rural

		communities
National Planning Policy	<p>Planning Policy Statement 1</p> <p>Delivering Sustainable Development 31 January 2005</p> <p>General supportive words that could be applied to green infrastructure</p>	<p>36. Planning authorities should prepare robust policies on design and access. Such policies should be based on stated objectives for the future of the area and an understanding and</p> <p>evaluation of its present defining characteristics. Key objectives should include ensuring that developments:</p> <ul style="list-style-type: none"> – are sustainable, durable and adaptable (including taking account of natural hazards such as flooding) and make efficient and prudent use of resources; – optimise the potential of the site to accommodate development, create and sustain an appropriate mix of uses (including incorporation of green and other public space as part of developments) and support local facilities and transport networks;
National Planning Policy	<p>Planning and Climate Change - Supplement to Planning Policy Statement 1</p> <p>17 December 2007</p> <p>Specific reference to green infrastructure</p>	<p>24. the contribution to be made from existing and new opportunities for open space and green infrastructure to urban cooling, sustainable drainage systems, and conserving and enhancing biodiversity;</p>
	<p>Planning Policy Statement 9</p> <p>Biodiversity and Geological</p>	<p>• to contribute to rural renewal and urban renaissance by:</p> <ul style="list-style-type: none"> – enhancing biodiversity in green spaces and among

	<p>Conservation 16 August 2005</p> <p>Green space reference</p>	<p>developments so that they are used by wildlife and valued by people, recognising that healthy functional ecosystems can contribute to a better quality of life and to people’s sense of well-being; and</p> <p>– ensuring that developments take account of the role and value of biodiversity in supporting economic diversification and contributing to a high quality environment.</p>
	<p>Planning Policy Statement 12 Local Spatial Planning 4 June 2008</p> <p>More specific reference to green infrastructure</p>	<p>2.3 Spatial planning plays a central role in the overall task of place shaping and in the delivery of land, uses and associated activities.</p> <p>2.4 In relation to housing, it:</p> <ul style="list-style-type: none"> • ensures that the necessary land is available at the right time and in the right place to deliver the new housing required; • orchestrates the necessary social, physical and green infrastructure to ensure sustainable communities are delivered.
	<p>Planning Policy Statement 25 Development and Flood Risk 7 December 2006</p> <p>green infrastructure</p>	<p>Reducing risk</p> <ul style="list-style-type: none"> • safeguarding land from development that is required for current and future flood management eg conveyance and storage of flood water, and flood defences; • reducing flood risk to and from new development through location, layout and design, incorporating sustainable drainage systems (SUDS);

	reference	<ul style="list-style-type: none"> • using opportunities offered by new development to reduce the causes and impacts of flooding eg surface water management plans; making the most of the benefits of green infrastructure for flood storage, conveyance
National Forestry Strategy and Delivery Plan	England's Trees Woods and Forests Strategy Delivery Plan	<p>Box 5: Green Infrastructure</p> <p>Green Infrastructure is a network of multi-functional green space, both new and existing, both rural and urban, which supports the natural and ecological processes and is integral to the health and quality of life of sustainable communities.</p> <p>Where this phrase is used in the Delivery Plan it can be taken to mean the trees and woods that make up the mix of habitats and features of Green Infrastructure. Green Infrastructure will seldom be purely woodland.</p>
Regional		
Regional Planning Policy	Regional Spatial Strategy	<p>EM1 B Natural Environment</p> <p>EM1 D Trees Woodlands and Forests</p> <p>EM2 Contaminated land</p> <p>EM3 Green Infrastructure</p>
Regional		113. Develop the economic benefit of the region's

Economic Strategy		natural environment through better alignment of environmental activities and economic gain
Regional Forestry Action plan	Regional Forestry Framework Action Plan	
NW Climate Change Action Plan	Rising to the Challenge CCAP	The potential for green infrastructure, including regional parks, to adapt and mitigate for climate change impacts and commence implementation of findings
NW and sub regional Biodiversity Action Plans	One regional BAP and 5 sub regional local plans	Regional Targets The North West has regional habitat targets, the latest version published April 2008, which are the regional contribution to UK Biodiversity targets and the England Biodiversity Strategy . The Strategy emphasises the need for large scale habitat restoration and better engagement with regional bodies to deliver the targets.
Sub Regional		
Sub Regional	Sub regional economic partnerships	The five Sub-Regional Partnerships are: <ul style="list-style-type: none"> • Cheshire and Warrington Economic Alliance • Cumbria Vision • Greater Manchester Forum • Lancashire Economic Partnership • The Mersey Partnership

	Sub Regional Woodland Initiatives	Mersey Forest Red Rose Forest Cumbria Woodlands Lancashire Woodlands Project
	Sub Regional Biodiversity groups	Cumbria Lancashire Manchester Merseyside Cheshire
Local		
Local Development Frameworks	47 in North West	All local planning authorities in NW
Local Area Agreements	22 Local Area Agreements in the North West NI 188 and NI 197 opportunity for green	Blackburn with Darwen
		Blackpool
		Bolton
		Bury NI 188 Adaptation to climate change
		Cheshire
		Cumbria NI 197 Biodiversity
		Halton

infrastructure link	Knowsley
	Lancashire NI 197 Biodiversity NI 188 Adaptation to c
	Liverpool NI 188 Adaptation to climate change
	Manchester
	Oldham
	Rochdale NI 188 Adaptation to climate change
	Salford
	Sefton NI 188 Adaptation to climate change
	St Helens
	Stockport
	Tameside
	Trafford
	Warrington NI 188 Adaptation to climate change
	Wigan NI 188 Adaptation to climate change
	Wirral

Multi Area Agreements		<p>Greater Manchester: Bolton, Bury, Manchester City Council, Oldham, Rochdale, Salford, Stockport, Tameside, Trafford and Wigan.</p> <p>Liverpool City Region: Liverpool, Sefton, Knowsley, St Helens, Wirral and Halton.</p> <p>Fylde Coast: Blackpool , Lancashire, Fylde and Wyre.</p> <p>Pennine Lancashire: Blackburn, Lancashire and Burnley, Pendle, Rossendale, Hyndburn and Ribble Valley.</p>
Growth Points	<p>Growth Points</p> <p>Inclusion of green infrastructure conditions applied to the Growth Point offer.</p>	<p>Greater Manchester</p> <p>Carlisle</p> <p>Central Lancashire and Blackpool</p> <p>West Cheshire</p> <p>Halton, St. Helens, Warrington</p> <p>Merseyside Heartlands</p>
Other Initiatives		
Cleaner Safer Greener	<p>Cleaner Safer Greener</p> <p>www.cleanersafer</p>	<p>Cleaner Safer Greener Communities is about creating quality spaces in which people want to live and can be proud - and which others will respect</p>

	<p>greener.gov.uk/</p> <p>Communities and Local Government</p> <p>www.communities.gov.uk/</p>	
<p>Housing and Communities Agency</p>	<p>Housing Market Renewal Pathfinders</p>	<p>Manchester Salford - Manchester and Salford</p> <p>Newheartlands - Liverpool, Sefton and Wirral</p> <p>Partners in Action - Oldham and Rochdale</p> <p>Elevate East Lancashire - Blackburn with Darwen, Hyndburn, Burnley, Pendle and Rossendale</p> <p>Over a 10- to 15-year timeframe, the HMR “schemes” set out plans for radical and sustained action to replace obsolete housing with modern sustainable accommodation, through demolition, refurbishment and new building. They have also aimed to ensure the other essential requirements of sustainable communities are addressed, such as good quality customer-focused services, good design and delivering clean, safe, healthy and attractive environments in which people can take pride.</p>

APPENDIX 2 SUB-REGIONAL GREEN INFRASTRUCTURE OPPORTUNITIES

The following lists of green infrastructure opportunities for each of the sub-regions were developed by ECOTEC for their report “The Policy Framework for Green Infrastructure in England’s Northwest and Opportunities for Green Infrastructure to Contribute to Sub-Regional Economic Growth”¹¹⁷.

CHESHIRE & WARRINGTON

<i>Opportunity 1</i>	Green Infrastructure improves the offer of the sub region to investors, entrepreneurs and a skilled workforce by creating a high quality live/work environment. Ensure that investment in Green Infrastructure initiatives is matched with marketing materials and the benefits of this 'green' environment are clearly understood.
<i>Opportunity 2</i>	Green Infrastructure can be integrated into transport improvement and infrastructure projects, enabling a wider offer of non motorised routes, improving (greening) gateways and transport corridors and providing for sound, visual and pollution buffering.
<i>Opportunity 3</i>	Green Infrastructure principles can be embedded into urban design for public realm projects to enable the maximisation of multifunctionality, accessibility, quality in design, implementation and management.
<i>Opportunity 4</i>	The sub region recognises the value of its high quality environment, particularly the rural environment, in terms of attracting and retaining business. The Weaver Valley can be developed as an exemplar for replication in other parts of the sub region and the accepted opportunities presented by rural areas can be developed into sub urban and urban centres via Green Infrastructure networks and city greening.
<i>Opportunity 5</i>	Ensure that new investment presented through New Growth Point funding and potential for eco towns development incorporates Green Infrastructure from the outset through a plan that is properly integrated with housing growth.
<i>Opportunity 6</i>	Undertake local authority level mapping of Green Infrastructure in accordance with guidance set out in the Regional Green Infrastructure Guide. Use this to produce a strategy/action plan, built into the 2008 refresh of the sub regional action plan.
<i>Opportunity 7</i>	Further identify sites for current and future Newlands programme funding – or other potential investment programmes which seek to utilise DUN land for temporary of permanent Green Infrastructure.

GREATER MANCHESTER

<i>Opportunity 1</i>	Green Infrastructure can be incorporated into the design of new business parks to create more attractive work environments. Greener urban centres will attract and retain a skilled workforce and entrepreneurs necessary for competitiveness to be sustained.
<i>Opportunity 2</i>	Identify opportunities for new city centre tree planting to enable urban cooling, alongside a programme of green roofs for new developments and soft surfacing of redeveloped areas.
<i>Opportunity 3</i>	Develop the city region's strategy for renewable energy production within energy planning initiatives and incorporated increased woodland management for biofuel

	production for use in CHP and other woodfuel initiatives.
<i>Opportunity 4</i>	The significance of the Green Infrastructure agenda is not yet fully appreciated in terms of its contribution to a world class environment for the city, capable of attracting new visitors, investors and a skilled workforce. There exists potential to better integrate Green Infrastructure principles relating to networking of green assets, multifunctional greenspaces, quality environments, the contribution to housing market renewal and the reuse of DUN land through a process of advocacy and demonstration with economic development and spatial planners alike.
<i>Opportunity 5</i>	Green Infrastructure can provide a network of non motorised routes capable of linking communities with services and employment nodes and reducing car dependency.
<i>Opportunity 6</i>	Greening of transport corridors and gateways can provide a positive contribution to the overall impression of the city, alongside improvements in pollution reduction, noise abatement and visual amenity.
<i>Opportunity 7</i>	Green Infrastructure investment can reduce incapacity through creating new opportunities for exercise and recreation. Investment can therefore be linked to this objective. Additionally, opportunities are presented for the environmental sector to develop opportunities for social enterprise, community engagement in the management and maintenance of greenspace and for training and volunteer activity, leading to improved engagement and opportunity for those from deprived communities.
<i>Opportunity 8</i>	Ensure that new investment presented through New Growth Point funding and the potential for future eco town development incorporates Green Infrastructure from the outset through an integrated masterplan – housing with environment.
<i>Opportunity 9</i>	The development of a city region wide Green Infrastructure strategy to guide development, linking priorities and utilising the regional Green Infrastructure Guide will enable the city to take forward a 'greener' action plan which meets more of its objectives, particularly in respect of climate change.
<i>Opportunity 10</i>	Further identify sites for current and future Newlands programme funding – or other potential investment programmes which seek to utilise DUN land for temporary or permanent Green Infrastructure.

LANCASHIRE

<i>Opportunity 1</i>	To ensure that the Green Infrastructure strategy in Lancashire is of a high quality and capable of promotion to other sub regions in the North West. The strategy puts Lancashire at the forefront of Green Infrastructure strategic thinking in the North West and can 'seal' its green credentials on the back of this, providing the strategy is backed up by action (i.e. no 'greenwashing').
<i>Opportunity 2</i>	The Green Infrastructure strategy process in Lancashire needs to embrace all stakeholders and ensure that contributions from the private and voluntary and community sectors in particular are embedded in the delivery process, as well as full buy in from economic development and spatial planning professionals and organisations.
<i>Opportunity 3</i>	Ensure that new investment presented through New Growth Point funding and potential for eco town development incorporates Green Infrastructure from the outset through an integrated Green Infrastructure plan, alongside housing growth.
<i>Opportunity 4</i>	Ensure that Green Infrastructure planning principles are embedded throughout sub regional growth strategies and that the Green Infrastructure Strategy is integrated with other plans, not set to one side.
<i>Opportunity 5</i>	Further develop the principles of Regional Parks into new areas of the sub Region which would benefit from this integrated approach to local growth within the context of a high quality environment.

