Site Alternative Study for Battery Energy Storage System (BESS) and Associated Infrastructure.

Land at West Leake Lane, Winking Hill.

On behalf of RES Ltd.

Date: December 2024 | Pegasus Ref: P23-1398 R001v3

Author: Emma Ridley

Document Management.

Version	Date	Author	Checked/ Approved by:	Reason for revision
0	16.10.2024	ER	NC	Draft
1	18.10.2024	ER	NC	Client Draft Issue
2	04.12.2024	ER	MAS/NC	Client Amends
3	19.12.2024	ER	MAS/NC	Final Draft

Contents.

Appendices contents.

1. INTRODUCTION

1.1. This Sites Alternatives Study (SAS) has been prepared by Pegasus Group on behalf of RES Ltd to accompany its planning application for the construction of Battery Energy Storage System (BESS) and associated infrastructure at West Leake Lane, Winking Hill.

1.2. Section 38(6) of the Planning and Compulsory Purchase Act 2004 requires that all planning applications to be determined in accordance with the Development Plan unless material considerations indicate otherwise. This study has been carried out to support the assessment of compliance with planning policy and to support other material considerations, specifically with regards to the National Planning Practice Guidance (PPG); Renewable and Low Carbon energy, issued on 18th June 2015.

1.3. Paragraph 013[1] of this guidance sets out a number of factors that should be considered by the Local Planning Authority (LPA) in the determination of a planning application for energy storage schemes. The second bullet of which states that:

> "**Where a proposal involves greenfield land, whether (i) the proposed use of any agricultural land has been shown to be necessary and poorer quality land has been used in preference to higher quality land; and (ii) the proposal allows for continued agricultural use where applicable and/or encourages biodiversity improvements around arrays. See also a speech by the Minister for Energy and Climate Change, the Rt Hon Gregory Barker MP, to the solar PV industry on 25 April 2013[2] and written ministerial statement on solar energy: protecting the local and global environment made on 25 March 2015[3]".**

1.4. Whilst the above points are made in relation to the location of solar facilities, the same considerations are relevant to the development of BESS.

1.5. The Application Site at West Leake Lane relates to undeveloped land which is currently in agricultural use and therefore represents greenfield land. The Site is located within the Derby and Nottinghamshire Green Belt. Accordingly, and with regards to Part (i), an assessment against the above criteria is required to be carried out as part of the determination of the planning application and given due weight whilst balanced against other material planning considerations. This report demonstrates that the proposed use of agricultural land is necessary due to there being no viable alternatives on brownfield land.

1.6. Due to the nature of the development, the proposal does not allow for continued agricultural use but owing to the operational lifetime of 40 years, it is considered that any consented scheme will be temporary in its nature. Furthermore, the proposed development will result in significant biodiversity net gain as detailed in the Biodiversity Impact Assessment supporting this application. Part (ii) of the above test is not therefore addressed further in this report.

---

1 NPPG: Renewable and Low Carbon Energy, Paragraph 013, reference ID: 5-013-20150327 (as at 27/03/2015)

2 Speech by the Minister for Energy and Climate Change: www.gov.uk/government/speeches/gregory-barkerspeech-to- the-large-scale-solar-conference

3 Written Ministerial Statement on Solar Energy: Protecting the local and global environment: https://questions-statements.parliament.uk/written-statements/detail/2015-03-25/HCWS488

1.7. This SAS provides demonstration of compliance with this material consideration. The report first sets out the methodology by which the study has been carried out, the assumptions made and their rational (Chapter 2). This is followed by a detailed discussion of the study findings (Chapter 4) which are summarised with conclusions (Chapter 5).

2. METHODOLOGY

2.1. The SAS has been carried out accordingly to the following stages:

i. Definition of the Study Area.

ii. Identification of any key constraints that rule out development in the study area, including consideration of agricultural land classification and green belt.

iii. Assessment that there is no poorer quality land available, or any other more appropriate sites capable of delivering the scale of development proposed, by reviewing the agricultural land classifications along with other technical and environmental constraints in the study area.

Study Area

2.2. In order to undertake the SAS, it is necessary to identify an appropriate and reasonable study area. However, there is no national or local guidance with regards to the definition of the study area against which the above criteria should be assessed.

2.3. Accordingly, the study area for this SAS has been defined as follows. The study focusses on the availability of a grid connection. For this scheme, grid capacity has been identified at the existing substation located at Ratcliffe on Soar Power Station. It has been determined that it would only be viable for a development to connect to the substation if it is located within 2km of the network. Further details regarding Grid Connection are set out in **Section 3.** Therefore, the criteria used for the assessment has been a 2km offset from the Ratcliffe on Soar substation.

