Runnymede Borough Council

Renewable Energy Assessment

Final Report
Prepared by LUC
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Runnymede Borough Council

Renewable Energy Assessment

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Contents

Chapter 1
Introduction

Background to the Study

1.1 LUC and the Centre for Sustainable Energy (CSE) were commissioned in February 2022 by Runnymede Borough Council to undertake a renewable and low carbon energy study as part of a wider study to inform the Council's action to reduce its own carbon emissions to net zero by 2030 and across the wider Borough by 2050.

1.2 This study seeks to provide a robust evidence base to underpin planning policies relating to renewable and low carbon energy generation and low carbon development within the emerging Local Plan. It identifies the potential for different renewable and low carbon energy technologies at all scales within the Borough.

Renewable energy refers to sources of energy that are not depleted when used, for example, wind and solar.

Low-carbon energy sources are technologies that produce power with substantially lower amounts of carbon dioxide emissions than are emitted from conventional fossil fuel power generation. An example of this is a heat pump. Whilst the heat from the ground is free and renewable, it still requires an electric pump to operate the system.

Decentralised energy generally refers to energy that is generated closer to where it will be used, rather than the more conventional very large scale 'centralised' energy plant that typically serve much wider areas.

1.3 Runnymede Borough Council has made a commitment to "*be resilient to and mitigate climate change impacts especially by reducing and minimising the risks from flooding, reducing greenhouse gas emissions and improving water quality and efficiency*" and has recognised that the local plan is an important mechanism to drive local action through development of two specific policies.

1.4 The Council is in the process of reviewing its current Local Plan (2030)[1]. The new Local Plan will review all strategic issues affecting the plan area, as well as providing the development management policies required to deliver the strategy.

[1] https://www.runnymede.gov.uk/planning-policy/review-runnymede-2030-local-plan

1.5 The Council is keen to ensure that sufficient evidence is available to inform its approach to these matters. It is also anticipated that the outputs of the study will be used by others, including local communities preparing Neighbourhood Development Plans. This could assist them in the identification and delivery of local renewable energy opportunities. This study is not specifically intended to inform any investment or energy generation options by the Council itself.

Aims and Objectives

1.6 The key aim of the study is to prepare a renewable and low carbon energy study that will assist with the preparation of the Local Plan and the determination of planning applications. The study identifies where different renewable and low carbon energy technologies are most suitable within the Borough of Runnymede and what opportunities there are for development to draw its energy supply from decentralised or low carbon energy sources.

1.7 This study provides Runnymede Borough Council with a robust evidence base that can be used to underpin planning policies relating to renewable and low carbon energy generation and low carbon development within the emerging Local Plan. The evidence base and the recommended policies meet the requirements of the National Planning Policy Framework (NPPF) and Planning Policy Guidance (PPG), and take into account the guidance and considerations set out in relevant national policy statements.

1.8 The evidence base and recommended policies will also help contribute towards achieving the net zero carbon vision and targets set out in the Council's Climate Change Strategy 2022-2030.

1.9 In summary, the key objectives of the study were to:

- Review the technical potential for renewable and low carbon energy within the Borough and summarise the factors that may affect the extent to which these technologies can be deployed – i.e. grid connection, planning, finance etc.
- Review the potential opportunities for development to draw its energy from decentralised renewable or low carbon energy systems such as District Heating Networks
- Provide recommendations or appropriate policy options to include in the revised Local Plan regarding renewable and low carbon energy – including areas of potential suitability for wind, solar and other technologies. Please note however that the potential planning policy options are included within the Low Carbon Development and Sustainable Design Principles Report that should be read in conjunction with this report.

Report Structure

1.10 The remainder of this report is structured as follows:

- **Chapter 2** provides a review of the policy context in relation to renewable and low carbon energy.
- **Chapter 3** outlines the existing renewable and low carbon energy generation in Runnymede.
- **Chapter 4** presents the findings of the assessment of 'technical' potential for renewable and low carbon energy.
- **Chapter 5** sets out the findings of the assessment of technical potential for district heating or cooling networks.
- **Chapter 6** sets out the summary and study conclusions.

Chapter 2
Renewable and Low Carbon Policy Context

Introduction

2.1 The following chapter provides a summary of the national and local legislative and policy context for the development of renewable and low carbon energy within Runnymede Borough Council.

National Climate Change and Renewable Energy Legislation and Policy

2.2 The current profile of climate change on the world's stage has never been higher. The risks in failing to limit a global average temperature increase to 1.5°have now been clearly set out in the IPCC Special Report 'Global Warming of 1.5°C' [2] and have recently been reiterated in COP26. In response to this and the Paris Agreement (2016), the UK's Committee on Climate Change (CCC) in its Sixth Carbon Budget recommended in December 2020 a new emissions target for the UK: reduction by 78% by 2035 relative to 1990 and net zero greenhouse gases by 2050[3]. It also advised that that by 2035, current plans would at best deliver around half of the required reduction in emissions, and the Committee stated that "*current policy is insufficient for even existing targets*" and that targets are "*only possible if clear, stable and well-designed policies to reduce emissions further are introduced across the economy without delay*." In facing up to this challenge, the need for radical changes to adapt and mitigate the impacts of climate change is now broadly accepted in UK government and by an increasing proportion of civil society.

National Planning Legislation

Climate Change Act 2008

2.3 The UK's legally binding emission reduction targets were first set by the Climate Change Act 2008 and included a reduction of at least 80% by 2050 against the 1990 baseline[4]. However, on 1st May 2019, Parliament declared a formal climate and environment emergency, and on 12th June 2019 the Government amended the Climate Change Act to target

[2] IPCC (2018) Global Warming of 1.5°C. Available at: www.ipcc.ch/sr15.
[3] Committee on Climate Change (2020) The Sixth Carbon Budget: The UK's path to net zero. Available at: https://www.theccc.org.uk/publication/sixth-carbon-budget/
[4] HM Government (2008) Climate Change Act 2008, c.27 [online] Available at: https://www.legislation.gov.uk/ukpga/2008/27/contents

full net carbon neutrality (a 100% reduction of greenhouse gas emissions) in the UK by 2050[5].

2.4 In response to its obligations to prepare policies to meet climate targets, the UK Government has also produced various sector-specific policies and strategies. These include the Net Zero Strategy (2021), Ten Point Plan for a Green Industrial Revolution (2020), UK National Energy & Climate Plan (2019), the Clean Growth Strategy (2017), Green Finance Strategy (2023) and the Industrial Strategy White Paper (2017) - further details below. In addition, in December 2020, the Department for Business Energy and Industrial Strategy (BEIS) published the Energy White Paper which sets out how the UK will clean up its energy system and reach net zero emissions by 2050. This was supplemented by the British Energy Security Strategy, published in April 2022, which is due to be redrafted in due course. The UK Government then published Powering up Britain in March 2023 which sets out how the government will enhance the country's energy security and deliver net zero commitments. Further to this, the UK Government has set targets for cars, new heating systems and the UK power system.

Net Zero Strategy

2.5 The Net Zero Strategy (Oct 2021) sets out the UK's policies and proposals to meet its allocated carbon budgets and Nationally Determined Contributions (NDC's) alongside the long term vision of decarbonising the economy by 2050. The strategy sets out a delivery pathway showing indicative emissions reductions across sectors to meet the UK's targets up to the sixth carbon budget (2033-2037). This builds on the proposals set out in the Ten Point Plan for a Green Industrial Revolution. Key policies in the strategy include:

- By 2035 the UK will be powered entirely by clean electricity, subject to security of supply; and
- 40GW of offshore wind by 2030 and further development of onshore wind and solar projects. Ensuring that new renewable projects incorporate generation and demand in the most efficient way – taking into account the needs of local communities.

2.6 The strategy also outlines key commitments in Local Climate Action, including:

- Setting clearer expectations on how central and local government interact in the delivery of net zero;
- Establishing a Local Net Zero Forum, chaired by BEIS, to bring together national and local government officials to discuss policy and delivery on net zero; and
- Continuing the Local Net Zero Programme to support local areas with their capability and capacity to meet net zero.

Energy White Paper – Powering Our Net Zero Future

2.7 This White Paper (2020) is based on the Ten Point Plan and sets out the specific energy-related measures that will be implemented in line with the UK's 2050 net zero target. The paper emphasises the UK government's commitment to ensuring that the cost of the transition is fair and affordable for consumers. Key commitments in the paper include:

- Targeting 40GW of offshore wind generation by 2030, including 1GW of floating wind generation. This is alongside the expansion of other renewable technologies;
- Supporting the development of CCUS in four industrial clusters;
- Consulting on whether to stop gas grid connections to new homes being built from 2025;
- Increasing the installation of electric heat pumps from 30,000 per year to 600,000 per year by 2028; and
- Aim to develop 5GW of low-carbon hydrogen production capacity by 2030.

The Ten Point Plan for a Green Industrial Revolution

2.8 This plan (published in 2020) puts forward the ten main areas where the UK wishes to scale up decarbonisation, mobilising £12 billion of government investment. The outlined areas in the plan will be continually built upon by further legislation and policy, such as the Net Zero Strategy (2021) and Energy White Paper (2020).

UK National Energy and Climate Plan

2.9 The UK National Energy and Climate Plan (2020) sets out the UK's approach to meeting the five objectives of the EU's Energy Union[6]: energy security; energy efficiency; decarbonisation; the internal energy market; and research, innovation and competitiveness.

2.10 The Plan describes the current state of the energy sector in the UK, outlining the government's current approach to

[5] HM Government (2019) The Climate Change Act 2008 (2050 Target Amendment) Order 2019 [online] Available at: https://www.legislation.gov.uk/uksi/2019/1056/contents/made
[6] The EU Energy Union is a project of the European Commission to coordinate the transformation of European energy supply. On 31st January 2020, the UK left the EU and is no longer part of the Energy Union. However, there are still UK policies and measures in force relating to the five dimensions of the EU's Energy Union.

climate change mitigation through policy, and how this is expected to affect the five objectives of the Energy Union in future. This is supported by a summary table containing all the relevant UK policies that contribute to achieving the UK's climate goals, taken from the UK's National Communication with the United Nations Framework Convention on Climate Change (UNFCCC).

2.11 The report also includes scenario testing on the UK's projected emissions to 2035, with business as usual, all current measures and all current and planned measure scenarios. It demonstrates that the government's current measures have the potential to reduce baseline emissions by approximately 20% over the current baseline, with a further 10% reduction through implementation of planned measures.

Clean Growth Strategy

2.12 In the context of the UK's legal requirements under the Climate Change Act, the UK's approach to reducing emissions, as set out in the Clean Growth Strategy (2017), has two guiding objectives:

1. To meet domestic commitments at the lowest possible net cost to UK taxpayers, consumers and businesses; and
2. To maximise the social and economic benefits for the UK from this transition.

2.13 The Clean Growth Strategy sets out three possible pathways to decarbonise the UK's economy by 2050:

1. Electric: Including full deployment of electric vehicles (EVs), electric space heating, and industry moves to 'clean fuels'.
2. Hydrogen: Including heating homes and buildings, fuelling many vehicles and the power industry.
3. Emissions removal: Including construction of sustainable biomass power stations with carbon capture and storage technology.

2.14 The Strategy also encourages local authorities to actively pursue a low carbon economy:

> "Local areas are best placed to drive emission reductions through their unique position of managing policy on land, buildings, water, waste and transport. They can embed low carbon measures in strategic plans across areas such as health and social care, transport, and housing." [p118]

2.15 The strategy also announced up to £557 million in further 'Pot 2' (less established renewables) funding for Contracts for Difference (CfD) – a 15-year contract that offers low-carbon electricity generators payments for the electricity they produce. This opened in May 2019. The most recent allocation round (fifth) opened in March 2023 and Round six of auctions is expected to open in 2024.

Green Finance Taskforce and the Green Finance Strategy

2.16 One of the key proposals within the Clean Growth Strategy is to develop world leading Green Finance capabilities by setting up a Green Finance Taskforce, the aim of which is to "provide recommendations for delivery of the public and private investment we need to meet our carbon budgets and maximise the UK's share of the global green finance market".

2.17 Building on the important work of the Green Finance Taskforce, the first Green Finance Strategy was produced in July 2019 and recently updated in 2023. This seeks to reinforce and expand the UK's position as a world leader on green finance and investment, delivering five key objectives:

- UK financial services growth and competitiveness;
- Investment in the green economy;
- Financial stability;
- Incorporation of nature and adaptation; and
- Alignment of global financial flows with climate and nature objectives.

2.18 The Strategy notes the importance of local key players in directing potential investors towards opportunities that meet local priorities and so are more likely to secure local community support.

Industrial Strategy White Paper

2.19 Achieving 'Clean Growth' is one of the future challenges the Government outlines as part of its Industrial Strategy. To maximise the advantages of the global shift to clean growth for the UK, the strategy proposes to:

- Develop smart systems for cheap and clean energy across power, heating and transport;
- Transform construction techniques to dramatically improve efficiency;
- Make our energy intensive industries competitive in the clean economy;
- Put the UK at the forefront of the global move to high efficiency agriculture;
- Make the UK the global standard setter for finance that supports clean growth; and
- Support key areas of innovation, investing £725m over 4 years.

British Energy Security Strategy

2.20 In response to the rising costs of oil and gas on the global energy market, the UK government has set out its plan to reduce the UK's dependence on imported oil and gas. A key part of this strategy (2022) is accelerating the UK's transition towards renewable sources. Regarding renewables, the strategy proposes to:

- Aim to cut the development and deployment of offshore wind projects by half through a streamlined planning process, including reducing consent time from up to four years down to one year and establishing a fast track consenting route for priority cases where quality standards are met;
- Consult on developing local partnerships for communities who wish to host new onshore wind infrastructure; and
- Consult on amending planning rules to favour development of solar projects on non-protected land and support projects that are co-located with other functions.

Powering up Britain

2.21 This policy paper[7] sets out how the government will enhance the UK's energy security, seize the economic opportunities of the transition, and deliver on the net zero commitments. One of the main aims is to accelerate the deployment of renewables with the goal of developing up to 50GW of offshore wind by 2030 and to quintuple solar power by 2035.

UK Ban of New Petrol and Diesel Cars by 2030

2.22 Step 1 sees the phase-out date for the sale of new petrol and diesel cars set at 2030. Step 2 will see all new cars and vans be fully zero emission at the tailpipe from 2035. This will likely mean that the uptake of Battery Electric vehicles (BEV) will significantly increase in Runnymede. This will increase the demand for electricity in the area. If Runnymede is to meet its targets set in their Climate Change Strategy, this increase in electricity demand will need to be met by renewable resources[8].

UK Heating System Target

2.23 The UK has a target for all new heating systems installed in UK homes from 2035 to be using low-carbon technologies, such as electric heat pumps. This will also increase the electricity demand in Runnymede, increasing the need for renewable electricity generation[9].

UK Power System Decarbonisation

2.24 The UK has committed to decarbonise the electricity system by 2035. This brings forward the 2050 commitment set out in the Energy White Paper by 15 years. This will be achieved by focusing on offshore wind, onshore wind, solar, nuclear and hydrogen[10].

National Planning Legislation

Planning and Compulsory Purchase Act

2.25 The Planning and Compulsory Purchase Act (2004) sets out the structure of the local planning framework for England, including the duty on plan-making to mitigate and adapt to climate change. In other words, local planning authorities must make positive and proactive policies and decisions which contribute to the mitigation of, and adaptation to, climate change – polices and decisions that make measurable, ongoing reductions in carbon emissions reported in Council's annual monitoring reports. This legislation is supported by national planning policy and guidance set out below.

2.26 Section 19(1A) of the Planning and Compulsory Purchase Act 2004 (PCPA) requires that climate change is addressed through development plan documents and that obligations regarding annual monitoring of any targets or indicators are fulfilled:

"Development plan documents must (taken as a whole) include policies designed to secure that the development and use of land in the local planning authority's area contribute to the mitigation of, and adaptation to, climate change" [Section 19(1A)]

"Every local planning authority must prepare reports containing such information as is prescribed as to…the extent

[7] Department for Energy Security and Net Zero (2023) Powering up Britain [online] Available at: https://www.gov.uk/government/publications/powering-up-britain
[8] Department for Transport (2020) Government takes historic step towards net-zero with end of sale of new petrol and diesel cars by 2030 [online] Available at: https://www.gov.uk/government/news/government-takes-historic-step-towards-net-zero-with-end-of-sale-of-new-petrol-and-diesel-cars-by-2030
[9] Department for Business, Energy and Industrial Strategy (2021) UK government announces major expansion of heat networks in latest step to power homes with green energy [online] Available at: https://www.gov.uk/government/news/plans-unveiled-to-decarbonise-uk-power-system-by-2035
[10] Department for Business, Energy and Industrial Strategy (2021) Plans unveiled to decarbonise UK power system by 2035 [online] Available at: https://www.gov.uk/government/news/government-takes-historic-step-towards-net-zero-with-end-of-sale-of-new-petrol-and-diesel-cars-by-2030

to which the policies set out in the local development documents are being achieved." [Section 35(2)]

2.27 This means that local plans **must** consider how policies can deliver on these requirements, including having regard to the objectives and trajectories for reducing emissions set out within the Climate Change Act (2008).

Planning Act and National Policy Statements

2.28 The Planning Act (2008) introduced a new planning regime for nationally significant infrastructure projects (NSIPs), including energy generation plants of capacity greater than 50 megawatts (50 MW). In 2011, six National Policy Statements (NPSs) for Energy were published. The energy NPSs are designed to ensure that major energy planning decisions are transparent and are considered against a clear policy framework. They set out national policy against which proposals for major energy projects will be determined by the National Infrastructure Directorate (NID) (formerly the Infrastructure Planning Commission or IPC).

2.29 The Overarching National Policy Statement for Energy (EN-1) sets out national policy for energy infrastructure and describes the need for new national significant energy infrastructure projects. EN-3 (NPS for Renewable Energy Infrastructure) provides the primary basis for decisions by the NID on applications it receives for nationally significant renewable energy infrastructure. It provides guidance on various technologies and their potential for significant effects. In 2016, onshore wind installations above 50MW were removed from the NSIP regime; as such these applications are now dealt with by local planning authorities, based on the NPPF. The NPSs were then consulted on in 2021 and subsequently updated to:

- Reflect the current regulatory framework and contain new transitional provisions applicable during and following a review;
- Update the Government's greenhouse gas emission reductions target from "at least 80%" by 2050 to net zero by 2050, and 78% by 2035 compared to 1990 levels;
- Add flexibility for the applicability of the NPS to new and developing types of energy infrastructure, such as carbon capture and storage and hydrogen infrastructure;
- Confirm future energy generation would come from a range of sources including renewables, nuclear, low carbon hydrogen, with "residual use of unabated natural gas and crude oil fuels" for heat, electricity, transport, and industrial applications; and
- Remove reference to the need for new coal and large-scale oil-fired electricity generation and update references to the need for other infrastructure.

2.30 Since the 2021 update, the British Energy Security Strategy (2022) was published and as such set out some commitments relating to planning reform. Therefore, various changes have been made to the draft energy NPS and were consulted on until the end of May 2023. The amended NPSs are likely to strengthen the process for delivering major new energy infrastructure in England and Wales, reinforcing the country's national priority of delivering on net zero. The updates are also expected to speed up the planning process so that low-carbon generation can be developed at the right time and place whilst protecting and enhancing the national and historic environments and landscape.

Planning and Energy Act

2.31 The Planning and Energy Act (2008) enables local planning authorities to set requirements for energy use and energy efficiency in local plans, including a proportion of energy used in development to be generated from renewable and low carbon sources in the locality of the development. Such requirements can relate to specific types and scales of development but also broad areas within a local planning authority's area of influence, such as areas with optimal conditions for decentralised heat networks.

2.32 The Act also enables local authorities to require standards for energy efficiency in new buildings beyond those in the Building Regulations. In 2015 the energy efficiency requirements were proposed to be repealed, to effectively make the Building Regulations the sole authority regarding energy efficiency standards for residential development, and leaving local authorities no longer able to set their own energy efficiency standards. However, while the power was removed in principle and consultation on new Building Regulation has been undertaken, the Government has not yet produced a commencement date for repealing these powers, which therefore remain in place. More details on Part L of Building Regulations are set out in paragraphs 2.48-2.54.

National Planning Policy

National Planning Policy Framework (NPPF)

2.33 The Government published an updated and revised NPPF in July 2021 and again in September 2023, which sets out the environmental, social and economic planning policies for England. Central to the NPPF policies is a presumption in favour of sustainable development, that development should be planned for positively and individual proposals should be approved wherever possible. One of the overarching objectives that underpins the NPPF is set out in Paragraph 8: *"an environmental objective – to contribute to protecting and enhancing our natural, built and historic environment;*

including …mitigating and adapting to climate change, including moving to a low carbon economy."

2.34 The revised NPPF supports the contents of the Neighbourhood Planning Act (2017) by making explicit reference to the need for local planning authorities to work with duty to cooperate partners on strategic priorities (paragraph 24) and defined strategic policies that make sufficient provision for climate change mitigation and adaptation (paragraph 20). These amendments provide a clear policy framework for local planning authorities to work collaboratively with partners and neighbours to tackle climate change mitigation and adaptation at a strategic scale and over the longer term.

2.35 Paragraph 153 of the NPPF states *"Plans should take a proactive approach to mitigating and adapting to climate change taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures".* Paragraph 155 states that "To *help increase the use and supply of renewable and low carbon energy and heat, plans should:*

a. *provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);*

b. *consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and*

c. *identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers."*

2.36 Paragraph 156 states that local planning authorities should *"support community-led initiatives for renewable and low carbon energy, including developments outside areas identified in local plans or other strategic policies that are being taken forward through neighbourhood planning.*"

2.37 The NPPF goes on to state that "*When determining planning applications for renewable and low carbon development, local planning authorities should*:

a. *not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions; and*

b. *approve the application if its impacts are (or can be made) acceptable. Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas"*

2.38 The updated NPPF made minor alterations to the renewable and low carbon development section. Footnote 54 states that, other than the repowering of existing wind turbines, wind energy development can only be permitted in an area identified suitable for such development in the development plan or a supplementary planning document and, following consultation, it can be demonstrated that the planning impacts identified by the local community have been appropriately addressed and the proposal has community support.

2.39 Additionally, the NPPF provides that onshore wind developments can be approved using local development orders, neighbourhood development orders or community right to build orders. Footnote 53a of the NPPF states that:

"Wind energy development involving one or more turbines can also be permitted through Local Development Orders, Neighbourhood Development Orders and Community Right to Build Orders. In the case of Local Development Orders, it should be demonstrated that the planning impacts identified by the affected local community have been appropriately addressed and the proposal has community support."

2.40 Very few wind energy applications have been submitted for planning approval in England since the policy was originally introduced in 2015[11] and the updates to the NPPF are unlikely to materially change the rate of deployment of onshore wind in England.

National Planning Practice Guidance (PPG)

2.41 The online National Planning Practice Guidance (PPG) resource, published by the Department for Levelling Up, Housing and Communities (DLUHC) and Ministry of Housing, Communities and Local Government (MHCLG) provides further interpretation of national planning policy for the benefit of local planning authorities and planning practitioners. Although the section on climate change has not been updated following the changes to the Climate Change Act and the UK Climate Emergency Declaration, it strongly asserts the

[11] Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities and Local Government (2014, updated 2019) Guidance: Climate change [online] Available at: https://www.gov.uk/guidance/climate-change

importance of climate change within the planning system and the need for adequate policies if Local Plans are to be found sound[12]:

> "Addressing climate change is one of the core land use planning principles which the National Planning Policy Framework expects to underpin both plan-making and decision-taking. To be found sound, local plans will need to reflect this principle and enable the delivery of sustainable development in accordance with the policies in the National Planning Policy Framework. These include the requirements for local authorities to adopt proactive strategies to mitigate and adapt to climate change in line with the provisions and objectives of the Climate Change Act 2008, and co-operate to deliver strategic priorities which include climate change." [Paragraph 1]

2.42 In respect of the approach to identifying climate mitigation measures for new development, the PPG also states:

> "Every area will have different challenges and opportunities for reducing carbon emissions from new development such as homes, businesses, energy, transport and agricultural related development. Robust evaluation of future emissions will require consideration of different emission sources, likely trends taking into account requirements set in national legislation, and a range of development scenarios." [Paragraph 7]

2.43 The PPG also makes it clear with regards to renewable energy that[13]:

> "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." [Paragraph 3]

2.44 The role community led renewable energy initiatives have been outlined and states that they:

> "are likely to play an increasingly important role and should be encouraged as a way of providing positive local benefit from renewable energy development…Local planning authorities may wish to establish policies which give positive weight to renewable and low carbon energy initiatives which have clear evidence of local community involvement and leadership." [Paragraph 4]

2.45 In terms of identifying suitable locations for renewable energy development, such as wind power, the NPPG section on 'Renewable and Low Carbon Energy' states:

> "There are no hard and fast rules about how suitable areas for renewable energy should be identified, but in considering locations, local planning authorities will need to ensure they take into account the requirements of the technology and, critically, the potential impacts on the local environment, including from cumulative impacts. There is a methodology available from the Department of Energy and Climate Change's website on assessing the capacity for renewable energy development which can be used and there may be existing local assessments. However, the impact of some types of technologies may have changed since assessments were drawn up (e.g. the size of wind turbines has been increasing). In considering impacts, assessments can use tools to identify where impacts are likely to be acceptable. For example, landscape character areas could form the basis for considering which technologies at which scale may be appropriate in different types of location." [Paragraph 5]

2.46 It also goes on to state that:

> "local planning authorities should not rule out otherwise acceptable renewable energy developments through inflexible rules on buffer zones or separation distances. Other than when dealing with setback distances for

[12] Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities and Local Government (2014, updated 2019) Guidance: Climate change [online] Available at: https://www.gov.uk/guidance/climate-change

[13] Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities and Local Government (2015) Guidance: Renewable and low carbon energy [online] Available at: https://www.gov.uk/guidance/renewable-and-low-carbon-energy

safety, distance of itself does not necessarily determine whether the impact of a proposal is unacceptable." [Paragraph 8]

Neighbourhood Development Plans

2.47 Neighbourhood planning offers local communities an opportunity to produce positive and ambitious sustainable energy plans for their local area. The PPG on Renewable and Low Carbon Energy states that "*Local and neighbourhood plans are the key to delivering development that has the backing of local communities." [Paragraph 3]*

2.48 Across the country, the large majority of the numerous plans adopted so far, show little evidence of having considered the issue of climate change and energy to the level that is required to have meaningful impact.

2.49 However, given the right support, Neighbourhood Development Plan (NDP) groups can serve to convene and inform local communities and stimulate bottom-up renewable energy policies and development.

Building Regulations- Part L

2.50 National standards for energy use and emissions within new developments are set by Part L1A and Part L2A of the Building Regulations, which concern the conservation of fuel and power in new dwellings and new buildings other than dwellings respectively. The current regulations came into operation in 2010 but were re-issued in 2013 and amended in 2016. The regulations apply a cap to a building's emissions through the use of a nominal Target Emissions Rate (TER) measured in kgCO2/m2/year, which for dwellings must not be exceeded by the Dwelling Emissions Rate (DER) as calculated according to the Standard Assessment Procedure (SAP) methodology.

2.51 In October 2019 the Government launched a consultation on the next revision of the Building Regulations and proposed a new 'Future Homes Standard' with the message that "We must ensure that new homes are future-proofed to facilitate the installation of low-carbon heat, avoiding the need to be retrofitted later, and that home builders and supply chains are in a position to build to the Future Homes Standard by 2025".

2.52 The consultation considered two levels of emission reductions for new dwellings from 2020: either 20% or 31% over current 2013 Part L standards, and for the 2025 Future Homes Standard a 75-80% reduction together with low carbon heating systems. These standards aim to reduce or remove the dependency on fossil fuels and encourage the use of heat pumps, heat networks or in some circumstances direct electric heating in the context of a rapidly decarbonising UK electricity supply. The 2020 31% target ('Fabric plus technology') is stated as being the Government's preferred option and would most likely comprise energy efficiency measures with onsite low carbon generation, whereas the 20% option ('Future Homes Fabric') would require higher levels of fabric energy efficiency.

2.53 The consultation also proposed that from 2020 the energy efficiency of new dwellings should be assessed in terms of 'primary energy' as the basis for the Part L performance target (alongside emission targets), and that from 2020, homes should be future-proofed for low carbon heating. This is likely to mean that, if not already fitted, homes should have a low temperature heat distribution system so that they will be compatible with heat pumps. Additionally, in order to counteract existing variations in local authority-set performance standards, the consultation also proposed to remove the powers from local authorities to set their own standards above Part L (as granted under the Planning and Energy Act).

2.54 In January 2021 the Government launched a consultation on the second stage of the 2-part consultation on proposed changes to Part L (Conservation of fuel and power) and Part F (ventilation) of Building Regulations. It confirmed that the Planning and Energy Act 2008 will not be amended, which means that local authorities will retain powers to set local energy efficiency standards for new homes. It also built on the Future Homes Standard consultation by setting out energy and ventilation standards for non-domestic buildings, existing homes and included proposals to mitigate against overheating in residential buildings.

2.55 This consultation considered two ambitious options to uplift energy efficiency and ventilation standards for new non-domestic buildings including: introduction of overheating standards for new residential buildings in 2021 and a 2021 uplift of energy and ventilation standards (Part L and Part F) for homes[14]. The Government responded in December 2021 to the consultation[15], the responses are summarised below:

- Starting from 2025, the Future Building Standard will produce highly efficient new non-domestic buildings;

[14] Ministry of Housing, Communities and Local Government (2021) The Future Buildings Standard [online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/956037/Future_Buildings_Standard_consultation_document.pdf
[15] Department for Levelling Up, Housing and Communities (2021) The Future Building Standard: 2021 Consultation on changes to Part L and Part F of the Building Regulations, Summary of responses received and Government response [online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1040925/Future_Buildings_Standard_response.pdf

- A new full technical consultation on the Future Buildings Standard will commence in 2023;
- Employment of the performance metrics set out in the consultation will be undertaken: a new primary energy target, a CO2 emissions target and minimum standards for fabric and fixed building services; and
- The interim uplift will also make sure that construction professionals and supply chains are working to higher specifications in readiness for the introduction of the Future Buildings Standard from 2025.

2.56 Alongside, the publication of the Government's response, the 2021 uplift has been implemented, therefore as of 15th June 2022, all new build homes and commercial buildings must reduce their carbon emissions by 31% and 27% respectively, according to the updated Building Regulations.

Local Policy and Guidance

Runnymede 2030 Local Plan

2.57 The Runnymede 2030 Local Plan[16] was adopted in 2020. The spatial vision states that *"Runnymede will be resilient to and mitigate climate change impacts especially by reducing and minimising the risks from flooding, reducing greenhouse gas emissions*". As such, Objective 6 seeks to "*increase resilience to climate change, including flood risk, to reduce greenhouse gas emissions and promote water efficiency and the use of renewable and low carbon energy*". Additional objectives also contribute to climate change mitigation and adaptation, for example, by seeking to improve accessibility to a range of active travel choices (thus reducing the need to travel by car) and to enhance the Borough's landscapes, green spaces and biodiversity.

2.58 Policy SD7: Sustainable Design embeds sustainable design principles to ensure development proposals mitigate and adapt to climate change impacts.

2.59 The Local Plan also includes Policy SD8: Renewable and Low Carbon Energy which states that "*the local planning authority will support proposals for stand-alone and community led renewable, low carbon and decentralised sources of energy, unless any adverse impacts to local amenity or to the built, natural and historic environments cannot be overcome".* The policy sets out a requirement for development proposals to explore opportunities to incorporate renewable, low carbon or decentralised forms of energy supply. While the local plan supports renewable energy, it has not identified any locations within the Borough that are deemed to be suitable for renewable or low carbon energy projects.

Local Plan Review

2.60 Runnymede Borough Council started work on the review of the 2030 Local Plan in January 2021, including producing revised and new evidence base documents such as a Climate Change Study[17]. Additionally, the Council is updating the Infrastructure Baseline Assessment, which is the first stage in preparing an Infrastructure Delivery Plan. A chapter of this assessment focuses on the capacity of renewable energy infrastructure, and how planned growth in the borough might impact this infrastructure. Issues such as the capacity of the electricity network will also be explored.

2.61 Further to the above, the revision to the Local Plan, will also be assessing land to be allocated for housing, employment and infrastructure uses in order to deliver the spatial strategy.

Runnymede Borough Council Climate Strategy 2022-2030

2.62 In 2022, Runnymede Borough Council adopted their Climate Strategy[18], which explores how the Local Plan objectives and policies can be improved and strengthened to better meet local and national net zero emissions targets. In January 2022, the Council committed to tackling climate change and adopted a target to achieve operational 'net zero carbon' emissions from its services and operations by 2030.

2.63 Key priorities include:

- Supporting communities to take positive action through event information, education, grants, support for voluntary initiatives and signposting sources of funding.
- Working together with other public sector organisations such as Surrey County Council and neighbouring boroughs to adopt a joint approach.

[16] Runnymede Borough Council (2020) Runnymede 2030 Local Plan [online] Available at: https://www.runnymede.gov.uk/localplan
[17] Runnymede Borough Council (n.d) Runnymede 2030 Local Plan review [online] Available at: https://www.runnymede.gov.uk/planning-policy/review-runnymede-2030-local-plan#:~:text=The%20review%20of%20the%20Runnymede,the%20updated%20evidence%20base%20documents.
[18] Runnymede Borough Council (2022) Runnymede Borough Council 2022-2030 [online] Available at: https://www.runnymede.gov.uk/downloads/file/1533/climate-change-strategy#:~:text=The%20Runnymede%20Local%20Plan%202030,and%20sustainable%20construction%20and%20demolition.

The Runnymede Design Supplementary Planning Document (SPD)

2.64 The Runnymede Design SPD[19] was published in July 2021 and provides guidance on achieving sustainable design in the Borough. The SPD encourages the use materials and construction methods that are renewable or sustainable and using techniques within developments that can reduce energy use over the long term: (e.g. through orientation, solar gain or renewable energy technologies, rainwater harvesting, greywater recovery and composting).

Runnymede Borough Council Green and Blue Infrastructure Supplementary Planning Document (SPD)

2.65 The Runnymede Borough Green Blue Infrastructure SPD was adopted on the 24th of November 2021[20] and provides guidance for embedding Green and Blue Infrastructure into development. The strategy outlines how GBI Design Principles can be used to build resilience to climate change in Runnymede, including the use of sustainable drainage systems, water conservation, renewable energy, green roofs/walls, tree planting and green building design.

[19] Runnymede Borough Council (2021) The Runnymede Design SPD [online] Available at: https://www.runnymede.gov.uk/downloads/file/826/adopted-rbc-spd

[20] Runnymede Borough Council (2021) Green and Blue Infrastructure Supplementary Planning Document (SPD) [online] Available at: https://www.runnymede.gov.uk/downloads/file/1243/gbi-spd-nov21

Chapter 3
Existing renewable and low carbon energy generation

Introduction

3.1 This Chapter sets out information on existing renewable and low carbon energy generation within Runnymede. It is not possible to identify an exact figure for the amount of existing renewable energy generation across the Borough, however estimates for installed electricity generation capacity and output are set out in Table 3.1. This draws on:

- Sub-regional data from the Government's Feed-in Tariff (FiT)[21] scheme; and
- Department for Business Energy and Industrial Strategy (BEIS) Renewable Energy Planning Database[22] (REPD) data which lists all renewable electricity projects over 150kW

3.2 Figures 3.1 to 3.3 only include those projects that were registered as operational and consented at the time of preparing this report.

[21] Department for Business, Energy and Industrial Strategy (2013, updated 2020) Sub-regional Feed-in Tariffs statistics [online] Available at: https://www.gov.uk/government/statistical-data-sets/sub-regional-feed-in-tariffs-confirmed-on-the-cfr-statistics

[22] Department for Business, Energy and Industrial Strategy (2014, updated 2023) Renewable Energy Planning Database: quarterly extract [online] Available at: https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract

Figure 3.1: Existing operational and consented renewable energy generation: capacity

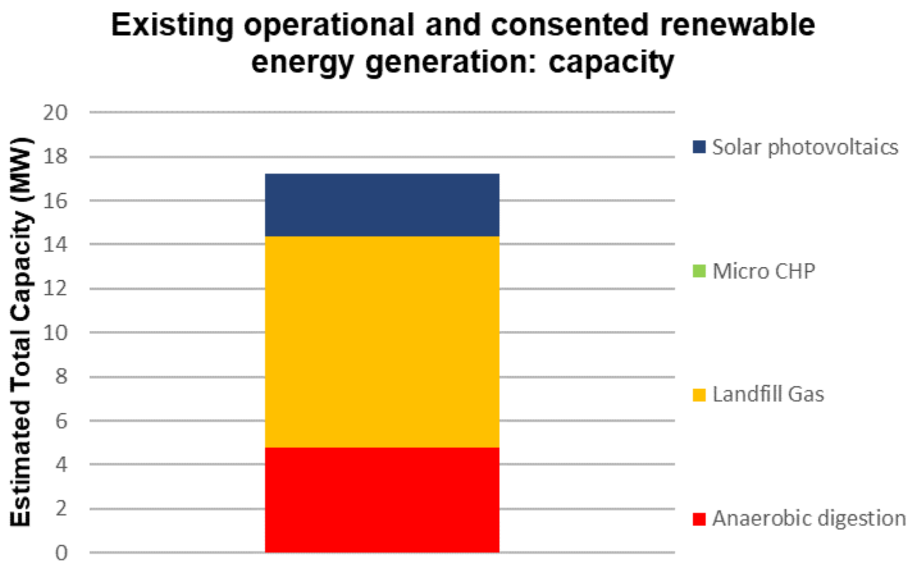


Figure 3.2: Existing operational and consented renewable energy generation: electricity output

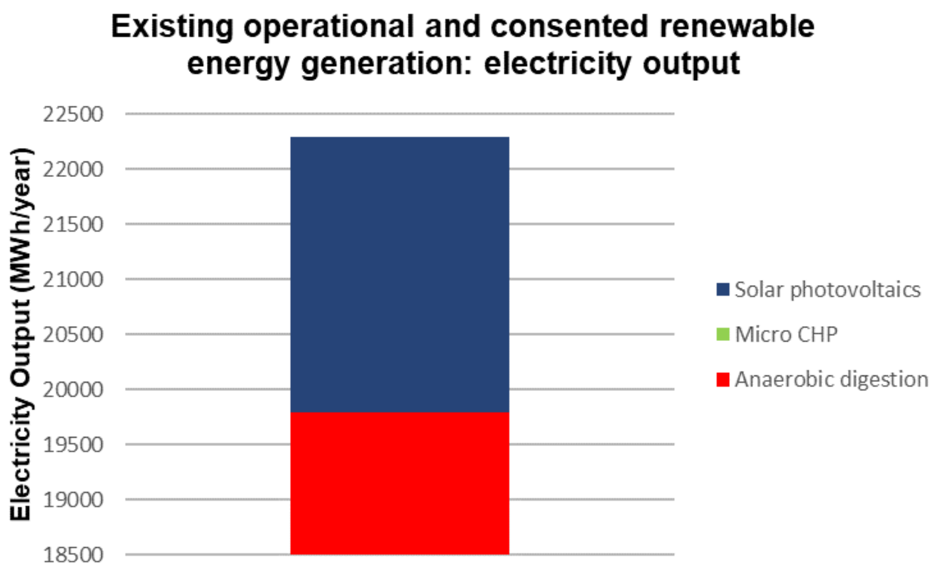
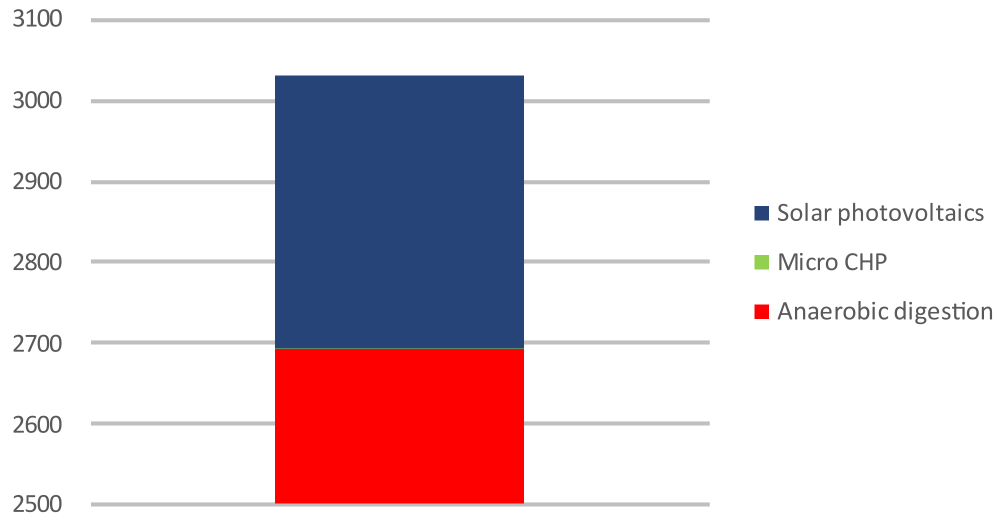


Figure 3.3: Existing operational and consented renewable energy generation: potential CO2 savings



3.3 The locations for existing and consented installations across Runnymede, as currently listed in the Renewable Energy Planning Database are shown in Figure 3.4 below[23].

3.4 Figure 3.4 shows that all of the renewable energy installations developments are located in the central belt of Runnymede. Most of these are Landfill gas sites.

3.5 As outlined in Table 3.1, there is currently 17.21 MW of operational renewable electricity generation capacity across Runnymede, with annual emission savings of over 3,031 tCO2.

3.6 Table 3.1 shows that landfill gas is the main source of renewable energy generation in Runnymede, with 9.6kW of electricity generated annually from three sites. There are no known large onshore wind turbines within Runnymede.

Table 3.1: Existing operational and renewable electricity installations in Runnymede

Technology	Estimated total capacity (MW)	Electricity output (MWh/year)	Potential CO_2 savings (tonnes/yr)
Operational – Solar Photovoltaics	2	2,493	339
Operational – Micro CHP	0.001	1	0.2
Operational – Landfill gas	10	n/a	n/a
Operational – Anaerobic Digestion	5	19,798	2,692

[23] The solar photovoltaics and micro CHP installations are not featured in the BEIS REPD dataset as they are below 500kW in size. Therefore, they are not within Figure 3.4.

Technology	Estimated total capacity (MW)	Electricity output (MWh/year)	Potential CO_2 savings (tonnes/yr)
Total operational	**17**	**22,292**	**3,031**
Withdrawn – EfW incineration	14	-	-

Renewable Heat

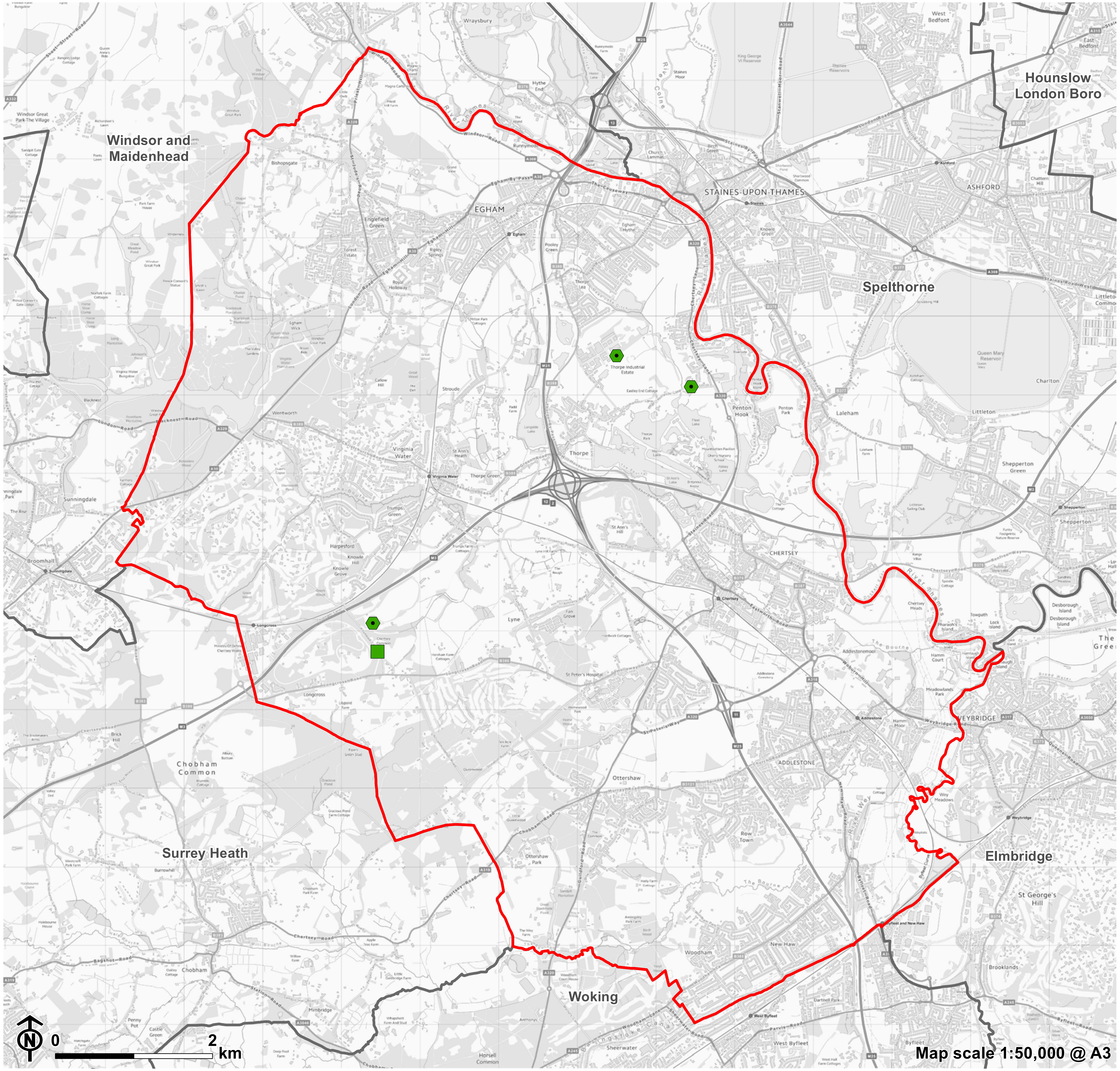
3.7 The amount of existing renewable heat generation in Runnymede from biomass, solar water heating and heat pumps has been estimated using sub-national data within the Renewable Heat Incentive (RHI) statistics. The BEIS Renewable Heat Incentive statistics indicate that there are 60 (approx. 0.6MW) domestic accredited full applications for the Renewable Heat Incentive within Runnymede. Technology breakdowns for domestic installations are given in Table 3.2. In addition, Table 3.1 indicates there is 9.6MW of operational landfill gas development.