<i>Opportunity 6</i>	Continue to identify new brownfield sites in urban and rural settings for greening, in line with the emerging Green Infrastructure Strategy but in particular responding to opportunities through Newlands and REMADE programmes.
<i>Opportunity 7</i>	Ensure that the Urban Regeneration Company in Blackpool (Re:Blackpool) recognises the potential of Green Infrastructure to contribute to its success, both in terms of development of Blackpool itself and in terms of the high quality countryside and coast on its doorstep.

MERSEYSIDE

<i>Opportunity 1</i>	Greening of the city centre, town centres, gateways and the waterfront provide a key opportunity to market the sub region as a green city.
<i>Opportunity 2</i>	Green gateways to the sub region and the city of Liverpool provide first impressions for the visitor, whether recreational or business, encouraging returns and potential new investment and residents. Land released through regeneration schemes can be used as green assets where there is no more economically viable use, for example the creation of nature/natural parks, new habitats
<i>Opportunity 3</i>	New hard infrastructure development can be accompanied by Green Infrastructure built into the design in order to reduce the visual, noise and pollutant impact of such developments on residential and business areas alike.
<i>Opportunity 4</i>	Green Infrastructure integration into urban design will provide for a more attractive place to live and work, attracting and retaining high calibre graduates, students, entrepreneurs and employees.
<i>Opportunity 5</i>	Land and property can be uplifted in value by high quality Green Infrastructure. Promotion of the concept of green business parks and the integration of greenspace into new development, enabling access to green places as well as providing local microclimate control benefits to industry and employees.
<i>Opportunity 6</i>	Communities can increase their capacity through the ownership, management and maintenance of greenspace assets – parks, woodlands, recreational areas – thereby increasing skills and capacity of individuals.
<i>Opportunity 7</i>	Increased investment in new and improved Green Infrastructure leads to improved health outcomes through exercise, stress reduction and improved environmental quality, reducing incapacity and costs to employers through time off work.
<i>Opportunity 8</i>	Local purchasing can extend to the increased use of local agricultural produce, allowing for a more sustainable food and farming sector and for diversification activity for the land based sector.
<i>Opportunity 9</i>	New and refurbished business parks can have Green Infrastructure designed in, for example with regard to access to greenspace, accessibility by non motorised modes of transport, renewable energy. City centre locations can benefit from similar accessible greenspace and sustainable technologies.
<i>Opportunity 10</i>	Integration and expansion of land management initiatives such as the Mersey Forest are noted: Promotion of exemplar activity under these initiatives and programmes to ensure best practice is recognised and replicated across the sub region, exploiting new sites and DUN land in particular. New opportunities for land based sector diversification to production of biofuels and biomass.
<i>Opportunity 11</i>	The development of the urban core, brought about by housing market failure, has and will continue to regenerate the area. This includes not only the type of housing offer with communal or personal gardens, but also the links with local community green infrastructure such as parks.
<i>Opportunity 12</i>	Ensure that new investment presented through New Growth Point funding and potential for eco town development incorporates Green Infrastructure from the outset through an integrated green infrastructure plan, alongside housing growth.

<i>Opportunity 13</i>	Develop a strategic approach to Green Infrastructure implementation across the city region through mapping, strategy and action planning processes, utilising the regional Green Infrastructure Guide approach as a template.
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CUMBRIA

<i>Opportunity 1</i>	The proposals for submitting the Lake District as a World Heritage site have indicated that the designation provides additional economic benefit. There would be a need to maintain and enhance the quality of green infrastructure in the area to maintain the designation and accommodate the additional visitors.
<i>Opportunity 2</i>	Green Infrastructure as a contributor to the renaissance of South / West Cumbria towns, and other urban centres, addressing poor quality of place and image issues, addressing poor health associated with heavy industry, and providing for new linkages to the high quality countryside surrounding deprived communities. Key strategies to influence include the Barrow Waterfront Masterplan, Carlisle Renaissance Strategy, Strategic Economic Plan and Masterplan for West Cumbria and Kendal Regeneration Plan.
<i>Opportunity 3</i>	West Cumbria masterplan – Britain's Energy Coast provides opportunities to build on the ambition to "become a globally competitive energy and environmental cluster", providing new opportunities for renewable energy, with Green Infrastructure contributing to this.
<i>Opportunity 4</i>	Ensure that new investment presented through New Growth Point funding and potential for eco town development incorporates Green Infrastructure from the outset through an integrated Green Infrastructure plan, alongside housing growth.
<i>Opportunity 5</i>	Green Business Parks, incorporating Green Infrastructure principles and renewables technologies as part of the renaissance of market towns and growth in appropriate industry for the rural heartland of the sub region.
<i>Opportunity 6</i>	The Broughton Moor MOD site in West Cumbria provides an opportunity to see hard end use and Green Infrastructure fully integrated across a wide area (950 ha)
<i>Opportunity 7</i>	The designated landscape extension provides a key opportunity to link the 2 National Parks together, providing a continuous joined up protected landscape encompassing the Lakes, Dales and North Pennines – the most significant protected stretch of high quality Green Infrastructure in the UK.
<i>Opportunity 8</i>	The creation of the North West Coastal Trail provides new opportunities for green links and corridors to the coast and uplands, as well as into urban areas where access to the countryside may be limited at present.

APPENDIX 3 ACTIONS

The following table identifies a series of actions that can assist in overcoming the pinch issues through green infrastructure planning. The list is non-exhaustive, one that should be added to. It is also aimed at sub-regional level, so is not specific about the typologies in all cases, unless there is an obvious reason to state the typology because it is particularly relevant or well adapted to delivering the function and overcoming the pinch.

The pinches are listed in order of priority as set out in the main document.

Pinch	Action	Type
Risk of flooding	Protect flood zones from new development	safeguard
	If development occurs within flood risk areas it should be designed for flood resilience	enhance
	In urban areas explore opportunities for deculverting of water courses where this can assist in reducing flood risk	enhance
	Explore areas upstream of flood risk area where it may be possible to reduce flood risk through green infrastructure e.g. water parks, woodland creation, and take opportunities where they exist	enhance
	Design all development and restructuring so that it does not pass on flood risk, especially where it is upstream of flood risk areas	enhance

	Take opportunities through development and restructuring to reduce flood risk downstream, through SUDS, green infrastructure and woodland creation	enhance
	Development should be avoided, where possible, in areas where the soil has a high infiltration rate and should not increase the proportion of impervious surface cover on such soils	safeguard
Risk of inadequate water supply	Actions are covered by United Utilities Water Resources Plan ²⁵ .	safeguard
	Support expansion of SCAMP type programmes in uplands	enhance
	Explore opportunities for watershed forestry programmes	enhance
	Develop opportunities for water collection and storage for use in times of drought for irrigating green infrastructure and maintain evaporative cooling, avoiding use of mains water in times of drought or water stress.	enhance
Risk of urban heat island effect	Protect assets such as city / town centre parks, open spaces in built up areas, and areas with vulnerable populations	safeguard
	Ensure no net loss of green cover and increase it wherever possible	safeguard

	Undertake creative greening to enhance green cover, with particular attention to town centres, areas with low green cover, and vulnerable populations - 10% rule, use of green roofs	enhance
	Maintain and increase cover of large canopied trees for shade provision	enhance
	Where possible, protect green infrastructure assets which encourage air flow into urban areas	safeguard
	Align new development and restructuring so that it encourages air flow into urban areas	enhance
	Ensure a water supply for vegetation	safeguard
Risk of loss of biodiversity	Follow principles set out in "Biodiversity by Design"	enhance
	Protect existing ecological networks in new development and restructuring areas	safeguard
	Maximise opportunities for creating new habitats and filling gaps in ecological networks during new development and restructuring, with particular attention to north-south connectivity	enhance
	Manage agricultural land to protect existing ecological networks	safeguard

	Maximise opportunities for creating new habitats and filling gaps in ecological networks in agricultural landscapes, with particular attention to north-south connectivity	enhance
Risk of loss of carbon storage	Aim for net removal of CO2 in the North West from land use, land use change and forestry	enhance
	Avoid new development in areas with highest carbon densities	safeguard
	Maintain the carbon storage in high density areas, such as areas with a higher density than the NW mean of 178 tC/ha	safeguard
	Increase carbon stored – e.g. through agricultural practices, woodland creation	enhance
	Offset carbon lost through new development by increasing carbon stores and/or maintaining the carbon stored in other areas	safeguard
	Target areas to maintain and increase carbon stored – e.g. woodland creation in lower quality agricultural areas where it has potential to be multi-functional, management of areas of significant carbon stores. This could be delivered through the newly launched north west climate fund.[1]	enhance
Risk of poor air quality	Increase woodland edge effect around and within urban areas	enhance
	Develop street tree opportunities	enhance

	Develop Community Forests and woodland initiatives to increase or at least maintain woodland cover	enhance
	Design woodland pockets within development master plans	enhance
	Allow street tree opportunities within smaller scale development proposals	enhance
Risk of coastal storms	Carry out dune protection through planting, thatching or fencing	enhance
	Ensure no loss of salt marsh occurs	safeguard
	Create braided river channels or other opportunities for flood areas	enhance
	Encourage appropriately stocked grazing to allow sward and therefore salt marsh integrity	enhance
Risk of poor tourism, recreation, cultural & heritage (TRCH)	Promote good design in areas that have a TRCH asset.	enhance
	Use environmental space such as street trees, pocket parks to safeguard assets or build new interest or interpretation.	safeguard
	Manage water courses and water features as part of the infrastructure that can enhance and safeguard areas of TRCH interest.	safeguard
	Allow green infrastructure to be interpreted as appropriate to build understanding of TRCH assets.	safeguard

Risk of soil erosion	Encourage agricultural practices to reduce soil erosion, particularly where there is a high or very high risk	safeguard
	In other areas where there is a high or very high risk of soil erosion use land cover change and management techniques to reduce the risk.	enhance
Risk of poor aesthetic	Integrate Green Infrastructure in to design and ensure that design takes into account landscape character if appropriate or the green infrastructure element of the design are appropriate for the site and enable other functionality	enhance
	Target gateways and key transport corridors as well as civic areas and improve quality of green infrastructure as part of the public realm.	enhance
	Work with CABI, English Heritage, HMR initiatives and Sustainable Development Commission to achieve good design.	enhance
	Ensure local authorities integrate green infrastructure into development proposals.	enhance
Risk of little green travel	Protect and create high quality network of recreation areas and local walking and cycling routes (for recreation and commuting) in and near to urban areas.	safeguard

	Protect and create local walking and cycling routes (for recreation and commuting) connecting services within rural areas, as well as rural to urban areas	enhance
	Highlight this as an issue to be addressed in local, city/sub-regional transport and statutory rights of way plans	safeguard
Risk of noise	Promote green noise barriers and other noise shelter planting in high noise areas.	enhance
	Protect existing green infrastructure that can play a role in reducing noise or perception of noise	safeguard
	Add street trees to urban settings to further dampen noise levels.	enhance

APPENDIX 4 THE FIVE STEP PROCESS FOR GREEN INFRASTRUCTURE PLANNING

The five step process for green infrastructure planning set out in the NW Green Infrastructure Guide are briefly described below in an extract from current work taking place in Liverpool to look at incorporating green infrastructure into the reconstruction of Liverpool Knowledge Quarter¹¹⁸.

1 PARTNERSHIP, VISION AND PRIORITIES

“Build partnerships of stakeholders who benefit from, and lobby for, green infrastructure

- Review relevant policies and strategies
- Determine the key outcomes for the green infrastructure mapping process
- The Partnership determines the scope of the plan based on resources, objectives and information available.
- Build organisational support for the Green Infrastructure Plan”

(Green Infrastructure Guide 2007)

2 DATA AUDIT AND RESOURCE MAPPING

“Identify available information, including maps, regional and national guidance, datasets, relevant policy frameworks, regional and national strategies and stakeholders. Generate a map of the physical area showing green infrastructure types and locations (usually on a GIS system).”

3 FUNCTIONAL ASSESSMENT

“Assess current situation – what the green infrastructure is ‘doing’, where it is functioning well and needs to be maintained, where it needs to be improved

Assess future situation – what are the threats to green infrastructure, where are the opportunities for improvement, how it might need to change, how to secure existing green infrastructure.”

4 NEEDS ASSESSMENT

“Cross-reference green infrastructure planning with strategic outcomes identified in Step 1. Reference relevant datasets such as deprivation indices, market research, house prices etc.”

5 INTERVENTION PLAN

“The Green Infrastructure Plan will set out:

- What the green infrastructure of an area is
- What it is doing and what it might do - functionality
- Where the green infrastructure is functioning well and needs maintaining
- How it needs to change – where functionality needs to be developed or improved
- What will be done to secure change – the plan for action.”