2.4. As discussed in the enclosed Technical Note (Reference 04875-8812629 -Appendix 1), direct battery storage connections to substations with a minimised interconnection distance are of heightened value to the network, as these features are important for the asset to contribute to balancing system frequency, providing support during peak load period and providing maximum ancillary support services such as voltage control. Greater interconnection distances between storage sites and the network owner, will limit the speed and efficiency of this response through longer communication channels.

2.5. In this instance, interconnection length is defined as '*the distance between the Grid Point of Connection and the Project Substation of a connecting point*'. The transmission and distribution of electrical energy across longer distances naturally creates greater electricity losses in the system due to the increase of line impedance. Therefore, when designing new battery storage sites, extra effort must be taken to find suitable land, which is close to either substation or overhead line tower substation infrastructure identified by the Network Owner as a suitable Point of Connection for the storage project.

2.6. As discussed within the Technical Note, when strategically placed, battery storage systems can manage local load imbalances, as the unit can import when the network experiences period of low demand or high generation output, and similarly the battery storage can export during high demand or low generation. This function is optimised when located close to the network connection point, as losses are minimised, and instructions can be received and actioned faster for the unit to operate quickly and effectively.

2.7. The study area as defined is shown at **Appendix 2 – Study Area Plan.**

<u>Identification of any key constraints that rule out development in the study area, including consideration of agricultural land classification</u>

2.8. As well as determining the area of assessment, further constraints have been applied. These constraints are based on the knowledge of the parameters that any energy storage development would have to consider and assess to gain approval through the planning system as well as technical constraints for energy storage development.

2.9. The following constraints that were applied in the SAS were:

- Sites which are already Allocated for development in the Local Plan.

2.10. 100m buffer from residential development, 10m buffer to other existing buildings.

- Ecological designations such as SSSI, SAC, NNR, LNR, ESA, Ancient Woodlands, Woodland, RPB Reserves and RAMSAR.

- Landscape and Heritage assets such as Conservation Areas, World Heritage Site, Schedule Monuments, Listed Buildings, Battlefield, Open Access and Registered Common Land, Country Parks and Registered Park/Gardens.

- Flood Zone 2 and 3 land.

2.11. With regard to the Green Belt, it was established that the whole of the study area was located in the Green Belt, as is the site of the proposed development, and therefore there was no potential for any site in the study area to be sequentially beneficial to the proposed development in terms of being located outside of the Green Belt. The Green Belt was not therefore considered further in the study.

<u>Consideration of the availability of any Previously Developed (Brownfield) Land</u>

2.12. The assessment is made with reference to the Rushcliffe Borough Council [4] published Brownfield Register of previously developed land at a local scale.

2.13. Where it is shown that there is no previously developed land that is both available and suitable, it is deemed that compliance with these criteria has been demonstrated.

2.14. Once these constraints were mapped, a further technical constraint was applied, specifically that any potential alternative sites would need to be at least of the same size as the proposed development site (i.e at least 5ha) in order for them to be able to deliver the same generation output.

2.15. **Appendix 3 – Constraints Plan** and **Appendix 4 – Alternative Sites** show the extent of the land that has been considered when these constraints have been applied.

[4] https://www.rushcliffe.gov.uk/planning-growth/planning-policy/brownfield-register/

2.16. It is acknowledged that the site is located in the Green Belt. The submitted Planning Design and Access Statement sets out the overall need for the development and the demonstration of ‘very special circumstances’ in accordance with national and local policy.

3. GRID CONNECTION ANALYSIS

Grid Capacity across the UK

3.1. Viable grid connections across the UK are few and far between. This is largely due to the decarbonisation of our energy system as we move from having large carbon producing power plants dotted across the network, to a more distributed system of renewable energy projects that power the grid with clean green electricity at the lowest cost to the consumer[5].

3.2. The UK is moving towards a greater proportion of renewable energy generation and a reduction in more stable and consistent fossil-fuel based generation. From National Grid's point of view, that means more electricity storage and flexibility is required in the network to help stabilise supply and demand, give the increasingly intermittent power generation mix. With greater support from demand-side storage and flexibility, mass energy black-out incidents can be reduced. National Grid's Future Energy Scenarios forecast a minimum of 23.5 GW of storage is needed by 2050 to meet our net zero carbon goals, which are to be set for 2035 – increasing the expediency to act now.

3.3. The Government have recently published the Clean Power 2030 Action Plan within which it is stated that '*wherever renewables can connect to the distribution network, this should be encouraged for reasons of speed and efficiency'* (page 63).

3.4. Battery storage facilities are essential infrastructure to support the UK's climate change targets, in maintaining and balancing a continuous supply of energy generated from renewable sources. This flexibility approach adds resilience to energy supply and allows the storage of energy until required through the electricity grid and before it is lost through un-use.

