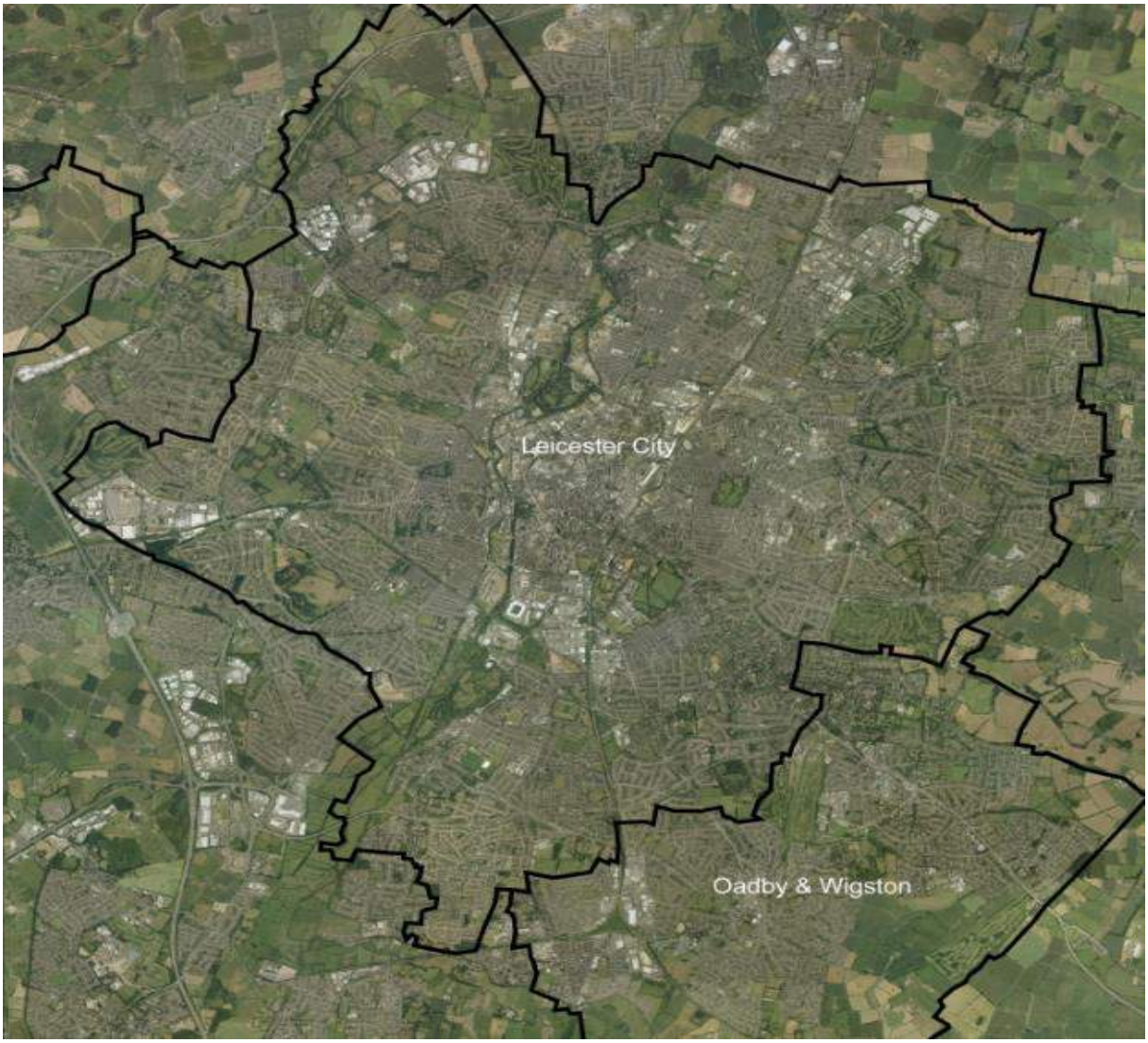
Climate Change Evidence Base Study

Leicester City Council and Oadby & Wigston Borough Council

Final Report



December 2015

Amec Foster Wheeler Environment
& Infrastructure UK Limited

Report for

Leicester City Council
Oadby & Wigston Borough Council

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Document revisions

No.	Details	Date
1	Draft Report	Feb 2015
2	Final Draft	July 2015
3	Revised Draft	Sep 15
4	Final Report	Dec 15

Executive summary

Purpose of this Report

This Report, prepared jointly for Leicester City Council and Oadby & Wigston Borough Council (the Councils), provides the evidence base to develop planning policies for climate change and renewable energy in the new local plans currently being prepared by each Council. This non-technical Executive Summary is intended to provide an overview of the key study findings and recommendations. The main body of the Report should be referred to for further detail.

Why planning for climate change is necessary

National planning policy requires local authorities to ***"adopt proactive strategies to mitigate and adapt to climate change"*** and ***"have a positive strategy to promote energy from renewable and low carbon sources"*** (paragraphs 94 and 97 of the National Planning Policy Framework [NPPF] respectively). This is within the context of the Planning and Climate Change Act 2008 which commits the UK to a reduction in carbon emissions by at least 80% by 2050 and seeks to ensure resilience to climate change impacts that are already likely to be faced.

At the local level, both Leicester and Oadby and Wigston are anticipated to face a higher frequency of extreme weather events, such as heatwaves, flooding and drought, with particular vulnerabilities to flooding associated with the River Soar and its tributaries. Ensuring that communities are resilient to these impacts is where the new local plans will have a key role to play.

Realising the benefits for Leicester and Oadby and Wigston's communities

Responding to climate change in Leicester and Oadby and Wigston could have a number of benefits for the area, including:

- Supporting economic growth through opportunities for inward investment and new jobs associated with greener technologies;
- Community benefits through helping to reduce energy bills, addressing fuel poverty and providing energy security; and
- Raising the profile of both Councils in leading on a response to climate change.

Role for the new local plans

The new local plans will need to accord with the NPPF and its range of objectives relating to climate change, as well as building on the significant positive steps that have already been taken, from the City Mayor's priority to deliver a 'low carbon city' in Leicester (and delivery of on-site renewable energy for a number of schemes) to Oadby & Wigston's 'low carbon vision'.

In response, this Report identifies two new draft policies and supporting evidence which will be subject to further consultation with the local communities, developers and other stakeholders. These draft policies can be found in the main body of the Report but in summary.

- Draft Policy 1 requires developers to plan positively for climate change in terms of both reducing carbon emissions, considering what the opportunities are to supply a development with renewable or low carbon sources of energy and ensuring that new development is resilient to the impacts of climate change that are already faced.
- Draft policy 2 provides a positive policy framework for the delivery of renewable and low carbon energy projects, including community-led schemes, subject to the local impacts of such schemes being suitably mitigated.

Ultimately these draft policies may be revised following further consultation and subsequent independent examination by a government appointed Planning Inspector. The draft policies may also need to be reviewed in response to future changes in national policy and building regulations.

How this Report can be used

Table EX1 sets out how this Report has informed the development of the draft policies and how the evidence can be used to support the local response to climate change more widely.

Table EX1 NPPF requirements (Paragraphs 94-99) and links with this Report and evidence base

NPPF Requirements	Links with this Report
Deliver more sustainable patterns of development to help reduce reliance on the car and associated carbon emissions	These three requirements are not directly addressed in this Report, since they relate to the policy approach and spatial strategy for the new Local plans as a whole. The response to these matters will be primarily informed by a process of Sustainability Appraisal (SA), incorporating Sustainable Environmental Assessment (SEA).
Ensure more sustainable forms of transport are used rather than the car, including walking, cycling and public transport	
Reduce the risk of flooding by ensuring that new development is neither vulnerable to flooding nor increase the risk of flooding elsewhere	
Plan for new development in locations and ways which reduce greenhouse gas emissions and taking account of landform, layout, building orientation, massing and landscaping to minimise energy consumption	The location of new development will relate to the spatial strategy in the new Local plans and the extent to which this supports reducing the need to travel by car, informed by the SA/SEA process (so beyond the scope of this Report). However, the design of an individual scheme and how it minimises energy consumption is central to this Report and reflected in Draft Policy 1 and supporting text.
Actively supports energy efficiency improvements to existing buildings	Draft Policy 1 encourages a fabric first approach to energy efficiency.
Align with the government's zero carbon buildings policy	In the 2015 Budget the government announced that it will be not be progressing its zero carbon buildings policy for homes, having abandoned plans to introduce allowable solutions legislation and an increase in energy efficiency standards in 2016 building regulations. No further announcements have been made regarding delivery of zero carbon non-residential development.
Have a positive strategy to promote energy from renewable and low carbon sources, using policies to maximise such development whilst ensuring that adverse effects are addressed	Draft Policy 2 provides a positive policy hook for developers wishing to deliver renewable and low carbon energy schemes, whilst identifying the key criteria which will need to be addressed to help mitigate or minimise potential adverse local impacts.
Consider identifying suitable areas for renewable and low carbon energy development	The renewable resource assessment provided in this Report identifies a number of areas with potential to deliver new renewable or low carbon energy projects. Whilst no conclusions are made regarding the *suitability* of these sites in planning terms (which would require further work, environmental surveys, consultation and developer and landowner interest) it is a helpful starting point to consider where the opportunities exist.
Support community-led initiatives for renewable and low carbon energy	Draft Policy 2 provides support and encouragement for community-led projects, with the resource assessment providing a helpful starting point to understand what opportunities exist and where.

Table EX1 (continued|) NPPF priorities (Paragraphs 94-99) and links with this Report and evidence base

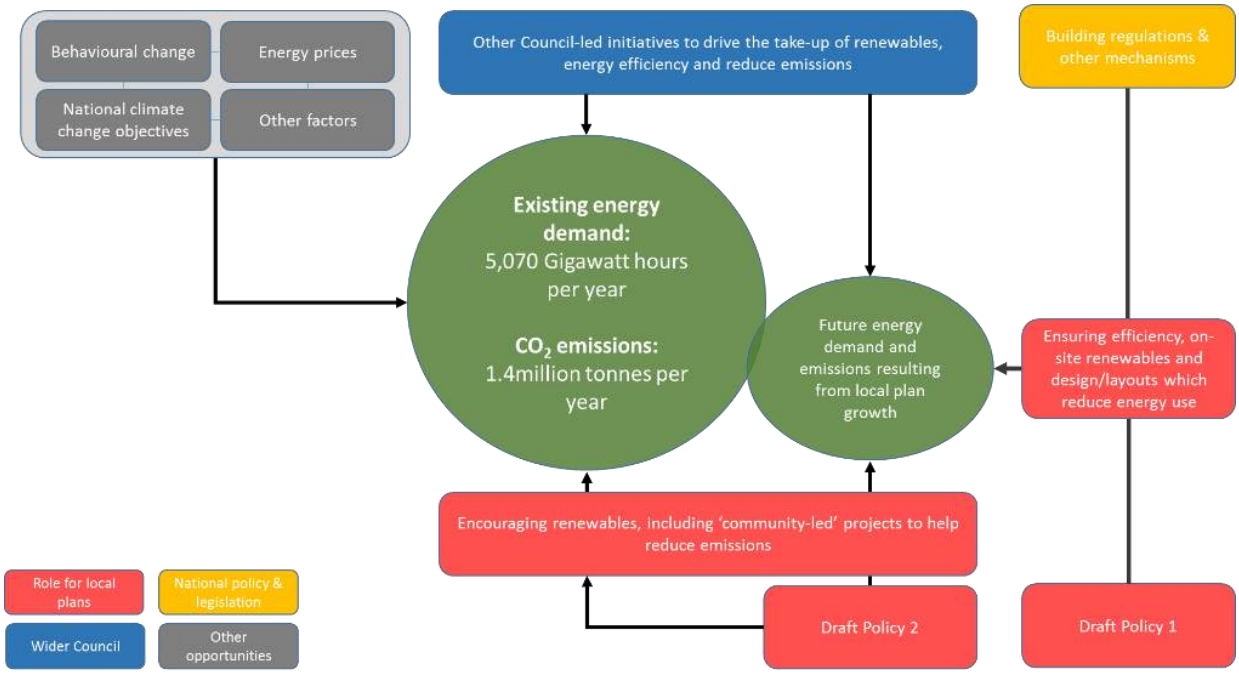
NPPF Priority	Links with this Report
Identify opportunities where development can draw energy supply from local energy supplies, such as low carbon district heating networks	Draft Policy 1 specifically references the need to consider connection to an existing heating network or the potential to establish a new one. In addition, the Report identifies the opportunities associated with an expansion of the existing heating network in Leicester City Centre. Leicester City Council is already well-engaged with the District Heating Vanguard Network. Opportunities for district heating in Oadby and Wigston will however be more limited given lower development densities and lack of anchor loads.
Not require developers to demonstrate the overall 'need' for a renewable and low carbon energy	Draft Policy 2 does not require the need for a renewable or low carbon energy development to be identified.
Take account of climate change over the longer term and minimise vulnerability to risks and ensure that communities are able to adapt to impacts that are already faced	This Report highlights the vulnerabilities to climate change that are already likely to be faced across Leicester and Oadby & Wigston. In addition, Draft Policy 1 requires developers to demonstrate how they have taken climate change adaptation into account, from minimising flood risk, to reducing water use and using green roofs.

How planning for climate change could affect development viability

The draft policies presented in this Report are unlikely to place an additional burden on a developer because the policies go no further than national standards and building regulations, reflecting the latest national policy position.

This Report shows that baseline (existing) carbon dioxide (CO_2) emissions across Leicester and Oadby & Wigston are estimated at 1.4 million tonnes per annum. Figure EX1 illustrates how this can be reduced, reflecting on the role of the local plans, wider Council actions (i.e. beyond planning) as well as national policy and legislation. The new local plans will therefore have a key role to play as part of the overall response, including minimising the impact of new growth and development on CO_2 emissions.

Figure EX1 Illustrating the role of the local plans and other mechanisms to reduce baseline energy demand and carbon dioxide emissions across Leicester and Oadby & Wigston



Further recommendations

As well as seeking to implement the policies suggested in this Report, further recommendations include:

- Further dissemination of the Report's findings, including what renewable and low carbon resource exists in the area.
- Potential further engagement with District Heating Vanguard Network (e.g. Leicester City Council hosted a recent workshop in July 2015[1]).
- On-going review and monitoring of schemes in Leicester which delivered on-site renewable energy and CO_2 reductions in response to the requirements of Local Plan Policy BE16. Leicester City Council's Environment Team hold information on the success of schemes and CO_2 savings from 2006-2015. This could include a review of projected versus actual performance to help developers understand the effectiveness of different technologies.
- Identifying projects or schemes where the Council can affect the delivery of renewable, low carbon or energy saving schemes, for example:
  - The potential to retrofit Council-owned properties with renewable energy (e.g. solar PV or biomass boilers) or energy efficiency schemes (insulation etc);
  - Taking forward a 'community-led' pilot project to deliver a renewable energy scheme, considering the renewable resource identified in this Report (e.g. a community owned wind turbine);
  - Identifying opportunities to achieve higher environmental performance for local authority-led buildings projects (e.g. through the procurement process);
  - Looking at opportunities for funding to deliver energy saving measures for the most deprived wards in Leicester, Oadby and Wigston (e.g. future ERDF funding bids);
  - Linking with educational institutions (schools, colleges and university) to raise the profile of climate change and renewable energy, to develop skills and attract 'green businesses' to locate and invest in the area; and
  - Review climate change impacts and consider what further measures may need to be taken in response to extreme weather events (e.g. emergency planning).

[1] http://www.heatandthecity.org.uk/dh_vanguards_network/workshop_-_financial_plans,_building_a_heat_tariff_and_heat_metering_july_2015 (accessed August 2015)

Contents

1. Introduction

1.1 Purpose of this Report

1.1.1 This Report, prepared jointly for Leicester City Council and Oadby & Wigston Borough Council, provides the evidence base to develop planning policies for climate change and renewable energy in their emerging local plans. The Report is intended to meet the requirements of both the National Planning Policy Framework (NPPF) and National Planning Practice Guidance (NPPG). The Report also reflects national climate change objectives, including the UK Government's commitment to reducing greenhouse gas emissions by 80% by 2050 and ensuring that communities and infrastructure are resilient to climate change impacts that are already faced.

1.2 Informing new local plans for Leicester and Oadby & Wigston

1.2.1 Leicester City Council and Oadby & Wigston Borough Council have adopted local plan policies to respond to climate change, ensure energy efficiency and encourage the delivery of renewable and low carbon energy projects (see Appendix C for a summary of adopted policies). With both Councils now preparing new local plans, there is the opportunity to include new climate change and energy policies, reflecting the latest national policy and guidance, including that contained within the NPPF and NPPG. This Report provides the evidence from which to do so, informed by a review of the latest policy context, the specific opportunities in each authority area and the potential implications for development viability.

1.3 Overall scope of this Report

Study area

1.3.1 The study area for this Report comprises the administrative boundaries of Leicester City Council and Oadby & Wigston Borough Council.

Identifying the renewable and low carbon energy resource

1.3.2 In assessing the potential for new renewable and low carbon energy projects it is important to note that the aim is not to identify specific suitable areas or sites in planning terms - it is simply to identify what 'technical potential' exists. Realising this technical potential will require the application of planning policy, development control, Environmental Impact Assessment (EIA) (where applicable) and engagement with stakeholders and local communities. It will also depend on scheme viability, including landowner and developer interest. This means that whilst the identification of technical potential is guided by overarching constraints, it does not make any conclusions or recommendations on the ultimate suitability of locations for energy-related development.

Policy recommendations

1.3.3 The policy recommendations in this Report reflect the national policy context as at October 2015 but it is important to note that national policy for climate change, renewable energy and energy efficiency is continuing to change. As a result, the draft policies in this Report are simply presented for information and may need to be reviewed and revisited as the respective local plans progress through consultation and examination.

1.3.4 Where viability is referred to in this Report it relates to any extra over costs associated with going beyond policies and regulations which are in force at the national level. The viability of national policies and building regulations is therefore beyond the scope of this study. In addition, no conclusions are drawn regarding the viability of the draft policies as a whole because this will depend on a local plan-wide assessment of viability and the relationship between the various policies in the plan.

1.4 Study objectives

1.4.1 The objectives addressed in this Report can be summarised as follows.

- Policy & legislation (section 2): to establish the latest position in what is an ever changing policy environment. This will be central to the development of planning policies for the emerging local plans of each authority;
- Climate change baseline (sections 3): understanding climate change impacts that are already faced within the respective Council areas as well as the existing situation in terms of energy demand, carbon dioxide emissions and renewable and low carbon energy provision;
- Resource assessment (sections 4-10): to assess future potential for local (decentralised) renewable or low carbon energy projects, from wind, solar, biomass and decentralised energy supply such as via district heating; and
- Policy conclusions (section 11): to provide draft policies and supporting conclusions to consider as part of the development of the new local plans.

2. National and Local Policy Context

This section reviews the national policy context for responding to climate change and delivering renewable and low carbon energy at the local level in Leicester and Oadby & Wigston.

2.1 National Policy and Legislation

National Legislation

2.1.1 The 2008 Climate Change Act commits the UK Government to delivering an 80% reduction in carbon emissions by 2050 (against a 1990 baseline) in order to help mitigate future climate change. With energy use from the built environment accounting for a significant proportion of the UK's total carbon emissions the government has identified both the planning system[2] and building regulations as having key roles to play. This is complemented by the Planning and Energy Act 2008, which first allowed local planning authorities to request on-site renewable or low carbon energy generation as part of new developments, typically referred to as the 'Merton rule' (e.g. that percentage of a development's energy demands shall be met via the use of on-site renewables). Leicester City Council has such a policy (BE16 – see section 2.2) but Oadby & Wigston does not.

National Planning Policy and Guidance

Overview

2.1.2 The role of the planning system in reducing emissions is affirmed in the National Planning Policy Framework (NPPF)[3] by encouraging local planning authorities to plan for new development in ways which reduce emissions (linked to wider policies on reducing the need to travel by car), actively supporting energy efficiency improvements to buildings and linking with the government's policy for zero carbon buildings, including zero carbon homes from 2016 and zero carbon non-residential development from 2019.

2.1.3 However, in the 2015 budget, the related measures to deliver zero carbon homes from 2016 (which included measures for carbon abatement [known as allowable solutions] and a tightening of building regulations in 2016) were withdrawn:

> *"The government does not intend to proceed with the zero carbon Allowable Solutions carbon offsetting scheme, or the proposed 2016 increase in on-site energy efficiency standards, but will keep energy efficiency standards under review, recognising that existing measures to increase energy efficiency of new buildings should be allowed time to become established"* [4] (page 46).

2.1.4 No further announcements have been made regarding zero carbon buildings and the previously set targets. The implication is that the zero carbon targets have now been withdrawn.

[2] http://www.planningportal.gov.uk/planning/planningsystem/ (accessed June 2015)
[3] Department for Communities and Local Government, March 2012
[4] Fixing the foundations: Creating a more prosperous nation, HM Treasury, July 2015

2.1.5 The NPPF also requires local planning authorities to have a positive strategy to promote energy from renewable and low carbon sources, design policies to maximise renewable and low carbon energy development, consider identifying suitable locations for such developments, support community-led initiatives and identify opportunities where development can draw its energy supply from decentralised, renewable or low carbon sources (including the co-location of potential heat customers and suppliers)[5] .

National Planning Practice Guidance

2.1.6 The NPPF is accompanied by the National Planning Practice Guidance (NPPG), which provides further details on how local planning authorities can promote the development of renewable energy strategies in their areas, balanced against the views of communities and local environmental impacts (Refer Table 2.1).

Table 2.1 Extract from NPPG (Paragraph: 003 Reference ID: 5-003-20140306)

How can local planning authorities develop a positive strategy to promote the delivery of renewable and low carbon energy?

The National Planning Policy Framework explains that all communities have a responsibility to help increase the use and supply of green energy, but this does not mean that the need for renewable energy automatically overrides environmental protections and the planning concerns of local communities. As with other types of development, it is important that the planning concerns of local communities are properly heard in matters that directly affect them.

Local and neighbourhood plans are the key to delivering development that has the backing of local communities. When drawing up a Local Plan local planning authorities should first consider what the local potential is for renewable and low carbon energy generation. In considering that potential, the matters local planning authorities should think about include:

- The range of technologies that could be accommodated and the policies needed to encourage their development in the right places;
- The costs of many renewable energy technologies are falling, potentially increasing their attractiveness and the number of proposals;
- Different technologies have different impacts and the impacts can vary by place;
- The UK has legal commitments to cut greenhouse gases and meet increased energy demand from renewable sources. Whilst local authorities should design their policies to maximise renewable and low carbon energy development, there is no quota which the Local Plan has to deliver.

Community-led initiatives

2.1.7 In particular, the NPPG lends support to ‘community-led’ renewable energy initiatives, directing to further guidance provided by DECC https://www.gov.uk/community-energy), which identifies opportunities including:

- Community-owned renewable electricity installations such as solar photovoltaic (PV) panels, wind turbines or hydroelectric generation;
- Members of the community jointly switching to a renewable heat source such as a heat pump or biomass boiler;
- A community group supporting energy saving measures such as the installation of cavity wall or solid wall insulation, which can be funded wholly or partly by the Green Deal;
- Working in partnership with the local Distribution Network Operator (DNO) to pilot smart technologies;
- Collective purchasing of heating oil for off gas-grid communities; and
- Collective switching of electricity or gas suppliers.

[5] Refer Paragraphs 95-97, NPPF

Specific provisions for wind turbine development

2.1.8 The NPPG includes specific provisions for wind turbine developments (Paragraph: 033 Reference ID: 5-033-150618). Under this section, the only way that new onshore wind development will be supported is if *"the development site is in an area identified as suitable for wind energy development in a Local or Neighbourhood Plan; and following consultation, it can be demonstrated that the planning impacts identified by affected local communities have been fully addressed and therefore the proposal has their backing. Whether the proposal has the backing of the affected local community is a planning judgement for the local planning authority."*

2.1.9 There is, however, little evidence of either local or neighbourhood plans allocating sites for wind turbine development, most likely given the level of detail and evidence that would be needed to support such an allocation, detail which would only really become available at the point at which a specific project was being pursued (number and size of turbines, landscape and visual effects, ecology effects, noise and amenity effects etc.).

Optional technical standards

2.1.10 The NPPG (27.03.2015) also includes three 'optional technical standards' for local planning authorities to adopt in their local plans[6]:

- Space standards: the Nationally Described Space Standard (published March 2015)[7];
- Water efficiency: new building regulations which come into force in October 2015 incorporate an optional standard if required by a planning permission[8] (the baseline standard being 125 litres per person per day [l/p/d] with the optional standard being 110 l/p/d); and
- Access: optional standards incorporated into October 2015 Building Regulations if required by a planning permission[9].

2.1.11 In order for these standards to be applied in Leicester City and Oadby & Wigston, they would need to have been included in an adopted local plan policy. Any policy incorporating these standards will therefore need to be sound and subject to clearly evidenced need, viability, consultation and independent examination.

Building regulations

2.1.12 As stated in section 2.1.3 no further changes are currently planned to the energy efficiency aspect of building regulations for homes ('Part L' Conservation of Fuel and Power).

Code for Sustainable Homes (CSH) and Building Research Establishment Environmental Assessment Methodology (BREEAM)

2.1.13 Following the 2015 Ministerial Statement, local planning authorities can no longer seek or request a level of the CSH in new local plan policies. At present, no announcements have been made regarding BREEAM (which relates to non-residential development).

[6] http://planningguidance.planningportal.gov.uk/blog/guidance/housing-optional-technical-standards/ (accessed June 2015)
[7] https://www.gov.uk/government/publications/technical-housing-standards-nationally-described-space-standard (accessed June 2015)
[8] http://www.planningportal.gov.uk/buildingregulations/approveddocuments/partg/approved (accessed June 2015)
[9] http://www.planningportal.gov.uk/buildingregulations/approveddocuments/partm/adm/ (accessed June 2015)

Viability and cost considerations

Scope

2.1.14 The aim of this Report is not to assess the viability or otherwise of national policy and legislation (e.g. current or proposed building regulations). This is the government's responsibility and will form the national baseline to which all developers will need to build to.

Going beyond 2013 Part L Conservation of Fuel and Power (national building regulations)

2.1.15 In accordance to the 2015 Ministerial Statement, both Councils could set planning policies which exceed the energy requirements in current building regulations (Part L 2013) with the expectation that this would not go beyond a level of energy performance equivalent to CSH Level 4 (circa £750 extra over cost on top of current 2013 Building Regulations). At this time, the expectation was that this is where 2016 building regulations would sit, with amendments to the 2013 regulations. However, there are no current plans to change building regulations to achieve this level of performance.

2.1.16 Whilst there is some uncertainty as to how the 2015 Ministerial Statement and 2015 Budget announcements should be interpreted, the Deregulation Bill 2015 (which received Royal Assent in March 2015) includes an amendment to the Planning and Energy Act 2008 removing the potential for local planning authorities to seek energy efficiency standards which exceed building regulations. On this basis, the potential to go beyond Part L 2013 is considered to be in conflict with the Deregulation Bill.

2.1.17 Whilst the Planning and Energy Act 2008 retains the provisions to seek a proportion of on-site renewable energy from new development, the extent to which this could be inferred as going beyond 2013 Part L is still an uncertainty and potential conflict.

Feedback from developers and landowners

2.1.18 As part of the study Amec Foster Wheeler undertook informal consultation with a number of developers and landowners active in the area. This centred on speaking to a small number of developers and landowners to understand their views on energy and sustainability policies to help inform the overall conclusions and recommendations.

2.1.19 The key findings from this process are summarised in Appendix B. This informal feedback highlighted the need to consider both viability and ensure flexibility in any future planning policies for renewable energy and climate change. This process also showed however that there is a level of capacity (skills and knowledge) already within the area as a result of adopted local plan policies where developers are already delivering on-site renewable and low carbon energy. Developers providing on-site renewable and low carbon energy is therefore not a new concept within the study area and so there is an opportunity to develop this further in delivering new growth.

Other 'equivalent standards' to the CSH

2.1.20 Focussing on sustainable design and construction, the Councils could seek to adopt the optional water efficiency standard of 110 l/p/d (an extra over cost of *up to* £2,697 per dwelling, which will reduce when a higher national baseline standard of 125 l/p/d is introduced in 2016 through changes to Part G of Building Regulations[10]). In Leicester, developers already need to meet this standard in adopted policy, since 110 l/p/d is commensurate with achieving Level 3 of the Code for Sustainable Homes. The feasibility and viability of incorporating this standard is beyond the scope of this study (which focusses on energy and climate change) but is something that the Councils could consider as part of an overarching sustainability policy.

[10] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/353387/021c_Cost_Report_11th_Sept_2014_FINAL.pdf (accessed July 2015)

BREEAM

2.1.21 There is no mandatory or national requirement to achieve BREEAM standards for private sector development. In terms of extra over costs, research suggests that the costs for achieving both BREEAM 'Very good' and 'Excellent' ratings are relatively small, although BREEAM 'Outstanding' is likely to have more significant costs (and is more challenging to achieve).

Inclusion of renewable or low carbon energy technologies

2.1.22 This Report identifies a range of different renewable and low carbon energy technologies (from wind to solar to heat pumps to district heating) but neither the Report nor the proposed policy requires a developer to use a particular technology or approach. The Report and proposed policies do not therefore incur additional costs for a developer or affect development viability. What this Report does show is how different technologies could be used in Leicester and Oadby & Wigston.

Technical Housing Standards

2.1.23 Separate to the climate change and energy related evidence provided in this Report, the Councils also now have the ability to set policies which require developers to build to the Nationally Described Space Standard, adopt the optional water efficiency standard (110 l/p/d) or request the access standard. This Report does not advise on the feasibility or viability of adopting these standards.

2.1.24 The water efficiency standard is something that the Councils could consider including as part of an overall climate change and sustainability policy.

Building Regulations and Standards (extensions, refurbishments & conversions)

2.1.25 Projects involving the extension, refurbishment or conversion of existing buildings can be considered under two categories for the purposes of planning for energy efficiency and renewable energy:

- Those which require planning permission *and* building regulations approval; or
- Those which only require building regulations approval, being deemed 'permitted development' and not requiring a separate planning application to be made.

2.1.26 National standards applicable to extensions, refurbishments and conversions include BREEAM Domestic Refurbishment (the same ratings as per new build development). The CSH does not apply to these types of project.

Projects requiring planning permission *and* building regulations approval

2.1.27 In principle, the local plans could include policies which require a level of BREEAM Domestic Refurbishment to be achieved, albeit limited information is available on the viability of achieving a particular level and it is likely to come down to the characteristics of a specific project on a site-by-site basis. Further requirements could also be introduced as part of local plan policy to ensure that these types of project achieve a particular level of carbon reduction or on-site renewable/low carbon energy generation, albeit this will be heavily dependent on site/project viability.

2.1.28 Building regulations approval will be required and Part L (Conservation of Fuel and Power) is likely to apply subject to the following exceptions:11

[11] http://www.planningportal.gov.uk/permission/responsibilities/buildingregulations/approvalneeded/exemptions (accessed February 2015)

- Certain buildings which are listed, in conservation areas or are included in the schedule of monuments - where compliance with the energy efficiency requirements would unacceptably alter their character or appearance;
- Buildings which are used primarily or solely as places of worship;
- Temporary buildings with a planned time of use of 2 years or less, with low energy demand;
- Industrial sites, workshops and non-residential agricultural buildings with low energy demand; and
- Stand-alone buildings other than dwellings with a total useful floor area of less than 50m².

Projects only requiring building regulations approval which are otherwise deemed 'permitted development'

2.1.29 The extent for plan-making to influence this type of scheme is limited, given that permitted development rights already apply. The only opportunity where this could be changed would be to introduce an 'Article 4' direction to remove permitted development rights for certain types of project and then seek to place planning policy requirements (e.g. BREEAM Domestic Refurbishment or on-site carbon reduction targets).

UK Implementation of EU Directives

2.1.30 UK policy is influenced by a number of European Directives. The most immediately relevant of these are:

- EU Energy Performance of Buildings Directive: the recast version of this Directive outlines requirements for all new non-domestic buildings occupied and owned by public authorities to be 'nearly zero energy' from December 2018 onwards. This will then be extended to all new buildings constructed from December 2020 onwards. A further requirement is that, prior to construction, technical, environmental and economic feasibility of alternative energy systems must be reviewed and documented. This specifically includes decentralised energy supply systems based on energy from renewable sources, cogeneration, district or block heating or cooling.
- Energy Efficiency Directive: this includes a requirement that Central Governments purchase only products, services and buildings with high energy-efficiency performance. High efficiency cogeneration and district heating /cooling is to be assessed for developments with a thermal input exceeding 20 MW.

Other Drivers

2.1.31 The Energy Act of 2008 enabled market incentives for some forms of low/zero carbon energy generation through provision of feed in tariffs (FiTs) and the renewable heat incentive (RHI).

FiTs

2.1.32 The scheme was introduced in 2010, aiming to encourage the deployment of small-scale renewable energy technologies (less than 5 megawatts (MW). It is open to organisations, businesses, communities and individuals.

2.1.33 Similar to other renewables support schemes, payment is made for each kilowatt hour (kWh) of electricity generated. As with the Renewables Obligation (RO), the rate paid is dependent on the technology used to produce the electricity. The rate is fixed for a 20 year period from date of registration on the scheme. Eligibility is determined and administered by the Office of Gas and Electricity Markets (Ofgem) and payments are made from the energy suppliers12 .

[12] A full list of Registered FIT Licensed Suppliers – http://www.ofgem.gov.uk/SUSTAINABILITY/ENVIRONMENT/FITS/RFITLS/Pages/rfitls.aspx (Accessed September 2014)

2.1.34 Changes to FiTs are on-going and need to be carefully monitored. The latest changes to FiTs (reducing the rate) are leading some developers to caution on the viability implications.

Renewable Heat Incentive

2.1.35 The RHI is a financial support scheme that aims to increase significantly the proportion of heat that is generated from renewable sources. It was introduced in 2011 initially for non-domestic sectors13: industrial and the commercial sector; the public sector; not-for-profit organisations; and communities. The scheme is a DECC policy mechanism and is administered by Ofgem.

2.1.36 It has certain similarities to FITs with various payment rates determined by technology type; the scheme provides payment for every eligible unit of heat produced (i.e. per kWhthermal) and the payment rate is fixed for a 20 year period.

Green Deal

2.1.37 Alongside these market incentives the Government also introduced the Green Deal[14], albeit the Green Deal Finance Company (financing Green Deal providers) is no longer being funded by Government.

2.2 Existing local commitments and policies

2.2.1 As signatories to the Nottingham Declaration on Climate Change[15] both Councils need to look at the opportunities to reduce carbon emissions (to help **mitigate** future climate change) and ensure that communities are resilient to the impacts that are already faced (climate change **adaptation**). This is already reflected in both Councils' respective corporate commitments and adopted planning policies, including:

Leicester

- One of Leicester City Mayor's key priorities is to deliver a 'low carbon city', with a Climate Change Programme of Action first published in 2012 which included objectives for ensuring energy efficiency in new homes and buildings with a greater use of renewable energy.
- A Climate Change Adaptation Plan is also in place in response to the specific challenges posed by flood risk in the city.
- Adopted planning policies include Core Strategy Policy CS2 (2010) and Local Plan Policy BE16 (2006) accompanied by an Energy Efficiency and Renewable Energy Supplementary Planning Document (SPD), and the Climate Change and Design Supplementary Planning Document (2011), all of which aim to reduce carbon emissions and ensure resilient communities (Refer also Appendix C). BE16 and supporting SPD have led to a number of developments installing renewable and low carbon energy equipment, as summarised in Table 3.2. It is important to note that in June 2015 the on-site renewable energy targets associated with BE16 (as set out in the SPD) were withdrawn by Leicester City Council in favour of a 'fabric first' approach.

Table 2.2 Success of Policy BE16 in driving the take-up of renewable and low carbon energy

Year	Number of developments complying with BE16*	Projected savings (kg CO_2 per annum)**
2015	11	167,215
2014	22	754,780

[13] The scheme was expanded to the domestic sector in April 2014

[14] https://www.gov.uk/green-deal-energy-saving-measures/overview (Accessed June 2015)

[15] http://www.nottinghamdeclaration.org.uk/ (Accessed February 2015)

Year	Number of developments complying with BE16*	Projected savings (kg CO_2 per annum)**
2013	37	2,738,240
2012	15	459,054
2011	24	773,957
2010	33	987,221
Total	142	5,880,467

Source: Leicester City Council annual monitoring information

*Where information received on projected CO_2 savings

**Note: actual CO_2 savings may be different, but Table demonstrates what developers have sought to design into their schemes

Oadby & Wigston

- Oadby and Wigston Borough Council has a low carbon vision for 2014 which is to:
  - To reduce energy consumption and increase efficiency;
  - To reduce our carbon emissions, associated costs, and
  - To act as an exemplar for the wider community.
- Adopted planning policies include Core Strategy Policy 8 Climate Change and Renewable Energy (2010) which sets out the Borough Council's approach to promoting renewable energy generation and addressing climate change (Refer also Appendix C).

2.3 Other Councils and Local Planning Authorities

2.3.1 Similar to Leicester and Oadby & Wigston, other local planning authorities have also sought to develop policies and strategies in response to climate change, through both planning policies and wider Council actions and activities. This list is not definitive, but shows what other Councils have been pursuing:

Encouraging high standards in new developments

- Cherwell District Council has lent support to the NW Bicester 'Exemplar' scheme – the first phase of a 'zero carbon' eco-town at Bicester in Oxfordshire http://www.cherwell.gov.uk/index.cfm?articleid=4513 (accessed July 2015).

Corporate commitments and raising the profile of climate change

- Bristol City Council is the 6th greenest city in Europe (only UK city to make the list in 2015) for its green initiatives, air cleanliness and ecologically-friendly transport. It has also been named European Green Capital (http://ec.europa.eu/environment/europeangreencapital/winning-cities/2015-bristol/). Initiatives include- doubling the number of cyclists by 2020 and a committed budget up to 300 million euros for energy efficiency and renewable energy by 2020.
- Oxford City Council won the Most Sustainability Public Sector organisation in the Local Authority category at the Public Sector Sustainability Awards in November 2014. The Council reduced its carbon emissions by 25% between 2005 and 2011 and has continued to meet its reduction target of 5% year on year.

Establishing an Energy Services Company (ESCO)

- Woking Borough Council is one of the most well-known examples of where a new company was set up to provide locally generated heat for residents.

Retrofitting schemes

- Birmingham City Council's 'Energy Savers' scheme to reduce energy use and retrofit energy saving measures on properties across Birmingham http://www.birmingham.gov.uk/bes (accessed July 2015);
- Greater London Authority (GLA) won Gold at the Public Sector Sustainability awards for its RE:FIT programme. This involved installing energy efficiency measures in over 400 public sector buildings in London; and
- Amec Foster Wheeler is also advising other Councils on how to retrofit renewable energy such as solar PV and biomass boilers on Council-owned land and buildings (e.g. schools and depots) as part of their own response to reducing CO_2 emissions.