APPENDIX 5 GREEN INFRASTRUCTURE FUNCTIONS

A range of functions delivered by green infrastructure have been identified and are listed below.

As identified in the main body of the document these functions are delivered by the green infrastructure types and we derive benefits in turn from groups of these functions.

In this critical GI study we have identified where there is a need for some of the functions listed below to help to overcome a pinch issue. Whilst not all of the functions are assessed in this study (as some were not seen to be related to a pinch), it is recommended that at a local level full green infrastructure functionality is assessed alongside the needs assessment in order to produce a coherent intervention plan.

Green infrastructure functions list

- Recreation - public
- Recreation - private
- Green travel route
- Aesthetic
- Water storage
- Water interception
- Water infiltration / natural drainage
- Storm protection - coastal
- Shading from sun
- Evaporative cooling
- Trapping pollutants
- Noise absorption
- Habitat for wildlife
- Corridor for wildlife
- Soil stabilisation
- Heritage
- Cultural asset
- Carbon storage
- Food production
- Timber production
- Biofuels production
- Water supply
- Wind shelter
- Learning

APPENDIX 6 DATASETS

Datasets used

Name (source)	Application	Issues
Natural Environment Index (TEP)	Landscape & Visual Quality Domain used to map aesthetic pinch	Doesn't match very well with common subjective assessments of aesthetic quality Super Output Area parcel system means that in some cases very large areas are considered as one
Carbon density mapping (R Milne, Centre for Ecology & Hydrology)	Used to map carbon storage pinch	Doesn't include anything deeper than 1m below ground level, and hence misses the most significant carbon stores 1km resolution is coarser than that used for other pinches
Coast (Ordnance Survey)	Used to map coastal storms pinch	Doesn't focus on potentially worst affected areas
Flood Zone 2 (Environment Agency)	Used to map flood risk pinch	Refers to tidal and fluvial flooding only, not pluvial
Ecological networks (Roger Catchpole, Natural England)	Used to map biodiversity pinch	Networks associated with different habitats were merged together
Urban areas (ESRI)	Used to map urban heat island effect pinch, noise pinch & areas of tourism significance	Doesn't focus on potentially worst affected areas
Main roads (ESRI)	Used to map noise pinch	Not very accurate
Railways (ESRI)	Used to map noise pinch	Not very accurate
Airports (Ordnance Survey)	Used to map noise pinch	

Soil erosion risk (Gina Cavan, University of Manchester)	Used to map soil erosion pinch	
Indices of Multiple Deprivation (Department for Communities & Local Government)	Air quality index used to map air quality pinch	Super Output Area parcel system means that in some cases very large areas are considered as one
Resource Zones (United Utilities)	Used to map water supply pinch	The likelihood of a real pinch occurring in different zones is not clear
Agricultural Land Classification (Natural England)	Used to map areas of high quality agricultural land	Doesn't distinguish between grades 3a & 3b
Likelihood of Best & Most Versatile Land (Natural England)	Used to map areas of high quality agricultural land	Not based on surveys
Growth Point Partnership Areas (Department for Communities & Local Government)		Precise locations of growth points have not yet been made public
Ocean Gateway (Peel)		'Fuzzy' boundary
National Parks (Natural England)	Used to map areas of tourism significance	Doesn't focus on areas expected to be subject to most significant short term development
Areas of Outstanding Natural Beauty (Natural England)	Used to map areas of tourism significance	Doesn't focus on areas expected to be subject to most significant short term development
Regional Parks (various)	Used to map areas of tourism significance	Doesn't focus on areas expected to be subject to most significant short term development
World Heritage Sites (English Heritage)	Used to map areas of tourism significance	
Heritage Parks & Gardens (English Heritage)	Used to map areas of tourism significance	Doesn't focus on those of regional importance

Datasets considered but not used

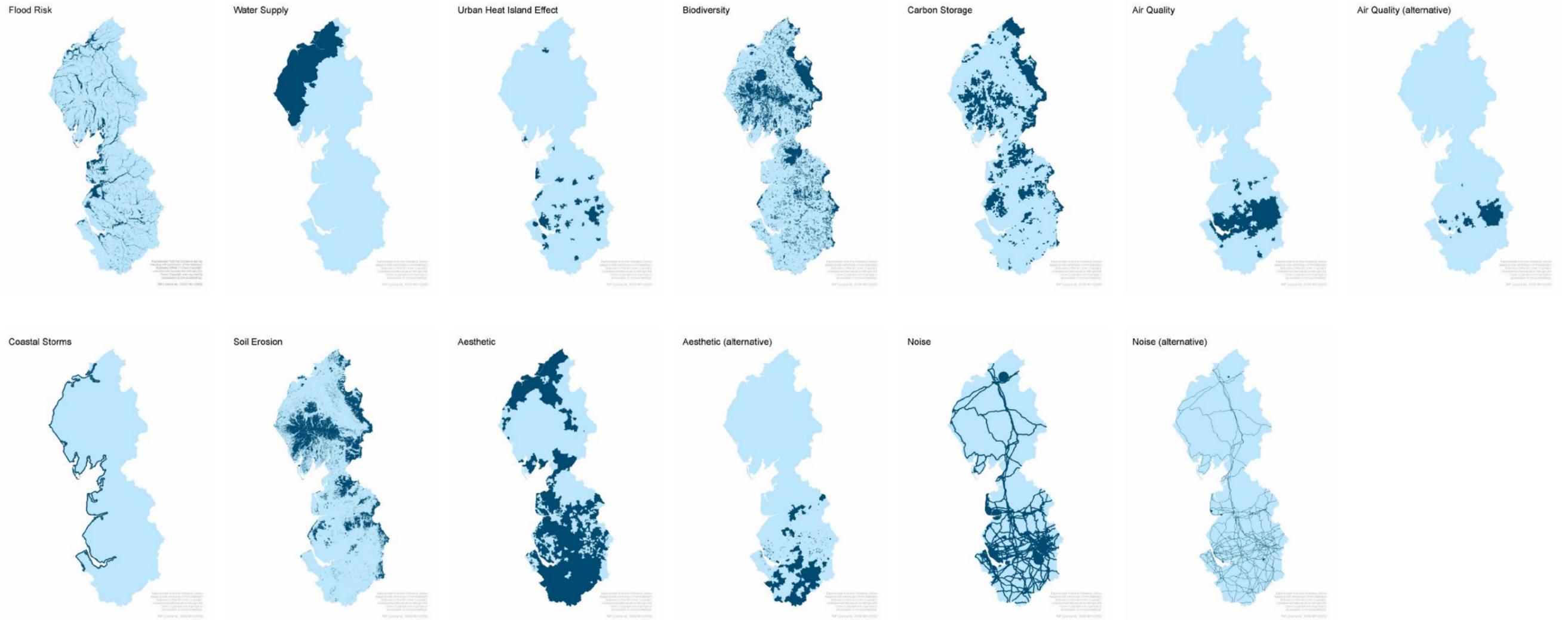
Name (source)	Application considered	Issues
Sites of Special Scientific Interest (Natural England)	Those in unfavourable condition on peat soils as areas of particular potential for enhancement of carbon storage function	Initial analysis showed that, according to the carbon density dataset mentioned above, the condition of SSSIs on peat soils does not correlate with the amount of carbon stored there
NATMAP soilscapes (Cranfield University)	To map peat and freely draining soils for carbon storage, water storage and water infiltration functions	See above Switch to mapping pinch rather than function removed need to map water-related function separately
Landscape capacity (Gina Cavan, University of Manchester)	To map reducing visitor pressure on vulnerable landscapes function	Not a pinch
Population density (Office for National Statistics)	To map need for aesthetic function, tourism, recreation, culture & heritage function and wind shelter function	Only one factor in a complex picture that extends beyond green infrastructure Doesn't take into account existing aesthetic quality or tourism, recreation, culture & heritage provision
National Trails (Natural England)	To map need for aesthetic function and tourism, recreation, culture & heritage function	Only one factor in a complex picture that extends beyond green infrastructure Doesn't take into account existing aesthetic quality or tourism, recreation, culture & heritage provision

Regional Investment Sites (NWDA)	To map need for aesthetic functions	Only one factor in a complex picture that extends beyond green infrastructure Doesn't take into account existing aesthetic quality
Scheduled Ancient Monuments (English Heritage)	To map tourism, recreation, culture & heritage function	Only one factor in a complex picture that extends beyond green infrastructure Doesn't focus on those of regional importance
Battlefields (English Heritage)	To map tourism, recreation, culture & heritage function	Only one factor in a complex picture that extends beyond green infrastructure
Heritage Coast (English Heritage)	To map tourism, recreation, culture & heritage function	Only one factor in a complex picture that extends beyond green infrastructure
Ancient Woodlands (Natural England)	To map tourism, recreation, culture & heritage function	Only one factor in a complex picture that extends beyond green infrastructure Doesn't focus on those of regional importance
Canals (Ordnance Survey)	To map tourism, recreation, culture & heritage function	Only one factor in a complex picture that extends beyond green infrastructure
Woods For People (Woodland Trust)	To map tourism, recreation, culture & heritage function	Only one factor in a complex picture that extends beyond green infrastructure Doesn't focus on those of regional importance
Countryside Rights of Way Act open access land (Natural England)	To map tourism, recreation, culture & heritage function	Only one factor in a complex picture that extends beyond green infrastructure

Sustrans routes (Sustrans)	To map tourism, recreation, culture & heritage function	Only one factor in a complex picture that extends beyond green infrastructure Doesn't focus on those of regional importance
Existing commercial plantations (Forestry Commission)	To map timber production function	Not a pinch
Inventory of Forests & Trees (Forestry Commission)	To map timber production and water interception function	Not a pinch Last updated 2002 Doesn't include woodlands of less than 2ha Switch to mapping pinch rather than function removed need to map water-related function separately
Community Forests (The Mersey Forest & Red Rose Forest)	To map timber production function	Not a pinch
Short Rotation Coppice land suitability mapping (Defra)	To map timber production and biofuels production functions	Not pinches Very coarse resolution
Miscanthus yield mapping (Defra)	To map biofuels production function	Not a pinch Very coarse resolution
Existing energy crops (Defra)	To map biofuels production function	Not a pinch
Woodland Grant Schemes (Forestry Commission)	To map biofuels production function	Not a pinch
Woodland management (The Mersey Forest)	To map biofuels production function	Not a pinch Limited to TMF region

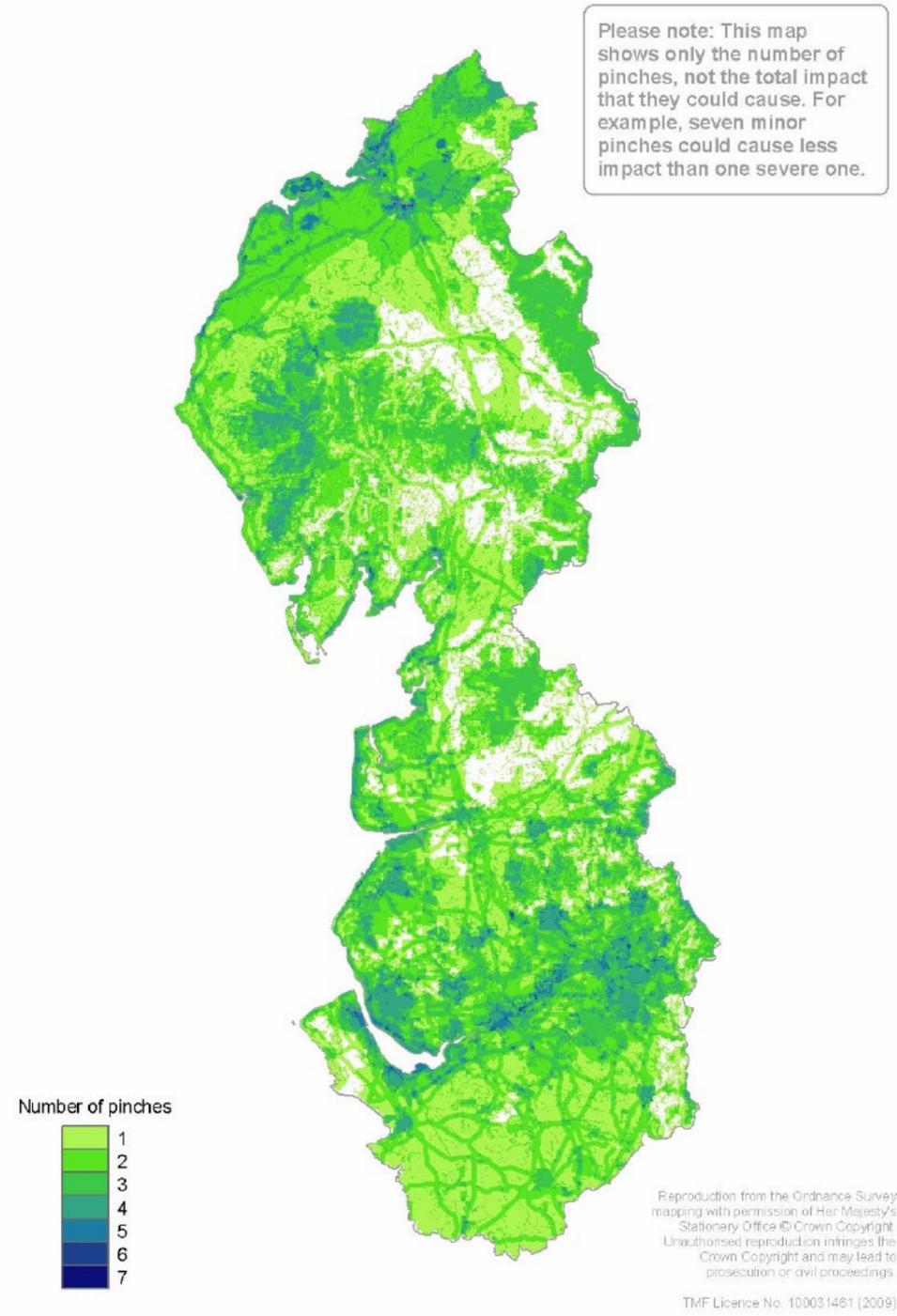
Reservoirs (ESRI)	To map water supply function	Doesn't take into account complexity of water supply system
Watercourses (Environment Agency)	To map water supply function	Doesn't take into account complexity of water supply system
Wind Speed Database (Department for Business, Enterprise & Regulatory Reform)	To map wind shelter function	Not a pinch Coarse resolution Only an average Lowest height is 10m above ground level
Nature Reserves (Natural England)	To map learning function	Not a pinch Only one factor in a complex picture that extends beyond green infrastructure
RSPB reserves (RSPB)	To map learning function	Not a pinch Only one factor in a complex picture that extends beyond green infrastructure
Traffic density (Highways Agency)	To map green travel routes function	Function not suitable for mapping at a regional scale Main roads only
Catchment boundaries (Environment Agency)	To map water storage and water interception functions	Switch to mapping pinch rather than function removed need to map water-related function separately