Grid Capacity at Ratcliffe on Soar Power Station

3.5. A grid application for Winking Hill BESS was obtained in December 2022 following discussions with the Distribution network Operator (DNO). The substation at the Ratcliffe on Soar Power Station was identified by the DNO as having capacity for 99.9MW battery storage connected by underground cable.

3.6. With a viable Point of Connection (PoC) being so close to the energy storage systems, this increases the viability of the Proposed Development as the grid connections can be made whilst:

- Maximising the use of existing grid infrastructure.
- Minimising disruption to the local community and biodiversity.
- Reducing energy losses and overall costs of the connection.

5 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/911817/electricity-generation-cost-report-2020.pdf

3.7. It is therefore concluded that the placement of the scheme in this location not only minimises infrastructure cots and energy losses, but it also maximises the responsiveness of the system, ensuring it can effectively manage demand fluctuations and support renewable energy integration.

Economic Viability

3.8. BESS systems contribute to frequency response on the Grid and the system can support sudden peaks or troughs in Active Power on the network in order to maintain constant balance between supply and demand.

3.9. The relevance of distance to the connection point and effect on viability is recognised in national policy in EN3. Paragraphs 2.10.24 and 2.10.25 state:

"the connection voltage, availability of network capacity, and the distance from the solar farm to the existing network [84] can have a significant effect on the commercial feasibility of a development proposal.

To maximise existing grid infrastructure, minimise disruption to existing local community infrastructure or biodiversity and reduce overall costs, applicants may choose a site based on nearby available grid export capacity."

3.10. Footnote 84 of EN3 referred to also states:

The route and type of terrain traversed by the cabling linking the solar project to the grid connection may also have an impact on the project's viability

3.11. Whilst the above points are made in relation to the location of solar facilities, the same considerations are relevant to the development of BESS.

3.12. There are also technical considerations specific to BESS schemes which further justify the need to locate close to the point of connection to the grid. Should the site be located outside of the Green Belt this would increase the distance between the Point of Connection and therefore increase the requirement for underground cabling. Underground cabling can be highly capacitive, which increases the volume and can be hard to manage, particularly where the generation type is BESS. As BESS switches between import (demand) and export (generation) which can impact voltage control of the substation and cable. Should the length of the cable increase there will be a greater reliance on additional equipment therefore, increasing the required footprint of the site and increasing the risk of noise pollution.

Impact on Environment and Community

3.13. Potential impacts on the environment are reduced where the PoC and the substation are closer to the existing grid infrastructure. The location of the substation close to a viable grid connection enables the Proposed Development to maximise existing grid infrastructure and limit the additional infrastructure that needs to be constructed, consequently avoiding impacts on the Green Belt and the wider landscape.

3.14. As detailed within the appended Technical Note, with increased distance from the point of connection there may be a requirement for additional reactive power compensation and power quality equipment. Specific assets required, include but are not limited to harmonic filters, reactive compensation units and potentially more PCS and inverter units. This additional equipment would require more space, increasing the footprint of the development site, resulting in more land and potentially greater visual impact.

4. SPATIAL ANALYSIS FINDINGS

Consideration of the Availability of any Previously Developed (Brownfield) Land

4.1. The study area comprises land within the administrative area of Rushcliffe Borough Council (as identified on the study area plan) where there is a relatively moderate amount of previously developed land. However, constraints are evident in the identified previously developed land.

4.2. Rushcliffe Borough Council's Brownfield Register details the location, size, allocation of potential parcels and those benefitting from permission/under construction. 12 brownfield sites are note in Rushcliffe Council's Brownfield Register dataset with the parcel of land ranging between 0.02ha and 35.4ha in size. Collectively the 12 brownfield sites cover 44.89ha of land in the administrative area. The majority of the sites proposed are under 1 hectare. These brownfield site areas are smaller than the proposed development of 4.5 hectares and would not be able to offer a development of similar scale to the proposed development.

4.3. Of the 12 sites listed on the Brownfield Register, five do not benefit from planning permission. However, they are all of a site area smaller than that of the proposed development, the largest being 0.1 hectares in size.

4.4. All brownfield sites are therefore disregarded as potential alternative sites.

Alternative Sites Review

4.5. Seven potential alternative sites presented as alternative site option of varying size. Table 1 (below) sets out a summary of each of the areas identified and considers the potential alternative sites in comparison with the Application Site and identifies whether the potential alternative site has a similar level of deliverability as the application site. These sites are shown in **Appendix 5 – Alternative Sites.**

Site	Deliverability
1	The landowner has been contacted and confirmed that they did not wish to engage.
2	This land is identified as under the control of another developer and has therefore been discounted.
3	The landowner has been contacted and confirmed that they did not wish to engage.
4	Same landowner as Site 3.
5	Same landowner as Site 1.
6	Same landowner as Site 1.