Table 3.2: Existing Domestic Renewable Heat Installations

Technology	Number of accredited full domestic applications	Average system capacity (kW)	Approx. installed capacity (MW)	Approx. delivered heat (MWh/year)	Approx. CO2 savings (tonnes/yr)
Air Source Heat Pumps	48	10	0.5	781	135
Ground Source Heat Pumps	6	15	0.1	140	338
Biomass systems – assuming heating only	-	27	-	-	-
Solar water heating	6	3	0	7	1

Runnymede Renewable Energy Study
Runnymede Borough Council

Figure 3.4: Existing and consented renewable energy installations within Runnymede



Runnymede boundary
Neighbouring Local Authority

Technology

Anaerobic Digestion
Landfill Gas

CB:PS EB:davies_h LUC 12212_r0_Fig_3_4_ExistingRenewables_A3L 17/05/2023
Source:OS, BEIS

Chapter 4
Renewable and Low Carbon Energy Opportunities

Introduction

4.1 This chapter provides the results of the assessment of the 'technical' potential for renewables within Runnymede. The 'technical potential' is the total amount of renewable energy that could be delivered in the area based on a number of assumptions regarding the amount of resource and space.

4.2 The assumptions used to calculate 'technical potential' for each renewable technology are provided within Appendix A. The assessment of technical potential has been applied at a strategic scale across Runnymede and more detailed site assessments (i.e. as required for a planning application) would be required to determine if specific sites are suitable in planning terms

4.3 This chapter also includes a discussion of the issues that will affect what could be realistically delivered within the Borough – i.e. the 'deployable potential'. This includes the consideration of factors such as planning, economic viability and grid connection.

Assessment of Potential for Renewables

4.4 The following section summarises the assessment of technical and deployable potential for each form of renewable and low carbon technology. For each resource, where relevant it includes:

- A description of the technology.
- Summary of existing deployment within Runnymede.
- Assumptions used to calculate technical potential.
- Results of assessment of technical potential.
- Summary of issues affecting deployment.

4.5 The assessment approach is based on the former Department of Energy and Climate Change (DECC) Renewable and Low-Carbon Energy Capacity Methodology: Methodology for the English Regions (2010)[24] as referenced in the PPG but this has been updated and refined to take account of local circumstances within Runnymede where appropriate.

[24] LUC and SQW (2010) Renewable and Low-carbon Energy Capacity Methodology: Methodology for the English Regions [pdf] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/226175/renewable_and_low_carbon_energy_capacity_methodology_jan2010.pdf

Wind

Description

4.6 Onshore wind power is an established and proven technology with thousands of installations currently deployed across many countries throughout the world. The UK has the largest wind energy resource in Europe.

4.7 Turbine scales do not fall intrinsically into clear and unchanging size categories. At the largest scale, turbine dimensions and capacities are evolving quite rapidly. As defined scales need to be applied for the purpose of the resource assessment, the assessment has used five size categories based on consideration of current and historically 'typical' turbine models:

- Very large (150-200m tip height).
- Large (100-150m tip height).
- Medium (60-100m tip height).
- Small (25-60m tip height).
- Very small (<25m tip height).

4.8 An assessment of technical potential for very small wind (<25m height) was not undertaken as it is not possible to define areas of suitability for these using the same assessment criteria. Notional turbine sizes for the purposes of the present resource assessment are approximately intermediate within each class size (Table 4.1).

Table 4.1: Notional turbines used for the resource assessment

Scale	Typical Turbine Installed Capacity	Typical Turbine Height (maximum to blade tip)
Very large	4MW	175m
Large	2.5MW	125m
Medium	0.5MW	80m
Small	0.05MW	45m

4.9 Most turbines above the smallest scales have a direct connection into the electricity network. Smaller turbines may provide electricity for a single premises via a 'private wire' (e.g. a farm or occasionally a large energy use such as a factory), or be connected to the grid directly for export. Typically, turbines will be developed in larger groups (wind farms) only at the larger scales. The amount of energy that turbines generate will depend primarily on wind speed but will be limited by the maximum output of the individual turbine (expressed as 'installed capacity' in Table 4.1).

4.10 A review of wind turbine applications across the UK found that tip heights range from less than 20m up to around 200m, with larger turbine models particularly in demand from developers following the reduction in financial support from Government. The majority of operational and planned turbines range between 80m and 200m, with the majority at the larger end of the scale.

4.11 As of 2022, the UK had 14,832 MW of installed onshore wind capacity, providing 35,119 GWh electricity during the year [25]. Since the removal of financial support and restrictive policy requirements in the 2015 Written Ministerial Statement referred to above and subsequently incorporated in the NPPF, onshore wind development activity has moved overwhelmingly away from England towards Scotland and Wales, where it is focusing particularly on sites with high wind speeds and the ability to accommodate large numbers of tall turbines. Very few onshore wind energy projects have been approved and built within England since 2015.

Existing Development within Runnymede Borough Council

4.12 According to the most recent BEIS Renewable Energy Data base[26], there are no known large operational wind developments within Runnymede currently.

Assumptions used to Identify Land with Technical Potential

4.13 The assessment of technical potential for very large, large, medium and small turbines was undertaken using GIS (Geographical information Systems) involving spatial mapping of key constraints and opportunities. The assessment identified areas with suitable wind speeds (applying a reasonable but relatively generous assumption in this respect, bearing in mind that only the highest wind speeds are potentially viable at the present time) and the number of

[25] Department for Business, Energy and Industrial Strategy (2013, updated 2022) Energy Trends: UK Renewables – Renewable electricity capacity and generation (ET 6.1 – quarterly) (2022 and January to March 2022) [online] Available at: https://www.gov.uk/government/statistics/energy-trends-section-6-renewables

[26] Department for Business, Energy and Industrial Strategy (2014, updated 2023) Renewable Energy Planning Database: quarterly extract [online] Available at: https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract

turbines that could theoretically be deployed within these areas. A series of constraints relating to physical features, such as environmental/heritage protection were then removed. The remaining areas have 'technical potential' for wind energy development.

4.14 The key constraints considered are set out in detail in Appendix A.

4.15 Unconstrained areas of land were excluded if they were below a minimum developable size of 40m width and an area that varied per turbine size:

- Very large: 0.8ha
- Large: 0.6ha
- Medium: 0.4ha
- Small: 0.2ha

Results

Technical Potential

4.16 Table 4.2 below provides a summary of technical potential for wind energy within Runnymede. The analysis examined the potential for very large, large, medium and small turbines. Where potential exists for more than one size of turbine, it was assumed that the larger turbines would take precedence as, to ensure viability, developers usually seek to install the largest capacity turbines possible.

4.17 The calculation of potential wind capacity involved applying an assumption concerning development density. In practice, turbines are spaced within developments based on varying multiples of the rotor diameter length. Although turbine separation distances vary, a 5 x 3 rotor diameter oval spacing[27], with the major axis of the oval oriented towards the prevailing wind direction, taken to be south-west as the 'default' assumption in the UK, was considered a reasonable general assumption to use at the present time in this respect. In practice, site-specific factors such as prevailing wind direction and turbulence are taken into account by developers, in discussion with turbine manufacturers. Bearing in mind the strategic nature of the present study, the density calculation did not take into account the site shape, and a standardised density was used instead as set out below:

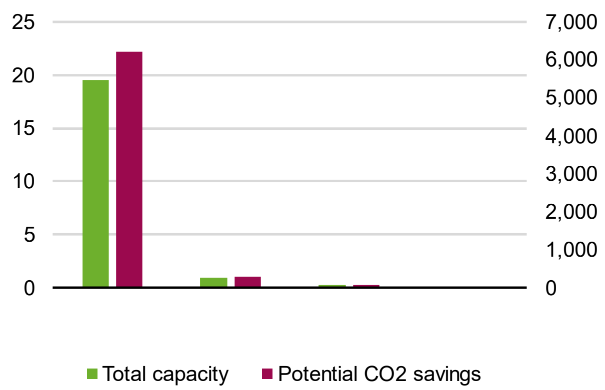
- Very large: 4 turbines per km^2
- Large: 8 turbines per km^2
- Medium: 22 turbines per km^2
- Small: 167 turbines per km^2

4.18 The calculation of potential energy yield requires the application of a 'capacity factor' i.e. the average proportion of maximum turbine capacity that would be achieved in practice over a given period. Capacity factors vary in practice in accordance with wind speed, terrain and turbine scale. It was not possible to find suitable local historic data on capacity factors, taking into account these kinds of variations in Runnymede for the present study, and so a single capacity factor of 26.8% was used for all turbine scales, based on regional data.

4.19 In addition, the potential carbon savings as a result of generation via the identified wind potential was calculated. This assumed that the electricity generated from the identified wind potential would result in negligible carbon emissions and would replace that currently provided by the national grid, which has an emission factor of 0.136kgCO2e/kWh[28].

4.20 The assessment results indicate that there is a technical potential to deliver up to around 20.64MW of wind energy capacity in Runnymede, with the greatest potential for small turbines as these can be located in more areas (see Figure B.5 and Table 4.2). It should be noted that there is no potential for very large or large turbines within Runnymede.

Figure 4.1: Onshore wind potential capacity and carbon savings within Runnymede



[27] To mitigate impacts on the productivity of wind turbines located close to one another caused by wind turbulence, it is standard practice for developers to maintain an oval of separation between turbines that is equal to 5 times the turbine rotor diameter (the cross sectional dimension of the circle swept by the rotating blades) on the long axis, and 3 times the rotor diameter on the short axis.
[28] BRE (2022) Standard Assessment Procedure (SAP 10.2): The Government's Standard Assessment Procedure for Energy Rating of Dwellings. Available at: https://bregroup.com/sap/sap10

Table 4.2: Onshore wind potential capacity, output and carbon savings within Runnymede

Development scale	Estimated total capacity (MW)	Electricity output (GWh/year)	Potential CO2 savings (mil. Tonnes/year
Small	20	46	6,227
Medium	1	2	301
Large	0.2	0.5	63
Very large	-	-	-
Total	**21**	**48**	**6,591**

4.21 The maps included in Appendix B show the areas which have been identified via the GIS analysis to have technical potential for wind development at each considered turbine scale. These figures indicate that the largest areas of potential for wind generation, particularly small scale generation, are scattered across the Borough with the majority in the southern part of Runnymede.

4.22 In order to illustrate the GIS tool parameters, a series of opportunity and constraints maps were produced. Figure B.1 in Appendix B shows the wind speed within Runnymede at 50m above ground level (agl). This shows that the highest winds speeds are predominantly located in the north west and south west of Runnymede. Other mapped constraints that have influenced the assessment outcomes are included in Appendix B. It is noted that maps depicting the physical constraints are only included for small and very large turbines for illustrative purposes, showing the minimum and maximum buffer distances applied to physical features depending on turbine size.

4.23 An assessment of this nature will necessarily have certain limitations, including:

- Wind data – It is important to note that the macro-scale wind data which was used for this assessment can be inaccurate at the site-specific level and therefore can only be used to give a high level indication of potential capacity and output within Runnymede. Developers will normally require wind speeds to be accurately monitored using anemometers for an extended period (typically at least one to two years) for commercial scale developments.
- Cumulative effects – Multiple wind turbine developments can have a variety of cumulative effects. Cumulative landscape and visual effects, in particular, would clearly occur if all the identified areas of wind development potential were to be realised. Cumulative effects, however, cannot be taken into account in a high-level assessment of this nature and must be considered on a site-by-site basis.
- Site-specific features and characteristics – In practice, developments outside protected areas may potentially have an impact on amenity and sensitive 'receptors' such as protected species. These impacts can only be assessed via site-specific surveys.
- Aviation – Although operational airports and airfields in active use were considered to be constraints to wind development, airport safeguarding zones were only mapped for information. Aviation interests were not used to restrict potentially suitable areas as these impacts require site by site consideration and mitigation may be available to address any issues.

Issues affecting deployment

4.24 The technical wind development potential within Runnymede, as estimated through application of reasonable constraints within a GIS tool, is not the same as the development capacity that may be expected to be deployed in practice.

4.25 Certain limitations of the resource assessment with respect to deployable wind potential have already been noted in the previous section. For example, cumulative impacts can only be considered fully when developments come forward in practice but would generally be expected to reduce the overall deployable capacity. However, there are four key factors that affect the deployable wind potential that merit individual consideration: grid connection, development income, planning issues and landscape sensitivity. These are discussed in turn below.

Grid Connection

4.26 Historically, it has been possible to connect a variety of wind energy development scales into the distribution network at a wide range of distances from the nearest connection point. This situation has changed dramatically over recent years due to two factors in combination:

- The distribution network, and even the transmission network[29], have become increasingly congested, to the point at which connections in many cases cannot take place without expensive network reinforcement costs (which fall to the developer) being incurred, or generation being curtailed, or both.
- The Government's cancelling of subsidies for onshore wind in 2016 has reduced wind development incomes to the point at which previously affordable reinforcement works would now render many developments unviable, particularly those of smaller scale.

4.27 Within Runnymede, Scottish & Southern Electricity Networks (SSEN) and UK Power Networks operate the grid network. A portion of Runnymede is served by the Laleham GSP network which is run by SSEN. In December 2021, SSEN submitted their RIIO-ED2 Business Plan to Ofgem, which proposed investment across SEPD from 1 April 2023 to 31 March 2028[30]. The Plan has now been approved by Ofgem. SSEN has proposed investments that will release capacity in specific areas of their network where constraints have been identified. This release of capacity may be through flexibility service providers offsetting the peak demand or generation, or through conventional reinforcement. Laleham GSP network has been identified as an area in need of investment. The planned intervention is to install new transformers with associated switchgear within two locations. Figure 4.2 below sets out the planned network interventions to be delivered by SSEN by 2028.

4.28 It should be noted that the majority of the investment requirements for Laleham GSP network will be completed between 2024 to 2028. As such, the grid capacity is likely to remain constrained for the immediate future. Grid could therefore be a significant constraint in the short-medium term in relation to the deployment of wind and all large-scale grid connected renewable energy developments. As the local plan period extends past 2028, policy will have to be flexible to allow for future scenarios, changes in national policy and the grid being upgraded, or better balanced.

Development Income

4.29 Financial support mechanisms in the form of Government subsidies such as the Renewables Obligation (RO) and Feed In Tariff (FiT) previously allowed onshore wind to be developed at a variety of scales and at a variety of wind speeds. The RO closed to all new generating capacity on 31 March 2017 and the FiT closed to new applicants from 1 April 2019.

4.30 The Contracts for Difference (CfD) scheme is now the Government's main mechanism for supporting low-carbon electricity generation[31]. The first auction included 'Pot 1' technologies; 'established' technologies, including onshore wind. The successful applicants of Round 1 auctions, as announced in February 2015, included onshore wind developments. Since then, Round 2 and Round 3 of the auctions in September 2017 and September 2019 excluded Pot 1 technologies, including onshore wind developments. As a result of the general decline in financial support for onshore wind, developers are predominantly interested in developing wind turbines in locations with high wind speeds, such as Scotland, Wales and northern England, to enable schemes to be financially viable.

4.31 Round 4 of CfD auctions opened in December 2021 and Round 5 opened in March 2023, and both of which now include Pot 1 technologies, such as onshore wind[32]. Nonetheless developers have found that CfDs do not make schemes financially viable in much of England where wind speeds are typically lower, and any potentially financially viable developments require a number of very large turbines to maximise the power output and make the scheme economic. These schemes are, however, unlikely to be acceptable in many locations in England at the present time due to planning constraints.

4.32 Various initiatives can in theory improve wind development viability beyond the provision of subsidy. These could include, for example, establishment of local supply companies that can 'capture' the uplift from wholesale to retail energy prices. The signing of Power Purchase Agreements (PPA), such as between a developer and the Council, agreeing that the developer will sell the electricity generated to the Council, could make individual turbines viable, for example on an industrial estate.

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[29] The transmission network refers to the highest voltage electricity network in the UK – the 'motorway network' of the energy world - it transmits large quantities of electricity over long distances via wires carried on a system of mainly metal towers (pylons) and large substations. The lower voltage, more local, parts of the system are called the distribution network.

[30] SSEN (2022) SEPD Network Development Report. Available at: https://www.ssen.co.uk/globalassets/our-services/network-capacity/network-development-plan-consultation-documents/sepd-network-development-report.pdf

[31] Department for Business, Energy and Industrial Strategy (2022) Contracts for Difference Available at: https://www.gov.uk/government/publications/contracts-for-difference/contract-for-difference

[32] Department for Business, Energy and Industrial Strategy (2020, updated 2022) Contracts for Difference (CfD):Allocation Round 4 – Contracts for Difference (CfD) for low carbon electricity generation [online]. Available at: https://www.gov.uk/government/collections/contracts-for-difference-cfd-allocation-round-4 Government response to consultation on proposed amendments to the scheme.

4.33 Between 2009 and 2021, capital costs such as turbine prices fell by between 48% and 62%[33] potentially driven in part by the loss of subsidy itself – although the migration of demand to larger turbines in a post-subsidy context is likely to limit any effect in this regard on smaller turbine sizes. However, over the last decade the decline in turbine prices globally has occurred despite the increase in roto diameters, hub-heights and nameplate capacities. In addition, the price differences between turbines with differing rotor diameters narrowed significantly in 2019.

4.34 In addition, the Smart Export Guarantee has been introduced since January 2020[34]. This is an obligation set by the Government for licensed electricity suppliers to offer a tariff and make payment to small-scale, low-carbon generators for electricity exported to the National Grid, providing certain criteria are met[35]. Wind developments of up to 5 MW capacity could benefit from this obligation. However, as mentioned above, the obligation does not provide equal financial benefits to the previous FiT scheme (which provided funding for smaller scale renewable energy developments), as it only provides payments for electricity export, not generation, and it does not provide a guaranteed price for exported electricity.

4.35 Overall, viability challenges, based on reduced income relative to capital costs, are a systemic challenge for wind development at all scales within southern England at the present time – to the extent that, if this challenge is not addressed by Government (alongside the existing planning constraints), the deployable wind potential within Runnymede is likely to be low.

Planning Issues

4.36 In addition to the lack of financial support mechanisms, the NPPF requires that wind energy development may only be permitted within areas identified suitable for wind energy developments within Local Plans and where the development has the backing of the local community (footnote 54 in the NPPF). The legitimate interpretation of this provision has not been definitively established via case law. However, it has had a discouraging influence on developers. Larger developers are currently not interested in pursuing wind farm developments within much of England, although there may be scope for small scale, single turbine installations implemented by farmers or community energy groups.

4.37 The Government has finished consulting on an amendment to Footnote 54 in the NPPF which if adopted would allow local planning authorities to identify suitable areas for wind within Supplementary Planning Documents as well as development plans. This change is unlikely to provide a level playing field with other technologies and developments.

Landscape Sensitivity

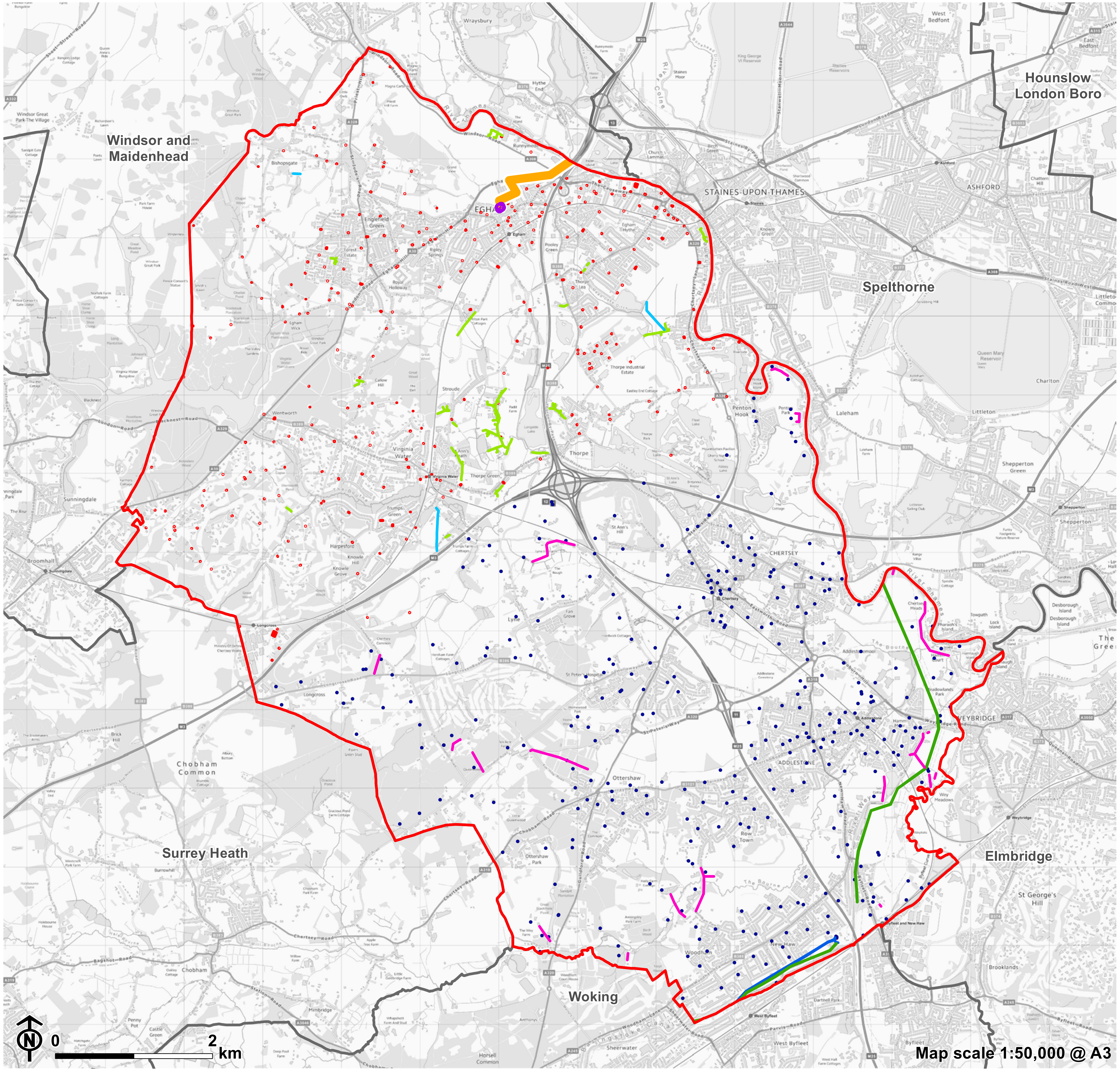
4.38 Landscape and Visual Impact (LVI) has historically often been a defining consenting consideration within the context of planning applications for wind developments, and has therefore been a particularly important influence on the choice of turbine scales and locations by developers.

4.39 As the degree of acceptable landscape and visual impact is generally a matter that needs to be considered within the context of an overall planning balance, no land was excluded from the GIS technical constraints assessment on landscape or visual grounds. Instead, a separate landscape sensitivity assessment (LSA) should be undertaken to consider all Landscape Character Areas defined within the Runnymede Landscape Character Assessment with technical potential for development. The LSA could be used alongside the output of this assessment of technical potential to help the Council identify which areas may be more or less suitable for onshore wind energy development within Runnymede. It should be noted that site specific assessments (including landscape and visual impact and residential amenity assessments) would also be needed to verify the suitability of specific wind energy development proposals in landscape terms. Careful consideration of the potential landscape impacts versus the public benefits of renewable energy would need to be weighed through the planning application process.

[33] IRENA (2022) Renewable Power Generation Costs in 2021 [online] Available at: https://www.irena.org/publications/2022/Jul/Renewable-Power-Generation-Costs-in-2021
[34] Ofgem (2020) Smart Export Guarantee (SEG) [online] Available at: https://www.ofgem.gov.uk/environmental-and-social-schemes/smart-export-guarantee-seg
[35] There are five eligible low-carbon technology types for SEG: solar PV, wind, micro combined heat and power (micro-CHP), hydro and anaerobic digestion. These installations must be located in Great Britain and have a total installed capacity of no more than 5MW, or no more than 50kW for Micro-CHP. Anaerobic Digestion installations will need to meet further sustainability criteria.

Runnymede Renewable Energy Study
Runnymede Borough Council

Figure 4.2: Runnymede grid infrastrucuture updates 2022-2028



Runnymede boundary
Neighbouring Local Authority

Upgrades (SSEN Network Development Report, May 2022)

SSEN substation upgrade
SSEN Transmission line upgrade

SSEN Network

SSEN substation
SSEN high voltage overhead line
SSEN low voltage overhead line

UK Power Network

UKPN substation
UK Power Network 33kv overhead line
UK Power Network 132kv overhead line
UKPN low voltage overhead line

CB:PS EB:kaczor_a LUC 12212_r0_Fig_5_3_r0_Grid_Reinforcements_2022_2028_A3L 02/05/2023
Source:OS, SSEN, UKPN

Solar PV – Ground Mounted

Description of Technology

4.40 In addition to PV modules integrated on built development, there are a large number of ground-mounted solar PV arrays or solar farms within the UK. These consist of groups of panels (generally arranged in linear rows) mounted on a frame. Due to ground clearance and spacing between rows (and between rows and field boundary features) solar arrays do not cover a whole field and allow vegetation to continue to grow between and even underneath the panels.

4.41 Ground-mounted solar project sizes vary greatly across the UK although developers in a post-subsidy environment are increasingly focusing on large-scale development, with the largest currently consented scheme in England (Cleve Hill in Kent) being over 350 MW[36]. There is no one established standard for land take per MW of installed capacity, although land requirements for solar are comparatively high compared with wind. For the present assessment, an approximate requirement of 1.2 hectares per MW has been applied based on past and recent development experience.

4.42 As of 2022, the UK had 14,660 MW of installed solar PV capacity, with this providing 13,921 GWh of electricity during the year[37] (the lower energy generation relative to wind – see paragraph 4.11 – despite the similar installed capacity is due to the lower capacity factors of solar PV generation – see paragraph 4.11). These figures include all forms of solar PV – although according to the most recent available data, ground-mounted schemes account for 48.6% of overall solar capacity[38]. Falling capital costs mean solar PV is increasingly viable in a post-subsidy context, although as outlined above, at present developers are generally focusing on large developments in order to achieve economies of scale. Grid connection costs can also critically affect viability.

Existing Development within Runnymede Borough Council

4.43 According to the most recent BEIS Renewable Energy Data base[39], there are no large operational ground mounted solar developments within Runnymede currently.

Assumptions used to Identify Land with Technical Potential

4.44 A GIS assessment of technically suitable land for solar development was undertaken using a similar approach to that undertaken for wind development. The assessment identified areas with financially viable solar irradiance levels (amount of sunlight) for PV. A series of primary constraints relating to physical features and environmental/heritage protection were then removed. The remaining areas have 'technical potential' for ground-mounted solar energy development.

4.45 Solar development is more 'modular' than wind (development size is dictated by the number of panels, which themselves do not differ greatly in size) and constraints are not affected by project scale in the way that they are for wind. Therefore, the identification of available land for ground-mounted solar has not been broken down into discrete project sizes but rather any land technically suitable for development has been identified.

4.46 The key constraints considered are set out in Appendix A.

Results

Technical Potential

4.47 Figure 4.3 and Table 4.3 below provide a summary estimate of the technical potential for ground-mounted solar PV within Runnymede. Adopting the 100% development scale would result in a total potential technical capacity from ground mounted solar PV across Runnymede of 943MW – this approximately equates to an area of 11.31km^2. The areas with technical potential are scattered throughout the borough with the largest areas located in the central belt of Runnymede.

4.48 The calculation of potential energy yield requires the application of a 'capacity factor' i.e. the average proportion of maximum PV capacity that would be achieved in practice over a given period. Capacity factors vary in practice in accordance with solar irradiation, which in turn is affected by location, slope and aspect. It was not possible to find suitable historic data on capacity factors taking into account these kinds of factors within Runnymede for the present study, and so a

[36] Cleve Hill Solar Park (2020) Cleve Hill Solar Park granted development consent – 28/05/2020 [online] Available at: https://www.clevehillsolar.com/

[37] Department for Business, Energy and Industrial Strategy (2013, updated 2023) Energy Trends: UK Renewables – Renewable electricity capacity and generation (ET 6.1 – quarterly) (2022 and January to March 2022) [online] Available at: https://www.gov.uk/government/statistics/energy-trends-section-6-renewables

[38] Department for Business, Energy and Industrial Strategy (2014, updated 2022) Solar photovoltaics deployment [online]. Available at: https://www.gov.uk/government/statistics/solar-photovoltaics-deployment Using June 2022 data within Table 2, considering all FiTs (standalone), RO (ground mounted) and CfDs (ground-mounted) within the UK

[39] Department for Business, Energy and Industrial Strategy (2014, updated 2023) Renewable Energy Planning Database: quarterly extract [online] Available at: https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract

single capacity factor of 10.1% was used, based on regional data for the South East.

4.49 The potential carbon savings as a result of generation via the identified ground-mounted solar potential was also calculated. This assumes that the electricity generated from the identified ground-mounted solar potential would result in negligible carbon emissions and would replace that currently provided by the national grid, which has an emission factor of 0.136kgCO2e/kWh[40].

Figure 4.3: Ground-mounted solar PV potential capacity and savings

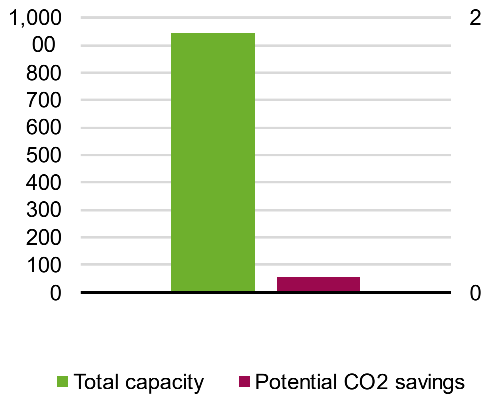


Table 4.3: Potential solar capacity and output

Developmen t scale	Potential installed capacity (MW)	Electricity output (GWh/year)	Potential CO2 Savings (Tonnes/yr)
100% of tech. resource	943	831	112,959

4.50 The key constraints and resulting potentially suitable land for solar development are presented in maps in Appendix C.

4.51 As with the wind resource assessment, the solar assessment has some key limitations. In particular, cumulative impacts are again a key consideration that the tool cannot take into account but which would affect the suitability of planning applications in practice. Due to the less constrained nature of solar, relative to wind, in terms of the factors that can reasonably be considered within a high-level resource assessment, a large area of land has been identified as technically suitable for ground mounted solar; but in practice development of all or even the majority of this land would clearly not be appropriate.

Issues Affecting Deployment

4.52 Considerations, other than cumulative impact, that would reduce the deployable potential of ground-mounted solar PV in practice include landscape sensitivity, grid connection and development income. These are discussed in turn below.

Landscape Sensitivity

4.53 Although the landscape and visual impacts of solar PV tends not to be as contentious as wind development, it is still often a key consenting issue, particularly for larger development scales. As the degree of acceptable landscape and visual impact is generally a matter that needs to be considered within the context of an overall planning balance, no land was excluded from the GIS technical constraints assessment on landscape or visual grounds. Instead, similar to wind, a separate landscape sensitivity assessment (LSA) should be undertaken to consider all Landscape Character Areas defined within the Runnymede Landscape Character Assessment with technical potential for development. The LSA could be used alongside the output of this assessment of technical potential to help the Council identify which areas may be more or less suitable for ground mounted solar development within Runnymede. Careful consideration of the potential landscape impacts versus the public benefits of renewable energy would need to be weighed through the planning application process.

Grid Connection

4.54 As with wind, a key consideration in relation to solar PV development viability is the interaction between development income and grid connection costs. As noted above, at the present time viable solar developments are generally larger scale. It is understood, however, that even larger scale solar developments will only generally be viable at present where a grid connection is available in relatively close proximity to the development site, and does not involve significant network reinforcement costs. Although connections can in principle be made either into existing substations or into power lines (a 'tee in' connection), proximity requirements alone would limit the deployable solar PV potential in much of Runnymede at the present time.

[40] BRE (2022) Standard Assessment Procedure (SAP 10.2): The Government's Standard Assessment Procedure for Energy Rating of Dwellings. Available at: https://bregroup.com/sap/sap10

Development Income

4.55 The current lack of financial support for solar PV will particularly constrain the deployable potential of smaller schemes and schemes at greater distances from potential grid connection points. The present assessment cannot, however, rule out the potential for such schemes, bearing in mind that the financial context for solar is changing – for example solar is to be included in the next round of the Contracts for Difference (CfD) auctions. Renewable generators located in the UK that meet the eligibility requirements can apply for a CfD by submitting what is a form of 'sealed bid'. Round 5 of auctions opened in March 2023 and includes Pot 1 technologies, such as solar and onshore wind. Round six of auctions is expected to open in 2024.[41]

4.56 Over recent years solar panel costs also have decreased significantly, and as such subsidy-free solar energy schemes in the right locations are financially viable at larger scales. Solar PV module prices have dropped in price by 89% since 2010. Forecasting published by the BEIS also places solar as the cheapest source of new power generation for the coming years. Between 2025 and 2040, it is anticipated that solar parks will be more cost effective than offshore or onshore wind, gas, nuclear and other technologies[42]. It is noted however that at present, commercial ground mounted solar PV schemes are predominantly pursued at large scales to ensure viability via economies of scale.

4.57 With regards to smaller scale solar developments, the Smart Export Guarantee has been introduced since January 2020[43]. This is an obligation set by the Government for licensed electricity suppliers to offer a tariff and make payment to small-scale low-carbon generators for electricity exported to the National Grid, providing certain criteria are met. This could help to increase the financial viability of solar energy developments of up to 5 MW capacity. However, the obligation does not provide financial benefits equal to the previous FiT scheme, as it only provides payments for electricity export, not generation, and it does not provide a guaranteed price for exported electricity. In its first year of operation, several new tariffs were launched, up to a peak of 11p/kWh, and the scheme is running smoothly, and enables customers to shop around for the best tariff, incentivising suppliers to increase their prices to compete[44]. However, in April 2021 the Environmental Audit Committee wrote a letter to the Business Secretary raising concern about the lack of clarity from the Government on the role of community energy in decarbonising the energy sector and called for the introduction of a floor price above zero for the Smart Export Guarantee to help support such community energy[45]. It may therefore be that future changes to the Smart Export Guarantee or introduction of additional schemes may increase the potential developer income on future solar PV developments.

Solar- Rooftop

Description of Technology

4.58 Both solar PV and solar water heating are well-established technologies in the UK, with uptake having been significantly boosted through the Feed-in Tariff (FiT) and the Renewable Heat Incentive (RHI) schemes. Installations are largely confined to southwest to southeast facing roofs, pitched between 20-60º, and which have minimal shading. These may be installed upon existing roofs or can be roof-integrated. Roof-integrated systems, such as PV tiles, shingles and semi-transparent PV panels, form part of the roof itself and can offset some of the cost of conventional roofing materials.

4.59 On flat roofs, commonly found on flats and on-domestic properties, the orientation of the roof is less critical to the viability of solar technologies. However, on these roofs, the panels will instead need to be pitched on tilted frames and spaced appropriately to limit self-shading.

4.60 On pitched roofs, approximately 7.5m^2 of roof space per kW of high efficiency (e.g. monocrystalline silicon) solar PV panel is required. These PV systems can also be connected to export power to the grid at times when there is insufficient energy use or storage capabilities within the property. In comparison, the rooftop size requirements for the installation of solar water heating systems is limited to the usage of hot water within the property itself.) On residential properties, solar water heating systems therefore typically occupy 1.5m^2 of flat panel per resident, and properties require sufficient space to accommodate a hot water storage tank.

[41] Department for Energy Security and Net Zero (2022) Considerations for future Contracts for Difference rounds [online] Available at: https://www.gov.uk/government/consultations/considerations-for-future-contracts-for-difference-cfd-rounds
[42] Solar Energy UK (2020) Solar Energy UK Impact Report 2020
[43] Ofgem (2020) Smart Export Guarantee (SEG) [online] Available at: https://www.ofgem.gov.uk/environmental-and-social-schemes/smart-export-guarantee-seg
[44] Solar Power Portal (2021) Ticking along: How the SEG has fared in its first year Available at: https://www.solarpowerportal.co.uk/blogs/ticking_along_how_the_seg_has_faired_in_its_first_year
[45] UK Parliament (2021) Regulatory barriers and lack of Government strategy stalling UK community energy on path to net zero Available at: https://committees.parliament.uk/committee/62/environmental-audit-committee/news/154954/regulatory-barriers-and-lack-of-government-strategy-stalling-uk-community-energy-on-path-to-net-zero/

4.61 Standard installations of solar panels are considered to be 'permitted development'[46] and therefore do not normally require planning consent. However, installations on listed buildings, or on buildings in designated areas (e.g. on the site of a scheduled monument or in a conservation area) are restricted in certain situations and may require planning consent.

Other and Emerging Solar PV Technologies Considered but not Assessed

4.62 The breadth of uses for solar PV technology is vast and spans many diverse applications such as solar phone chargers, roof or ground-mounted power stations and solar streetlamps. There is also a new design for a solar PV integrated motorway noise barrier that is being considered for use by Highways England, and a trial of track-side solar panels being used to power trains by Imperial College. Solar car park canopies also offer potential, as demonstrated by the 88.5kW system installed at the Ken Martin Leisure Centre by Nottingham City Council[47].

4.63 Emerging solar PV technologies include 'floatovoltaics', whereby PV systems float on waterbodies such as reservoirs and lakes, often floating on rafts and anchored to the side of the water body. For example, a 6.3 MW 23,046 panel scheme has been developed on Queen Elizabeth II Reservoir, near Heathrow airport[48], and a 3 MW 12,000 panel scheme has been installed on Godley Reservoir near Manchester[49]. These schemes generally occupy only a small area of the water bodies and are beneficial in reducing evaporation over the summer. As such, there may be potential to utilise the various lakes within Runnymede for 'floatovoltaics'.

4.64 However, if such 'floatavoltaic' systems were installed on more natural water bodies as opposed to reservoirs, their installation could risk impacting the ecosystems of water bodies by creating too much shading beneath the panels. This would require more investigation if proposals for such 'floatavoltaic' systems are proposed on sensitive or protected water bodies.

Existing Development within Runnymede Borough Council

4.65 In Runnymede there was 2,102 kW of solar PV capacity installed between April 2010 (launch of the FiT) and March 2019 (when it closed), with 589 panels deployed on domestic properties[50].

Assumptions Used to Calculate Technical Potential

4.66 The total potential capacity of roof mounted solar was estimated based on typical system sizes and the estimated percentage of suitable roofs within the study area. A high-level assessment was undertaken, considering the number of buildings and types of building within Runnymede. Assumptions on the suitability of the roofs of these buildings were applied – see Appendix A.

4.67 Roofs that have potential to deliver solar PV also have the potential to deliver solar water heating generation. However, this was treated as being mutually exclusive with solar PV potential, i.e. the same roof space can only be utilised for one of the technologies.

4.68 The total potential capacity of solar PV and solar water heating was calculated along with the generation potential. The calculation of potential energy yield requires the application of a 'capacity factor' i.e. the average proportion of maximum PV capacity or solar water heating that would be achieved in practice over a given period. A capacity factor of 10.1% was used for Solar PV, based on regional data for the South East[51], and a capacity factor of 4.5% was used for solar water heating, based on national scale BEIS data[52].

4.69 The potential carbon savings as a result of generation via the identified roof-mounted solar potential was also calculated. This assumed that the electricity generated from the identified solar PV potential would result in negligible carbon emissions and would replace that currently provided by the national grid,

[46] HM Government (2015) The Town and Country Planning (General Permitted Development) (England) Order 2015 [online] Available at: https://www.legislation.gov.uk/uksi/2015/596
[47] BRE (2016) Solar car parks – A guide for owners and developers, p.16 [pdf] Available at: https://www.bre.co.uk/filelibrary/nsc/Documents Library/BRE/89087-BRE_solar-carpark-guide-v2_bre114153_lowres.pdf
[48] Lightsource bp (2021) Floating solar powering Thames Water [online] Available at: https://www.lightsourcebp.com/uk/projects/queen-elizabeth-ii-reservoir-solar-project/
[49] Energy Matters (2015) Huge Floating Solar Power System On UK Reservoir [online] Available at: https://www.energymatters.com.au/renewable-news/floating-solar-uk-em5156/
[50] Department for Business, Energy and Industrial Strategy (2013, updated 2020) Sub-regional Feed-in Tariffs statistics [online] Available at: https://www.gov.uk/government/statistical-data-sets/sub-regional-feed-in-tariffs-confirmed-on-the-cfr-statistics
[51] Department for Business, Energy and Industrial Strategy (2014, updated 2022) Quarterly and annual load factors [online]. Available at: https://www.gov.uk/government/publications/quarterly-and-annual-load-factors The average of all the available load factors for the South East was used.
[52] Department for Business, Energy and Industrial Strategy (2022) Non-domestic RHI mechanism for budget management: estimated commitments – RHI budget caps [online] Available at: https://www.gov.uk/government/publications/rhi-mechanism-for-budget-management-estimated-commitments

which has an emission factor of 0.136kgCO2e/kWh[53]. Similarly, this assumed that the heat generated from the identified solar water heating potential would result in negligible carbon emissions and would replace that currently provided by the mains gas (emission factor of 0.210kgCO2e/kWh[54]), or either heating oil (emission factor of 0.298kgCO2e/kWh[55]) or national grid electricity (emission factor of 0.136kgCO2e/kWh[56])for properties located 'off-gas' – see Appendix A.

Results

Technical Potential

4.70 Figure 4.4, Figure 4.5 and Table 4.4 below provide a summary estimate of the technical potential for roof-mounted solar PV and Figure 4.6 and Table 4.5 below provide a summary estimate of the technical potential for roof-mounted solar water heating within Runnymede.