Individual pinch maps

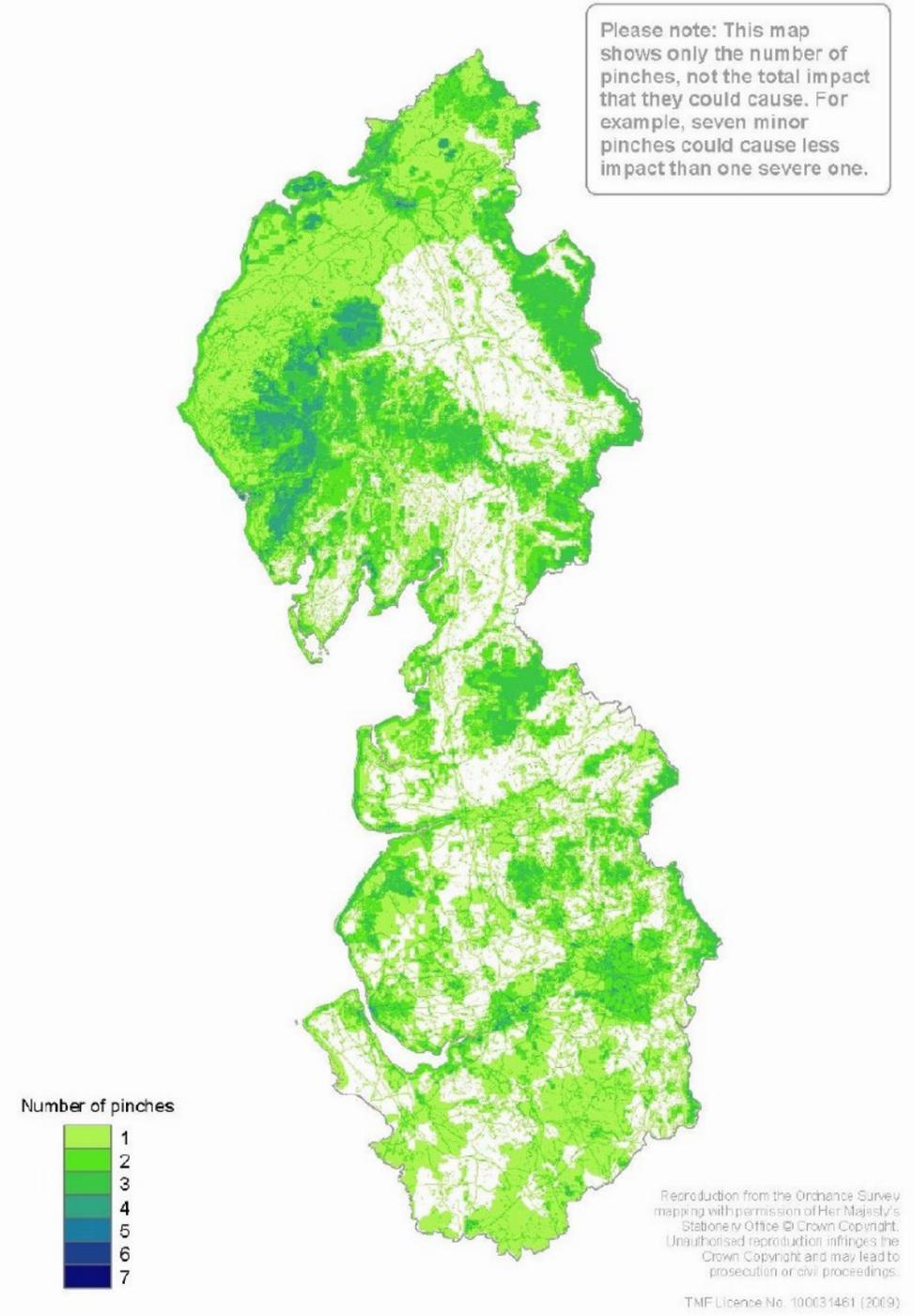


Number of pinches maps

Based on initial thresholds



Based on alternative thresholds

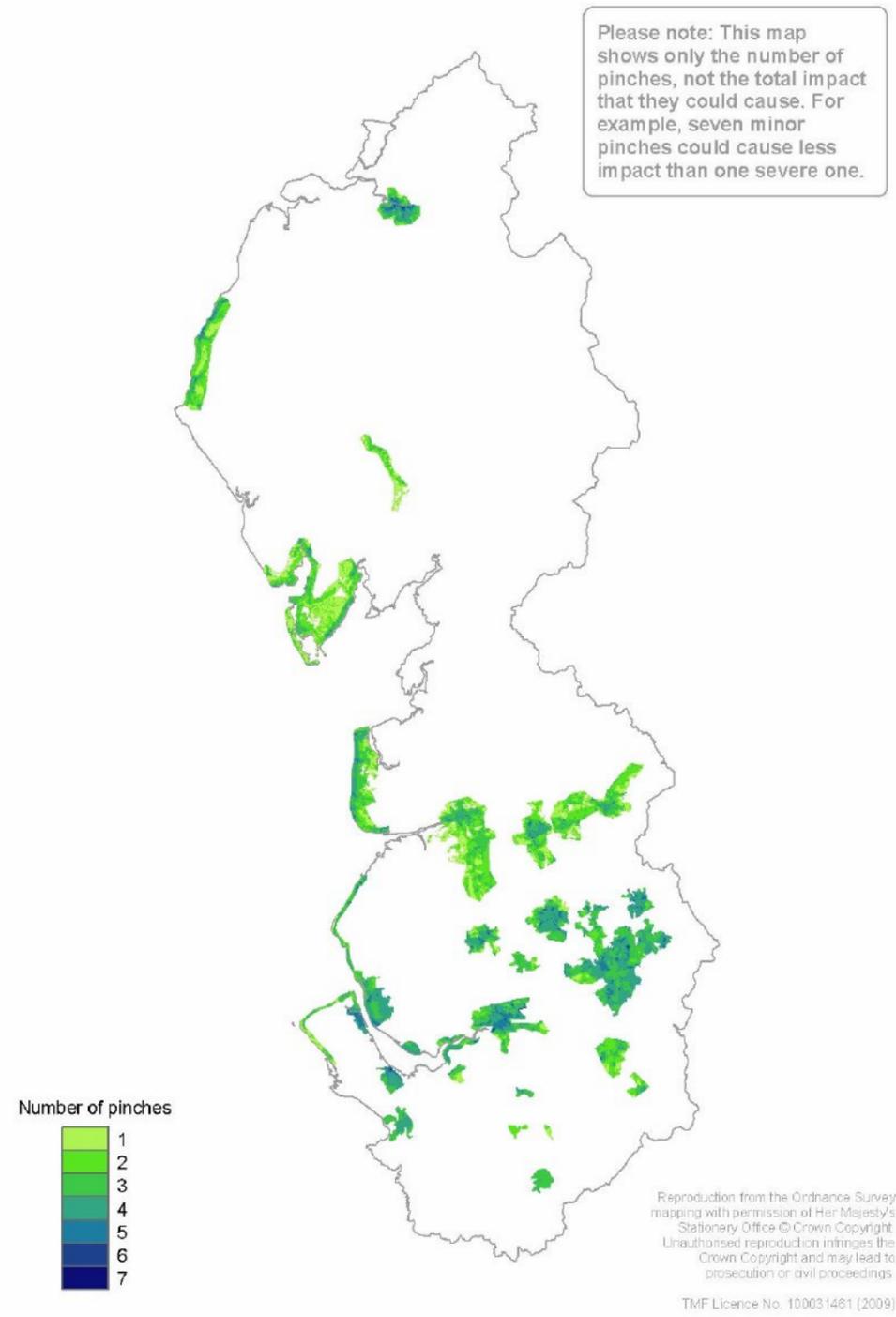


Individual strand 1 pinch point maps

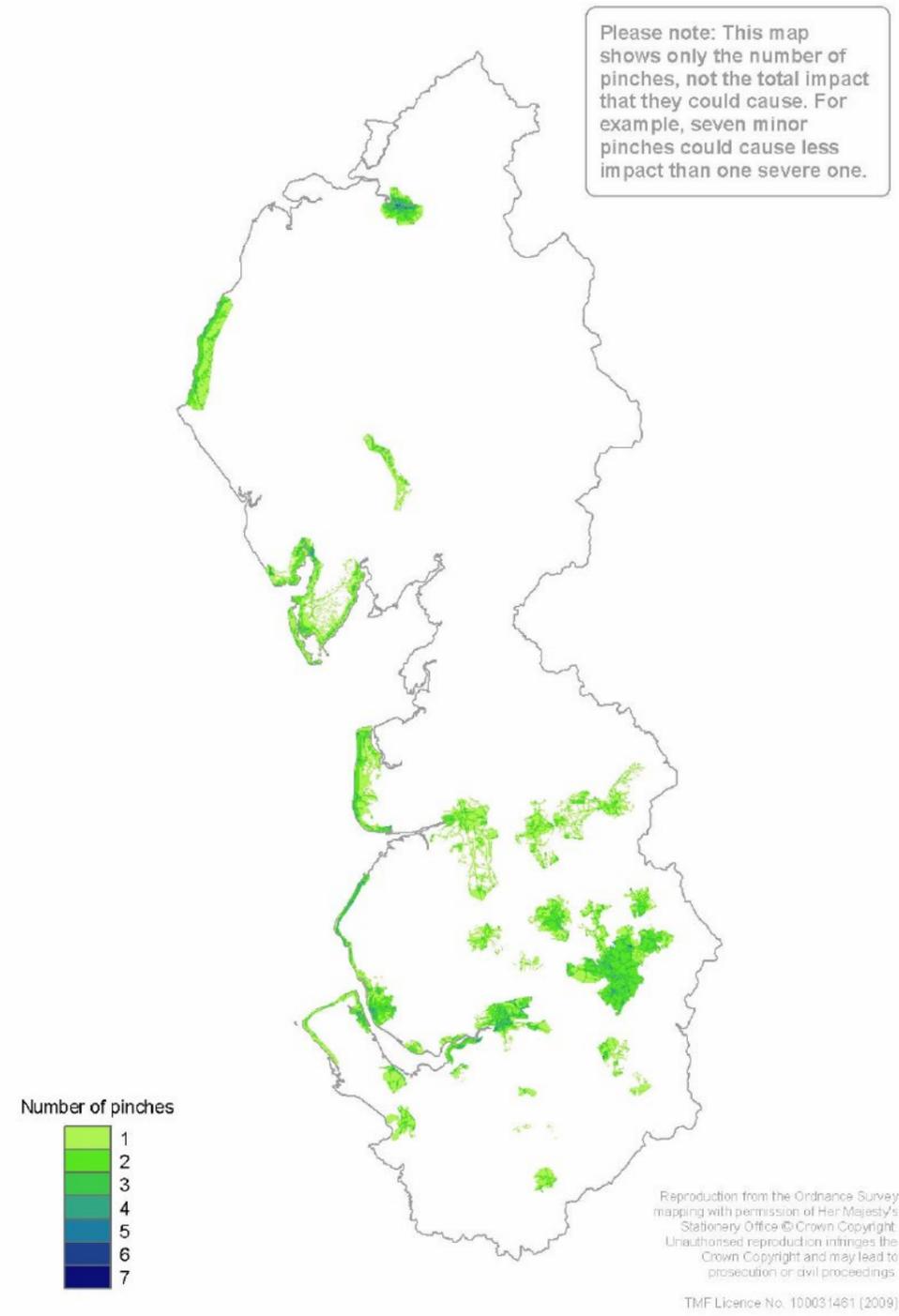


Number of pinches maps for strand 1 areas of search