7	Same landowner as Site 1.

4.6. Analysis within Table 1 and the accompanying graphics demonstrate that the potential sites identified are not available for development compared to the Application Site.

<u>Site Identification – Land at West Leake Lane</u>

4.7. The Application Site is considered to be the most preferable having regard to the relevant matters set out above and was therefore progressed to a planning application. In summary, the reasons are:

- The Application Site allows for a viable connection to the Electricity Network. This will be achieved by a grid connection to the existing substation at former operational Ratcliffe on Soar Power Station.
- The Application Site can be accessed using roads of sufficient capacity to accommodate vehicles for construction and decommissioning, with site access connecting to the wider Highway network.
- The landowner is willing to enter into an agreement to promote this land for a battery energy storage system (BESS) development. The site is therefore available to accommodate the development.
- A review of the Rushcliffe Borough Council Brownfield Register does not identify any land of a sufficient size to accommodate the proposed development. As such, there is no unconstrained non-agricultural land on which the scheme could alternately be provided. It is therefore necessary for this development to be located on agricultural land.
- There are no suitable alternative sites within the study area that are outside of the Green Belt.

4.8. The Landscape and Visual Assessment confirms that the Proposed Development has been designed with consideration to local character and has appropriate regards to its surrounding landscape and setting. As a result of this sensitive design and the additional landscape mitigation proposed, the actual perceivable extent of any harm to the Green Belt is relatively limited, especially in future years as the mitigation develops.

4.9. In the context of the other considerations, relevant to site selection, the Application Site would allow for a viable scheme on land which is available for BESS development to achieve the substantial public benefits of renewable energy generation.

4.10. The Application Site is therefore considered to represent an appropriate location for the Proposed Development.

5. SUMMARY AND CONCLUSION

5.1. The Site Alternatives Study (SAS) has been prepared on behalf of RES Ltd to accompany their planning application for construction of a Battery Energy Storage Scheme (BESS) on land at West Leake Lane.

5.2. This study has been carried out to support the assessment of compliance with planning policy, and other material considerations.

5.3. This policy context includes consideration of policy on Green Belt included in the National Planning Policy Framework. The assessment has concluded that there are no suitable alternative sites within the search area which are outside of the Green Belt.

5.4. In addition, the National Planning Practice Guidance (NPPG): Renewable and Low Carbon Energy, Paragraph 013 which sets out a number of factors that should be considered by the Local Planning Authority (LPA) in the determination of a planning application for large-scale solar farms.

5.5. The SAS considers compliance with regards to the second bullet of Paragraph 013 and concludes that:

i. The use of agricultural/greenfield land is necessary in the absence of, previously developed land/brownfield land.

ii. There are no potential alternative sites subject to any less environmental constraints than the Application Site within the study area, or located outside of the Green Belt;

iii. That the Application Site would allow continued agricultural use and that significant biodiversity net gain would be delivered as part of the Proposed Development.

5.6. Accordingly, this SAS demonstrates compliance with the criteria set out within Paragraph 013 (bullet 1 and 2) of the Planning Policy Guidance.

Appendix 1 – Technical Note

18th December 2024

Technical Report: Winking Hill Battery Storage

Grid Considerations for Project Location

Author	Kahil Ram
Date	18/12/2024
Ref	04875-8812629

Contents

1 Introduction

Battery Energy Storage Systems (BESS) are integral to the function and success of modern electricity grids or smart grid systems. Energy storage systems play a critical role in supporting an Electricity Network maintain stability, whilst offering services to maximise grid efficiency and network flexibility during peak and trough periods.

The requirement for Grid connected Battery storage has significantly grown in recent years, following the influx in renewable energy sources across the United Kingdom. It is crucial Battery Storage developers, such as Renewable Energy Systems (RES), continue to progress projects across the United Kingdom and Ireland to ensure sufficient storage is available, across the entire network, at all voltage levels, to maximise the network's ability to harness this clean, renewable generation. This is crucial for net zero targets to be realised.

This report discusses the importance of battery storage to the Electricity Network and outlines the key factors associated with the general placement of new BESS sites. Direct focus is then applied to RES' project 'Winking Hill,' located in Ratcliffe on Soar, where the information detailed in this report is translated to this specific case study. The report will explain RES' efforts in maximising project viability and the technical considerations reviewed before committing to a project in this area.

2 Technical Considerations for RES Battery Storage Project Placement

Storage projects must be strategically placed within the UK Electricity system to maximise system efficiency and provide the greatest support to Transmission and Distribution networks. During early-stage development of new RES Battery Storage projects, the following considerations are reviewed to ensure that the new project is a viable solution for realising Grid Energy Storage requirements.