2.4 Summary

2.4.1 This section shows that in terms of national policy and legislation:

- Both Councils should be actively planning for both climate change adaptation and mitigation in response to the NPPF, NPPG and national targets in response to climate change. This will build on adopted planning policies and corporate commitments already adopted by both Councils; and
- With both Councils now embarking on the preparation of new local plans, the following issues need to be taken into account:
  - The implications of the Deregulation Bill 2015 which received Royal Assent in March 2015 and includes an amendment to the Planning and Energy Act 2008 removing the potential for local planning authorities to seek energy efficiency standards which exceed building regulations;
  - The withdrawal of the Code for Sustainable Homes on 27th March 2015. Levels of the Code for Sustainable Homes can no longer be requested through planning policy; and
  - There has been no formal statement to prevent a request for particular levels of BREEAM although it would go against the direction of travel with national government policy in relation to housing.
- In the transitional period until the new local plans are adopted the following should be noted:
  - The 27th March Ministerial Statement will be a material consideration in the application of adopted local plan policies, for example where Leicester City Council is seeking Code for Sustainable Homes Level 3 for new developments; and
  - The Planning and Energy Act 2008 still allows for local authorities to seek a proportion of on-site renewable energy. However, the relationship with more stringent building regulations (2013 Part L), NPPF policy and developer's wishing to pursue a 'fabric first' approach will need to be considered (as Leicester have already done – see 2.2.1).
- In preparing the new local plans, the Councils could also consider the separate review of Technical Housing Standards and the ability to set targets for space standards, water efficiency and accessibility. Further evidence base would be needed to adopt these standards since it would be beyond the scope of this Report.

2.4.2 In the following section we consider the wider technical evidence base for renewable and low carbon energy generation across both authority areas to develop conclusions on the future direction of planning policies in the new local plans.

3. Climate Change Baseline

This section provides an overview of the baseline position in Leicester City and Oadby & Wigston, in terms of climate change impacts, existing and project energy demand (and carbon dioxide emissions) and the contribution from renewable and low carbon energy and sustainable buildings.

3.1 Climate change impacts facing Leicester and Oadby & Wigston

3.1.1 According to climate change projections (Refer Appendix D) Leicester and Oadby & Wigston can expect to experience hotter, drier summers, and milder, wetter winters in future. The frequency and intensity of extreme weather events which are already currently experienced, such as heatwaves, flooding and drought, is also projected to increase.

3.1.2 The Leicester Local Climate Impacts Profile (LCLIP)16 carried out in 2011 identified a number of weather events which had already affected Leicester in recent years (2000-2008). These include:

- Heavy rain and flooding;
- Storms and high winds;
- Heatwaves and drought; and
- Snow.

3.1.3 All of the above extreme events lead to additional economic costs being incurred by Leicester City council, for example the flooding lead to flood damage to council infrastructure (buildings and roads), storms also caused damage to council buildings in addition to extensive tree damage, which lead to higher costs for the Trees and Woodlands Department.

3.1.4 The frequency and intensity of such extreme events is projected to increase in future, therefore it will benefit both councils to put in place adaptation measures now to minimise the impact of future events. Leicester itself is particularly vulnerable to flooding due to its location on the River Soar and tributaries (Old River Soar, River Biam).

3.2 Existing energy consumption & carbon emissions

Overview

3.2.1 In this section of the Report we look at the existing energy demand from existing domestic and non-domestic properties across Leicester and Oadby & Wigston. This relates solely to energy demand from these buildings (for power, heating and cooling) in order to estimate the baseline level of CO_2 emissions that is likely to be associated with this demand.

[16] A summary of the Local Climate Impacts Profile for Leicester (2011). Climate East Midlands and Leicester City Council

Total baseline energy demand from existing domestic and non-domestic properties

Electricity / power

3.2.2 Total electricity consumption at 2013 (the latest available figures from DECC) is estimated at 1,460 GWh per annum for Leicester, broken down as:

- 30% domestic (approx. 440 GWh); and
- 70% non-domestic (approx. 1,020 GWh).

3.2.3 Total electricity consumption at 2013 is estimated at 190 GWh per annum for Oadby & Wigston, broken down as:

- 43% domestic (approx. 80 GWh); and
- 57% non-domestic (approx. 110 GWh).

Gas

3.2.4 Total gas consumption in Leicester at 2013 is estimated at 2,980 GWh per annum, broken down as follows:

- 55% domestic (approx. 1,640 GWh); and
- 45% non-domestic (approx. 1,340 GWh).

3.2.5 Total electricity consumption in Oadby & Wigston at 2013 is estimated at 440 GWh per annum, broken down as follows:

- 77% domestic (approx. 340 GWh); and
- 23% non-domestic (approx. 100 GWh).

Using this figures as a 'baseline' for future monitoring

3.2.6 These figures for both gas and electricity represent the baseline against which the success of future planning policies (both local and national), changes to building regulations and other initiatives can potentially be monitored.

3.2.7 For reference, the energy demand set out in this section would result in a total of 1.4 million tonnes of CO_2 per annum (tCO_2 per annum), as set out in Table 3.1.

Table 3.1 CO_2 emissions associated with baseline energy consumption from residential and non-residential properties (2013)

Energy consumption (GWh)	Council area	tCO_2 per annum
Gas		
2,980	Leicester	548,439
440	Oadby & Wigston	80,978
Electricity		
1,460	Leicester	706,012
190	Oadby & Wigston	91,878
	Total	**1,427,307**

Note: this CO_2 estimate relates solely to domestic and non-domestic energy demand and so therefore excludes other CO_2 generators such as transport

Average energy consumption

3.2.8 Figures 3.1 and 3.2 show how domestic and non-domestic energy demand across both Leicester and Oadby & Wigston compare to the national (England) average.

3.2.9 Electricity consumption per household is already well below the national average within both Council areas. Whilst non-domestic electricity consumption aligns with the national average in Oadby & Wigston, it is much higher in Leicester.

3.2.10 In terms of gas consumption, Oadby & Wigston consumes more gas per household than both Leicester and the national average but consumes significantly less than both in terms of non-domestic consumption.

Figure 3.1 Average annual electricity consumption

Source: DECC consumption figures, 2013[17]

Figure 3.2 Average annual gas consumption

3.2.11 Considering average energy consumption is helpful because it shows that:

- Both Council areas already perform better than the national average in terms of electricity consumption per household;
- One area Leicester could look at in more detail is to seek to reduce average electricity consumption and gas consumption for non-domestic uses (explored in more detail later in this Report); and
- One area that Oadby & Wigston could consider in more detail is to seek to reduce average gas consumption within domestic properties.

[17] https://www.gov.uk/government/statistical-data-sets/regional-and-local-authority-electricity-consumption-statistics-2005-to-2011 and https://www.gov.uk/government/statistical-data-sets/gas-sales-and-numbers-of-customers-by-region-and-local-authority (both accessed June 2015). 2013 is the latest available information.

3.3 The impact of new residential development on energy consumption and CO_2 emissions

3.3.1 New homes proposed across Leicester and Oadby & Wigston will have an impact on the baseline energy demand and CO_2 emissions identified in section 3.2. As illustrated in Figure 3.3 and Figure 3.4, new homes could increase gas consumption by 7% in Leicester and 1.5% in Oadby & Wigston and increase electricity consumption by 9% in Leicester and by 2.5% in Oadby & Wigston. This is a consequence of Leicester's housing stock increasing by some 16% and a 5% increase in Oadby & Wigston (see Appendix E for details).

3.3.2 In response, there are two areas that both Councils will need to consider:

- How the impact of new development on CO_2 emissions can be reduced through energy efficiency and on-site renewables in response to NPPF policies, building regulations and future local plan policies. Planning policy and building regulations will both have a key role to play in minimising the impact that these new homes have on energy consumption and associated CO_2 emissions.
- What wider measures the Council can pursue to reduce energy consumption and CO_2 emissions from *existing* homes given the levels of consumption and emissions that these already generate. This is where the biggest savings will need to be delivered to reduce CO_2 emissions across Leicester and Oadby & Wigston overall.

Figure 3.3 Projected future domestic energy demand (Leicester)

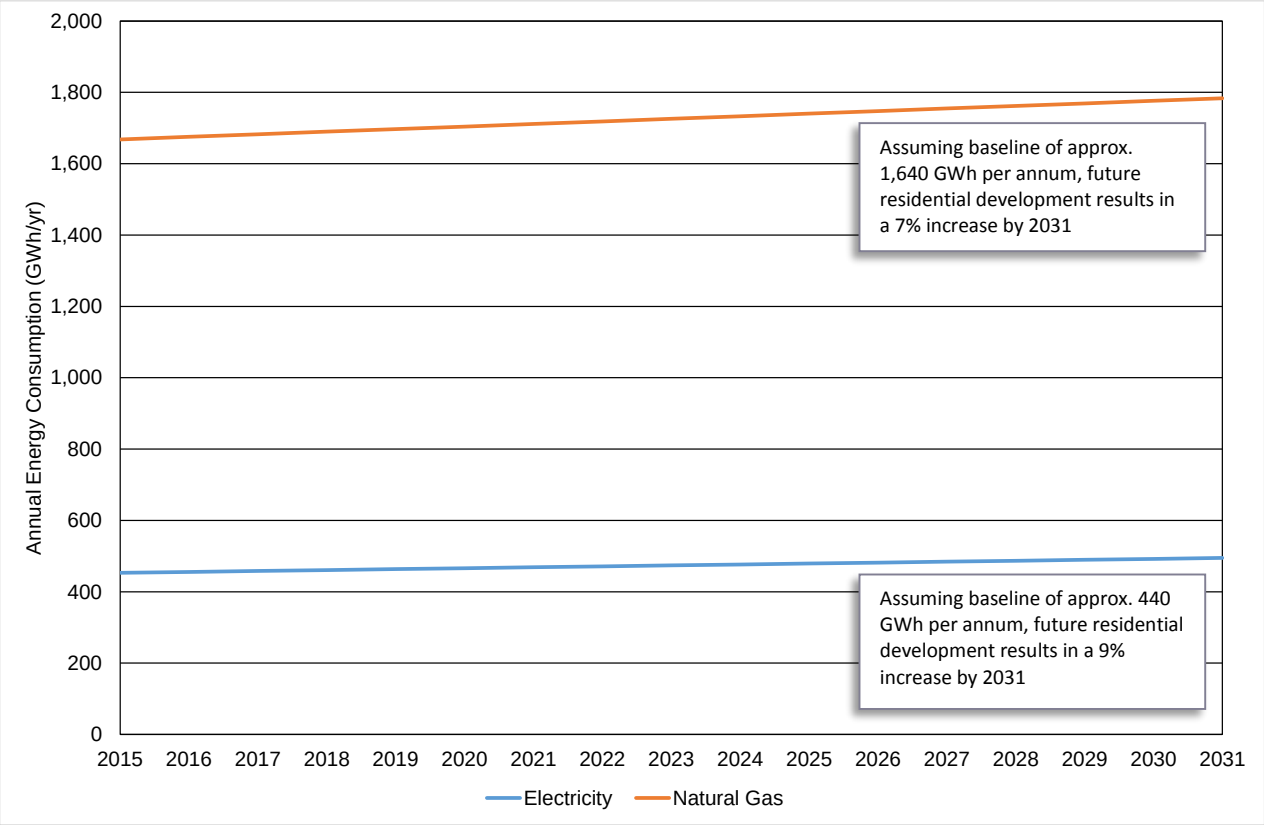
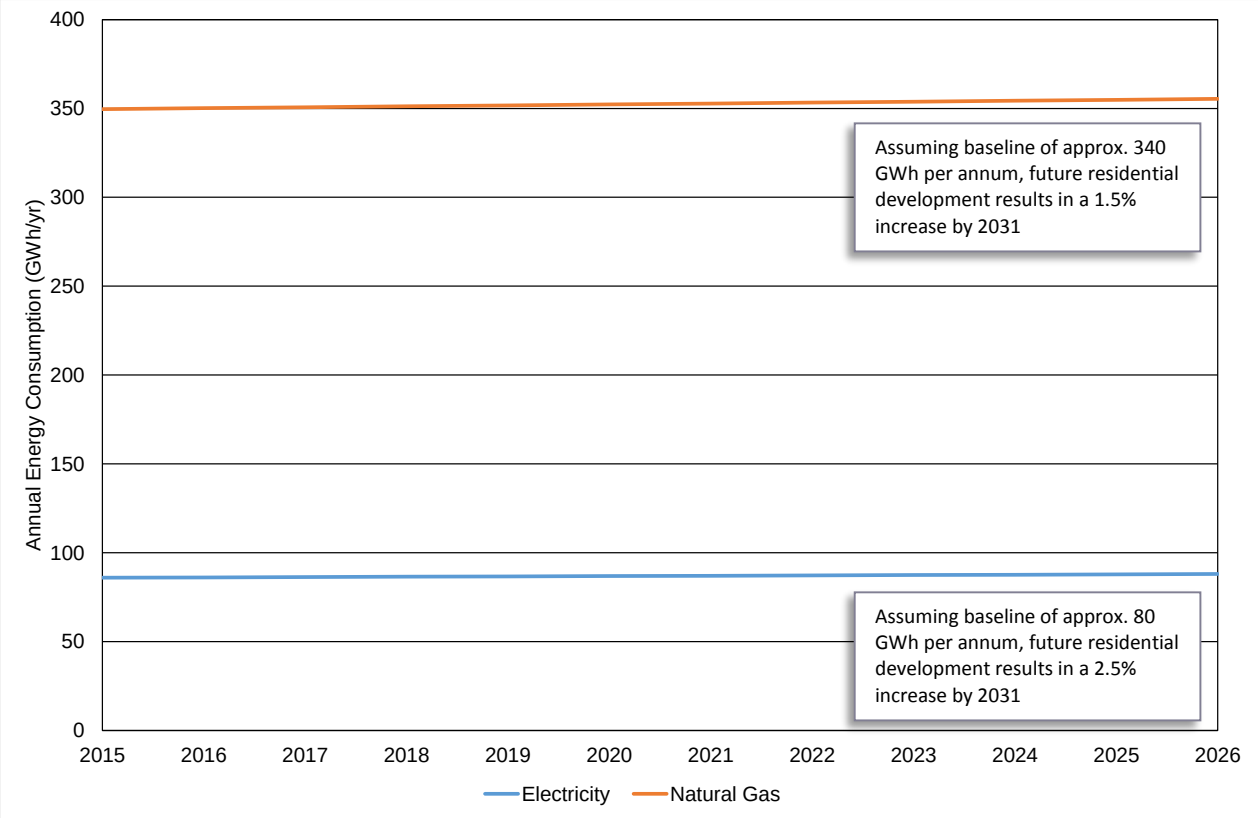


Figure 3.4 Projected future domestic energy demand (Oadby & Wigston)



3.3.3 The assumptions underpinning Figures 3.3 and 3.4 are summarised in Appendix E.

3.4 Impact of new non-residential development

3.4.1 The impact from non-residential growth (e.g. businesses, retail and community facilities) is harder to estimate, with little certainty on the level and mix of uses that could come forward. As a smaller authority area, significant non-residential development is unlikely to come forward in Oadby & Wigston, but for Leicester we have estimated that a projected increase of approximately 140,000 square metres of industrial uses could potential increase demand by circa 30 GWh (see Appendix E). Through planning policy and building regulations it will be important to reduce energy demand and associated CO_2 emissions.

3.4.2 As with the residential assessment under section 3.3, one of the biggest challenges is also how existing non-residential development and how energy demand and associated emissions can be reduced.

3.5 Existing contribution from renewable and low carbon energy

Existing Capacity - Leicester

3.5.1 In Leicester, as across the rest of the UK, there is a continuing growth in the extent of energy generation available from renewable or low carbon sources. Renewable energy and low carbon generation can come in the form of either stand-alone devices used at individual building level (e.g. roof mounted solar PV or a small scale wind turbine) or in decentralised systems supplying individual or a number of buildings (e.g. district heating). Before considering what new potential exists for renewable and low carbon energy, it is first helpful to look at what existing schemes are operational in Leicester. A summary of known existing renewable energy capacity is provided in Table 3.2.

Table 3.2 Existing Low/Zero Carbon Generating Capacity in Leicester

Technology	No. of Installations	Installed Capacity (kW_p)	Installed Capacity (kW_{th})	Commentary
Solar PV – Domestic		8,512		Feed in Tariff – DECC Statistics at December 2014
Solar PV – Non-Domestic		413		Feed in Tariff – DECC Statistics at December 2014
Solar PV – Community		30		Feed in Tariff – DECC Statistics at December 2014
Wind – Community		24		
Micro CHP – Domestic		1		
Non-Domestic Renewable Heat Incentive (Biomass, Heat Pumps, Solar Collectors, Biogas)	1 - 5	*		RHI DECC Statistics at October 2014

* Details withheld due to commercial sensitivity around small number of installations

District Heating & CHP - Leicester

3.5.2 The first phase of the city's district heating network came into operation in June 2012 (see Figure 3.5). It is supplied by a combination of two gas fired combined heat and power (CHP) units and additional biomass boilers. The first phase of the scheme supplies a mix of residential, Council and University buildings. Further future development of the network is planned so as to connect a number of further users including the local prison and other municipal buildings. A summary of the proposed development is provided in Appendix A. Existing network capacity amounts to around 10 MWe of energy generation across two energy centres.

3.5.3 Although not connected to the district heating network, there are several stand-alone CHP installations.

Table 3.3 Stand-alone CHP installations

Constructed	Proposed
• Nixon Court – 27 -33, Putney Road; Permission; 20091626 and 20101460, Gas CHP = 259,508kWh/annum. Student flats • Grocot Road, Pilgrim Gardens; Permission; 20110816,12.5kW mini gas CHP : Sheltered Housing • Sainsbury`s, Melton Road, Troon Way; Permission; 20130688, 500kWe CHP: Supermarket. • Jemsox building, 39 -41, Welford Road: Permission; 20131585,10-20kWe 25-40kWth CHP expected output 153,400kWha elec, 314884kWa thermal output. • Leicester Royal Infirmary, Welford Road: Permission; 20141023/20142195, 1560kW electrical, 1578kW thermal, gas CHP • YMCA, Granby Street; flats, café and theatre. Gas CHP • Bath Lane/ Jarvis Street • Abbey Lane • DMU: Fletcher Building • 7-11, Jarrom Street, 150, Students; Permission 20131845/20141500 • 31, Lower Brown Street: Gas CHP	• Primus Place – 9, Jarrom Street, 159, Students; Permission; 20141095 • Lancaster Boys School/ John E North BSF schools: Shared gas CHP • Bath Lane/ Merlin Works, 388 Flats, Permission 2060614/20100610 • Shires Shopping Centre extension Vaughan Way/ High cross • 61, Great Central Street, Waterside

Figure 3.5 Existing District Heating Network

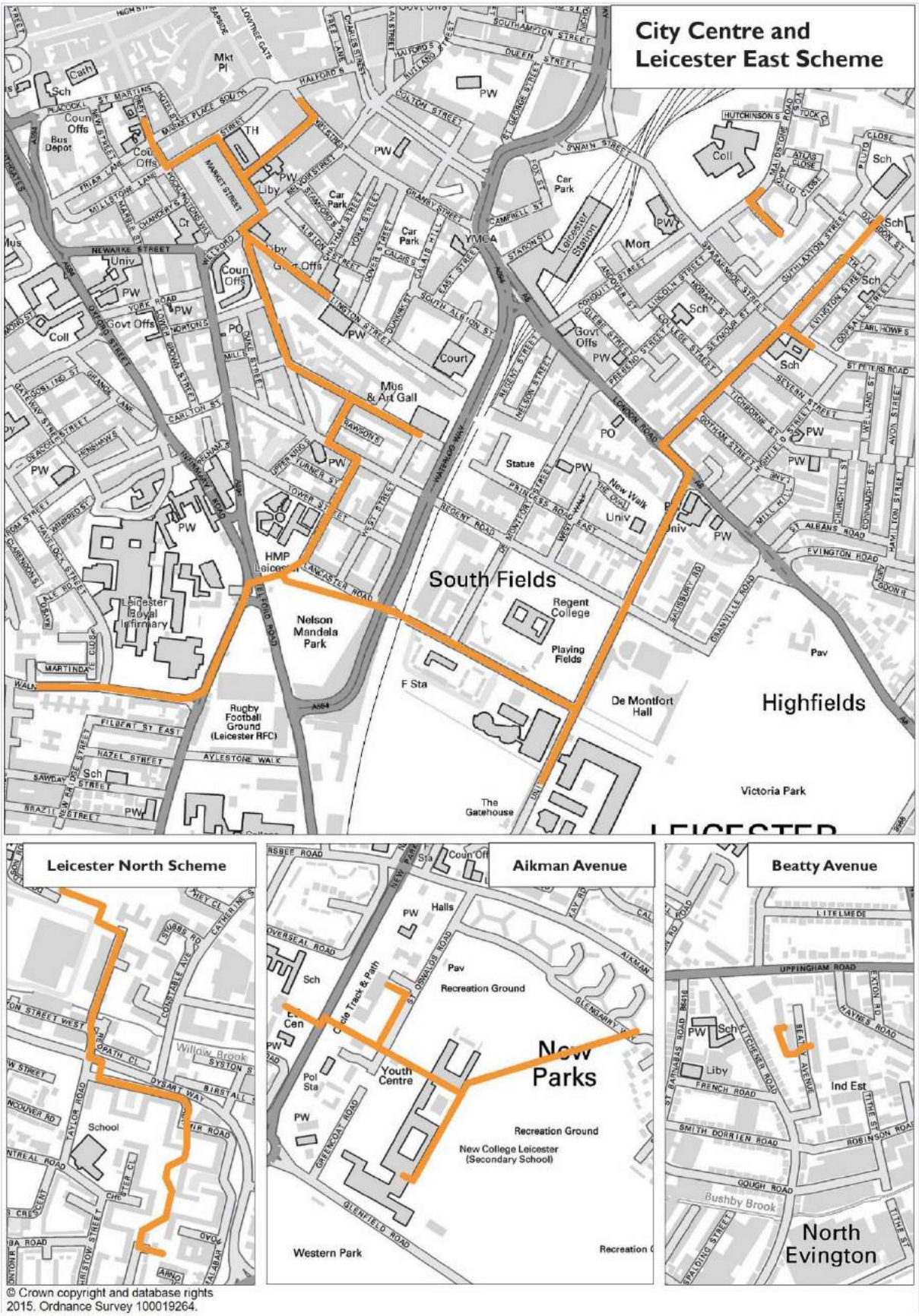


Image provided by Leicester City Council

Existing Developments – Leicester

3.5.4 Beyond the national statistics summarised above there are also details collated by Leicester City Council's Environment team as part of ongoing monitoring of planning applications to ensure compliance with Policy BE16. A summary of the technologies installed on the new development sites monitored in each calendar year is provided in Table 3.4.

Table 3.4 Summary of Monitoring Data (Leicester) – number of projects/schemes installed

	2009	2010	2011	2012	2013	2014	Total
Solar PV	5	14	22	22	39	15	117
Solar Hot Water	2	8	3		2	1	16
Ground Source Heat Pump	1		5		2		8
Air Source Heat Pump	3	14	22	15	16	7	77
Biomass		2	1	4	3	2	12
Biomass CHP					2		2
CHP		4	6		8	3	21
Waste Heat Recovery		2					2
Domestic Hot Water				1			1
Fabric Efficiency	1	1	3			2	5
Energy Efficiency					1		1
Totals	12	45	62	42	73	30	262

Source: Leicester City Council Environment Team data

3.5.5 As the wider statistics regarding FiTs suggest, solar PV is widely used in both existing and new build properties. Policy BE16 has also supported the use of a wider mix of technologies including air source heat pumps, biomass, CHP, solar thermal and ground source heat pumps.

Existing Capacity – Oadby & Wigston

3.5.6 A summary of known existing renewable energy capacity is provided in Table 3.5.

Table 3.5 Existing renewable/low carbon capacity in Oadby & Wigston

Technology	No. of Installations	Installed Capacity (kW_p)	Installed Capacity (kW_{th})	Source
Solar PV – Domestic	445	1,489		Feed in Tariff – DECC Statistics at December 2014
Solar PV – Non-Domestic	4	141		Feed in Tariff – DECC Statistics at December 2014
Non-Domestic Renewable Heat Incentive (Biomass, Heat Pumps, Solar Collectors, Biogas)			0	RHI DECC Statistics at October 2014

Note: No FiT installations registered for either wind or micro-CHP

3.5.7 This evidence shows solar PV is one the main technologies used in Leicester and Oadby & Wigston. In response to the requirements of BE16, developers have predominantly been using solar PV and air source heat pumps. With the exception of Leicester's district heating network, the use of other renewable heat installations is limited across both Council areas. One of the key considerations now for both Councils is how further take-up can be achieved.

3.6 Code for Sustainable Homes (CSH)

3.6.1 Government figures show that 749 post construction stage certificates have been issued for Leicester City Council, with 22 certificates for Oadby and Wigston. No figures are available to show to what specific level these homes have been built.

3.7 Summary

3.7.1 This section shows that Leicester and Oadby & Wigston are already facing climate change impacts that need to be planned for, including heavy rain, storms and heatwaves. National policy is clear in the NPPF that the Councils will need to respond to these challenges as part of local planning policies and decision-making, the implications of which are explored in more detail in section 11.

3.7.2 The demand for heat and electricity from residential and non-residential development across both Leicester and Oadby & Wigston results in an estimated 1.4 million tonnes of CO_2 per annum so one of the challenges will be to see how these emissions can be reduced. In addition, both Councils will also need to ensure that the impacts from new growth and development on energy demand and emissions are minimised.

3.7.3 It is therefore necessary to consider what role the new local plans can play. Opportunities include:

- Ensuring that the impacts of new development on energy demand and emissions are lessened by requiring that developers respond to the NPPF's priorities for energy efficiency as well as taking account of landform, layout, building orientation, massing and landscaping to minimise energy consumption. This can be enforced by having a planning policy which requires developers to demonstrate this as part of the new local plans.
- Having a 'positive strategy' to promote energy from renewable and low carbon sources, as required by NPPF paragraph 97. This will mean local plan policies which support the development of new renewable and low carbon energy projects (including community-led schemes), be it as part of new residential/mixed-use/commercial developments or stand-alone schemes which could either serve existing homes and businesses (or offset the emissions that these uses generate).

3.7.4 More widely, and going beyond the role of the local plans, this positive strategy to promote renewable and low carbon energy could include corporate commitments or investment in taking forward Council or community-led projects including setting up an Energy Services Company (ESCO). This could include supporting an extension to Leicester's district heating network (to provide more buildings existing buildings or new developments with a source of low carbon heat) or taking forward a retrofitting programme (e.g. installing renewable energy or energy saving measures).

3.7.5 This local action, be it via local plans or wider Council strategies and initiatives, will also complement national mechanisms, including building regulations (e.g. Part L Conservation of Fuel and Power with regard to homes), the EU Energy Performance of Buildings Directive, Energy Efficiency Directive, FiT, RHI and Green Deal (see section 2.1).

3.7.6 Together, all of these local and national measures will help to reduce existing emissions and minimise the impact of emissions from planned new residential and non-residential development.

4. Resource Assessment: Summary

This section summarises the renewable and low carbon energy resource across both Council areas.

4.1 Purpose of the resource assessment

4.1.1 There are two purposes to the resource assessment:

- To identify the opportunities for *new* renewable and low carbon energy projects across Leicester and Oadby & Wigston. In doing so we provide a high level overview of 'technical potential' to see what capacity exists. It is important to note that this is not a direct recommendation of any given site, nor a conclusion as to the suitability of a given site in planning terms. The ability to realise the potential from any given site (and any particular technology) will depend on landowner interest as well as consideration of environmental impacts, amenity impacts and other potential planning and design constraints.
- To help support the delivery of renewable and low carbon energy projects, including community-led schemes, to help reduce CO_2 emissions associated with existing and new developments.

4.2 Technical potential for *new* renewable and low carbon energy

4.2.1 Table 4.1 and 4.2 provide an overview of the potential from new renewable and low carbon energy projects, in addition to the existing sources of supply outlined in section 3.5.

Table 4.1 Estimated Potential Deployment by Technology - Leicester

Technology	Potential Capacity (MW)
Wind	NA
Solar PV (Domestic Buildings)	64
Solar PV (Non-Domestic Buildings)	100
Solar PV (Ground Mounted)	5
Solar Thermal	13
Biomass*	4.8
Hydro	0.1
District Heating	25 – 30
Heat Pumps	45
Micro-CHP	< 0.05
Geothermal	NA
Anaerobic Digestion	NA

* Energy available from local biomass resource

Table 4.2 Estimated Potential Deployment by Technology - Oadby & Wigston

Technology	Potential Capacity (MW)
Wind	1.5
Solar PV (Domestic Buildings)	11
Solar PV (Non-Domestic Buildings)	4
Solar PV (Ground Mounted)	8
Solar Thermal	2
Biomass**	2
Hydro	0.03
District Heating	1
Heat Pumps	6.2
Micro-CHP	< 0.01
Geothermal	NA
Anaerobic Digestion	NA

** Energy available from local biomass resource

4.2.2 Tables 4.1 and 4.2 show that:

- The most potential generation capacity is likely to be realised via the use of solar PV, district heating and heat pump technologies;
- Locally available biomass resource (woodland and forestry) will offer limited energy generation capacity;
- Small scale hydro can contribute to energy generation in both Leicester and Oadby & Wigston; and
- Wind, anaerobic digestion, geothermal and micro CHP technologies will not offer significant energy generation opportunities.

4.3 What technologies could work as part of new developments

4.3.1 Table 4.3 reviews the role that different renewable and low carbon energy technologies could play alongside different types of new development which are likely to come forward in Leicester and Oadby & Wigston. Ultimately the developer will have their own approach so Table 4.3 is simply intended as a guide to help inform what technologies could have a role to play as part of new developments. This is not therefore a recommendation that a developer should pursue a particular solution or approach. Of course the developer may also choose to focus solely on energy efficiency ('fabric first') before considering on-site energy solutions.

Table 4.3 Suitability of renewable/low carbon technologies by development type

Development type	Potential Energy Solutions			Key Considerations
	Space Heating	**Hot Water**	**Electricity**	
Conversion/refurbishment project (e.g. a former/commercial unit factory to residential apartments)	Communal Boiler (Gas or Biomass)	Via Boiler	Solar PV	
	Electric Storage Heaters	Electric Point of Use	Solar PV	System contingency if boiler fails, e.g. electric showers and secondary electric heaters for space heating. Fuel storage space and access for biomass deliveries
	Small Gas CHP + Gas Boiler Back-up	CHP/Boiler	Solar PV	Electric Shower
	Space Heating	Hot Water	Electricity	Assumes built in energy centre within development
City centre mixed use scheme (e.g. commercial/retail on ground floor with apartments above – includes student accommodation)	Heat Pump (Retail); Individual boilers (gas or electric)	Electric Point of Use	Solar PV	
	Connection to existing District Heating network		CHP	Main consideration will be the distances involved between the existing network and the new development which affect the viability of the project
Greenfield urban extension site (say 500 homes, residential-led)	Individual boilers (gas / biomass)	Via Boiler	Solar PV	
	Establishment of new district heating network where connection cannot be made to the existing Leicester City network		CHP	Viability of establishing a network would be the key challenge, with an ESCO typically taking on the project costs and risks rather than the developer
Mixed-use regeneration site (commercial plus residential)	Heat Pump (Commercial); individual gas boilers (residential)	Electric Point of Use (commercial); Solar HW (residential)	Solar PV	May go for advanced fabric efficiency - high specification low emissivity windows and reduced air tightness
	Biomass boilers (individual commercial and residential)	Via Boiler	Solar PV	
	District heating - Gas CHP / biomass back up boilers	Via Heating	Solar PV	
Residential infill scheme – 3-4 individual houses on a town centre plot	Heat Pumps	Solar HW	Solar PV	
	Gas Boilers	Via Boiler	Solar PV	Likely high fabric efficiency - high specification windows and reduced air tightness
	Storage Heaters	Electric Point of Use	Solar PV	

5. Resource Assessment: Wind

This section provides an overview of wind resource in the local area and an assessment of the potential for wind development in Leicester and Oadby & Wigston.

5.1 Wind Resource and Constraints

5.1.1 At a height of 45 m above ground level (agl) the average annual wind speed in Leicester is shown in Figure A.1. It can be seen that the majority of average wind speeds are in the range 6.3 – 6.6 ms-1. Energy developers will typically consider wind turbines in areas where the average wind speed is 6 ms-1 or higher.

5.1.2 Wind speed is only one factor influencing the commercial viability of wind turbines. A list of relevant factors in assessing development potential, are summarised in Table 5.1.

Table 5.1 Constraints Considered for Wind Assessment

Constraint	Description	Impact on siting turbines
Environmental Designations	Biodiversity, landscape and heritage designations, e.g. Sites of Special Scientific Interest (SSSI), ancient woodland, Sites of Nature Conservation Importance (SNCIs) and local nature reserves.	Restricts siting turbines within these designated areas
Landscape Character	Preservation of landscape character areas and national landscape designations	Dependant on landscape and visual impacts
Historic Environment	Listed buildings, registered parks and gardens, scheduled monuments, conservation areas, registered battlefields and heritage at risk	Restricts siting turbines within these designated areas
Wind Resource	Reviewing published average wind speed data for areas within the Leicester and Oadby & Wigston boundaries	Wind turbines best sited where mean average wind speeds are highest.
Land availability / Ecology	Green belt, green infrastructure, designated environmental sites, built heritage sites	Development should avoid green belt, designated environmental sites or other sensitive natural heritage sites
Infrastructure	Roads, railways, power lines, airfields, airports	Turbines need to be sited away from major infrastructure
Noise	Separation distances to buildings and development areas	Wind turbines must be sited at sufficient distance from existing buildings to ensure noise levels meet national requirements.
Flood Risk	Proximity to water courses	Siting turbines in areas of flood risk would require expensive foundations and make access for maintenance more costly
Ministry of Defence	MOD owned sites and related radar operation issues	Turbines need to be at a distance from MOD sites that avoids any compromising of MOD activities.
Grid Connection	Proximity to a feasible grid connection point	This will indicate whether substantial cabling and support infrastructure may be required

Table 5.1 (continued) Constraints Considered for Wind Assessment

Constraint	Description	Impact on siting turbines
Grid Capacity	Availability of the distribution network to incorporate the additional power output.	Lower network capacity may require upgrades to grid infrastructure such as substations and safety systems (at a cost to the wind developer)
Safeguarded CAA sites, NERL and other radar systems (aviation issues):	Potential issues of interference with radar systems.	Careful siting will minimise impacts on radar systems and reduce any potential mitigation costs
Radio / Communications Links / fixed microwave links:	Existing location of communication links	Careful siting will minimise impacts on the links and reduce any potential mitigation costs
Construction	Outline construction requirements	Avoiding complex development areas (e.g. wetland areas), minimising the need for more complex wind turbine infrastructure.
Access	Ease of access to site for construction / maintenance.	Due to the size of medium to large scale wind turbine components access can determine if a site will be physically and economically feasible.

5.1.3 The constraints assessment has also taken account of potential future as identified in the Strategic Housing Land Availability Assessment (SHLAA). It is important to note however that this does not infer any conclusion as to whether these sites will necessarily come forward for housing. We have simply used the SHLAA to consider where future residential may come forward for the purposes of considering wind potential.

5.2 Wind Potential - Leicester

5.2.1 The analysis shows no potential for medium to large scale wind in Leicester given the combination of environmental designations, communication and radar issues and noise attenuation from buildings. Any proposed wind turbine development is therefore most likely to be a single turbine or two turbines at most in a given location (Further details are provided in Appendix A).

5.3 Wind Potential – Oadby & Wigston

5.3.1 Application of these constraints suggests that the technical potential available for medium to large scale wind within Oadby & Wigston amounts to 1.5 MW of capacity. There is otherwise limited scope for any wind farm development given the combination of environmental designations, communication and radar issues and noise attenuation from buildings. Any proposed wind turbine development is therefore most likely to be a single turbine or two turbines at most in a given location (Further details are provided in Appendix A).

5.4 Summary

5.4.1 This section shows that:

- The mean annual average wind speed within Leicester (at 45 metres above ground level) ranges from 6.3 – 6.6 ms^{-1}. This is just above the threshold wind speed typically used to assess commercial viability of medium and large scale wind turbines;
- The predominant urban nature of both authority areas restricts opportunities for wind turbine development; and
- Given a number of constraints, and proposed additional housing development, it is unlikely that any developments with the exception of a few small turbines will be proposed in either area.

6. Resource Assessment: Solar

This section considers the potential for solar photovoltaics (solar PV) development within Leicester and Oadby & Wigston both in terms of building and ground mounted installations. It also considers solar hot water technology (solar thermal).

6.1 Building Mounted Development Potential - Leicester

6.1.1 Building mounted solar PV can be installed on both domestic and non-domestic properties where roof orientation and overshading allow.

6.1.2 Solar PV has already been encouraged through the application of the Council's adopted planning policy in BE16 and a number of installations already developed. For example there is already around 9 MWp of building mounted solar PV already installed in Leicester (8.5 MWp domestic; 0.5 MWp non-domestic with a small residual amount of community owned assets).

6.1.3 The technical potential available in Leicester for building mounted solar PV on domestic properties is estimated at 64 MWp. In terms of non-domestic properties there is an estimated total roof area of around 3 km2 throughout Leicester. If it is assumed that around 25% of these roofs are capable of hosting solar PV then the associated generating capacity is around 100 MWp. Further details are provided in Appendix A.

6.2 Building mounted development potential – Oadby & Wigston

6.2.1 In the case of Oadby & Wigston the data presented in Section 3 shows that there is around 1.5 MWp of solar PV already installed (1.5 MWp domestic and 0.1 MWp non-domestic).

6.2.2 The technical potential available in Oadby & Wigston for building mounted solar PV on domestic properties is estimated at 11 MWp. In the case of non-domestic buildings it is more difficult to assess the available roof area given the granularity of data used in this study. The order of magnitude is likely to be in line with previous assessment[18] at around 4 MWp. Further details are provided in Appendix A.

6.3 Ground mounted development potential – Leicester

6.3.1 Land availability for such arrays will be restricted by constraints similar to those applied in the case of wind. Given the capacity constraints it is unlikely that single site multi-Megawatt schemes will be brought forward in the Leicester area. There is growing interest in community owned assets such as solar farms, financed via public share offerings, crowd funding or a combination of both. Similar types of schemes may be brought forward in Leicester.