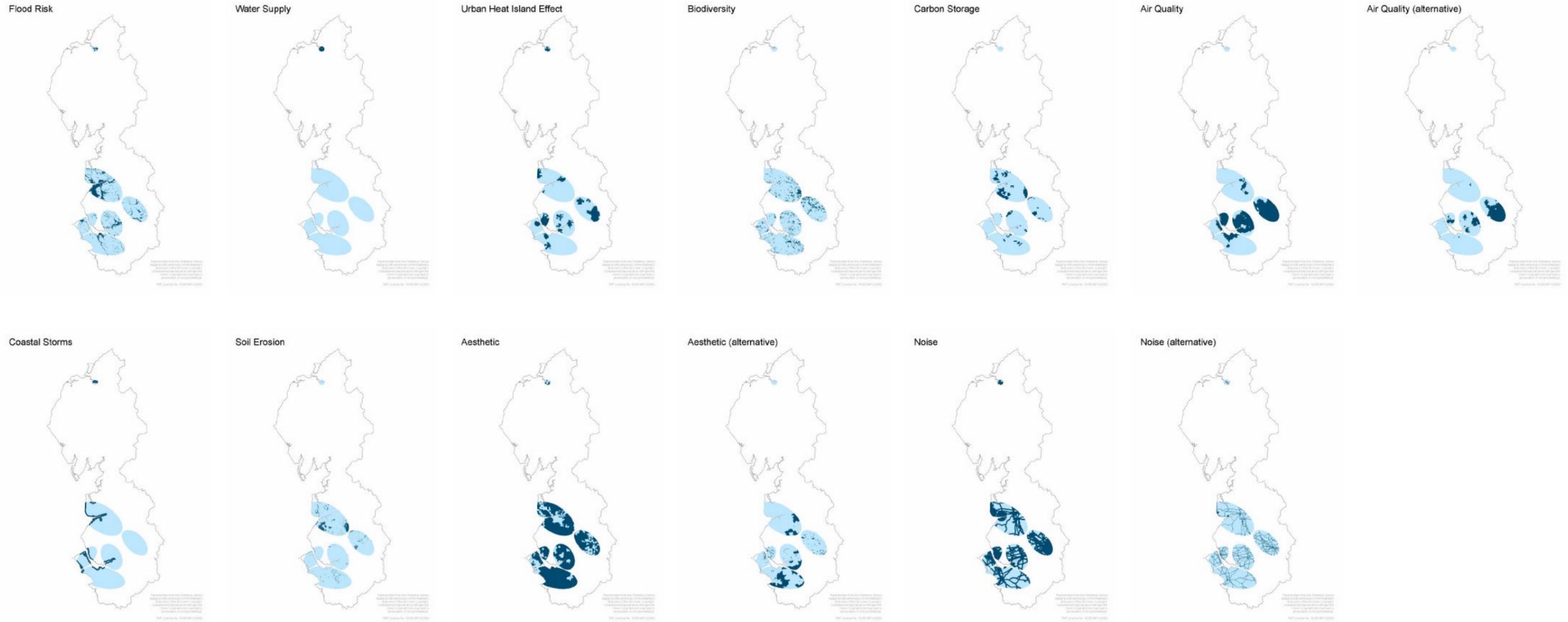
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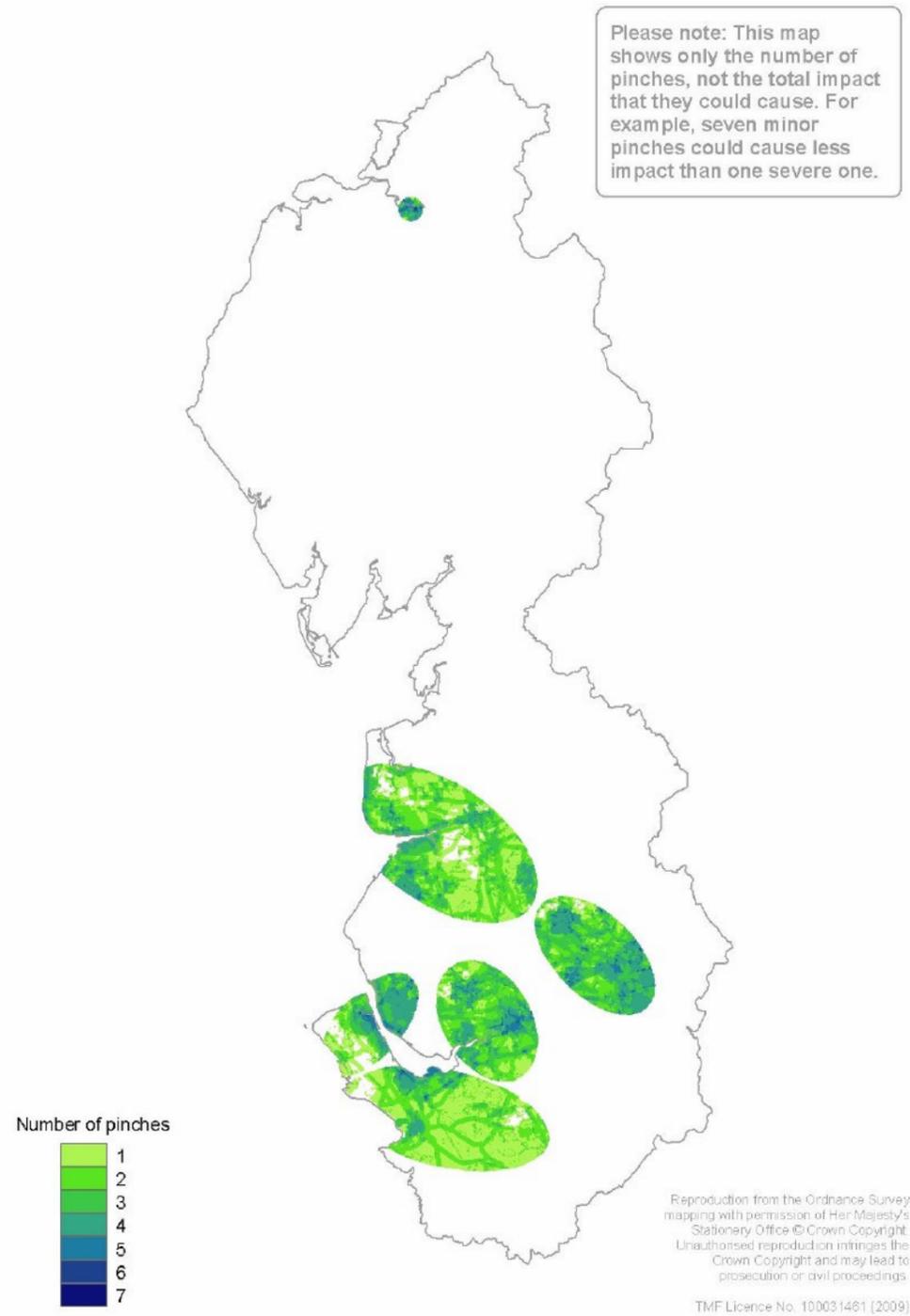


Individual strand 2 possible pinch point maps: Growth Point Partnership Areas

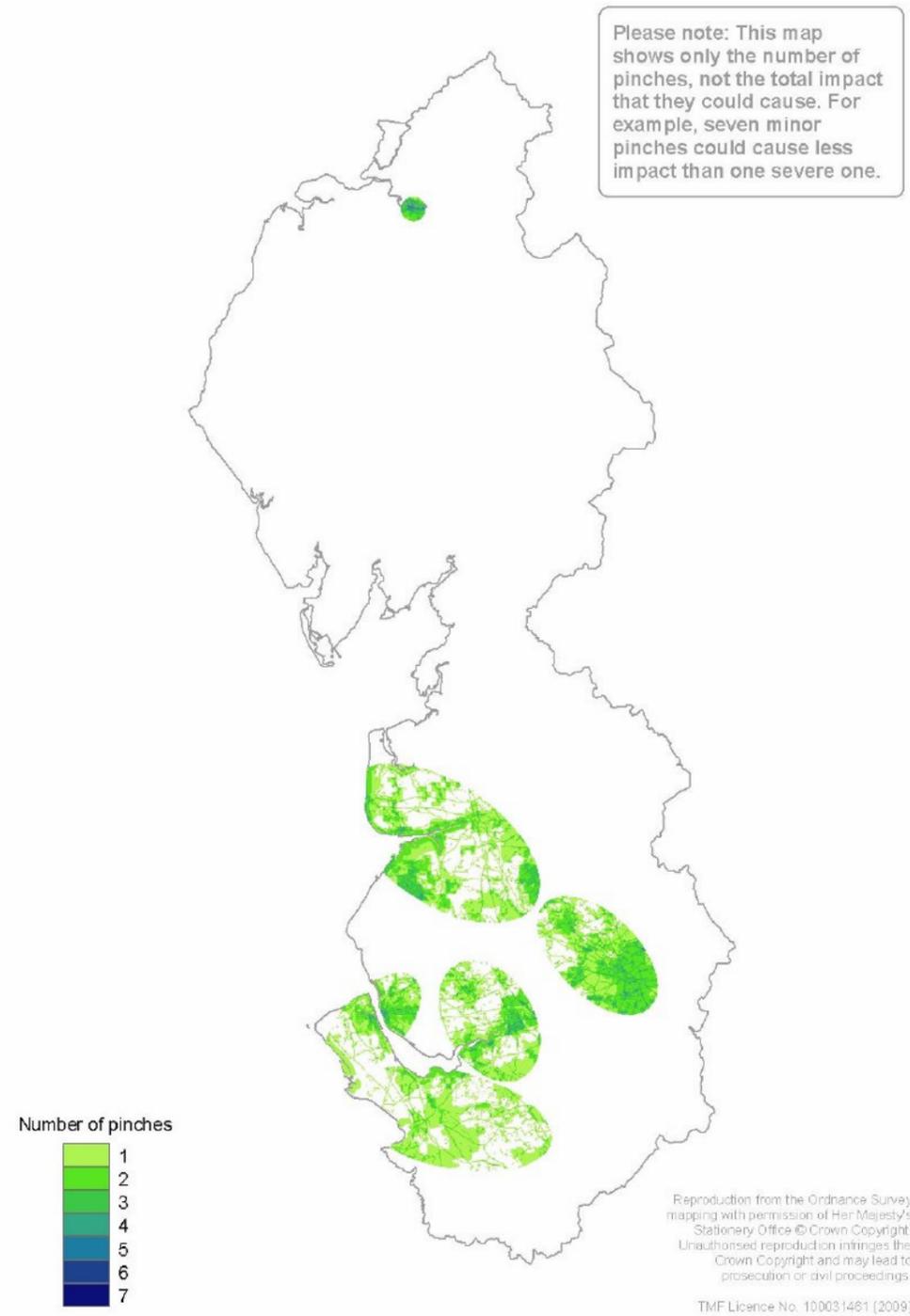


Number of pinches maps for strand 2 areas of search: Growth Point Partnership Areas