2.1 Proximity to Grid Infrastructure and Minimising Losses

Electricity substations function as key, nodal points on the UK Electricity power system. It is at these locations, where the interface between Demand, Generation, Transmission and Distribution occurs and where key electricity infrastructure is located (1). Battery storage systems, when placed within a proximity of less than 2km to a Substation or key Overhead Line, can integrate to the grid quicker and respond to network events faster. This enables the storage unit to provide a more adept service to the Network Operator and create greater value to network operation and resilience. This is actioned by the battery storage unit, via quick responses to mitigate deviations in Supply and Demand, especially crucial as the UK moves towards more renewable energy sources, which are intermittent by nature. (2).

Direct Battery Storage connections to Substations with a minimised interconnection distance are of heightened value to the network, as these features are important for the asset to contribute efficiently to control system frequency, managing system voltage within statutory limits and providing support during peak load periods when the network is under stress. Greater interconnection distances between Storage site and the Network Substation, will limit the speed and efficiency of these ancillary services responses to where it is needed. (3).

Interconnection length is defined as 'the distance between the Grid Point of Connection and the Substation of a connecting project.' Transmission and Distribution of electrical energy across longer distances naturally creates greater electricity losses in the system due to increasing line impedance (4). Therefore, when designing new Battery Storage sites, extra effort must be taken to find suitable land, which is close to a suitable Point of Connection for the Storage project, so overall interconnection losses can be minimised. The International Renewable Energy Agency (IRENA), specify that minimising transmission (or distribution) distance for energy storage systems vastly improves system efficiency, especially in large-scale systems and emphasise the importance of this consideration for new Battery Storage sites. (5). In addition, the Exeter based, 'Westcroft' Battery Storage project, developed by EDF Renewables, further discloses the importance of locating battery storage close to Substations. (6). EDF emphasise that having secured land close to their Point of Connection at Exeter Substation, the Battery System will run more efficiently, through reduction in Transmission losses in Underground Cables. This further compounds the importance of minimal interconnection distance in new storage developments.

When strategically placed close to Point of Connection, battery storage systems can manage local load imbalances, as the unit can import when the network experiences periods of low demand or high generation output, and similarly the battery storage can export during high demand or low generation. Having flexibility at the local Network Substation level from Battery Storage, will support the Network Operator during peak times. This function is optimised when located close to the network connection point, as losses are minimised in order to maximise the energy transfer to and from the network therefore the actions from the Storage unit is efficient and effective (7). New National Energy System Operator (NESO), dynamic response markets require suitable generation to support network frequency stability, by being readily available to offer generation reserve within a 0.5-1 second window. (8). Battery storage sites are a very suitable technology to operate in this market, due to their fast-acting characteristics. Yet, it is crucial the distance is minimised, so the system services can be delivered without technical complexity at the substation node. Slow response to system events could cascade into major network disturbances and power cuts. It is therefore crucial to minimise the distance for interconnection for the battery storage site to maximise its intended functions and offer best value to the network and energy consumers.

2.2 Minimising Connection Impact and the requirement for additional infrastructure

In scenarios where Battery Storage systems are located further away from Electricity Substations, there are greater underground cabling requirements to connect the site to the nearest, feasible connection option. This increases the potential requirement of additional equipment to manage the system as a result. While overhead line (OHL) is the least cost solution, RES projects take the approach of utilising Underground Cabling as the preferred method for interconnection, to minimise visual impact, however this must be valued against any potential costs and technical impacts.

Increasing Underground Cable length could potentially contribute to voltage stability issues as the oscillations triggered by inverter-based resources are exacerbated by the naturally capacitive nature of Underground Cables. Uncompensated capacitance in the cable system can cause voltage rise issues and will need to be managed. The Network Owner will first utilise tap changers on Transformers, and local generators to manage system reactive power levels to mitigate voltage increases on the Distribution Network, however if these measures are unable to have the desired impact, the Network Operator may require the installation of reactive power management equipment to mitigate excess reactive power. Specific assets include, and are not limited to, reactors or static VAR compensators, dependent on the outcome of an in-depth power system analysis (10). The additional equipment will require more space in a constrained Network Operator’s substation, resulting in more land take, capital, operational and maintenance cost. (11).

These technical issues mean further compensation equipment could be required to ensure system compliance. (9). In Distribution connected scenarios, the metering point of the Storage project is located on-site. This means losses across the interconnection route are classified as Distribution Network losses rather than project specific losses, and greater interconnection length contributes to greater inefficiencies for the Network Owner. An efficient solution for all parties can be achieved with reduced interconnection route length.