Figure 4.4: Rooftop solar PV potential: total capacity and potential savings – residential

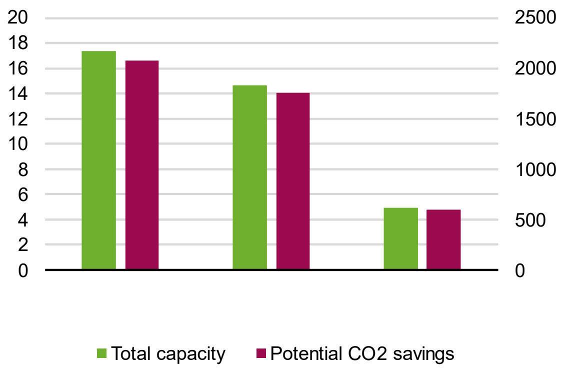


Figure 4.5: Rooftop solar PV potential: total capacity and potential savings – non - residential

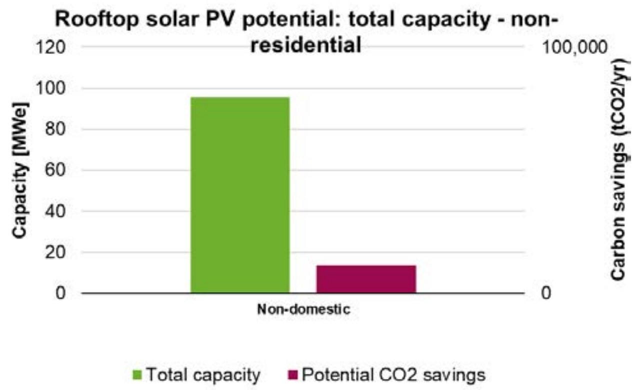


Table 4.4: Assessment of Rooftop solar PV

Building Category	Estimated capacity (MW)	Electricity output (MWh/year)	Potential CO2 Savings (tonnes/year)
Detached	17	15,293	2,080
Semi-detached	15	12,938	1,760
Terrace/end terrace	5	4,368	594
Non-domestic	95	84,001	11,424
Total	**135**	**116,600**	**15,858**

[53] BRE (2022) Standard Assessment Procedure (SAP 10.2): The Government's Standard Assessment Procedure for Energy Rating of Dwellings [online] Available at: https://bregroup.com/sap/sap10/

[54] Ibid

[55] Ibid

[56] Ibid

Figure 4.6: Rooftop solar water heating potential capacity and savings

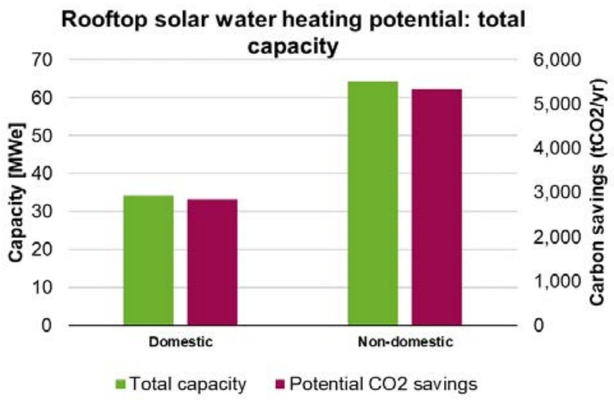


Table 4.5: Assessment of rooftop solar water heating

Building category	Estimated Capacity (MW)	Delivered Heat (MWh/yr)	Potential CO2 Savings (tonnes/yr)
Domestic	34	13,509	2,851
Non-domestic	64	25,297	5,339
Total	**98**	**38,806**	**8,190**

Issues Affecting Development

Grid Decarbonisation

4.71 Rooftop solar PV is proving to be attractive to developers as an easily deployed renewable energy generation technology that offsets high-carbon mains electricity usage, thereby helping to meet tightening buildings emission standards. However, the 'value' of this offsetting will continue to drop as the mains grid electricity gradually decarbonises.

4.72 Nonetheless, for those already receiving a proportion of free electricity from onsite solar PV, the financial benefits of reduced bills from mains electricity usage will continue. Over the past decade, the cost of solar PV has reduced significantly, and this fall in cost is likely to continue in conjunction with UK grid parity (generation of power at or below the cost of mains power) expected in 1-3 years, without the need of subsidies.

4.73 In addition, recent advances in smart power management controls and energy storage systems have benefited solar PV. The dual deployment of these technologies with rooftop solar PV, for example through time-of-use electricity tariffs, could automate and optimise the generation and storage of power, determining whether power is used directly on site, stored for later use, or exported immediately directly to the grid. Furthermore, the integration of solar PV into 'whole house' systems, which could also incorporate electric vehicle charging, could further incentivise uptake of rooftop solar PV technologies.

Lack of Financial Incentives

4.74 The FiT scheme, which enabled properties to gain payments for energy generation and export from small-scale renewable installations, closed to new applicants in March 2019. Following this, the Government introduced the Smart Export Guarantee scheme in January 2020. This scheme requires that licenced electricity suppliers offer a tariff to pay small-scale (>5MW) low carbon electricity generators to export electricity to the grid. However, this scheme is generally less beneficial than the FiT as the payments are only related to the exported electricity, rather than the total amount of electricity generated. Furthermore, the VAT payable on solar PV battery systems increased from 5% to 20% in October 2019 for the majority of installations, making schemes potentially less financially viable for some users[57].

4.75 Although it is likely that rooftop solar PV will make a significant contribution to total installed capacity within the UK, as well as play a vital role in the majority of new developments, the uptake of rooftop solar PV in the future is difficult to predict. Without policy changes regarding subsidies, it is likely to become more limited on existing properties until non-subsidy financial viability improves.

4.76 In comparison, solar water heating installations are less common, as preference was previously given to PV installations during the more profitable FiT period. This is with the exception of solar water heating installations on properties that are located off the gas grid. For off-gas properties, the installation of roof-mounted solar water heating panels are often more financially beneficial, due to the higher cost of heating fuels like electricity and oil in comparison to mains gas.

4.77 With regards to non-domestic properties, the installation of roof-mounted solar water heating technologies is more limited than on domestic properties, as the viability of these installations is dependent on hot water demand, as well as competition with point-of-use hot water heating. This

[57] Solar Energy UK (2021) VAT on Solar and Battery Storage [online] Available at: https://solarenergyuk.org/resource/vat-on-solar-and-battery-storage/?cn-reloaded=1&nowprocket=1

technology is less likely to play a significant role in the decarbonisation of heat in comparison to heat pumps, particularly if grid electricity continues to decarbonise as predicted.

4.78 It is noted, that in certain circumstances, rooftop solar PV and solar water heating installations can be considered to be permitted development[58] and therefore may not need planning permission, potentially encouraging uptake.

Biomass and Waste

Description of Resource

4.79 Biomass is defined generally as material of recent biological origin that is derived from plant or animal matter. 'Dry' biomass is commonly combusted to produce electricity or generate heat. 'Wet' biomass is commonly used to produce biogas via anaerobic digestion. This can be used as 'green' gas on the grid or used to produce 'biofuel' for transport.

4.80 In many countries, dry biomass materials such as wood are commonly used as a fuel for modern heating systems. These modern technologies can be used to heat a variety of building sizes and can be utilised within individual boilers or district heating systems (see Chapter 5).

4.81 In addition, organic wastes can be considered a source of low-carbon energy production if their use in generation prevents them from otherwise decomposing and potentially releasing methane, contributing to greenhouse gas levels in the atmosphere.

4.82 Biomass can also be used to generate electricity, fuelling electricity plants or combined heat and power (CHP) plants. This is becoming increasingly common due to the low carbon emissions of its use. However, to ensure the technology is low-carbon, consideration must be given to ensuring the biomass feedstocks are sustainably sourced with minimal carbon emissions associated with any required processing and transportation. Except for landfill gas, energy supply from most bioenergy sources has grown since 2010 with the largest upturn from plant biomass (imported and domestic).

4.83 The most common types of biomass feedstocks for energy production include:

- Virgin woodfuel: Including forestry and woodland residues, and energy crops.
- Waste residues: Including municipal and commercial solid waste, recycled wood waste, agricultural residues and sewage

Virgin Woodfuel

Description of Technology

4.84 The virgin woodfuel considered within this study includes:

- Untreated wood residues (from forestry, woodlands, arboriculture, tree surgery, etc); and
- The energy crops Miscanthus and Short Rotation Coppice (SRC).

4.85 It is noted that there is some overlap in which virgin wood enters certain waste streams, however this is difficult to extract from contaminated non-virgin wood. As such, virgin woodfuel within waste streams is not considered within this part of the assessment.

4.86 It is necessary to separately consider virgin and non-virgin woodfuel resources as different legislation will apply to its usage for energy generation regarding emission permits. Virgin woodfuel is considered to be clean and safer than non-virgin woodfuel, which may be contaminated for example by paint or preservatives. As such the use of non-virgin woodfuel for energy generation would fall under stricter emission and pollution controls.

4.87 Provided virgin woodfuel is sustainably sourced, such as via sustainable woodland management through re-growth and low emissions from processing and transportation, it can be considered a sustainable fuel. The carbon emissions released from the combustion of the wood are theoretically balanced by the regrowth of replacement woodland and energy crops, provided the carbon emissions released in growing and transporting the woodfuel are mitigated. For example, logs and woodchip are considered to be less sustainable due to their 'bulky' nature, and as such should be sourced locally to limit greater transport emissions.

4.88 Woodfuel biomass is commonly produced as logs, woodchips, pellets and briquettes, and there are several processes that are required to prepare the woodfuel to reach these usable states. Processing influences the moisture content, size and form of the biomass fuels and the quality control of these factors is necessary to ensure the biomass is usable within specific boilers and thermal conversion processes.

4.89 Virgin woodfuel biomass can be utilised for both heat-only generation as well as CHP, and a variety of energy conversion technologies can be used, such as direct combustion, gasification and pyrolysis.

[58] Subject to complying with criteria set out as Part 14 of the Town and Country Planning (General Permitted Development) (England) Order 2015 (as amended).

Existing Development within Runnymede Borough Council

4.90 The data available from the department for Business, Energy and Industrial Strategy (BEIS)[59] identifies there is currently no dedicated biomass installed in Runnymede. The Renewable Heat Incentive (RHI) scheme data[60] indicates that there are 62 accredited installations within Runnymede, all of which are small installations.

4.91 No further data was identified on use of woodfuel within the area, although there will be significant amounts used domestically in open fires, stoves and wood burners.

Results

Technical Potential of Forestry and Woodland Resource

4.92 To determine the potential for biomass generation from forestry and woodland, it was assumed that all woodland within the study area has a sustainable yield of two odt/ha/yr (oven-dried tonnes/ha/year)[61] and the assumptions within Appendix A were applied. Both the potential for heating and for combined heat and power were calculated.

4.93 To identify existing suitable woodland within the study area, the Forestry Commission's National Forest Inventory (NFI) was used. Only woodland categories that were considered to be mature[62] and able to provide a sustainable yield of woodfuel, and that were not protected ancient woodland or a biodiversity site, were considered (see Appendix A).

4.94 Figure 4.7 and Figure 4.8 shows the existing woodland opportunities and constraints to woodland exploitation for biomass considered within this assessment.

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[59] Department for Business, Energy and Industrial Strategy (2014, updated 2023) Renewable Energy Planning Database: quarterly extract [online] Available at: https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract

[60] Department for Business, Energy and Industrial Strategy (2022) RHI monthly deployment data: January 2022 [online] Available at: https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-january-2022

[61] Forestry Research (2021) Potential yields of biofuels per ha p.a. Available at: https://www.forestresearch.gov.uk/tools-and-resources/fthr/biomass-energy-resources/reference-biomass/facts-figures/potential-yields-of-biofuels-per-ha-pa/. Data for Wood (forestry residues, SRW, thinnings, etc.)

[62] Note that short rotation coppice has been considered separately as an energy crop below.

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Runnymede Borough Council

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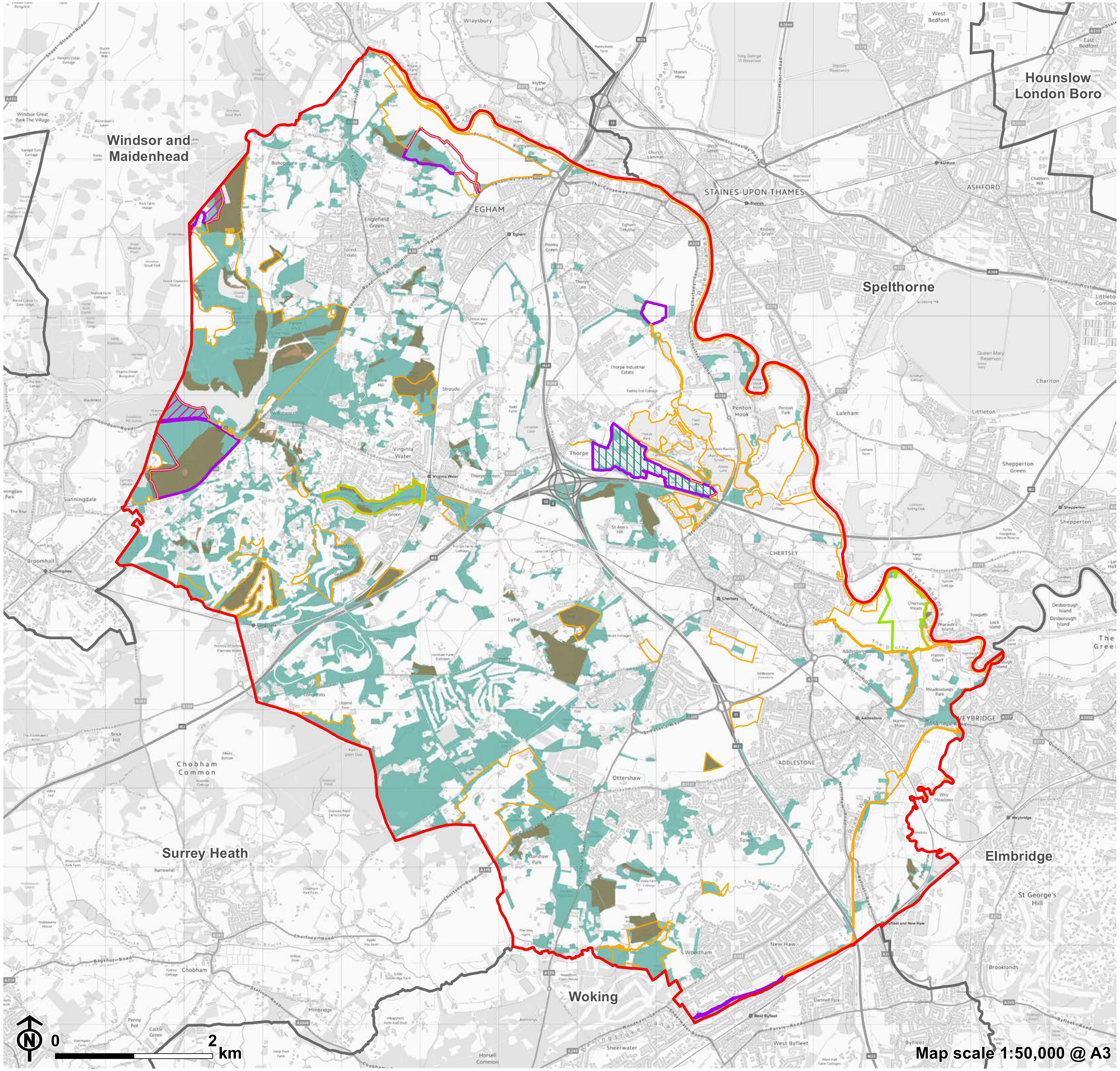
Figure 4.7: Opportunities and constraints: Biomass - Virgin Woodfuel - Forestry and Woodland (Natural Heritage Constraints)



Runnymede boundary

Neighbouring Local Authority

Opportunities

Woodland*

Constraints

Sites of Nature Conservation Importance

Local Nature Reserve

Sites of Special Scientific Interest

Special Protection Areas

Special Area of Conservation

RAMSAR

Ancient woodland

*Woodland is categorised by the National Forest Inventory as woodland over 0.5ha and includes the following categories:
- Broadleaved
- Conifer
- Coppice
- Coppice with standards
- Assumed woodland
- Mixed mainly conifer
- Mixed mainly broadleaved

CB:PS EB:kaczor_a LUC 12212_r0_Fig_4_7_r0_BiomassOppsConstraints_Forestry_Woodland_A3L 12/05/2023

Source:RBC, OS, NE, FC

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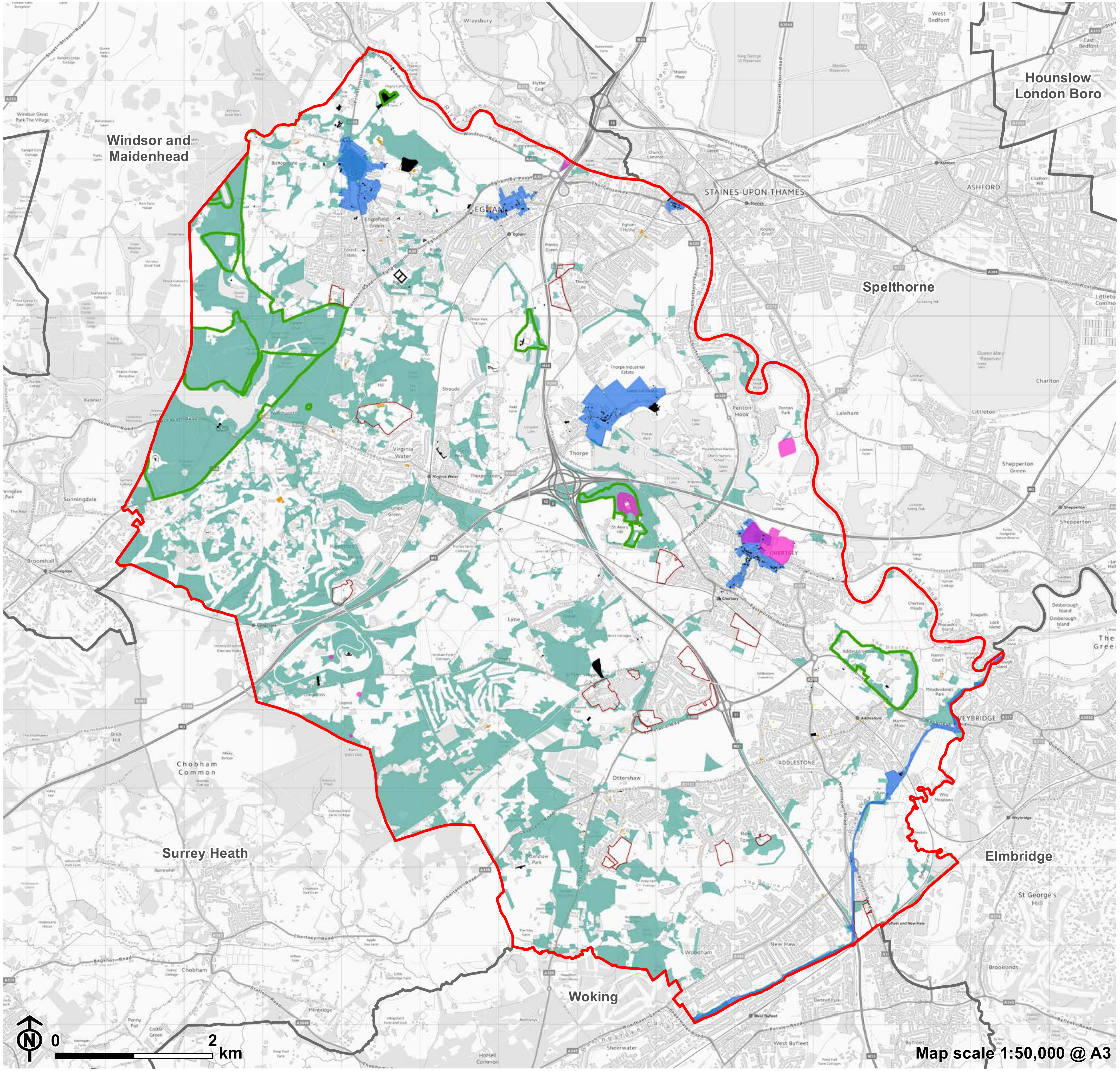
Runnymede Borough Council

Figure 4.8: Opportunities and constraints: Biomass - Virgin Woodfuel - Forestry and Woodland (Cultural Heritage and Planning Constraints)



Runnymede boundary
Neighbouring Local Authority

Opportunities

Woodland*

Constraints

Conservation Area
Registered Parks and Gardens
Locally Listed Heritage Asset
Locally Listed Building
Listed Building
Scheduled Monument
Housing/employment allocation

*Woodland is categorised by the National Forest Inventory as woodland over 0.5ha and includes the following categories:
- Broadleaved
- Conifer
- Coppice
- Coppice with standards
- Assumed woodland
- Mixed mainly conifer
- Mixed mainly broadleaved

CB:PS EB:kaczor_a LUC 12212_r0_Fig_4_8_r0_BiomassOppsConstraints_Forestry_Woodland_Cultural_Planning_A3L 12/05/2023

Source:RBC, OS, HE, FC

4.95 The calculated woodland and forestry biomass resource was calculated in line with the assumptions outlined in Appendix A. The technical potential findings are presented in Table 4.6, considering the biomass resource is used for heating only, and in Table 4.7 considering the biomass resource is used for heat and electricity generation via CHP. This only assumes the use of woodfuel from woodland within the Borough of Runnymede.

Table 4.6: Woodfuel: Assessment of forestry and woodland resource: use for heating only

Woodland type	Estimated Capacity (MW)	Delivered Heat (MWh/yr)	Potential CO2 Savings (tonnes/yr)
Total	1.75	7,971	1,682

Table 4.7: Woodfuel: Assessment of forestry and woodland resource – use for CHP

Woodland type	Estimated Capacity (MW)	Delivered Electricity (MWh/yr)	Delivered heat (MWh/yr)	Potential CO2 savings (tonnes/yr)
Total	1.75	3,106	5,176	1,515

4.96 In addition to the calculated potential woodland and forestry biomass resource within Runnymede, surplus woodfuel could potentially also be sourced from neighbouring authorities, provided the cost and transportation sustainability were viable. Furthermore, the cutting of hedgerows could additionally provide a source of woodfuel, however due to the lack of data regarding hedgerow yields, it has not been possible to factor this within the assessment. Woodfuel could be used from neighbouring areas, however, as stated above, this assessment only focuses on what technical potential there is for wood fuel grown within the Borough.

Technical Potential of Energy Crops

4.97 Miscanthus and Short Rotation Coppice (SRC) are the two main virgin woodfuel energy crops used within biomass and considered within this study. Such crops are commonly planted specifically to be used in the production of heat and electricity, whilst other 'biofuel' crops, including sugar cane, maize and oilseed rape, are more commonly planted to be used as transport fuels.

4.98 The benefits of Miscanthus cultivation relative to SRC are:

- It utilises existing machinery (SRC requires specialist equipment to be cultivated);
- It is higher yielding;
- It is annually harvested (SRC is harvested only once every three years); and
- It is a relatively dry fuel product when cut (SRC requires drying once cut, prior to use).

4.99 The benefits of SRC cultivation relative to Miscanthus are:

- It is easier and cheaper to establish;
- It is better for biodiversity; and
- It is suitable for a wider range of boilers.

4.100 Although both crops have similar lead in times of approximately four years until they are able to produce commercial harvests, Miscanthus will reach its peak yield in the fifth year and SRC in the seventh year, after its second rotation.

4.101 In order to protect the best and most versatile agricultural land for food crops, it was assumed that neither energy crop should be planted on Grade 1 or 2 agricultural land within Runnymede. It was assumed that both crops have the ability to successfully grow on Grade 3 and 4 agricultural land. It was also assumed the SRC has the potential to grow on Grade 5 agricultural land, however there is no Grade 5 land located within Runnymede. Cultural heritage, natural heritage and physical constraints were also considered to prevent the growing of the crops. The constraints to energy crop planting are presented in Figures 4.9 - 4.12 and the full assumptions considered within the assessment are outlined in Appendix A.

4.102 Table 4.8 presents the findings of the technical assessment, assuming that the energy crops would be used for heating only, and Table 4.9 presents the findings assuming that the energy crops were used to produce electricity and heat via CHP. A total area of 1,086ha was identified to have technical potential for energy crop growth. It is noted that this land use, and thus assessed technical potential, is mutually exclusive between Miscanthus and SRC, i.e. a single area of land can only be used to plant one crop.

Table 4.8: Woodfuel: Assessment of energy crops - use for heating only

Woodland Type	Estimated Capacity (MW)	Delivered Heat (MWh/yr)	Potential CO2 Savings (tonnes/yr)
Miscanthus	9	42,311	8,930
SRC	2	7,576	1,599
Total	11	49,887	10,529

Table 4.9: Woodfuel: Assessment of energy crops - use for CHP

Woodland Type	Estimated Capacity (MW)	Delivered Heat (MWh/yr)	Potential CO2 Savings (tonnes/yr)
Miscanthus	9	27,475	5,799
SRC	2	4,919	1,038
Total	11	32,394	6,837

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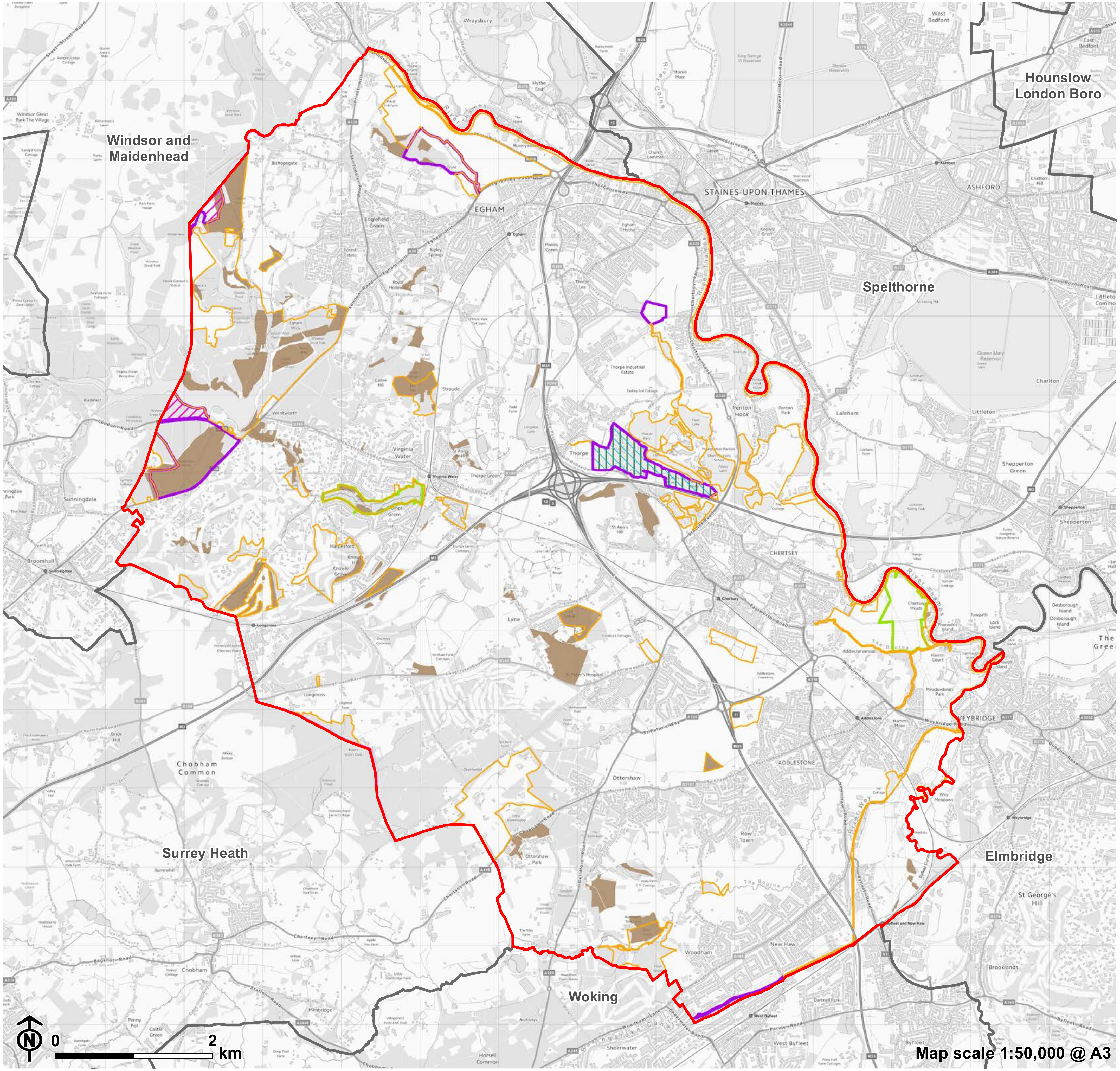
Figure 4.9: Constraints: Biomass - Virgin Woodfuel - Energy Crops (Natural Heritage Constraints)

Runnymede boundary
Neighbouring Local Authority
Sites of Nature Conservation Importance
Local Nature Reserve
Sites of Special Scientific Interest
Special Protection Area
Special Area of Conservation
RAMSAR
Ancient woodland



CB:PS EB:kaczor_a LUC 12212_r0_Fig_4_9_r0_BiomassConstraints_Naturalheritage_A3L 12/05/2023

Source: RBC, OS, NE

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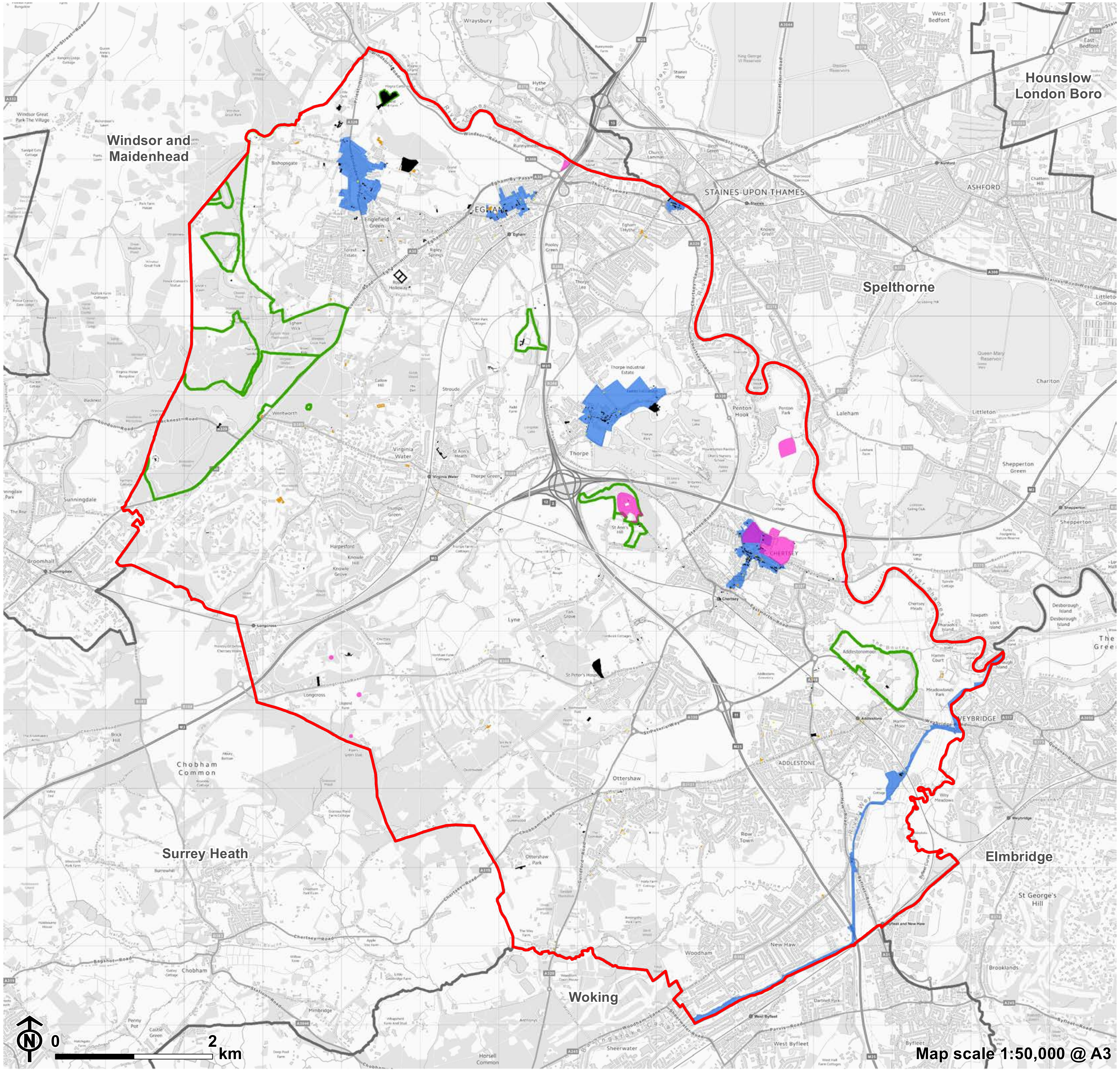
Figure 4.10: Constraints: Biomass - Virgin Woodfuel - Energy Crops (Cultural Heritage Constraints)



- Runnymede boundary
- Neighbouring Local Authority
- Conservation area
- Registered Parks and Gardens
- Locally Listed Heritage Asset
- Locally Listed Building
- Listed Building
- Scheduled Monument

CB:PS EB:kaczor_a LUC 12212_r0_Fig_4_10_r0_BiomassConstraints_CulturalHeritage_A3L 12/05/2023
Source:RBC, HE, OS

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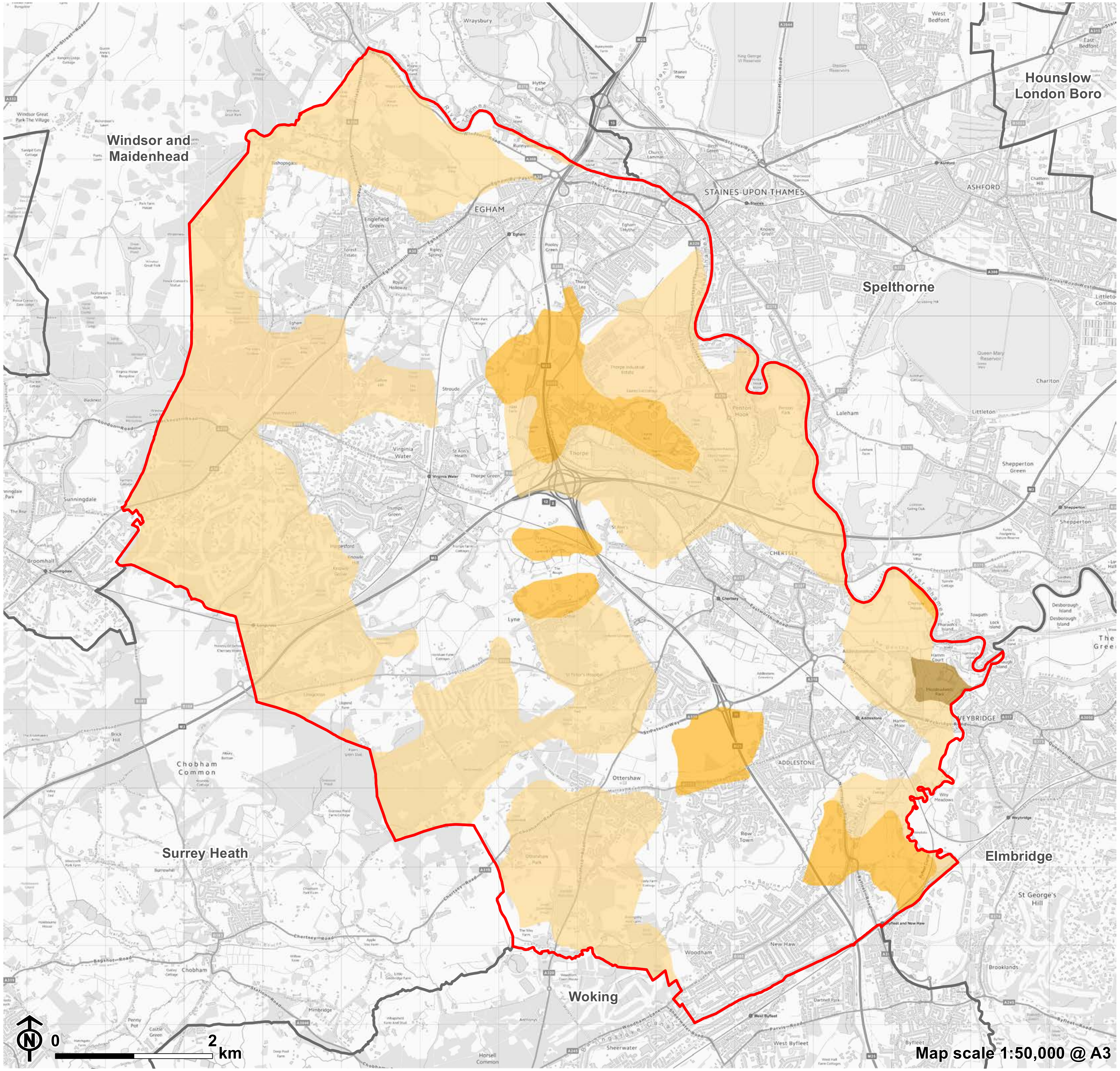
Runnymede Borough Council

Figure 4.11: Constraints: Biomass - Virgin Woodfuel - Energy Crops (Agricultural Constraints)

- Runnymede boundary
- Neighbouring Local Authority

Agricultural constraints

- Grade 1
- Grade 2
- Non Agricultural



CB:PS EB:kaczor_a LUC 12212_r0_Fig_4_11_r0_BiomassConstraints_Agri_A3L 12/05/2023

Source:RBC, NE, OS

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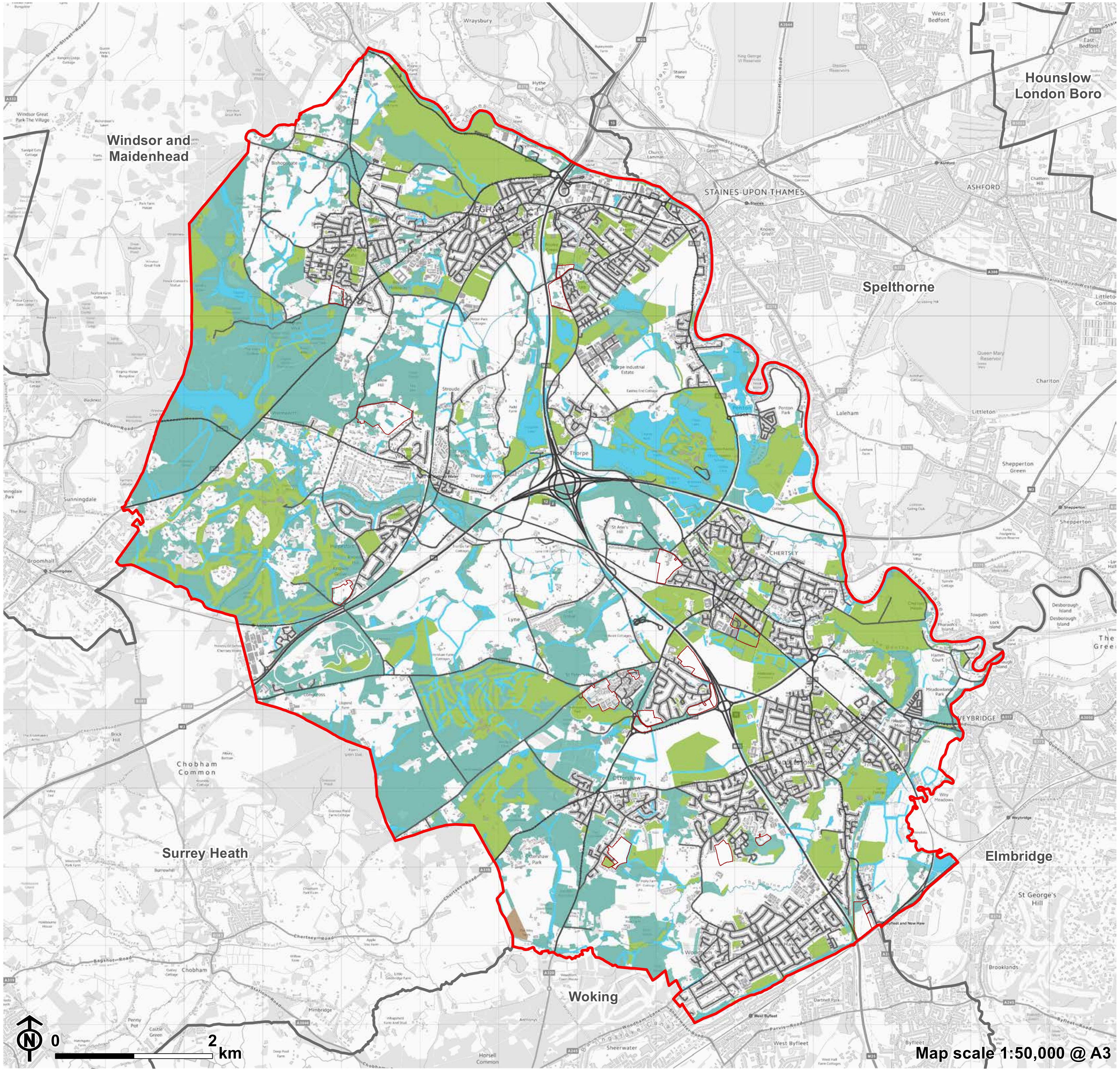
Figure 4.12: Constraints: Biomass - Virgin Woodfuel - Energy Crops (Physical Constraints)



CB:PS EB:kaczor_a LUC 12212_r0_Fig_4_12_r0_BiomassConstraints_Physical_A3L 12/05/2023
Source:NE, OS, RBC, FC

Issues affecting development

4.103 Constraints on the quantity of production of virgin woodfuel for biomass from forestry and woodland will depend on the quantity of woodland that can be actively managed and the incentives available for landowners to extract and process the woodfuel. At present, the demand for domestic log-burners dominates the virgin woodfuel market. The demand for woodchip stoves and pellet boilers is less than that for log-burners, however the economic viability of these installations is greater for off-gas properties, due to the higher costs of heating fuels such as oil and electricity, and due to the benefits offered by the Renewable Heat Incentive scheme. However, heat pump deployment is anticipated to significantly increase in the UK as the electricity grid decarbonises and the electrification of heat increases. The viability of biomass installations will need to compete with the costs of heat pumps, as well as additional constraints such as space for fuel storage, solid fuel flue regulations and maintenance requirements.

4.104 The deployment of energy crops, and to a lesser degree the management of woodland for woodfuel, will be influenced by:

- Economic viability;
- End-use/market;
- Land ownership;
- Existing farming activities;
- Potential biodiversity impacts;
- Protected landscapes; and
- The presence of water-stressed areas.

4.105 Notably, the conflict between land use for food production or for energy crops will require consideration with regards to the potential scale of energy crop potential within Runnymede. Additionally, since 2010, biomass energy costs per kWh have remained the same compared with other renewable energy technologies[63].

4.106 The availability of incentives for landowners and farmers to grow and harvest crops will impact energy crop production. Often longer-term supply contracts with end users will need to be arranged in advance. In addition, the establishment of supply-chains and logistics of fuel processing may initially limit the widespread uptake of energy crop resource. Other issues that may limit the exploitation of Runnymede energy crop resource include the requirement for an Environmental Impact Assessment (EIA) of energy crop projects, the planning and permitting of energy generating plants and the question of alternative markets for Miscanthus and SRC.

4.107 There is ambition at national level for biomass to play an important role in decarbonising the UK's energy generation. The Government's Clean Growth Strategy (2017) and the Committee on Climate Change's 'Net Zero – the UK's contribution to stopping global warming' report (201) both acknowledge the significant opportunities offered by biomass, notably if it is used in conjunction with carbon capture and storage technology to both sequester carbon from the atmosphere via plant growth and capture that subsequently released in bioenergy conversion processes. The Committee on Climate Change has also reviewed the carbon and wider sustainability impacts of biomass production and use and concluded that sustainable low-carbon bioenergy is possible, but that this can only be achieved in certain circumstances, if certain practices and criteria are applied[64].

4.108 Since the 1 60 s, agricultural subsidies under the EU's Common Agricultural Policy (CAP) have significantly shaped farming practices in the UK, including the extent to which bioenergy initiatives have been deployed. The UK's 25-year Environment Plan and phased exit from CAP-based subsidies now provide a new context for policies and strategies to scale up biomass production, not least by the Government's new Environmental Land Management (ELM) scheme which will pay farmers to deliver beneficial outcomes. There is one biomass fuel supplier within the boundaries of Runnymede, EnVar Composting in Chertsey at Trumps Farm. There are also three suppliers located approximately 10km from the Borough. The closest of which are:

- LC Energy Ltd, The Vineyard Nursery;
- LC Energy Ltd, Swinley Depot; and,
- The Crown Estate, Crown Estate Biomass Depot[65].

Energy from Waste

Description of Technology

4.109 Generally referred to as 'Energy from Waste', this technology involves extracting energy using a process undertaken on the non-recyclable residual elements of waste stream. Solid dry materials can be processed into Refuse-Derived Fuel (RDF) and are usually incinerated to produce heat and/or electricity. A proportion of this fuel (usually up to 50% of the residual waste prior to being processed) could be considered as 'renewable' depending on its organic, non-fossil

[63] 3keel (2022) Biomass for energy [online] Available at: https://www.rspb.org.uk/globalassets/downloads/pa-documents/bioenergy/rspb_biomass-for-energy_3keel_report_may-22.pdf

[64] Committee on Climate Change (2018) Biomass in a low carbon economy, p.12, Box 2

[65] Biomass Suppliers List (undated) UK Government [online] Available at: https://www.biomass-suppliers-list.service.gov.uk/find-a-fuel/

fuel content, for example as set out by Ofgem for the purposes of the Renewables Obligation[66]. However, the RDF itself remains a significant source of carbon emissions, particularly from the plastic content of the waste stream, so there is some debate whether it should be classed as a renewable or even a partially renewable fuel. Residual waste arisings should therefore be minimised at source as far as possible in order to reduce their impact on emissions.