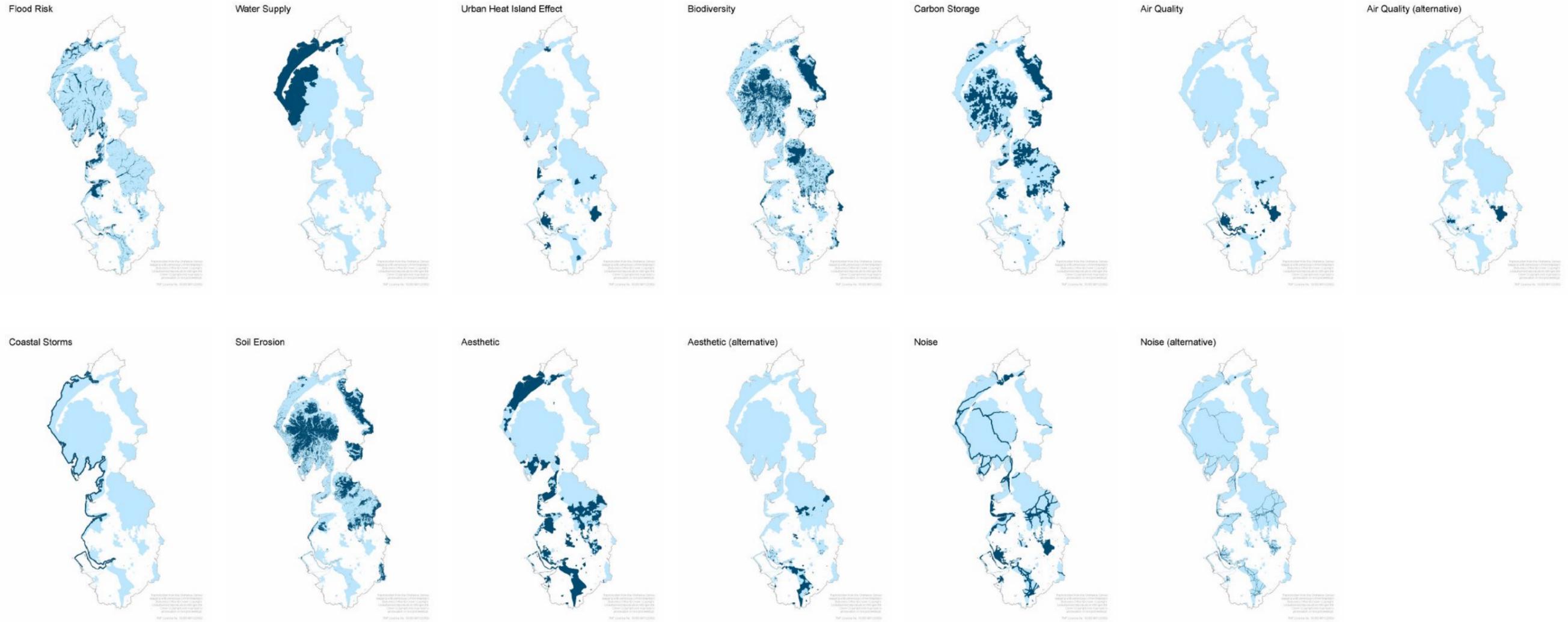
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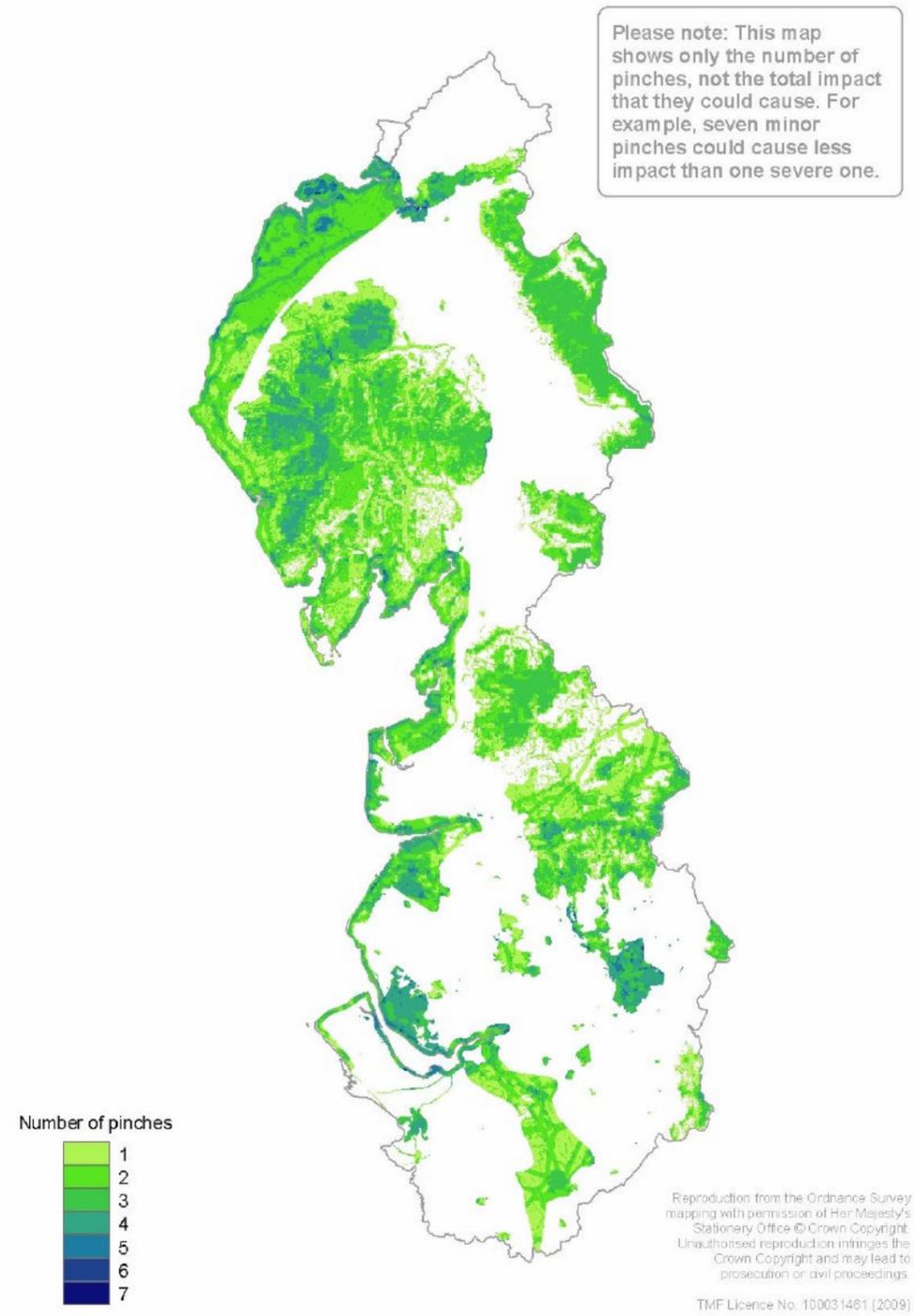


Individual strand 2 possible pinch point maps: Areas of Tourism Significance

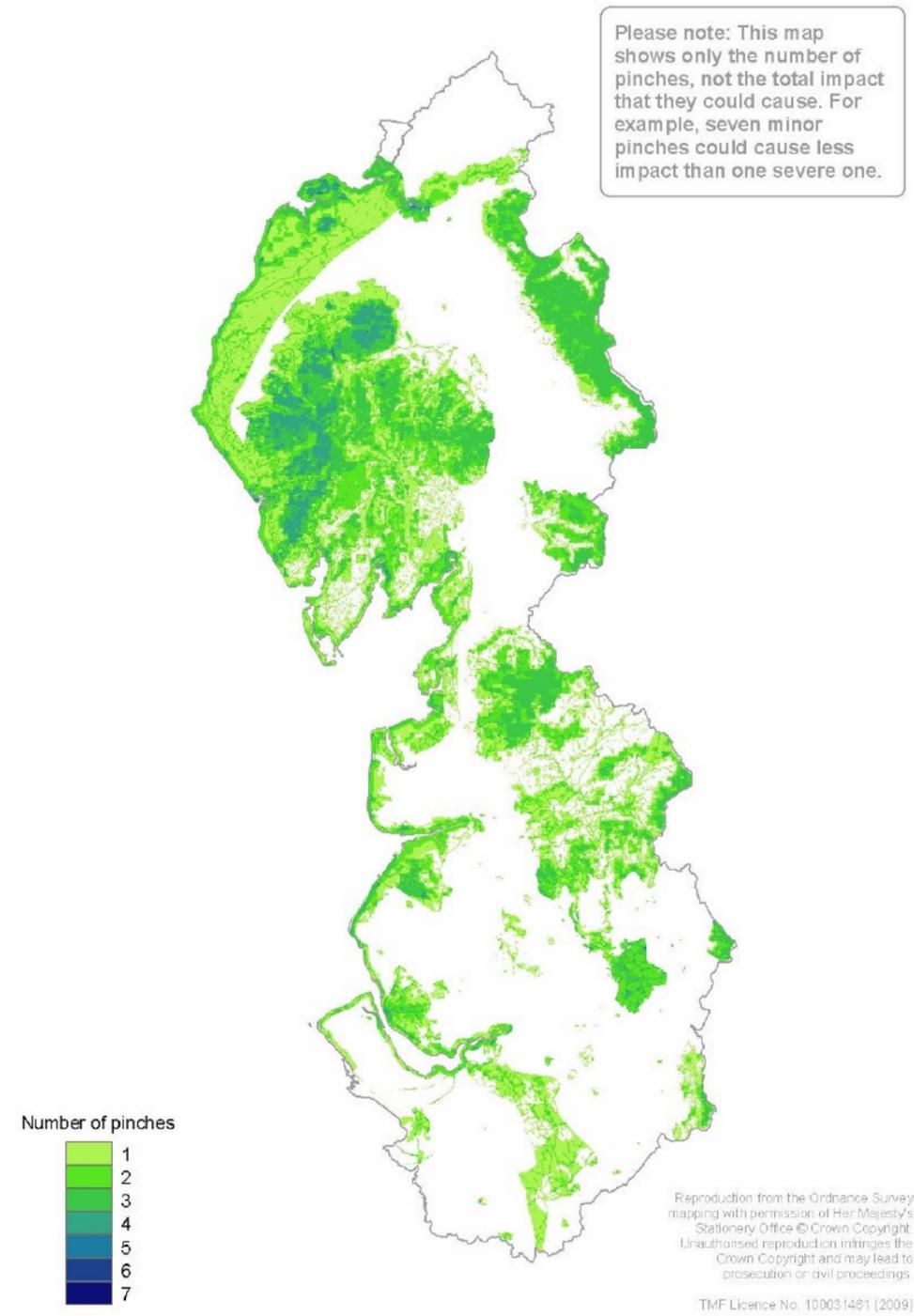


Number of pinches maps for strand 2 areas of search: Areas of Tourism Significance