A longer cable route not only contributes to voltage rise issues, but also contributes to an increased, capacitive reactive current component in the cable, resulting in inefficient use of the cable capacity. If reactive current exceeds the rated capacitive charging current of the Circuit Breaker, this will prevent safe management of system during network faults. To bring the capacitive charging current within the safe limits of the Circuit Breaker rating, additional reactive power compensation equipment, such as reactors, will be required.

Furthermore, greater interconnection in Distribution projects amplifies system harmonic issues. A long underground cable increases the harmonic resonance seen at the metering point of the BESS site and therefore increases the magnitude of the voltage harmonic that must be mitigated, in order to achieve harmonic compliance. It is essential that the project complies with harmonic compliance outlined in ENA G5/5 code documentation, for the Generators to be connected correctly and safely on the Distribution Network. This can lead to the requirement of harmonic filters at the BESS site, to control harmonic issues and ensure compliance. Similarly to reactive equipment, harmonic filters will require additional land, additional expense and may create further visual impact. Additional equipment could increase the noise output of the Energy Storage site, which RES wish to mitigate. For example, nameplate details of a 132kV Shunt Reactor identifies a peak decibel output that would contribute to site noise and acoustics, an area RES is committed to reducing.

3 The necessity for Winking Hill placement

The following section builds on the information outlined in Section 2 and relates the discussed factors to RES' project at Winking Hill.

3.1 Grid Capacity at Ratcliffe on Soar Substation

The importance of developing and connecting new renewable energy sources to the UK Electricity System has triggered a major influx in grid connections in recent years, which has overwhelmed the existing grid system, signalling the requirement for major network reinforcement requirement and process overhaul. With a total of 701GW of contracted offers across both the Transmission and Distribution Network, all main connection nodes are over-subscribed and not suitable for connection. (13).

The decision to place this Battery Storage System at Ratcliffe, was driven by the availability of grid capacity, where National Grid are constructing a new Grid Supply Point Substation, according to Appendix G, in their Statement of Works document. (14). This new GSP offers additional network capacity in the form of connection bays for demand and generation connections, unavailable elsewhere on the network. Battery Systems operate differently to other technologies, as they can function as a Demand whilst importing and Generation source whilst exporting. When Battery Storage sites are able to connect to these substation nodes, they can maximise the other generator and demand capacities connecting to the same node.

3.2 Competing developments and alternate connection locations

Upon review of Ratcliffe and acknowledging that any project connecting into the area would require placement in Greenbelt land, RES actively reviewed alternate network options first, before committing to formal grid application and planning application in this region. Alternate substations in the surrounding area had been reviewed for capacity, but deemed unfeasible due to the following reasons:

Staythorpe: Major substation capacity issues with no notable network reinforcements, therefore a connection in this area is exceedingly difficult.

Nottingham: Heavily built-up location with no viable land options for a Battery Storage project near to a suitable substation.

Willington: Fault level issues at this substation would require extensive network reinforcement works to be completed before a connection is viable, meaning the energisation date for new projects would be significantly delayed and could trigger the requirement for new Substation infrastructure. Most surrounding land also falls within flood zones.

Coalville: In-sufficient capacity available at this substation, with the risk of connection triggering Statement of Work process, which would result in a later energisation date and potentially new network infrastructure.

Willoughby: Not enough capacity at this substation - Appendix G indicates both thermal headroom and fault level headroom have been exceeded at the GSP - connections here would be subject to Project Progression/Modification Applications and subject to either delayed connection date or increased curtailment.

As Ratcliffe Power Station is due to close in late 2024, there is a potential gap in the dispatchable generation mix in this area. New connections can support and fill the gap in network infrastructure this Power station will leave behind, ensuring network stability in the region for future years. (15).

3.3 Benefits to the Network Owner and Consumer

Through placement of Winking Hill at the proposed site location, partnered with the existing power station set to be decommissioned (16) and opportunities to connect at the new GSP Substation, Battery Storage at Ratcliffe can create the following value for the Network and Consumer:

- With the absence of Ratcliffe Power Station, Winking Hill can contribute to maintaining clean, dispatchable generation in the region, and deliver system services using key Battery Storage characteristics. Contributing to the network by operating at either import or export modes when required, will therefore maximise wider renewable generation and demand connecting to the system. In other words, stored energy within Winking Hill's Battery unit can alleviate the pressures at peak demand periods and will be crucial to Network operation.
- Maximisation of the UK's vision to achieve Clean Power 2030 targets. Without Battery Storage connections on the network, the UK Electricity network will struggle to utilise all the renewable generation sources available and will continue to curtail valuable wind and solar generation due to network capability and operability. Battery Storage can support network flows, provide network services such as voltage, reactive power and frequency, maximising network operability and utilisation of all available generation.
- Utilising a site location closer to Ratcliffe Substation will reduce the construction radius, by limiting the length of cable and need for supporting equipment. This means a smaller environmental footprint for the project and limited impact to the Greenbelt area.