4.110 Another form of energy from waste technology uses anaerobic digestion to process food waste. One of the by-products of the process is biogas which is then either combusted to generate electricity or processed into biomethane and injected directly into the gas grid.

Existing Development within Runnymede

4.111 In 2020, Surrey County Council published their waste strategy, Surrey Waste Local Plan 2019-2033[67], which focuses on waste services within Surrey and seeks to further develop the services offered, as well as improve waste minimisation, reuse, recycling, and composting. Surrey developed the Surrey Waste Partnership[68], a collaboration of the 11 District and Borough councils within the authority's boundaries, including Runnymede. The 11 district and borough councils are waste collection authorities and are responsible for the collection of Surrey's municipal waste which includes waste from households. The County Council is the waste disposal authority and is responsible for the disposal and treatment of Surrey's municipal waste collected at the kerbside and waste and recycling from Surrey's community recycling centres.

4.112 The Waste Local Plan has several strategic ambitions including:

- 50% recycling of household waste by 2020.
- 65% recycling of municipal waste by 2035 (in line with EU CE package).
- 10% (or less) of municipal waste to landfill by 2035 (in line with EU CE package).
- Eliminate all food waste to landfill by 2030.
- All plastic packaging to be cyclable, reusable or compostable by 2025.
- 75% recycling of packaging by 2030.

4.113 In 2017, only a small proportion of waste (6%) was sent to landfill while 94% was recycled, composted or recovered. Regarding Commercial and Industrial Waste, 30% was sent to landfill compared to 62% which was reused and recycled and 58% of Construction, Demolition and Excavation waste was recycled.

Results

Technical Potential

4.114 Runnymede's technical resource for municipal and commercial waste, as a sustainable energy generating technology, is directly related to the amount of residual waste that is generated and collected within the Borough, and whether all this can be treated using energy recovery processes. This is complicated by the fact that waste disposal is dealt with at County level and there is only one energy recovery treatment plant which is located outside of the Borough, in Spelthorne (Charlton Lane Eco Park). At the time of writing detailed data on commercial waste arisings in Runnymede had not been identified.

Issues Affecting Deployment

4.115 As discussed above, 'deployment' of this technology is related to levels of residual waste arisings within the Borough and County. These levels are likely to decrease in the future as waste minimisation and recycling initiatives increase to comply with tightening regulations. Additionally, biomaterials (e.g., wood products, pulp, paper, fibre, etc) are a key input to several sectors of the economy – and are likely to increase in importance. Given that competition for renewable materials is likely to increase in the coming decades, it will become increasingly essential to prioritise the recycling and reuse of biomaterials – and not for energy recovery.

Landfill Gas

Description of Technology

4.116 Landfill gas is a natural byproduct of the decomposition of organic material in landfills. Landfill gas is composed of roughly 50 percent methane (the primary component of natural gas), 50 percent carbon dioxide (CO_2) and a small amount of non-methane organic compounds. Instead of escaping into the air, landfill gas can be captured, converted, and used as a renewable energy resource.

[66] See: Renewables Obligation: Fuel Measurement and Sampling; Ofgem e-serve; 2016; p40
[67] Surrey Waste Local Plan (2020) Surrey County Council [online] Available at: https://www.surreycc.gov.uk/land-planning-and-development/minerals-and-waste/waste-plan
[68] SEP 2025. Available at: https://www.surreyep.org.uk/wp-content/uploads/2023/01/sep25_report_final.pdf

Existing Development within Runnymede

4.117 BEIS[69] data indicates there are three operational landfill gas developments, totalling 9.6MW, within Runnymede.

Results

Technical Potential

4.118 It is assumed that the large majority of opportunities for gas obtained from landfill in Runnymede have already been developed, although it has not been possible to quantify amount or the energy produced.

Issues Affecting Development

4.119 As discussed above, 'deployment' of this technology is related to levels of residual waste arisings that are sent to landfill within the Borough. These levels are likely to decrease in the future as waste minimisation and recycling initiatives increase to comply with tightening regulations. As a result, it is unlikely that landfill gas has much potential beyond current utilisation levels for the Borough.

Waste Residues – Agricultural Residues

Description of Technology

4.120 Agricultural waste also represents a potential renewable energy resource, particularly from using livestock slurry as a feedstock for the anaerobic digestion (AD) process. This describes the process by which organic matter is broken down by microbes in the absence of oxygen to produce methane-based biogas for heat and/or power generation, and a liquid or solid digestate residue, which can often safely be used as a fertiliser.

4.121 Biogas generation from the anaerobic digestion of sewage is also classed as a renewable form of energy, with most large plant generating heat and/or electricity for the site's own needs and exporting excess power to the local grid. Biogas can also be upgraded to biomethane and injected directly into the gas grid. Heat recovery systems can also be used with sewage or wastewater infrastructure to provide heat to local users, although this application is not yet widespread.

Existing Development within Runnymede

4.122 According to Surrey County Council's Annual Monitoring Report[70] there is one operational anaerobic digestion development at Trumps Farm, operated by Severn Trent Green Power Limited, totalling 4.78MW, within Runnymede.

Results

Technical Potential

4.123 Although Runnymede is not predominantly rural, agricultural waste is still a potential renewable energy resource, particularly from using livestock slurry as a feedstock for the anaerobic digestion process. Using estimates from Defra statistics on animal numbers for 2022[71] and resulting slurry and biogas yields, an estimate has been made of the potential emissions savings.

4.124 The calculated biogas from agricultural residues was calculated in line with the assumptions outlined in Appendix A. The technical potential findings are presented in Table 4.10, considering the biomass resource is used for electricity, and in Table 4.11 considering the biomass resource is used for heat.

Table 4.10: Biomass: Assessment of slurry – use for electricity only

Livestock	Estimated Capacity (MW)	Delivered electricity (MWh/yr)	Potential CO2 Savings (tonnes/yr)
Cattle	0	220	30
Pigs	-	-	-
Poultry	0	1	0
Total	**0**	**221**	**30**

Table 4.11: Biomass: Assessment of slurry - use for heating only

Livestock	Estimated Capacity (MW)	Delivered heat (MWh/yr)	Potential CO2 Savings (tonnes/yr)
Cattle	0	367	77

[69] BEIS (2023) Renewable Energy Planning Database: quarterly extract - January 2023. Available at: https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract.
[70] Surrey County Council (2023) Planning Service Annual Monitoring Report 2020 to 2021. Available at: https://www.surreycc.gov.uk/land-planning-and-development/minerals-and-waste/performance-monitoring/annual-monitoring-report-2020-to-2021#section-10
[71] Defra (2023) Structure of the agricultural industry in England and the UK at June. Available at: https://www.gov.uk/government/statistical-data-sets/structure-of-the-agricultural-industry-in-england-and-the-uk-at-june

Livestock	Estimated Capacity (MW)	Delivered heat (MWh/yr)	Potential CO2 Savings (tonnes/yr)
Pigs	-	-	-
Poultry	0	2	1
Total	**0**	**369**	**78**

Issues Affecting Development

4.125 Larger AD (or biomass) plants can also cause landscape impacts, with the presence of features such as storage tanks, lighting and ground disturbances having the potential to impact the landscape of the site itself and the landscape character of the surrounding area. The presence of the storage tanks and industrial buildings within AD plants could also impact views from key viewpoints and settlements, and multiple AD plants could have cumulative impacts on landscape character.

Hydropower

Description of Technology

4.126 The generation of energy via hydropower involves using water flowing from a higher to a lower level to power a turbine that is connected to an electrical generator. The resultant energy generation is therefore directly proportional to the height difference (the head) of the water flowing and the volume of water flowing.

4.127 Hydropower is a proven well-established technology. There are few technological constraints to its use, with the exception of ensuring:

- The water course has sufficient flow rates and heads (height difference) throughout the year;
- The electricity generates can be transmitted to the end user; and
- The site is accessible and can accommodate the required equipment.

4.128 Based on these few constraints, the energy yields of potential installations can be accurately estimated and the economic viability of installations determined relatively easily.

4.129 However, due to the environmental constraints on large-scale multi-MW installations, the most potential for hydropower exists mainly from small or micro-scale schemes. In the UK, micro scale (typically under 100 kW) hydropower installations can include schemes that provide power to individual homes, whilst small-scale schemes can reach up to a few hundred kW in size and export electricity directly to the grid. These small schemes commonly incorporate dams, weirs, leats, turbine houses and power lines, which have the potential to visually impact the landscape. However, suitable siting and design of these installations can commonly mitigate these impacts. For 'low head run of river' developments, typically for schemes located in lowland areas, these can often be located on the site of old mills and utilise existing channel systems and weirs or dams. In comparison, in 'high head run of river' schemes, that are typically found in upland steeper areas, the water flow is often diverted via enclosed penstocks (pipelines) to the turbines.

4.130 In addition to potential landscape and visual impacts, impacts on hydrology and river ecology require consideration in determining the suitability of sites for hydropower developments. For example, aquatic plants may impact the performance of a hydropower scheme by impacting the water flows and waterfalls. Moreover, river fish populations may be sensitive to changes in water flows, as well as risk physical harm from the hydropower equipment installed. However, mitigation measures including the incorporation of 'fish passes' are often included within schemes to limit such impacts.

4.131 Potential impacts of hydropower developments upon the status indicators of a water body, as set out in the Water Framework Directive, may require abstraction licences, discharge permits and flood defence consent from the Environment Agency. As well as the assessment of potential impacts from individual hydropower installations upon waterways, the cumulative impacts of hydropower and any other water abstraction activities along a waterway on the protected rights of other river users will require assessment. Moreover, as permissions on use of waterways for hydropower are commonly issued with a time limit on the permitted abstraction period, this must also be considered. Unless such time periods are sufficiently long, the long-term viability of hydropower developments may be at risk if these permissions are not renewed in the future.

Existing Development within Runnymede Borough Council

4.132 FiT[72] data indicates that there are currently no known hydropower installations located within Runnymede.

[72] Department for Business, Energy and Industrial Strategy (2013, updated 2020) Sub-regional Feed-in Tariffs statistics [online] Available at:https://www.gov.uk/government/statistical-data-sets/sub-regional-feed-in-tariffs-confirmed-on-the-cfr-statistics

Results

Technical Potential

4.133 It has not been possible within the scope of this study to undertake a new assessment of the potential hydropower resource within Runnymede. However, in 2010 the Environment Agency published the findings of a study identifying hydropower opportunities within England and Wales[73]. This was produced to provide an overview at national and regional scales of the potential hydropower opportunities available, as well as the relative environmental sensitivity of identified potential sites to development. It is noted that this data is indicative and that further site-specific study would be required in order to determine the technical potential and suitability of sites for hydropower developments.

4.134 The study included identifying 'heavily modified water bodies' that are identified as being at significant risk of failing to achieve good ecological status because of modifications to their hydromorphological characteristics resulting from past engineering works, including impounding works. Due to these characteristics, such waterbodies were identified as having the potential to create hydropower barriers that would also be beneficial to the passage of fish upstream. These were overlayed with identified locations where suitable yearly flow characteristics are present and could feasibly support hydropower sites. The resultant identified sites were classified as 'win-win' opportunities where hydropower developments could potentially be installed whilst also improving the ecological status of waterways.

4.135 Figure 4.13 shows the win-win locations that were identified within Runnymede. The data shows that six sites were identified within Runnymede, which have the potential to support a total of 931.97 kW of hydropower installations. Using the capacity factor of 38.2% for the UK[74], it is calculated that this could provide 3,118 MWh of electricity per year and provide carbon savings of 424 tonnes of CO2 per year. Further site-specific study would, however, be required to determine more accurately the suitability and technical potential of each site.

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

[74] BEIS (2022) Quarterly and annual load factors. Available at: https://www.gov.uk/government/publications/quarterly-and-annual-load-factors. The average of all the available load factors was used.

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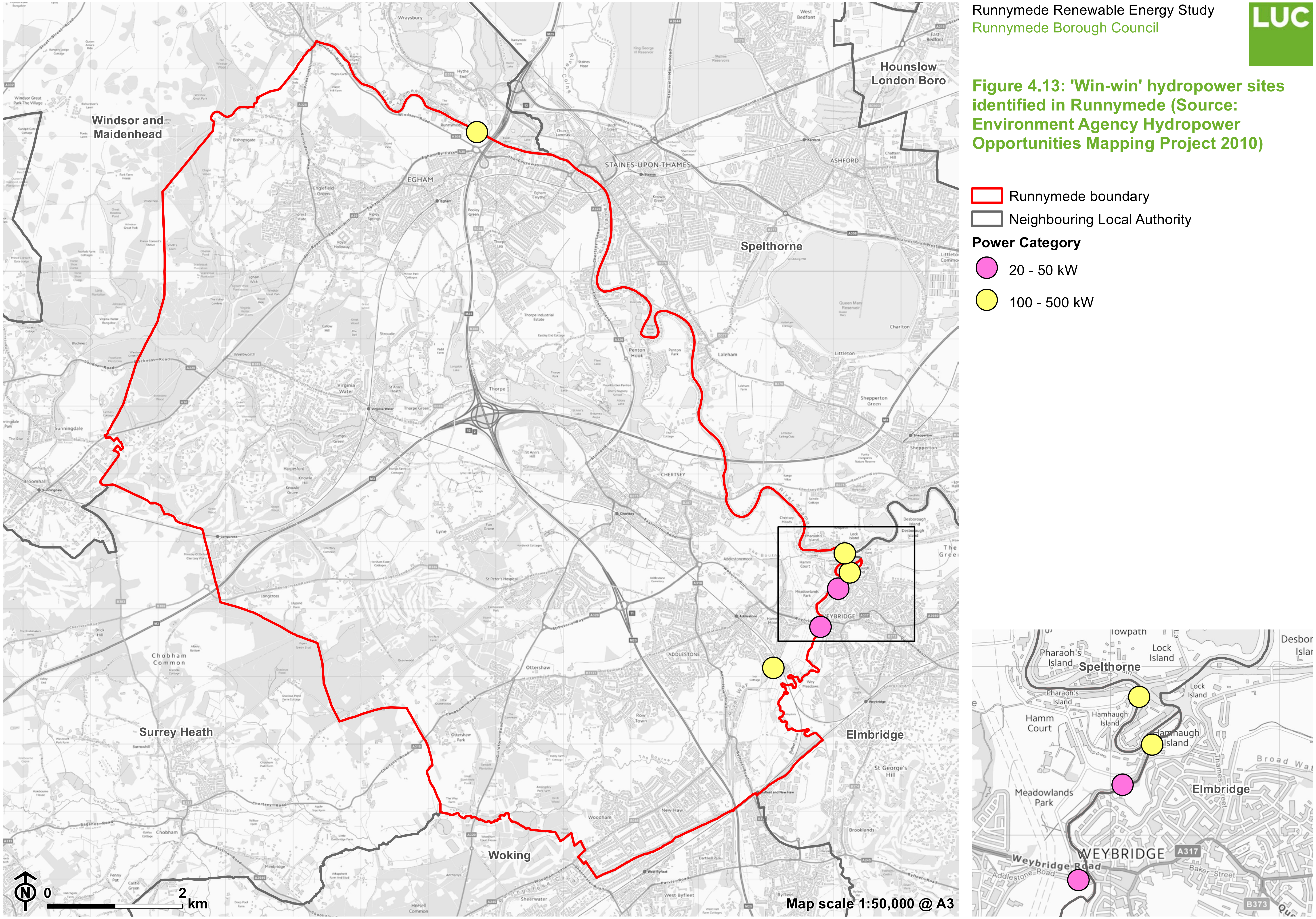
Runnymede Borough Council

Figure 4.13: 'Win-win' hydropower sites identified in Runnymede (Source: Environment Agency Hydropower Opportunities Mapping Project 2010)



CB:PS EB:kaczor_a LUC 12212_r0_Fig_4_13_PotentialHydroPowerSites_A3L 12/05/2023
Source: OS, EA

Heat Pumps

Description of Technology

Air Source Heat Pumps

4.136 Almost any building theoretically has the potential for an air source heat pump to be installed. Therefore, the assessment considered the potential for air source heat pumps to be delivered in all buildings.

4.137 Data to be used for assessment of air source heat pump potential:

- System Size:
  - Average size of solar PV systems, derived from the Renewable Heat Incentive (RHI) Register (commercial and residential).
  - Capacity factor derived from national BEIS data.
- Heating fuel assumed to be offset:
  - Seasonal Performance Factor (heat pump efficiency) derived from BEIS RHI data.
  - The actual proportions of electricity and oil usage by off-gas properties is unknown. As such, an illustrative 50% or these properties are estimated to be fuelled by electricity and 50% by oil for the purposes of this study.

Figure 4.14: Air source heat pump potential capacity and savings for domestic and non-domestic

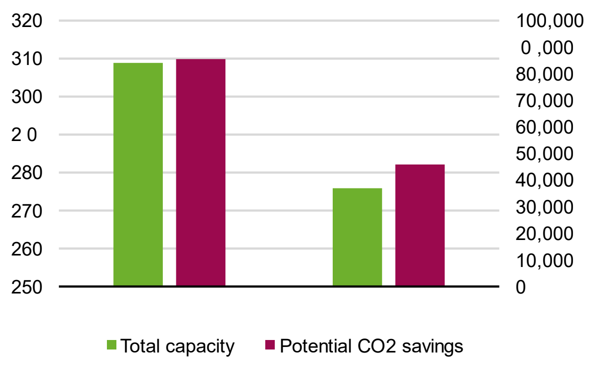


Table 4.12: Assessment of air source heat pumps

Building category	Estimated capacity (MW)	Delivered Heat (MWh/yr)	Potential CO2 Savings (tonnes/yr)
Domestic	309	498,123	105,130
Non-domestic	276	444,812	93,879
Total	**585**	**942,935**	**199,009**

Ground Source Heat Pumps

4.138 Ground source heat pumps require more space than air source, requiring pipes to be buried vertically in a deeper system or horizontally in a shallow wider system. Due to these significant space constraints, this study did not estimate the potential capacity of ground source heat pumps across the study area, as it was not possible to estimate how many properties have access to the required space.

4.139 Average system sizes of domestic pumps were derived however from BEIS data.

Open Loop Ground Source Heat Pumps

4.140 The British Geological Survey has produced a map identifying the potential viability of open-loop ground source heat pumps across England and Wales, considering hydrogeological and economic factors[75]. This indicates that land within Runnymede is favourable for open-loop ground source heat pumps.

4.141 However, the British Geological Survey states that this is an initial screening assessment only and that identified areas favourable for open-loop systems are not automatically suitable for this technology to be installed. Instead, detailed environmental assessments of proposed sites would be required, considering local variations in environmental conditions and factors such as the availability of water (i.e. the amount of water that is available for licensing by the Environment Agency) and discharge of water from a scheme[76]. With the limited data available, it is therefore not possible to determine the potential annual energy generation and carbon savings that could be produced by open loop ground source heat pumps within Runnymede.

[75] British Geological Survey (2021) Open-loop ground source heat pump viability screening map [online] Available at: https://www.bgs.ac.uk/technologies/web-map-services-wms/open-loop-ground-source-heat-pump-viability-screening-map-wms/

[76] British Geological Survey (2012) Open-loop GSHP screening tool (England and Wales) [online] Available at: https://www.bgs.ac.uk/geology-projects/geothermal-energy/open-loop-gshp-screening-tool/

Water Source Heat Pump

4.142 The DECC 2014 water source heat map identified, at a high level, opportunities for water source heat pump technologies[77]. Less is known about the potential for water source heat pumps. In the right locations, they have been shown to have the potential to provide efficient low carbon heating or cooling at scale as long as the buildings to be served are in close vicinity, as demonstrated by the Kingston Heights installation by the River Thames[78]. This incorporates a 2.3MW water source heat pump for space and water heating of a mixed development. In addition, the Grade I listed house Kelmarsh Hall installed a water source heat pump to obtain heat from the estate's lake and reduce the site's carbon footprint by 50%[79].

4.143 Although it has not been possible within the scope of this study to assess the potential for water source heat pumps, the sensitivity analysis included in the 2014 DECC water source heat map[80] identified the River Thames as having a heat capacity of 334 MW. Viability would largely depend on having a sufficiently high heat demand local to the potential heat pump location.

Geothermal

4.144 Geothermal energy technologies differ from ground source heat pump technologies. Instead of a shallower system, geothermal energy extracts heat from geothermal boreholes that can extend multiple kilometres downwards beneath the ground. Water or steam that has been heated by geothermal activity can be used directly to extract heat or used to generate electricity in locations where there are higher temperatures. Heat can be a by-product from these electric generation systems, such as the Southampton District Energy Scheme in Southampton which utilises heat from a geothermal aquifer[81]. In locations where there are lower temperatures, heat only or combined heat and power systems are more suited.

4.145 At present, geothermal energy is used in a limited number of locations around the UK; predominantly within Cornwall and the Lake District/Weardale where the highest heat flows within the UK are present. BEIS data indicates that there are no geothermal installations within Runnymede and, with the data available, it is not possible to determine the potential annual energy generation and carbon savings that could be produced by geothermal energy within the area. To investigate localised potential for geothermal energy generation, specialist surveys would need to be undertaken. However, before pursuing this it is recommended that the Council monitors the progress of this technology in other locations in order to understand the potential technical and economic viability of geothermal generation and how this is applicable to Runnymede.

Issues affecting deployment

4.146 Further to the information provided above on issues affecting deployment, such as grid capacity, planning issues and economic viability, below sets out further information regarding the current situation surrounding grid capacity and energy storage.

Grid Capacity

4.147 The ability to connect to the electricity grid can be a limiting factor in the deployment of all larger energy developments where the energy generated is to be exported.

Overview of the Network

4.148 The UK distribution network was designed for a 'top down' flow of electricity, from small numbers of very large power stations. The increasing deployment of distributed generation is causing new challenges for the electricity network, with ever-larger areas of the network reaching maximum capacity. In these areas, the grid is no longer able to accept new grid connections for supply of power.

4.149 The near term opportunities for new renewable energy deployment presented by the distribution network are therefore limited to areas where there is capacity still available, or an existing connection which isn't being fully utilised. Such sites offer the opportunity to host additional generating capacity without the need for a new grid connection. Identifying such sites within Runnymede will require engagement with site operators and/or Scottish & Southern Electricity Networks (SSEN) and UK Power Networks - the Distribution Network Operators (DNO). Additionally, DNOs regularly upgrade the network to create extra capacity, which can be applied for in advance, even

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[77] DECC (2015) National Heat Map: Water source heat map layer. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/416660/water_source_heat_map.PDF
[78] CIBSE (2014) CIBSE Case Study Kingston Heights [online] Available at: https://www.designingbuildings.co.uk/wiki/CIBSE_Case_Study_Kingston_Heights
[79] Kelmarsh Hall & Gardens (2012) A Green Solution to Heating a Country House [online] Available at: https://kelmarsh.com/
[80] Department of Energy and Climate Change (2015) National Heat Map: Water source heat map layer [pdf] Available at:https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/416660/water_source_heat_map.PDF
[81] EQUANS (undated) Southampton District Energy Scheme [online] Available at: https://www.equans.co.uk/sites/g/files/tkmtob116/files/2022-01/EQUANS_Case%20Study-Southampton%20District%20Energy.pdf

when these upgrades take years to come online. It is therefore worth periodically checking with the DNO on capacity at a specific site of interest.

4.150 SSEN maintains a generation availability map on their website[82], which provides an "indication of the network's capability to connect large-scale developments to Major Substations." Connections to substations are classified to be either red (constrained), amber (partially constrained) or green (unconstrained). However, it notes that:

- "Connections to the substations with an overall RED classification are still possible, however there might be a requirement for significant network reinforcement to overcome the impact on the network constraints.
- Connections to the substations with an overall GREEN classification may still not be possible, because of up-stream requirement for significant network reinforcement to overcome the impact on the network constraints."
- The map can be viewed on the SSEN website at ssen.co.uk/generation availability.

4.151 The present capacity of the network to accept new generation appears partially constrained across the Borough.

Energy Storage and Demand Side Response

4.152 Energy storage technology, particularly batteries, has advanced considerably in recent years and is well placed to help alleviate the constraints that currently limit connections to the grid. By co-locating battery storage with renewable energy developments, developers can store excess power and sell during high demand. This also helps keep the grid 'in balance', can reduce voltage peaks and fluctuations, overheating and faults on the network and thus help to release capacity on the network for more renewable distributed generation. Detailed modelling is required to assess financial viability of investment in batteries, but initial attractiveness can be tested via engagement with SSEN to determine whether the generation site sits in an area which has significant network constraints.

4.153 At the domestic level, smart control systems are now available, which integrate onsite generation such as rooftop solar PV with battery storage, and optimise loads and power exports to the financial benefit of the occupant. Electric vehicles are also expected to integrate with such systems, potentially providing a significant amount of extra plug-in storage capacity.

4.154 Similar to storage, albeit 'one-way' only, provision of Demand Side Response (DSR) capacity can help relieve grid constraints by businesses reducing power demand during times of high demand, and switching back on when such peaks are over. Again, this helps keep the grid 'in balance' and release capacity on the network for more renewable distributed generation. Businesses which represent most potential for provision of DSR, such as large commercial or industrial sites, can be identified in areas with known grid constraints and options considered. Typically, such sites should be able to provide a minimum 'downturn' of power of 50 kW to represent commercially viable opportunities.

Conclusions

4.155 The technical potential assessment has shown that the greatest potential lies in the opportunity to use the power of the sun in the form of ground mounted solar PV and rooftop solar PV. If the council were to utilise 100% of the ground mounted solar potential 112,959 tonnes of CO2 would be saved each year. Furthermore, for heating, air source heat pumps have the most potential and could provide CO2 savings of 131, 863 tonnes per year. In contrast onshore wind has the least potential within Runnymede, with no potential for very large or large turbines, due to the constrained nature of the borough. As discussed above, when deploying the above renewable technologies, issues affecting deployment, such as grid capacity, energy storage, planning issues and economic viability must be factored in.

[82] SSEN (2023) Generation Availability Map [online] Available at: https://network-maps.ssen.co.uk/opendataportal

Chapter 5
Potential for District Heating Networks

Introduction

5.1 District heating is a technology which uses one heat source to provide heat to more than one building. Instead of each property having its own heating system separate from any other property, a group of buildings connected to a district heating network all receive heat (in the form of hot water or steam) from a central source (energy centre), via a network of insulated flow and return pipes. This can be more beneficial than each property having its own heating system because heat generation can be more efficient at larger scales, and the heat source can be replaced with new zero carbon technologies as they become available in the future with minimal disruption to the end-user. The term ‘communal heating’ differs from district heating in that the heat source in communal heating supplies heat to two or more customers within the same building.

5.2 It has been estimated that in considering their economic potential, heat networks could provide 20% of the UK’s total heat demand[83] compared to the current 2% supplied by existing networks. The Committee on Climate Change’s core Net Zero scenario suggests that around 5 million homes across the UK will need to be connected to heat networks by 2050. In this context, the Government’s Clean Growth Strategy suggests that around one in five buildings will have the potential to access a largely low carbon district heat network by 2050.

5.3 In October 2021 the Government launched a consultation to seek views on their proposed approach to identifying areas in England where heat networks may offer the most appropriate solution for decarbonising heating. In responding to the consultation findings, the Government has stated their intention to "*proceed with the key elements of the proposed framework including:*

- *developing a nationwide methodology for identifying and designating areas as heat network zones, within which heat networks are the lowest cost solution for decarbonising heat.*
- *establishing a new zoning coordinator role, which we generally expect would be fulfilled by local government,*

[83] Opportunity areas for district heating networks in the UK: second National Comprehensive Assessment (BEIS Sept 2021)

with responsibility for designating areas as heat network zones and enforcing requirements within them.

- *requiring heat networks developed in zones to meet a low carbon requirement, and for certain buildings and heat sources within zones to connect to a heat network within a specific timeframe.*"[84]

5.4 In 2023, CSE's social research report was published exploring how heat network zoning policy could be developed and implemented[85]. The research engaged with several stakeholders including local authorities. The workshop findings suggest local authorities see themselves playing a strategic role in planning and overseeing heat network zoning, whilst also raising concerns about insufficient capacity within the public sector to deliver against the scale of the challenge.

5.5 Heat networks are fuel-agnostic, meaning that in theory they can be heated by systems using any fuel or technology. For example, systems can include gas-fired boilers, Combined Heat and Power (CHP), use of waste or recycled heat (such as energy from waste or from industrial processes) or use of ambient heat via heat pumps. CHP is relatively common in the UK, including both gas-fired and a small number of biomass fuelled systems. This produces heat (sometimes with cooling, often referred to as trigeneration) and electricity, so with a CHP district heating system, as well as a network of pipes distributing heat (or cooling), there may also be a grid connection or network of wires ('private wire') to distribute electricity to one or more local users.

5.6 Third generation networks supply heat at around 90-60°C with return temperatures at 50-40°C and can supply domestic hot water directly. Fourth and fifth generation networks operate at much lower temperatures, compared to the third generation (CHP or boiler supplied). These may use boosters to supply domestic hot water.

5.7 To achieve national net zero targets, heat networks that are now being fuelled by fossil fuels will need to be switched to low or zero carbon energy sources in the future. Thermal stores are increasingly used in heat network systems to provide flexibility by balancing demand swings and maintaining supply during short outages. These are typically large, insulated tanks of water that can store excess heat from generation (of electricity via CHP) at periods of low heat demand and supply heat at periods of high demand.

Viability of District Heating

5.8 A large part of the cost of developing a district heating network is laying pipes, due to the need to excavate roads or other land, which is expensive. An energy centre, which houses the heat source, also needs to be established; this could be located within one of the buildings being served by the network or it could be in its own separate building. Overall costs vary depending on the type of energy centre and source of heat, number and type of buildings connected, ground types through which piping is run and the total length of the network. It is usually cheaper to provide heat networks for new development than for existing development because pipes can be laid at the same time as other infrastructure when roads are built. In this way, new developments often act as a trigger for a wider network which can also serve existing heat demands from buildings in the vicinity and potentially improve overall economic viability.

5.9 Energy centres for most existing district heating systems are based on gas-fired boilers or CHP due to the relatively low cost of gas over recent years. However, with strict carbon emission targets and regulations now in place regarding energy supplies to new development, and the increase in global gas prices, the viability of using gas has dramatically reduced. The focus has now switched to using low or zero carbon technologies such as heat pumps which use ambient heat from the ground, air or bodies of water, and the use of waste heat such as that generated from industrial processes. The viability of applying these technologies at scale has yet to be fully established, although in areas where waste heat is available, generation costs will be minimised.

5.10 Heat networks are most suited to dense clusters of buildings having high heat demands and will benefit from supplying a mix of heating requirements which result in a more even and consistent demand supply profile. For example, a mix of industrial, commercial and domestic buildings will tend to even out the demand across a 24-hour period and make it less 'peaky'. Buildings which have continuous predictable demands ('anchor' loads) and are more likely to sign up for long term supplies of heat, such as those in the public sector, can also be beneficial to overall viability.

5.11 Properties connected to a district heating network normally pay the heating network operator for units of heat delivered. Therefore, the economics of a district heating system are largely dependent on the amount of heat provided per metre of pipe, known as the linear heat density; the higher the amount of heat delivered per metre of pipe, the better. Linear heat density is often used as a critical parameter in heat distribution economics, but this can only be calculated at the stage when a network route has been defined.

5.12 Heat networks are often developed in phases, which impacts both technical and financial viability, and may for example factor in future additional low or zero carbon energy

[84] www.gov.uk/government/consultations/proposals-for-heat-network-zoning

[85] https://www.gov.uk/government/publications/heat-network-zoning-social-research

centres or generation capacity to align with the completion of phased new development and to satisfy a required trajectory of emission reduction targets.

5.13 As a proxy for linear heat density, spatial heat demand density (along with other factors) can be used to find parts of the study area most likely to contain high concentrations of heat demand by means of an 'overlay analysis' which can then be investigated in more detail. Spatial demand density is the amount of heat demand per unit area (for example, per square metre). This type of heat mapping can be considered as the first step in identifying district-wide opportunities for heat networks and has been applied to Runnymede as described below.

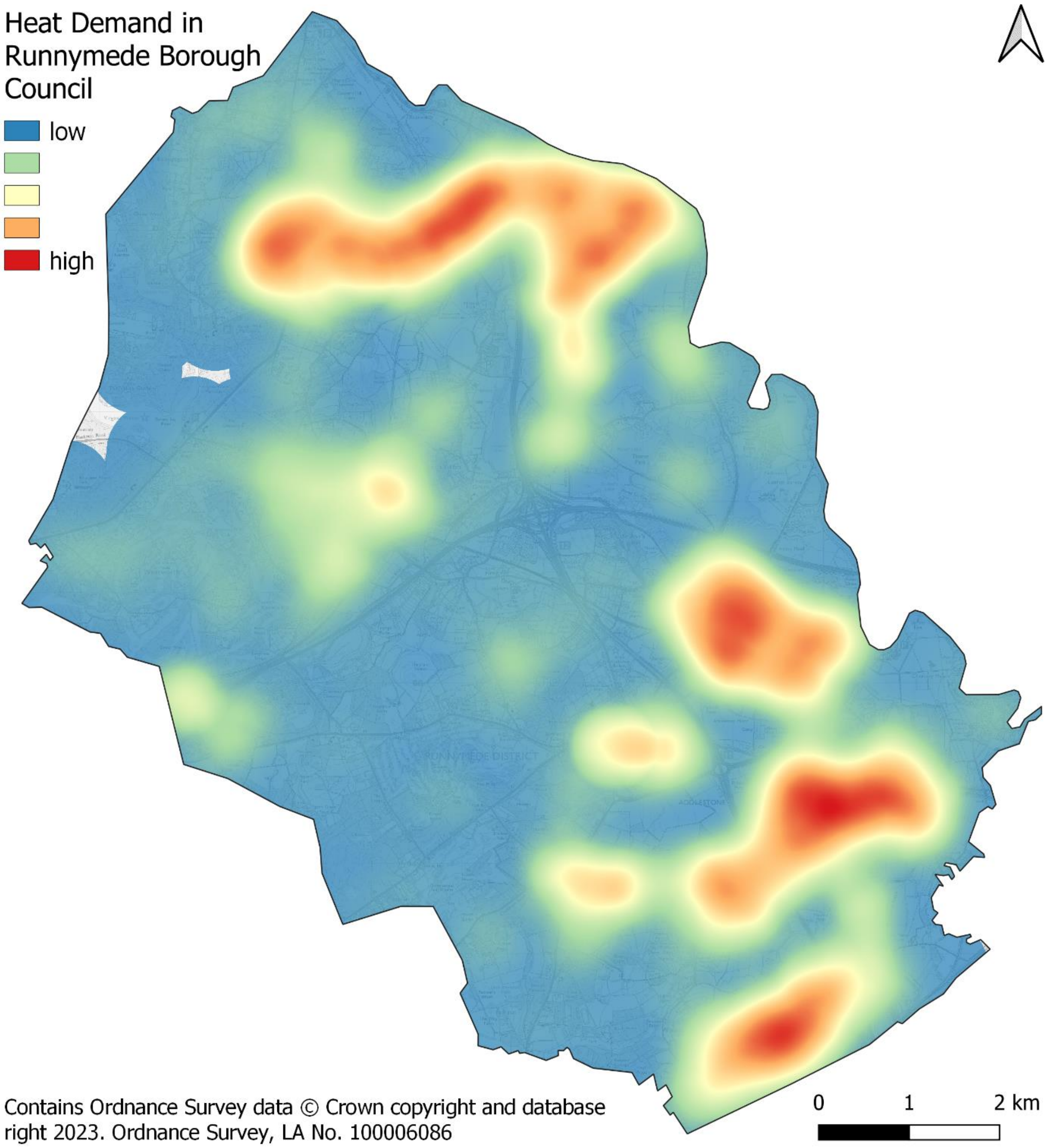
Heat Mapping

5.14 Heat mapping is a process of using available datasets to make accurate estimates of heat demand from buildings within a given area and presenting these visually on a map. The map can then be used to find areas of high heat demand which may be suitable for district heating. This analysis, as undertaken for Runnymede, uses data from the heat demand model of the THERMOS tool[86], which has been produced as part of an EC Horizon 2020-funded research project led by CSE. The THERMOS model incorporates a hierarchical approach to estimating annual and peak heat demand, with the method used depending on the available input data. This starts with a basic heat demand estimation method using a 2-D representation of a building's footprint polygon (e.g. where only OpenStreetMap data is available) or, as in the case of Runnymede, this can be improved using a more detailed model which uses Ordnance Survey building outlines and LiDAR data to estimate the 3-D shape and surface area of buildings.

5.15 For this analysis, address-level heat demand data for every building across Runnymede was first estimated using the THERMOS tool and a Geographic Information System (GIS) was then used to analyse the spatial distribution of heat demand. All addresses in the study area, along with their associated heat demand, were mapped using Ordnance Survey building outlines. A heat demand density map was then produced covering the study area – see Figure 5.1.

[86] https://www.thermos-project.eu/home/

Figure 5.1: Heat demand density in Runnymede Borough Council



5.16 Areas with high concentrations of heat demand have higher spatial density values. Heat density is shown on the map from blue to red, with blue areas being low density and red areas high density.

5.17 As would be expected, the heat map shows heat demand density to be greatest in the more urban areas of the district, with the clusters in Addlestone, Woodham and New Haw, Chertsey and Egham.

District-Wide Overlay Analysis

5.18 With a large area to explore, a useful way of initially identifying areas which are more likely to be suitable for district heating is to find areas which satisfy three conditions favourable to district heating relating to: overall heat demand; presence of potential anchor loads; and groups of dwellings with high heat demand (normally blocks of flats). Specifically, these conditions are:

- Areas must be within the 5% of land area with the highest heat demand density.
- Areas must be within 200m of residential buildings with an annual heat demand of more than 25,000 kWh.
- Areas must be within 200m of potential anchor loads.

5.19 Anchor loads are defined as those types of buildings likely to have relatively high and stable heat demands and/or be in sectors more likely to participate in heat network projects. For the purpose of this study, this includes all buildings with an annual demand for heat of above 25,000 kWh that fall within the following categories within the THERMOS heat demand model:

- Office.
- Commercial.
- Sport and Leisure.
- Industrial.
- Medical.
- Hotel.
- Prison.

5.20 The THERMOS heat demand model uses data from a variety of sources which classify commercial buildings into different types. The categories are reasonably wide, so not all buildings in the above categories will actually be suitable as anchor loads (particularly in the case of industrial buildings). However, they provide a good basis for establishing the initial area of search. When these areas are established, the locations identified and the areas around them can be checked for suitability by examining Ordnance Survey maps and Google Streetview to find out more about the types of buildings and their appropriateness. For example, high heat demand can be caused by dense terraced housing, which is less suitable than individual larger loads due to the number of connections that would be required.

5.21 In Runnymede, examples of anchor loads with high heat demands are shown in Table 5.1. This includes St Peter's Hospital, schools and university buildings such as Sir William Perkins's School and the Founders Building at Royal Holloway. The Runnymede Civic Centre has also been identified as an anchor load. The estimated heat demand has been updated to show the actual heat demand (shown as A) and the heat peak has been adjusted to reflect this. These buildings are likely to have a high, stable heat demand and projects involving these sites may be less complex as they would have fewer stakeholders than those involving many smaller individual buildings with the same overall heat demand. Examples of residential loads include Parklands Manor Care Home in Chertsey, Pretoria Road Apartments and Longcross House (a large, detached manor house).

Table 5.1: Anchor loads and residential loads identified within Runnymede Council

Building Name	Estimated Annual Heat Demand (kWh/yr)	Estimated Peak Heat Demand (kWp)	OS Classification	Anchor or residential load
St Peter's Hospital	3,562,063	1,790	Hospital	Anchor load
Founders Building, Royal Holloway, University of London	1,697,600	864	Residential Institution: Residential Education	Anchor load
Sir William Perkins's School	824,527	431	Secondary / High School	Anchor load
St. Georges College	670,836	355	Further Education	Anchor load
Fullbrook County Secondary School	593,695	316	Secondary School	Anchor load
Runnymede Civic Centre	500,860 (A)	305	Library / Police / Office	Anchor load
Jubilee High School	480,894	261	Secondary School	Anchor load

Building Name	Estimated Annual Heat Demand (kWh/yr)	Estimated Peak Heat Demand (kWp)	OS Classification	Anchor or residential load
Queens Building, Royal Holloway, University of London	434,022	237	Education	Anchor load
The Veterinary Medicines Directorate	408,630	225	Medical / Testing / Research Laboratory	Anchor load
Magna Carta School	391,975	216	Secondary School	Anchor load
Parklands Manor	375,457	208	Care / Nursing Home	Residential load
Pretoria Road Apartments	366,951	204	Self-Contained Flat (Includes Maisonette / Apartment)	Residential load
Longcross House	361,689	201	Detached	Residential load
Strodes College	365,396	203	Further Education	Anchor load
St Augustines Care Home	329,937	186	Care / Nursing Home	Residential load
Runnymede Hospital	322,397	182	Hospital	Anchor load
Merlewood Care Home	314,668	178	Care / Nursing Home	Residential load
Gowar Hall Royal Holloway, University of London	302,961	172	Self-Contained Flat (Includes Maisonette / Apartment)	Residential load

5.22 In Runnymede Borough, this analysis has identified 81 anchor load buildings and 1,133 residential load buildings.

5.23 For the purpose of this study, the areas identified through the overlay analysis can be termed as 'Heat Focus Areas' (HFAs) and may be worthy of further consideration. These areas should ideally also be considered alongside planned large new development sites which offer particular opportunities for heat networks and any known sources of heat supply. The majority of the HFAs in Runnymede Borough are located in Chertsey and Addlestone, see Figure 5.2.

Figure 5.2: Heat focus areas in Runnymede

5.24 Table 5.2 shows the estimated annual heat demand and peak heat demand of a selection of anchor loads that are located within the Addlestone area for further analysis. The estimated heat demands for the Civic Centre and Eileen Tozer Centre have been updated to show the actual heat demand (shown as A) and the heat peaks have been adjusted to reflect this.

Table 5.2: Buildings classified as anchor loads within or within close proximity to the Heat Focus Areas within Addlestone

Building Name	Estimated Annual Heat Demand (kWh/yr)	Estimated Peak Heat Demand (kWp)	OS Classification Description
Runnymede Civic Centre	500,860 (A)	305	Library / Police / Office
Darley Dene County Primary School	99,457	71	Preparatory / First / Primary / Infant / Junior / Middle School
Addlestone Community Association	143,046	93	Public / Village Hall / Other Community Facility
Eileen Tozer Centre	68,090 (A)	60	Community Service Centre / Office
Health Centre, Station Road	88,685	66	Health Centre
Darley Dene Court	138,038	90	Sheltered Accommodation
Surrey Towers	236,249	139	Self-Contained Flat (Includes Maisonette / Apartment)
Dukes Court	71,179	57	Self-Contained Flat (Includes Maisonette / Apartment)

New development

5.25 When considering heat networks, new development creates an additional demand for heat and power, as well as an opportunity to find a more flexible site for an energy centre and to lay heat distribution pipework at the same time as other building service infrastructure. Existing development in the close vicinity can also act as additional heat demands which may improve the economic viability of a network, particularly where anchor loads may exist along with other types of heat demand which can smooth out the overall heat demand profile.

Due to the proximity to the Addlestone HFA, the Addlestone East and Addlestone West site allocations (shown in Figure 5.3) have been included for further heat network modelling analysis presented later in this section. Details on the indicative number of dwellings and estimated heat demands are shown in Table 5.3[87]. Whilst the 2030 Local Plan Policy IE7 allocates the land at Addlestone East for a minimum of 70 (net) residential units, planning permission was granted subject to legal agreement in March 2023 for 75 units.

[87] Heat demand figures are estimated based on unpublished analysis undertaken for Greater Manchester Combined Authorities by Currie and Brown.