6.3.2 Application of relevant constraints suggests that there is a total land area of around 110 ha with potential for ground based solar PV development. Experience to date suggests that only a small proportion of this total area is likely to be developed. This would suggest that there is capacity for around 5 MWp of ground mounted solar generation across the City. Further details are provided in Appendix A.

[18] http://broughtonastley.leicestershireparishcouncils.org/uploads/1751224d4ee6656061012734.pdf (Accessed February 2015)

6.4 Ground mounted development potential – Oadby & Wigston

6.4.1 Land availability for such arrays will be restricted by constraints similar to those applied in the case of wind. Given the capacity constraints it is unlikely that single site multi-Megawatt schemes will be brought forward in the Oadby & Wigston area. There is growing interest in community owned assets such as solar farms, financed via public share offerings, crowd funding or a combination of both. Similar types of schemes may be brought forward in Oadby & Wigston.

6.4.2 Application of relevant constraints suggests that there is a total land area of around 340 ha with potential for ground based solar PV development. Experience to date suggests that only a small proportion of this total area is likely to be developed. This would suggest that there is capacity for around 8 MWp of ground mounted solar generation across Oadby & Wigston. Further details are provided in Appendix A.

6.5 Solar Thermal

6.5.1 As the existing statistics for Leicester and Oadby & Wigston show in Section 4 the number of solar thermal systems installed is not known at this point but does not make up a significant proportion of existing capacity. The technical potential for further installation is limited by a number of factors:

- Not all buildings have suitable roof areas available;
- For any given building only one of heat producing technologies is likely to be installed (e.g. biomass boiler rather than solar thermal, or heat pump);
- For any given building only one of solar thermal or solar PV is likely to be installed;
- Properties that are off the national gas grid will benefit most from the introduction of solar thermal systems; and
- In some instances built heritage designations may preclude installation of solar thermal systems.

6.5.2 It is unlikely that solar thermal will feature significantly in future development within Leicester and Oadby & Wigston (either domestic or non-domestic). It is most likely to be installed as a retrofit measure on a proportion of existing properties (predominantly domestic). Assuming that 5% of all suitable domestic dwellings in each area install solar thermal with an average capacity of 2 kW_{th} this would amount to 12.7 MW_{th} (Leicester) and 2.3 MW_p (Oadby & Wigston) respectively.

6.6 Summary

6.6.1 This section shows that:

- There is considerable existing Solar PV capacity installed in both Leicester and Oadby & Wigston;
- There is some potential for the development of ground based solar arrays; and
- Solar thermal systems are unlikely to see widespread uptake among new build properties. A small contribution to retrofit works on existing domestic properties is more feasible

7. Resource Assessment: Biomass

This section considers potential energy generation using different forms of biomass as a potential fuel to provide heat and/or electricity.

7.1 Woodland Residues and Energy Crops

7.1.1 The Landscape and Woodland Strategy for Leicester, Leicestershire and Rutland[19] provides an indication of the extent of woodland in the area, its ownership and management. The Report states that woodland cover in Leicestershire and Rutland accounts for 3.3% of land use in comparison to an average of 7.3% in English counties; 78% of land use is agricultural. Of the woodland cover the majority of species are conifer or broad-leaved while only a small proportion (< 20%) are coppice or scrub.

7.1.2 Woodland ownership is predominantly private (85.7% in comparison to a national average of 66%) so any decisions regarding land management are largely out of direct local authority influence. There are a number of smaller woodlands (< 10 ha) across the two Councils administrative areas. The purpose of these woodlands is likely to be more for recreation or biodiversity interest rather than active management for the production of energy crops or general biomass fuel supply.

7.1.3 There is, to some degree, a slight tension between landscape character objectives that seek to maintain and/or extend existing woodland areas, and wider resource efficiency and carbon management objectives that seek to utilise local woody resources as part of a switch in heating fuel use away from fossil fuels. The Carbon Reduction Strategy for Leicestershire[20], for example, includes specific objectives regarding the establishment of a local biomass supply chain around the National Forest, and a SME biomass cluster group.

7.1.4 A previous assessment for Leicestershire[21] included details regarding potential capacity for renewable energy generation within Leicestershire. This included an assessment of the available biomass resource. A summary of relevant details are provided in Appendix A.

7.2 Anaerobic Digestion – Leicester

7.2.1 Under the terms of the existing waste contract with Biffa, all household waste in the City of Leicester is taken to a recycling centre where it is treated and separated into different waste streams. This is estimated to ensure that around 70% of the waste collected is prevented from being taken to landfill.

7.2.2 In the case of food and other organic waste, this material is then taken to the Anaerobic Digestion (AD) facility at Wanlip where the digestion process generates a combination of methane and a residual 'cake' that is used as a soil improver. This means that the scope for any anaerobic digestion within Leicester is limited to small scale plant utilising commercial food waste streams. It is likely that such commercial waste will be uplifted to similar large scale AD plants via waste management contractors. Small scale autonomous plants attached to industrial process could be developed – for example Pepsico/Walkers Crisps have recently installed a 1.5MW system on their site at Bursom Road, Leicester.

[19] http://www.leics.gov.uk/landscape_woodland_strategy_feb_2001_addendum_feb_2006.pdf (Accessed February 2015)

[20] http://www.leics.gov.uk/leicestershire_county_council_carbon_reduction_strategy_implementation_plan_final.pdf (Accessed February 2015)

[21] http://broughtonastley.leicestershireparishcouncils.org/uploads/1751224d4ee6656061012734.pdf (Accessed February 2015)

7.3 Anaerobic Digestion – Oadby & Wigston

7.3.1 There are existing collection schemes for both garden and food waste from households within the area. There is also a collection facility for used cooking oils and fats. The food waste is taken to a central AD facility in Northamptonshire. This also reduces the scope for any localised AD plants given the lack of any extensive waste stream.

7.4 Summary

7.4.1 This section shows that:

- The small areas of woodland in both Leicester and Oadby & Wigston mean that the scope for local biomass supply is limited to a small contribution to overall heat and electricity production; and
- Organic waste streams are subject to existing collection and management outside of the local areas. This reduces the potential capacity for anaerobic digestion within the respective local areas.

8. Resource Assessment: Hydro

This section considers the potential scope for development of hydro scheme within the City of Leicester and Oadby & Wigston, drawing on research published by the Environment Agency which was supported by Amec Foster Wheeler.

8.1 Assessment Overview

8.1.1 The Environment Agency (EA) published a Report looking at the opportunities for hydropower alongside the environmental sensitivity associated with exploiting hydropower opportunities to give a national overview[22] (the EA Study). This therefore provides a guide as to areas most likely to have potential to host a hydropower scheme. It is indicative only, and does not avoid the need for further analysis on a site by site basis to assess the viability of any given scheme.

8.2 Hydro Potential - Leicester

8.2.1 There are no large scale hydro schemes opportunities within the City of Leicester.

8.2.2 However, the EA study suggests a number of potential sites within Leicester that may sustain a small scale hydropower scheme. These have been reviewed with regard to:

- General location – proximity to built-up areas;
- Ecological – proximity to designated habitat areas and any specific species;
- Landscape/Historic – proximity to conservation area or significant landscape features; and
- Flood risk – extent of flood risk zone.

8.2.3 It should be noted that the majority of sites are within EA zone 3 flood risk zones (1 in a 100 chance of flooding occurring within a given year) and this is why all sites are medium sensitivity or above. The total potential capacity for hydro power opportunities is estimated at 100 kW. Details are provided in Appendix A.

8.3 Hydro Potential – Oadby & Wigston

8.3.1 There are no large scale hydro scheme opportunities within Oadby & Wigston. A review of the previous opportunities identified in the EA Study suggests potential capacity of around 30 kW. Further details are provided in Appendix A.

8.4 Summary

8.4.1 This section shows that:

- There are no large scale hydro generation opportunities in either Leicester or Oadby & Wigston; and
- Some small-scale opportunities exist in each area with an estimated total energy generation potential of around 130 kW (0.13 MW).

[22] Mapping Hydropower Opportunities and Sensitivities in England and Wales, Environment Agency (2010)

9. Resource Assessment: District Heating and Heat Pumps

This section provides a broad overview of the role of heat pumps and the potential for expansion of district heating provision in both authority areas.

9.1 District Heating

Leicester

9.1.1 The initial development plan for the network has identified a number of buildings and end users that can be connected to the network in future. The decision to connect any future development to the district heating network will be influenced by a number of different factors. One key factor is the distance from the development to a point of connection on the heating network. The further a development is from the primary heating mains then the more prohibitive the cost of connection.

9.1.2 The other key factor is the commercial terms under which any given development is offered access to the network. Unless the price of heat from the district heating network is sufficiently discounted relative to the cost of conventional heating fuels (predominantly natural gas) then it does not make an attractive option for end consumers.

9.1.3 If all the proposed future buildings are connected to the heating network then the required generating capacity is likely to rise from the existing 10 MWe to somewhere in the region of 25 – 30 MWe. Further details are provided in Appendix A.

Oadby & Wigston

9.1.4 The distance between the proposed extent of the district heating scheme in Leicester and the Oadby & Wigston area is likely to be one of the biggest to constraints to the economic viability of such a scheme.

9.1.5 Any opportunities for district heating in Oadby & Wigston will therefore be small scale networks centred on a single or small number of 'anchor loads'[23]. Such anchor loads are most likely to need to be non-domestic buildings in order to build sufficient base load to make any such heating network viable. Previous national mapping of existing heat demand identified four areas within Oadby & Wigston with greatest density of heat demand. Further details are provided in Appendix A.

9.2 Heat Pump Opportunities - General

9.2.1 While the majority of properties in both Leicester and Oadby & Wigston have access to natural gas, there are a number of dwellings that do not. Published estimates from DECC24 suggest that around 8,500 dwellings in Leicester (~ 6% of total dwellings) are not connected to the mains gas supply; in the case of Oadby & Wigston this figure is around 150 (~ 0.5% of total dwellings). These dwellings are therefore likely to offer the most economic opportunities for heat pump installation.

9.2.2 There are also opportunities to integrate heat pumps into new build developments, dependent upon the nature of the proposed development (as has already taken place in Leicester in response to Policy BE16).

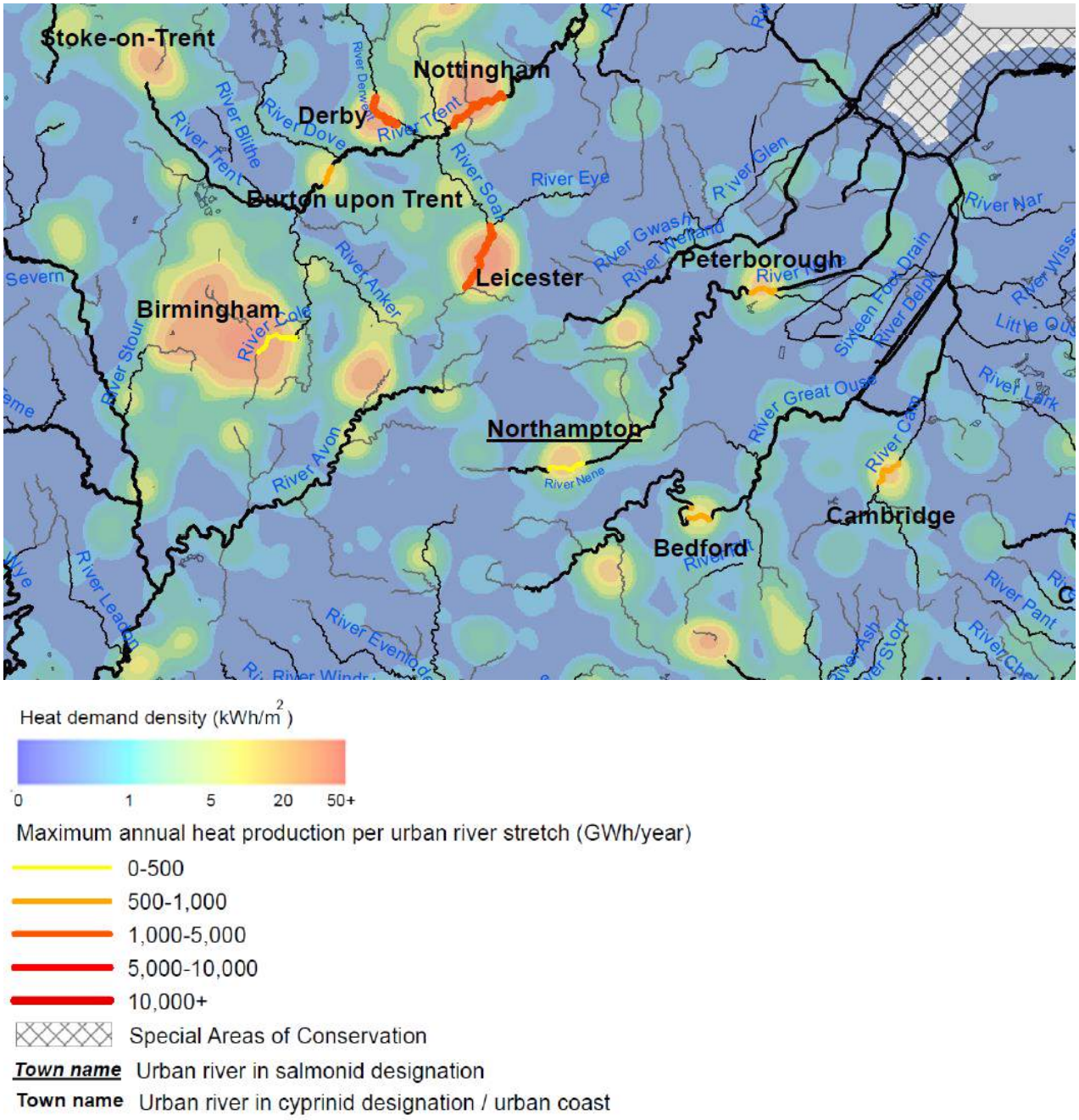
[23] An anchor load being a use which has a high and predictable heat demand throughout the day

[24] https://www.gov.uk/government/statistics/lsoa-estimates-of-households-not-connected-to-the-gas-network (Accessed February 2015)

9.2.3 The heat output from heat pumps (whether ground, air or water) is lower than a typical wet radiator system fuelled via natural gas or oil. For this reason heat pumps are generally best used with underfloor heating, providing a larger surface area for supply. If used to supply a wet radiator system then these radiators need to be much bigger than conventional systems. Consequently it is more difficult to retrofit heat pump systems in existing buildings than it is to install them in new build properties.

9.2.4 Large scale heat pumps, serving multiple properties, form part of the mix of technologies the UK Government anticipates will contribute to low carbon energy supply from 2030 onwards. A resource map providing an indication of areas where potential for water source heat pump use at this scale shows some potential opportunities within Leicester using the heat capacity of the River Soar (see Figure 9.1). DECC identifies Leicester as having a high potential for heating of this nature.

Figure 9.1 DECC Water Heat Map



Source: DECC

9.2.5 In summary, heat pump opportunities are more likely to be considered for new build properties or buildings not served by the national gas network.

9.3 Summary

9.3.1 This section shows that:

- Extension of the existing district heating network in Leicester will depend upon the number of consumers within close proximity to the primary heating mains and the commercial terms governing connection;
- Existing heat pump installations in Leicester have been delivered by developers responding to local plan policy BE16; and
- Further use of heat pumps is more likely to suit new build developments and properties not connected to the main gas network.

10. Resource Assessment: Other Sources

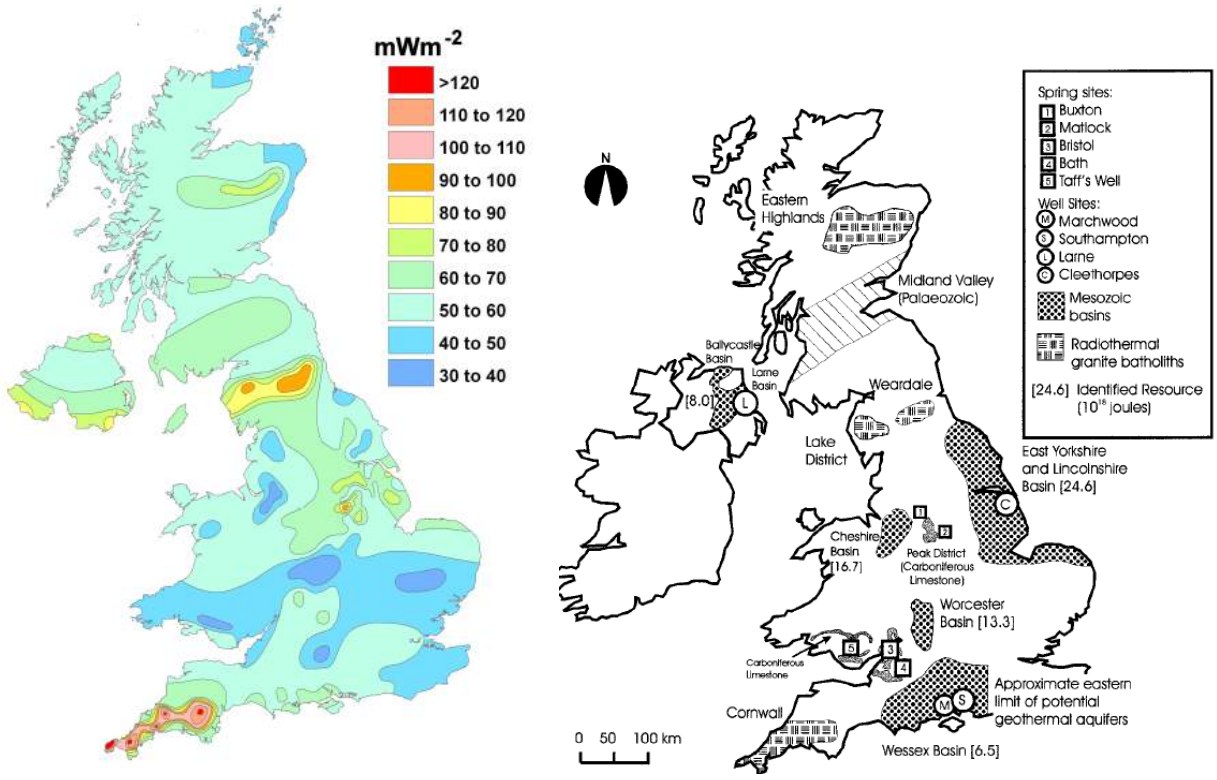
This section provides an overview of other potential sources of low/zero carbon energy generation.

10.1 Geothermal

10.1.1 The potential for geothermal energy generation in the UK has been analysed as part of the Deep Geothermal Review study undertaken by DECC and summarised in a Report released in October 2013[25]. The Report used evidence from a number of previous studies examining the potential for geothermal energy generation in different areas of the UK.

10.1.2 The Report identifies the key areas for UK geothermal resource which include granite outcrops in South West and northern England, and hot sedimentary aquifers in the Wessex and Cheshire basins (Figure 10.1). The Southampton Geothermal Heating Company (SGHC) was set up to exploit this resource in terms of the district heating scheme operational within Southampton.

Figure 10.1 Heat Flow Map of the UK (Left); Location of Sedimentary Basins and Major Radiothermal Granites (Right)



Source: DECC

10.1.3 The Report identifies key criteria for the viability of any geothermal power generation systems in terms of being able to access a thermal store of greater than 100 deg C at a depth of no greater than 5 km. On this basis, the Report does not identify any significant potential for geothermal power production within the Leicester region.

[25] Deep Geothermal Review Study Final Report Department of Energy & Climate Change (DECC) October 2013 (Accessed January 2015)

10.2 Domestic Micro CHP

10.2.1 Micro-CHP, as the name suggests, are small scale combined heat and power (CHP) units designed for use in domestic premises (note: this is therefore different to the small scale commercial CHP units which have been delivered in Leicester, outlined in section 3.5). These Micro-CHP units feed space heating and hot water circuits in the dwelling just as a conventional boiler, but also provide additional energy output in the form of electricity. The electricity produced requires a single cable connection and can be readily integrated with existing electrical circuits.

10.2.2 Previous field trials conducted by the Carbon Trust suggest that micro CHP is best suited to larger houses[26]. There are a small number of commercially available units currently within the UK market, though this is anticipated to increase given the feed-in tariff support available to micro-CHP users[27].

10.2.3 As can be seen in section 3 the present installed capacity of micro-CHP in Leicester is 1.2 kWe. It is not anticipated that this figure will rise significantly in future.

10.3 Summary

10.3.1 This section demonstrates that:

- There is little scope for use of geothermal energy generation within either Leicester or Oadby & Wigston; and
- Domestic Micro-CHP is not well established within the UK market as a whole. It is unlikely to contribute any significant generation potential to meet future energy needs in either Leicester or Oadby & Wigston.

[26] http://www.carbontrust.com/media/77260/ctc788_micro-chp_accelerator.pdf (Accessed September 2014)
[27] http://www.ecuity.com/wp-content/uploads/2013/03/The-role-of-micro-CHP-in-a-smart-energy-world.pdf (Accessed September 2014)

11. Conclusions and Policy Recommendations

This section draws together the policy review and resource assessment details to provide some conclusions and recommendations for future policy development. In doing so, it should be recognised that we are in a transitional period where national policy is constantly changing, with further developments expected in 2016. These conclusions may therefore need to be reviewed and revisited.

11.1 Summary of evidence base

Overview

11.1.1 This Report shows that both Councils need to be actively planning to mitigate future climate change and ensure that local communities, businesses and infrastructure is resilient to the impacts that area already faced. This section summarises the key findings and implications.

Both Councils need to actively plan for climate change in response to national policy priorities

11.1.2 Climate change will have tangible impacts on Leicester and Oadby & Wigston that need to be addressed as part of the new local plans, particularly in Leicester City which is already vulnerable to flood risk. A range of opportunities exist to ensure communities and infrastructure which are resilient to the future impacts of climate change (Refer Appendix D for further details).

The energy demand and CO_2 emissions from existing homes and businesses needs to be reduced, and the impacts of new growth and development on these emissions will need to be minimised

11.1.3 Energy demand across Leicester and Oadby & Wigston results in some 1.4 million tonnes of CO_2 per annum and one of the key challenges will be to see how this can be reduced, through local plan policies, wider Council initiatives and the impact of national mechanisms.

11.1.4 Whilst new homes and employment development will be more energy efficient (enforced through building regulations), planning policy will still have a role to play to ensure that the impact of new development on existing energy demand and CO_2 emissions is minimised. The NPPF is clear regarding the role of energy efficiency and site layout and design to reduce energy consumption. Developers will need to demonstrate how this has been taken into account as part of their planning applications.

11.1.5 Having a ‘positive strategy’ for renewable and low carbon energy, as required by the NPPF, will also be important to minimising emissions associated with both existing development and future growth.

Solar PV and district heating will have an important role to play

11.1.6 Solar PV is already prevalent in both Leicester and Oadby & Wigston, will continue to be important particularly in delivering new renewable energy capacity (notwithstanding ongoing uncertainties regarding financial incentives). Areas of technical potential have been identified for solar PV which if fully exploited in Leicester could deliver 169 MW of generating capacity, the equivalent to offsetting 70,000 tonnes of CO2 per annum. In the case of Oadby & Wigston the figures are 23 MW and 9,500 tCO2e per annum.

11.1.7 In terms of district heating the opportunity exists to connect to and support the future expansion of the existing district heating network in Leicester. This could deliver a further 20 MW, the equivalent to offsetting around 19,000 tonnes of CO_2 per annum.

The resource assessment can be used to support on-site renewable and low carbon energy

11.1.8 Whilst it is not suggested that developers be *required* to provide on-site renewable and low carbon energy generation, it is recommended that developers consider it (entirely within the principles in the NPPF), building on the capacity that already exists in the study area (developers are already doing this). This evidence base helps to identify what technologies could work for what type of project.

There is a transitional period affecting what standards the Councils can ask for now in relation to adopted policies

11.1.9 In the period until new local plan policies are adopted:

- The 27th March Ministerial Statement will be a material consideration in the application of adopted local plan policies, for example where Leicester City Council is seeking Code for Sustainable Homes Level 3 for new developments.
- The Planning and Energy Act 2008 still allows for local authorities to seek a proportion of on-site renewable energy. However, the relationship with more stringent building regulations (2013 Part L), NPPF policy and developer's wishing to pursue a 'fabric first' approach will need to be considered (Leicester has already reflected this in withdrawing BE16 related on-site energy targets in June 2015).

Key considerations for new planning policies

11.1.10 In terms of *new* policies for the respective local plans, the implications of the national policy context are as follows:

- The Councils cannot include a policy request for a level of the CSH given that this has now been withdrawn; and
- The Councils cannot seek policies which go beyond energy efficiency standards in national building regulations, in accordance with the Deregulation Bill 2015.

11.1.11 More widely, the local plans need to reflect the provisions of the NPPF in terms of having a 'positive strategy' for renewable and low carbon energy development as well as reflect the various guidance contained in the NPPG.

11.2 Policy recommendations

Draft Policy 1: Sustainable design and low carbon development

11.2.1 Draft Policy 1 aims to ensure that sustainable design and low carbon development is central to new growth in Leicester. The policy is in response to NPPF Paragraphs 95-97 which requires local authorities to support the move to a low carbon future, take account of landform, layout, building orientation and massing to minimise energy consumption.

11.2.2 In demonstrating compliance with Draft Policy 1, developers will be required to submit a Sustainable Design and Construction Statement which outlines how the scheme addresses the key elements of the policy.

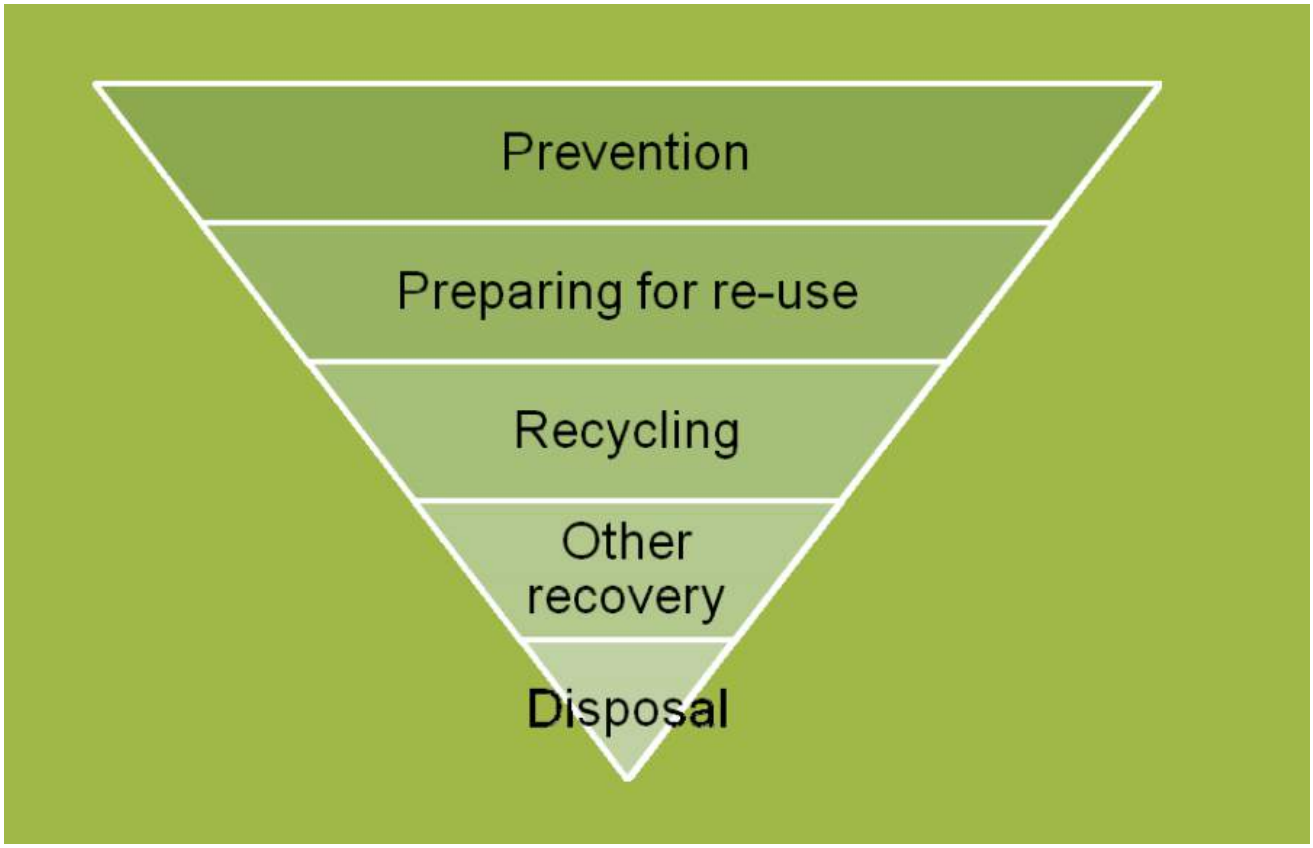
Energy hierarchy

11.2.3 Although the Councils cannot seek a policy which goes beyond the energy efficiency standards in adopted building regulations, they can ask the developer to demonstrate how reducing energy demands and emissions has been taken into account as part of the design and layout of a scheme and its individual buildings (minimising energy use, supplying energy efficiently and using renewable sources of energy). This is entirely consistent with the NPPF and the provisions of sustainable design.

11.2.4 In considering the supply of energy efficiently, for Leicester this could mean connection to or the ability to connect to the existing district heating network subject to the feasibility and viability of doing so. The capital costs of connection are heavily influenced by the distance between the existing district heat network and the individual development in question. The shorter the distance then the shorter the pipework requirements for connection and the lower the associated capital costs. Individual buildings with a high load factor (i.e. little variation in peak demand on a month by month comparison) will typically be more economic to connect to a heat network. In the case of a development area heat demand density will influence the viability of connection to the existing heat network. If there is little heat demand and it is dispersed across the development then this is unlikely to favour use of the heat network. Conversely, if the area heat demand density is greater than 3 MW/km^2 then this makes investigation of connection more favourable.

Resource efficiency

11.2.5 Encouraging the reuse of existing resources, a prudent use of natural resources and minimising waste are set out in the NPPF. Draft Policy 1 therefore requires developers to demonstrate how they propose to achieve this, through both the construction and subsequent occupancy of their schemes. In this regard developers should demonstrate how they have taken account of the waste hierarchy identified in the National Planning Policy for Waste (DCLG, October 2014).



Source: DCLG, October 2014

11.2.6 At construction stage developers should consider how waste can be reduced through design, procurement, modern methods of construction and use of recycled materials. To minimise waste and maximise recycling during occupation, developers should consider the provision of sufficient internal and external storage for segregated waste linked to the existing collection regime.

Resilience to climate change

11.2.7 UK Climate Projections[28] and the Leicester Local Climate Impacts Profile[29] show that the frequency and intensity of extreme weather events, such as heatwaves, flooding and drought, are projected to increase. Leicester itself is particularly vulnerable to flooding due to its location on the River Soar and tributaries. In response, Leicester City Council developed its first Climate Change Adaptation Action Plan in 2008, which was updated in 2013.

11.2.8 Draft Policy 1 can help to deliver the objectives of the Climate Change Adaptation Action Plan and to help minimise the potential effects of climate change by requiring developers to consider the following.

- Use of SuDS - Sustainable Drainage Systems. SuDS include a range of approaches and technologies, such as the use of permeable surfaces, green roofs, filter strips and infiltration trenches, swales, and ponds among others.
- Design or new buildings (or consider retrofitting) to minimise water demand. This can be linked to SuDS, e.g. rainwater collection systems which collect rainwater off building roofs, for use as non-drinking water within the building. Green roofs should also be considered.
- Flood proofing measures for buildings. These include: locating all fittings, fixtures and services above the design flood level (i.e. raising electricity sockets from ground level to higher/to flood level). For flooring, use of concrete flooring with integrated and continuous damp proof membrane and damp proof coursing; avoiding use of chipboard floors. Fitting anti-flooding devices to drainage systems. Fitting flood-proofing measures externally to buildings in at-risk flood areas (e.g. flood guards on doorways).
- Designing new build to avoid overheating. Since future summers are projected to be warmer, overheating (and associated health impacts from overheating) or increasing electricity demand due to air-conditioning will become increasingly relevant issues. Overheating can be avoided by designing buildings to maximise summer cooling through natural ventilation, and to reduce or avoid solar gain (in summer months when the solar angle of incidence is higher, applying external shading, siting buildings appropriately etc.).
- Designing new build to provide reasonable levels of daylighting in new development, provide amenity space and ensure suitable levels of privacy to mitigate the excessive use of artificial light.

[28] Known as UKCP09, http://ukclimateprojections.metoffice.gov.uk

[29] Local Climate Impacts Profile for Leicester, 2011, Climate East Midlands and Leicester City Council

Draft Policy 1: Sustainable design, construction and low carbon development

Sustainable design and construction statement

For all major developments, applicants will be required to submit a Sustainable Design and Construction Statement which demonstrates how the following issues have been addressed:

Low carbon development

Demonstrating how the proposals take account of the following energy hierarchy:

1. Minimising energy use through the design and layout of the scheme and its individual buildings, including a fabric first approach and consideration of landform, layout, building orientation, massing and landscaping to minimise energy consumption.
2. Supplying energy efficiently, through assessing feasibility and viability of establishing or connecting to communal heating networks (supplied by biomass boilers, biomass/gas CHP or heat pumps for example).
3. Using renewable sources of energy.

Applicants must also demonstrate how their proposals address any national standards relating to energy efficiency and renewable energy generation.

Resource efficiency

Demonstrating how the development will maximise an efficient use of resources, including minimising waste and maximising recycling/re-use of materials through both construction and occupation.

Resilience to climate change

Demonstrating how the risks associated with future climate change have been planned for as part of the layout of the scheme and design of its buildings to ensure its longer term resilience through measures which could include:

- Use of sustainable drainage systems (SuDS)
- Design of new buildings to minimise water demand and promote water efficiency
- Green roofs and walls
- Flood proofing measures for buildings
- Designing new buildings to avoid overheating

Draft Policy 2: Stand-alone Renewable and Low Carbon Energy Schemes

11.2.9 Draft Policy 2 identifies how stand-alone renewable and low carbon energy installations of all types will be encouraged and supported in Leicester. The policy includes criteria against which proposals for such developments will be assessed in accordance with NPPF and NPPG policy. The Climate Change Evidence Base Study (Amec Foster Wheeler, August 2015) can be used to help identify what potential exists from various renewable and low carbon energy sources across the City, with the suitability of specific sites and opportunities to be tested in accordance with Draft Policy 2 and the wider policies in this Local Plan.

11.2.10 The policy will not apply to wind turbines, given guidance in the NPPG which states that wind turbine sites will need to be allocated in either a local plan or neighbourhood plan. At this stage, whilst there is some wind potential in the study area, the opportunity to specifically allocate sites for development would need to be considered further and subject to a separate detailed evidence base.

Draft Policy 2: Delivering renewable & low carbon energy projects (excluding wind turbines)

Proposals for new renewable and low carbon energy projects, including community-led schemes, will be encouraged provided that adverse local impacts can be mitigated, with particular regard to:

- Impacts on the historic environment, local character, visual appearance and landscape
- Impacts on ecology and biodiversity including protected species, and designated and non-designated wildlife sites
- Impacts on residential amenity including air quality, noise, traffic, recreation and access.

Assessment of impacts will need to be tested through the application process based on appropriate surveys and assessments also reflecting the wider design and environmental policies in this Local Plan.

Further areas for plan-making

11.2.11 In addition to Draft Policies 1 and 2 other areas where the local plans can have an influence include:

- Wider design policies in the plan linked to building performance, green infrastructure and open space;
- Other policies for development and flood risk in the plan; and
- Site specific allocations and associated policies to ensure that climate change adaptation and mitigation have been taken into account.

Monitoring and implementation

11.2.12 The key to effective monitoring is the use of a limited number of indicators that are based on readily accessible information. While a wide raft of indicators can be used, the broader the range then the more difficult and time-consuming the process of monitoring becomes. The process of monitoring is assisted by a number of datasets already recorded by other bodies. One such example would be the technology type, capacity and number of installations within Leicester and Oadby & Wigston recorded by Ofgem in the context of registration for payment of FiTs and RHI.

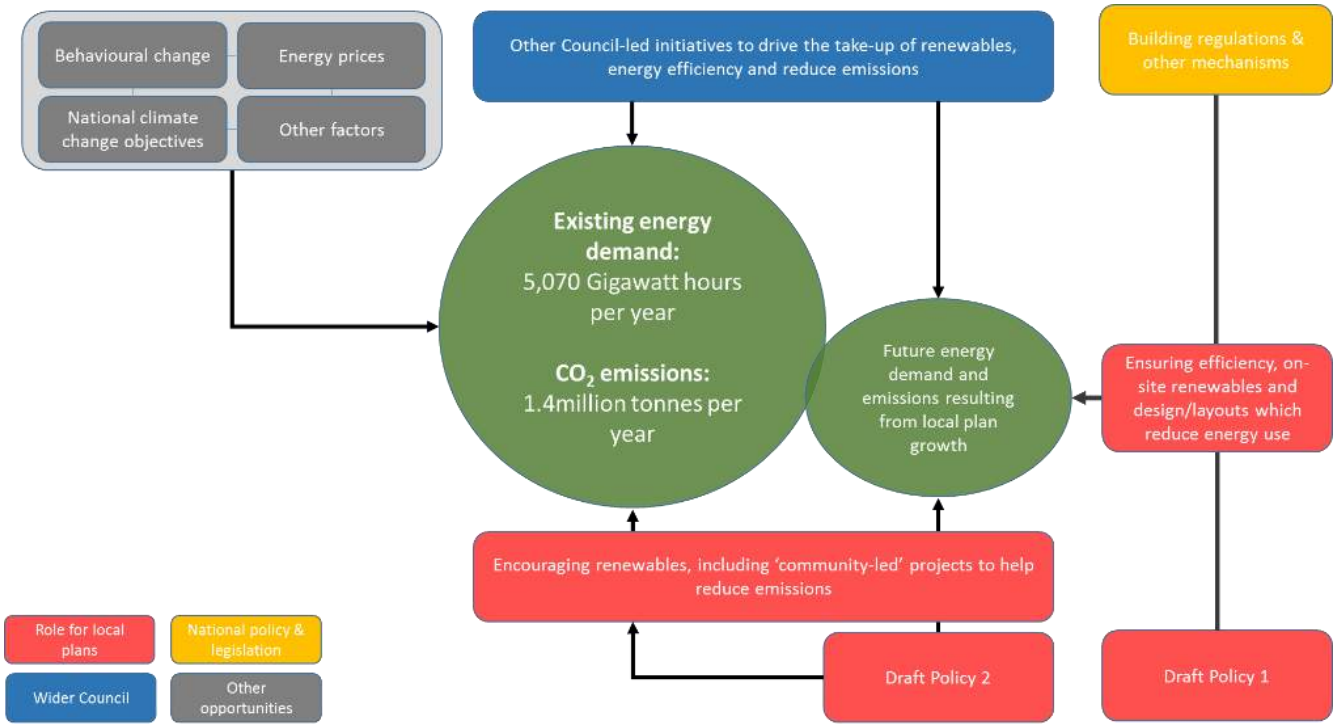
11.2.13 It is suggested that monitoring could focus on two indicators which should be relatively straightforward to monitor:

- The number of Sustainability Statements submitted for major applications in accordance with the policy requirement; and
- Number of MW installed capacity from new energy projects granted planning consent. This could exclude householder applications (to save time/resources) and focus on stand-alone schemes or community-led projects incorporated as part of major developments.