4 Conclusion

The proposed Winking Hill battery storage system is essential due to its strategic alignment with grid efficiency, environmental goals, and long-term energy reliability. Proximity to the newly built Grid Supply Point (GSP) ensures that the battery can efficiently integrate into the grid, utilising the available capacity that is unavailable elsewhere on the network, thus enhancing overall grid stability and performance in undersupplied areas.

This placement not only minimises infrastructure costs and energy losses, but it also maximises the responsiveness of the system, ensuring it can effectively manage demand fluctuations and support renewable energy integration.

While the use of greenbelt land necessitates careful planning and mitigation measures to minimise environmental impact, the broader benefits—such as reduced carbon emissions by supporting the transition to Net Zero energy sources, improved energy security, and enhanced resilience of the power network—are significant to society's progression to a Net Zero future. Energy storage is well placed to help the UK reach its emissions target, as such, this strategic location supports the transition to a more sustainable energy system, benefiting the utility provider, consumers, and the environment alike.

RES are committed to doing the upmost in developing sustainable projects and are committed to ensuring that Winking Hill Battery Storage achieves our sustainability agenda to benefit the local community, consumers, and network. Our vision is to provide affordable, zero-carbon energy and believe Winking Hill contributes to this goal and we will do our upmost to ensure it is developed to provide limited impact to existing greenbelt area.

5 Bibliography

1. **National Grid.** National Grid Energy Explained. *What is a Substation?* [Online] 23 January 2024. https://www.nationalgrid.com/stories/energy-explained/what-is-a-substation#:~:text=One%20of%20the%20main%20roles,our%20homes%2C%20businesses%20and%20buildings..

2. **Choton K. Das, Octavian Bass, Ganesh Kothapalli.** *Overview of energy storage systems in distribution networks: Placement, sizing, operation and power quality.* s.l. : Elsevier, 2018.

3. **Bonnin, John.** PCI Energy Solutions. *Battery Energy Storage Systems & Electric Distribution.* [Online] 2023. https://www.pcienergysolutions.com/2021/11/12/battery-energy-storage-systems-and-electric-distribution/.

4. **International Electrotechnical Commission.** IEC 60287-3-2. *Technical Committee 20 Electric Cables.* s.l. : IEC, 2012, p. 77.

5. **International Renewable Energy Agency.** *Electricity storage and renewables: Costs and markets to 2030.* s.l. : IRENA, 2017.

6. **EDF Renewables.** Westcroft (Exeter) battery storage. *Our Sites.* [Online] 2024. https://www.edf-re.uk/our-sites/westcroft-exeter/.

7. **National Grid.** Connecting Energy Storage. [Online] 2024. https://www.nationalgrid.co.uk/connecting-energy-storage#:~:text=In%20simple%20terms%2C%20it%20can,balance%20power%20supply%20and%20demand..

8. **National Energy System Operator.** New Dynamic Services (DC/DM/DR). *Frequency Response Services.* [Online] July 2024. https://www.neso.energy/industry-information/balancing-services/frequency-response-services/new-dynamic-services-dcdmdr.

9. **Haroun Abba Labane, Alphonse Omboua, Desire Lilonga-Boyenga.** *Capacitive Effects on Electrical Lines and Cables.* s.l. : International Journal of Engineering Science Invention, October 2017.

10. **Hitachi Energy.** Shunt Reactors. *Reactors and Inductors.* [Online] 2024. https://www.hitachienergy.com/uk-ie/en/products-and-solutions/transformers/reactors-and-inductors/shunt-reactor-insulation.

11. **National Grid.** Investment Decision Pack NGET_A9.17 - Reactors. [Online] December 2019. https://www.nationalgrid.com/electricity-transmission/document/132531/download.

12. **Ville Industry.** Series and Shunt Reactors. [Online] 2023. https://www.cnville.com/productinfo/1144641.html?templateId=1133605.