Figure 5.3: Addlestone allocation sites for new development

Table 5.3: Addlestone site allocations based on indicative housing mix and estimated heat demand and heat peak

Site Allocations	IE7 - Addlestone East Allocation	IE8 - Addlestone West Allocation
Total Number of Dwellings	75	70
Estimated Annual Heat Demand (kWh/yr)	233,557	263,864
Estimated Peak Heat Demand (kWp)	128	145

5.26 Another area of interest is St Peter's Hospital (shown in Figure 4). The main hospital building is identified as an anchor load (the largest estimated heat demand in the borough). Surrounding buildings are residential loads such as hospital accommodation (classified as HMO bedsit/ other non-self-contained accommodation) and self-contained flats and apartments. Since the site was allocated in the 2030 Local Plan under Policy SL13, various development proposals have come forward for the site. This includes proposals for a minimum of 400 dwellings. This includes 212 x 1, 2, 3, 4 and 5 bedroom houses and flats, 116 x 1 and 2 bedroom retirement apartments in two, three and four storey buildings. There are also apartments and cottages to form a retirement village, affordable dwellings and 138 x 1, 2 and 4 bedroom key worker dwellings.

5.27 It is also worth mentioning that the hospital heating system may need replacing which offers an opportunity for a new energy plant.

Figure 5.4: ' H , residential loads and allocation sites

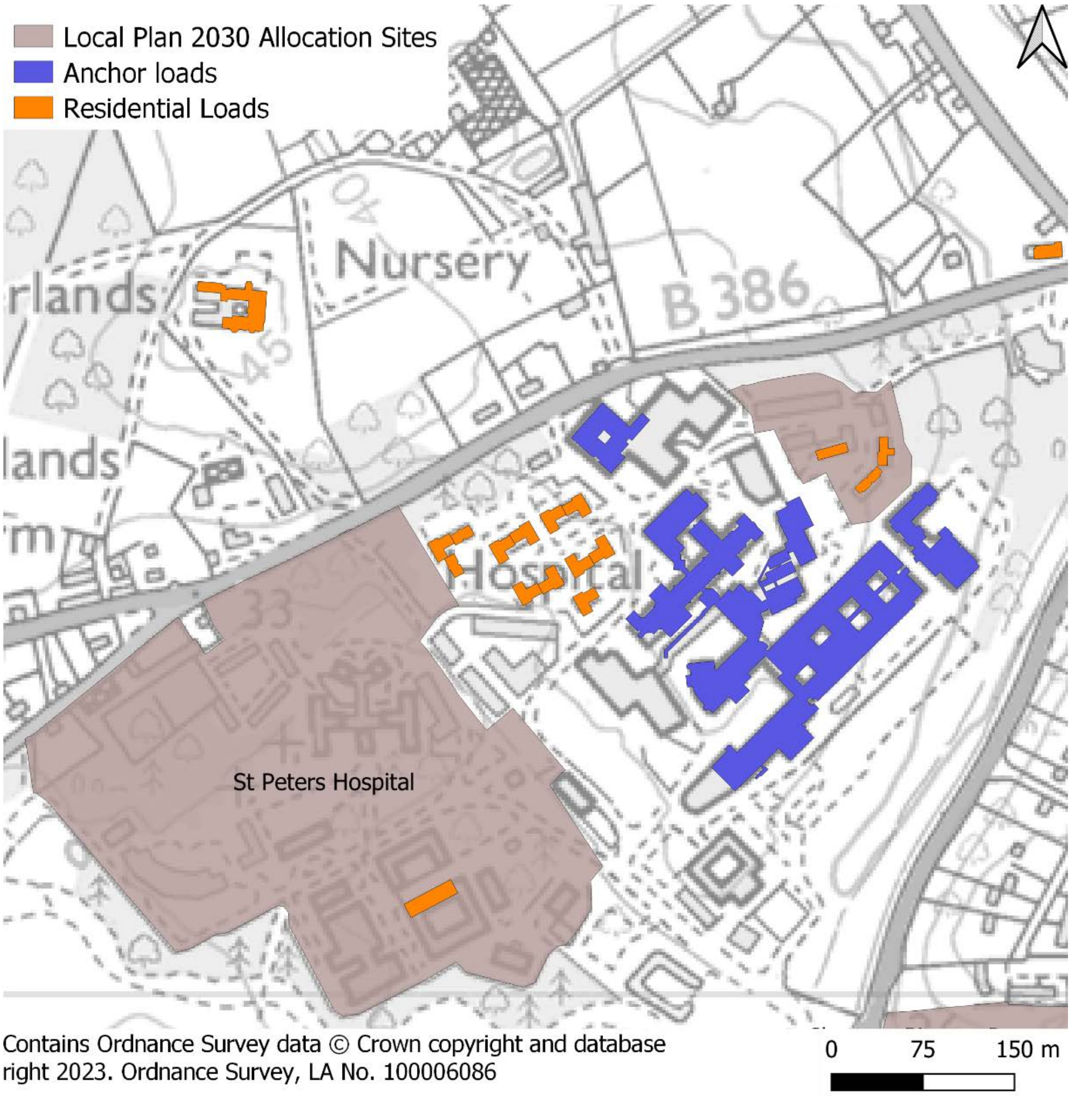


Table 5.4: Site allocations based on plans and estimated heat demand and heat peak

Site allocations	St Peter's Hospital South West site	St Peter's Hospital North East site
Total Number of Dwellings	427	72
Estimated Annual Heat Demand (kWh/yr)	1,771,527	246,849
Estimated Peak Heat Demand (kWp)	886	123

Heat supply opportunities

5.28 There will be a number of sites or building types within the borough that may be able to supply waste heat. This can potentially be sourced from a range of activities including industrial sites such as incinerators, power stations, landfill gas heat recovery, anaerobic digestion plants, industrial thermal processes, and waste water treatment works. Waste heat can also be supplied from sites such as data centre cooling facilities[88], cold stores, supermarkets, and in some cases underground railways and minewater. Other sources that are being investigated elsewhere in the UK include extraction of heat from sewers and electrical transformer equipment.

5.29 In theory, almost any location could source heat via heat pumps using ambient heat from either the ground, air or bodies of water. For example, the lakes at Thorpe may offer opportunities where suitable heat demands are located close by. In practice however, the scale of such systems would typically be limited to 1-2 MW heat supply capacity due to physical constraints at any one site. Another consideration when using heat pumps is the additional demand placed on the local electricity supply needed to power the pump.

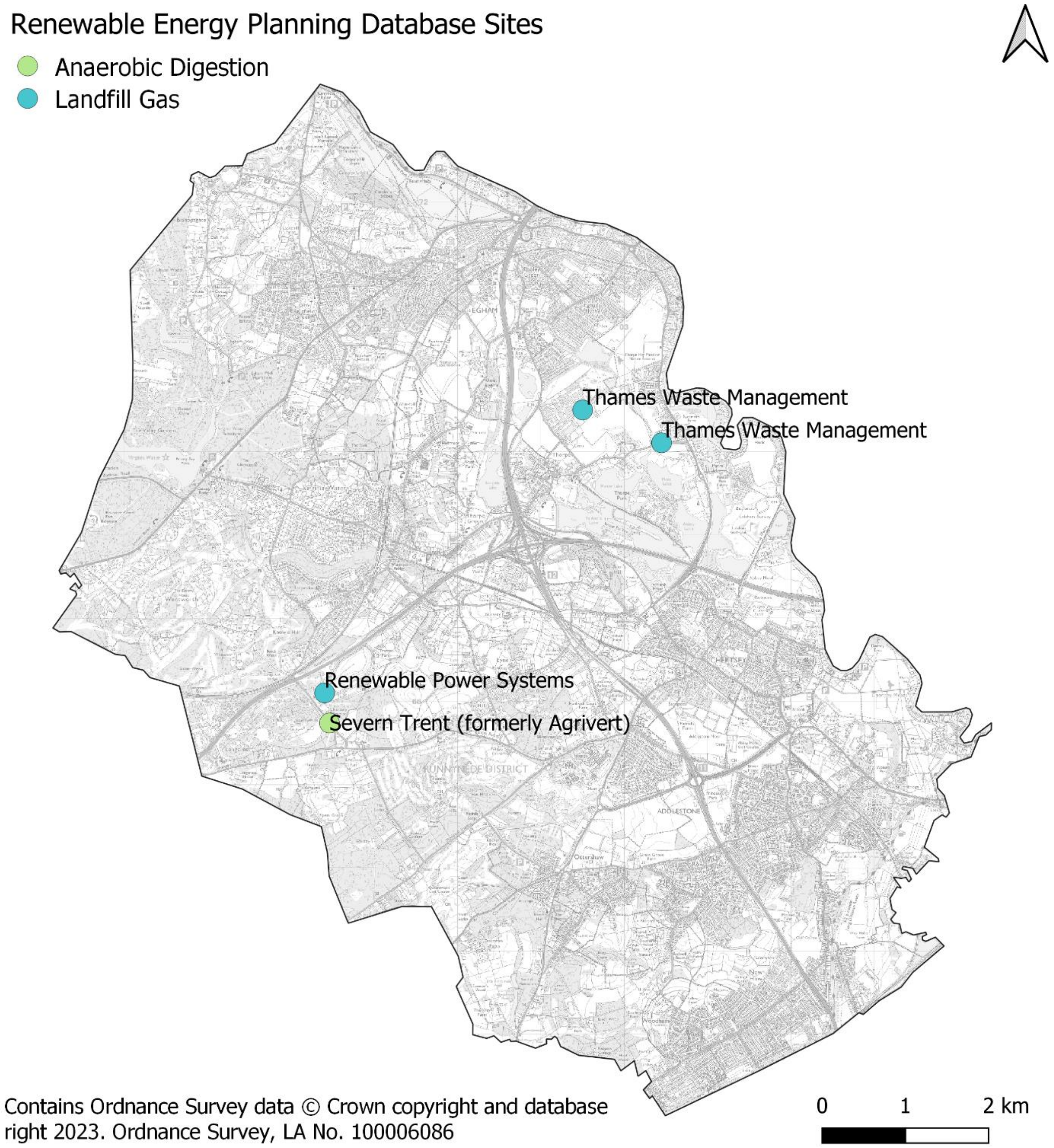
5.30 On the Renewable Energy Planning Database (REPD)[89], it is noted that there are four sites in Runnymede Borough that are operational for generating electricity (total 17MW). These are shown in Figure 5.5. Three of these sites are landfill gas and the other is an anaerobic digestion site. None of these have CHP enabled and the potential for these to supply useful heat has not been established. None of the REPD sites overlap with heat focus areas which could mean that there is a potential heat supply but with insufficient local demand.

5.31 Potential waste heat opportunities within heat focus areas include Tesco Supermarket in Addlestone.

[88] https://eastdevon.gov.uk/news/2023/03/exmouth-swimming-pool-is-heated-by-a-uk-first-in-technology-heating-solutions/

[89] https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract

Figure 5.5: Renewable energy planning database sites in Runnymede



Focused analysis using the THERMOS tool

5.32 Following the overlay analysis, two sites have been selected for further analysis using the THERMOS tool:

- The heat focus area in Addlestone (near the Addlestone East and Addlestone West allocation sites)
- St Peter's Hospital, the new development (Policy SL13) and surrounding area

5.33 This is a high-level pre-feasibility analysis, assessing network route options, energy supply options and outline costs. It is based primarily on modelled data and indicative cost assumptions have been used for these examples. Should the Council wish to review and adjust the parameters or create new networks based on better local knowledge then access to the analysis can be provided via the THERMOS online collaboration facility. The analysis is indicative and is intended to be a starting point for more in-depth technical and economic feasibility analysis. More information on the tool, including training materials, can be found on the THERMOS website4.

5.34 The THERMOS software finds the optimal heat network layout in a given area for a selection of buildings based on one of two objectives:

- Maximise Network NPV (net present value) - the goal is to choose which demands to connect to the network so as to maximize the NPV for the network operator. This is the sum of the revenues from demands minus the sum of costs for the network.
- Maximise Whole System NPV - the goal is to choose how to supply heat (or abate demand) to the buildings in the area under consideration at the minimum overall cost. The internal transfer of money between buildings and network operator is not considered, so network revenues and tariffs have no effect. Alternative individual heating systems (such as air source heat pumps) and building fabric insulation can be offered where this may be considered a more financially viable option.

5.35 For the purposes of this case study, the objective to maximise the network NPV has been explored.

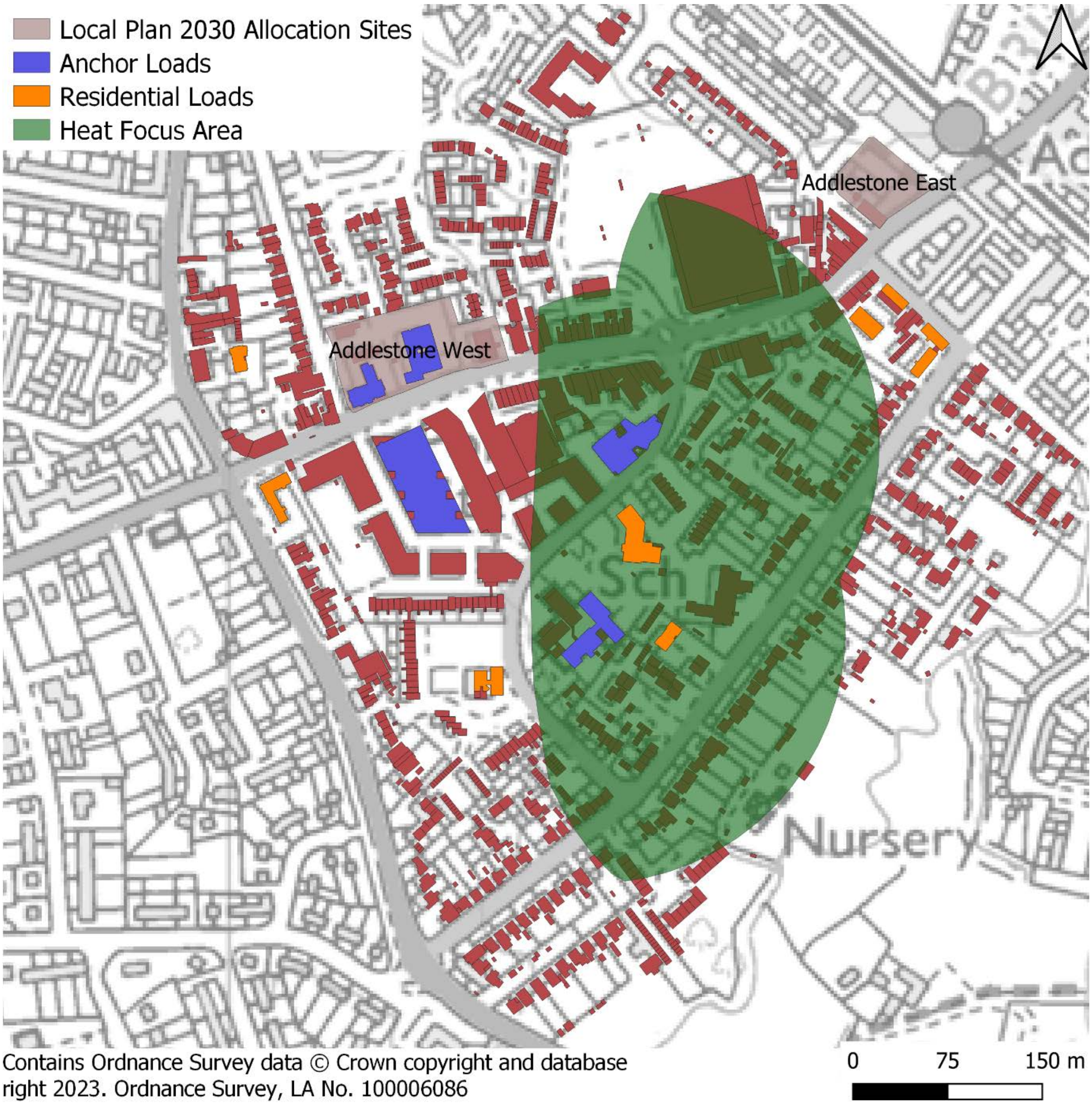
5.36 The tool allows the user to select specific buildings to be considered within the analysis, and these can be marked as 'required' or 'optional' depending on user preferences. A building or location must also be selected to act as a heat supply point (i.e. the location of an energy centre to house the required plant to supply the network with heat). The supply points, the Civic Centre and St Peter's Hospital, have been set a maximum heat supply capacity of 15MW.

Addlestone Heat Focus Area

5.37 The Addlestone heat focus area is shown in Figure 5.6 and the Civic Centre, Darley Dene Primary School and Addlestone Community Centre as anchor loads. The residential loads within the area are Surrey Towers and Darley Dene Court.

5.38 For the purposes of modelling in THERMOS, the two allocation sites have been included with 145 dwellings across the two sites. The heat demand for these dwellings has been estimated. In THERMOS these sites are represented by two single buildings with a connector to a road (and single heat demand and heat peak). Therefore, the cost of pipework within the site area has not been estimated (as site configurations are not yet known).

Figure 5.6: Addlestone heat focus area and buildings for THERMOS heat network analysis



5.39 There is an existing heat network supplied by a combined heat and power plant installed as part of the Addlestone One development. The CHP is located in Block 1A, a residential building next to the Civic Centre on Market Street. According to Elementa Consulting, the CHP has a 365kW thermal capacity[90] with a buffer tank of 10,000 litres (as a thermal store). Many residential and commercial buildings nearby are already supplied by heat or hot water or by both. There are plans for Phase 1 and 2 of the heat network which have been modelled by Elementa Consulting (shown in Figure 5.7).

5.40 For the purposes of modelling the current plans and potential extensions in THERMOS, all buildings included in Phase 1 or 2 are marked as required (red) for inclusion (shown in Figure 5.8). The heat pipes supplying these buildings are modelled as existing, therefore the model will not estimate the cost of these pipes. Surrounding anchor loads,

[90] Building and Environmental Consultancy. Loads Assessment and CHP Sizing, Addlestone Town Centre, Elementa Consulting

residential loads, council owned buildings and new developments are marked as optional. This will enable the model to act as if the Phase 2 network is already in place and model whether it is economically viable to extend further.

5.41 In Figure 5.8 two buildings are highlighted where development on land allocated by policies IE7 and IE8 could take place. The heat demands of these buildings have been updated to reflect the estimated heat demand of new developments of 75 and 70 dwellings respectively.

Figure 5.7: Buildings for Phase 1 and 2 of the Addlestone heat network (Source: Elementa, Loads Assessment and CHP Sizing)

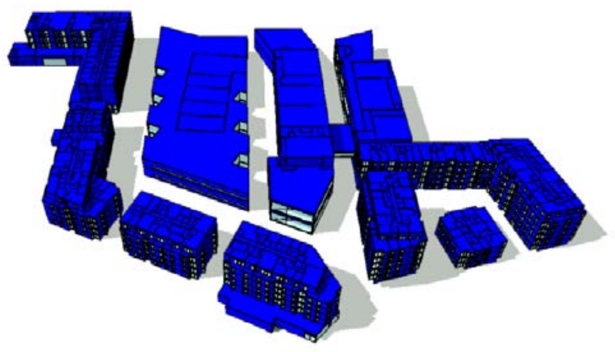
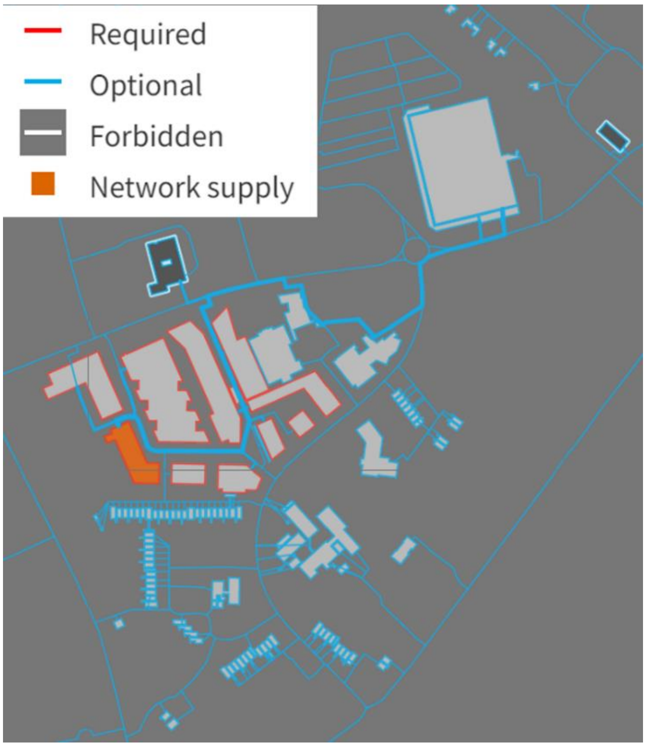
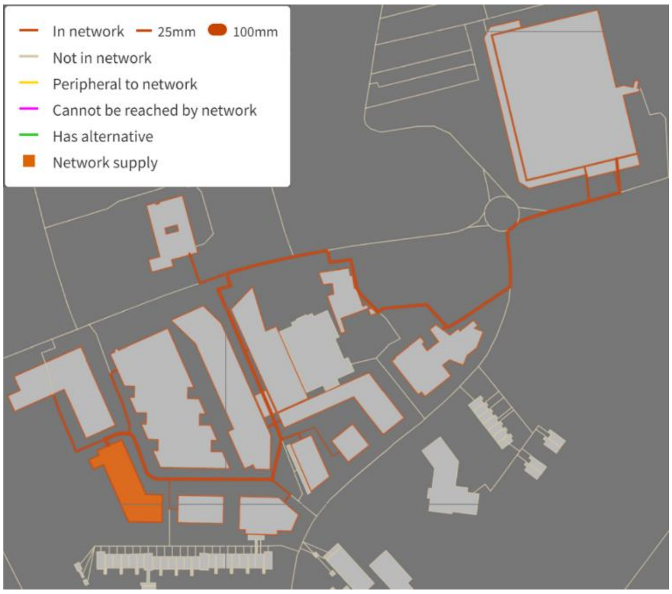


Figure 5.8: Addlestone network constraints



5.42 For the purposes of THERMOS analysis, the supply capacity has been set to 15MW so that the heat capacity will not constrain the network. In Figure 5.9 an example network extension is shown if supply cost is 10p/kWh with no increased capacity cost or fixed cost (assuming the current CHP is able to supply this heat). The network extends to 6 optional buildings (on top of the required Phase 1 and 2 buildings) including Tesco, which may be a heat supply as well as a heat demand (due to chillers), and potential new development at site IE8. It is likely that other buildings on Station Road would be connected if the heat pipes are running past them, however these have not been modelled. Proposed development at IE7 is not included in the network and the Council buildings to the south of the Addlestone One development are also not included. This is because it is economically preferable for them to stay on a gas boiler tariff.

Figure 5.9: Addlestone heat network extension – supply price 10p/kWh



5.43 If heat is able to be supplied at a cost of 8p/kWh, 41 optional buildings are connected to the network (highlighted in Figure 5.10). These include Surrey Towers and some of the council homes to the south of Addlestone One as well as development at allocated sites (IE7 and IE8).

5.44 Table 5.5 shows the THERMOS summary results. It is worth mentioning that the whole system NPV is always negative as it does not include network revenues.

Figure 5.10: Addlestone heat network extension – supply price 8p/kWh

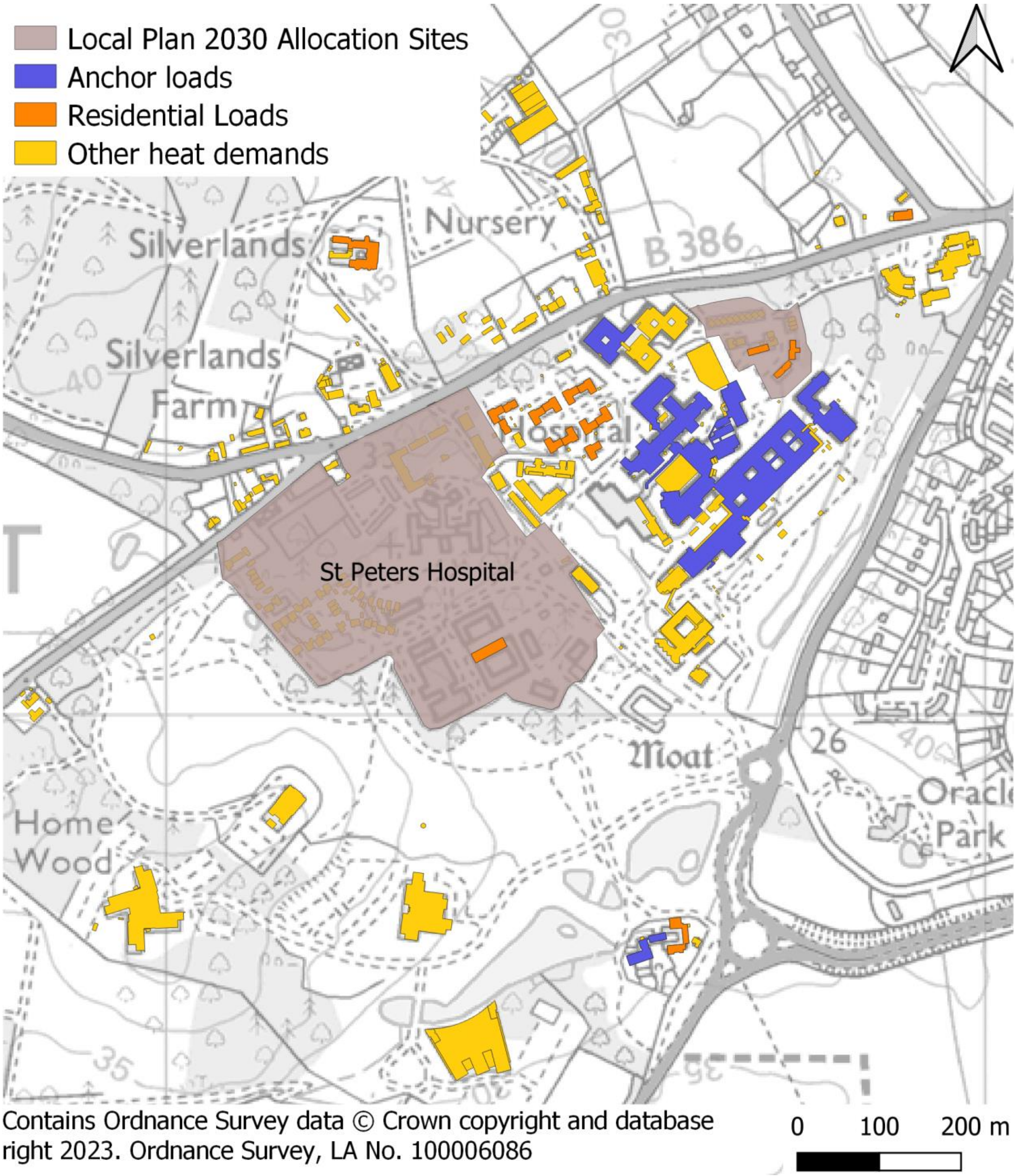
Table 5.5: Addlestone heat network extension – summary of THERMOS results

	Addlestone – 10p/kWh heat supply price	Addlestone – 8p/kWh heat supply price
Net Present Value		
Network NPV (£M)	£0.70	£2.25
Whole System NPV (£M)	-£6.76	-£7.89
Network Size		
Buildings	17	52
Paths	75	168
Pipework Solution		
Length (km)	0.88	1.55
Base Cost (£k)	287.20	695.37
Maximum pipe diameter (mm)	100	125
Total Capital Cost (£M)	£0.73	£1.28
Demand Solution		
Total Undiversified Peak Demand (MWp)	1.60	2.79
Total Demand (GWh/yr)	2.49	3.36
Revenue (£M/yr)	0.31	0.43
Supply Solution		
Total Capacity Required (MW)	1.49	2.58
Heat Production Costs (fuel) (£M)	10.71	11.76

’ H

5.45 St Peter’s Hospital is estimated as the largest heat demand in the borough. The surrounding areas have a relatively low heat demand which may be one of the reasons why the area is not identified as a heat focus area in this study. However, the site has a lot of potential as its current heating system will soon need replacing and there is a large new development nearby. Figure 5.11 shows the area selected for further analysis.

Figure 5.11: ’ H H k



5.46 At the St Peter’s Hospital site there are two different technology scenarios modelled:

1. Gas central heating (CH) scenario: the network supply source is anything that can undercut the price of gas. It is assumed that all buildings in the network area already have gas central heating, therefore the model is deciding if it is cheaper to supply heat to each building either by joining the network or leaving them disconnected and they stay on a gas boiler.
2. Air source heat pump (ASHP), net zero scenario: the supply is a large (and efficient) air source heat pump and every home needs to decarbonise heat either by

installing an individual air source heat pump (less efficient than network) or to join the network.

5.47 Defaults within the software include but are not limited to the pipe costs, standard tariff for customers on the network and costs for individual heating systems to be installed. Some of the cost assumptions have been laid out in Table 5.6. It is worth mentioning that there is no price cap for commercial or non-domestic consumers and therefore heat network operators fall into this category. This means that they are passing on the high costs of energy to their customers. These numbers are used for indicative purposes only.

Table 5.6: Cost assumptions based on the October 2022 domestic energy price cap (£2,500)

Cost assumptions	Gas (p/kWh)	Electricity (p/KWh)
£2,500 price cap cost (p/kWh)	10	34
Price cap cost when assuming 80% efficient gas boiler (p/kWh)	12.5	
Price cap cost when assuming 300% efficient large (commercial) air source heat pump (p/kWh)		11.33
Price cap cost when assuming 250% efficient individual (domestic) air source heat pump (p/kWh)		13.6

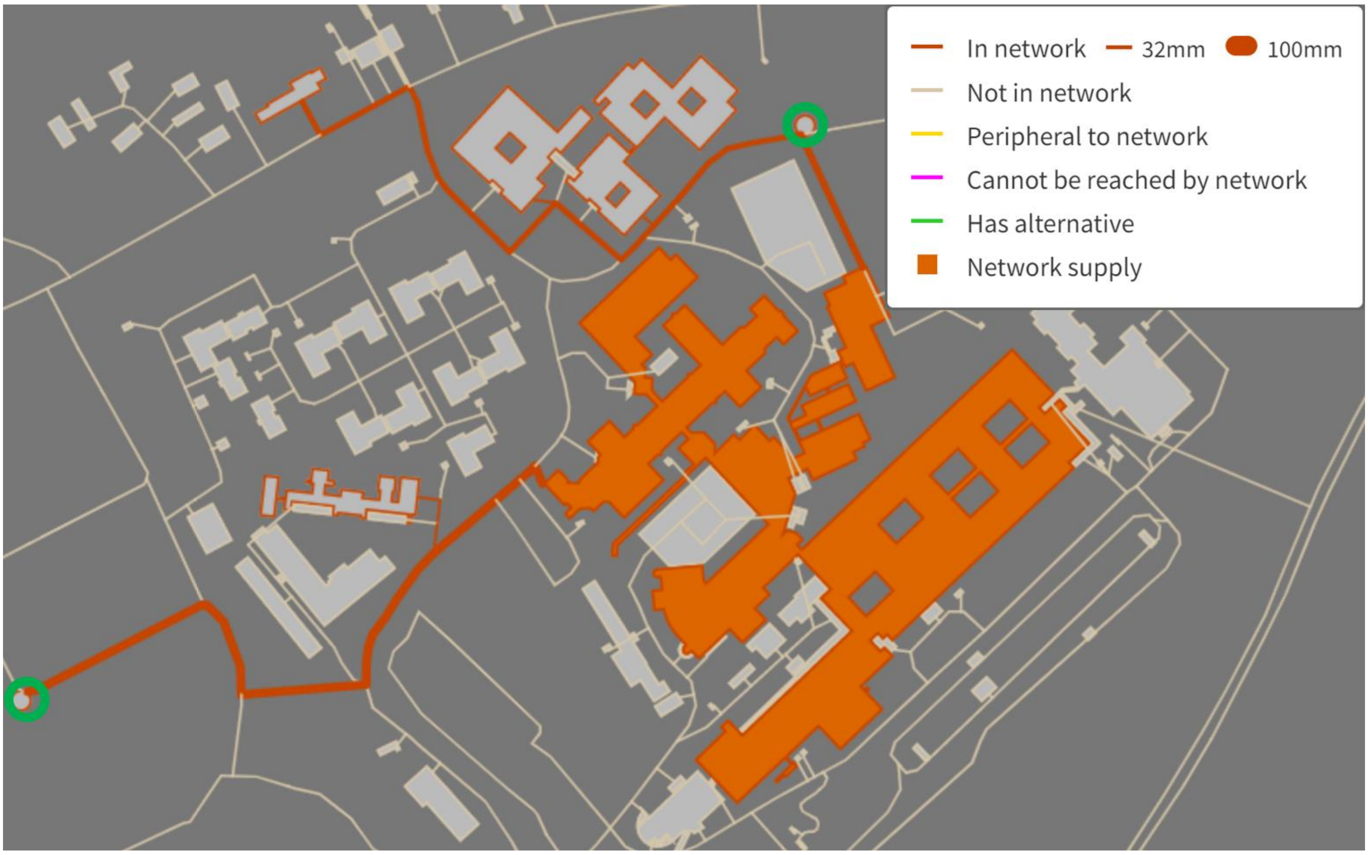
5.48 Table 5.7 shows the parameters that were entered into the two scenarios in THERMOS. These can also be found in Table 5.6.

Table 5.7: Financial input parameters

Input Parameters	Gas CH	Net Zero
Individual supply heat cost (p/kWh)	12.5 (80% efficient gas boiler)	13.6 (250% efficient ASHP)
Individual supply fixed capital cost (£)	As most homes already have gas boilers, there will be no fixed cost	10,000 (for installation of individual ASHP)
Heat network supply cost (p/kWh)	10 (gas price cap – although will not apply to network operators)	11.3 (300% efficient heat pump)
Heat network supply fixed capital cost (£)	£100,000 (arbitrary figure to set up energy centre)	£100,000 (arbitrary figure to set up energy centre)

5.49 Figure 5.12 provides an example of the network layout produced by the THERMOS tool. The energy centre (network supply) is highlighted as the hospital building filled in orange. The new development sites are added as new buildings shown as a green circle (bottom left and top right).

Figure 5.12: THERMOS map ’ H k – Gas CH scenario



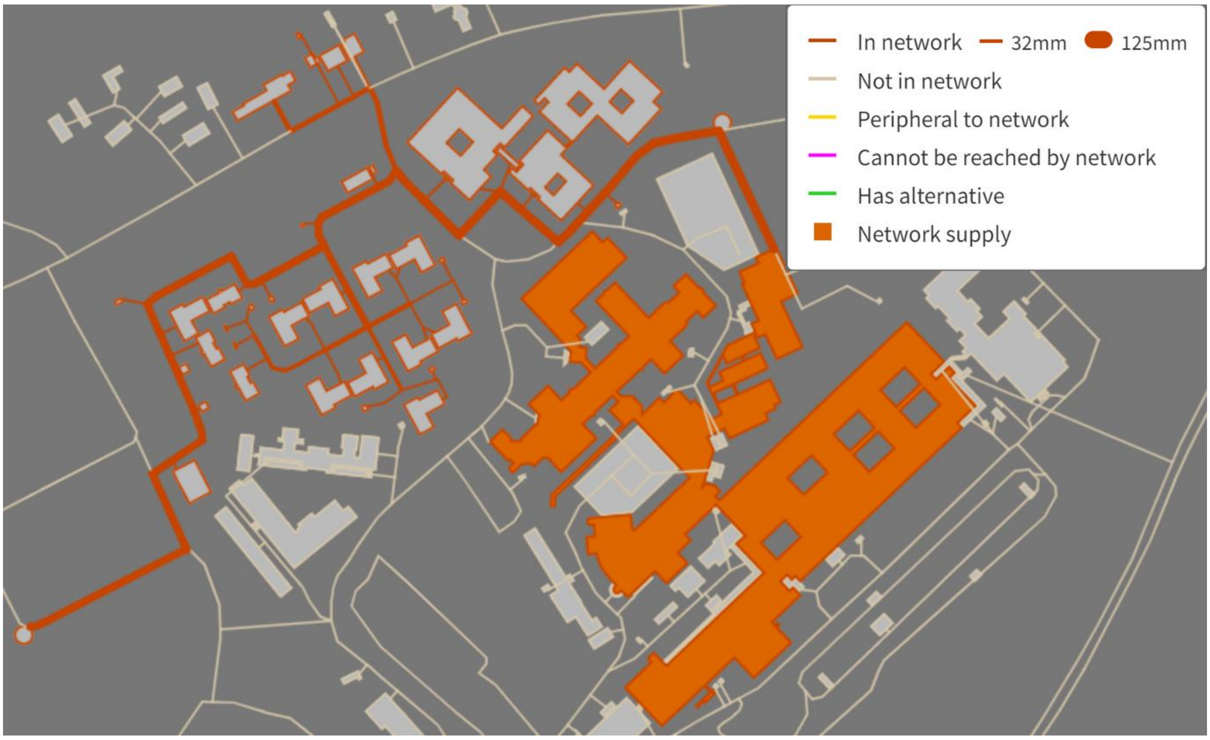
5.50 In the above example the analysis is aiming to maximise the network NPV by allowing all buildings to be ‘optional’. This means that buildings will not be added if it is not optimal for the network operator. There is the option for the network to join 266 demands (buildings) with a total of 14.16 GWh/yr heat demand (heat peak 14.16 MWp). This includes the estimated heat demands for the new development. This has been split over two sites with the site to the West of the hospital having 88% of the demand and the site to the North East with 12%.

5.51 In the gas CH scenario (Figure 5.12), the suggested network connects 7 buildings, including both of the new development sites. 1.15 MWp of the supply capacity (15MW) is connected, which means that technically more buildings could be connected but it was not economically beneficial to join them. The annual heat demand of this network is 7.61 GWh/yr (heat peak 1.71 MWp). Heat is offered to the connected buildings at 11.29p/kWh.

5.52 This would be a good opportunity to start the network with minimised costs (due to ability to lay heat distribution pipework as the building takes place).

5.53 In the ASHP net zero scenario (Figure 5.13) the suggested network connects 42 buildings. The required capacity of the supply source is 2.19 MW meaning that not all of the supply capacity is being used. The annual heat demand of this network is 8.15 GWh/yr and the heat peak is 3.47 MWp. Heat is offered to the connected buildings at 24.61p/kWh.

Figure 5.13: H ’ H k – Air source heat pump scenario



5.54 Table 5.8 shows the results from each network including the network NPV and whole system NPV. The whole system NPV is always negative as it does not include network revenues. This is an indicator for the amount of funding required.

Table 5.8: ’ H k – summary of THERMOS results

	St Peter's Hospital – Gas Counterfactual	St Peter's Hospital – ASHP
Net Present Value		
Network NPV (£M)	£1.15	£0.66
Whole System NPV (£M)	-£19.29	-£24.15
Network Size		
Buildings	7	42
Paths	32	93
Pipework Solution		
Length (km)	0.76	1.41
Base Cost (£k)	96.15	114.45
Maximum pipe diameter (mm)	100	125
Total Capital Cost (£M)	£0.78	£1.40
Demand Solution		
Total Undiversified Peak Demand (MWp)	1.71	3.47
Total Demand (GWh/yr)	7.61	8.15
Revenue (£M/yr)	0.86	1.4
Supply Solution		

	St Peter's Hospital – Gas Counterfactual	St Peter's Hospital – ASHP
Total Capacity Required (MW)	1.15	2.19
Heat Production Costs (fuel) (£M)	31.09	38.21

Conclusions and next steps

5.55 The heat mapping overlay analysis presented above provides a high-level indication of areas within Runnymede where heat networks are likely to be most viable, based on the demand for heat from existing buildings. As expected, these are predominantly in built up areas such as Egham, Chertsey and Addlestone and further detailed analysis to identify specific opportunities within these areas would be required. This could involve a closer look at energy supply opportunities and the buildings of interest to review energy demand estimates (replacing with actual demand data where available) and to test the appetite of stakeholders in linking up to a network, particularly in the case of identified anchor loads. Scenarios for heat network routes and the buildings they might serve can then be developed and analysed.

5.56 Although detailed analysis is beyond the scope of this study, CSE has provided an example of network scenario development by using the THERMOS tool to assess the Heat Focus Area (HFA) in Addlestone and the area of interest at St Peter's Hospital. This analysis has been undertaken using a set of default parameters within THERMOS and as a next step it is recommended that interested parties explore inputs and results via the tool's collaboration feature, which allows multiple users to remotely collaborate on projects, including scenario development[91]. Further work would require reviewing heat demand at the sites, including the impacts of any potential or proposed energy efficiency works or redevelopment, and scoping out the costs of low or zero carbon supply technologies when deployed at scale.

5.57 In terms of the potential for low or zero carbon heat supply, the findings are not exhaustive but existing opportunities identified and worth further investigation include the Thames Waste Management anaerobic digestion sites in Thorpe and landfill gas site and anaerobic digestion in Longcross. There may also be waste heat opportunities from commercial sites (such as data centres) and manufacturing which are not investigated as part of this study.

5.58 Further information on the development of heat networks is available from Government guidance[92]. Local authority funding towards the early stages of heat network development, including energy masterplanning, techno-economic feasibility and detailed project development is potentially available through the Government's Heat Networks Delivery Unit (HNDU)[93].

[91] Please contact CSE for further information
[92] https://www.gov.uk/guidance/heat-networks-overview
[93] https://www.gov.uk/guidance/heat-networks-delivery-unit

Chapter 6
Summary and Conclusions

Summary

6.1 This study has sought to provide the Council with evidence of the potential for renewable and low carbon energy within the Borough and how renewable and local issues could be embedded within the Council's emerging Local Plan.

6.2 There is currently 17MW of operational renewable electricity generation capacity across Runnymede, with annual emission savings of over 3,031 tCO2. The findings show that there is significant technical potential for renewable and low carbon energy within the Borough, 1,011,806 MWh/year[94]. The greatest potential lies in the opportunity to use the power of the sun in the form of ground mounted solar PV, rooftop solar PV and solar hot water heating.

6.3 One of the difficulties for local authorities in setting Borough-wide carbon targets is the co-dependency on national policy measures, such as those which will contribute to decarbonising both the electricity grid and heat supplies. Such measures are likely to be achieved through a mix of technologies, including some which most local authorities have little or no influence over such as offshore wind power and the development of hydrogen infrastructure. The rate at which grid decarbonisation occurs will be dependent on national policies and local authorities will in turn be largely dependent on a decarbonised grid to fulfil their own policy commitments.

6.4 New developments do, however, have the potential to make a significant contribution towards low and zero carbon energy generation capacity within the area, particularly if a rapid trajectory towards operational net zero carbon is adopted for new buildings – aided by the Future Homes Standard when this is implemented. It is difficult to quantify their impact as the mix of technologies used will depend on costs, onsite emission targets and applied emission factors, but it is likely that developers will focus on heat technologies such as heat pumps and rooftop solar. However, the additional capacity will not decrease overall emissions; it will instead limit the additional emissions resulting from the new development itself.

[94] This assumes: 100% wind potential, 100% GM solar potential, 100% rooftop solar potential, 100% hydro potential, 100% slurry potential (assuming all used for CHP), 100% woodfuel potential (assuming all used for CHP), 100% energy crops potential (assuming 80% miscanthus, 20% SRC, all used for CHP). This is not very realistic and so deployable will likely be much lower.

Conclusions

6.5 Achieving net zero is hugely challenging considering the radical changes that are needed to enact the necessary innovative transformative action across all sectors. However, in their 'Net Zero' report, the Committee on Climate Change view the UK-wide target as being "achievable with known technologies, alongside improvements in people's lives… …However, this is only possible if clear, stable and well-designed policies to reduce emissions further are introduced across the economy without delay".

6.6 As such, this study focusses primarily on the potential interventions through local planning for net zero carbon development, sustainable building design and renewable energy. With Runnymede Borough Council in the process of preparing its next Local Plan, there is a clear window of opportunity to ensure that the new Local Plan sets out a step change in the support given to the development of renewable and local carbon energy projects.

6.7 To support the deployment of renewable energy in the Borough, it is recommended that stronger polices should be put in place supporting:

- Delivery of net zero carbon operational development, including residential and non-residential development, and support for electric vehicle charging infrastructure provision.
- Onsite renewable and low carbon energy generation via supportive and positively worded criteria based policies.
- Areas of suitability for solar PV and wind energy.
- Community renewable and low carbon energy schemes.
- Heat networks (connections by developments and stations and network infrastructure).

6.8 Information on the potential planning policy options, set out above, for the revised Local Plan can be found within Chapter 4 of the Low Carbon Development and Sustainable Design Principles Report that should be read in conjunction with this report.

6.9 Careful monitoring of the success of the policies should also be established to measure the Borough's progress towards its ultimate goal of becoming carbon neutral. Additionally, monitoring can also help address unintended consequences on future occupants such as badly installed heat pumps or higher costs to run the technology.

6.10 All policy recommendations will also need to consider viability issues. The higher standards proposed in this study (and required to meet climate change targets) may impact on the viability of developments and as such, further work to understand this will be required.

6.11 The delivery of renewable and low carbon projects will also require changes not just to planning policy but also to the implementation of policy. It will be imperative that due weight and consideration is given to the importance of addressing climate change in development management decisions. This should include providing appropriate training and checklists for development management officers and planning committees to ensure that Climate Change issues are fully considered and given due weight in all planning decisions.