11.3 Conclusions

11.3.1 The new local plans being prepared present a key opportunity to both help mitigate and ensure resilience to future climate change. The draft policies presented in this Report are however simply included as a guide for both Councils to consider as part of the plan-making process and may need to be revisited and reviewed as national policy continues to evolve. In addition, it is clear that there is a wider role, beyond the local plans, in response to climate change. This will include wider national policy and initiatives and other Council commitments at the corporate level. Figure 11.1 provides an overview of the different interrelationships with respect to reducing energy demand and CO_2 emissions in particular.

Figure 11.1 Illustrating the role of the local plans and other mechanisms to reduce baseline energy demand and carbon dioxide emissions across Leicester and Oadby & Wigston



11.4 Further recommendations

11.4.1 As well as seeking to implement the policies suggested in this Report, further recommendations include:

- Further dissemination of the Report's findings, including what renewable and low carbon resource exists in the area.
- Potential further engagement with District Heating Vanguard Network (e.g. Leicester City Council hosted a recent workshop in July 2015[30]).
- On-going review and monitoring of schemes in Leicester which delivered on-site renewable energy and CO_2 reductions in response to the requirements of Local Plan Policy BE16. Leicester City Council's Environment Team hold information on the success of schemes and CO_2 savings from 2006-2015. This could include a review of projected versus actual performance to help developers understand the effectiveness of different technologies.
- Identifying projects or schemes where the Council can affect the delivery of renewable, low carbon or energy saving schemes, for example:
  - The potential to retrofit Council-owned properties with renewable energy (e.g. solar PV or biomass boilers) or energy efficiency schemes (insulation etc.);
  - Taking forward a 'community-led' pilot project to deliver a renewable energy scheme, considering the renewable resource identified in this Report (e.g. a community owned wind turbine);
  - Identifying opportunities to achieve higher environmental performance for local authority-led buildings projects (e.g. through the procurement process);

[30] http://www.heatandthecity.org.uk/dh_vanguards_network/workshop_-_financial_plans,_building_a_heat_tariff_and_heat_metering_july_2015 (accessed August 2015)

- Looking at opportunities for funding to deliver energy saving measures for the most deprived wards in Leicester, Oadby and Wigston (e.g. future ERDF funding bids);
- Linking with educational institutions (schools, colleges and university) to raise the profile of climate change and renewable energy, to develop skills and attract ‘green businesses’ to locate and invest in the area; and
- Review climate change impacts and consider what further measures may need to be taken in response to extreme weather events (e.g. emergency planning).

Appendix A
Technical Assessment

A.1 Wind

The amount of energy any single wind turbine can generate is directly related to the speed of the wind it experiences. The first requirement when assessing the potential for use of wind turbines is therefore to consider the annual average wind speed in a given area. DECC's UK wind speed database is based on use of the NOABL model, a wind flow model based on a mass-consistent model method. The NOABL database contains estimates of wind speed at 10 m, 25 m and 45 m above ground level to 1 km grid square resolution assuming ground cover of short grass and no obstacles (e.g. trees or buildings). The model makes some important assumptions and approximations. However, the results are useful as a rough guide and have been shown to match reasonably well to observed wind conditions.

At a height of 45 m above ground level (agl) the average annual wind speed in Leicester is shown in Figure A.1. It can be seen that the majority of average wind speeds are in the range 6.3 – 6.6 ms-1. Developers will typically consider wind turbines in areas where the average wind speed is 6 ms-1 or higher.

Wind speed is only one factor influencing the commercial viability of wind turbines of course. The other relevant factors are considered in the following sections.

Wind Turbine Development

When considering the installation of any turbine the owner or developer needs to consider what size of turbine is best suited for the wind resource available. The feed-in tariffs (FiTs) for wind turbines are structured according to the rated output of the turbine (in kW). The physical size of turbines within each FiT band is summarised in Table A.1.

Table A.1 Working Definition of Wind Turbine Sizes

Feed-in Tariff Band (Installed Capacity) (kW)	Hub Height (m)		Blade Diameter (m)		Total Height (m)		Comment
Less than or equal to 1.5	10	18	1	3.2	10.5	19.6	
1.6 – 15	10	25	2.8	9	11.4	29.5	
16 – 100	15	39	9	22	19.5	50	
101 – 500	30	65	13.5	56	36.75	93	
501 – 1,500	30	80	40	77	50	118.5	
1,501 – 2,000	60	105	60	93	90	151.5	Most common max size is 127 m
2,001 – 3,000	60	105	76	126	98	168	145 m is maximum consented currently

Note: Hub height measures the distance from the ground to the centre point of the rotating blades of the turbine. Total height measures the height from ground level to the tip of the blades when at their greatest vertical extent.

Methodology

A number of constraints need to be applied when considering the potential for wind development in the region.

Table A.2 Constraints Considered for Wind Assessment

Constraint	Description	Impact on siting of wind turbines
Wind Resource	Reviewing published average wind speed data for areas within the Leicester and Oadby & Wigston boundaries	Wind turbines best sited where mean average wind speeds are highest.
Land availability / Ecology	Green belt, green infrastructure, designated environmental sites, built heritage sites	Development should avoid green belt, designated environmental sites or other sensitive natural heritage sites
Infrastructure	Roads, railways, power lines, airfields, airports	Turbines need to be sited away from major infrastructure
Noise	Separation distances to buildings and development areas	Wind turbines must be sited at sufficient distance from existing buildings to ensure noise levels meet national requirements.
Flood Risk	Proximity to water courses	Siting turbines in areas of flood risk would require expensive foundations and make access for maintenance more costly
Ministry of Defence	MOD owned sites and related radar operation issues	Turbines need to be at a distance from MOD sites that avoids any compromising of MOD activities.
Grid Connection	Proximity to a feasible grid connection point	This will indicate whether substantial cabling and support infrastructure may be required
Grid Capacity	Availability of the distribution network to incorporate the additional power output.	Lower network capacity may require upgrades to grid infrastructure such as substations and safety systems (at a cost to the wind developer)
Safeguarded CAA sites, NERL and other radar systems (aviation issues):	Potential issues of interference with radar systems.	Careful siting will minimise impacts on radar systems and reduce any potential mitigation costs
Radio / Communications Links / fixed microwave links:	Existing location of communication links	Careful siting will minimise impacts on the links and reduce any potential mitigation costs
Construction	Outline construction requirements	Avoiding complex development areas (e.g. wetland areas), minimising the need for more complex wind turbine infrastructure.
Access	Ease of access to site for construction / maintenance.	Due to the size of medium to large scale wind turbine components access can determine if a site will be physically and economically feasible.

Each of these constraints reduces the available land area where there is greatest potential for wind development.

Leicester

11.4.2 The following figures show the areas of land affected by each constraint;

- Figure A.1 Average Annual Wind Speed in Leicester;
- Figure A.2 Environmental Designations (Ecology);
- Figure A.3 Cultural Heritage Designations;

- Figure A.4 Infrastructure Constraints;
- Figure A.5 Radar/Communications Constraints;
- Figure A.6 Noise Buffer Constraints; and
- Figure A.7 Areas of technical potential for ground-based or commercial rooftop solar.

Oadby & Wigston

11.4.3 The following figures show the areas of land affected by each constraint.

- Figure A.8 Average Annual Wind Speed in Oadby & Wigston;
- Figure A.9 Environmental Designations (Ecology);
- Figure A.10 Cultural Heritage Designations;
- Figure A.11 Infrastructure Constraints;
- Figure A.12 Radar/Communications Constraints;
- Figure A.13 Noise Buffer Constraints;
- Figure A.14 Potential Areas for Wind Development; and
- Figure A.15 Areas of technical potential for ground-based or commercial rooftop solar.

Details of the constraints applied in determining the wind capacity potential in Leicester and Oadby & Wigston are summarised in Table A.3.

Table A.3 Buffers applied to site constraints

Constraint	Minimum Buffer Requirement[31]	Minimum Buffer Justification	Maximum Buffer Requirement[32]	Maximum Buffer Justification
Motorway	Blade Tip fall over (125 m) measured to edge of highway boundary – normally post and rail fence.	National Planning Policy Guidance Note 22 (Companion Guide[33]) defines fall over distance as being "the height of the turbine to the tip of the blade" (p.171, para 51) and states in para 52 that: "it may be advisable to achieve a set-back from roads and railways of at least fall over distance". When commenting on the Reading the turbine the Highways Agency in 2002 required a separation distance of 2 blade lengths from the tower to the motorway fence i.e. 70 m, whereas the total height of the turbine is 120 m. The Reading Turbine is actually 149 m from MW boundary. NB If the maximum separation buffer cannot be achieved, the Highways Agency, as statutory consultee, should be consulted in DP1.	Blade Tip fall over + 50 m (175 m for 125 m N90) measured to edge of highway boundary – normally post and rail fence.	Highways Agency: SPATIAL PLANNING ADVICE NOTE: SP 02/06 States: "Assessment of the risk associated with structural failure suggests that a reasonable offset would be to site the wind turbines at a distance of not less than (H + 50) metres where H is the maximum height to the tip of blade. The offset should be measured from the highway boundary fence rather than the edge of carriageway so as to ensure the safety of our roadside equipment and our workforce. However, analysis of the risk posed by 'icing' suggests that it would be wise to adopt a minimum offset of 100 metres. Therefore, no turbine should be sited closer to the trunk road boundary than the greater of (H + 50) or 100 metres." The later edition Spatial Planning Advice Note 04/07 "Planning Applications for Wind Turbines sited near to Trunk Roads" advises that commercial wind turbines should be set back from the trunk road boundary by their height + 50m, which is widely understood to mean blade tip + 50m.

[31] The minimum separation distance considered reasonable to expect the Local Planning Authority and the consultee to accept. There is a probability that negotiation and discussion will be required. **It is important to note that:**

1. The results of the Feasibility Study, in terms of turbine numbers, predicted annual energy production and costs are based on the minimum separation distances to identified constraints, unless the maximum separation distance can be achieved without reducing the installed capacity of the site and
2. These buffers are to be treated as guidance only, since it is not possible to stipulate separation distances for every site specific eventuality.

[32] Considered the failsafe separation distance, where no negotiation with consultees/LPA will be required and no material planning objections will be put forward once the planning application has been submitted.

[33] In England this is the national planning advice on wind energy, which all local planning authorities will use as guidance when assessing planning applications.

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
Trunk Road	Blade Tip fall over measured to edge of highway boundary – normally post and rail fence.	Consider this is an appropriate minimum separation distance for reasons set out for motorways. NB If the maximum separation buffer cannot be achieved, the Highways Agency, as statutory consultee, should be consulted in DP1.	Blade Tip fall over + 50m measured to edge of highway boundary – normally post and rail fence.	Consider this is an appropriate maximum separation distance for reasons set out for motorways.
A Road	Blade tip fall over measured to the edge of the highway boundary.	Consider this is an appropriate minimum separation distance for reasons set out for motorways, given the likely traffic flows on main roads. Aware of one example of a 120m blade tip turbine being approved 82m from an A road (Manchester City Football Club). NB If the maximum separation buffer cannot be achieved, the Highways Authority, as statutory consultee, should be consulted in DP1.	Blade tip fall over measured to the edge of the highway boundary +10%.	Precautionary principle, considered best practice approach.
B Road	50m (assumed max blade length) from centre point of turbine tower i.e. no part of blade should be overhanging the highway boundary.	Potentially contrary to advice referenced in Planning Practice Guidance for Renewable and Low Carbon Energy[34] which refers to The Strategic Road Network and the Delivery of Sustainable Development[35], but there are examples of turbines within fall over distance to minor roads.	Blade tip fall over measured to the edge of the highway boundary.	Precautionary principle, based upon guidance in The Strategic Road Network and the Delivery of Sustainable Development.

[34] Department for Communities and Local Government, July 2013
[35] Department for Transport, February 2013

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
		NB If the maximum separation buffer cannot be achieved, the Highways Authority, as statutory consultee, should be consulted in DP1.		
Minor Road	50m from centre point of turbine tower i.e. no part of blade should be overhanging the highway boundary.	Regard needs to be given to advice referenced in Planning Practice Guidance for Renewable and Low Carbon Energy[36] which refers to The Strategic Road Network and the Delivery of Sustainable Development[37]. A turbine in Dagenham (Ford) is over sailing a road with public access – although there have been incidents of ice fall… There are other examples of operational wind turbines within fall over distance to minor roads. i.e. Royd Moor turbines (0.5mw bonus) operating since 1993 within fall over distance to minor road. If the maximum separation buffer cannot be achieved, the Highways Authority, as statutory consultee, should be consulted in DP1.	Blade tip fall over measured to the edge of the highway boundary.	Precautionary principle, based upon guidance in The Strategic Road Network and the Delivery of Sustainable Development.
Unclassified Road, but adopted public highway.	50m from centre point of turbine tower i.e. no part of blade should be overhanging the highway boundary.	As for Minor Road above.	50m from centre point of turbine tower i.e. no part of blade should be overhanging the highway boundary.	As per justification for minor roads.

[36] Department for Communities and Local Government, July 2013
[37] Department for Transport, February 2013

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
Railway (all)	Blade tip fall over measured to the edge of the railway track.	Regard needs to be given to advice referenced in Planning Practice Guidance for Renewable and Low Carbon Energy[38] which refers to The Strategic Road Network and the Delivery of Sustainable Development[39]. NB If the maximum or minimum separation buffers cannot be achieved, Network Rail, as statutory consultee, should be consulted in DP1.	Blade tip fall over +10% measured to the edge of the railway track.	Network Rail, objected to a planning application for 5 turbines in Sedgemoor District Council in 2006, where a turbine was exactly fall over distance to track. The objection was only removed when the scheme was amended and a fall over +10% separation distance was achieved.
Permanent Structures which are not buildings i.e. water tanks; communications towers.	If there is no public access, no buffer should be applied. However, account needs to be taken of construction activities which may require that a 15m buffer is applied for the foundation. For structures used for the storage of "hazardous materials" blade tip fall over distance.	These are essentially plant and machinery not on public land. There do not appear to be any insurance restrictions for these non-occupied buildings. The LPA would though need to undertake an appropriate Risk Assessment to ensure that Personnel accessing the plant are adequately protected i.e. wearing a hard hat in the area swept by the turbine blades.	50m from centre point of turbine tower i.e. no part of blade should be overhanging the structure. For structures used for the storage of "hazardous materials" blade tip fall over +10% separation distance.	Planning Practice Guidance for Renewable and Low Carbon Energy[40]
Public Car Parks and Public Open Space	50m buffer from centre of turbine i.e. not over hanging.	No national policy in this regard, but rule of thumb applied based on professional judgement.	Blade tip fall over distance.	No national policy in this regard, but rule of thumb applied based on professional judgement.

[38] Department for Communities and Local Government, July 2013
[39] Department for Transport, February 2013
[40] Department for Communities and Local Government, July 2013

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
Private/Staff car parks	No Buffer, but ideally 50m buffer from centre of turbine i.e. not over hanging.	The option to lease should specify that it may be necessary for health and safety reasons to exclude access under the swept area of the turbine – should, for example, insurance be problematic and/or a planning condition on health and safety is attached.	Blade tip fall over distance (125m) from centre point of turbine tower.	Minimises any potential safety risk, in terms of ice and component/blade failure.
Commercial Buildings	No over sailing of building by blades i.e. 45m buffer for N90.	Regard needs to be given to advice referenced in Planning Practice Guidance for Renewable and Low Carbon Energy[41] However: A turbine (120m blade tip) at Dagenham is 77m from a commercial building; Business Development are aware of 2 turbines with blades oversailing a factory by up to 8m i.e. towers 27m from factory. But due to a Reported component failure incident and risk of ice, the blade swept area i.e. circle of 35m radius is fenced off to prevent access and walkways/fire escapes within swept area have been roofed.	137.5m (fall over +10% for a 125m tip turbine)	Complies with Planning Practice Guidance for Renewable and Low Carbon Energy[42]

[41] Department for Communities and Local Government, July 2013
[42] Department for Communities and Local Government, July 2013

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
		At Manchester City Football Club, a 120m to blade tip turbine was approved within a car park, 52m from an athletic stadium and 110m from main football stadium. However, due to concerns from the Health and Safety Executive the turbine is no longer being built. NB There are potentially public liability and safety issues which need addressing regarding public access beneath the swept area of the turbine blades e.g. some turbine manufactures require all personnel to wear hard hats under the turbine and explicitly state that manufacturers are not liable for public injury caused by mechanical failure/ice through. INSURANCE Ace confirmed that having a building within the topple zone is material information; however, in the context of clients portfolio, advised that it wouldn't impact the overall premium. Aon's advice was to apply common sense and consider each site on a case-by-case basis. The following flags increase the level of concern on insurance terms: Occupied buildings; High value buildings and infrastructure (eg electricity pylons, pipelines, bridges etc);		

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
		Large congregations of people; and Proximity of the building to the turbine (particularly if it approaches the oversail area).		
Third party Residential Building[43]	Site layout design should be based on the 40 dB contour which will typically result in a separation distance of 500 m. Where predicted turbine noise levels exceed 40 dB there needs to be evidence that prevailing back ground noise will be no more than 5 dB below predicted turbine noise i.e. if turbine noise predicted to be 42 dB background needs to be 37 dB. For sites in Scotland with 10 or more turbines, the Feasibility Study should include three layout designs: 1. No properties within 35 dB contour; 2. No properties within 750 m of any turbine; 3. No properties within 40 dB contour.	Based on known planning conditions it is assumed that the LPA will require a daytime limit of between 35-40 dB or background +5 dB, normally whichever is the greater. A more conservative approach is taken by applying the 40 dB contour, in recognition of parliamentary pressure to revise noise guidance and review permissible separation distances between turbines and properties. The use of the 40 dB contour also takes account of rural areas, where background noise levels are low. At Feasibility, the issue of visual dominance/over bearing on residential properties should be taken into account i.e. if 500 m achieved but property is at the bottom of a hill with uninterrupted principal views to the turbine on top of the hill, this is unlikely to achieve planning permission.	35dB contour which will typically result in a separation distance of 750m	750m is arguably the minimum optimum separation distance to ensure that visual and noise effects do not significantly affect residential amenity, and takes account of backbench MP calls for set separation distances between turbines and housing. It should be noted that each site should be considered on its merits and planning appeals have been dismissed on residential amenity grounds even where separation distances considerably in excess of 450m have been achieved. The 35dB noise contour represents the definitive safeguard beyond which currently no noise monitoring or assessment is required. Important to note the 2009 Shipdham Appeal decision, in which the Inspector found (broadly) that background monitoring must be undertaken at the Noise Sensitive Property, since otherwise there is significant doubt about the representativeness of the data – if a resident therefore denies access, it could be problematic. Secondly the Inspector, found that planning conditions alone were not sufficient to protect NSP's. Therefore advice from the HMP is that all developments should comply with ETSU without mitigation being required, since conditions requiring/enforcing mitigation are open to legal challenge on the basis of failing some of the 6 tests for conditions set out in Planning Circular 11/95. So, if turbines need to be powered down to meet noise limits, significant risk that Environmental Health Officer (EHO) not accept mitigation (since not enforceable) and an open invitation to objectors to challenge the decision.

[43] For all noise sensitive constraints in Feasibility Studies, the noise contour derived separation distance should in the first instance be based on the 80 m hub Nordex N90 High Speed 2.5 MW turbine. If the relevant noise contour cannot be achieved the 80 m N90 Low Speed 2.5 MW turbine should be used. Judgement is required for sites where existing background noise levels may allow the minimum 43 dB buffer to be exceeded. The Feasibility Study should be based upon the turbine selected for achieving compliance with the minimum buffer requirement.

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
	Layout design 2 (750 m) should be used as the basis for the MW capacity of the site. Caravan Parks and campsites are classed as noise sensitive land uses and should be treated as third party residential buildings. Although a degree of judgment is required for campsites.	40dB is the upper daytime level and assumes that background noise levels are no more than 35dB. (taking into account the reduction of 2dB from LAeq – LA90 and use of 4m receiver height and use of mixed ground and reflect published guidance: (2009) Prediction and Assessment of Wind Turbine Noise. Acoustics Bulletin, Volume 34 Issue 2.) Bowdler, D., Bullmore, A., Davis, B., Hayes, M., Jiggins, M., Leventhall, G. & McKenzie, A. Regard needs to be given to Planning Practice Guidance for Renewable and Low Carbon Energy[44] Examples of minimum separation distances to turbines include: Due to high background noise levels Manchester approved turbine (120m blade tip): Nearest 3rd party residential property is 125m. The Swaffham Ecotech turbine is 360m from nearest 3rd party house.		

[44] Department for Communities and Local Government, July 2013

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
		An ecotricity turbine at the B&Q warehouse in Worksop, is believed to be <200m from housing. Dundee Turbines: Closest property is 330m from a turbine, however, noise monitoring found no exceedance of permitted levels. Noise levels from microwind may be limited to 45dB (DCLG News release 13/3/08).		
Residential property owned by the Local Planning Authority (LPA) (i.e. within LPA property Boundary and confirmed as being in residential use)	No residential property within blade tip fall over distance +10%. In addition, where possible, the turbine layout should be configured to ensure that predicted noise levels do not exceed 55dB.	As for third party residential (Planning Practice Guidance for Renewable and Low Carbon Energy[45]) and ETSU (summary, para 24) advises that lower noise levels can be increased from 35-40 to 45dB and that the level above background can be increased beyond the permitted 5dB level. As ETSU states that it is the lower day and night limits which can be increased to 45dB it may be (this is an untested theory) possible to increase the maximum permissible day time level to 50dB (as there is a difference of 10dB between the lower limits for third parties and those with a financial involvement).	300m. 45dB noise contour	ETSU-R-97 stipulates that the fixed lower day and night time limits can be 45dB where the occupier has a financial involvement. In areas where background levels are above 45dB it would be possible to decrease the separation distance until the background + 5 has been complied with. NB This is dependent upon changes to the tenancy agreement or financially involving the occupier (not the owner) of the property.

[45] Department for Communities and Local Government, July 2013

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
		A 5 dB increase in the ETSU-R-97 stakeholder limit may also be permissible, as this would then result in a minimum buffer justification sound level which would be broadly comparable to the lower of the WHO's guidance levels for gardens or balconies, generally applicable to daytime, and would not be seen as being too dissimilar to the ETSU-R-97 guidance. However, this would still result in higher than acceptable noise levels at night, which would require the provision of secondary glazing at the property and alternative ventilation, unless windows (existing/new) in the same room could open onto non-noise affected facades. Worth noting that although the Noise Exposure Criteria set out in PPG24 Noise apply to new housing and existing noise levels (i.e. new housing adjacent to motorways) a noise level of 55dB is deemed acceptable, although mitigation maybe required. Legal agreement can be negotiated with LPA to agree acceptable noise. Although at the limits of acceptability, negotiation/legal agreement may be possible with LPA to remove residential use of building.		

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
		NB This is dependent upon financially directly involving the resident (not the owner) of the property (as set out on p66 of ETSU-R-97), through for example, rent reduction.		
Staff Accommodation i.e. at hospitals	Not within the blade tip fall over distance +10%. In addition, where possible, the turbine layout should be configured to ensure that predicted noise levels do not exceed the 53dB (LA90) noise contour.	Distance based on fall over +10% to occupied buildings requirement in PPS22. Using the 53dB(LA90) noise contour assumes a 20dB attenuation for closed windows with 2dB subtracted to allow for conversion from LAeq to LA90, resulting in internal noise levels of 35dB – in compliance with ETSU-R-97. This approach is based on the accommodation being either closed ventilation (windows do not open) and/or the EHO/LPA accepting that it is sufficient mitigation for the windows to be shut if noise is disturbing occupiers. It also assumes that outside space for these receptors is not considered to be noise sensitive. Government guidance available in “Health Technical Memorandum 08-01: Acoustics” does not consider permanent staff accommodation and therefore the most appropriate UK design guidance is BS 8233:1999 “Sound insulation and noise reduction for buildings - Code of practice”.	Not within the blade tip fall over distance +10%. In addition, where possible, the turbine layout should be configured to ensure that predicted noise levels do not exceed the 43dB (LA90) noise contour.	This assumes that windows are opening and that the EHO/LPA considers that noise levels should take this into account. Based on principal of ETSU-R-97 that there is a 10dB(A) allowance for attenuation through an open window and that 2dB is subtracted to allow for the use of LA90 rather than LAeq. This approach achieves the 35dB sleep disturbance noise level with an open window. If existing background (night-time) noise levels exceed 43dB at the external façade of the accommodation, likely that noise levels from the turbines could be increased to match but not exceed background levels.

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
		The protection of staff outdoors is not relevant and hence only internal levels require consideration. The 53 dB level may cause an exceedance of the desirable internal level of 35 dB (BS 8233:1999) by 3 dB, if an assumed maximum of 15 dB and not 20 dB attenuation through the window. However, in modern healthcare facilities closed windows even this may be acceptable as HVAC systems should provide acceptable levels of ventilation. If existing background (night-time) noise levels exceed 53dB at the external façade of the accommodation, likely that noise levels from the turbines could be increased to match but not exceed background levels. There may though be a requirement to ensure that the frequency distribution of noise is taken into account. i.e. that lower frequency noise from turbines does not exceed the lower frequency background noise.		

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
Hospital Wards (measured to external façade)	Not within the blade tip fall over distance +10%. In addition, where possible, the turbine layout should be configured to ensure that predicted noise levels do not exceed the 48dB (LA90) noise contour.	Distance based on fall over +10% to occupied buildings requirement in PPS22. The World Health Organisation 1999 Guidelines for Community Noise recommends that the guideline values indoors on wardrooms are 30dBLAeq. Using the 48dB(LA90) noise contour assumes a 20dB attenuation for closed windows with 2dB subtracted to allow for conversion from LAeq to LA90. This approach is based on the accommodation being either closed ventilation (windows do not open) and/or the EHO/LPA accepting that it is sufficient mitigation for the windows to be shut if noise is disturbing occupiers. It also assumes that outside space for these receptors is not considered to be noise sensitive. The HTM-08-01 (for new healthcare buildings) recommends that internal sound levels during the night are 35 dB LAeq,T, there may therefore be some latitude in increasing the minimum buffer to 53dB where the windows do not open. The Hayes McKenzie Partnership adopted this approach when conducting a noise assessment for a 2008 planning application for a wind turbine at the QEH Hospital in King's Lynn.	Not within the blade tip fall over distance +10%. In addition, where possible, the turbine layout should be configured to ensure that predicted noise levels do not exceed the 38dB (LA90) noise contour.	This assumes that windows are opening and that the EHO/LPA considers that noise levels should take this into account. Based on principal of ETSU-R-97 that there is a 10dB(A) allowance for attenuation through an open window and that 2dB is subtracted to allow for the use of LA90 rather than LAeq. If existing background (night-time) noise levels exceed 38dB at the external façade of the ward, likely that noise levels from the turbines could be increased to match but not exceed background levels. The HTM-08-01 (for new healthcare buildings) recommends that internal sound levels during the night are 35 dB LAeq,T, there may therefore be some latitude in increasing the maximum buffer to 43dB where the windows open.

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
		If existing background (night-time) noise levels exceed 48dB at the external façade of the ward, likely that noise levels from the turbines could be increased to match but not exceed background levels.		
Prison accommodation Blocks (measured to external façade)	Not within the blade tip fall over distance +10% In addition, where possible, the turbine layout should be configured to ensure that predicted noise levels do not exceed the 53dB (LA90) noise contour.	Using the 53dB(LA90) noise contour assumes a 20dB attenuation for closed windows with 2dB subtracted to allow for conversion from LAeq to LA90, resulting in internal noise levels of 35dB – in compliance with ETSU-R-97. This approach is based on the accommodation being either closed ventilation (windows do not open) and/or the EHO/LPA accepting that it is sufficient mitigation for the windows to be shut if noise is disturbing occupiers. It also assumes that outside space for these receptors is not considered to be noise sensitive. If existing background (night-time) noise levels exceed 53dB at the external façade of the cell block, likely that noise levels from the turbines could be increased to match but not exceed background levels. There is no known design guidance for acceptable noise levels at prisons.	Not within the blade tip fall over distance +10%. In addition, where possible, the turbine layout should be configured to ensure that predicted noise levels do not exceed the 43dB (LA90) noise contour.	This assumes that windows are opening and that the EHO/LPA considers that noise levels should take this into account. Based on principal of ETSU-R-97 that there is a 10dB(A) allowance for attenuation through an open window and that 2dB is subtracted to allow for the use of LA90 rather than LAeq. This approach achieves the 35dB sleep disturbance noise level with an open window. If existing background (night-time) noise levels exceed 43dB at the external façade of the cells, likely that noise levels from the turbines could be increased to match but not exceed background levels.

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
Halls of Residence	Not within the blade tip fall over distance +10% In addition, where possible, the turbine layout should be configured to ensure that predicted noise levels do not exceed the 53dB (LA90) noise contour.	Using the 53dB(LA90) noise contour assumes a 20dB attenuation for closed windows with 2dB subtracted to allow for conversion from LAeq to LA90, resulting in internal noise levels of 35dB – in compliance with ETSU-R-97. This approach is based on the accommodation being either closed ventilation (windows do not open) and/or the EHO/LPA accepting that it is sufficient mitigation for the windows to be shut if noise is disturbing occupiers. It also assumes that outside space for these receptors is not considered to be noise sensitive. If existing background (night-time) noise levels exceed 53dB at the external façade of the Hall, likely that noise levels from the turbines could be increased to match but not exceed background levels.	Not within the blade tip fall over distance +10% In addition, where possible, the turbine layout should be configured to ensure that predicted noise levels do not exceed the 43dB (LA90) noise contour.	This assumes that windows are opening and that the EHO/LPA considers that noise levels should take this into account. Based on principal of ETSU-R-97 that there is a 10dB(A) allowance for attenuation through an open window and that 2dB is subtracted to allow for the use of LA90 rather than LAeq. This approach achieves the 35dB sleep disturbance noise level with an open window. If existing background (night-time) noise levels exceed 43dB at the external façade of the hall, likely that noise levels from the turbines could be increased to match but not exceed background levels.
Public Building (Schools)	Not within the blade tip fall over distance +10% In addition, where possible, the turbine layout should be configured to ensure that predicted noise levels do not exceed the 53dB (LA90) noise contour.	Public buildings have a much greater sensitivity than commercial/industrial buildings. PPS22 Companion guide p171, para 51: “Fall over distance…. Plus 10% is often used as a safe separation distance”.	Not with in 450 m. In addition, where possible, the turbine layout should be configured to ensure that predicted noise levels do not exceed the 43dB (LA90) noise contour (to classroom façade) and/or 53dB(LA90) noise contour to playing field.	Minimises any potential safety risk, in terms of ice and component/blade failure and minimises power loss from turbine shut down due to noise and shadow flicker. 43dB standard ETSU night time level allowing for attenuation through open window.

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
		The World Health Organisation 1999 Guidelines for Community Noise recommends that the background sound pressure level in classrooms does not exceed 35dB (55dBLAeq – 20 dB subtracted for attenuation through a closed window and an allowance of 2dB for LAeq – LA90 conversion). The 53dB LA90 contour should be measured at the nearest classroom façade. “Building Bulletin 93 - Acoustic Design of Schools. A Design Guide” provides design guidance for new schools. Internal targets range from 30 to 40 dB LAeq, 30min and when corrected for the LA90, 10min metric and the temporal variation, the levels are comparable to those stated within the WHO guidance. The WHO guidance also recommends that for outdoor playgrounds the SPL from external noise sources should not exceed 55dB (53 = -2dB for LAeq-LA90). Increasing the minimum buffer requirement to 48dB would reduce the risk of community concerns unless the school has some direct involvement with the proposals, i.e. an interactive science project. 48 dB would be comparable to the lower WHO guidance level.		

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
		Achieving these levels is dependent on the ventilation in the school not being dependant on opening windows.		
LPA Property Boundary	5 m from maximum horizontal length of blade tip. So 55 m if max blade length assumed to be 50 m.	Ensures that there is no possibility turbine will oversail 3rd party land and provides some degree of micro—sighting should it be required	-	-
Public Right of Way	50 m from centre point of turbine tower i.e. no part of blade should be overhanging the public right of way.	Companion Guide to PPS 22 states (p172 para 57) "Similarly, there is no statutory separation distance between a wind turbine and a public right of way. Often, fall over distance is considered an acceptable separation, and the minimum distance is often taken to be that the turbine blades should not be permitted to oversail a public right of way." At a Public Inquiry in August 2007, no challenge was raised to turbines located just overhang separation distance from public footpaths. Industry wide premise that turbines should not oversail public rights of way.	Blade tip fall over distance.	Companion Guide to PPS22.

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
Bridleway	50m from centre point of turbine tower i.e. no part of blade should be overhanging the public right of way.	Para 56 p. 172 of the Companion guide sets out that the British Horse Society has suggested a 200m separation distance. The BHS November 2008 policy note on turbines reiterates the 200m distance, but with a maximum separation to national trails of 4 x tip height i.e. 500m. BUT tested at appeal (Cemmaes Wind Farm) the inspector concluded: "What cannot be concluded from the evidence is that there is a generic proven difficulty (I.e. with wind turbines and horses). What can be concluded is that the 1995 BHS policy, which may influence many riders, riding schools and clubs is overtly alarmist in a way which is not supported by evidence. It is not accepted that wind turbines necessarily or even more than occasionally alarm horses. The evidence is not there". A presentation at a BHS conference has also recently concluded that wind turbines pose no discernible risk to horse riding.	200 m from centre point of turbine tower.	To appease and minimize any cause for objection from horse riding community, in line with PPS22 companion guide.

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
Woodland	Non classified woodland no buffer. However, where there is sufficient space on site, after all other constraints have been taken into account, turbine locations should avoid over sailing all woodland i.e. 45 m buffer. A 70 m buffer for a 125 m tip turbine should be applied to any Ancient Woodland.	No specific statutory guidance recommending separation distances. However, ecological importance of woodlands for birds and bats increases with the age and species diversity of the woodland. To prevent unnecessary loss of habitat through construction of foundations. Natural England Feb 2009 guidance on Bats and Wind Turbines identifies that some bat species have a high sensitivity to wind turbines and as a result a minimum separation distance of 50 m between the habitat and the blade tip is required. This equates, broadly, to a separation distance of 70 m between turbine tower and the edge of the habitat. In some instances the removal of sufficient woodland to achieve a 70 m or less separation distance and additional net replanting elsewhere, may be an acceptable mitigation option. Also, bat roosts can be moved under license in cases of over-riding public interest in order to enable development - need to demonstrate though that there was no alternative and that the works are necessary for reasons of overriding public interest (not economic gain) – considered unlikely NE would want to set a precedent that the need for turbines overrides the protection in situ of bats.	70 m from centre point of turbine for all woodland (as shown on a 1:25,000 map/site visit). This distance should be maximised where other site specific constraints allow.	Ecological surveys may identify bat populations within woodland, for which Natural England are likely to require a separation distance. Natural England Feb 2009 guidance on Bats and Wind Turbines identifies that some bat species have a high sensitivity to wind turbines and as a result a minimum separation distance of 50 m between the habitat and the blade tip is required. This equates, broadly, to a separation distance of 70 m between turbine tower and the edge of the habitat.

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
Field Boundaries and non-protected hedgerows	Non designated hedgerows and/or field boundaries no buffer. However, where there is sufficient space on site, after all other constraints have been taken into account, turbine bases should be 70 m from field boundaries. In addition any removal of hedgerows should be avoided wherever possible.	Field margins and hedgerows are important wildlife corridors and are often managed for biodiversity under the DEFRA Environmental Stewardship Scheme. These features are known movement corridors for some bat species and therefore NE may request a c.70 m buffer if high risk bat species are present. Removal of hedgerows requires the LPA to approve a hedgerow removal notice under the Schedule 4 of the Hedgerow Regulations (1997) and the 1995 Environment Act.	70 m from turbine tower and in accordance with NE 2009 bats and wind turbines guidance.	Field margins and hedgerows are important wildlife corridors and are often managed for biodiversity under the DEFRA Environmental Stewardship Scheme. These features are known movement corridors for some bat species and therefore Natural England may request a c.70 m buffer if high risk bat species are present. Application 1/1386/2007 refused by Torridge DC (29/2/08), due to objection from NE as turbines oversailing hedgerows used by bats commuting and foraging.
Hedgerows (protected)	70 m. Can only be applied when local information and/or surveys are available to confirm that the hedge is/qualifies for protection.	Hedgerows are wildlife corridors, utilised by, for example, bats. Protected hedgerows species rich and established. Likely to be used as bat movement corridors, especially in low land/sheltered sites. Any woodland/hedgerow will need to be surveyed for breeding birds/protected species before removal.	70 m	Natural England Feb 2009 guidance on Bats and Wind Turbines identifies that some bat species have a high sensitivity to wind turbines and as a result a minimum separation distance of 50 m between the habitat and the blade tip is required. This equates, broadly, to a separation distance of 70 m between turbine tower and the edge of the habitat.

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
Water Courses Adopted by local Drainage Board and/or those identified on a 1:50,000 map[46], including reservoirs.	15 m from turbine centre point.	Drainage Boards normally require that no part of development within c.10 m of an adopted drainage water course. With an assumed foundation radius of 15 m, the minimum separation distance is therefore taken to be 15 m. On a site by site basis this could be reviewed and an engineering solution negotiated with the Environment. Agency/Drainage Board. The Environment Agency requires an 8m separation to main rivers, inclusive of foundations.	70 m	Likely minimum separation distance required by Natural England to protect the use of water courses as movement corridors by birds/bats.
Navigable Waterways (Canals)	20 m to allow for construction of turbine foundations (see water courses above).	Applied in the absence of any specific guidance or known best practice	50 m (not over sailing) to water way and any moorings or public rights of way adjoining the waterway i.e. towpaths.	Companion Guide to PPS 22 states (p172 para 57) "Similarly, there is no statutory separation distance between a wind turbine and a public right of way. Often, fall over distance is considered an acceptable separation, and the minimum distance is often taken to be that the turbine blades should not be permitted to oversail a public right of way." An assessment of whether house boats are noise sensitive receptors will need to be undertaken. This may be dependent on whether or not the boats are independently powered and can therefore relocate.