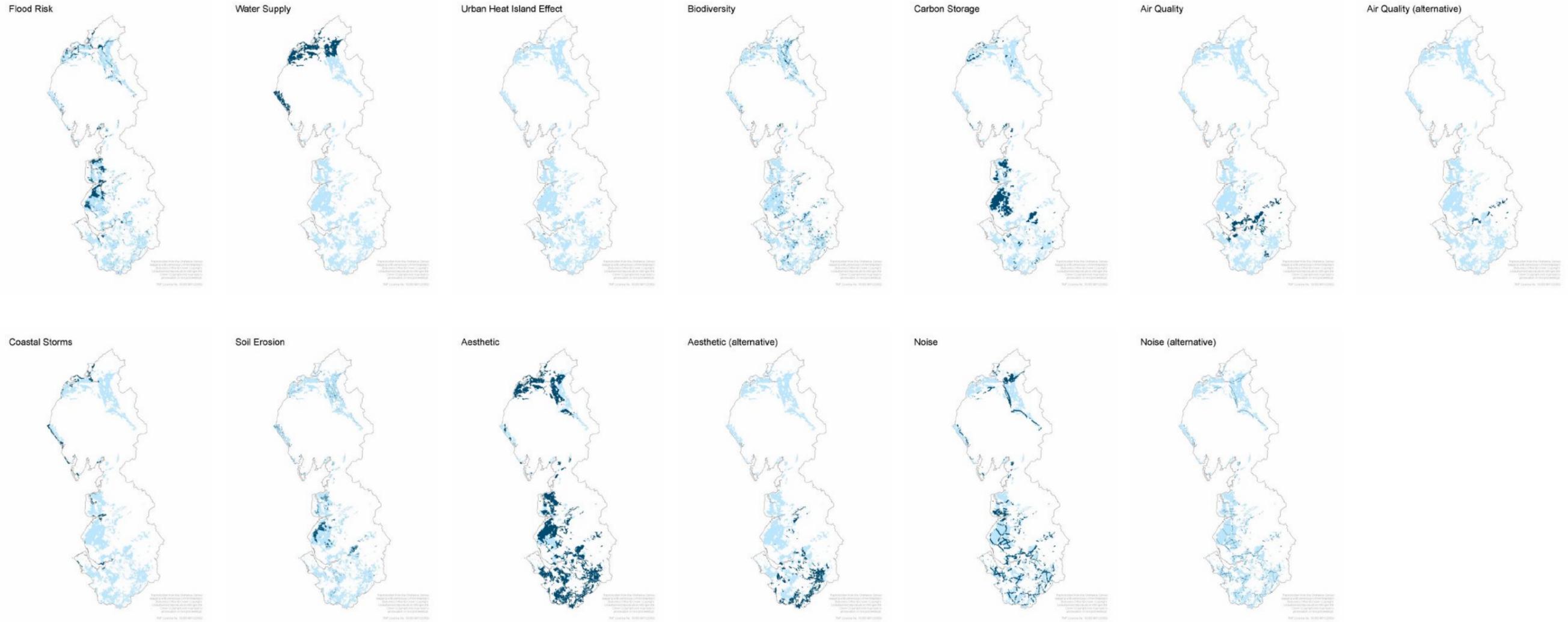
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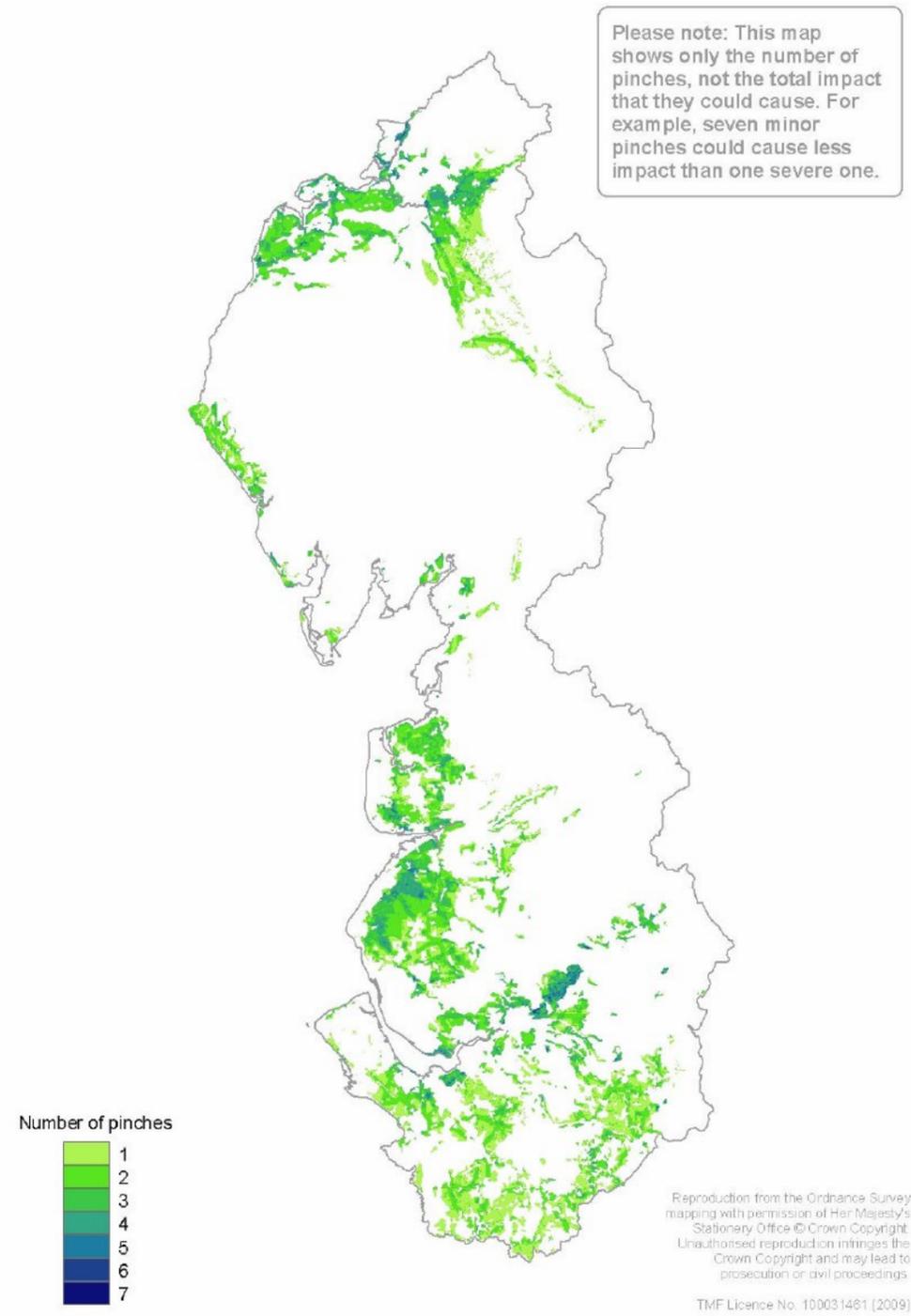


Individual strand 2 possible pinch point maps: Areas of High Quality Agricultural Land

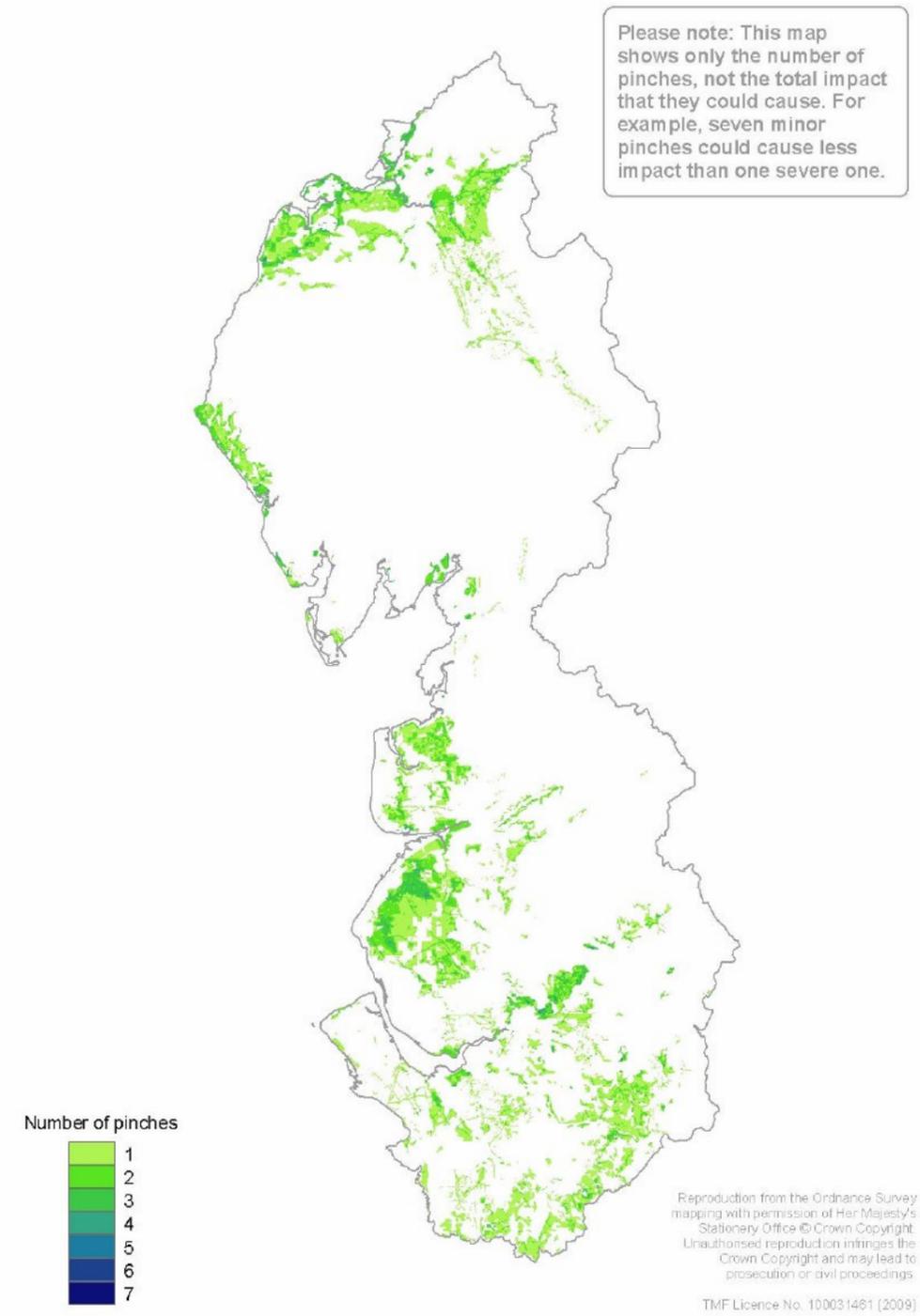


Number of pinches maps for strand 2 areas of search: Areas of High Quality Agricultural Land