Appendix A

Key Assumptions to be Applied in the Assessment of Renewable and Low Carbon Energy Resource

Existing Property Statistics for Runnymede

A.1 The existing stock of domestic dwellings and non-domestic properties within Runnymede was derived from LLPG Address data.

A.2 The overall proportion of 'off-gas' properties (those not connected to the gas network) was derived from the 2021 BEIS LSOA estimates[1].

Table A - 1: Properties in Runnymede (Source: Runnymede LLPG Address data)

Property type	Number of properties in Runnymede
Detached dwelling	10,847
Semi-detached dwelling	14,118
Terraced dwelling	5,633
Flat	11,277
Other dwelling[2]	2,902
Total dwellings	**44,777**

[1] BEIS (2023) LSOA estimates of properties not connected to the gas network 2015 to 2021. Available at: https://www.gov.uk/government/statistics/lsoa-estimates-of-households-not-connected-to-the-gas-network

[2] Excluding ancillary buildings, car parking, garages, house boats, caravans and chalets.

Property type	Number of properties in Runnymede
Properties other than dwellings[3]	4,543
Total properties	**49,320**

Emission Factors

A.3 To determine the potential CO_2 savings from the identified potential renewable resources, the identified potential electricity/heating output was multiplied by the emissions factors of the fuels the renewable energy generation would replace:

- Grid electricity: 0.136 kgCO2e/kWh[4]
- Mains gas: 0.210 kgCO2e/kWh[5]
- Heating oil: 0.298 kgCO2e/kWh[6]
- Woodfuel: 0.011 kgCO2e/kWh[7]

A.4 The actual proportions of electricity and oil usage by off-gas properties for heating is unknown. As such, an illustrative 50% of these properties are estimated to be fuelled by electricity and 50% by oil for the purposes of this study.

UK Capacity Factors

A.5 Regional capacity factors, where available, were used when calculating technical potential within Runnymede[8]. Where unavailable, national BEIS and RHI data on annual load factors were used when calculating technical potential.

Table A - 2: UK Capacity Factors

Technology	UK-level Capacity Factor
Anaerobic Digestion[9]	67.9%
Hydro[10]	38.2%
Micro CHP[11]	12.9%
Solar PV[12]	9.7%
Wind[13]	25.3%

[3] Commercial properties excluding land, ancillary buildings, military buildings, objects of interest, parent shells, waste sites, minerals sites, ancillary buildings, parking, and other inappropriate locations including fisheries, telephone boxes, lighthouses, beach huts; ATMs, cemeteries; and utilities.
[4] BRE (2022) Standard Assessment Procedure (SAP 10.2): The Government's Standard Assessment Procedure for Energy Rating of Dwellings. Available at: https://bregroup.com/sap/sap10
[5] BRE (2022) Standard Assessment Procedure (SAP 10.2): The Government's Standard Assessment Procedure for Energy Rating of Dwellings. Available at: https://bregroup.com/sap/sap10
[6] BRE (2022) Standard Assessment Procedure (SAP 10.2): The Government's Standard Assessment Procedure for Energy Rating of Dwellings. Available at: https://bregroup.com/sap/sap10
[7] BEIS (2022) Greenhouse gas reporting: conversion factors 2022. Available at: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2022. Wood logs/chips/pellets.
[8] Regional capacity factors have been used for Wind, Ground mounted solar and Roftop solar.
[9] BEIS (2022) Quarterly and annual load factors. Available at: https://www.gov.uk/government/publications/quarterly-and-annual-load-factors. The average of all the available load factors was used.
[10] BEIS (2022) Quarterly and annual load factors. Available at: https://www.gov.uk/government/publications/quarterly-and-annual-load-factors. The average of all the available load factors was used.
[11] BEIS (2022) Quarterly and annual load factors. Available at: https://www.gov.uk/government/publications/quarterly-and-annual-load-factors. The average of all the available load factors was used.
[12] BEIS (2022) Quarterly and annual load factors. Available at: https://www.gov.uk/government/publications/quarterly-and-annual-load-factors. The average of all the available load factors for the South East was used.
[13] BEIS (2022) Quarterly and annual load factors. Available at: https://www.gov.uk/government/publications/quarterly-and-annual-load-factors. The average of all the available load factors for the South East was used.

Technology	UK-level Capacity Factor
Solar Water Heating[14]	4.5%
Air Source Heat Pumps[15]	18.4%
Ground Source Heat Pumps[16]	18.2%
Biomass (plant-based)[17]	67.5%
Sewage Sludge Digestion[18]	47.3%

[14] BEIS (2023) Non-domestic RHI mechanism for budget management: estimated commitments – RHI budget caps. Available at: https://www.gov.uk/government/publications/rhi-mechanism-for-budget-management-estimated-commitments

[15] BEIS (2023) Non-domestic RHI mechanism for budget management: estimated commitments – RHI budget caps. Available at: https://www.gov.uk/government/publications/rhi-mechanism-for-budget-management-estimated-commitments

[16] BEIS (2023) Non-domestic RHI mechanism for budget management: estimated commitments – RHI budget caps. Available at: https://www.gov.uk/government/publications/rhi-mechanism-for-budget-management-estimated-commitments

[17] BEIS (2022) Load factors for renewable electricity generation. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1094495/DUKES_6.3.xlsx

[18] Statista (2023) Load factor of electricity from sewage sludge digestion in the United Kingdom (UK) from 2010 to 2021. Available at: https://www.statista.com/statistics/555718/sewage-sludge-digestion-electricity-load-factor-uk/

Wind Resource Assessment Parameters

A.6 The potential wind development resource within Runnymede was assessed using a Geographical Information Systems (GIS) approach. This involved mapping a variety of technical and environmental parameters to identify parts of the borough which are constrained with respect to wind development at various scales. The remaining land was then identified as having 'technical potential' (subject to further site-specific assessment at application stage). The parameters of the GIS tool are set out in **Table A - 2**.

A.7 The maximum theoretical wind generation capacity of the areas of technical potential was estimated using:

- Standardised turbine densities and assumed turbine maximum generation capacities (the latter expressed in Megawatts (MW));
- One or more assumed capacity factors based on historic data broken down at least to regional level (using data from the Department for Business, Energy and Industrial Strategy (BEIS) relating to Feed in Tariff (FiT) installations)[19]; and
- The assumption that, where land has technical potential for multiple turbine scales, the largest scale will be developed in preference to smaller scales.

[19] An energy generator's 'capacity factor' can be defined as the actual energy yield produced over a period of time expressed as a proportion of the energy yield that would have been produced if the generator had operated at its full generation capacity continuously over the same period.

Table A - 3: Proposed assumptions to be used for assessment of technical potential for onshore wind – Constraints

Parameter	Assumption	Data Source	Justification and Notes
Wind Turbine Size	Five turbine sizes were considered: ■ Very large (150-200m tip height) ■ Large (100-150m tip height) ■ Medium (60-100m tip height) ■ Small (25-60m tip height) ■ Very small (<25m tip height) Assessment was based on notional turbine sizes, approximately intermediate within each class size i.e.: ■ Very large: 175m tip height, 4MW capacity ■ Large: 125m tip height, 2.5MW capacity ■ Medium: 80m tip height, 0.5MW capacity ■ Small: 45m tip height, 0.05MW capacity No mapped-based assessment of 'very small' turbines was undertaken. The type of buffers applied to constraints for the assessment of other turbine size categories in many cases do not reasonably apply to very small turbines. Equally, mapping a strategic district-wide 'resource' for very small turbines (which are generally developed singly in association with	■ LUC ■ Research into turbine manufacturers ■ BEIS renewable energy planning database and other databases containing information on wind turbine applications.	There are no standard categories for wind turbine sizes. The categories chosen are based on consideration of currently and historically 'typical' turbine models at various different scales. The approach is intended to be flexible in the light of uncertainty regarding future financial support for renewable energy. A review of wind turbine applications across the UK showed tip heights ranging from less than 20m up to around 200m, with larger turbine models in demand from developers following the reduction in financial support from Government[20]. Due to the structure of the financial support system in the past, smaller turbines (those in the medium to small categories) have tended to be deployed as 1-2 turbine developments.

[20] LUC review in July 2022.

Parameter	Assumption	Data Source	Justification and Notes
	particular farm or other buildings) is not particularly meaningful. Instead, it is recommended that policy references the entire plan area as suitable for very small wind in principle (subject to site-specific assessment).		
Wind Speed	Exclude: ■ All areas with mean annual average wind speed <5m/s at 50m above ground level (agl).	■ Global Wind Atlas/Vortex ■ Industry practice	Wind speed requirements change with turbine scale and model. Some turbine manufacturers produce models which may operate at lower wind speeds and the configuration of certain turbine models can be altered to improve yield in lower wind speed environments. Future changes in government policy and turbine technology could allow developments to be deliverable at lower wind speeds than are currently viable. A 5m/s threshold was applied to take account of such changes.
Roads	Exclude: ■ Roads (excl. restricted access tracks) with a buffer of the height of the turbine (to blade tip height) +10%.	■ Ordnance Survey OpenRoads	These buffers were applied as a safety consideration. The proposed buffer distance is based on standard safety distances used by wind turbine developers and the DECC Renewable and Low-carbon Energy Capacity Methodology[21]. Restricted access tracks were excluded from consideration as these predominantly comprise of forestry and other tracks which could be more easily diverted than standards roads.
Railways	Exclude: ■ Railways with a buffer of the height of the turbine (to blade tip height) +10%.	■ Ordnance Survey VectorMap District	This buffer was applied as a safety consideration, based on the same principles as used for roads.
Electricity Lines	Exclude: ■ Major transmission lines (132kV minimum) with a buffer of the height of the turbine (to blade tip height) +10%.	■ Ordnance Survey OpenMap ■ National Grid ■ SSE/UKPN	This buffer was applied as a safety consideration. It is derived from guidance by the Energy Networks Association (Engineering Recommendation L44) and National Grid (Technical Advice Note 287). It is noted that this guidance also states that a buffer of 3x the rotor diameter should be applied to account for turbine wake downwind of a turbine impacting the weathering of electricity lines. However, this also states that this impact is variable

[21] DECC (2010) Renewable and Low-carbon Energy Capacity Methodology. Available at: https://www.gov.uk/government/news/decc-publishes-methodology-for-renewable-and-low-carbon-capacity-assessment

Parameter	Assumption	Data Source	Justification and Notes
			depending on factors including turbine positioning. This would require site-level study and consultation with the relevant DNO. As such, this buffer distance was not applied as a constraint.
Airports and Airfields	Exclude: ▪ Operational airports and airfields.	▪ Ordnance Survey OpenMap Local Functional Site layer with the theme 'Air Transport'	OS VectorMap Local Functional Site data with the theme Air Transport was used in the assessment. It is noted that land within consultation zones surrounding airports and airfields may also be unsuitable for wind turbine development, and further consultation between potential developers and airport and airfields is required to determine if there is any impact from a proposed development.
Noise	Exclude: ▪ Residential and commercial buffer zones based on turbine size: – Very large scale: 500m for residential/other sensitive receptors[22], 250m for non-residential. – Large scale: 480m for residential/other sensitive receptors, 230m for non-residential. – Medium scale: 400m for residential/other sensitive receptors, 180m for non-residential. – Small scale: 180m for residential/other sensitive receptors, 80m for non-residential. For properties outside (but close to) the Authority Boundary, indicative buffers were applied to the available property/buildings	▪ OS Addressbase ▪ OS OpenMap	Wind turbines generate sound during their operation, and their noise impacts upon nearby properties must be limited to appropriate levels, defined in particular by the 'ETSU' Guidance – The Assessment and Rating of Noise from Wind Farms (1995) (as supplemented by the Institute of Acoustics). The relationship between turbine size and the separation distance from properties at which acceptable noise levels will be achieved is in practice quite complex and variable. However, the present assessment has applied specialist acoustic advice to define minimum distances below which it is generally unlikely that the required noise levels under ETSU-R-97 will be achievable. The approach taken necessarily involves applying various assumptions, including: ▪ An assumed single turbine development in all cases (rather than multiple turbines); and ▪ The assumption that no properties will be 'financially involved' in the wind development (financial involvement may allow higher noise levels to be accepted in individual cases). The limitations associated with such assumptions are considered preferable to avoiding the use of noise-related separation distances for the assessment, bearing in mind that noise is a key factor that influences the acceptable siting of turbines in practice. The assessment defines the minimum distances below which adherence to the Industry standard (ETSU-R-97) noise guidance would not be possible and it

[22] Sensitive receptors include schools, hospitals and care homes. These were identified via the LLPG data.

Parameter	Assumption	Data Source	Justification and Notes
	data from OS VectorMap. As this data does not distinguish commercial and residential properties, and it was not possible to verify uses by other means, non-residential buffers were used throughout.		should not be inferred that the proposed distances represent acceptance of any given proposal within the areas of identified suitable potential as site based noise monitoring and assessments would still be required. Note: Within the Authority, where address points did not overlay OS OpenMap buildings data, points were buffered 5m to estimate building footprint. Where OS OpenMap buildings did not overlay address point data, these buildings were assumed to be of non-sensitive use. Moreover, due to lack of sufficient data, buildings outside of the authority were assumed to be of non-sensitive use. This was to ensure that land was not unnecessarily ruled as being constrained to wind development, as a result of non-sensitive buildings being mistakenly assessed as being sensitive. It is noted further site specific study would be required to determine the necessary buffer distance between specific buildings and proposed turbines.
Buildings	Exclude: ■ Buildings with a buffer of the height of the turbine (to blade tip height) +10%.	■ OS Addressbase ■ OS OpenMap	National Planning Practice Guidance notes that the topple distance + 10% is a safe separation distance between turbines and buildings. The same building and addressbase datasets used in the consideration of noise was used to determine the location of buildings for this parameter.
Future Developments, Safeguarded Land and Employment Sites	Exclude: ■ Housing and employment allocations from Runnymede Borough Council Plan	■ Runnymede Borough Council	Generally unsuitable for wind turbine development, unless allocations contain relatively large undeveloped portions. Identification of suitable land for wind within specific allocation boundaries would require a separate site-specific study. In addition, it is assumed that opportunities for renewables within such sites will already be considered as part of their design. In agreement with the Council, Strategic Employment Areas were not treated as constraints. The Council confirmed that these sites are not “allocated” for future development and instead are areas of protected existing employment developments.
Existing Renewable Energy Developments	Exclude: ■ Land boundaries of consented and operational renewable energy installations.	■ BEIS ■ Aerial imagery ■ LUC windfarm database	The quarterly BEIS Renewable Energy Planning Database and the LUC internal windfarm database was used to determine the locations of operational and consented renewable energy installations. These datasets did not indicate that there were any consented or operational wind turbine or ground mounted solar development present within Runnymede. As such, no land was excluded on this basis.

Parameter	Assumption	Data Source	Justification and Notes
			Existing roof-mounded solar PV developments were not excluded, as these are building-integrated and therefore excluded via the consideration of existing build development as a constraint. Additionally, existing landfill gas developments were not considered a constraint to wind developments, as there is potential that turbines could be incorporated onto such existing sites. A single operational anaerobic digestion installation was identified within the authority and this was treated as a constraint to wind developments.
Terrain	Exclude: ■ Slopes greater than 15%.	■ OS Terrain 50	This is a development/operational constraint. Developers have indicated that this is the maximum slope they would generally consider feasible for development. Although it is theoretically possible to develop on areas exceeding 15% slopes, turbine manufacturers are considered unlikely to allow turbine component delivery to sites where this is exceeded.
Water Environment	Exclude: ■ Watercourses and waterbodies with a 50m buffer.	■ Ordnance Survey VectorMap Local	A 50m buffer was applied around all rivers and waterbodies to take account of good practice such as that relating to pollution control during construction. OS Survey OpenMap Local surface water area data includes waterways of approximately a minimum of 2m width. OpenMap Local surface water line data is line data, and so a 1m buffer was applied to approximate a footprint of smaller waterways.
Woodland	Exclude: ■ Ancient Woodland Inventory with a 50m buffer; and ■ Woodland as shown on the National Forest Inventory with a 50m buffer including: – Assumed woodland; – Broadleaved;	■ Forestry Commission ■ Natural England	All areas of woodland were excluded with a +50m buffer to reduce risk of impact on bats. A 50m clearance distance of turbines from trees and other habitat features is standard practice and endorsed by Natural England guidance set out in 'TIN051'. A 50m horizontal buffer is a reasonable proxy clearance for the purposes of a strategic study bearing in mind unknowns concerning tree height and turbine dimensions. A 50m buffer cannot be applied to all linear habitat features and individual trees due to a lack of data for a study of this scale.

Parameter	Assumption	Data Source	Justification and Notes
	– Conifer; – Coppice; – Coppice with standards; – Low density; – Mixed mainly broadleaved; – Mixed mainly conifer; and – Young trees.		The following National Forestry Inventory categories of woodland were considered non-permanent or non-woodland and therefore not excluded as wind turbine development may be suitable in these locations: ■ Cloud/shadow; ■ Failed; ■ Felled; ■ Group prep; ■ Shrub; ■ Uncertain; and ■ Windblown.
Biodiversity (International Designations)	Exclude international designations[23]: ■ Special Protection Areas (SPA); ■ Special Areas of Conservation (SAC); and ■ Ramsar sites.	■ Natural England	As protected by: ■ Conservation of Habitats and Species Regulations 2017 (as amended)
Biodiversity (National Designations)	Exclude national designations[24]: ■ Sites of Special Scientific Interest.	■ Natural England	As protected by: ■ Wildlife and Countryside Act 1981 ■ Conservation of Habitats and Species Regulations 2017 (as amended)
Biodiversity (Regional and Local Designations)	Exclude other designations[25]: ■ Local Nature Reserves; and	■ Natural England ■ Runnymede Borough Council	Generally, would not be suitable for renewables development based on law/policy/guidance including: ■ NPPF

[23] There are no Potential SAC, Potential SPA or Proposed Ramsar sites present within Runnymede.
[24] There are no National Nature Reserves within Runnymede.
[25] There are no RSPB Reserves within Runnymede.

Parameter	Assumption	Data Source	Justification and Notes
	■ Sites of Nature Conservation Importance.		■ Natural Environment and Rural Communities Act 2006 ■ 2030 Local Plan
Cultural Heritage	Exclude[26]: ■ Registered Parks and Gardens; ■ Scheduled Monuments; ■ Listed Buildings; ■ Locally Listed Buildings; ■ Conservation Areas; and ■ Locally Listed Heritage Assets.	■ Historic England ■ Runnymede Borough Council	As protected by: ■ NPPF ■ The Convention Concerning the Protection of the World Cultural and Natural Heritage ■ National Heritage Act 1983 ■ Ancient Monuments and Archaeological Areas Act of 1979 ■ Planning (Listed Buildings and Conservation Areas) Act 1990 ■ 2030 Local Plan and Neighbourhood Plans The council's polygon version of the Nationally Listed Buildings dataset was used to represent Listed Buildings more accurately than the Historic England point dataset. Although wind development may not be strictly prohibited by policy within designated World Heritage Site Buffer Zones, is should be noted that it would likely be highly problematic to seek planning permission within these. It is noted that further site specific study would be required to determine if any unexpected archaeological remains or undesignated but nationally significant features are present that would require consideration, as well as the setting of historic features. Note: Locally Listed Heritage Asset point data was buffered 5m to estimate building footprints where they did not intersect the Locally Listed Building polygon data.
Minimum Development Size	Unconstrained areas of land were excluded if they were below a minimum developable size of 40m width and an area that varied per turbine size:	■ N/A	The minimum development size was based on developer knowledge of recent wind turbine developments, and accounts for the estimated land take requirements for a single turbine base, the adjacent laydown area and other immediate infrastructure requirements adjacent to the turbine itself.

[26] There are no Registered Battlefields or World Heritage Sites within Runnymede.

Parameter	Assumption	Data Source	Justification and Notes
	- Very large: 0.8ha - Large: 0.6ha - Medium: 0.4ha - Small: 0.2ha		However, further site specific study would be required in order to determine the land take requirements of individual turbines depending on factors such as their model and location.
Turbine Spacing	The following standardised turbine densities were considered when determining the overall potential for turbine development across Runnymede: - Very large: 4 per km2 (assuming a rotor diameter of 130m) - Large: 8 per km2 (assuming a rotor diameter of 90m) - Medium: 22 per km2 (assuming a rotor diameter of 55m) - Small: 167 per km2 (assuming a rotor diameter of 20m)	- N/A	The calculation of potential wind capacity involved applying an assumption concerning development density. In practice, turbines are spaced within developments based on varying multiples of the rotor diameter length. Although turbine separation distances vary, a 5 x 3 rotor diameter oval spacing[27], with the major axis of the oval oriented towards the prevailing wind direction, taken to be south-west as the 'default' assumption in the UK (see **Figure A - 1**), was considered a reasonable general assumption at the present time in this respect. In practice, site-specific factors such as prevailing wind direction and turbulence are taken into account by developers, in discussion with turbine manufacturers. Bearing in mind the strategic nature of the present study, the density calculation did not take into account the site shape, and a standardised rectangular grid density based on a 5 x 3 rotor diameter was used instead (see image below).

[27] To mitigate impacts on the productivity of wind turbines located close to one another caused by wind turbulence, it is standard practice for developers to maintain an oval of separation between turbines that is equal to 5 times the turbine rotor diameter (the cross sectional dimension of the circle swept by the rotating blades) on the long axis, and 3 times the rotor diameter on the short axis.

Figure A - 1: Wind turbine spacing

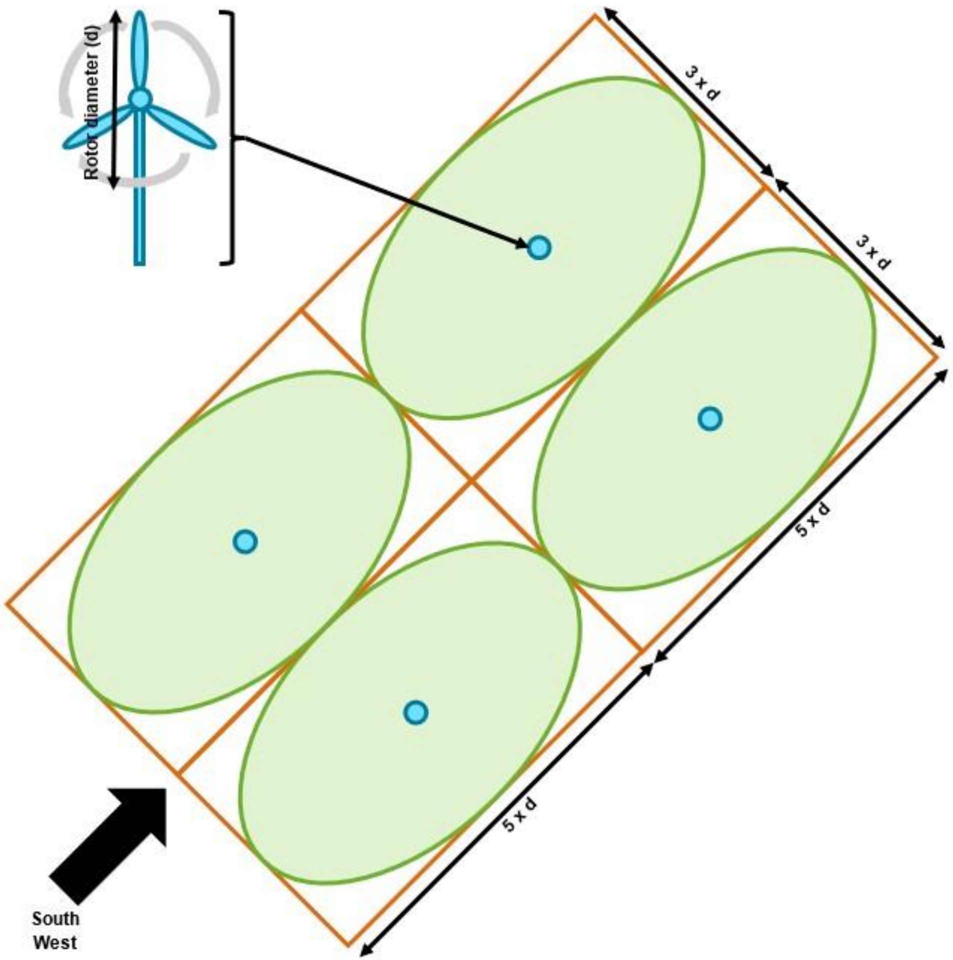


Table A - 4: Proposed assumptions to be used for assessment of technical potential for onshore wind – Constraints considered but not used

Parameter	Assumption	Data Source	Justification and Notes
MOD Land	No land excluded on this basis.	■ OpenStreetMap ■ Runnymede Borough Council	Based on Open Street Map and council data there are no MOD sites within Runnymede. As such, no land was excluded on this basis.
Areas of Outstanding Natural Beauty	No land excluded on this basis.	■ Natural England	There are no Areas of Outstanding Natural Beauty located within Runnymede. As such, no land was excluded on this basis.
National Park	No land excluded on this basis.	■ Natural England	There are no National Parks located within Runnymede. As such, no land was excluded on this basis.
Electricity Grid	No land excluded on this basis.	■ SSE/UKPN	General commentary was provided on the current state of grid capacity within Runnymede to inform the assessment of deployment potential. Moreover, the proximity of land to substations and major transmission lines (132kV minimum) was mapped for information to indicate the locations were potential substation and T-in connections respectively could be more feasible, such as for individual community-scale wind developments. However, as grid capacity is so variable with little certainty in advance of where there could be capacity for additional electricity generation to be connected, no land was excluded on this basis for the technical assessment. Further consultation would be required with SSE/UKPN to determine the feasibility to connect specific sites to the electricity grid. Moreover, for larger wind turbine schemes, developers commonly deliver substations and additional grid infrastructure as required to support the additional generation capacity requirements of the development, limiting concerns regarding connecting to constrained parts of the existing grid.
NATS Safeguarding Areas	Guidance includes reference to the following safeguarding areas: ■ 30km for aerodromes with a surveillance radar facility; ■ 17km for non-radar equipped aerodromes with a runway of 1,100m	■ NATS	Further consultation between potential developers and NATS is required to determine if there is any impact from a proposed development. NATS safeguarding areas were therefore not excluded. They were mapped for information only.

Parameter	Assumption	Data Source	Justification and Notes
	or more, or 5km for those with a shorter runway; - 4km for non-radar equipped unlicensed aerodrome with a runway of more than 800m or 3km with a shorter runway; - 10km for the air-ground-air communication stations and navigation aids; and - 15 nautical miles (nm) for secondary surveillance radar. These are indicative of potential constraints to wind development but cannot be used to definitely exclude land as unsuitable. They are generally presented as separate figures alongside the main assessment of technical potential.		
Shadow Flicker	No land excluded on this basis.	- N/A	Wind turbines may in some circumstances cause 'shadow flicker' within nearby properties. However, shadow flicker effects are readily mitigated and so shadow flicker was not considered as a constraint for the purposes of this study.
Residential Amenity	No land excluded on this basis.	- N/A	It is noted that it may be inappropriate to develop wind turbines in proximity to residential properties, due to impacts upon residential amenity. However, due to the potential for micro siting, property aspect and potential for mitigation, it would require further site specific study to determine whether wind turbines would be suitable in proximity to residential properties. Therefore, this factor was considered within the landscape sensitivity assessment and no land was excluded on this basis from the technical assessment.
Public Rights of Way and Cycle Paths	No land excluded on this basis.	- Runnymede Borough Council - SusTrans	Public Rights of Way and cycle paths can be relatively easily diverted to ensure they are safely distanced from wind turbines. Public Rights of Way and cycle paths were therefore not excluded. They were mapped for information only.

Parameter	Assumption	Data Source	Justification and Notes
Blade Oversail of Biodiversity and Cultural Heritage Designations	No land excluded on this basis.	■ N/A	Depending on individual designated site characteristics, it may not be suitable for the blades of adjacent wind turbines to oversail the site. However, this is site dependent and would require further studies. As such, a blade oversail buffer was not excluded.

Ground-Mounted Solar Resource Assessment Parameters

A.8 Runnymede's technical potential for ground mounted solar PV development was assessed in a similar way to the potential for wind. The key GIS tool parameters are set out in **Table A - 2** below.

A.9 The maximum solar PV capacity of the area of technical potential was estimated using an assumed development density expressed as Megawatts (MW) per hectare; and regional capacity factor[28] (again, derived from historic data broken down to at least regional level).

A.10 As solar PV is essentially modular, the land with technical potential was not differentiated by project scale.

Table A - 5: Proposed assumptions to be used for assessment of technical potential for commercial/large scale ground-mounted solar – Constraints

Parameter	Assumption	Data Source	Justification and Notes
Development Size Categories	None.	■ N/A	Solar development is more 'modular' than wind (development size is dictated by the number of panels, which themselves do not differ greatly in size) and constraints are not affected by project scale in the way that they are for wind. Therefore, the identification of available land for ground-mounted solar has not been broken down into discrete project sizes but rather any land technically suitable for development has been identified.
Roads	Exclude: ■ Roads.	■ Ordnance Survey OpenRoads	Physical features preventing the development of ground-mounted solar PV were excluded. There is no requirement for safety buffers in relation to these with respect to ground-mounted solar PV. Restricted access tracks were excluded from consideration as these predominantly comprise of forestry and other tracks which could be more easily diverted than standards roads. Note: Only line data for roads was available and in order to create a footprint from the road centre, it was assumed that single carriageways are 10m in width, dual carriageways 20m and motorways 30m.
Railways	Exclude: ■ Railways.	■ Ordnance Survey OpenMap	Physical features preventing the development of ground-mounted solar PV were excluded. There is no requirement for safety buffers in relation to these with respect to ground-mounted solar PV. Note: In order to create a footprint from the railway centrelines data, it was assumed that railways were 15m in width.

[28] An energy generator's 'capacity factor' can be defined as the actual energy yield produced over a period of time expressed as a proportion of the energy yield that would have been produced if the generator had operated at its full generation capacity continuously over the same period.

Parameter	Assumption	Data Source	Justification and Notes
Planning/Land Use Other	Exclude: ■ Registered Common Land; ■ Open Access Land; ■ Suitable Alternative Natural Green Space; ■ Local Open Space; and ■ Local Green Space.	■ Natural England (Common Land) ■ Runnymede Borough Council	Due to land take requirements, these land uses/types were considered generally to constrain ground-mounted solar development, particularly at larger scales, although in some circumstances they may offer opportunities for smaller scale development collocated with their other facilities. They were excluded from the resource assessment but may be subject to bespoke policies with the Local Plan allowing development to take place in principle subject to defined criteria being satisfied.
Buildings	Exclude: ■ All buildings with a 10m buffer.	■ OS OpenMap Local data	Buildings were buffered by 10m to account for shading and impacts on solar output. It is noted that further site specific study considering building heights and orientation in relation to the site would be required to determine the exact buffers required to account for shading.
Future Developments, Safeguarded Land and Employment Sites	Exclude: ■ Housing and employment allocations from Runnymede Borough Council Plan.	■ Runnymede Borough Council	Generally these will be unsuitable for ground-mounted solar, although there may be some potential for installations on undeveloped land/open space within these areas. Identification of this potential would require a separate, site-specific study. In addition, it is assumed that opportunities for renewables within such sites will already be in development as part of their allocation. In agreement with the Council, Strategic Employment Areas were not treated as constraints. The Council confirmed that these sites are not “allocated” for future development and instead are areas of protected existing employment developments.
Existing Renewable Energy Developments	Exclude: ■ Land boundaries of consented and operational renewable energy installations.	■ BEIS ■ Aerial Imagery ■ LUC windfarm database	The quarterly BEIS Renewable Energy Planning Database and the LUC internal windfarm database was used to determine the locations of operational and consented renewable energy installations. These datasets did not indicate that there were any consented or operational wind turbine or ground mounted solar development present within Runnymede. As such, no land was excluded on this basis. Existing roof-mounded solar PV developments were not excluded, as these are building-integrated and therefore excluded via the consideration of existing build development as a constraint.

Parameter	Assumption	Data Source	Justification and Notes
			Additionally, existing landfill gas developments were not considered a constraint to wind developments, as there is potential that solar panels could be incorporated onto such existing sites. A single operational anaerobic digestion installation was identified within the authority and this was treated as a constraint to solar developments.
Minerals Sites with a 250m buffer	Exclude: ■ All operational minerals sites with a 250m buffer ■ Allocated minerals sites with a 250m buffer	■ Runnymede Borough Council	The IAQM 2016 Guidance on the Assessment of Mineral Dust Impacts for Planning indicates that adverse dust impacts from sand and gravel sites are uncommon beyond 250m and beyond 400m from hard rock quarries measured from the nearest dust generating activities.
All operational waste Sites	Exclude: ■ All operational waste sites ■ Allocated waste sites	■ Runnymede Borough Council	Waste sites will frequently be quite highly constrained with respect to ground-mounted solar development (e.g. areas of active landfill) but equally may present opportunities in some circumstances, particularly when they are to be decommissioned/restored during a plan period. Waste sites should be excluded from the identified ground-mounted solar resource but potentially subject to bespoke policy wording in the local plan.
Terrain	Exclude: ■ Areas with north-east to north-west aspect and inclinations greater than 7 degrees; and ■ All areas with inclinations greater than 15 degrees.	■ OS Terrain 50	Although it is possible to develop Ground-mounted solar PV installations on slopes facing north-east to north-west, it would generally not be economically viable to do so. However, slopes that are north-east to north-west facing and below 7° are considered potentially suitable[29], as generation output will not be significantly affected.
Agricultural Land Use	Exclude: ■ Agricultural land use classifications grades 1 and 2.	■ Natural England ■ Runnymede Borough Council	Agricultural Land Use is a consideration, with grades 1, 2 and 3a land being classed as *"the best and more versatile (BMV)"* land and having higher value for food production. Further investigation would be required of grade 3 land to determine whether it is grade 3a or b, as available data does not distinguish these. Ground-

[29] Based on current standard developer practice.

Parameter	Assumption	Data Source	Justification and Notes
			mounted Solar PV projects, over 50kWp, should ideally utilise previously developed land, brownfield land, contaminated land, industrial land or agricultural land preferably of classification 3b, 4, and 5. However, solar developments can be built on BMV land, if they have been deemed to pass the sequential test, whereby sites on lower grade a non-agricultural land are prioritised over BNM land. Within Runnymede, the majority of agricultural land is grade 3 or 4 agricultural land. As such, only grade 1 (excellent) and grade 2 (very good) agricultural land was treated as a constraint to solar development, and further site-specific study would be required to determine if sites on lower grade BMV would be suitable based on the sequential text.
Water Environment	Exclude: ■ Watercourses and waterbodies with a 50m buffer.	■ Ordnance Survey VectorMap Local	A 50m buffer was applied around all rivers and waterbodies to take account of good practice such as that relating to pollution control during construction. OS Survey OpenMap Local surface water area data includes waterways of approximately a minimum of 2m width. OpenMap Local surface water line data is line data, and so a 1m buffer was applied to approximate a footprint of smaller waterways.
Woodland	Exclude: ■ Ancient Woodland Inventory with a 20m buffer; and ■ Woodland as shown on the National Forest Inventory with a 20m buffer including: – Assumed woodland; – Broadleaved; – Conifer; – Coppice; – Coppice with standards;	■ Forestry Commission ■ Natural England	Forested areas were buffered by 20m to account for shading and impacts on solar output. It is noted that further site specific study considering woodland heights and orientation in relation to the site would be required to determine the exact buffers required to account for shading. The following National Forestry Inventory categories of woodland were considered non-permanent or non-woodland and therefore not excluded as ground mounted solar development may be suitable in these locations: ■ Cloud/shadow; ■ Uncertain; and Windblown.

Parameter	Assumption	Data Source	Justification and Notes
	– Failed; – Felled; – Group prep; – Low density; – Mixed mainly broadleaved; – Mixed mainly conifer; – Shrub; and – Young trees.		
Biodiversity (International Designations)	Exclude international designations[30]: ■ Special Protection Areas (SPA); ■ Special Areas of Conservation (SAC); and ■ Ramsar sites.	■ Natural England	As protected by: ■ Conservation of Habitats and Species Regulations 2017 (as amended)
Biodiversity (National Designations)	Exclude national designations[31]: ■ Sites of Special Scientific Interest.	■ Natural England	As protected by: ■ Wildlife and Countryside Act 1981 ■ Conservation of Habitats and Species Regulations 2017 (as amended)
Biodiversity (Regional and Local Designations)	Exclude other designations[32]: ■ Local Nature reserves; and ■ Sites of Nature Conservation Importance.	■ Natural England ■ Runnymede Borough Council	Generally, would not be suitable for renewables development based on law/policy/guidance including: ■ NPPF ■ Natural Environment and Rural Communities Act 2006

[30] There are no Potential SAC, Potential SPA or Proposed Ramsar sites present within Runnymede.
[31] There are no National Nature Reserves within Runnymede.
[32] There are no RSPB Reserves within Runnymede.

Parameter	Assumption	Data Source	Justification and Notes
Cultural Heritage	Exclude[33]: ■ Registered Parks and Gardens; ■ Scheduled Monuments; ■ Listed Buildings; ■ Locally Listed Buildings; ■ Conservation Areas; and ■ Locally Listed Heritage Assets.	■ Historic England ■ Runnymede Borough Council	As protected by: ■ NPPF ■ The Convention Concerning the Protection of the World Cultural and Natural Heritage ■ National Heritage Act 1983 ■ Ancient Monuments and Archaeological Areas Act of 1979 ■ Planning (Listed Buildings and Conservation Areas) Act 1990 The council's polygon version of the Nationally Listed Buildings dataset was used to represent Listed Buildings more accurately than the Historic England point dataset. Although solar development may not be strictly prohibited by policy within designated World Heritage Site Buffer Zones, is should be noted that it would likely be highly problematic to seek planning permission within these. It is noted that further site specific study would be required to determine if any unexpected archaeological remains or undesignated but nationally significant features are present that would require consideration, as well as the setting of historic features. Note: Locally Listed Heritage Asset point data was buffered 5m to estimate building footprints where they did not intersect the Locally Listed Building polygon data.
Minimum Development Size	Unconstrained areas of land were excluded if they were below a minimum developable size of 0.6ha.	■ N/A	A minimum development size of 0.6ha (0.5MW) was set in agreement with Runnymede Borough Council.
Development Density	1.2 hectares per MW.	■ N/A	The Draft National Policy Statement for Renewable Energy Infrastructure (EN-3) states that, along with associated infrastructure, generally a solar farm requires between 2 to 4 acres for each MW of output. This equates to 0.8-1.6ha per MW. For this study, the average of 1.2ha per MW was used.

[33] There are no Registered Battlefields or World Heritage Sites within Runnymede.

Parameter	Assumption	Data Source	Justification and Notes
			It its noted that on sites where solar farms are co-located with wind turbines, the value of MW per ha may increase as infrastructure may be able to be shared between the technologies.

Table A - 6: Proposed assumptions to be used for assessment of technical potential for commercial/large scale ground-mounted solar – Constraints considered but not used

Parameter	Assumption	Data Source	Justification and Notes
Solar Irradiance	No land excluded on this basis.	■ Global Solar Atlas	Using modern solar panel technology, the vast majority of land within England is deemed suitable for solar panel development in terms of solar irradiance. Any land unsuitable due to slope and aspect which limit the total hours of direct daily sunlight within a location, were excluded from consideration as based on the above constraints table. Therefore, no land was excluded from this assessment based on this, and solar irradiance levels they were mapped for information only to indicate where the more productive sites may be located.
MOD Land	No land excluded on this basis.	■ OpenStreetMap ■ Runnymede Borough Council	Based on Open Street Map and council data there are no MOD sites within Runnymede. As such, no land was excluded on this basis.
Areas of Outstanding Natural Beauty	No land excluded on this basis.	■ Natural England	There are no Areas of Outstanding Natural Beauty located within Runnymede. As such, no land was excluded on this basis.
National Park	No land excluded on this basis.	■ Natural England	There are no National Parks located within Runnymede. As such, no land was excluded on this basis.
Electricity Grid	No land excluded on this basis.	■ SSE/UKPN	Grid connection is a key consideration for solar developments, as additional grid connections costs, such as long cable distances and additional substation requirements, can significantly hinder the economic viability of this technology. General commentary was provided on the current state of grid capacity within Runnymede to inform the assessment of deployment potential. Moreover, the proximity of land to substations and major transmission lines (132kV minimum) was

Parameter	Assumption	Data Source	Justification and Notes
			mapped for information to indicate the locations were potential substation and T-in connections respectively could be more feasible. However, as grid capacity is so variable with little certainty in advance of where there could be capacity for additional electricity generation to be connected, no land was excluded on this basis for the technical assessment. Further consultation would be required with SSE/UKPN to determine the feasibility to connect specific sites to the electricity grid.
Residential Amenity	No land excluded on this basis.	■ N/A	It is noted that it may be inappropriate to develop solar farms in proximity to residential properties, due to impacts upon residential amenity. However, due to the potential for micro siting, property aspect and potential for mitigation, it would require further site specific study to determine whether solar developments would be suitable in proximity to residential properties. Therefore, this factor was considered within the landscape sensitivity assessment and no land was excluded on this basis from the technical assessment.
Public Rights of Way/Cycle Paths	No land excluded on this basis.	■ Runnymede Borough Council ■ DEFRA ■ SusTrans	Public Rights of Way and cycle paths can be relatively easily diverted around or safely through ground mounted solar developments, and these impacts are considered as part of the assumed development density. Public Rights of Way and cycle paths were therefore not excluded. They were mapped for information only.
Airports and Airfields	No land excluded on this basis.	■ Ordnance Survey VectorMap Local Functional Site layer with the theme 'Air Transport' ■ Aerial imagery	Glint and glare caused by solar panels is a consideration for aviation safety. However, this is site dependent and scheme design can enable solar developments to be situated within airports and airfields themselves. As such, only the airport and airfield buildings and hardstanding should treated as constraints to solar development. Although airport buildings were treated as constraints to solar development, considered under *"Buildings"*, no spatial data was available to map runways and in-use airport hardstanding. Therefore, further site-specific study would be required to make consideration of these.

Rooftop Solar Resource Assessment

A.11 The total potential capacity of roof mounted solar was estimated based on typical system sizes and the estimated percentage of suitable roof space within the study area. Roofs that have potential to deliver solar PV also have the potential to deliver solar water heating generation. However, this was treated as being mutually exclusive with solar PV potential, i.e. the same roof space can only be utilised for one of the technologies. Generation potential was therefore calculated for each technology for separate comparison.

Table A - 7: Proposed assumptions to be used for assessment of technical potential for rooftop solar PV

Parameter	Assumption	Data Source	Justification and Notes
System Size	Average size of system based on property type: ▪ Detached: 4kW[34] ▪ Semi-detached[35]: 2.6kW ▪ Terrace/end-terrace[36]: 2.2kW ▪ Non-domestic: 28.0kW[37]	▪ BEIS	Typical system sizes for dwellings were estimated based on Energy Saving Trust Data[38]. Due to lack of appropriate data on typical system sizes and suitability of roofs, dwellings classed as 'flats', 'in part of a converted or shared house (including bedsits)' and those classed as 'other dwellings' were not included within the assessment. Average sized solar PV systems in Runnymede for non-domestic installations recorded on the FiT Register up to March 2019 was 27.8kW.
Suitable Roofs	Proportion of properties with suitable roofs (estimate): ▪ 40% of dwellings[39]; and ▪ 75% of non-domestic properties[40].	▪ OS Addressbase ▪ OS OpenMap	Proportions estimated from prior research undertaken by CSE, which considered suitable type and orientation of roof, and space availability[41]. Conservation areas and listed buildings were not treated as constraints to rooftop solar generation. Permitted development rights in England allow solar to be installed within conservation areas provided this is not on walls fronting a highway. In addition, rooftops solar generation has the potential to be installed in this circumstance and on any listed buildings through the granting of planning permission. Properties were included in the assessment based on Runnymede LLPG Address data (see **Table A - 1**).