[46] Local Drainage Board provides site specific maps of adopted waterways

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
11, 33 kV lines (Poles)	No Buffer[47]	Operation: Based on assumption that should the DNO (National Grid do not have responsibility for 11/33/132kV network) require a 1.5 x the blade tip height (187.5 m for 125 m tip turbines) fall over separation distance, the section of line could be placed underground or re-routed. Construction: Consideration could also be given to covering lines with "sheath insulation" and or fencing to protect construction activities within c.12 m and that micro sighting will enable construction activities to not conflict with safety criteria. In addition to trenching the cable, it may be cost effective to de-energise the line, in order to comply with HSE requirements during construction, should the DNO raise no concerns with separation distance between the line and the operating turbine. NB. HSE guidance note GS6 and Energy Networks Association Technical Specification 43-8 set out that within 15 meters of any overhead line supported on steel towers or 9 meters of any overhead line supported on wood poles, the relevant network operator must be consulted. i.e. DNO for 11/33kV lines.	1.5 x the blade tip height (187.5m for 125m tip turbines)	Companion Guide to PPS para 55 on p.172 states that "wind turbines should be separated from overhead power lines in accordance with the Electricity Council Standard 44-8 "Overhead Line Clearances". This reference should in fact be to ECS 43-8. The EC has now been abolished and DNO's/NGrid do not appear to be applying these separation distances (fall-over+ maximum swing of overhead wires), instead are stipulating 1.5 x the blade tip height (187.5m for 125m tip turbines). Scottish and Southern have requested (Rushy Mead site) that: "The clearance between any overhead line and a wind turbine shall not be less than 1.5 times the height of the turbine, taken to the top of the turbine blade" (PR-PS-340 APPLICATION OF CLEARANCES TO OVERHEAD LINES AT LV TO 400kV).

[47] The Feasibility Study should specify the indicative costs of trenching the 11/33kV cables through the 1.5 x blade tip fall over zone.

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
11, 33, 66 and 132 kV electricity lines	Not over sailing, for 11 and 33 kV poled lines and tip height plus 10% for 33, 66 and 132 kV lines on pylons.	11, 33 and 132 kV (Not 132 in Scotland) lines are the responsibility of the DNO. If the maximum buffer cannot be achieved consultation with DNO to be undertaken. Tip height + 10% for 33-132 kV based on National Grid's minimum requirement for 275 kV and above lines. Notwithstanding this, if the installed capacity of the site would be likely to support the cabling of overhead lines this should be taken into account	1.5 x blade tip height	Scottish and Southern DNO have advised (September 2009): "The clearance between any overhead line and a wind turbine shall not be less than 1.5 times the height of the turbine, taken to the top of the turbine blade" (Ref.PR-PS-340 APPLICATION OF CLEARANCES TO OVERHEAD LINES AT LV TO 400kV) Note that this reference has not been validated.

275 – 400 kV in UK and 132 kV in Scotland	Tip height plus 10%[48]	In England and Wales National Grid are responsible for 275kV and above. In Scotland National Grid are responsible for 132kV and above. In October 2009, National Grid issued PS(T)087 – Issue 2 – Overhead line separation from wind turbines. It establishes that there is no impact on transmission lines by turbines that are sited more than 3 rotor diameters away from the line. In addition it does not prohibit closer sitting (provided that separation is greater than topple distance) but instead encourages early communication with NGET.	3 rotor diameters (c.300 m)	In some instances National Grid have requested a separation distance much greater than blade tip height +10%, due to extra strain/wear and tear placed on the HVLines caused by turbulence and wake effects from the turbines. This issue has yet to be tested at Public Inquiry. Current guidance from National Grid (PS(T)087 – Issue 2 – Overhead line separation from wind turbines) is that there is no impact on transmission lines by turbines that are sited more than 3 rotor diameters away from the line.

[48] Assumes that cost of trenching HV line is not economic

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
		The definition of topple distance has changed from tip height plus 20m to tip height plus 10%. National Grid, when consulted by Local Planning Authorities on planning applications (e.g. Ford Turbines, Dagenham) have requested that separation distances are based on the blade tip fall over distance + the maximum calculated swing of the HV cable. Fall over +10% would be a minimum allowing for a 12m cable swing. This is broadly in line with Electricity Association Standard 43-8 Overhead Line Clearances (2004) – which is referenced in National Grid guidance “Sense of Place” these Design Guidelines have been developed by National Grid to address the issues associated with developing sites crossed by, or in the vicinity of, pylons and high voltage overhead lines.		

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
High pressure fuel pipelines (ie those identified through linesearch.org.uk)	125 – Blade Tip Fall Over. NB Separation distances for other fuel lines (medium, local high pressure and lower pressure gas pipelines and gas mains) should be determined by the standard separation distance required by the operator for construction activities. Local gas network operator should be consulted for information on the network in the vicinity of the site.	National Grid (Transco) has prepared a confidential internal Report on separation distances between wind turbines and high pressure gas pipelines. This risk assessment concluded that blade tip fall over distance is required. Responding to consultations Transco have stated that an objection will be raised to any turbine within this distance. Experience to date is that Transco do not impose weight restrictions on plant crossing pipelines ie access tracks can cross pipelines. Clarification should be sought from pipe operator. Some turbine manufactures recommend fall over separation distances to "sour" gas pipe lines.	150 m	Precautionary principle separation distance, to allow for micro-sighting of turbines. The National Grid risk table for development near high pressure gas pipelines http://www.nationalgrid.com/NR/rdonlyres/325B83B7-096C-4599-BBE2-D944E9307509/19056/aptdstmay07.pdf identifies as negligible the risk from pilling at 150m+ to a high pressure gas pipeline.
Sewage and Water Pipes	No buffer	Not considered sensitive	No buffer	Not considered sensitive
Fixed Links (Microwave/Scanning Telemetry)	100 m[49] Fixed links: 2nd and 8th Fresnel Zone (where frequency of link is available) and/or operator defined (if achievable) Scanning Telemetry links: 8th Fresnel zone.	Default separation distance requested by majority of fixed link operators. Bacon Report/Ofcom and majority of fixed link operators will accept a separation distance of the 2nd Freznel zone in most instances.	100 m (Fixed Links) 1 km + Blade length to Scanning Telemetry links.	Default separation distance request by majority of fixed link operators Basically scanning telemetry links operate at a lower frequency and so are liable to increased disruption to the signal path from turbines: http://www.jrc.co.uk/windfarms/

[49] Distance between blade tip (when at 90 degrees from vertical) and the centre of fixed link

Table A.3 (continued) Buffers applied to site constraints

Constraint	Minimum Buffer Requirement	Minimum Buffer Justification	Maximum Buffer Requirement	Maximum Buffer Justification
Turbine Warranty	-	Different manufacturers put in place different warranty restrictions and/or these maybe negotiable	There should be no buildings taller than 15 m within 300-400 m of turbines and there should be no buildings within blade tip fall over distance.	Nordex advised in meeting of 8.5.08 with commercial director that they have recently turned down some single turbine sites because of their proximity to buildings. Nordex advised keeping the topple distance completely free of buildings (also driven by insurance) and restricting building heights to less than 15 feet within an approximate area of 300/400 meters of the base of the turbine.
Turbine Optimisation	5 rotor diameters downwind (SW assumed prevailing direction for turbine orientation) x 3 rotor diameters cross wind.	Minimum required to ensure turbulence and wake effects do not significantly reduced output/affect performance	6 rotor diameters downwind (SW assumed prevailing direction for turbine orientation) x 4 rotor diameters cross wind	More conservative separations

A.2 Solar

A.2.1 Solar Photovoltaics (PV)

Solar PV systems exploit the direct conversion of daylight into electricity in a semi-conductor device. The individual cells are interconnected to form a module (more commonly known as a panel). These modules can either be mounted on building roofs (a roof mounted array) or simply installed at ground level (a ground based array or solar farm). A typical domestic installation will cover a roof area of 7 – 14 m^2 with an output of 1 – 2 kW of electricity (referred to as kW peak output or kW_p). Solar farms typically range in size from around 1 ha -50 ha (depending upon land availability).

To maximise the electricity output from a solar PV system it needs to be:

- Orientated to be South facing; and
- Clear from any obstruction (overhanging trees or vegetation) or overshading from neighbouring buildings.

The electricity output from solar PV panels can be used directly in the home or business premises to which they are connected. During periods of the day when any surplus electricity is generated (i.e. more than is needed for use in the premises) then this can be exported to the national grid. Present feed-in tariffs offer owners of these systems a tariff payment for each kWh of electricity produced. Any exported electricity attracts an additional (lower) payment for each kWh supplied to the grid.

A summary of existing capacity, based on FiT registrations, is shown in Figure A.16 for Leicester and Figure A.17 for Oadby & Wigston.

A.2.2 Solar Assessment Methodology – Building Mounted

The assessment methodology applied uses the following working assumptions.

- Domestic properties (including flats) – 25% will have suitable aspect features; will not have planning constraints and will not be subject to shading. These roofs will accommodate a 2 kW rated system. A load factor of 0.09 is used in estimating the potential annual energy yield from these systems.
- Commercial properties – 50% will not have issues with shading; these properties will accommodate a 5 kW system. A load factor of 0.09 is used in estimating the potential annual energy yield from these systems.

Census figures from 2011[50] provide a guide as to the number of domestic dwellings in each authority area, as well as a breakdown in terms of dwelling type.

A summary of the estimated capacity for solar PV is calculated based on these figures.

[50] Table KS402UK 2011 Census: Tenure, local authorities in the United Kingdom, Office for National Statistics (2011)

Table A.4 Estimated Capacity for Building Mounted Solar PV

	Leicester	Oadby & Wigston
Total Domestic Dwellings	127,383	22,481
of which:		
Detached	13,390	6,601
Semi-detached	44,880	10,691
Terraced	40,290	3,369
Flat	28,757	1817
Estimated Dwellings Suitable for Solar PV	31,829	5,620
Estimated Capacity (MW_p)	64	11

Note: Assume 2 kW_p capacity for each household deemed to have capacity to host solar PV.
Temporary dwellings excluded from analysis

The present study has extended the scope of assessment to include ground mounted solar PV arrays. Available land areas within the Leicester City and Oadby & Wigston Council boundaries have been reviewed. This excludes all Grade 1 agricultural land and accounts for a buffer around buildings.

Key issues to address in the assessment of available land areas include:

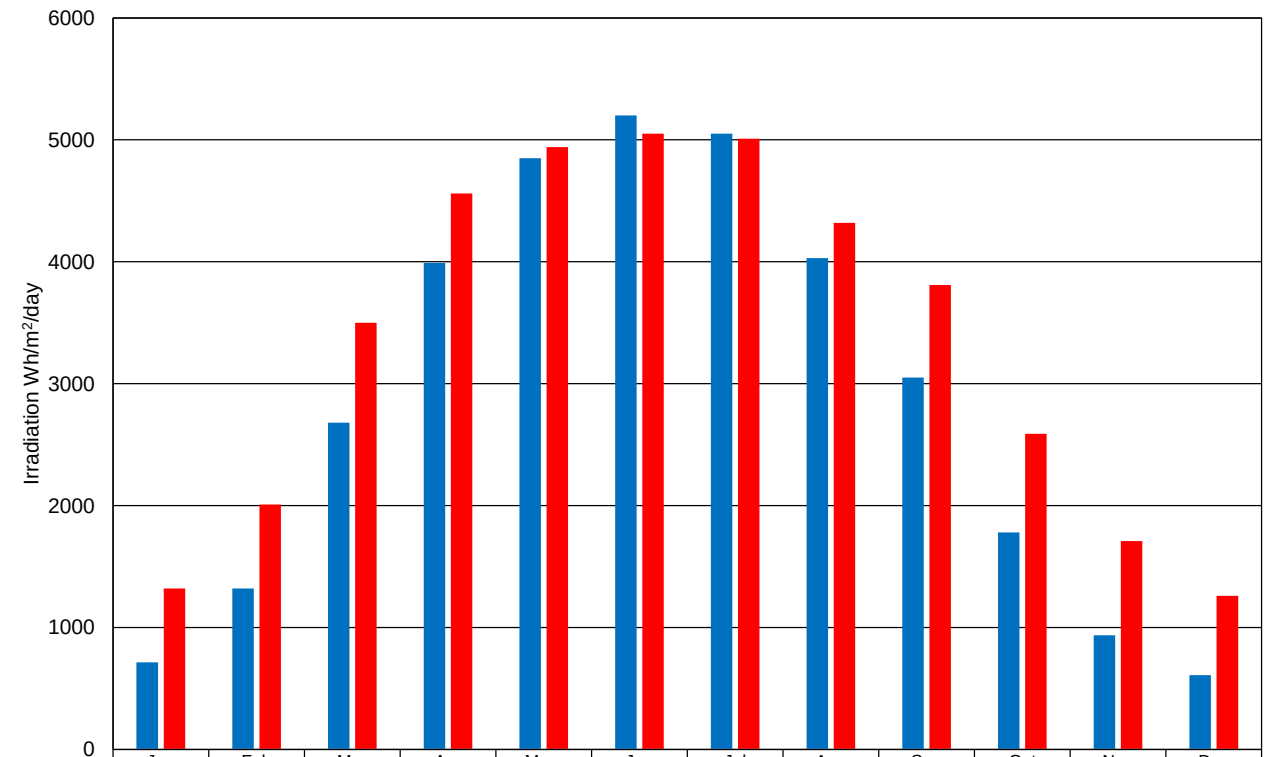
- Land area – area of unconstrained land available for development, constraints include watercourses, waterbodies, pathways, trees, overhead lines etc.;
- Land use – high value agricultural land should be retained for agricultural use where possible, brownfield sites are the most desirable;
- Topography – flat land is most suitable for solar development, otherwise levelling of the land may be required which incurs additional costs and site works;
- Sensitivity – if the site has value in terms of local or national designations is it likely to be unsuitable for development;
- Flood risk – areas with significant risk of flooding could be problematic for developments;
- Glint and Glare - Glint and glare results from reflection of sunlight off solar panels, it is not likely to be a major issue but can present an issue for aviation/driver safety; and
- Landscape and Visual –any nearby sensitive receptors increase the visual impact of the potential development.

A.2.3 Solar Resource

The average incident solar radiation in Leicester and Oadby & Wigston is estimated to be 2,760 Wh/m^2/day for a horizontal plane (Hh) and 3,290 Wh/m^2/day on an optimally inclined plane (Ho), corresponding to an average annual solar radiation of 1,142 kWh/m^2 and 1,343 kWh/m^2 respectively[51]. The optimum inclination angle for solar panel installed in Leicester is 38°. Figure A.19 shows the local average monthly radiation based on long term averages.

[51] http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php PVGIS © European Communities, 2001-2012

Figure A.20 Long Term Average Monthly Radiation in Leicester and Oadby & Wigston



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hh	715	1320	2680	3990	4850	5200	5050	4030	3050	1780	937	609
Hopt	1320	2010	3500	4560	4940	5050	5010	4320	3810	2590	1710	1260

PVGIS © European Communities, 2001-2012

A.2.4 Ground Based Solar PV Arrays

In addition to the key issues outlined in section A.2.2, there are general issues that need to be considered when looking at a ground-based solar PV development.

- **Security** of a solar farm is an important consideration. Sites are generally surrounded by security fencing with monitored CCTV cameras installed. Natural features such as hills, rivers etc. can assist in securing a site. Ideally a site would have one secure entrance and be difficult to access from other locations. Isolated sites are vulnerable.
- **Delivery** of solar panels and associated equipment is done by a standard vehicles with no abnormal loads required with the potential exception of the transformer. Some sites may not have standard access.
- **Grid capacity**: Should a development be considered beyond this assessment, there are two important factors to be considered: the nearest grid connection point and the capacity of the local network to accept the additional electricity generated by the solar farm. It is strongly recommended that the local Distribution Network Operator is contacted to establish the grid capacity and the cost of connecting to the local grid network. The point of any connection will depend upon existing local electrical loads and the scale of any proposed solar PV development. This level of detail isn't available at this stage of assessment.
- **Land Availability** – The size of land area will determine the energy generating potential of the proposed solar PV array. As an approximate rule of thumb 2 Ha of land is required for each 1 MW of generating capacity[52].

[52] http://www.solar-trade.org.uk/solarFarms.cfm (Accessed February 2014)

- **Gradient Slope –** Land areas with a slope of 5% or more are difficult to develop in terms of optimising the orientation of panels (as well as general accessibility issues).
- **Orientation of Slope –** South facing slopes are best suited to maximising energy yields.

Application of these constraints results in land area availability as shown in Figure A.7 (Area of Solar Ground Based Array Potential). This results in a total potential land area of around 25 Ha.

A.2.5 Energy yield calculation

The potential solar farm capacity has been calculated based on a density of 1MWp per 1.5 hectare and the estimated annual energy output then calculated using the method outlined in the '*Guide to installation of Photovoltaic systems MCS 2012*'. A kWh/kWp value of 871 has been used based on tilt angle of 20° which is not optimal for this area but allows greater density of panels to fit into the available area. Orientation directly south and no shading has been assumed.

A.2.6 Solar Thermal

Solar thermal systems use solar energy to heat water which is stored in a hot water cylinder. A boiler or immersion heater is required to provide an additional source of heat over and above the energy available from the sun. Solar thermal panels (collectors) come in two designs:

- **Evacuated tube**: Water flows through a number of copper pipes, which in turn are sealed in a glass tube. This reduces heat losses and makes these systems very efficient at transferring the heat of the sun to the water; and
- **Flat Plate**: Water flows through copper pipes that are encased with a glass covered plate.

Solar collectors are suitable for use in both domestic and light industrial premises as well as part of systems supplying swimming pools.

Installation Considerations

There are a number of factors to consider in relation to solar thermal system installation including:

- As with solar PV systems the optimum roof space available to solar thermal systems is South facing areas with little or no immediate overshading;
- The system must include a hot water cylinder to store the resulting hot water. It is therefore more costly to install a solar thermal system in properties with an existing combi boiler since there is no existing water tank;
- The proposed installation area of the roof must be structurally capable of supporting the weight of the water-filled collector;
- Solar collectors are eligible for Renewable Heat Incentive (RHI) payments for each kWh of heat produced in a year; and
- Solar collectors are likely to be most cost effective when reducing water heating demand from electricity or oil/LPG fuelled systems, i.e. those not on the national gas grid.

Of the total dwellings estimated to be suitable for solar development (as per Solar PV calculations) if 5% were to install solar thermal of an average capacity of 2 kW_{th} then this would result in an overall capacity of 12.7 MW_{th} in the case of Leicester 2.3 MW_{th} in the case of Oadby & Wigston.

Non-domestic installations are likely to be limited in nature given the relative scale of water consumption (and therefore associated potential savings) at the majority of businesses.

A.3 Biomass

A.3.1 Previous Estimated Installed Capacity

A previous study carried in 2011[53] provides a summary of estimated generation potential from biomass sources (Table A.5)

Table A.5 Estimated Energy Generation Capacity from Biomass

Energy Source	Estimated Generating Capacity Leicester (MW)	Estimated Generating Capacity Oadby & Wigston (MW)
Managed Woodland (heat)	0.04	0.02
Managed woodland (electricity)	0.01	0.00
Energy crops (heat)	0.45	1.20
Energy crops (electricity)	0.08	0.21
Agricultural arisings	0.05	0.03
Waste wood (heat)	1.95	0.23
Waste wood (electricity)	2.28	0.27

Note: Figures relate to technical potential

These figures are based on the following working assumptions:

- Areas of woodland for Leicester (33.8 ha) and Oadby & Wigston (9.6 ha) account for 0.04% and 0.01% respectively of the total woodland area in the East Midlands region;
- The proportion of total available oven dried tonnes (odt) is therefore calculated using these percentage contributions based on a total figure for the East Midlands of 152,333 odt. Oven dried tonnage figures are derived from Forestry Research data;
- 1 MW of electricity capacity requires 6,000 odt of fuel input; and
- In the case of heating energy output an 80% conversion efficiency is assumed along with a 45% capacity factor

A.3.2 Energy Crops

In the case of woodland residues, the extent of resource depends on how much woodland is actively managed within Leicestershire and the incentives for landowners to extract and process woodfuel.

In the case of energy crops several factors will influence the extent to which landowners will be willing to grow such crops:

- Long term supply contracts with end users;
- Financial incentives to grow and harvest the crops;
- Conflict over land-use for food production; and
- Logistics of fuel processing.

[53] http://broughtonastley.leicestershireparishcouncils.org/uploads/1751224d4ee6656061012734.pdf (Accessed February 2015)

There are a number of biomass suppliers already operating in the area. For the purposes of illustration, those suppliers operating within a 50 mile radius of Leicester are listed in Table A.6.

Table A.6 Biomass Suppliers within Leicester area

#	Supplier	Location	Log	Chip	Pellet	Briquette
1	EWF Melton Mowbray	LE15 8DX		x	x	
2	Forest Fuels Ltd	LE14 2EP		x	x	
3	Forest Fuels Ltd	LE15 8DX		x	x	
4	East midlands firewood	LE127PY	x			
5	Hunterelm	LE12 6LB	x			
6	Beddow tree ltd	LE92BE	x	x		
7	CPL Leicester	LE67 1FB	x		x	x
8	Aspect Forestry and Rural Management	IP19 0JX	x	x		
9	A & A RECYCLING SERVICES LTD	CV9 2HJ		x		
10	Midland Bio Energy Ltd	CV9 3PF	x		x	x
11	Forest Fuels Ltd	CV13 6LD		x	x	
12	Caton Recycling Ltd	CV13 6LD		x	x	
13	EWF Warwickshire	CV13 6LD		x		
14	Weston Hayes farm	CV12 9HN	x			
15	Corley bio-wood	CV7 8AQ			x	
16	Biofuels.uk.com	CV4 7BJ				x
17	Jack Moody Limited Berkswell	CV7 7LH		x	x	
18	Kingsbury Pallets Ltd	B76 9BG		x		
19	Biomass Timber Solutions Ltd	DE11 7BP	x	x		
20	Ten Mile Timber Company	LE65 1RT	x			
21	BTS Biomass Timber Solutions	DE11 7BP		x		
22	CPL Derbyshire	DE7 8JF	x		x	x
23	Wood waste uk ltd	NG13 8AY		x		
24	The Manthorpe Firewood Company	NG31 9PL	x			x
25	I Hart Woodland & Groundcare Services	NG33 5JD	x			
26	Exton Logs	LE15 8BQ	x			
27	Logs Krazy Ltd	PE8 5RH	x	x		x
28	Forest Fuels Ltd	NN14 3HP		x	x	

Table A.7 Biomass Suppliers within Leicester area

#	Supplier	Location	Log	Chip	Pellet	Briquette
29	EWF Corby	NN14 3HP		x		
30	Bougthon Estate	NN16 9UP	x	x		
31	CPL Northampton	NN7 3HY	x		x	x
32	PCB Services	NN10 0SY	x			
33	Midlands Wood Fuel (Leamington Spa)	SY5 6EB		x	x	
34	Warwickshire Wood Fuel Ltd	CV34 4BB		x		
35	Bradshaw lumberjacks	DE56 0RU	x			

Source: http://www.woodfueldirectory.org

Given the extensive number of suppliers already operating in the area it is unlikely that a significant number of further suppliers based within Leicestershire will enter the supply market via woodland management.

In terms of large scale consumers of biomass there are a small number within the proximity of Leicester (within the East Midlands region). A summary of these users is provided in Table A.7.

Table A.8 Large Biomass Consumers

Facility	Location	Capacity (MW_p)	Capacity (MW_{th})	Total Capacity (MW)	Status
Bolingbroke Road	Louth, Lincolnshire	3.0			Planning Permission Granted
Pulse Park, Wellingborough	Wellingborough, Northamptonshire	5.0			Under Construction
Northampton General Hospital	Northampton, Northamptonshire	1.9			Planning Permission Granted
Stallingborough Biomass Power	Immingham, Lincolnshire	65.0			Planning Permission Granted
Sutton Bridge Renewable Energy Park	Spalding, Lincolnshire	48.0			Planning Permission Granted
Sleaford Renewable Energy Plant	Sleaford, Lincolnshire	38.0			Operational

Source: Renewable Energy Planning Database, DECC (January 2015)

All of these facilities will have existing fuel supply contracts in place. It is therefore difficult to see how further suppliers operating within Leicestershire could easily enter the market for energy crop supply.

A.4 Hydro

Hydropower is a technology that is well established. Water flowing from a higher to a lower level is used to drive a turbine, which produces mechanical energy, which is usually turned into electrical energy by a generator. The energy produced is directly proportional to the flow volume of water and the head (distance from higher to lower level). There are high head–low volume applications and low head-high volume applications.

Larger scale projects involve a reservoir where a large body of water is stored (dammed) and then released to lower level enabling energy generation. The larger majority of schemes, however, are so called run-of-river schemes where water flow is diverted along a channel and through a turbine before being discharged back into the river at a lower point. A further design type, the Archimedes screw turbine, can be located directly in the flow of the river.

A.4.1 Hydro Assessment Methodology

The potential sites identified are listed in Table A.9 and Table A.10. These tables are accompanied by Figure A.18 and Figure A.19. In identifying these sites no environmental constraints are considered or mapped.

Table A.9 Potential Small Scale Hydropower Development Sites (Leicester)

Ref	Feature	Estimated Maximum Head (m)	Potential Power Output Range (kW)	Development Sensitivity	Estimated Annual Energy Generation (kWh/yr)
1	Weir	1.75	0 - 10 kW	Medium	84,317
2	Weir	1.46	0 - 10 kW	Medium	13,958
3	Weir	0.98	0 - 10 kW	High	47,921
4	Weir	1.60	10 - 20 kW	High	93,075
5	Weir	1.06	0 - 10 kW	Medium	45,932
6	Weir	5.65	0 - 10 kW	Medium	4,866
7	Weir	1.65	0 - 10 kW	Medium	4,077
8	Weir	5.41	0 - 10 kW	Medium	11,270
9	Weir	1.65	0 - 10 kW	Medium	71,327
10	Weir	1.39	0 - 10 kW	High	59,526
11	Weir	2.72	0 - 10 kW	Medium	6,709
12	Weir	2.50	0 - 10 kW	Medium	13,489
13	Weir	1.09	0 - 10 kW	Medium	53,071
14	Weir	2.19	0 - 10 kW	Medium	2,011
15	Weir	5.20	0 - 10 kW	Medium	11,183
16	Weir	1.50	0 - 10 kW	Medium	3,332
17	Lock	1.99	0 - 10 kW	Medium	86,373
18	Lock	1.99	0 - 10 kW	Medium	27,600

Table A.10 Potential Small Scale Hydropower Development Sites (Leicester)

Ref	Feature	Estimated Maximum Head (m)	Potential Power Output Range (kW)	Development Sensitivity	Estimated Annual Energy Generation (kWh/yr)
19	Lock	3.29	10 - 20 kW	Medium	159,778
20	Lock	2.20	10 - 20 kW	High	94,474
21	Lock	1.68	0 - 10 kW	Medium	15,981
22	Weir	1.38	0 - 10 kW	Medium	3,139
23	Weir	1.56	0 - 10 kW	Medium	2,907
24	Weir	4.06	0 - 10 kW	Medium	23,868

Note: Based on Environment Agency study data

Table A.11 Potential Small Scale Hydropower Development Sites (Oadby & Wigston)

Ref	Feature	Estimated Maximum Head (m)	Potential Power Output Range (kW)	Development Sensitivity	Estimated Annual Energy Generation (kWh/yr)
25	Lock	2.40	0 - 10 kW	High	35,252
26	Lock	2.29	0 – 10 kW	Medium	33,619
27	Lock	2.33	0 – 10 kW	Medium	54,330
28	Weir	2.30	0 – 10 kW	Medium	51,144
29	Lock	1.81	0 – 10 kW	Medium	31,356
30	Lock	2.39	0 – 10 kW	Medium	41,336

Note: Based on Environment Agency study data

A.4.2 Site Classification

The overall sensitivity of a given site was evaluated using a three stage process. This process considered the presence of diadromous, migratory and mobile species as listed in Table A.11.

Table A.12 Fish Species Groupings

Diadromous Species	Migratory Species	Mobile Species	Non-Migratory Species
Salmon	Barbel	Bleak	Bream (Silver)
Shad (Allis and Twaite)	Dace	Bream (Common)	Loach (Spined and Stone)
Lamprey	Grayling	Carp	Stickleback (3 and 9 spined)
Eel	Chub		Carp (Crucian)
Smelt	Pike		Gudgeon
	Trout		Perch
			Roach
			Rudd

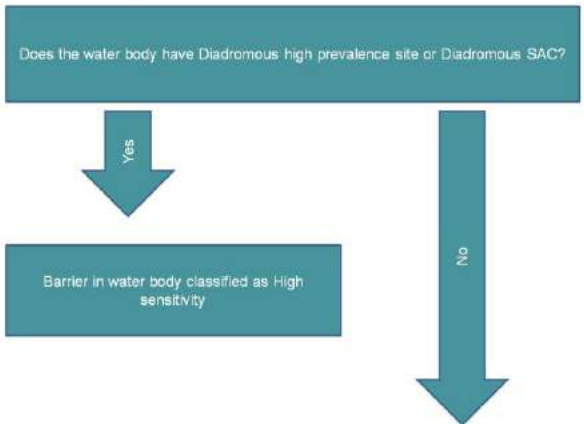
Table A.13 Fish Species Groupings

Diadromous Species	Migratory Species	Mobile Species	Non-Migratory Species
			Bullhead
			Tench
			Minnow

The three stages of the evaluation process are as follows:

Figure A.21 Site Classification Process

Stage 1

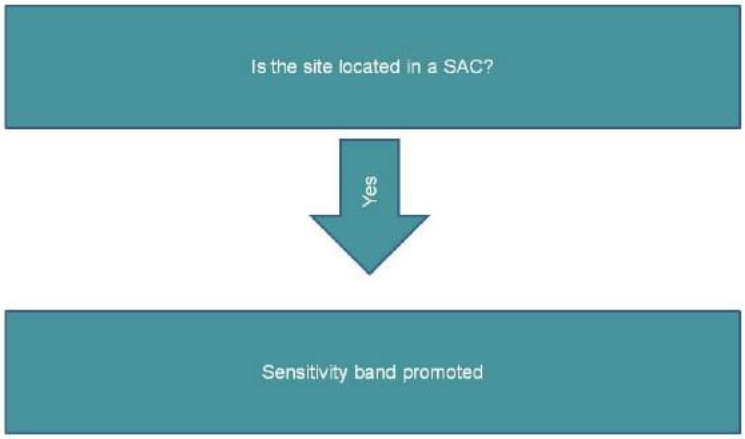


Stage 2 Site scored using:

Diadromous	Medium Probability of Presence	3 pts
	Low Probability of Presence	0 pt
Migratory Species	High Probability of Presence	4 pts
	Medium Probability of Presence	2 pts
	Low Probability of Presence	0 pt
Mobile Species	High Probability of Presence	2 pts
	Medium Probability of Presence	1 pt
	Low Probability of Presence	0 pt
	Presence of Non-migratory species not considered	

Barriers Scored based on Total Score:	
Total Scores	**Sensitivity Band**
6 – 9	High
3 – 5	Medium
0 – 2	Low

Stage 3



A further categorisation of 'Win-Win' was applied to those locations with a medium to high power potential and which sit within a heavily modified water body (as defined in the Water Framework Directive).

The resulting locations of potential development are shown in Figure A.18 Areas of technical potential for hydro development.

A.5 District Heating

A.5.1 District Heating – Leicester

The existing district heating scheme was developed with a number of phased extensions in mind. A summary of the existing and proposed connections is provided in Table A.14.

Table A.14 Existing and Future Connections to District Heating

#		Phase 1	Phase 2	Phase 3	Phase 4
B1	St Andrews Primary School	X			
B2	Uplands Infant School	X			
B3	Uplands Junior School	X			
B4	Highfield Community Centre	X			
B5	Highfield Library	X			
B6	St Peters Housing Office	X			
B7	Islamic DaWah Academy	X			
B8	St Matthews Neighbourhood Centre	X			
B9	Douglas Bader House	X			
B10	Catherine St School	X			

Table A.15 Existing and Future Connections to District Heating

#		Phase 1	Phase 2	Phase 3	Phase 4
B11	Prince Philip House	X			
B12	Malabar Road Library	X			
C1	New Walk Centre		X		
C2	Phoenix House		X		
C3	Marlborough House		X		
C4	Central Library		X		
C5	Town Hall Square		X		
C6	Municipal Library		X		
C7	Pilot House		X		
C8	16 New Walk		X		
C9	New Walk Museum		X		
C10	Sovereign House		X		
C11	University of Leicester Campus		X		
C12	HM Prison Leicester		X		
C13	1 – 3 Greyfriars		X		
C14	Leicester Adult Education Centre		X		
C16	Attenborough House		X		
C18	DeMontford Hall		X		
C20	Sparkenhoe Primary School		X		
C21	Sparkenhoe St Theatre		X		
C22	African Caribbean Centre		X		
C23	Moat Community College		X		
C24	Highfields Primary School		X		
D1	Leicester College			X	
D2	Western Challenge Housing			X	
D3	Leicester Royal Infirmary			X	
D4	Crown Court			X	
D5	De Montford University – City Campus			X	
D6	Charles Keane College			X	
D7	Newarke Houses Museum			X	
D8	Magistrates Court			X	

Table A.16 Existing and Future Connections to District Heating

#		Phase 1	Phase 2	Phase 3	Phase 4
D9	City Gallery			X	
D10	Police Station			X	
D11	Alexander House			X	
D12	Sainsburys Store Redevelopment (St Marks)			X	
D13	Mercure Hotel			X	
D14	Regents College Sports Centre			X	
D15	Peepul Centre			X	
D16	Mahatma Gandi House			X	
D17	University Sports Centre			X	
D18	Wyggeston and Queen Elizabeth I College			X	
D19	Leicester Tigers Stadium			X	
D20	DMU Sports Hall			X	
D21	Tesco New Park Street			X	
D22	Blackfriars Student Residences			X	
D23	Alfurquan Community Building			X	
D24	James House			X	
D25	Enterprise House			X	
D26	UoL Centre Research Facility (CRF)			X	
D27	UoL Medical Training Building			X	
D28	Mercury Building			X	
D29	Havelock St Development			X	
D30	Freeman's Common UoL South Campus			X	
D31	Nixon Court			X	
D32	UoL Education Centre			X	
D33	Tyman House			X	
D34	Provincial House			X	
D35	Cooper Parry Building			X	
D36	Heart of Oak House			X	
D37	Renaissance House			X	
D38	Herbert Driver Building			X	
D39	Unite Student Living			X	

Table A.17 Existing and Future Connections to District Heating

#		Phase 1	Phase 2	Phase 3	Phase 4
D40	Bannatyne Leisure Centre			X	
D41	Job Centre			X	
D42	Job Centre			X	
D43	Castle Hotel			X	
D44	Phoenix House Building			X	
D45	Eagle Star House			X	
D46	Hurlington Estates			X	
D47	Bank Building			X	
D48	Alliance House			X	
D49	Old Post Office			X	
D50	Charles House			X	
D51	Encore Hotel			X	
D52	60 Charles Street			X	
D54	Wellington House			X	
D55	St Georges Rental			X	
D56	Employment Tribunal Office			X	
D57	The Curve Theatre			X	
D100	BHS Store			X	
D101	M&S Store			X	
D102	Haymarket Shopping Centre			X	
D103	Offices			X	
D104	Job Centre & offices			X	
D105	Midland House Offices			X	
D106	Age Concern			X	
D107	Sainsburys			X	
D108	Fitness First			X	
D109	ESBM Centre (Asian Cultural Centre)			X	
D110	Humberstone House Offices			X	
D111	Leicester Housing Association Apartments			X	
D112	Rutland Centre			X	
D113	Apartments – Rutland Centre			X	

Table A.18 Existing and Future Connections to District Heating

#		Phase 1	Phase 2	Phase 3	Phase 4
D114	Development – Offices/Apartments			X	
D115	PKF Accountants			X	
D116	Derelict Land / Building			X	
D117	Apartments			X	
D118	Athena Entertainments Centre			X	
D119	Apartments – Wimbledon Street			X	
D120	BT Exchange			X	
D121	Wellesley House			X	
D122	Harvey Ingham Solicitors			X	
D123	Telephone Exchange			X	
D124	Jarrom Street			X	
D125	Victoria Park Medical Centre			X	
D126	Old HSBC bank			X	
D127	Elizabeth House			X	
D128	Post Office / Delivery Office			X	
D129	Premier Inn			X	
D130	Office			X	
D131	IBIS Hotel			X	
D132	Matrix House			X	
D133	Pochin Building			X	
D134	Peat House			X	
D135	St John's House			X	
D136	Arnhem House			X	
D137	De Montford House			X	
D138	Apartment – Wimbledon House			X	
D139	Newarke Street Student Accommodation			X	
D140	Peacock Lane Bus Depot Redevelopment			X	
D141	Thomas May			X	
D142	1 – 9 Pocklingtons Walk			X	
D143	55 Oxford Street			X	

Note: Details based on schematic provided by Leicester City Council

A.5.2 District Heating – Oadby & Wigston

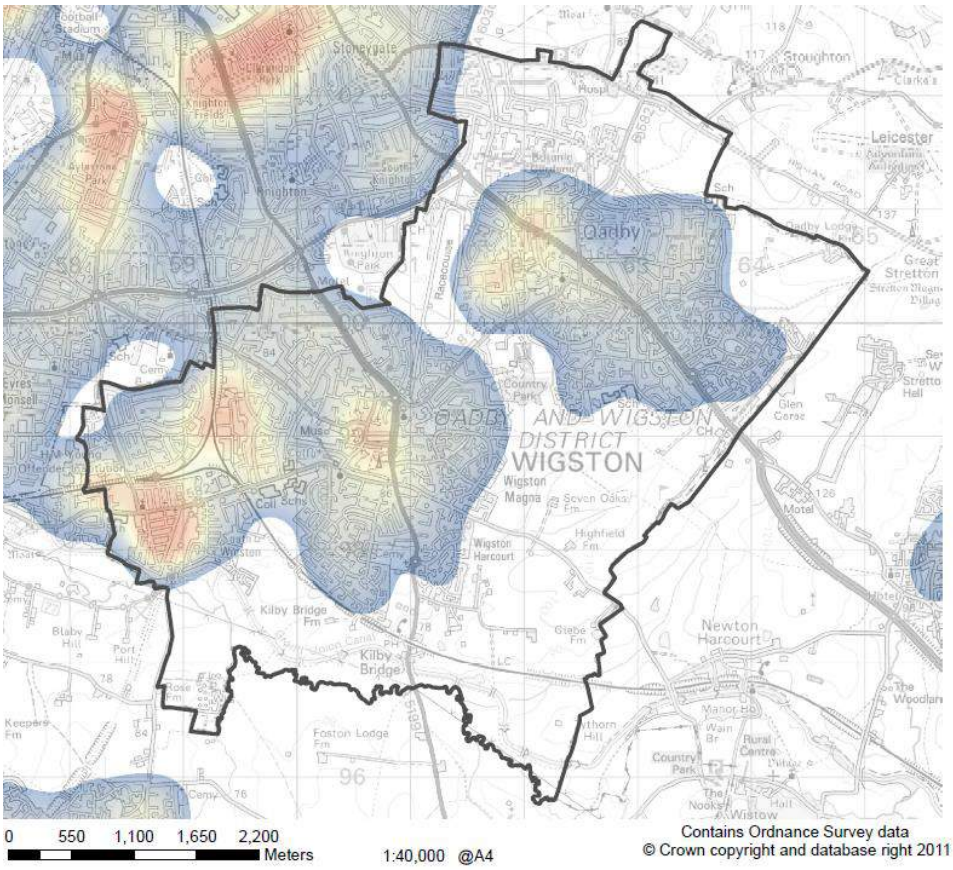
There is no existing district heating scheme operating within Oadby & Wigston at present. Given the distance between the nearest extents of the Leicester district heating scheme (ca. 7 km) and the lower aggregate heat demand within the area, it is not economically viable to seek to connect to the wider Leicester District Heating scheme.