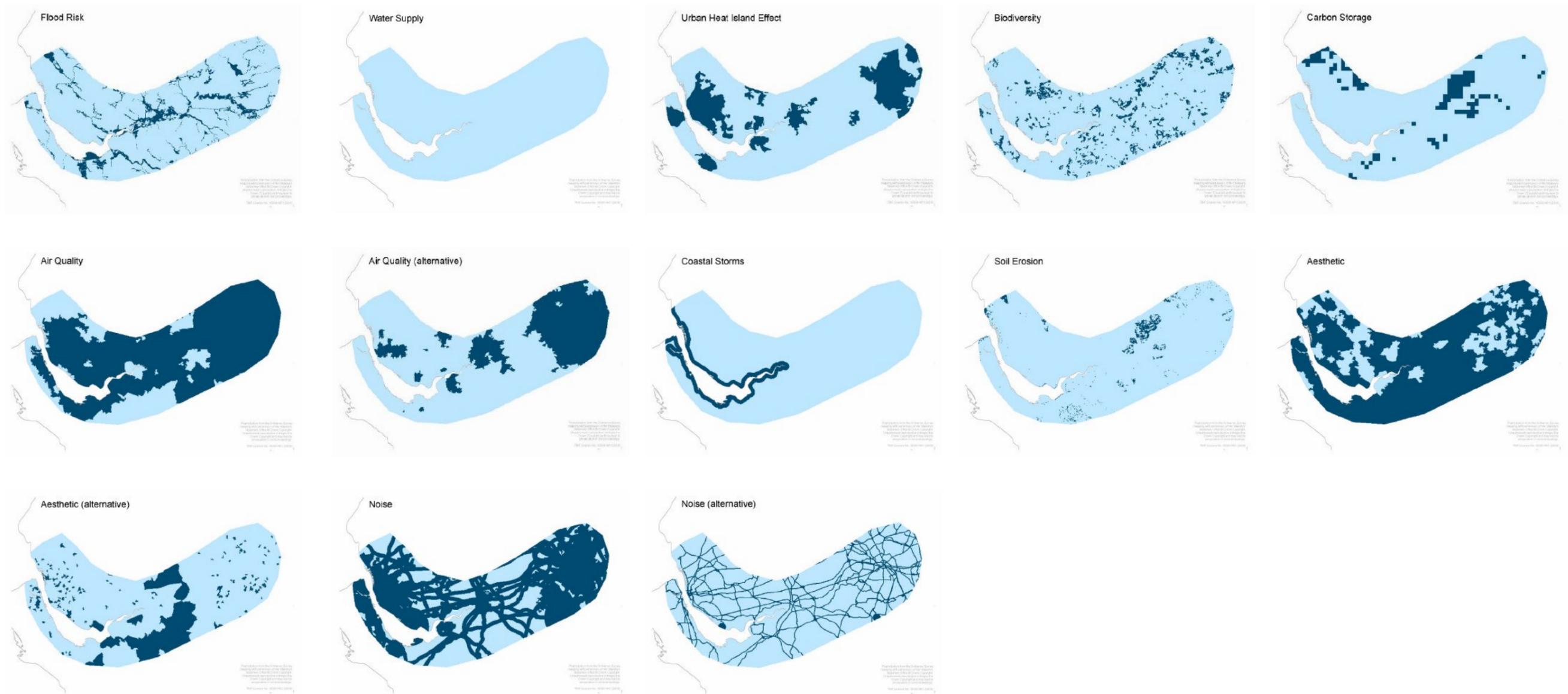
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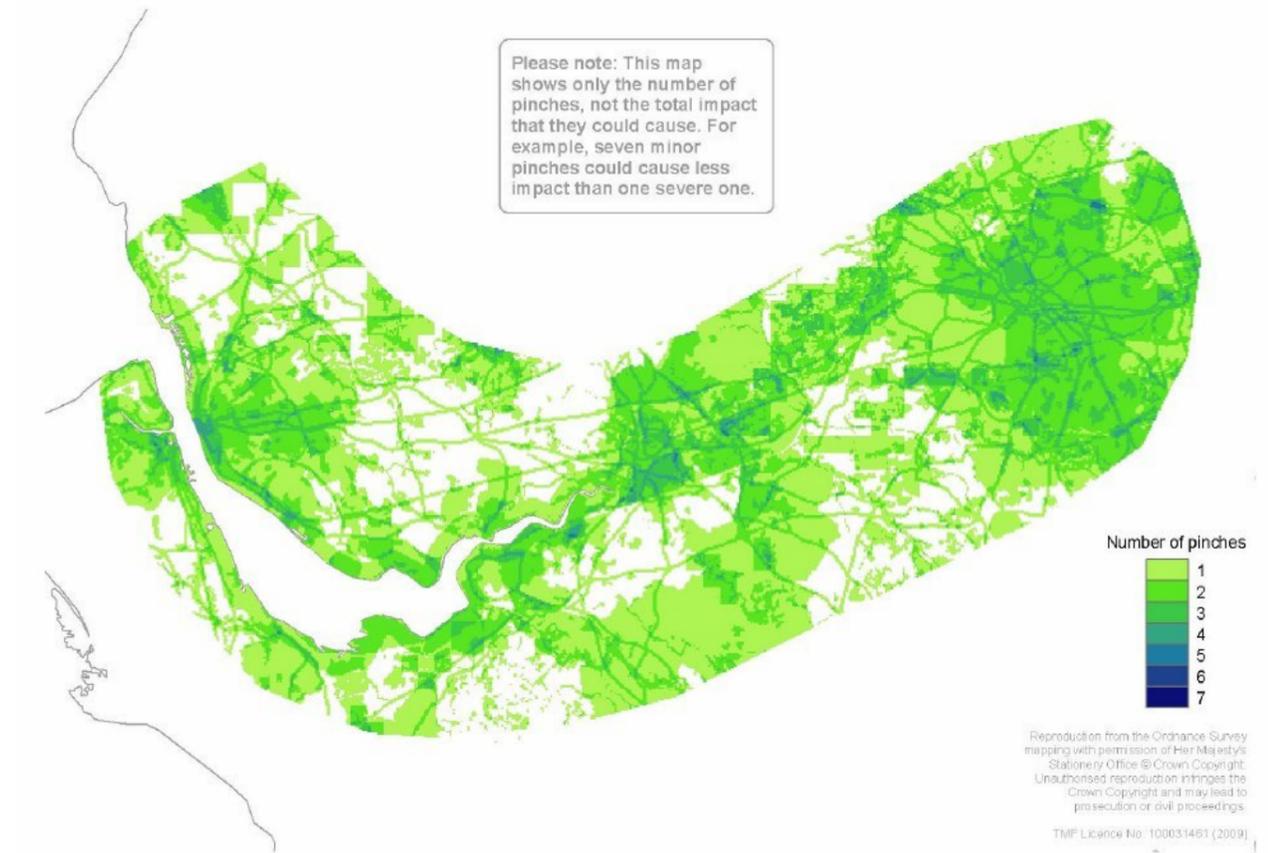
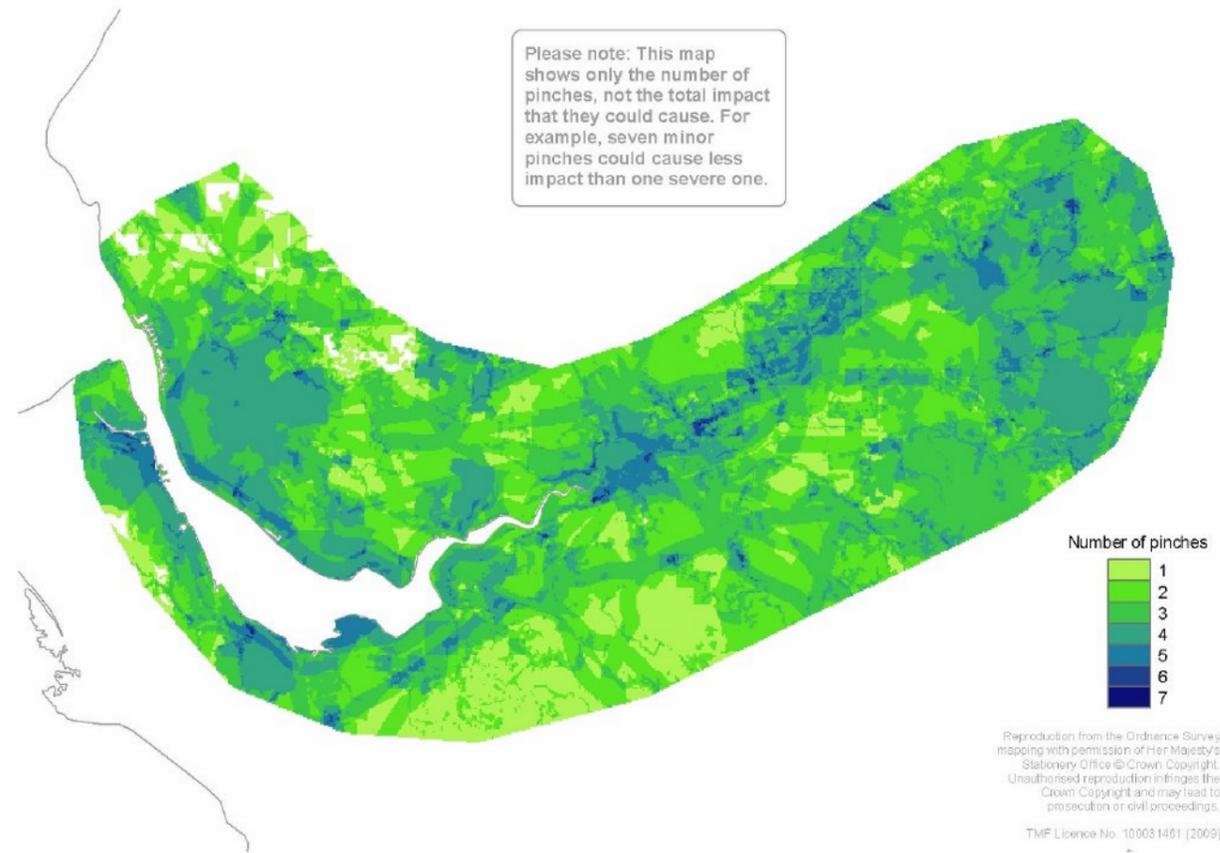
Individual strand 2 possible pinch point maps: Mersey Corridor



Number of pinches maps for strand 2 areas of search: Mersey Corridor

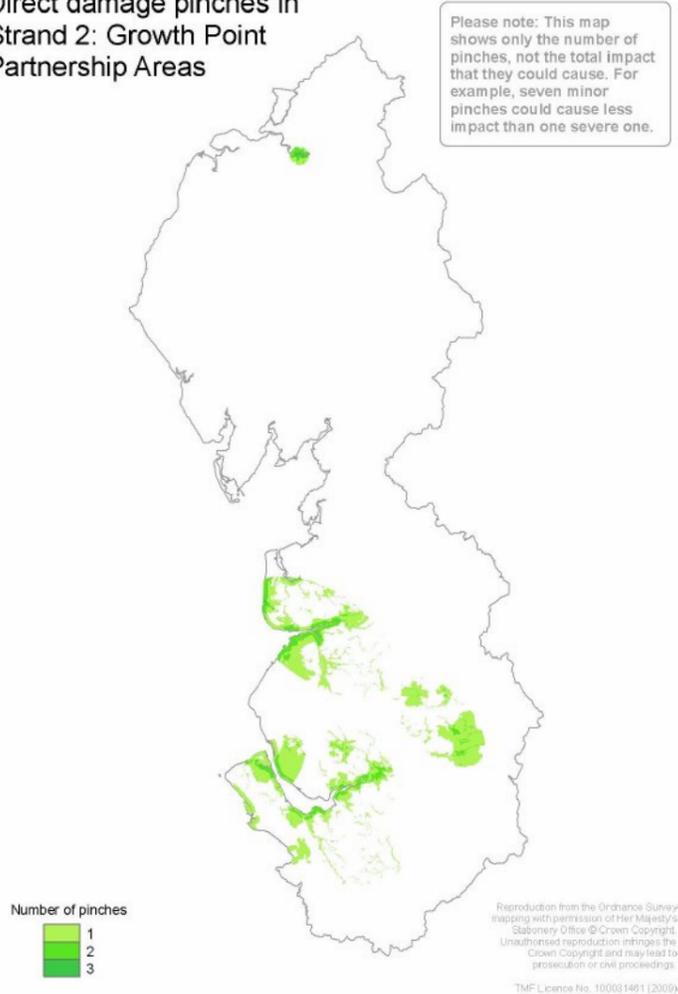
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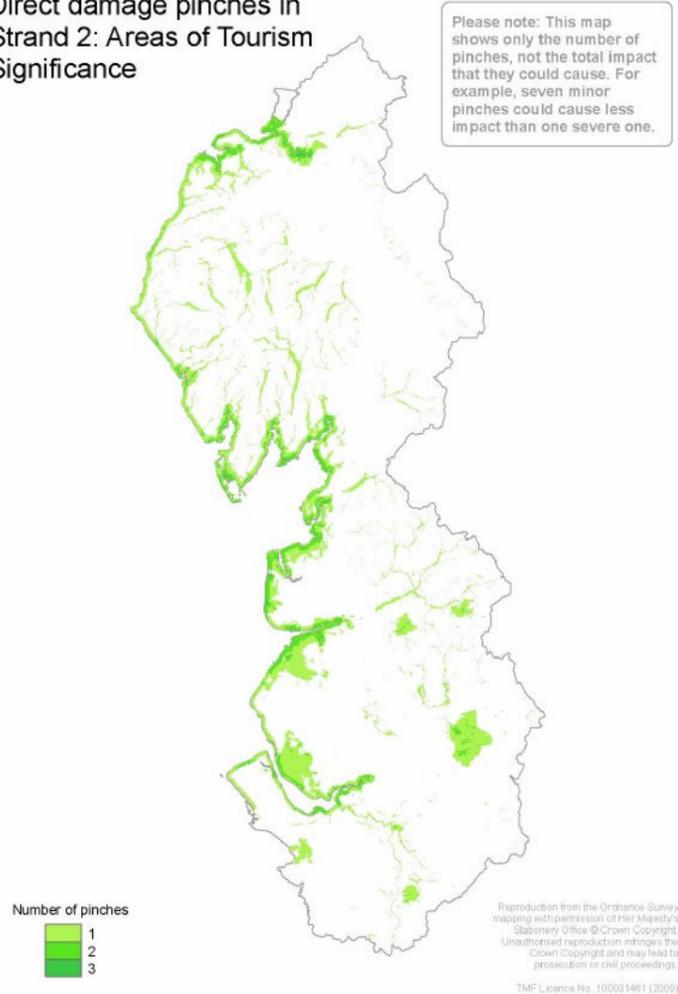


Number of direct damage pinches maps for strand 2 areas of search

Direct damage pinches in Strand 2: Growth Point Partnership Areas

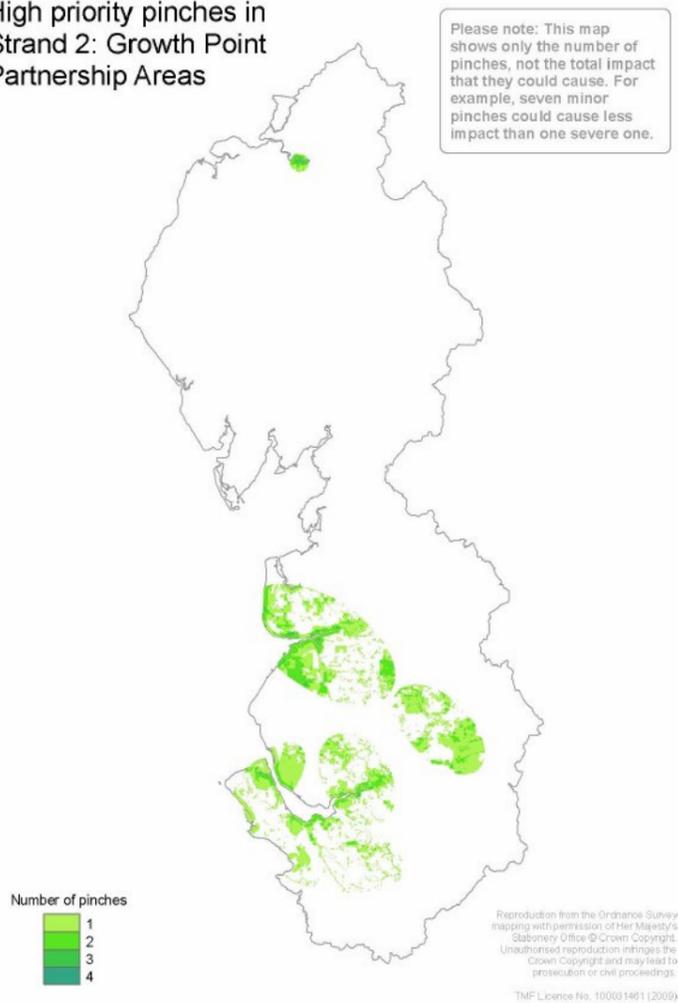


Direct damage pinches in Strand 2: Areas of Tourism Significance



Number of high priority pinches maps for strand 2 areas of search

High priority pinches in Strand 2: Growth Point Partnership Areas



High priority pinches in Strand 2: Areas of Tourism Significance