34 Average detached house.
35 Average semi-detached house.
36 Modern mid-terrace or end terrace.
37 BEIS (2020) Sub-regional Feed-in Tariffs statistics: March 2019. Available at: https://www.gov.uk/government/statistical-data-sets/sub-regional-feed-in-tariffs-confirmed-on-the-cfr-statistics
38 Energy Saving Trust (2015) Solar Energy Calculator Sizing Guide. Available at: https://www.pvfitcalculator.energysavingtrust.org.uk/Documents/150224_SolarEnergy_Calculator_Sizing_Guide_v1.pdf
39 Detached, semi-detached and terrace/end terrace.
40 Excluding land, car parking, utilities, marina and moorings, and objects of interest.
41 LUC and CSE (2020) Test Valley Renewable and Low Carbon Energy Study. Available at: https://www.testvalley.gov.uk/planning-and-building/planningpolicy/evidence-base/evidence-base-environment

Parameter	Assumption	Data Source	Justification and Notes

Table A - 8: Proposed assumptions to be used for assessment of technical potential for rooftop solar water heating

Parameter	Assumption	Data Source	Justification and Notes
System Size	Average size of system based on property type: ■ Domestic: 2.8kW ■ Non-domestic: 18.8kW	■ BEIS	Average sizes for solar water heating systems obtained from RHI deployment data[42]. Due to lack of appropriate data on typical system sizes and suitability of roofs, dwellings classed as 'flats', 'in part of a converted or shared house (including bedsits)' and those classed as 'other dwellings' were not included within the assessment.
Suitable Roofs	See above – the same as for roof-mounted solar PV.	■ See above – the same as for roof-mounted solar PV.	See above – the same as for roof-mounted solar PV.
Heating Fuel Offset	Heating fuel assumed to be offset: ■ Electricity: 50% of off-gas properties ■ Oil: 50% of off-gas properties ■ Gas: All on-gas properties	■ BEIS	The actual proportions of electricity and oil usage by off-gas properties is unknown. As such, an illustrative 50% of these properties are estimated to be fuelled by electricity and 50% by oil for the purposes of this study.

Hydropower

A.12 It has not been possible within the scope of this study to undertake a new assessment of the potential hydropower resource within Runnymede.

A.13 However, in 2010 the Environment Agency published the findings of a study identifying hydropower opportunities within England and Wales. This was produced to provide an overview at national and regional scales of the potential hydropower opportunities available, as well as the relative environmental sensitivity of identified potential sites to development. These findings were reviewed as part of this study. It is noted that this data is indicative and that further site specific study would be required in order to determine the technical potential and suitability of sites for hydropower developments.

A.14 The study included identifying 'heavily modified water bodies' that are identified as being at significant risk of failing to achieve good ecological status because of modifications to their

[42] BEIS (2022) RHI monthly deployment data: January 2022. Available at: https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-january-2022

hydromorphological characteristics resulting from past engineering works, including impounding works. Due to these characteristics, such waterbodies were identified as having the potential to create hydropower barriers that would also be beneficial to the passage of fish upstream. These were overlayed with identified locations where suitable yearly flow characteristics are present and could feasibly support hydropower sites. The resultant identified sites were classified as ‘win-win’ opportunities where hydropower developments could potentially be installed whilst also improving the ecological status of waterways.

Heat Pumps

Air Source Heat Pumps

Almost any building theoretically has the potential for an air source heat pump to be installed. Therefore, the assessment considered the potential for air source heat pumps to be delivered in all buildings as based on Runnymede LLPG Address data (see **Table A - 1**).

Table A - 9: Proposed assumptions to be used for assessment of technical potential for air source heat pumps

Parameter	Assumption	Data Source	Justification and Notes
System Size	Average size of system based on property type: - Domestic: 10.1kW - Non-domestic: 60.8kW	- BEIS - OS Addressbase - OS OpenMap	Average sizes for air source heat pump systems obtained from RHI deployment data[43].
Heating Fuel Offset	SPF: 3.5 (efficiency of 71%). Heating fuel assumed to be offset: - Electricity: 50% of off-gas properties - Oil: 50% of off-gas properties - Gas: All on-gas properties	- BEIS	SPF derived from BEIS Renewable Heat Incentive data: 3.5[44]. For every 3.3kW of heat generated, offsetting CO_2 from the existing heating fuel (gas/oil/electricity), 1kW of energy is consumed, contributing to CO_2 generated by consuming electricity. The actual proportions of electricity and oil usage by off-gas properties is unknown. As such, an illustrative 50% of these properties are estimated to be fuelled by electricity and 50% by oil for the purposes of this study.

Ground Source Heat Pumps

A.15 Ground source heat pumps require more space than air source, requiring pipes to be buried vertically in a deeper system or horizontally in a shallow wider system. Due to these significant space constraints, this study did not estimate the potential capacity of ground source heat pumps across the study area, as it was not possible to estimate how many properties have access to the required space.

A.16 It is noted however that the average system size of domestic pumps are 14.6 kW[45].

Open Loop Ground Source Heat Pumps

A.17 The British Geological Survey has produced a map identifying the potential viability of open-loop ground source heat pumps across England and Wales, considering hydrogeological and economic factors[46]. This indicates that land within Runnymede is favourable for open-loop ground source heat pumps.

A.18 However, the British Geological Survey states that this is an initial screening assessment only and that identified areas favourable for open-loop systems are not automatically suitable for this technology to be installed. Instead, detailed environmental assessment of proposed sites would be required, considering local variations in environmental conditions and factors

[43] BEIS (2022) RHI monthly deployment data: January 2022. Available at: https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-january-2022
[44] BEIS (2022) RHI monthly deployment data: January 2022. Available at: https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-january-2022
[45] BEIS (2022) RHI monthly deployment data: January 2022. Available at: https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-january-2022
[46] British Geological Survey (2021) Open-loop ground source heat pump viability screening map. Available at: https://www.bgs.ac.uk/technologies/web-map-services-wms/open-loop-ground-source-heat-pump-viability-screening-map-wms/

such as the availability of water (i.e. the amount of water that is available for licensing by the Environment Agency) and discharge of water from a scheme[47]. Therefore, with the data available, it is not possible to determine the potential annual energy generation and carbon savings that could be produced by open loop ground source heat pumps within Runnymede.

Water-Source Heat Pump

A.19 The DECC 2014 water source heat map identified, at a high level, opportunities for water source heat pump technologies[48]. This was reviewed as part of this study.

A.20 Although it has not been possible within the scope of this study to assess the potential for water source heat pumps, the sensitivity analysis included in the 2014 DECC water source heat map identified the River Thames as having a heat capacity of between 334 MW. Viability would largely depend on having a sufficiently high heat demand local to the potential heat pump location.

Geothermal

A.21 At present, geothermal energy is understood to be exploited in a limited number of locations around the UK; predominantly within Cornwall and the Lake District/Weardale where the highest heat flows within the UK are present.

A.22 To investigate localised potential for geothermal energy generation, specialist surveys would need to be undertaken. However, before pursuing this it is recommended that the Council monitors the progress of this technology in other locations in order to understand the potential technical and economic viability of geothermal generation and how this is applicable to Runnymede.

Biomass Resource Assessment

Virgin Woodfuel Thermal Conversion: Forestry and Woodland

A.23 To determine the potential for biomass generation from forestry and woodland, it was assumed that all woodland within the study area has a sustainable yield of two odt/yr (oven-dried tonnes/ha/year)[49] and assumptions (see **Table A - 10**) were applied. Both the potential for heating and for combined heat and power were calculated.

A.24 To identify existing suitable woodland within the study area, the Forestry Commission's National Forest Inventory (NFI) was used. The NFI records the location and extent of all forests and woodland above 0.5ha across the UK and it is noted that although a sample of forests and woodland are ground surveyed every 5 years, the inventory is updated annually using aerial photography, interpretation of satellite imagery and administrative records of newly planted areas covered by government grant schemes[50]. Therefore, there can be occasional errors due to misidentification of sites not ground-surveyed.

A.25 To calculate the total capacity of the resource in MW from the annual generation potential in MWh, a national capacity factor was applied, as based on national data for plant-sourced biomass[51].

Table A - 10: Proposed assumptions to be used for assessment of technical potential for virgin woodfuel thermal conversion: forestry and woodland

[47] British Geological Survey (2012) Non-Technical Guide: A screening tool for open-loop ground source heat pump schemes (England and Wales). Available at: https://www.bgs.ac.uk/geology-projects/geothermal-energy/open-loop-gshp-screening-tool/
[48] DECC (2015) National Heat Map: Water source heat map layer. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/416660/water_source_heat_map.PDF
[49] Forestry Research (2021) Potential yields of biofuels per ha p.a. Available at: https://www.forestresearch.gov.uk/tools-and-resources/fthr/biomass-energy-resources/reference-biomass/facts-figures/potential-yields-of-biofuels-per-ha-pa/. Data for Wood (forestry residues, SRW, thinnings, etc.).
[50] Forestry Commission (2019) About the NFI. Available at: https://www.forestresearch.gov.uk/tools-and-resources/national-forest-inventory/about-the-nfi/
[51] BEIS (2022) Load factors for renewable electricity generation. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1094495/DUKES_6.3.xlsx

Parameter	Assumption	Data Source	Justification and Notes
Woodland Resource	The following National Forestry Inventory (NFI) woodland categories within the study area were included: ■ Assumed woodland; ■ Broadleaved; ■ Conifer; ■ Coppice; ■ Coppice with standards; ■ Mixed mainly conifer; and ■ Mixed mainly broadleaved. Energy generation per hectare per year: 10.3 MWh/ha/year	■ Forestry Commission	These woodland categories were included as they were assumed to be mature and able to provide a sustainable yield of woodfuel. The following woodland categories were not included as they were assumed to currently be unable to provide a sustainable yield of woodfuel: ■ Assumed woodland; ■ Cloud\shadow; ■ Failed; ■ Felled; ■ Ground prep; ■ Low density; ■ Shrub; ■ Uncertain; ■ Windblow; and ■ Young trees. The non-woodland categories within the NFI were also not assessed as they do not provide woodfuel. The assumed energy generation per hectare per year is derived from Forestry Commission data[52].
Constraints	The following constrained areas of woodland were excluded from the assessment[53]: ■ Ancient woodland; ■ Special Protection Areas (SPA);	■ Natural England ■ Historic England ■ Runnymede Borough Council	As protected by: ■ Conservation of Habitats and Species Regulations 2017 (as amended) ■ Wildlife and Countryside Act 1981

[52] Forestry Research (2023) Potential yields of biofuels per ha p.a. Available at: https://www.forestresearch.gov.uk/tools-and-resources/fthr/biomass-energy-resources/reference-biomass/facts-figures/potential-yields-of-biofuels-per-ha-p-a/. Data for Wood (forestry residues, SRW, thinnings, etc.).
[53] There are no Potential SAC, Potential SPA, Proposed Ramsar sites, National Nature Reserves, RSPB Reserves Registered Battlefields, World Heritage Sites, MOD land or National Parks present within Runnymede.

Parameter	Assumption	Data Source	Justification and Notes
	■ Special Areas of Conservation (SAC); ■ Ramsar sites; ■ Sites of Special Scientific Interest; ■ Local Nature Reserves; ■ Sites of Nature Conservation Importance; ■ Registered Parks and Gardens; ■ Scheduled Monuments; ■ Listed Buildings; ■ Locally Listed Buildings; ■ Conservation Areas; ■ Locally Listed Heritage Assets; and ■ Housing and employment sites.		■ Conservation of Habitats and Species Regulations 2017 (as amended) ■ NPPF ■ Natural Environment and Rural Communities Act 2006 ■ Runnymede 2030 Local Plan
Heating Fuel Offset: Heating Only	Boiler efficiency assumed to be 77%[54]. Heating fuel assumed to be offset: ■ Electricity: 50% of off-gas properties ■ Oil: 50% of off-gas properties ■ Gas: All on-gas properties	■ BEIS	Biomass boiler efficiency derived from research by BEIS[55]. The actual proportions of electricity and oil usage by off-gas properties is unknown. As such, an illustrative 50% of these properties are estimated to be fuelled by electricity and 50% by oil for the purposes of this study.

[54] BEIS (2018) Measurement of the in-situ performance of solid biomass boilers. Available at: https://www.gov.uk/government/publications/biomass-boilers-measurement-of-in-situ-performance. As this study is calculating the potential energy generation from a known amount of fuel, as opposed to an infinite energy supply such as wind, only the boiler efficiency was considered to calculate the overall energy generation potential, not the load factor for biomass boilers, which considered the percentage of time a boiler is operating at peak output annually.

[55] BEIS (2018) Measurement of the in-situ performance of solid biomass boilers. Available at: https://www.gov.uk/government/publications/biomass-boilers-measurement-of-in-situ-performance

Parameter	Assumption	Data Source	Justification and Notes
Fuel Offset: Combined Heat and Power (CHP)	CHP efficiency: ■ Electricity: 30% ■ Heating: 50% Heating fuel assumed to be offset: ■ Electricity: 50% of off-gas properties ■ Oil: 50% of off-gas properties ■ Gas: All on-gas properties	■ CSE	Average CHP efficiencies estimated from prior research undertaken by CSE[56].

Virgin Woodfuel Thermal Conversion: Energy Crops

A.26 To determine the potential for biomass generation via thermal conversion (burning within a boiler) from the two main woodfuel energy crops Miscanthus and Short Rotation Coppice (SRC), the below assumptions (**Table A - 4**) were applied. Both the potential for heating and for combined heat and power were calculated.

A.27 To calculate the total capacity of the resource in MW from the annual generation potential in MWh, a national capacity factor was applied, as based on national data for plant-sourced biomass[57].

Table A - 11: Proposed assumptions to be used for assessment of technical potential for virgin woodfuel thermal conversion: energy crops

Parameter	Assumption	Data Source	Justification and Notes
Energy Crop Resource	Yields: ■ Miscanthus: 13 odt/ha/year ■ SRC: 9 odt/ha/year Ratio of crops per hectare:	■ Forestry Commission	Miscanthus and SRC yields and assumed energy generation per hectare per year was derived from Forestry Commission data[58].

[56] LUC and CSE (2020) Test Valley Renewable and Low Carbon Energy Study. Available at: https://www.testvalley.gov.uk/planning-and-building/planningpolicy/evidence-base/evidence-base-environment
[57] BEIS (2022) Load factors for renewable electricity generation. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1094495/DUKES_6.3.xlsx
[58] Forestry Research (2023) Potential yields of biofuels per ha p.a. Available at: https://www.forestresearch.gov.uk/tools-and-resources/fthr/biomass-energy-resources/reference-biomass/facts-figures/potential-yields-of-biofuels-per-ha-p-a/.

Parameter	Assumption	Data Source	Justification and Notes
	■ Miscanthus: 80% ■ SRC: 20% Energy generation per hectare per year: ■ Miscanthus: 63 MWh/ha/year ■ SRC: 46 MWh/ha/year		The average proportion of miscanthus and SRC grown in the UK was derived from Defra data[59]. The analysis assumed that of the land identified as suitable for energy crops, 4ha of Miscanthus would be delivered for every 1ha of SRC.
Constraints	Agricultural land constraints for miscanthus: ■ Grade 1 ■ Grade 2 ■ Grade 5[60] ■ Non-agricultural land Agricultural land constraints for SRC: ■ Grade 1 ■ Grade 2 ■ Non-agricultural land Physical constraints[61]: ■ Roads ■ Railways ■ Registered Common Land ■ Open Access Land	■ Aerial imagery ■ BEIS ■ Forestry Commission ■ Land Registry ■ Natural England ■ Ordnance Survey OpenMap ■ Ordnance Survey OpenRoads ■ Runnymede Borough Council	The NNFCC energy crops report produced for DECC indicates that miscanthus planting should be restricted to good and moderate quality (Grade 3) and poor quality (Grade 4) agricultural land and that SRC can grow on this land as well as very poor (Grade 5) land[64]. Excellent quality (Grade 1) and very good quality (Grade 2) agricultural land has the potential to deliver the highest crop yields and as such it was assumed that food crops would be prioritised above energy crops on this land. Physical features preventing the planting of energy crops were excluded. With regards to existing renewable energy developments, only existing ground-mounted solar farms were excluded as their land take prevents crop planting. Wind turbines have a far smaller land-take and crops could in theory be planted beneath and surround int turbines within a wind farm. In addition, designated sites were also excluded, as protected by: ■ Conservation of Habitats and Species Regulations 2017 (as amended) ■ Wildlife and Countryside Act 1981 ■ Conservation of Habitats and Species Regulations 2017 (as amended) ■ NPPF ■ Natural Environment and Rural Communities Act 2006

[59] Defra (2021) Crops Grown For Bioenergy in the UK: 2020. Available at:https://www.gov.uk/government/statistics/area-of-crops-grown-for-bioenergy-in-england-and-the-uk-2008-2020.
[60] There is no Grade 5 agricultural land located within Runnymede.
[61] There is no MOD land, National parks, Potential SAC, Potential SPA or Proposed Ramsar sites, National Nature Reserves, RSPB Reserves present within Runnymede.
[64] NNFCC (2012) Domestic Energy Crops; Potential and Constraints Review. Available at: https://www.gov.uk/government/publications/domestic-energy-crops-potential-and-constraints-review

Parameter	Assumption	Data Source	Justification and Notes
	■ Suitable Alternative Natural Green Space ■ Local Open Space ■ Local Green Space ■ Buildings ■ Airports and airfields ■ Housing and employment sites ■ Existing solar farms[62] ■ Watercourses and waterbodies ■ Woodland and ancient woodland Natural heritage constraints: ■ Special Protection Areas (SPA) ■ Special Areas of Conservation (SAC) ■ Ramsar sites ■ Sites of Special Scientific Interest ■ Local Nature Reserves ■ Sites of Nature Conservation Importance Cultural heritage constraints[63]: ■ Registered Parks and Gardens ■ Scheduled monuments		■ The Convention Concerning the Protection of the World Cultural and Natural Heritage ■ National Heritage Act 1983 ■ Ancient Monuments and Archaeological Areas Act of 1979 ■ Planning (Listed Buildings and Conservation Areas) Act 1990 Note: Only line data for roads was available and in order to create a footprint from the road centre, it was assumed that single carriageways are 10m in width, dual carriageways 20m and motorways 30m. In order to create a footprint from the railway centrelines data, it was assumed that railways were 15m in width. Locally Listed Heritage Asset point data was buffered 5m to estimate building footprints where they did not intersect the Locally Listed Building polygon data.

[62] The quarterly BEIS Renewable Energy Planning Database was used to determine the locations of operational and consented renewable energy installations. These datasets did not indicate that there were any consented or operational ground mounted solar development present within Runnymede. As such, no land was excluded on this basis.
[63] There are no Registered Battlefields or World Heritage Sites within Runnymede.

Parameter	Assumption	Data Source	Justification and Notes
	■ Listed Buildings ■ Locally Listed Buildings ■ Conservation Areas ■ Locally Listed Heritage Assets		
Heating Fuel Offset: Heating Only	Boiler efficiency assumed to be 77%[65]. Heating fuel assumed to be offset: ■ Electricity: 50% of off-gas properties ■ Oil: 50% of off-gas properties ■ Gas: All on-gas properties	■ BEIS	Biomass boiler efficiency derived from research by BEIS[66]. The actual proportions of electricity and oil usage by off-gas properties is unknown. As such, an illustrative 50% of these properties are estimated to be fuelled by electricity and 50% by oil for the purposes of this study.

[65] BEIS (2018) Measurement of the in-situ performance of solid biomass boilers. Available at: https://www.gov.uk/government/publications/biomass-boilers-measurement-of-in-situ-performance. As this study is calculating the potential energy generation from a known amount of fuel, as opposed to an infinite energy supply such as wind, only the boiler efficiency was considered to calculate the overall energy generation potential, not the load factor for biomass boilers, which considered the percentage of time a boiler is operating at peak output annually.
[66] BEIS (2018) Measurement of the in-situ performance of solid biomass boilers. Available at: https://www.gov.uk/government/publications/biomass-boilers-measurement-of-in-situ-performance

Parameter	Assumption	Data Source	Justification and Notes
Fuel Offset: Combined Heat and Power (CHP)	CHP efficiency: - Electricity: 30% - Heating: 50% Heating fuel assumed to be offset: - Electricity: 50% of off-gas properties - Oil: 50% of off-gas properties - Gas: All on-gas properties	- CSE	Average CHP efficiencies estimated from prior research undertaken by CSE[67].

Biogas from agricultural residues

A.28 Although Runnymede is not predominantly rural, agricultural waste is still a potential renewable energy resource, particularly from using livestock slurry as a feedstock for the anaerobic digestion process. Using estimates from Defra statistics on animal numbers for 2022[68] and resulting slurry and biogas yields, an estimate has been made of the potential emissions savings.

A.29 To calculate the total capacity of the resource in MW from the annual generation potential in MWh, a capacity factor was applied, as based on national data for anaerobic digestion[69].

[67] LUC and CSE (2020) Test Valley Renewable and Low Carbon Energy Study. Available at: https://www.testvalley.gov.uk/planning-and-building/planningpolicy/evidence-base/evidence-base-environment
[68] Defra (2023) Structure of the agricultural industry in England and the UK at June. Available at: https://www.gov.uk/government/statistical-data-sets/structure-of-the-agricultural-industry-in-england-and-the-uk-at-june
[69] BEIS (2022) DUKES chapter 6: statistics on energy from renewable sources. Load factors for renewable electricity generation (DUKES 6.5). Available at: https://www.gov.uk/government/statistics/renewable-sources-of-energy-chapter-6-digest-of-united-kingdom-energy-statistics-dukes

Table A – 12: Proposed assumptions to be used for assessment of technical potential for biogas from agricultural residues

Parameter	Assumption	Data Source	Justification and Notes
Slurry Resource	Number of animals required to produce 1 tonne of slurry per day: ■ Cattle: 30 ■ Pigs: 275 ■ Poultry: 10,500 Biogas yield: ■ Cattle: 20m^3/tonne ■ Pigs: 20m^3/tonne ■ Poultry: 65m^3/tonne Energy content of biogas: ■ 6.7kWh per m^3	■ Shared Practice ■ The Andersons Centre	The number of animals required to produce 1 tonne of slurry per day was derived from the average of the figure brackets provided in the Shared Practice Anaerobic Digestion Good Practice Guidelines[70]: ■ Cattle: 20-40 ■ Pigs: 250-300 ■ Poultry: – Laying hen litter: 8,000-9,000 – Broiler manure: 10,000-15,000 Biogas yields derived from the average of the figure brackets provided in The Andersons Centre data[71]: ■ Cattle: 15-25 m^3/tonne ■ Pigs: 15-25 m^3/tonne ■ Poultry: 30-100 m^3/tonne Energy content of biogas also derived from The Andersons Centre data.
Heating and Electricity Fuel Offset	CHP plant efficiency[72]: ■ Heat: 50% ■ Electricity: 30%	■ The Andersons Centre	CHP plant efficiency derived from The Andersons Centre data[73]. The actual proportions of electricity and oil usage by off-gas properties is unknown. As such, an illustrative 50% of these properties are estimated to be fuelled by electricity and 50% by oil for the purposes of this study.

[70] Shared Practice (1997) Good Practice Guidelines: Anaerobic Digestion of farm and food processing residues. Available at: http://www.sharedpractice.org.uk/Library/library.html
[71] The Andersons Centre (2010) A Detailed Economic Assessment of Anaerobic Digestion Technology and its Suitability to UK Farming and Waste Systems. Available at: https://theandersonscentre.co.uk/service/economic-analysis/
[72] As this study is calculating the potential energy generation from a known amount of fuel, as opposed to an infinite energy supply such as wind, only the CHP efficiency was considered to calculate the overall energy generation potential, not the load factor for biogas CHP units, which considered the percentage of time a boiler is operating at peak output annually.
[73] The Andersons Centre (2010) A Detailed Economic Assessment of Anaerobic Digestion Technology and its Suitability to UK Farming and Waste Systems. Available at: https://theandersonscentre.co.uk/service/economic-analysis/

Parameter	Assumption	Data Source	Justification and Notes
	Heading fuel assumed to be offset: ■ Electricity: 50% of off-gas properties ■ Oil: 50% of off-gas properties ■ Gas: All on-gas properties		

Energy from Waste

A.30 The Surrey County Council Waste Needs Assessment, Annual Monitoring Report and Waste Local Plan were reviewed to assess the energy generation potential from waste.

Landfill Gas

1.3 It is assumed that the large majority of opportunities for gas obtained from landfill in Runnymede have already been developed, although it has not been possible to quantify amount or the energy produced. BEIS[74] data indicates there are three operational landfill gas developments, totalling 9.6MW, within Runnymede. District Heating

A.31 Heat networks can provide a more efficient way of delivering heating to a group of buildings when compared to stand-alone heating systems. CSE undertook this assessment using a sophisticated 3D demand model to estimate building heat demand and identified areas with potential for heat networks, including producing a GIS map layer locating them. This included identifying the co-location of key 'anchor' heat loads and significant building energy demands, including development sites, identifying clusters with most potential for heat networks.

Grid Capacity

A.32 The ability to connect to the electricity grid can be a limiting factor in the deployment of all larger energy developments where the energy generated is to be exported.

A.33 In the UK, the distribution network was designed for a 'top down' flow of electricity, from small numbers of very large power stations. However, the increasing deployment of distributed generation from renewable and low-carbon sources is causing new challenges for the electricity network, with ever-larger areas of the network reaching maximum capacity. In these areas, the grid is no longer able to accept new grid connections for supply of power.

A.34 Due to this constrained nature of the network, the near-term opportunities for new renewable energy deployment are therefore limited to areas where there is capacity still available, or to an existing connection that isn't being fully utilised. Such sites provide the opportunity to host additional generating capacity without the need for a new grid connection. Identifying such sites within Runnymede will require engagement with site operators and/or SSE/UKPN. Additionally, DNOs regularly upgrade the network to create extra capacity, which can be applied for in advance, even when these upgrades take years to come online. It is therefore worth periodically checking with the DNO on capacity at a specific site of interest.

A.35 As noted above, grid connection is a particularly key consideration for ground mounted solar developments, as additional grid connections cost, such as long cable distances and additional substation requirements, can significantly hinder the economic viability of this technology in the current post-subsidy climate. General commentary was provided on the

[74] BEIS (2023) Renewable Energy Planning Database: quarterly extract - January 2023. Available at: https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract.

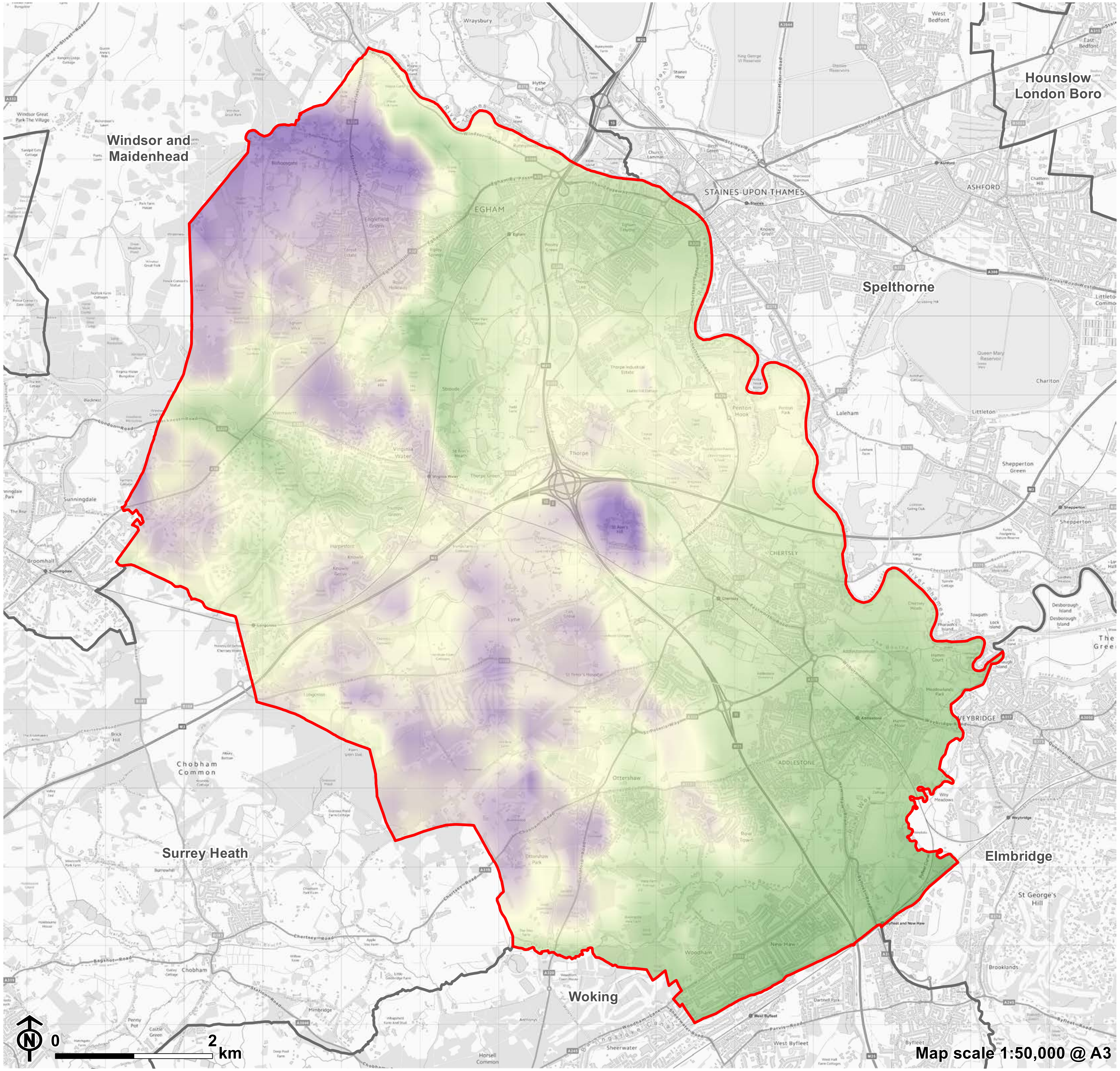
current state of grid capacity within Runnymede to inform the assessment of deployment potential. Further consultation where possible with the local DNO was undertaken to inform commentary on this topic.

Appendix B

Wind Maps

Runnymede Renewable Energy Study
Runnymede Borough Council

Figure B-1: Wind constraints - Wind speed at 50m above ground level



Runnymede boundary
Neighbouring Local Authority

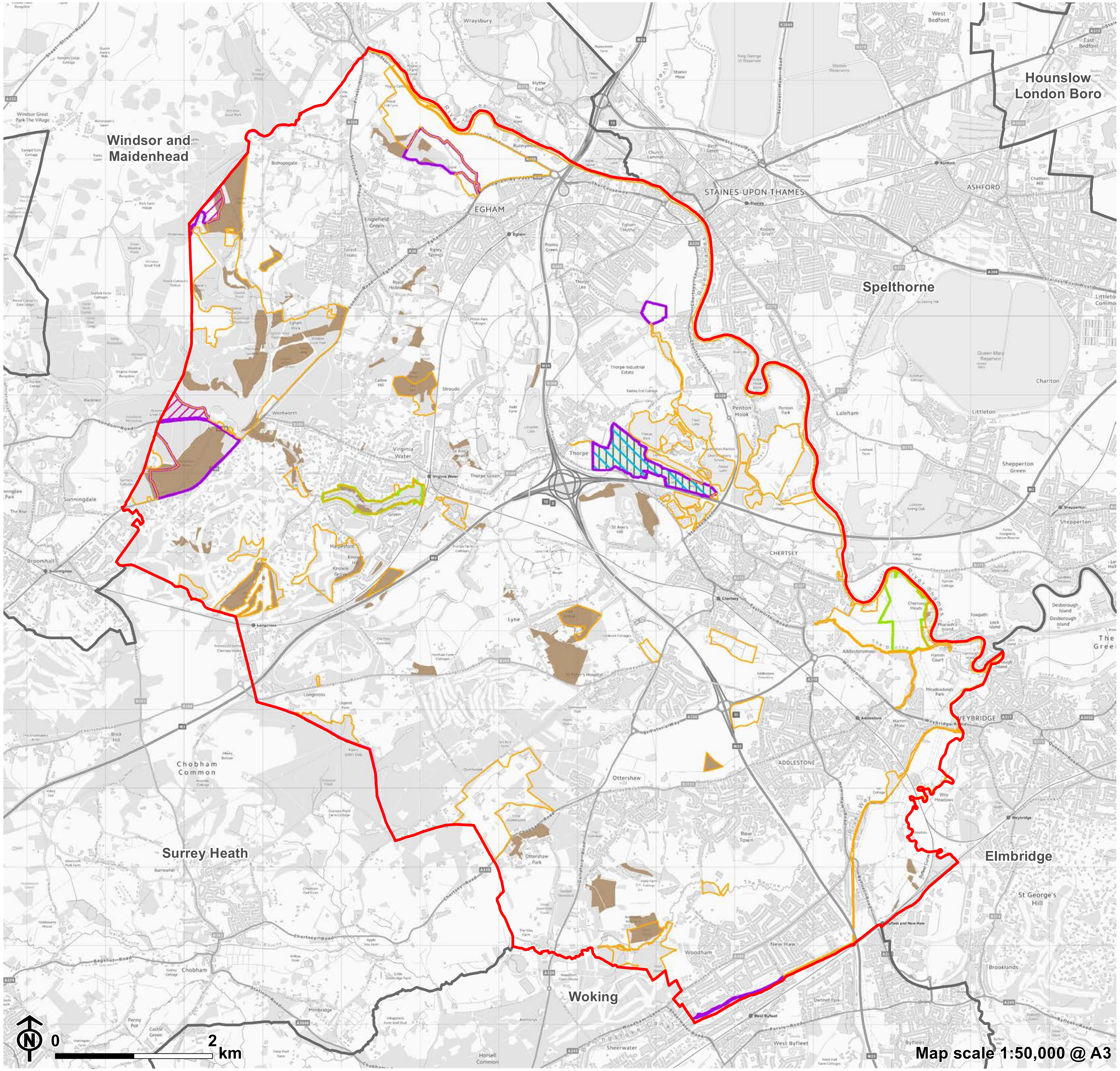
Wind speed at 50m above ground level
7.05 m/s
5.29 m/s

Global Wind Atlas 3.0, a free, web-based application developed, owned and operated by the Technical University of Denmark (DTU). The Global Wind Atlas 3.0 is released in partnership with the World Bank Group, utilizing data provided by Vortex, using funding provided by the Energy Sector Management Assistance Program (ESMAP). For additional information: https://globalwindatlas.info

CB:PS EB:kaczor_a LUC 12212_r0_Fig_B_1_WindConstraints_50mGroundLevel 02/05/2023
Source:OS, GWA

Runnymede Renewable Energy Study
Runnymede Borough Council

Figure B-2: Wind constraints - Natural Heritage Constraints



- Runnymede boundary
- Neighbouring Local Authority
- Sites of Nature Conservation Importance
- Local Nature Reserve
- Sites of Special Scientific Interest
- Special Protection Area
- Special Area of Conservation
- RAMSAR
- Ancient woodland

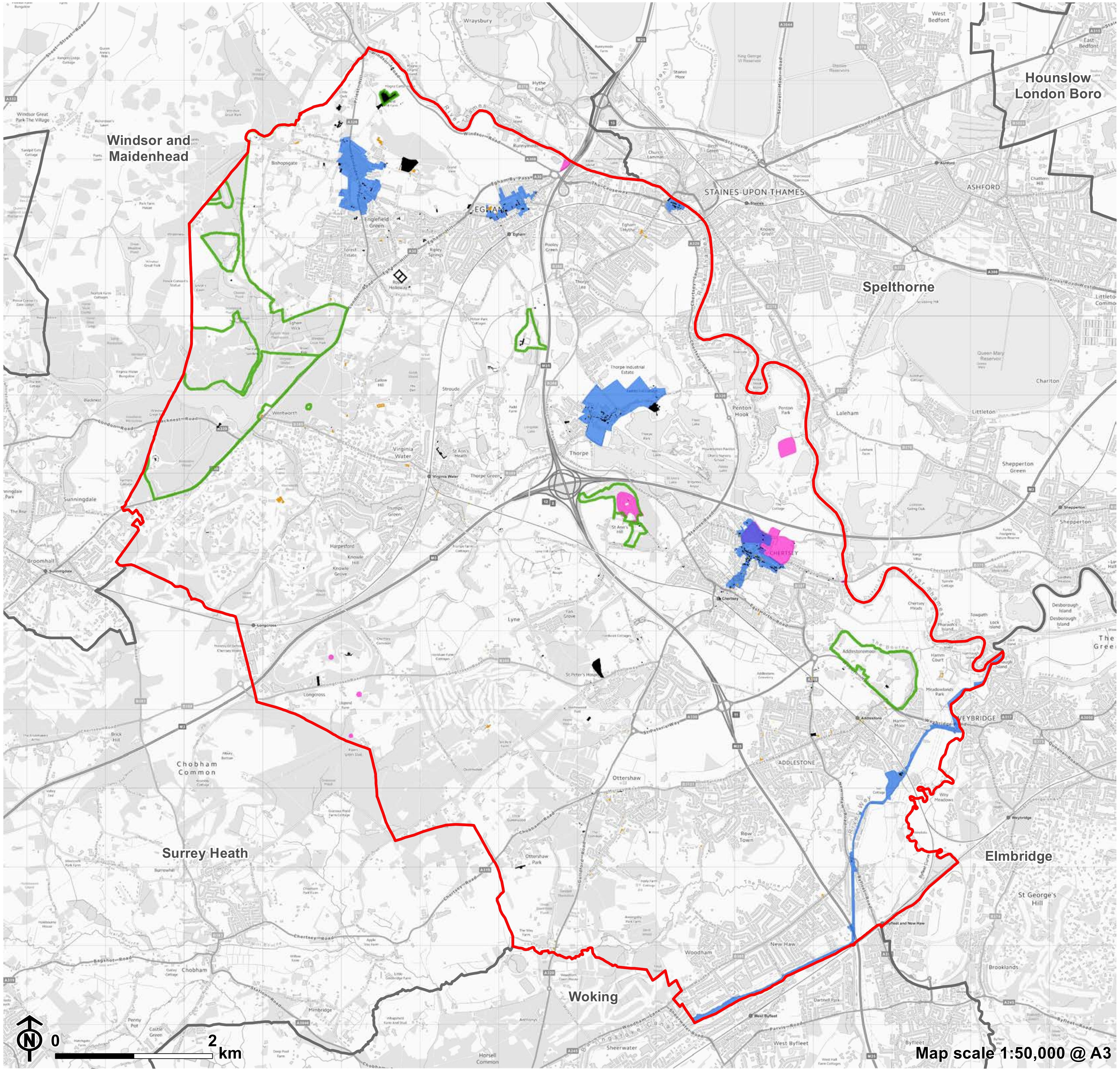
CB:PS EB:kaczor_a LUC 12212_r0_Fig_B_2_r0_WindConstraints_NaturalHeritage_A3L 02/05/2023

Source:RBC, OS, NE

Runnymede Renewable Energy Study
Runnymede Borough Council

Figure B-3: Wind constraints - Cultural Heritage constraints

- Runnymede boundary
- Neighbouring Local Authority
- Conservation area
- Registered Parks and Gardens
- Locally Listed Heritage Asset
- Locally Listed Building
- Listed Building
- Scheduled Monument



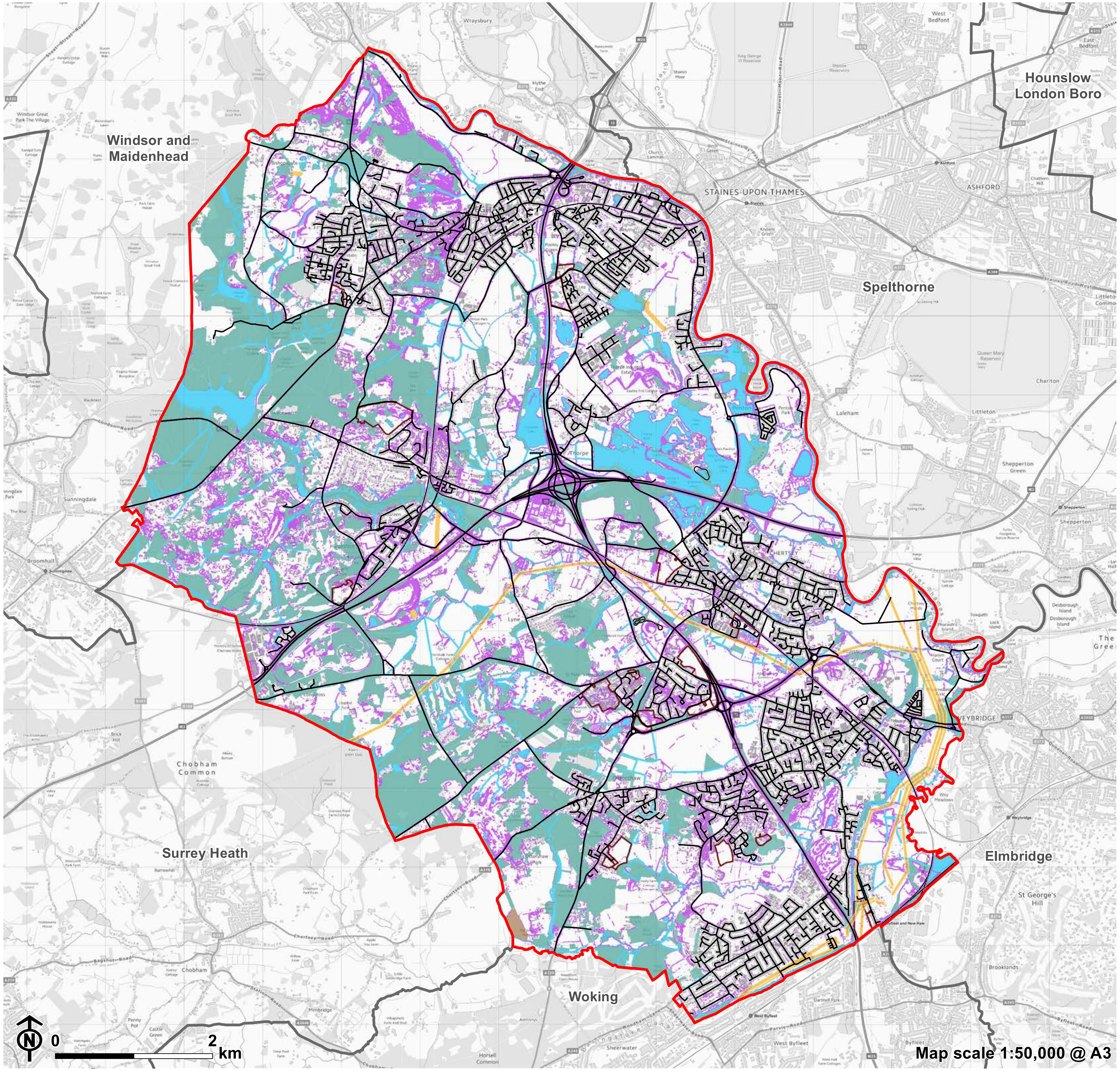
CB:PS EB:kaczor_a LUC 12212_r0_Fig_B_3_r0_WindConstraints_CulturalHeritage_A3L 02/05/2023

Source: RBC, HE, OS

Runnymede Renewable Energy Study
Runnymede Borough Council

LUC

Figure B-4: Wind constraints - Physical

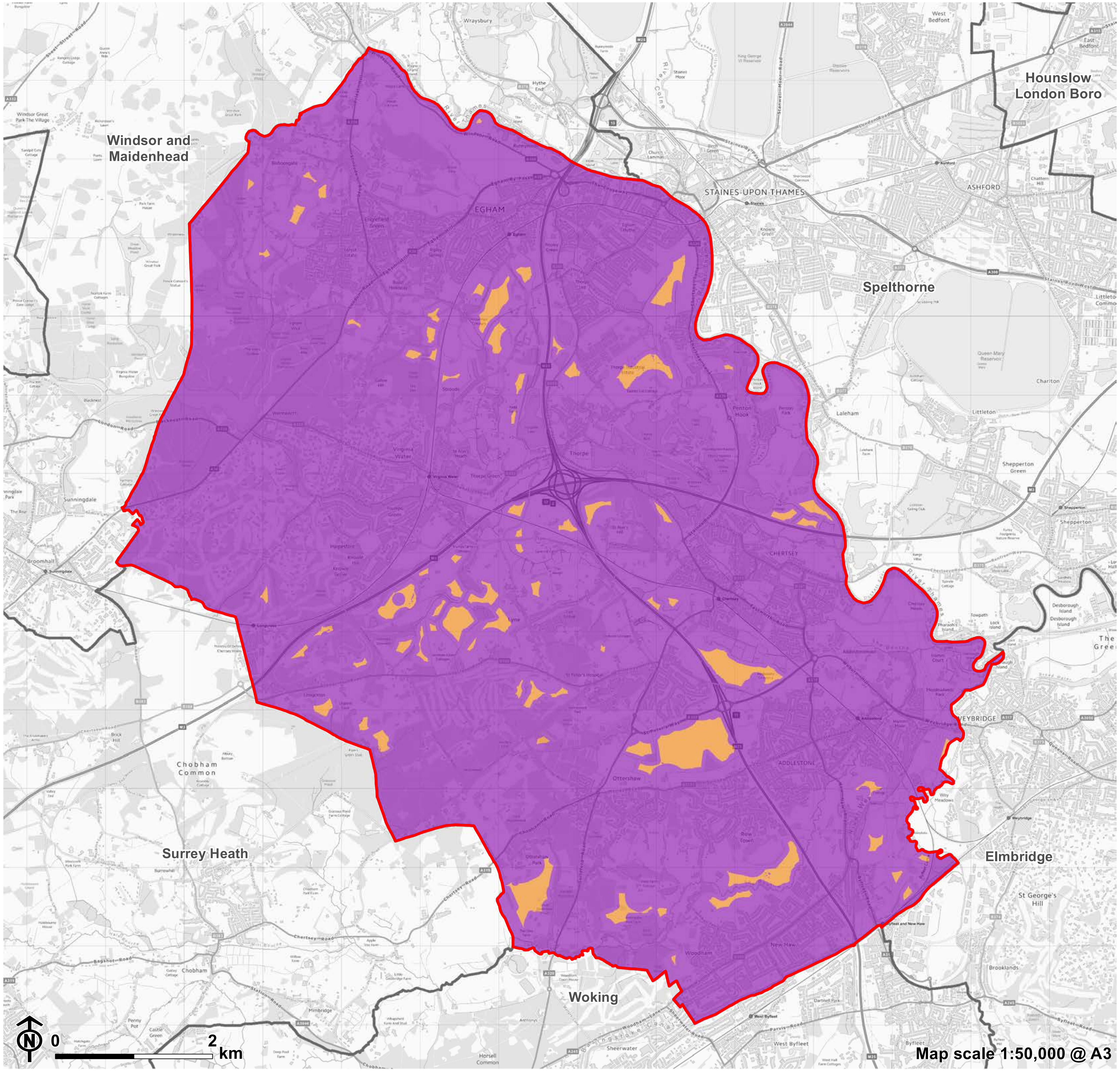


- Runnymede boundary
- Neighbouring Local Authority
- Roads and railways
- Electricity lines
- Airports and airfield
- Building
- Watercourses and water bodies
- Existing renewable development
- Woodland
- Slope above 15%
- Housing/employment allocation