The major areas of existing heat demand within the Borough can be identified using nationally available data from DECC[54]. A summary of this data is shown in Figure A.

There are four main areas where anchor loads suitable for district heating may be viable.

- Area 1 (South of South Wigston railway station) – There is a large supermarket (Tesco) to the South of the railway station. Non-domestic buildings along Canal St include the biscuit factory and South Leicestershire College. A number of other non-domestic buildings in the area are vacant and being considered for residential or mixed use redevelopment[55].
- Area 2 (North East of South Wigston railway station) – There are a number of non-domestic properties located around Chartwell Drive and neighbouring streets. These include small engineering firms, autoparts suppliers, catering suppliers and other small warehousing activities.
- Area 3 (Central Wigston) – There are a number of non-domestic retail units in this area including a supermarket and large general retail units.
- Area 4 (Oadby – East of the racecourse beside the A6) – This includes general small to medium retail units and several large supermarkets.

Figure A.22 High level heat map for Oadby & Wigston



[54] http://tools.decc.gov.uk/nationalheatmap/ (Accessed February 2015)

[55] See, for example, http://www.andash.co.uk/files/properties/724/Grand%20Hotel,%20South%20Wigston.pdf

A.6 Heat Pumps

There are three different forms of heat pump that can be used to provide space heating.

A.6.1 Ground Source Heat Pump

A ground source heat pump extracts heat from the ground, which can then be used to supply radiators, underfloor or warm air heating systems and hot water systems. A mixture of water and antifreeze is circulated around the so called ground loop, which is a loop of pipe arranged either horizontally (in a trench) or vertically (in a borehole). The circulating water/antifreeze fluid absorbs heat from the ground and this is then passed through a heat exchanger and into the heating system.

A.6.2 Air Source Heat Pump

Air source heat pumps extract heat from the outside air using the same approach as a fridge uses to extract heat from its inside. Heat from the air is absorbed at low temperature into a fluid. This fluid then passes through a compressor where its temperature is increased, and transfers its higher temperature heat to the heating and hot water circuits of the house. The heat in the house can then be provided via an underfloor system, warm air circulated by fans or a wet radiator system using outsized radiators.

A.6.3 Water Source Heat Pump

Water source heat pumps extract heat from water bodies. These can be lakes, ponds, rivers, springs, wells or boreholes. The heat transfer rate from water is higher than that from the ground or the air. So called ‘open loop’ designs circulate water via a heat exchanger and then discharge it back to the original source; a ‘closed loop’ system operates in a similar manner to a ground source heat pump with a water/antifreeze fluid mixture being circulated through pipes set within the water source.

An extraction licence is required from the Environment Agency when using open loop heat pumps that require more than 20 m3/day of water to be abstracted from the water source (typically a 4 kW system and above). A discharge consent is also required for the cold water that has flowed through the heat pump.

Closed loop systems do not require any licensing from the Environment Agency.

A.6.4 Heat Pump Use

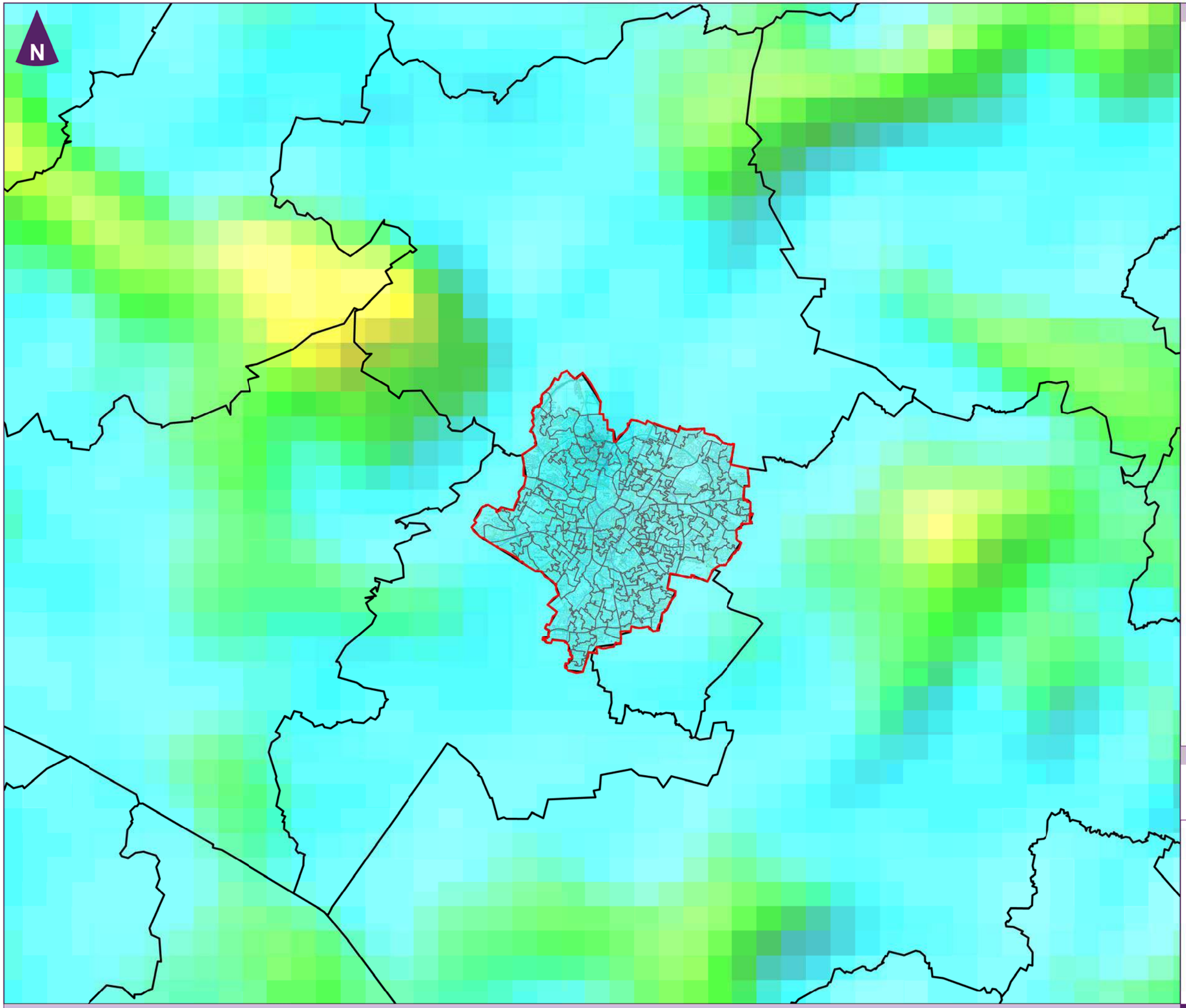
The heat output from heat pumps (whether ground, air or water) is lower than a typical wet radiator system fuelled via natural gas or oil. For this reason heat pumps are generally best used with underfloor heating, providing a larger surface area for supply. If used to supply a wet radiator system then these radiators need to be much bigger than conventional systems.

While the source of heat is renewable (ground, air or water), circulating fluid requires electricity to power the pumps. For this reason heat pumps are less economic to install in areas where natural gas fed heating systems already operate. In situations where heat pumps are replacing oil or electric heating systems the savings in terms of energy and cost will be more attractive.

In the case of Leicester it is estimated that 3% of existing dwellings and 20% of projected future dwellings could install heat pumps. At an average capacity of 5 kWth this would amount to around 40 MWth.

Similar capacity in the case of Oadby & Wigston would amount to around 4.2 MWth.

It is not anticipated that there will be substantial non-domestic uptake. Retrofit and/or new developments involving supermarkets or food stores are potential users of heat pumps for both heat and refrigeration. There may also be future scope to incorporate heat pumps as heat sources for the district heating scheme in Leicester. Such technical potential could amount to a further 5 MW_{th} in Leicester and 2 MW_{th} in Oadby & Wigston (at an average installed capacity of 100 kW per site).



Key

Council boundary

Lower Layer Super Output Area boundary

District boundaries

NOABL Windspeed at 45m a.g.l. (m/s)

- 11.6
- 7.2
- 6.6
- 6.3
- 1.4

0 km 9 km

Scale 1:150,000 @ A3

Client

Leicester City Council

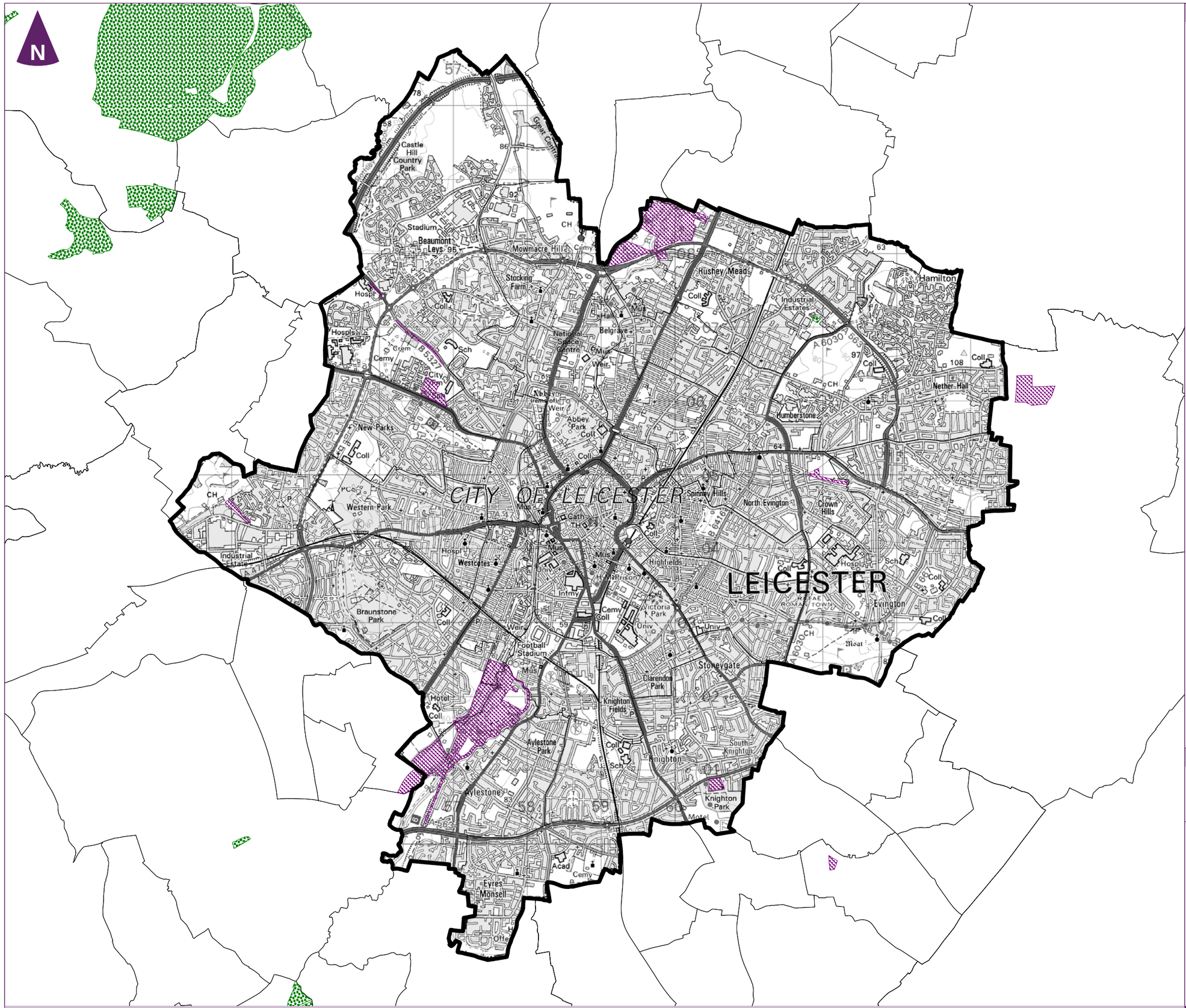
Leicester City Council Climate Change Evidence Base Study

amec foster wheeler

Figure A.1

Average annual wind speed in Leicester City

February 2015 36118-edi002a.wor fitzs



Key

- Council boundary
- Sites of Special Scientific Interest (SSSI)
- Local Nature Reserve (NNR)

0 km — 3 km

Scale 1:50,000 @ A3

Client

Leicester City Council

Leicester City Council Climate Change Evidence Base Study

amec foster wheeler

Figure A.2

Environmental Designations (Ecology)

February 2015

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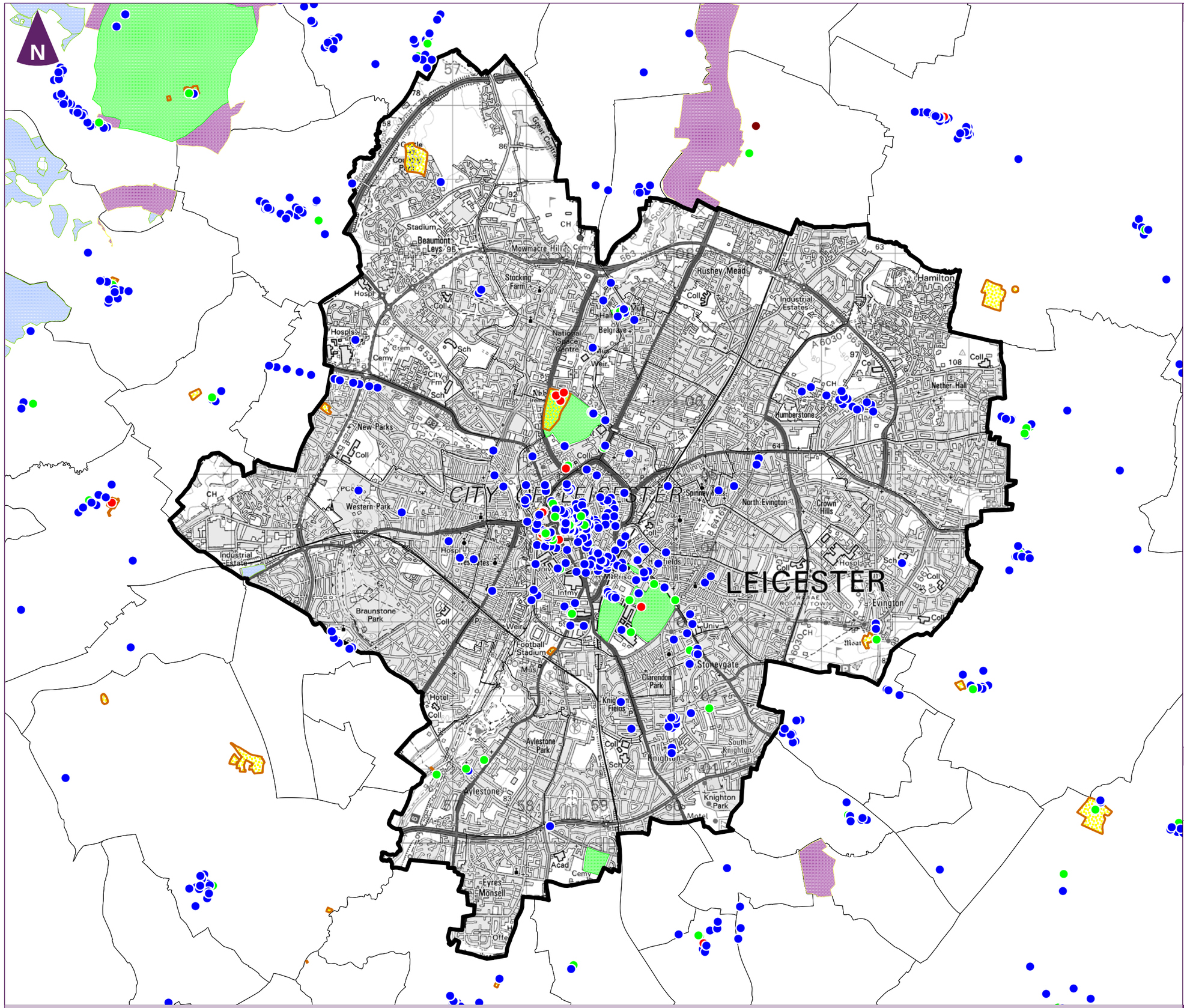

Key

- Council boundary
- Scheduled monument
- Historic battlefield
- Country park
- Registered Parks & Gardens
- Ancient woodland

Listed Buildings

- Grade I
- Grade II*
- Grade II

0 km 3 km

Scale 1:50,000 @ A3

Client

Leicester City Council

Leicester City Council
Climate Change
Evidence Base
Study

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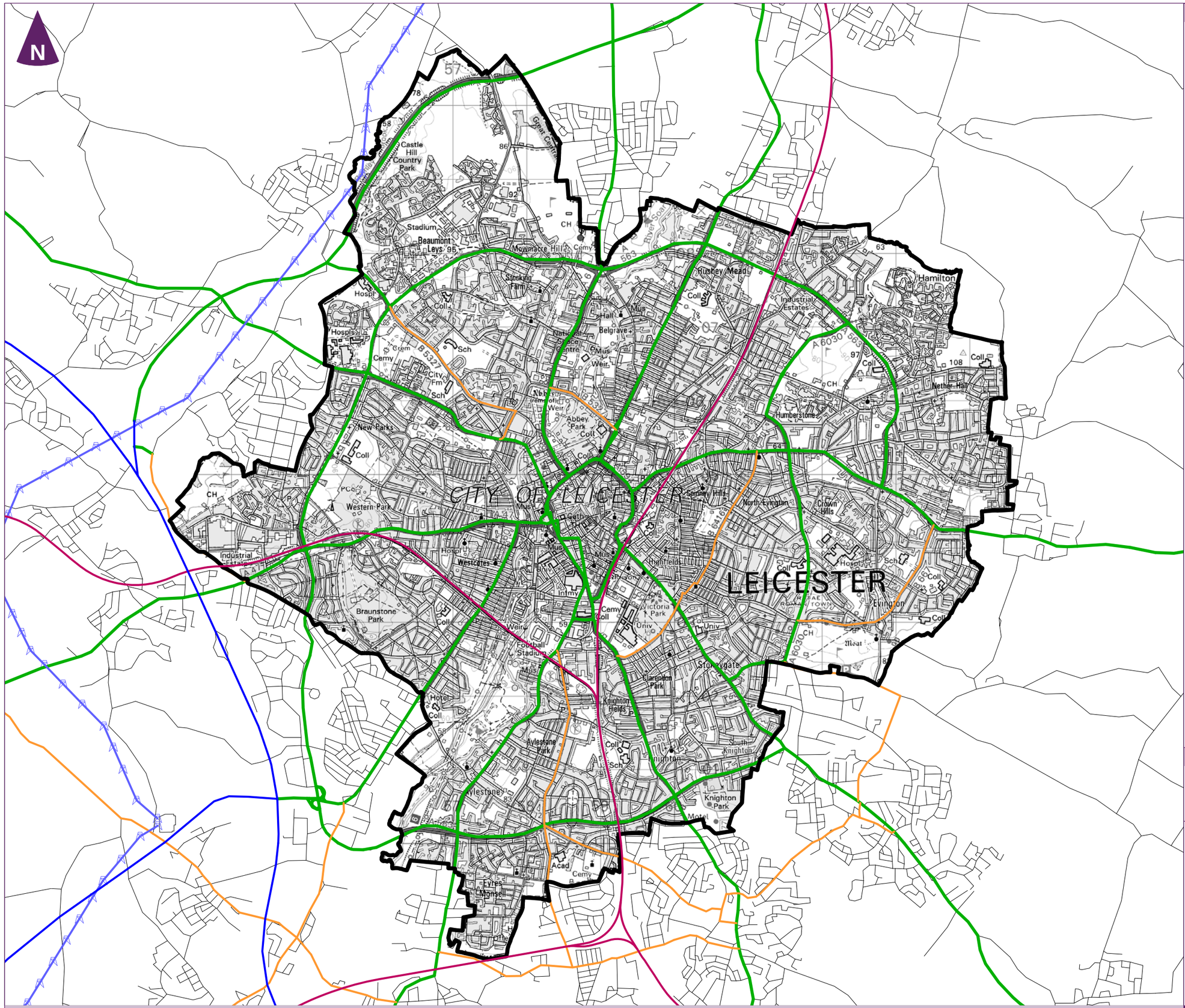
Figure A.3

Cultural Heritage Designations

February 2015 36118-edi004a.wor fitzs



Key

- Council boundary
- Minor road
- B road
- A road
- Motorway
- Rail line
- Gas transmission pipeline
- Electrical transmission overhead power line

0 km 3 km

Scale 1:50,000 @ A3

Client

Leicester City Council

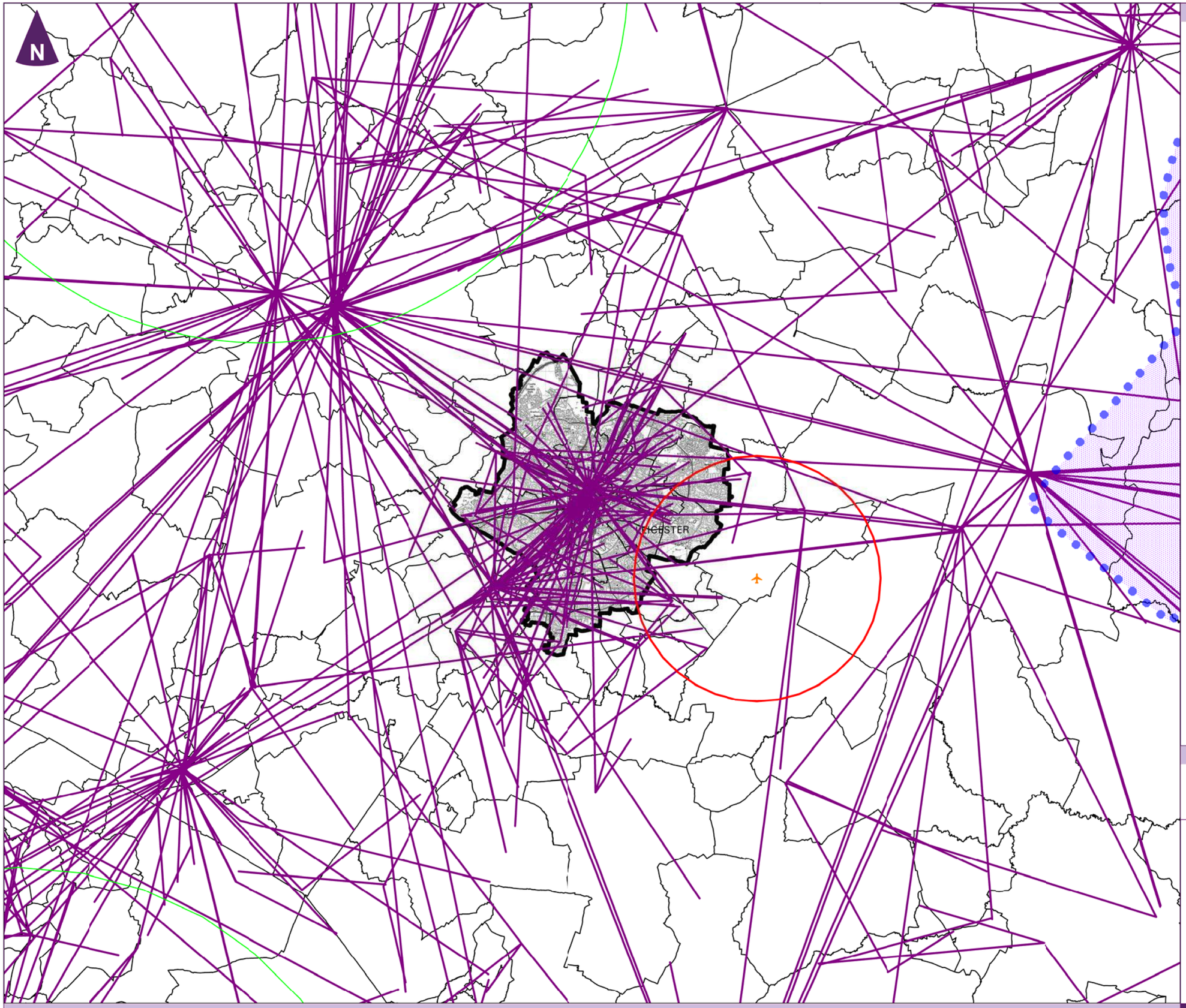
Leicester City Council
Climate Change
Evidence Base
Study

amec foster wheeler

Figure A.4

Infrastructure Constraints

February 2015 36118-edi005a.wor fitzs



Key

- Council boundary
- Microwave links
- Potential MOD radar zone
- Non-safegaurded airport
- Non-safegaurded airport 5 km buffer
- Safegaurded airport 15 km buffer

0 km — 9 km

Scale 1:150,000 @ A3

Client

Leicester City Council

Leicester City Council Climate Change Evidence Base Study

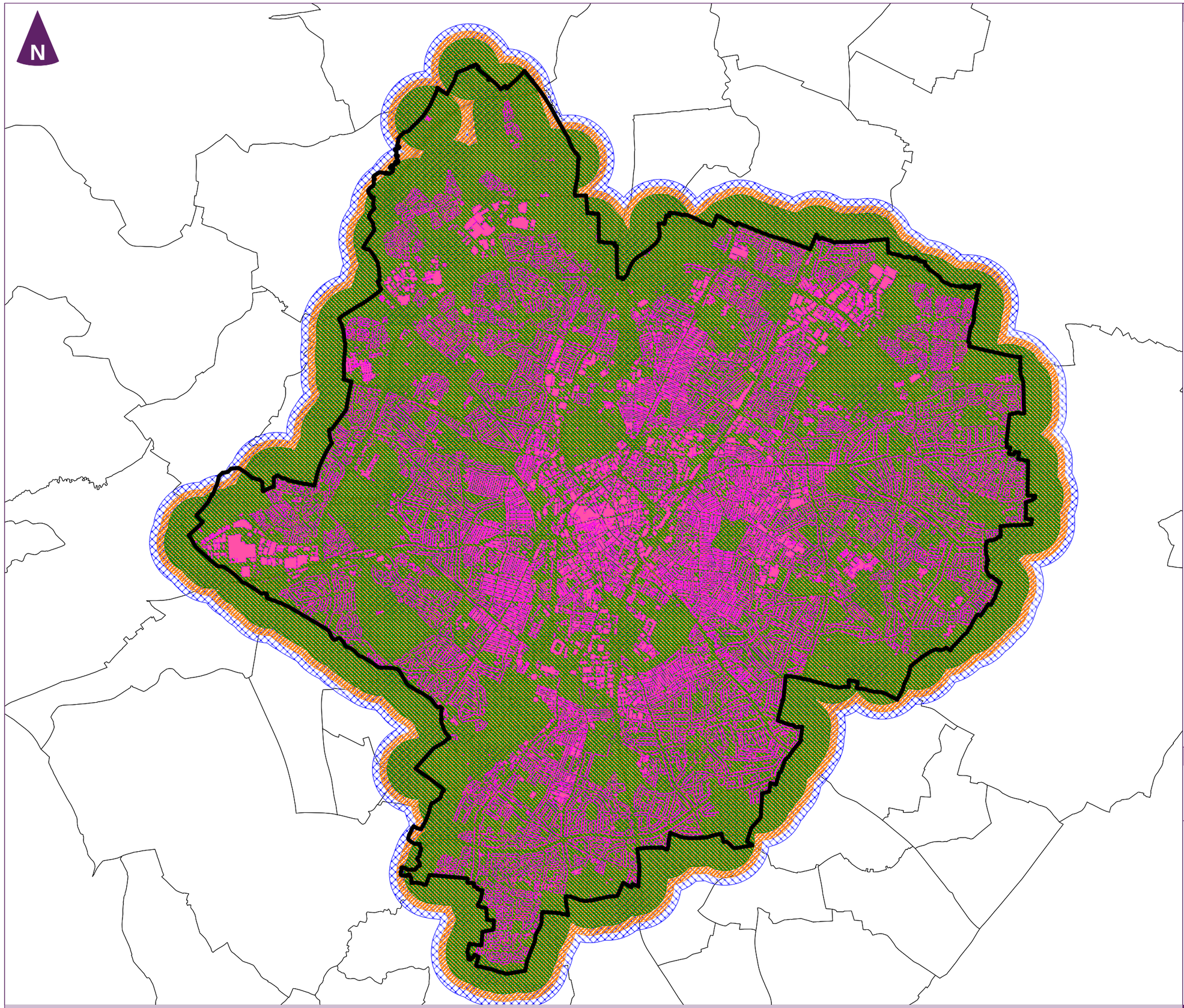
amec foster wheeler

Figure A.5

Airports, Radar and Communications Constraints

February 2015

36118-edi006a.wor fitzs



Key

- Council boundary
- Buildings
- Building 400 m buffer
- Building 500 m buffer
- Building 600 m buffer

0 km 3 km

Scale 1:50,000 @ A3

Client

Leicester City Council

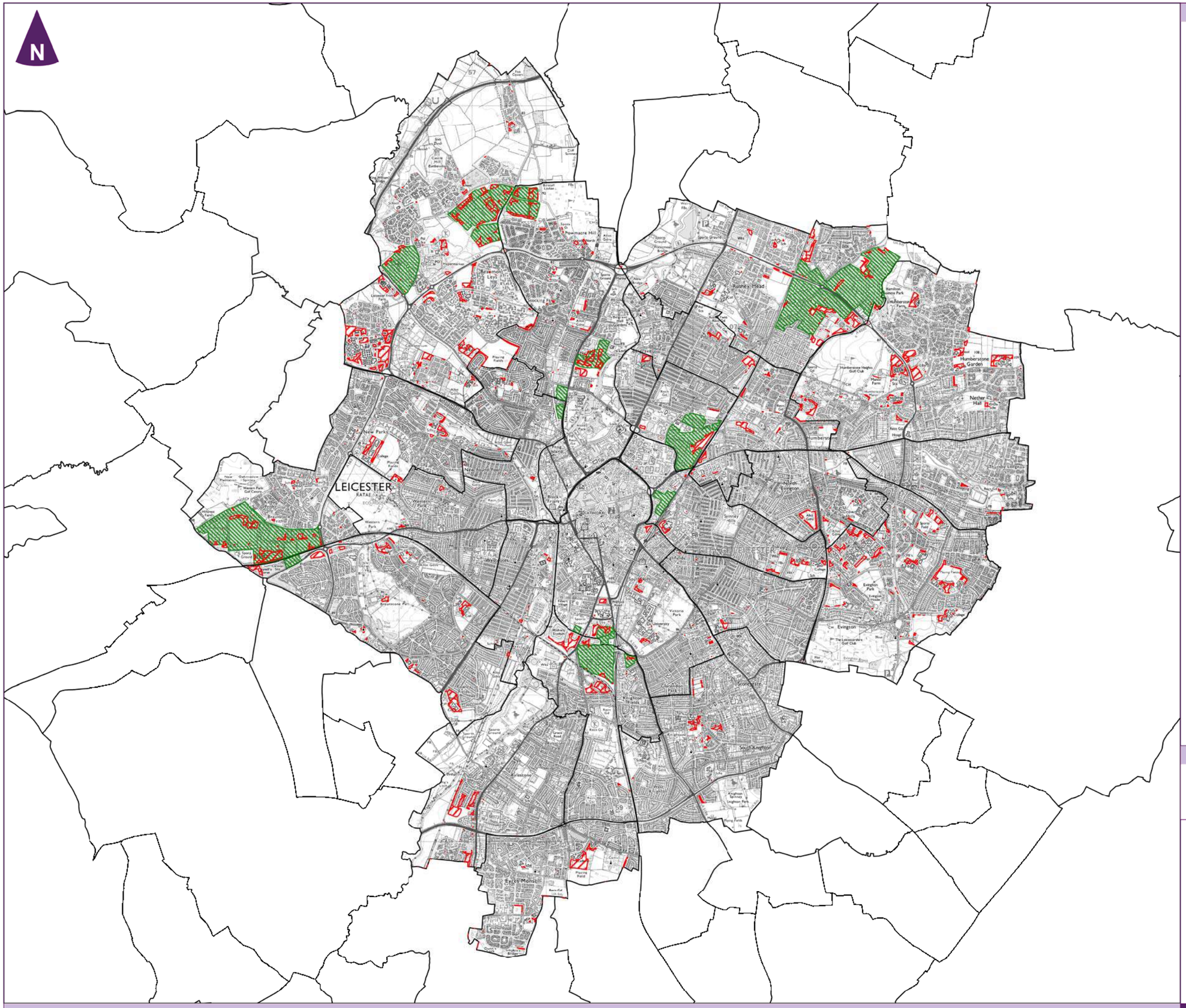
Leicester City Council
Climate Change
Evidence Base
Study

amec foster wheeler

Figure A.6

Noise Buffer Constraints

February 2015 36118-edi007a.wor fitzs



Key

- Council boundary
- Areas with technical potential for ground-mounted solar
- Areas with technical potential for commercial roof-mounted solar

0 km 3 km

Scale 1:50,000 @ A3

Client

Leicester City Council

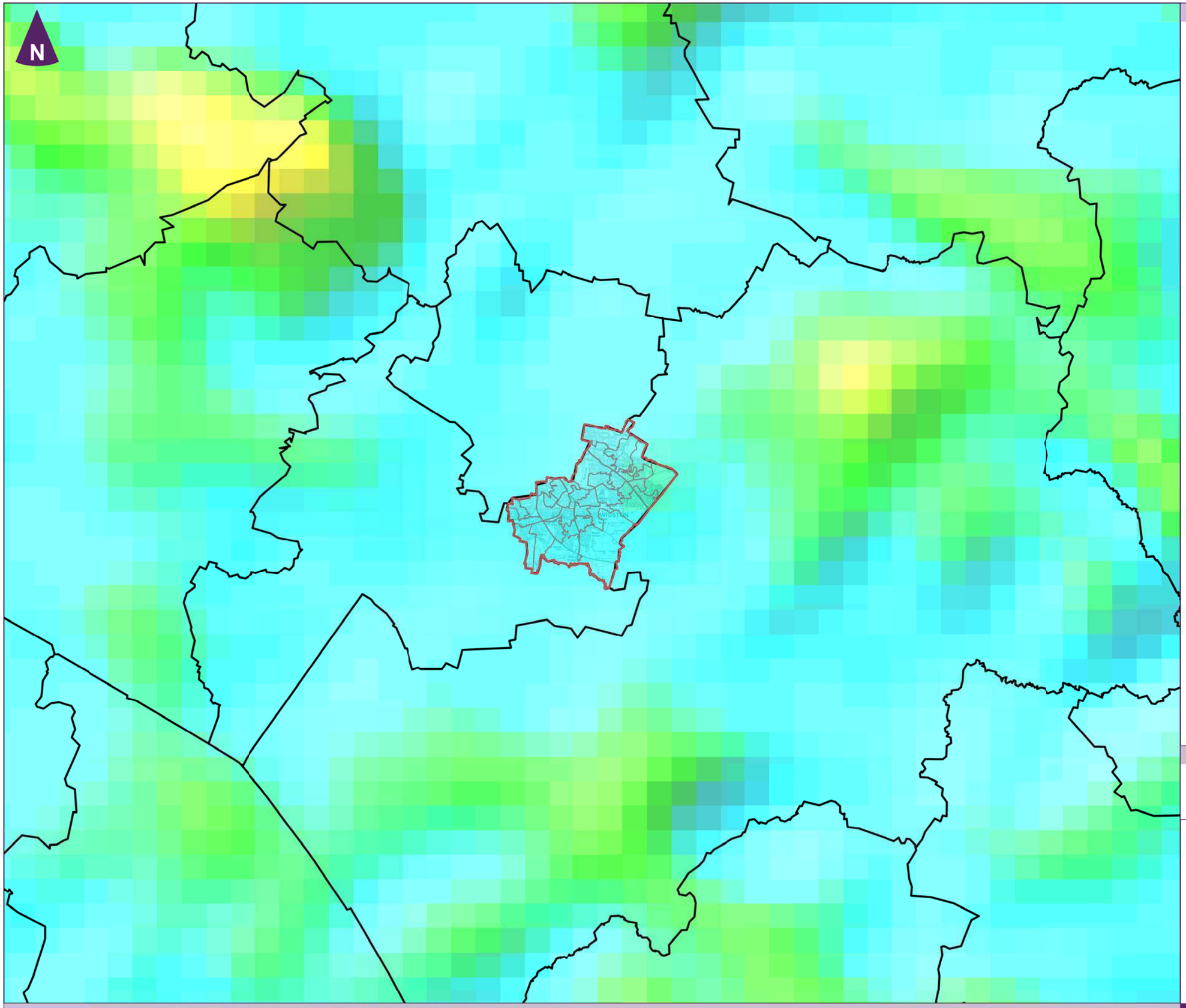
Leicester City Council
Climate Change
Evidence Base
Study

amec foster wheeler

Figure A.7

Areas of ground mounted and commercial scale roof top solar potential

February 2015 36118-edi018.wor fitzs



Key

Council boundary

Lower Layer Super Output Area boundary

District boundaries

NOABL Windspeed at 45m a.g.l. (m/s)

- 11.6
- 7.2
- 6.6
- 6.3
- 1.4

0 km 9 km

Scale 1:150,000 @ A3

Client

Oadby & Wigston Borough Council

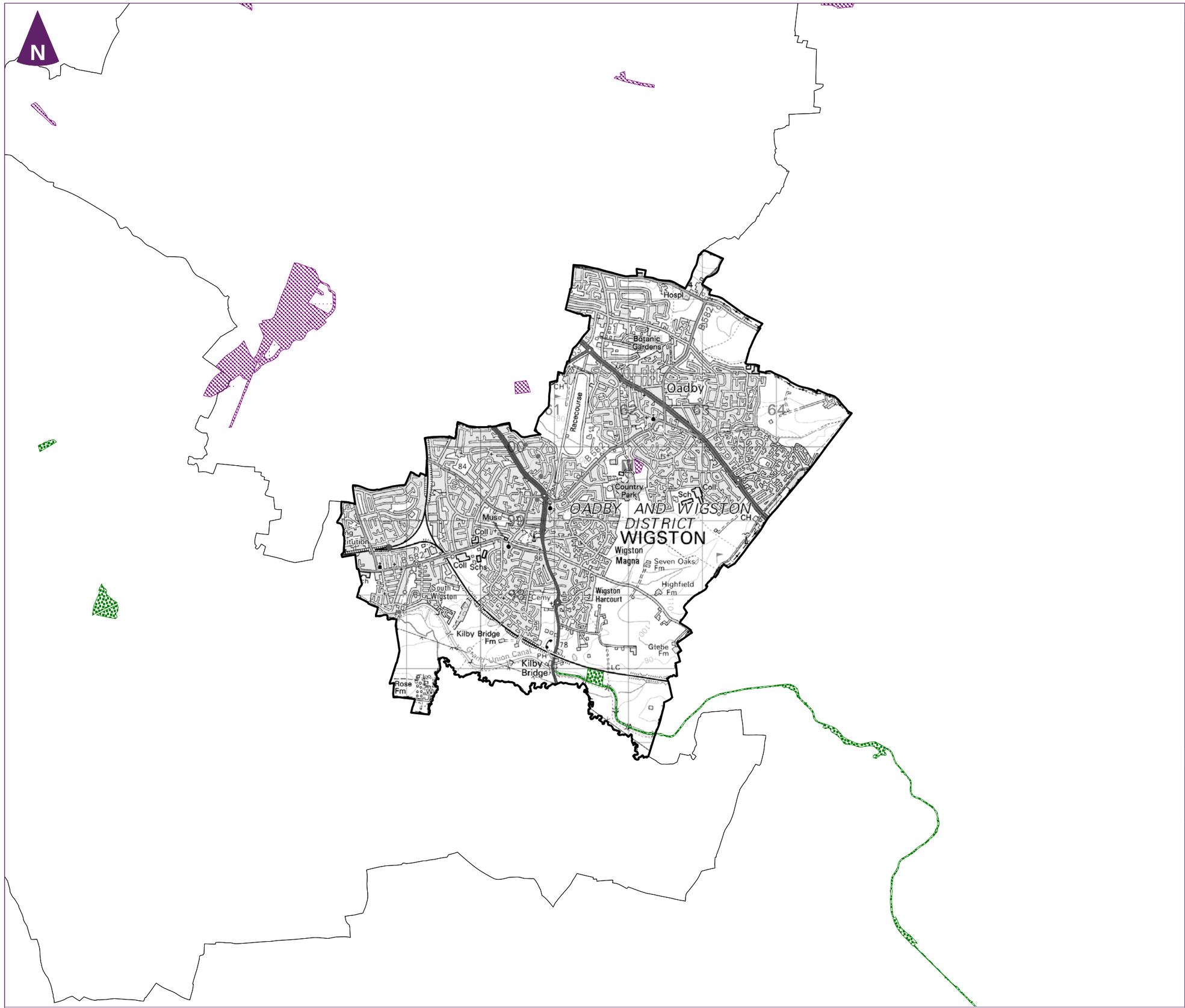
Oadby and Wigston Borough Council - Climate Change Evidence Base Study

amec foster wheeler

Figure A.8

Average Annual Wind Speed

February 2015 36118-edi008a.wor fitzs



Key

- Council boundary
- Sites of Special Scientific Interest (SSSI)
- Local Nature Reserve (NNR)

0 km — 3 km

Scale 1:50,000 @ A3

Client

Oadby & Wigston Borough Council

Oadby and Wigston Borough Council - Climate Change Evidence Base Study

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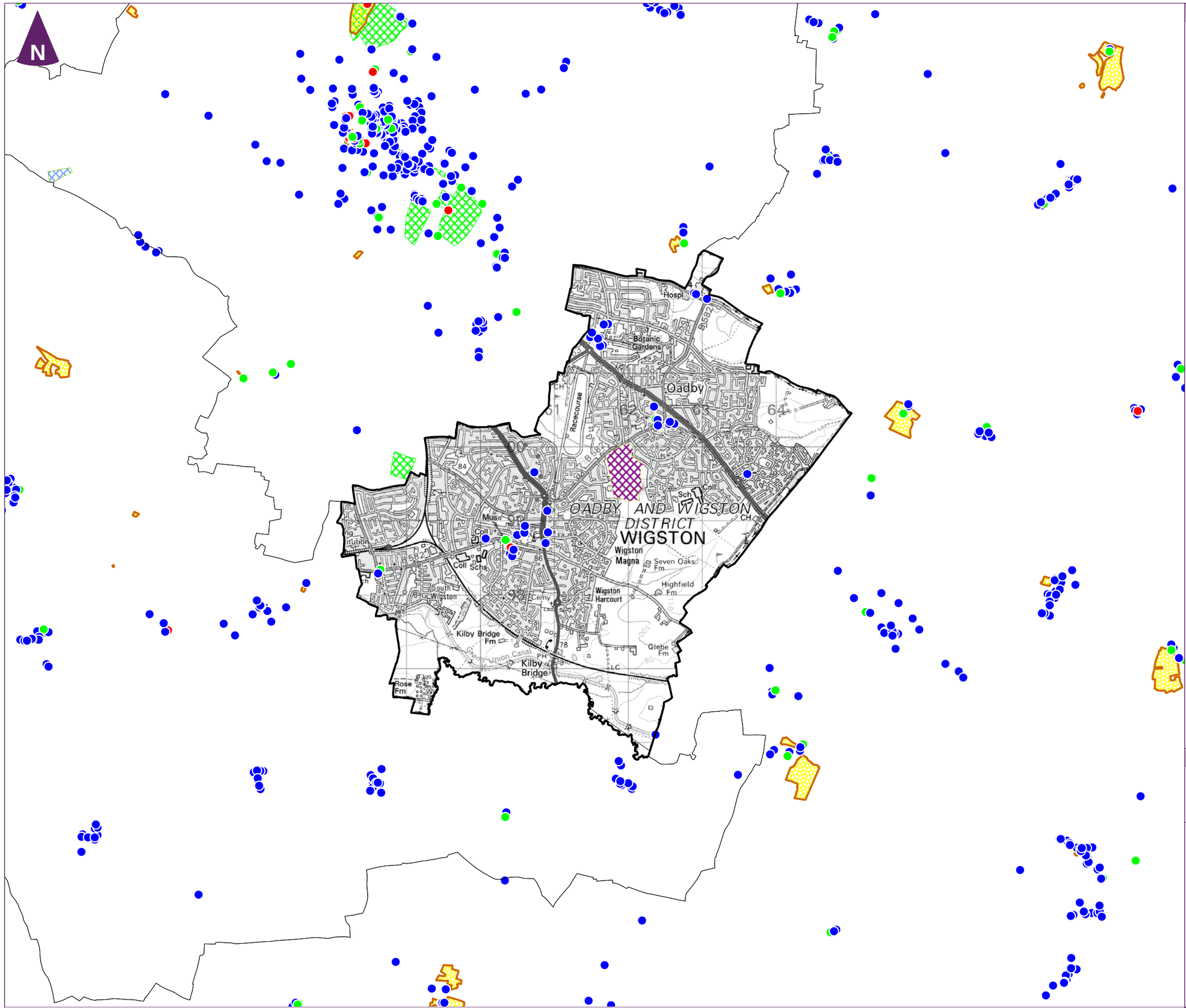
Figure A.9

Environmental Designations (Ecology)

February 2015

36118-edi009a.wor fitzs



Key

- Council boundary
- Scheduled monument
- Historic battlefield
- Country park
- Registered Parks & Gardens
- Ancient woodland

Listed Buildings

- Grade I
- Grade II*
- Grade II

0 km — 3 km

Scale 1:50,000 @ A3

Client

Oadby & Wigston Borough Council

Oadby and Wigston Borough Council - Climate Change Evidence Base Study

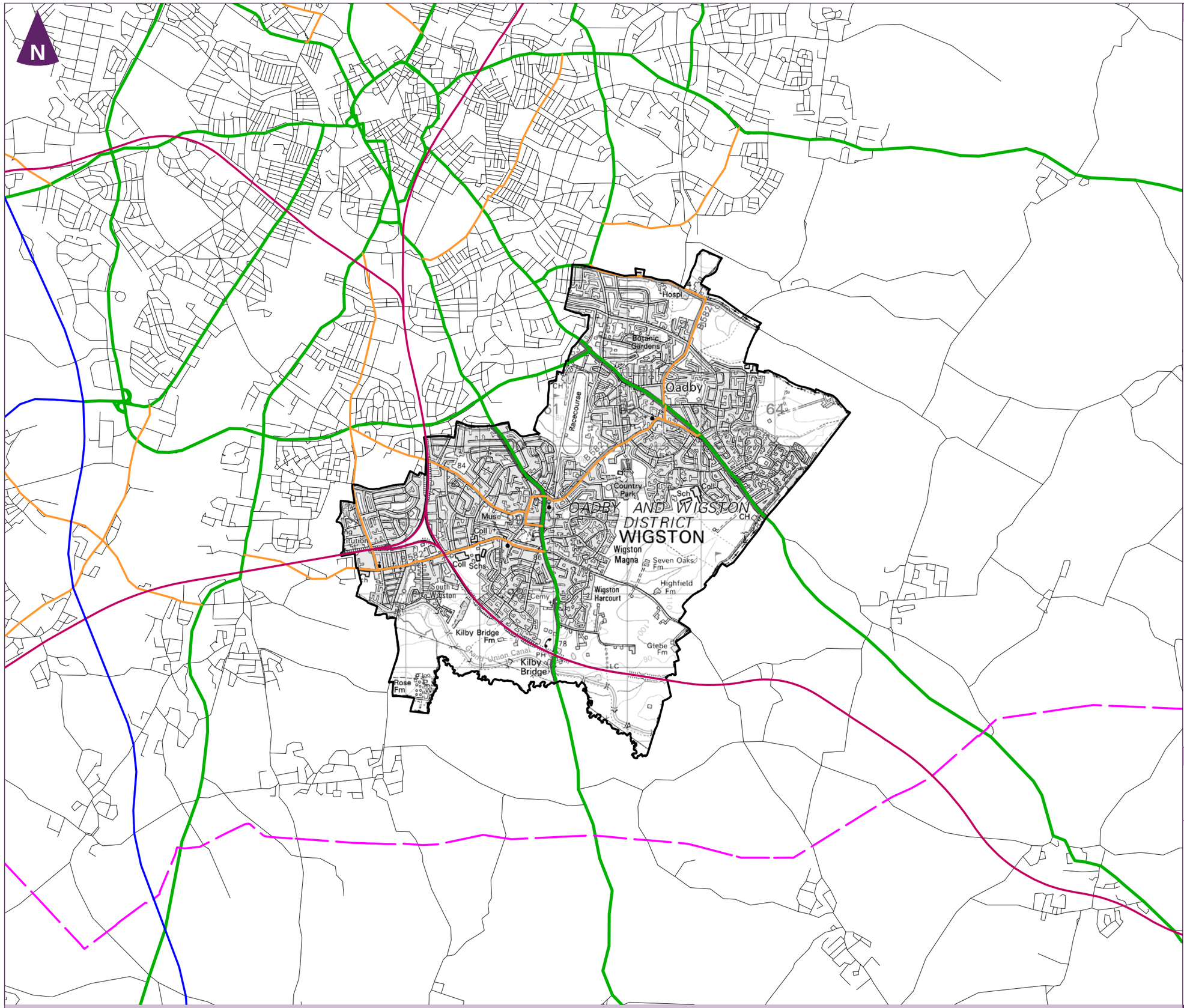
amec foster wheeler

Figure A.10

Cultural Heritage Designations

February 2015

36118-edi010a.wor fitzs



Key

- Council boundary
- Minor road
- B road
- A road
- Motorway
- Rail line
- Gas transmission pipeline
- Electrical transmission overhead power line

0 km — 3 km

Scale 1:50,000 @ A3

Client

Oadby & Wigston Borough Council

Oadby and Wigston Borough Council - Climate Change Evidence Base Study

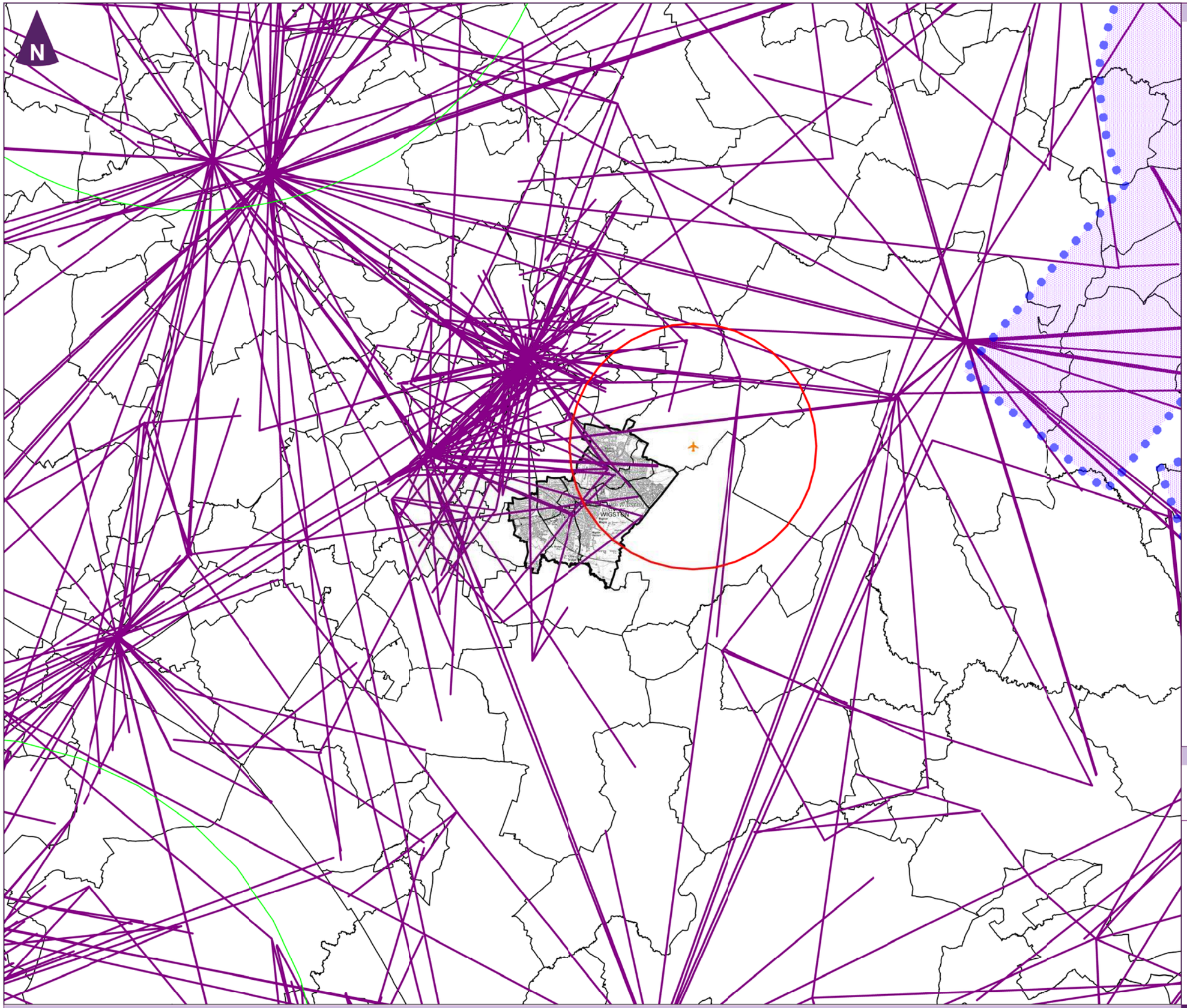
amec foster wheeler

Figure A.11

Infrastructure Constraints

February 2015

36118-edi011a.wor fitzs



Key

- Council boundary
- Microwave links
- Potential MOD radar zone
- Non-safegaurded airport
- Non-safegaurded airport 5 km buffer
- Safegaurded airport 15 km buffer

0 km 9 km

Scale 1:150,000 @ A3

Client

Oadby & Wigston Borough Council

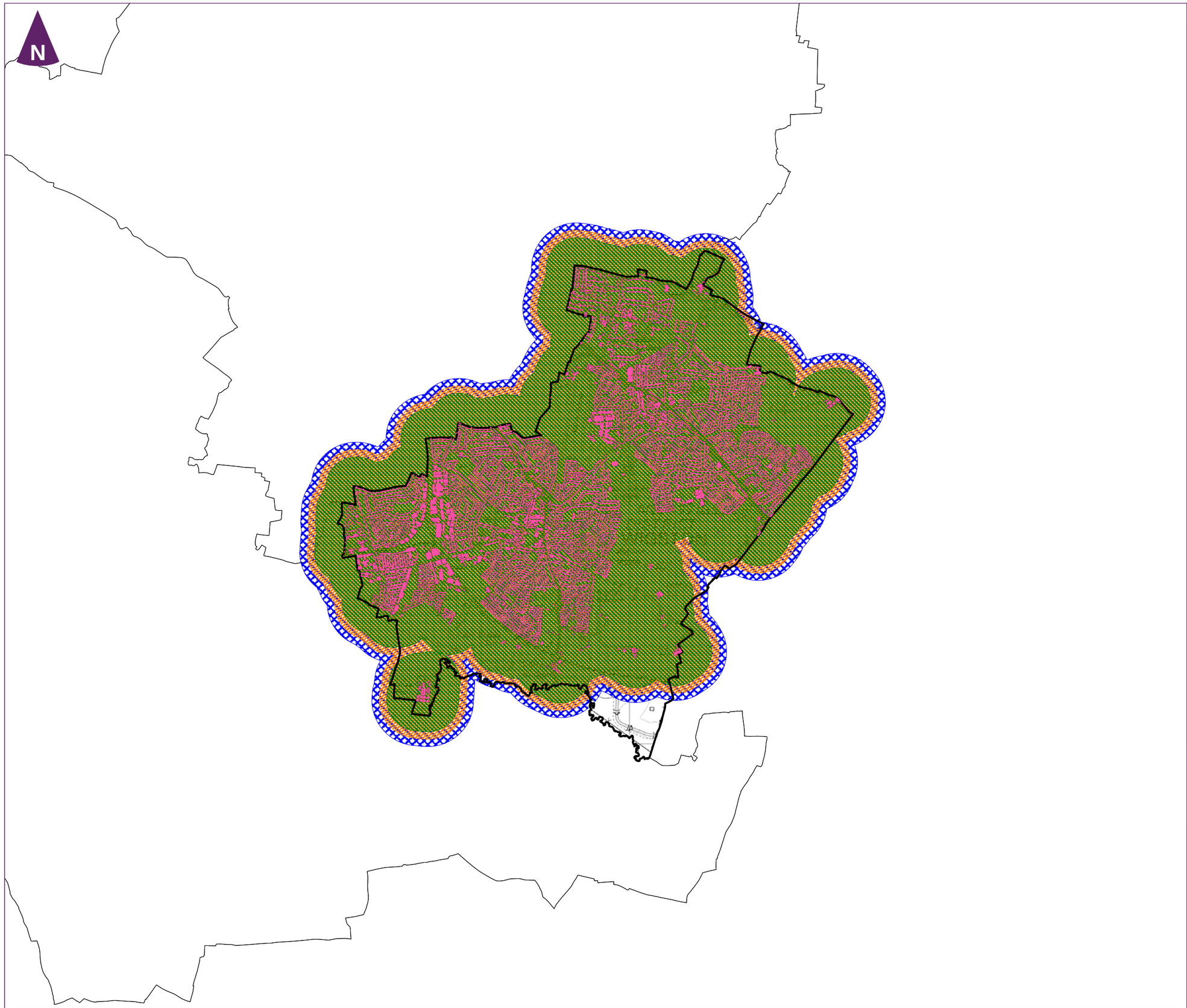
Oadby and Wigston Borough Council - Climate Change Evidence Base Study

amec foster wheeler

Figure A.12

Airports, Radar and Communications Constraints

February 2015 36118-edi012a.wor fitzs



Key

- Council boundary
- Buildings
- Building 400 m buffer
- Building 500 m buffer
- Building 600 m buffer

0 km 9 km

Scale 1:50,000 @ A3

Client

Oadby & Wigston Borough Council

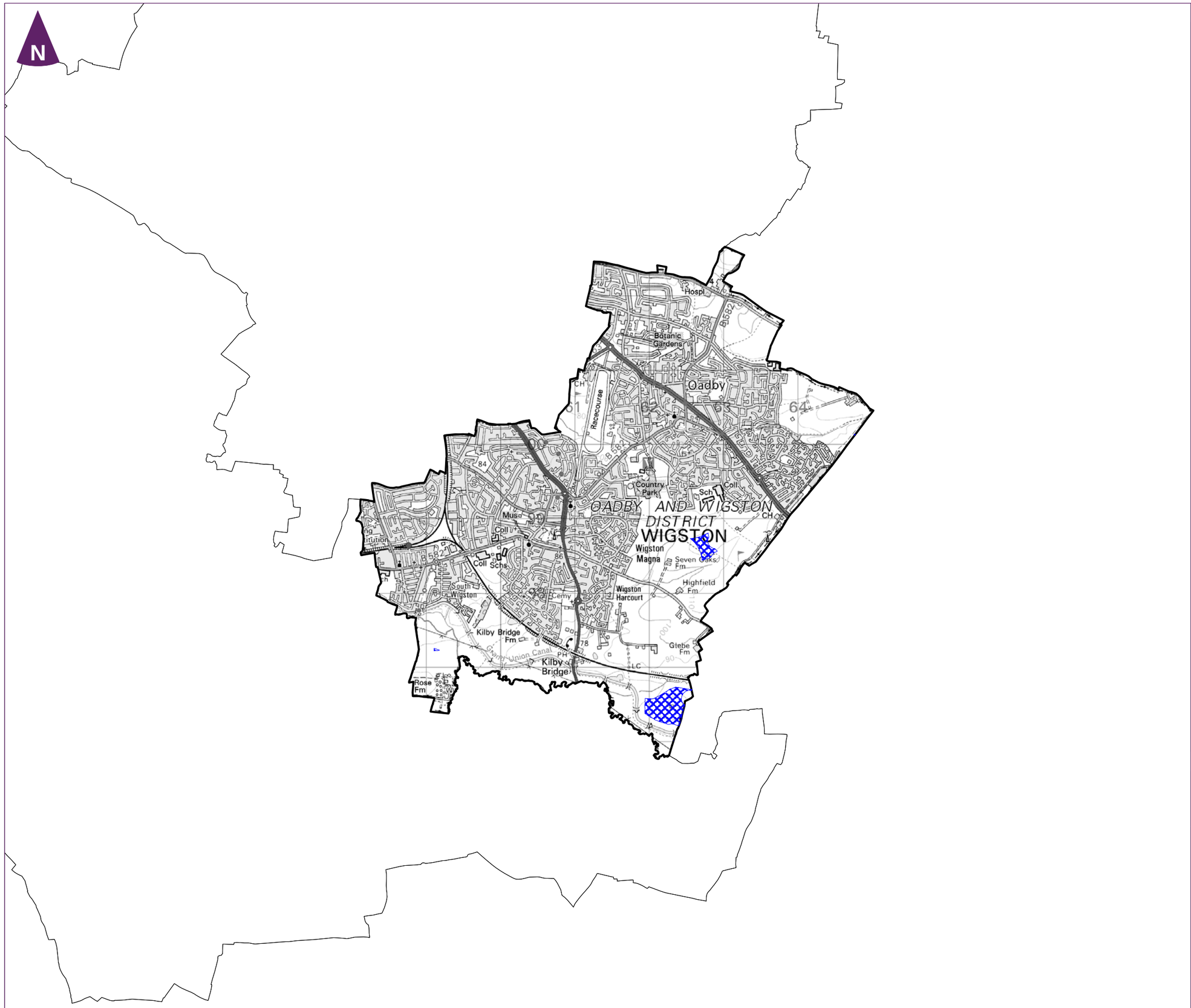
Oadby and Wigston Borough Council - Climate Change Evidence Base Study

amec foster wheeler

Figure A.13

Noise Buffer Constraints

February 2015 36118-edi013a.wor fitzs



Key

Council boundary

Areas with medium wind potential

0 km 9 km

Scale 1:50,000 @ A3

Client

Oadby & Wigston Borough Council

Oadby and Wigston Borough Council - Climate Change Evidence Base Study

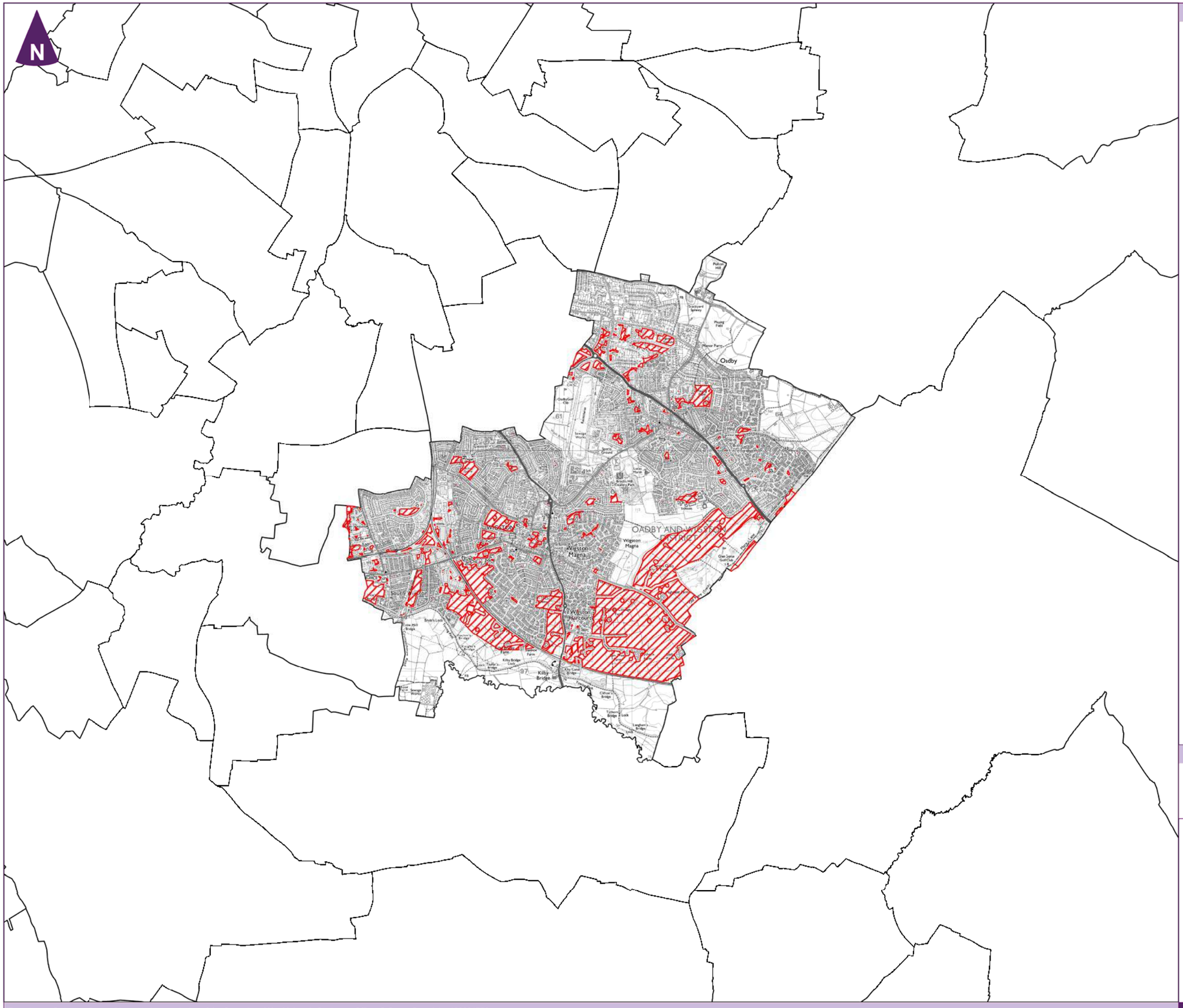
amec foster wheeler

Figure A.14

Areas of medium wind potential

February 2015

36118-edi015a.wor fitzs



Key

Council boundary

Areas with technical potential for ground-mounted solar

0 km 9 km

Scale 1:50,000 @ A3

Client

Oadby & Wigston Borough Council

Oadby and Wigston Borough Council - Climate Change Evidence Base Study

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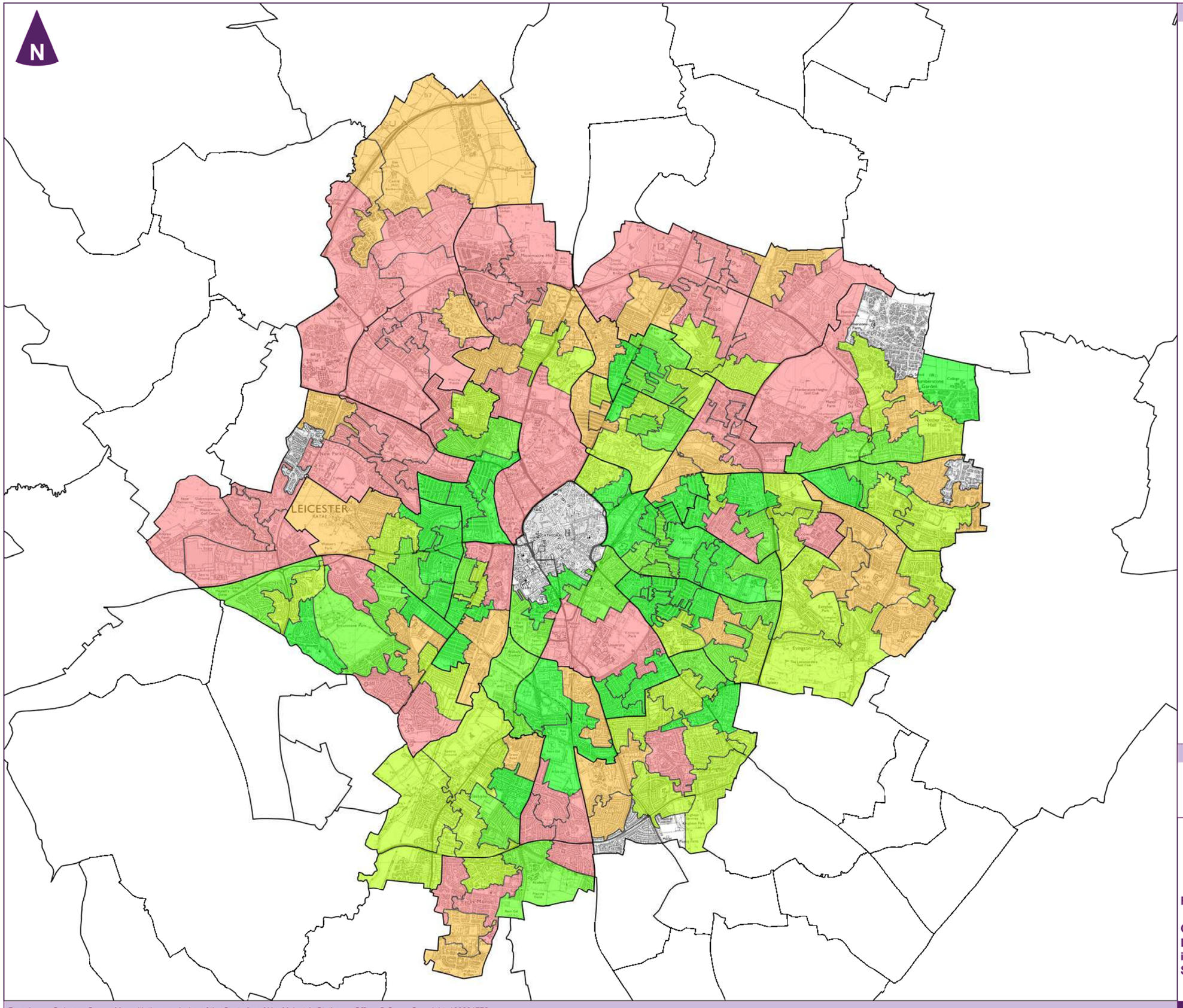
Figure A.15

Areas of ground mounted solar potential

February 2015 36118-edi019.wor fitzs



Key

Council boundary

Installed capacity of Solar based on FiTs Registrations

- 0 kW to 14 kW
- 14 kW to 21 kW
- 21 kW to 35 kW
- 35 kW to 67 kW
- 67 kW to 258 kW

0 km 3 km

Scale 1:50,000 @ A3

Client

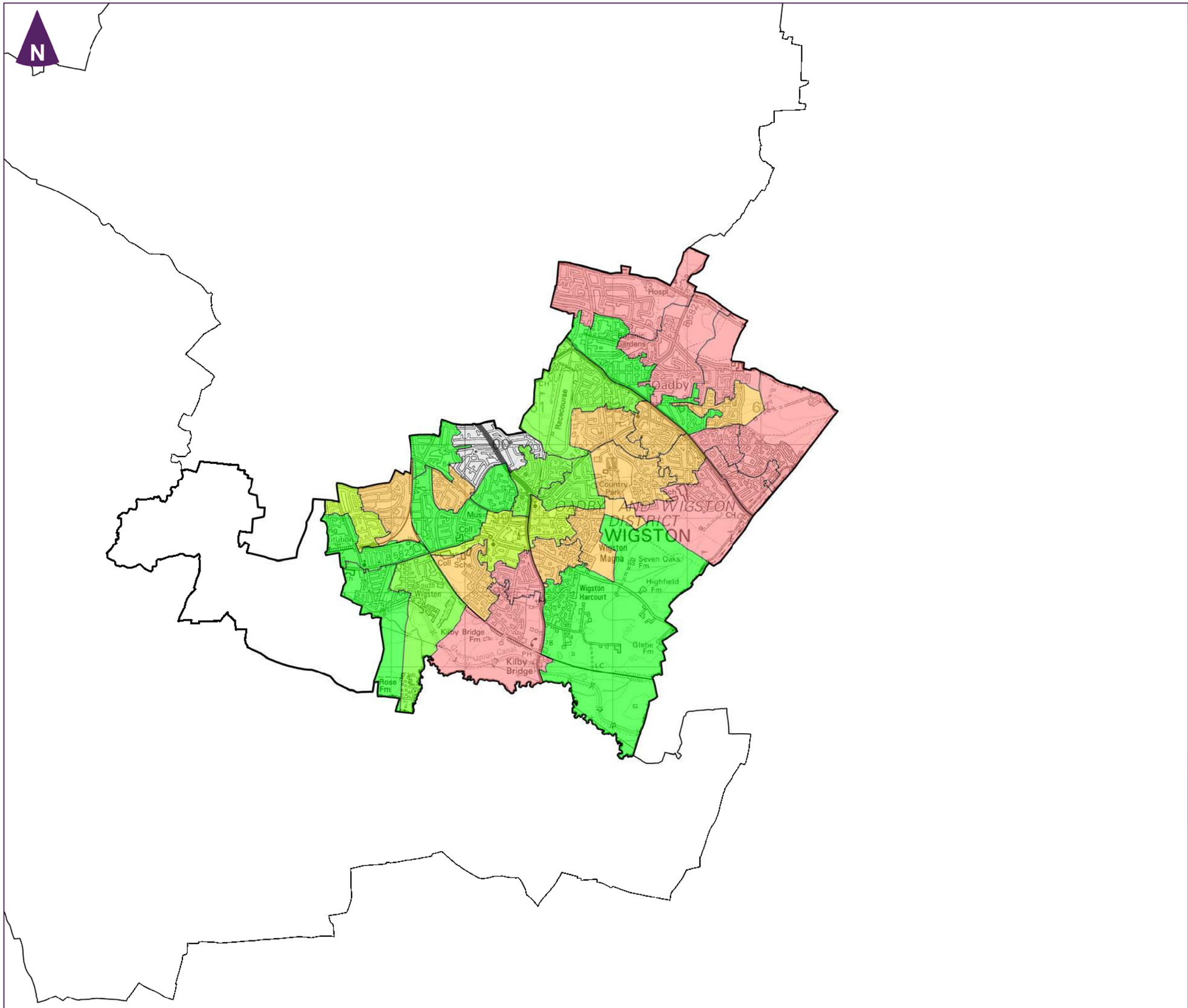
Leicester City Council

Leicester City Council Climate Change Evidence Base Study

amec foster wheeler

Figure A.16

Capacity of solar PV installations in Leicester registered under the Feed-in-Tariff by LLSOA Geographic Area
Source: Feed-in-Tariff data from December 2014



Key

Council boundary

Installed capacity of Solar based on FiTs Registrations

- 0 kW to 14 kW
- 14 kW to 21 kW
- 21 kW to 35 kW
- 35 kW to 67 kW
- 67 kW to 200 kW