CB:PS EB:kaczor_a LUC 12212_r0_Fig_B_4_r0_WindConstraints_PhysicalA3L 02/05/2023
Source: UKPN, BEIS, FC, NG, SSE, RBC, OS

Runnymede Renewable Energy Study
Runnymede Borough Council

Figure B-5: Opportunities and constraints: Small scale wind development

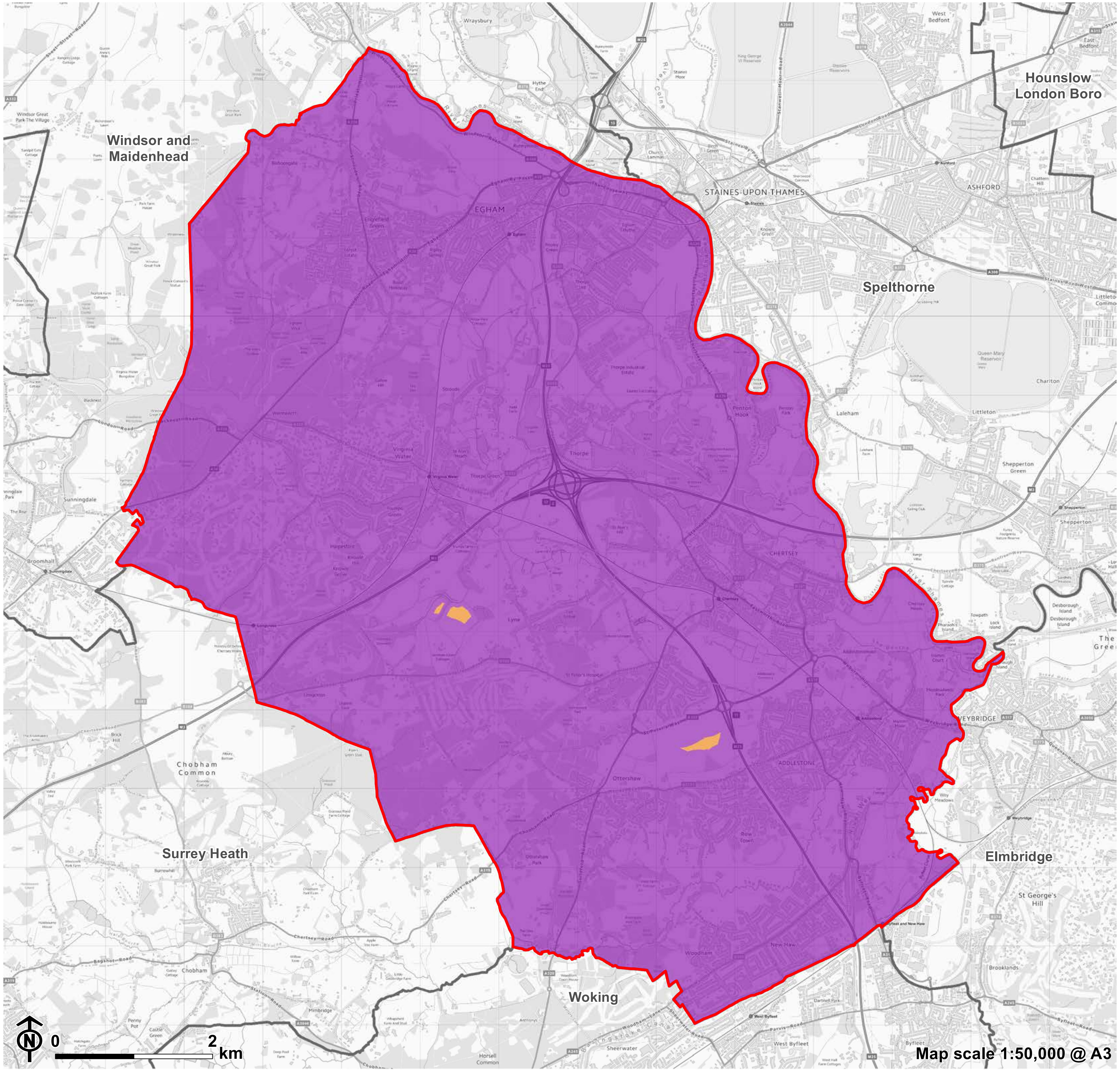


- Runnymede boundary
- Neighbouring Local Authority
- Technical potential for small wind
- Constrained area for small wind

CB:PS EB:kaczor_a LUC 12212_r0_Fig_B_5_Wind_ConOpps_small_A3L 02/05/2023
Source:OS

Runnymede Renewable Energy Study
Runnymede Borough Council

Figure B-6: Opportunities and constraints: Medium scale wind development

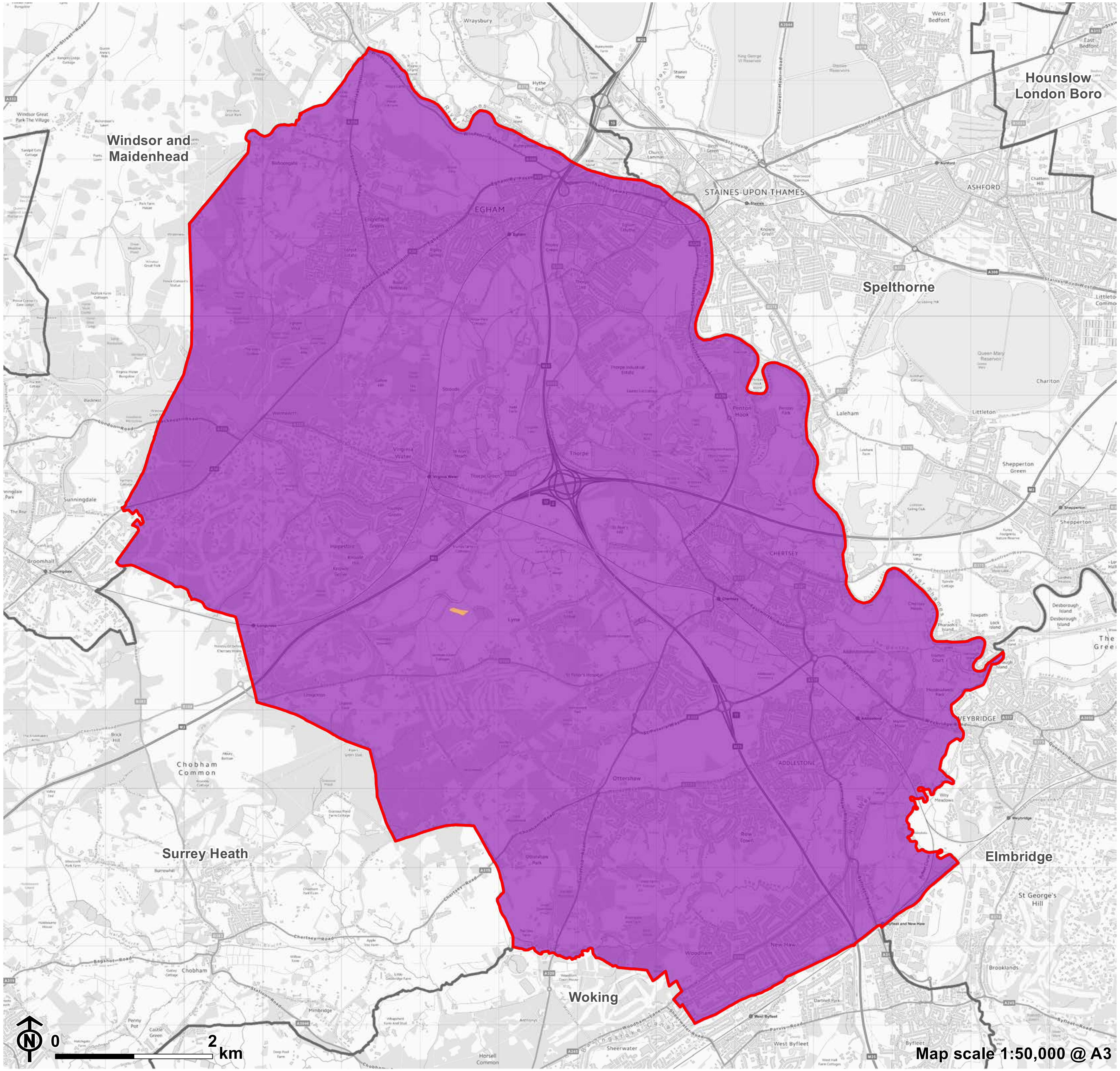


- Runnymede boundary
- Neighbouring Local Authority
- Technical potential for medium wind
- Constrained area for medium wind

CB:PS EB:kaczor_a LUC 12212_r0_Fig_B_6_Wind_ConOpps_medium_A3L 02/05/2023
Source:OS

Runnymede Renewable Energy Study
Runnymede Borough Council

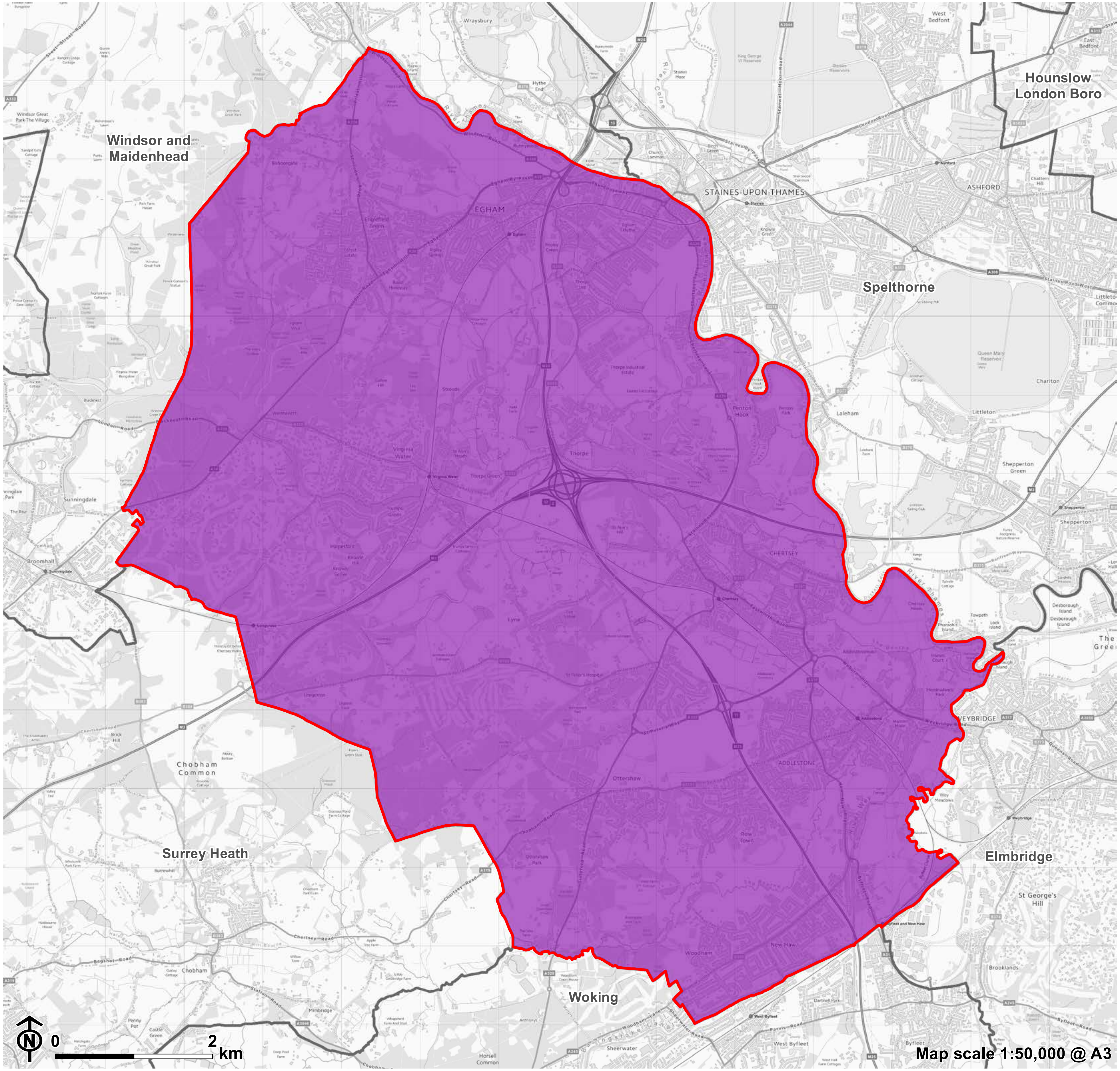
Figure B-7: Opportunities and constraints: Large scale wind development



CB:PS EB:kaczor_a LUC 12212_r0_Fig_B_7_Wind_ConOpps_large_A3L 02/05/2023
Source:OS

Runnymede Renewable Energy Study
Runnymede Borough Council

Figure B-8: Opportunities and constraints: Extra large scale wind development

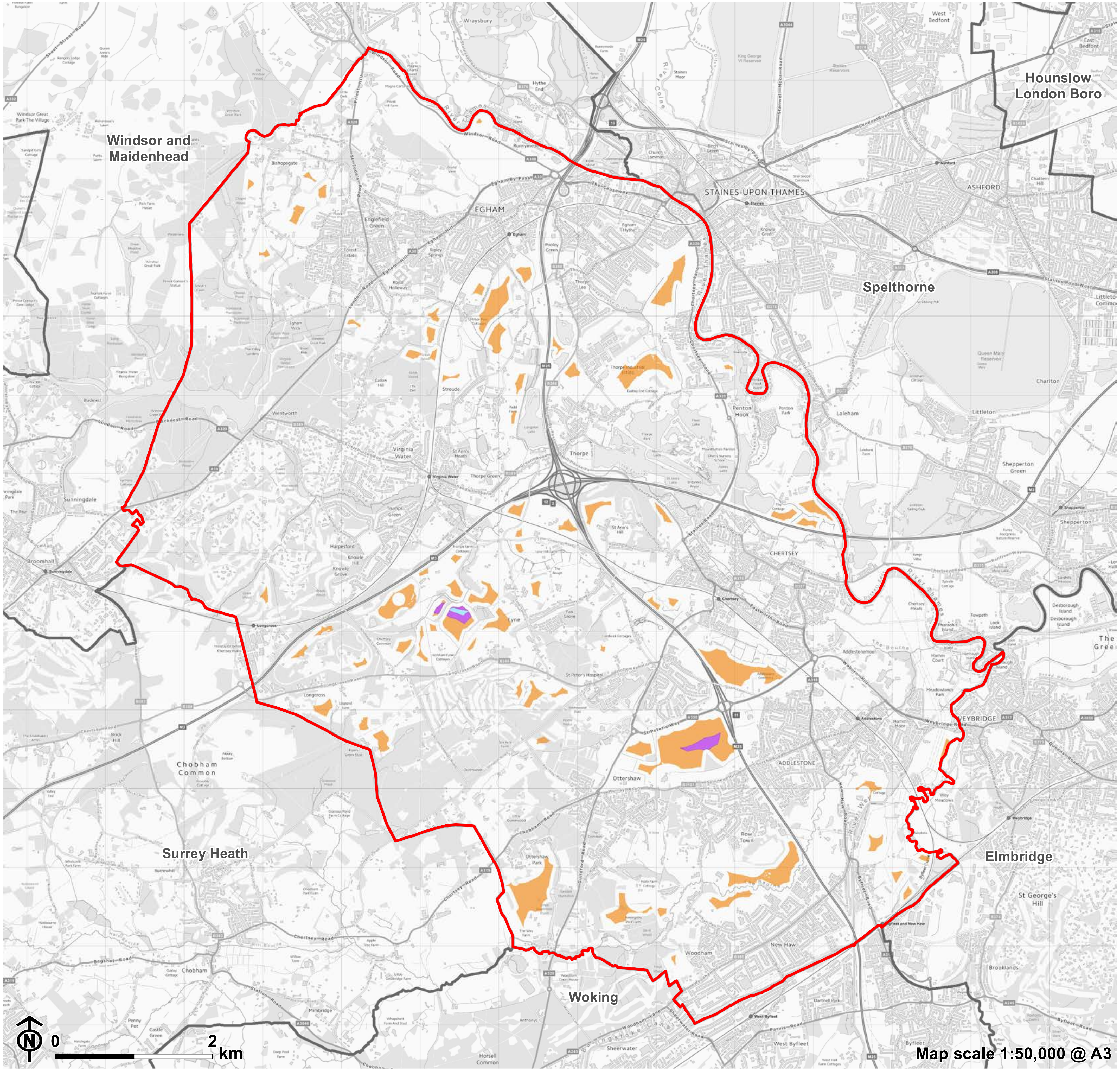


Runnymede boundary
Neighbouring Local Authority
Constrained area for extra large wind

CB:PS EB:kaczor_a LUC 12212_r0_Fig_B_8_Wind_ConOpps_Xlarge_A3L 02/05/2023
Source:OS

Runnymede Renewable Energy Study
Runnymede Borough Council

Figure B-9: Opportunities and constraints: All scales



- Runnymede boundary
- Neighbouring Local Authority
- Suitable area for small to large turbines only
- Suitable area for small to medium turbines only
- Suitable area for small turbines only

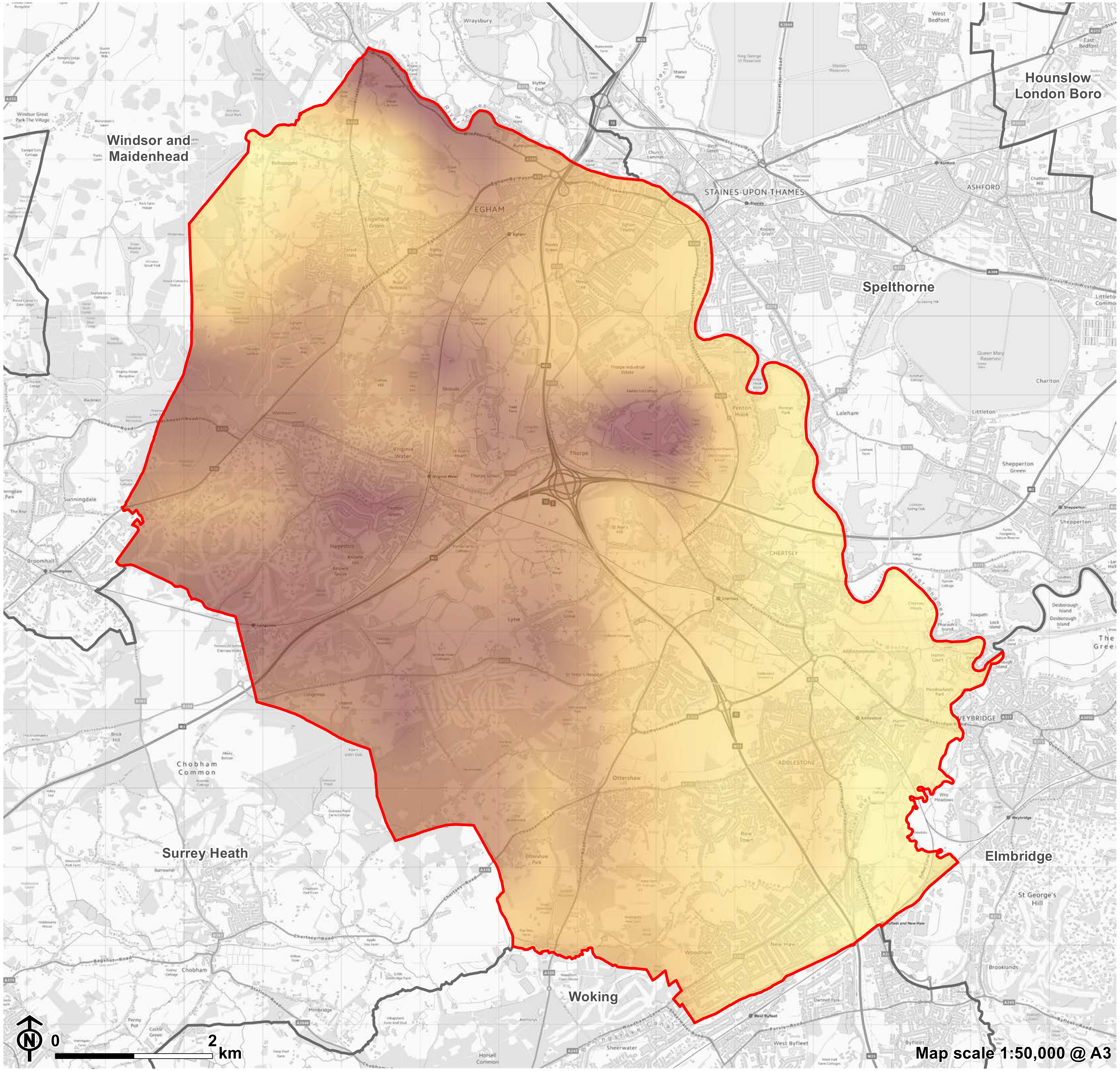
CB:PS EB:kaczor_a LUC 12212_r0_Fig_B_9_Wind_AllOpps_A3L 02/05/2023
Source:OS

Appendix C

Solar Maps

Runnymede Renewable Energy Study
Runnymede Borough Council

Figure C-1: Annual solar irradiance



Runnymede boundary
Neighbouring Local Authority

Annual solar irradiance
2.9 kWh/kWp
2.8 kWh/kWp

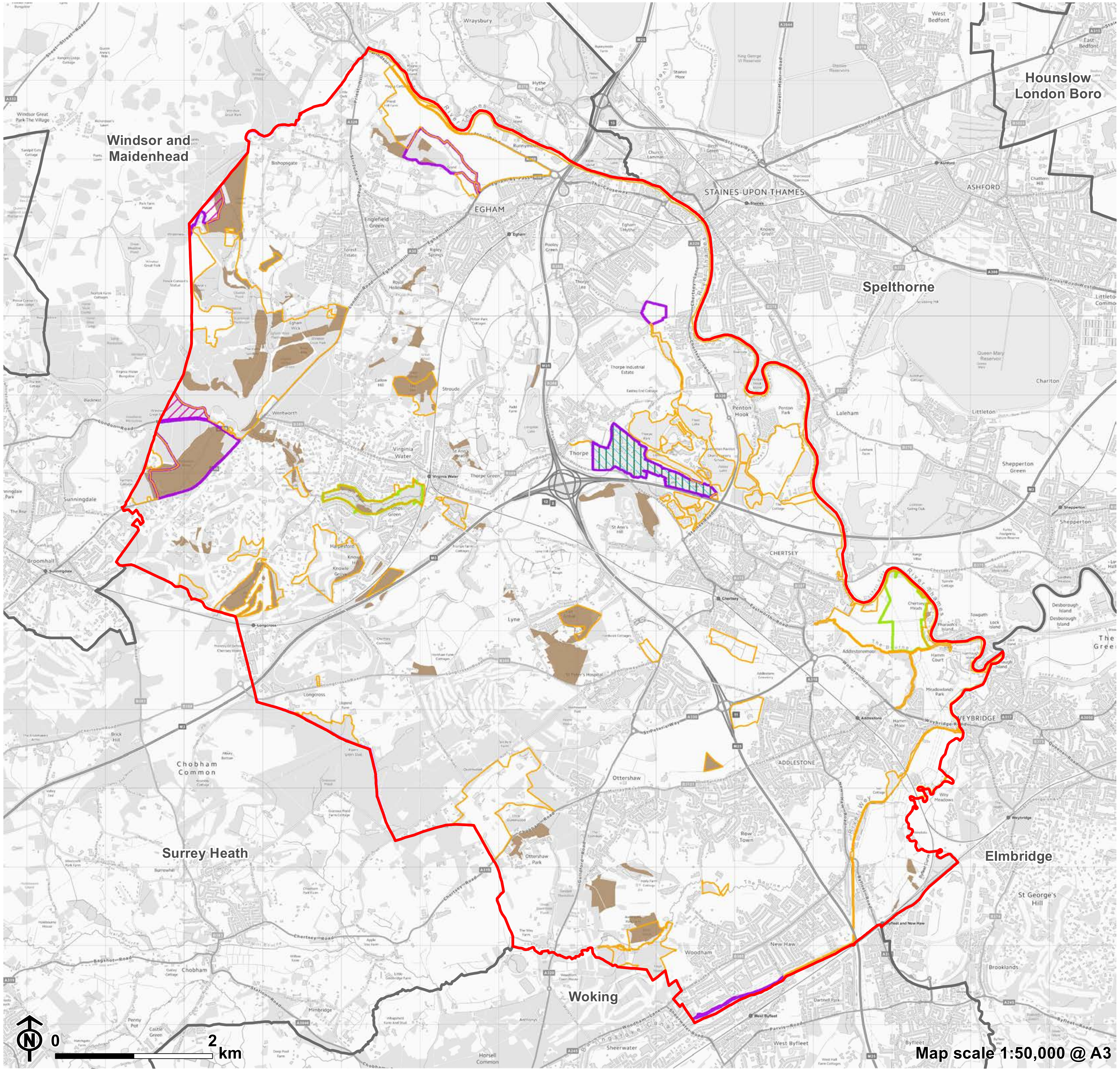
Global Solar Atlas 2.0, a free, web-based application is developed and operated by the company Solargis s.r.o. on behalf of the World Bank Group, utilizing Solargis data, with funding provided by the Energy Sector Management Assistance Program (ESMAP). For additional information: https://globalsolaratlas.info

CB:PS EB:kaczor_a LUC 12212_r0_Fig_C_1_r0_Annual_Solar_Irradiance_A3L 02/05/2023
Source:OS, GSE

Runnymede Renewable Energy Study

Runnymede Borough Council

Figure C-2: Solar constraints - Natural heritage



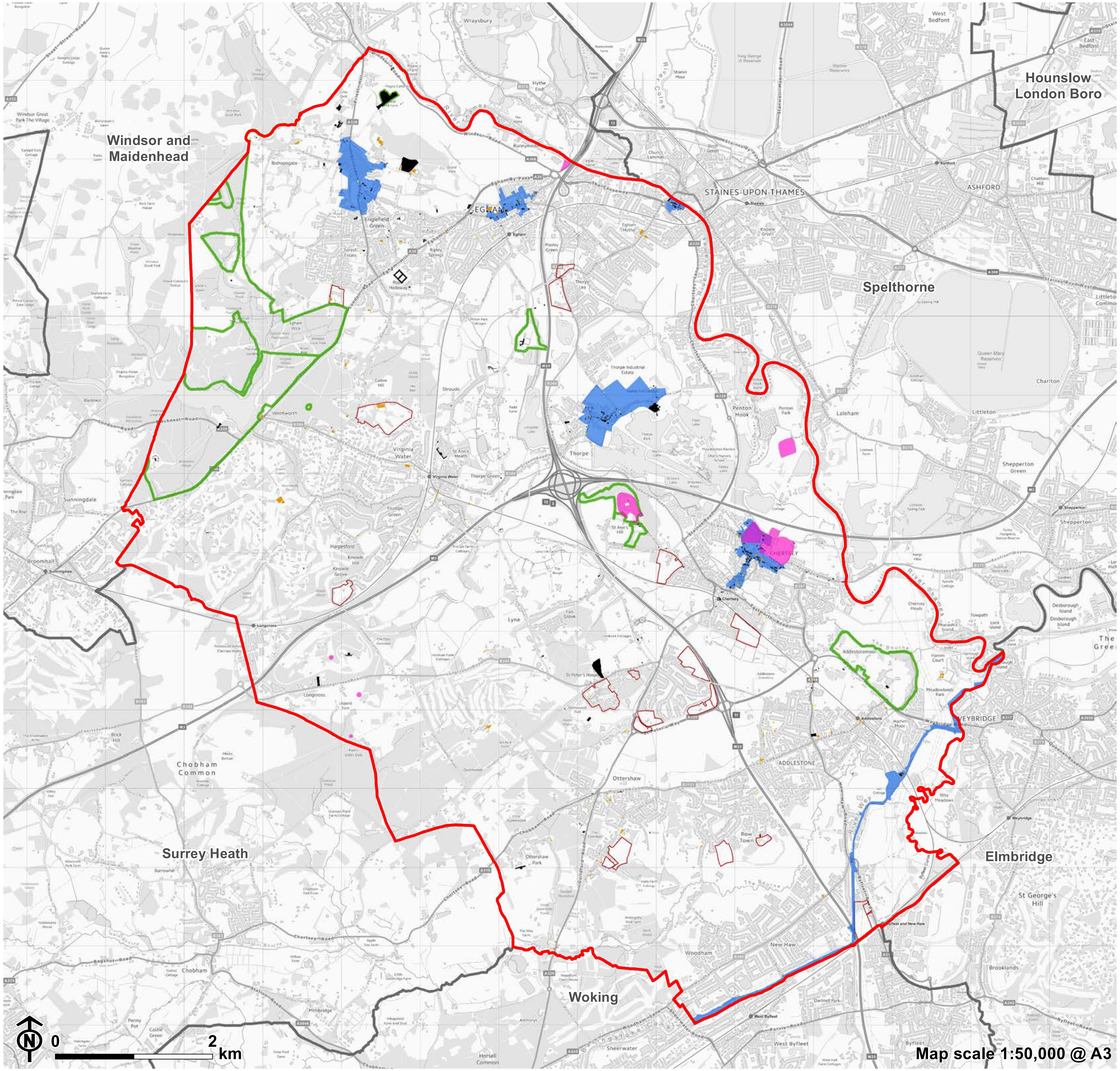
- Runnymede boundary
- Neighbouring Local Authority
- Sites of Nature Conservation Importance
- Local Nature Reserve
- Sites of Special Scientific Interest
- Special Protection Area
- Special Area of Conservation
- RAMSAR
- Ancient woodland

CB:PS EB:kaczor_a LUC 12212_r0_Fig_C_2_r0_SolarConstraints_Naturalheritage_A3L 02/05/2023

Source:BC, OS, NE

Runnymede Renewable Energy Study
Runnymede Borough Council

Figure C-3: Solar constraints - Cultural heritage

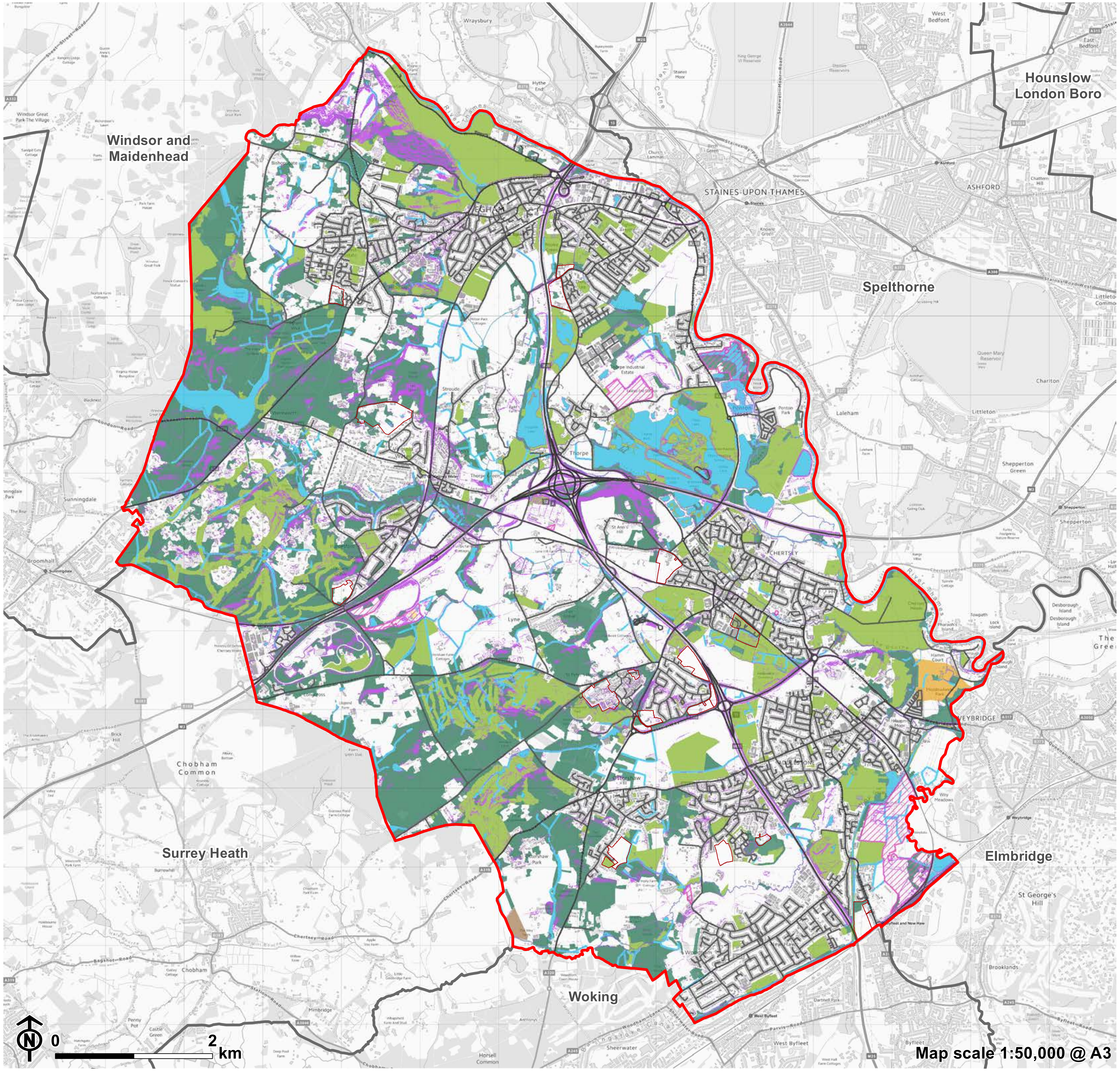


- Runnymede boundary
- Neighbouring Local Authority
- Conservation area
- Registered Parks and Gardens
- Locally Listed Heritage Asset
- Locally Listed Building
- Listed Building
- Scheduled Monuments
- Housing/employment allocation

CB:PS EB:kaczor_a LUC 12212_r0_Fig_C_3_r0_SolarConstraints_CulturalHeritage_A3L 02/05/2023
Source:RBC, OS, HE

Runnymede Renewable Energy Study
Runnymede Borough Council

Figure C-4: Solar constraints - Physical, land use and infrastructure



- Runnymede boundary
- Neighbouring Local Authority
- Roads and Railways
- Mineral waste site
- Airports and airfields
- Building
- Designated open space
- Existing renewable development
- Grade 1 agricultural land
- Slope above 15° or slope above 7° and north-east to north-west aspect
- Watercourses and water bodies
- Woodland
- Housing/employment allocation

CB:PS EB:kaczor_a LUC 12212_r0_Fig_C_4_r0_SolarConstraints_Physical_A3L 02/05/2023
Source: OS, RBC, FC, REPD, NE

Runnymede Renewable Energy Study

Runnymede Borough Council

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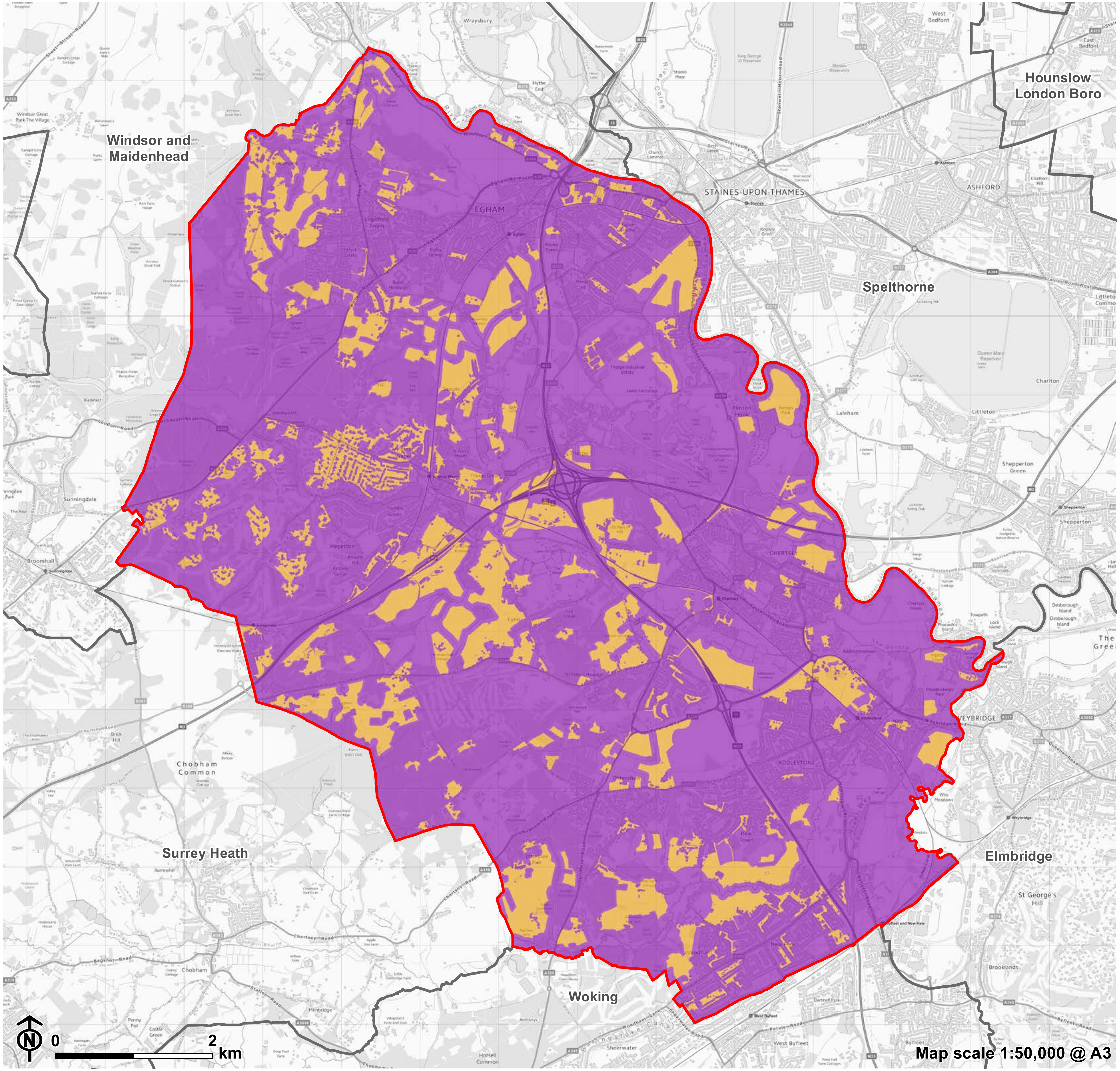
Figure C-5: Opportunities and constraints: Solar development

- Runnymede boundary
- Neighbouring Local Authority
- Area with technical potential for solar development
- Constrained area for solar development

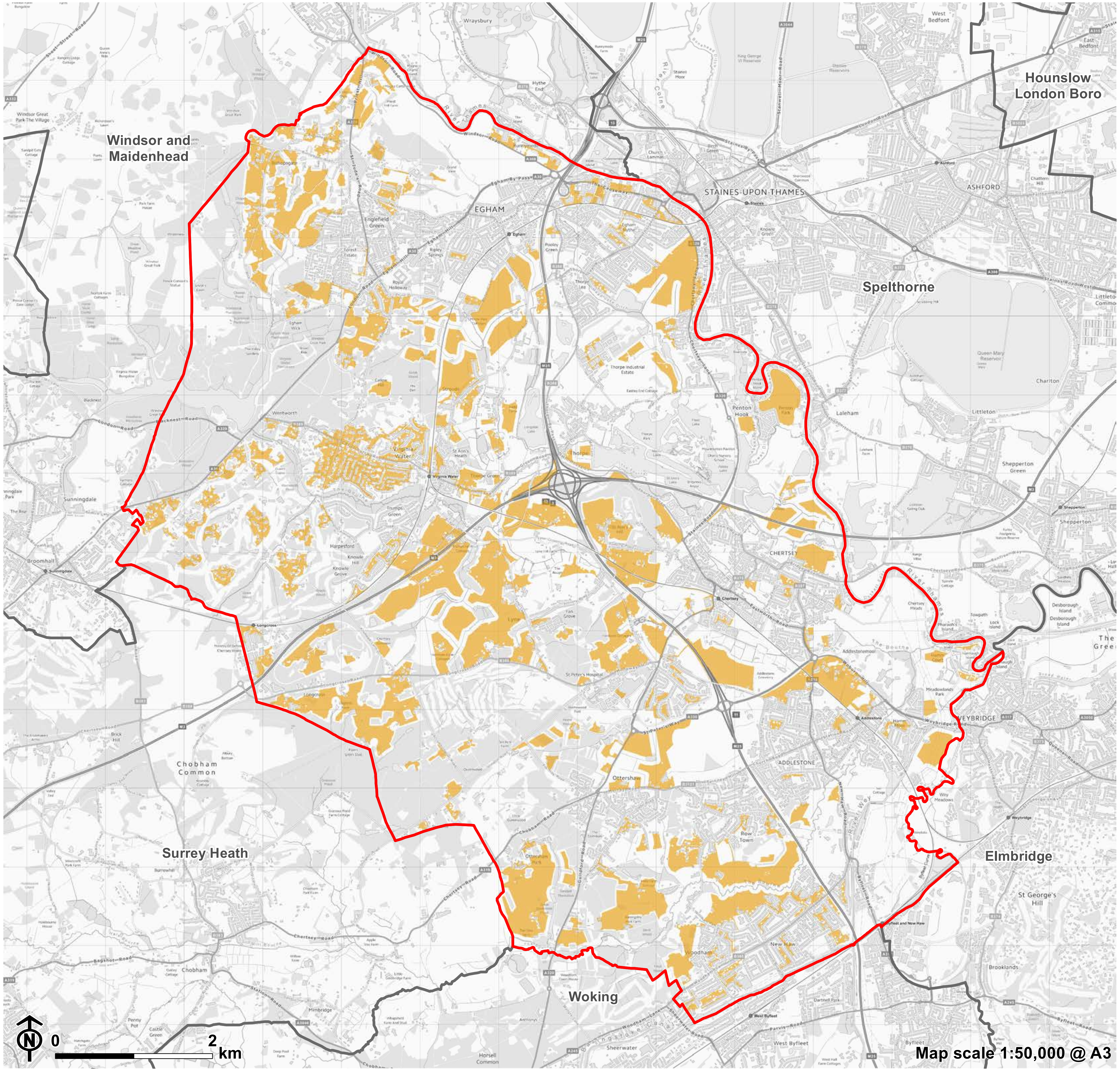


CB:PS EB:kaczor_a LUC 12212_r0_Fig_C_5_r0_Solar_ConOpps_A3L 02/05/2023

Source:OS

Runnymede Renewable Energy Study
Runnymede Borough Council

Figure C-6: Opportunities for solar development



- Runnymede boundary
- Neighbouring Local Authority
- Area with technical potential for solar development

CB:PS EB:davies_h LUC 12212_r0_Fig_C_6_r0_Solar_Opps_A3L 26/04/2023
Source:OS