0 km — 9 km

Scale 1:50,000 @ A3

Client

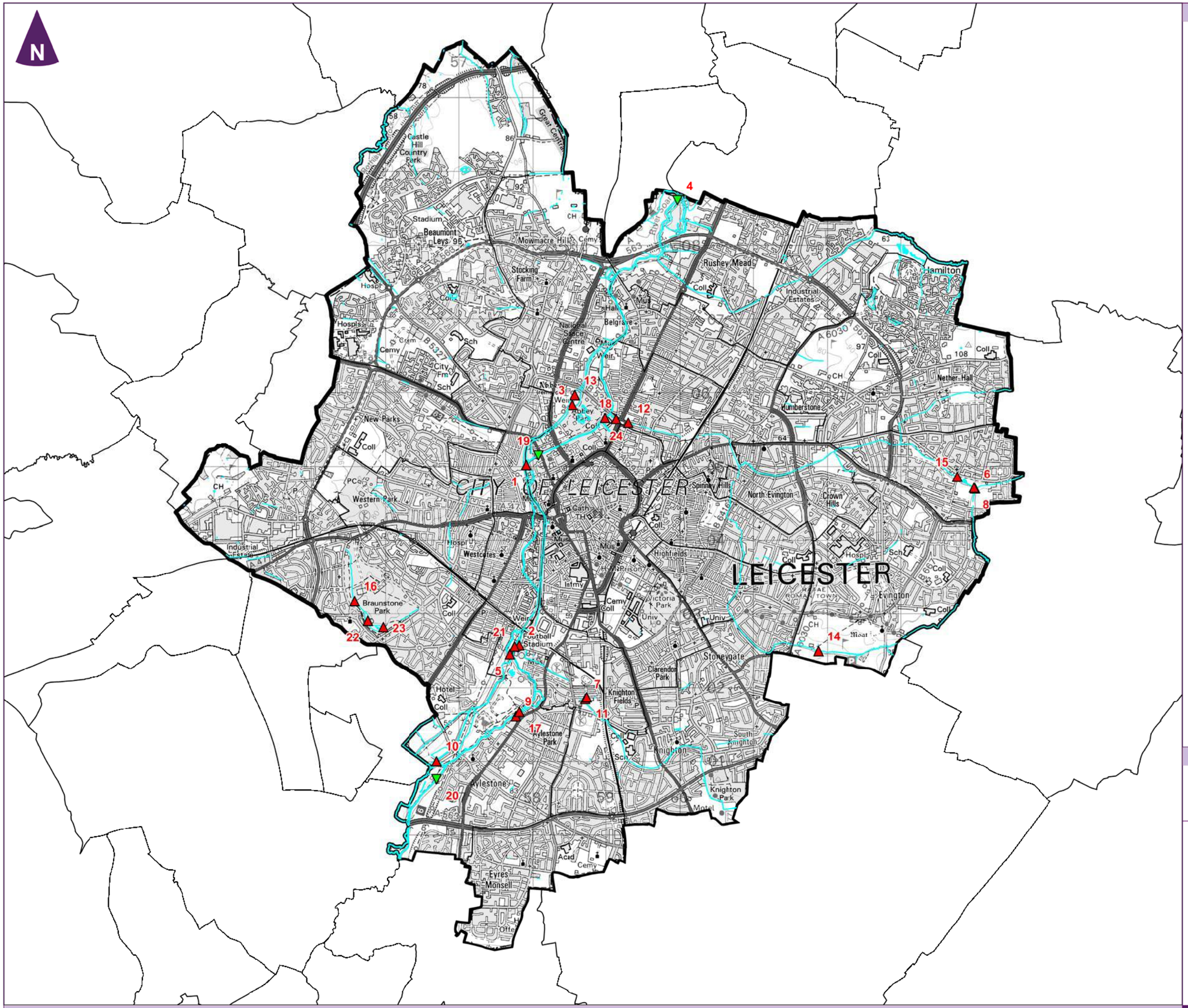
Oadby & Wigston Borough Council

Oadby and Wigston Borough Council - Climate Change Evidence Base Study

amec foster wheeler

Figure A.17

Capacity of solar PV installations in Oadby &Wigston registered under the Feed-in-Tariff by LLSOA Geographic Area
Source: Feed-in-Tariff data from December 2014



Key

- Council boundary
- Locations with technical potential for hydropower - 0 - 10 kW
- Locations with technical potential for hydropower - 10 - 20 kW
- Water course

0 km — 3 km

Scale 1:50,000 @ A3

Client

Leicester City Council

Leicester City Council
Climate Change
Evidence Base
Study

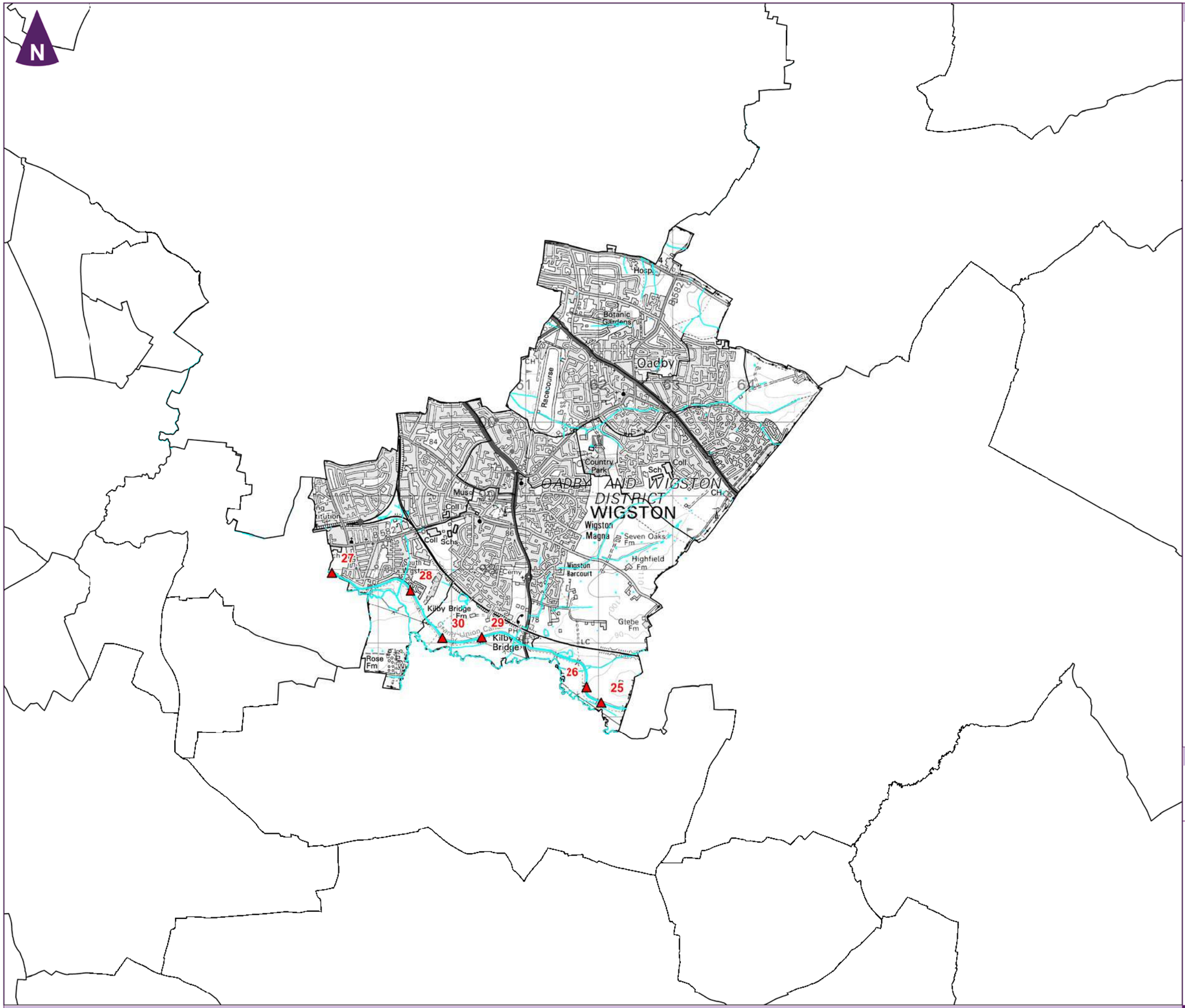
amec foster wheeler

Figure A.18

Locations with technical potential for hydropower

June 2015

36118-edi020a.wor fitzs



Key

- Council boundary
- Locations with technical potential for hydropower - 0 - 10 kW
- Locations with technical potential for hydropower - 10 - 20 kW
- Water course

0 km — 3 km

Scale 1:50,000 @ A3

Client

Oadby & Wigston Borough Council

Oadby and Wigston Climate Change Evidence Base Study

amec foster wheeler

Figure A.19

Locations with technical potential for hydropower

June 2015

36118-edi021.wor fitzs

Appendix B
Feedback from developers and landowners

B.1 Leicester City Council developer workshop, Monday 15th December 2014

Council planning officers led a workshop with developers, landowners and agents in December 2014 to discuss the emerging Leicester Local Plan. Part of the agenda for this workshop concerned how the City Council should forward policies for climate change and renewable/low carbon energy as part of the new plan.

Feedback from this session highlighted a number of issues:

- On higher density schemes, where space is at a premium, the inclusion of renewable/low carbon energy infrastructure can be difficult to achieve;
- Some developers are already delivering homes built to higher levels of energy efficiency and on-site renewable energy solutions as part of their overall offer and marketing of their product;
- Site viability is crucial to the overall delivery of growth in the City so there was a general view that new policy should therefore be looking to work with the grain of national policies and building regulations, rather than add additional requirements and developer costs; and
- National policy is rapidly changing given the on-going Housing Standards Review and likely scaling back in use of the Code for Sustainable Homes – policies in the new Local Plan therefore need to be flexible

B.2 Developer interviews (email and telephone correspondence), January 2015

18 developers, agents and other stakeholders operating in Leicester City were contacted to gather their views and experiences on the implementation of local and national policy targets for renewable energy and responding to climate change. The focus of this engagement centred on three specific areas:

- How they were reflecting the government's 2016 zero carbon homes target in their masterplans and planning applications (note that the target has since been withdrawn);
- What their views are on adopted Core Strategy Policy CS2 Addressing Climate Change and Flooding; and
- Other views on the feasibility and viability of delivering renewable energy as part of new development schemes.

Feedback was provided on the basis that comments would not be attributable to a specific organisation. A total of 4 formal responses were received, summarised in Table B.1.

Table B.1 Summary of Responses

Respondent 1 Tend to only incorporate renewable energy targets into scheme when required, in line with planning policy. Find it difficult to implement targets into all schemes, there needs to be an element flexibility within the policy as often opportunities for on-site renewables vary on a case by case basis. The need for on-site renewables on all schemes, alongside other obligations can create viability issues.
Respondent 2 Seek to ensure clients are informed of the importance of high quality design including in relation to energy efficiency Previously encountered a lack of flexibility with regard to the requirement to produce onsite renewable energy in line with the Merton Rule. This is in terms of applying Renewable Energy Policies as opposed to the word of the Policy. The lack of flexibility has led to some counter-productive implications where the City Council required x% of energy demand from renewables instead of the proposal by the Developer to reduce overall energy demand by various measures (including fabric first) but with a lower level of renewable energy generated on site. The Developer's proposal would have led to an energy demand well below the non-renewable energy required by the City Council's approach but the City Council maintained its position on the need to provide onsite renewable energy: in the Council's view it was better to have a larger energy demand because x% was from on-site renewables than to have the energy demand for the scheme reduced by more than x% with a lower onsite renewable energy generation The Council appears to be more pragmatic in recent applications Onsite renewable can be appropriate / reasonable but it must be on a site by site basis.
Respondent 3 The desire to produce on-site renewable energy is client dependant, tend to adhere to minimum policy requirements. Find it difficult to comply with on-site renewable energy policy and often to opt for most simple solution but not necessarily the best long – term solution, as concern is with the capital costs not the running costs
Respondent 4 Seek to adhere to current policy standards Agree with the principle of renewable energy but find it difficult to apply every scheme, along with other policy requirements. Flexibility within the policy is needed

Table B.2 Organisations contacted

Organisations contacted
Astill Planning Consultants
Marrons Shakspeares
Paul Cleaver Architect
The Drawing Room
Andrew Granger & Co
David Beaumont
Design Studio Architects Ltd
Ink / Drawn
Landmark Planning Ltd
R P Design Ltd
R G & P Ltd
Staniforth Architects
Sturgis Snow and Astill
Home Builders Federation

Table B.2 Organisations contacted

Organisations contacted
Pegasus
James Sellicks
West London Properties
Homes and Communities Agency

B.3 Developers active in Oadby & Wigston Borough

Oadby & Wigston differs from Leicester in that the overall levels of growth proposed are much smaller, with the Core Strategy focussed on delivering a single greenfield release site for 450 dwellings an up to 3.5ha of employment space. Planning permission was granted subject to the signing of a Section 106 Agreement. In terms of climate change and renewable energy the conditions referred to the Council's Committee Report include:

- Design 7 Prior to, or concurrent with the submission of the first application for reserved matters, a Design Guide shall be submitted to and approved in writing by the Local Planning Authority. The Design Guide shall cover the whole site and be prepared in accordance with the Pegasus Group Design and Access Statement dated September 2013. The content and scope of the Design Guide shall address the following: i) Architectural and sustainable design principles including materials palette ii) Street types including cross sections, parking arrangements, street trees, hard and soft landscaping and street furniture iii) Bus routing through and around the site iv) Footpath and Cycleway design v) Detailed routing and design of the public footpath from Foston Gate to Cooks Lane. vi) Boundary treatments vii) Open space areas viii) Lighting of outdoor spaces ix) Wildlife habitats and ecological areas x) SUDS features to include wetland habitats of biodiversity value xi) Tree and hedgerow retention and new tree planting xii) Storage and access routes for bins xiii) Opportunities to maximise resource efficiency and climate change adaptation in the design of the development through external means such as landscaping, orientation, massing and external building features. *Reason: To secure the satisfactory development of the site and in accordance with Core Strategy Policy 14 and the National Planning Policy Framework paragraphs 59, 60 and 61.*

Appendix C
Adopted Planning Policies for Leicester City and Oadby & Wigston

C.1 Leicester City Council

The Development Plan for Leicester City Council currently comprises of the Revised Core Strategy (adopted 2014, with the Core Strategy adopted 2010) and Saved Policies from the City of Leicester Local Plan (adopted 2006). A review of the relevant Renewable and Climate Change Policies are summarised in Table C1 below.

Leicester City Council are in the process of producing a new Local Plan and are currently consulting on the Issues and Options. The Council anticipates adopting the Local Plan in 2016.

Table C.1 Planning Policy Review

Planning Policy	Summary
Core Strategy Policy CS2 Addressing Climate Change and Flooding	Requires all development to mitigate and adapt to climate change and reduce greenhouse gas emissions. Sets out principles which provide the climate change policy context for the City. Includes a requirement for homes to achieve a minimum of Code for Sustainable Homes Level 3.
Local Plan Policy BE16	States permission will be granted for renewable energy installations where they do not have an unacceptable effect on the local environment that would outweigh wider community or environmental benefits. All major developments will be expected to provide an assessment of how they will contribute towards the regional targets for renewable energy. Planning permission will only be granted for major developments that realise their potential for meeting their energy requirements from renewable sources.

The Council adopted its Climate Change Supplementary Planning Document (SPD) in 2011. The purpose of the SPD is to provide practical advice to planners, architects, developers and officers on how to address the issue of climate change in relation to new development.

The Council adopted its Energy Efficiency and Renewable Energy SPD in 2005. The SPD aims to provide guidance for new and existing developments in how energy saving measures, and renewable energy developments can be incorporated, and the potential for renewable energy generation maximised. Starting from a minimum baseline of 10% on-site energy demand (at 2010), the SPD requires 1% increases per year as follows:

- 2006: 10%;
- 2007: 11%;
- 2008: 12%;
- 2009: 13%;
- 2010: 14%;
- 2011: 15%;
- 2012: 16%;
- 2013: 17%;
- 2014: 18%;
- 2015: 19%; and
- 2016: 20% (20% as the maximum target through to 2020).

These targets were withdrawn in June 2015 in favour of a 'Fabric First' approach to better align with the direction of travel with national policy and building regulations.

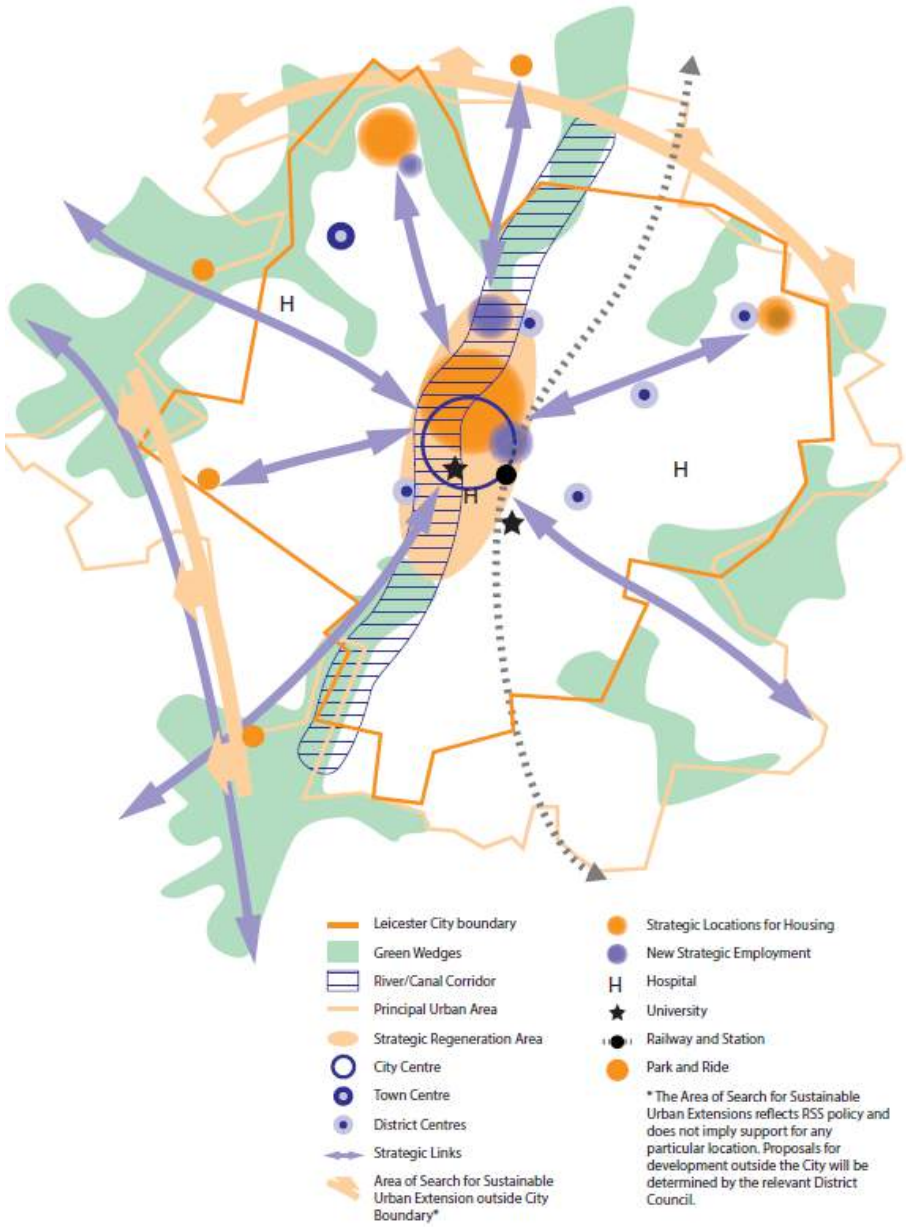
Proposed Levels of Growth and Allocations

The Core Strategy sets the target of 25,600 new dwellings in Leicester by 2026. This level of growth was originally proposed in the RSS and the Council has maintained this target.

As shown on Figure C1, the Core Strategy identifies 54% of the growth to be located within the Strategic Regeneration Area, 16% in a sustainable urban extension at Ashton Green and 5% at Hamilton on committed housing sites. The remaining allocations will be on smaller non- strategic sites.

Employment growth will be focused in City Centre offices, Abbey Meadows Science and Innovation Park and up to 10 hectares of land at Ashton Green.

Figure C.1 Leicester City Council Key Diagram (Source Core Strategy)



*Note: The adopted Policies map is an interactive online version http://citystreatz2.leicester.gov.uk/citystreatz/frame.npx?site=citystreatz_internet&lang=en&group=public&resol=2&tabs=11100?

C.2 Oadby and Wigston

Planning Policy Context

The Development Plan for Oadby and Wigston comprises of the Core Strategy (adopted September 2010), the Oadby and Wigston Town Centre Area Action Plan (adopted 2013) and saved Local Plan Policies (adopted 1999). A review of the relevant Renewable and Climate Change Policies are summarised in Table C2 below.

The Council is intending to develop a new local plan in 2016 with a view to adoption in 2017.

Table C.2 Planning Policy Review

Planning Policy	Summary
Core Strategy Policy 8 Climate Change and Renewable Energy	Requires all new development to make effective use of resources and materials, incorporate decentralised and renewable or low carbon energy generation and use design to mitigate and adapt to the likely effects of climate change.
Core Strategy Policy 9 Flood Risk and Water Resources	Requires all new development proposals to take into account the potential impact of climate change in water resources, water quality and on the level of flood risk posed.

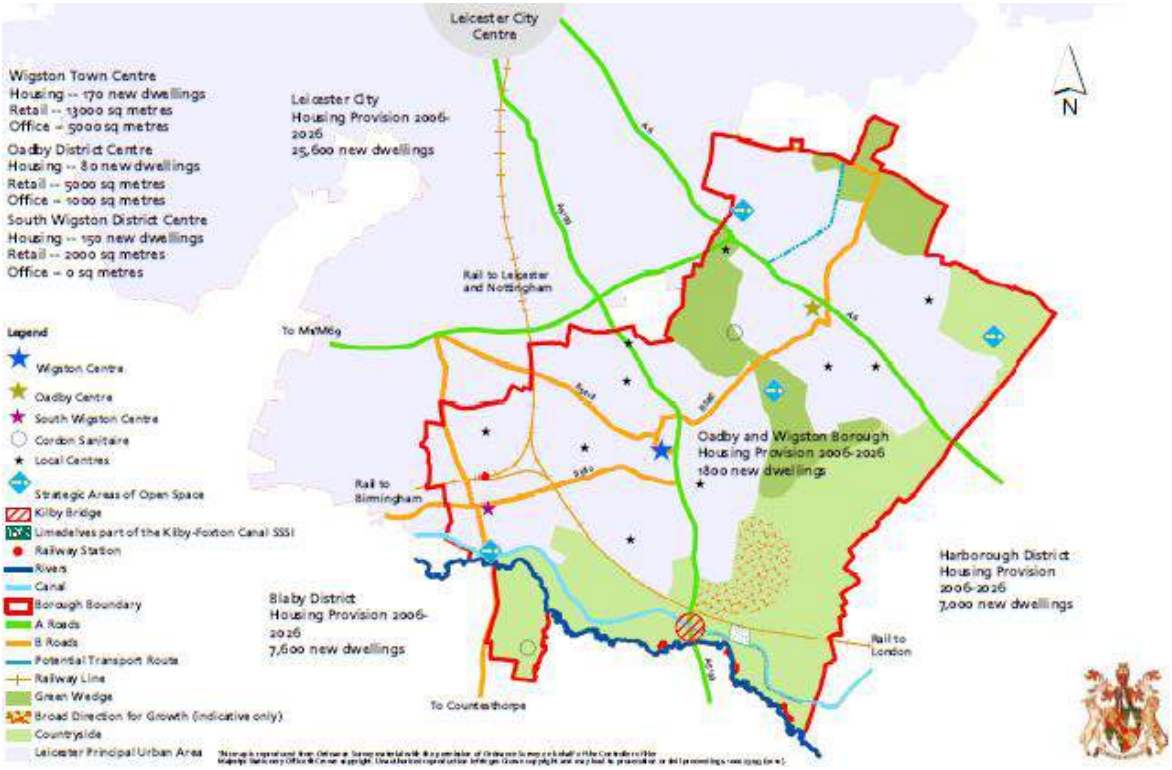
The Renewable Energy Supplementary Planning Guidance (SPG) was adopted in 2004 to outline what renewable energy should be factored in to any proposal for new development.

Proposed Levels of Growth and Allocations

The Core Strategy allocates land for a minimum of 1,800 new dwellings between 2006 and 2026. In terms of employment growth, 5,800 sq m of office floor space is identified in the centres of Wigston and Oadby and 1.3 ha of industrial and warehousing land

Figure C.2 shows the broad direction for growth with Oadby and Wigston.

Figure C.2 Key Growth (Source Core Strategy)



Appendix D
Planning for Climate Change Adaptation

Greenhouse gases already in the atmosphere today will continue to impact on the earth's climate for many years - even if greenhouse gas emissions were to be cut significantly from today, a degree of climate change is inevitable. This is where adaptation to climate change has a role to play, by preparing for the projected climate impacts, in order to minimise the negative impacts and take advantage of any opportunities which may arise as a consequence of climate change impacts.

This section presents the projected climate change impacts for Leicester, Oadby and Wigston, summarises key points from existing policies, and outlines a range of adaptation actions suitable to the planning sector.

D.1 Climate change projections for Leicester, Oadby and Wigston

This section presents a brief summary of projected climate change impacts for Leicester, Oadby and Wigston. The climate change projections used are the UK Climate Projections, known as UKCP09[56]. UKCP09 includes projections of future change for a range of variables to the end of this century, and is the primary source of information on climate change for the UK.

UKCP09 provides probabilistic projections of future change under three different emissions scenarios: low, medium and high. Each emission scenario illustrates a different storyline of how the world will develop in the future. For this Report, the medium emissions scenario has been selected, as being a balanced and reasonably foreseeable scenario.

UKCP09 projections provide data for a number of 30-year time slices, from the 2020s (covering 2010-2039) to the 2080s (2070-2099). For this Report, data for the 2050s and 2080s time periods is presented, to provide an illustration of both medium and long term climate change impacts.

The UKCP09 projections are probabilistic projections of UK climate, where the probability gives an indication of the strength of scientific evidence which supports and underlies the different projections. The central estimate value for any of the climate variables (50%) shows change which has a 50% probability of being exceeded, and a 50% probability of being lower than the figure provided. This 50% means that any given change is 'as likely as not' to happen. It does not indicate that any given change value is the most likely outcome. The extreme indicators, the 10% and 90% probability, show change values that are unlikely to be less than (10%) or unlikely to be greater than (90%) respectively.

In this Report, the central estimate values are presented in the first instance, and the 90% probability values are also provided in order to provide an indication of the potential extreme changes. For example, in the first headline climate change impact for the 2050s below, projections suggest that annual mean temperatures will warm by 2.4C (this is the 50% or central estimate value), but could warm by as much as 3.5C (the 90% probability estimate).

Finally, UKCP09 climate projections are available at a number of geographical scales, the most accurate of which is at 25km^2 grid square level. For this Report, the grid square most relevant to Leicester, Oadby and Wigston has been selected[57].

[56] http://ukclimateprojections.metoffice.gov.uk/
[57] Grid square 1431

D.1.1 Headline climate change projections for Leicester, Oadby and Wigston in the 2050s

Projections suggest that for:

Temperature

- Annual mean temperatures will warm by 2.4 ˚C, but could warm by as much as 3.5 ˚C;
- Mean summer temperatures will rise by 2.6 ˚C, and could rise by up to 4.4 ˚C; and
- Mean winter temperatures will rise by 2.2 ˚C, and could increase by up to 3.4 ˚C.

Precipitation

- Annual average precipitation is projected to remain broadly equal, although it could increase by up to 6%;
- Winter precipitation is expected to increase by 15%, but could increase by up to 31%; and
- Average summer precipitation is expected to decrease by 17%, but could decrease by up to 37%.

D.1.2 Headline climate change projections for Leicester, Oadby and Wigston in the 2080s

Projections suggest that for

Temperatures

- Annual mean temperatures will warm by 3.4 ˚C, but could warm by as much as 4.9 ˚C;
- Mean summer temperatures are expected to rise by 3.7 ˚C, and could rise by up to 6 ˚C; and
- Mean winter temperatures are projected to rise by 5 ˚C, and could increase by up to 4.6 ˚C.

Precipitation

- Annual average precipitation is projected to increase slightly (1%), and could increase by up to 7%;
- Winter precipitation is projected to increase by 20%, and could increase by up to 44% (90%); and
- Summer precipitation is expected to decrease by 21%, but could decrease by up to 44% (the 90% probability value), or could increase by up to 6% (the 10% probability value).

D.2 Projected climate change impacts and vulnerabilities for Leicester, Oadby and Wigston

Overall Leicester, Oadby and Wigston can expect to experience hotter, drier summers, and milder, wetter winters in future. The frequency and intensity of extreme weather events which are already currently experienced, such as heatwaves, flooding and drought, is also projected to increase.

The Leicester Local Climate Impacts Profile (LCLIP)[58] carried out in 2011 identified a number of weather events which had already affected Leicester in recent years (2000-2008). These include:

- Heavy rain and flooding;
- Storms and high winds;
- Heatwaves and drought; and
- Snow.

All of the above extreme events lead to additional economic costs being incurred by Leicester City council, for example flooding which leads to damage to council infrastructure (buildings and roads), storms also caused damage to council buildings in addition to extensive tree damage, which lead to higher costs for the trees and woodlands department.

The frequency and intensity of such extreme events is projected to increase in future, therefore it will benefit the councils (Leicester and Oadby and Wigston) to put in place adaptation measures now to minimise the impact of future events.

Leicester itself is particularly vulnerable to flooding due to its location on the River Soar and tributaries (Old River Soar, River Biam).

D.3 Existing key policies

Leicester City Council developed its first Climate Change Adaptation Action Plan in 2008[59].

A number of subsequent updates and progress Reports have built on the first Adaptation Action Plan. The 2012 Report 'A low Carbon City. Climate Change – Leicester's Programme of Action'[60] included a section on preparing for the impacts of climate change - flooding, heat and drought. A key action already taken by Leicester City Council as Lead Local Flood Authority was the development of a Surface Water Management Plant (SWMP), and updated of the Strategic Flood Risk Assessment (see below for more info on the SFRA). The SWMP identified areas in the city of Leicester which are at high risk of flooding from surface water.

Leicester City Council's 2013 'Climate Change Adaptation Plan'[61] provided a progress update on adaptation actions carried out by Leicester City Council. These include:

- The introduction of a Climate Change Supplementary Planning document, produced to support implementation of relevant Core Strategy policies on climate change mitigation and adaptation relating to buildings, travel and other aspects of land use;
- The development of the Surface Water Management Plan described previously; and
- The development of the Leicester Local Climate Impacts Profile (LCLIP) mentioned above.

The 2013 Climate Change Action Plan also sets out further objectives, including an action to introduce guidance on the use of Sustainable Drainage Systems (SuDS).

[58] A summary of the Local Climate Impacts Profile for Leicester (2011). Climate East Midlands and Leicester City Council

[59] http://www.leicester.gov.uk/your-council-services/ep/the-environment/climate-change/adapting-to-climate-change/

[60] http://www.leicester.gov.uk/your-council-services/ep/the-environment/greener-leicester/climate-change-action-programme/

[61] www.leicester.gov.uk/EasySiteWeb/GatewayLink.aspx?alId=194355

Leicester City Council also has a Level 2 Strategic Flood Risk Assessment (SFRA)[62], carried out in 2012 by URS. The aim of the Level 2 SFRA was to provide sufficient information to facilitate application of the *former* Planning Policy Statement 25 on Development and Flood Risk (PPS25[63]) Sequential and Exception Tests. To this end the SFRA identified areas at risk of flood and analysed the condition of existing flood defences.

The SFRA found that Leicester City is at risk from a variety of sources of flooding, the dominant sources including flooding from rivers, surface water and sewers.

The Oadby and Wigston Core Strategy Development Plan (2010)[64] sets out Oadby and Wigston's strategy on Climate Change and Renewable Energy (Core Strategy Policy 8). Under this policy, all new development, including large scale refurbishment, will be required to demonstrate how it makes effective use of resources and materials, and is sited and designed so as to minimise, mitigate and adapt to the likely effects of climate change.

D.4 Potential adaptation measures

There are a number of adaptation measures which can be implemented in the planning context, to minimise the negative impacts of projected climate changes. These include.

- Use of Sustainable Drainage Systems (SuDS)[65]. SuDS include a range of approaches and technologies, such as the use of permeable surfaces, green roofs, filter strips and infiltration trenches, swales, and ponds among others. The SuDS approach differs from the traditional approach of increasing hard drainage infrastructure to meet increasing needs, instead focussing on a variety of measures to decrease reliance and demand on traditional drainage and sewerage.
- Design of new buildings (or consider retrofitting) to minimise water demand. This can be linked to SuDS, e.g. rainwater collection systems which collect rainwater off building roofs, for use as non-drinking water within the building.
- Flood proofing measures for buildings. These include: locating all fittings, fixtures and services above the design flood level (i.e. raising electricity sockets from ground level to higher/to flood level). For flooring, use of concrete flooring with integrated and continuous damp proof membrane and damp proof coursing; avoiding use of chipboard floors. Fitting anti-flooding devices to drainage systems. Fitting flood-proofing measures externally to buildings in at-risk flood areas (e.g. flood guards on doorways).
- Designing new build to avoid overheating. Since future summers are projected to be warmer, overheating (and associated health impacts from overheating) or increasing electricity demand due to air-conditioning will become increasingly relevant issues. Overheating can be avoided by designing buildings to maximise summer cooling through natural ventilation, and to utilise heavy weight building materials with the ability to absorb heat and to sensitively design development so as limit the risk of excessive solar gain in summer months, causing a heat build-up. Other causes of overheating are the urban heat island effect, top floor flats - poor design approach, single aspect flats without through ventilation, internally insulated dwellings, lightweight construction, dark coloured walls and facades.

[62] http://www.leicester.gov.uk/your-council-services/ep/the-environment/flood-risk-management/flood-risk-studies/sfra/

[63] http://webarchive.nationalarchives.gov.uk/20100520022021/http:/www.communities.gov.uk/planningandbuilding/planning/planningpolicyguidance/planningpolicystatements/planningpolicystatements/pps25/

[64] http://www.oadby-wigston.gov.uk/files/documents/core_strategy/Oadby%20Wigston%20Core%20Strategy.pdf

[65] http://www.ukSuDS.com/

There are some good examples of the above measures already being implemented in Leicester, Oadby and Wigston. These include:

- The use of SuDS at the North Hamilton new housing development[66], north-west of Leicester city. By incorporating SuDS techniques including river meadows, greenways, and extensive wetlands, the development has managed to avoid the need to connect to traditional sewer systems.

A Local Resilience Forum Scheme which has recruited community flood wardens, helping communities respond better to floods. This is part of the flood resilience work being carried out by Leicestershire County Council and partners[67].

[66] See the case study at: http://www.climate-em.org.uk/images/uploads/CEM-Leicester-HamSuDS-5-A4.pdf
[67] http://www.climate-em.org.uk/images/uploads/CEM-Leicestershire-5-A4.pdf

Appendix E
Growth assumptions

Overarching assumptions

The energy projections assume use of electricity and natural gas in all dwellings.

At this stage we assume that all dwellings meet 2013 Part L requirements, but this does not take account of any potential gap in design/projected performance versus actual which may ultimately occur. However it is important to note that the overall intention is simply to provide an order of magnitude in terms of the scale of the challenge.

In both Council areas we assume an indicative development mix. No other information is available on the precise mix and details of these new homes at this stage.

Leicester residential development

The new local plan being prepared by Leicester City Council indicates that an average of 1,250-1,350 domestic dwellings per annum will be built during the period 2016-2031. This would add a total of between 20,000-21,600 dwellings to the existing stock (a 16% increase in the total number of homes, assuming that there are circa 124,000 homes in Leicester at present). It will therefore be important to consider how the emissions from these new homes can be reduced and minimised.

In terms of an *indicative* mix (used simply for this modelling exercise): 40% 1-bed, 40% 2-bed, 10% 3-bed and 10% 4-bed.

Oadby & Wigston residential development

The existing adopted Core Strategy proposes an average of 90 domestic dwellings per annum are projected to be required over the period 2006-2026. This would add a total of around 990 dwellings to the existing stock over the period between 2015 and 2026 (a 5% increase in the total number of homes, assuming that there are circa 21,000 homes in Oadby and Wigston at present). It will therefore be important to consider how the emissions from these new homes can be reduced and minimised.

In terms of an *indicative* mix (used simply for this modelling exercise): 40% 1-bed, 40% 2-bed, 10% 3-bed and 10% 4-bed.

Non-residential development in Leicester

Based on employment floorspace projections provided by Leicester City Council, Table E1 provides a high level estimate of the likely energy demands that this could have (considering both heat and power). No projections are available on the level of other non-residential development which is likely to come forward (e.g. shops, schools and community facilities).

Table E1 Estimated energy demand (electricity and gas) from non-domestic development in Leicester projected over the period 2010-2031

Estimated floor area (m^2)	MWh per annum	CO_2 emissions per annum (tonnes)
B1a (office): 52,500	11,288	3,846
B1c, B2 & B8 (light industrial): 58,800	12,642	3,064
B8 (storage and distribution): 30,000	5,850	1,452
Total	29,780	8,362

Note: floorspace projections provided by Leicester City Council and energy demand estimated by Amec Foster Wheeler

Committed developments being monitored under BE16

Using Leicester City Council's monitoring information Table E2 identifies sites with planning permission and the likely energy demand associated with them. It is important to note that where this includes residential energy demand, this will form part of the projected growth of 20,000-21,600 homes identified above (i.e. benefiting from planning permission but not having been built yet). For non-residential development which has not been built yet this will form part of the projections outlined in Table E1.

Table E2 Energy demand and CO_2 emissions from major committed developments monitored under BE16 (past 3 years)

Year	Energy demand (MWh per year)	Tonnes of CO_2
2013	26,489	6,757
2014	19,103	5,566
2015	6,296 (to date)	1,492

Note: based on monitoring information provided by Leicester City Council's Environment Team

Appendix F
Abbreviations

Abbreviation	Description
agl	Above Ground Level
AD	Anaerobic Digestion
BREEAM	Building Research Establishment Environmental Assessment Methodology
CAA	Civil Aviation Authority
CHP	Combined Heat and Power
CO_2	Carbon Dioxide
CSH	Code for Sustainable Homes
DECC	Department for Energy and Climate Change
DH	District Heating
DNO	District Network Operator
ESCO	Energy Services Company
ETSU	Energy Technology Support Unit
FiT	Feed-in-Tariff
FRA	Flood Risk Assessment
GW	Gigawatt
GW_p	Gigawatt power
GW_{th}	Gigawatt thermal
GWh	Gigawatt hours
km	Kilometres
kW	Kilowatt
kW_p	Kilowatt power
kW_{th}	Kilowatt thermal
kWh	Kilowatt hours
HVAC	Heating Ventilation Air Conditioning
LCLIP	Leicester Local Climate Impacts Profile
LPA	Local Planning Authority
L/p/d	Litres per person per day
m	Metres
MOD	Ministry of Defence

Abbreviation	Description
MW	Megawatt
MW_e	Megawatt electricity
MW_p	Megawatt peak
MW_{th}	Megawatt thermal
MWh	Megawatt hours
NA	Not applicable
NPPF	National Planning Policy Guidance
NPPG	National Planning Practice Guidance
PV	Photovoltaic
RHI	Renewable Heat Incentive
SA	Sustainability Appraisal
SEA	Strategic Environmental Assessment
SFRA	Strategic Flood Risk Assessment
SGHC	Southampton Geothermal Heating Company
SME	Small or Medium sized Enterprise
SNCI	Sites of Nature Conservation Importance
SPD	Supplementary Planning Document
SPG	Supplementary Planning Guidance
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage Systems
tCO_2	Tonnes of carbon dioxide