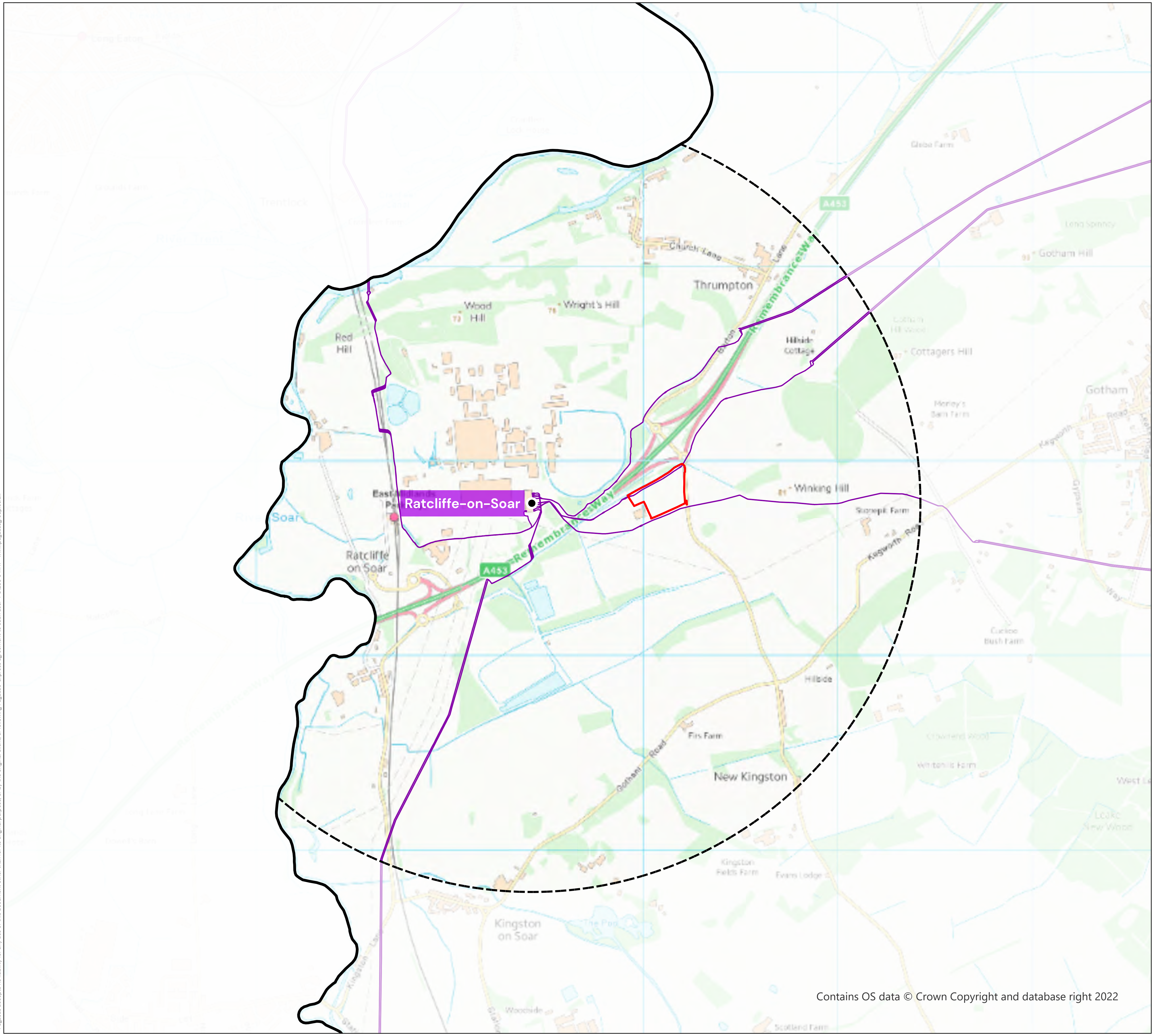
13. **Ofgem.** Preparing for a faster, more efficient electricity connections process. [Online] 25 March 2024. https://www.ofgem.gov.uk/blog/preparing-faster-more-efficient-electricity-connections-process#:~:text=The%20connections%20queue%20now%20stands,ESO%3A%20Future%20Energy%20Scenarios)..

14. **National Grid Electricity Distribution.** Appendix G overview. [Online] 2024. https://www.nationalgrid.co.uk/our-network/statement-of-works/appendix-g-overview.

15. **National Grid Electricity Distribution**. Embedded capacity register. [Online] 2024. https://www.nationalgrid.co.uk/our-network/embedded-capacity-register.

16. **Uniper.** The end of an era - Ratcliffe-on-Soar power station ends coal generation. [Online] 1 October 2024. https://www.uniper.energy/news/the-end-of-an-era---ratcliffe-on-soar-power-station-ends-coal-generation.

Appendix 2 – Study Area Plan



KEY

- Rushcliffe Borough Boundary
- 132kV Line
- 132kv Substation
- Study Area - 2km from Substation
- Site Boundary

ALTERNATIVE SITE ASSESSMENT - STUDY AREA

WINKING HILL FARM BESS

RES LTD

N

0 0.5 km

DATE	SCALE	TEAM	APPROVED
19/12/2024	1:20,000@A3	CS	DT

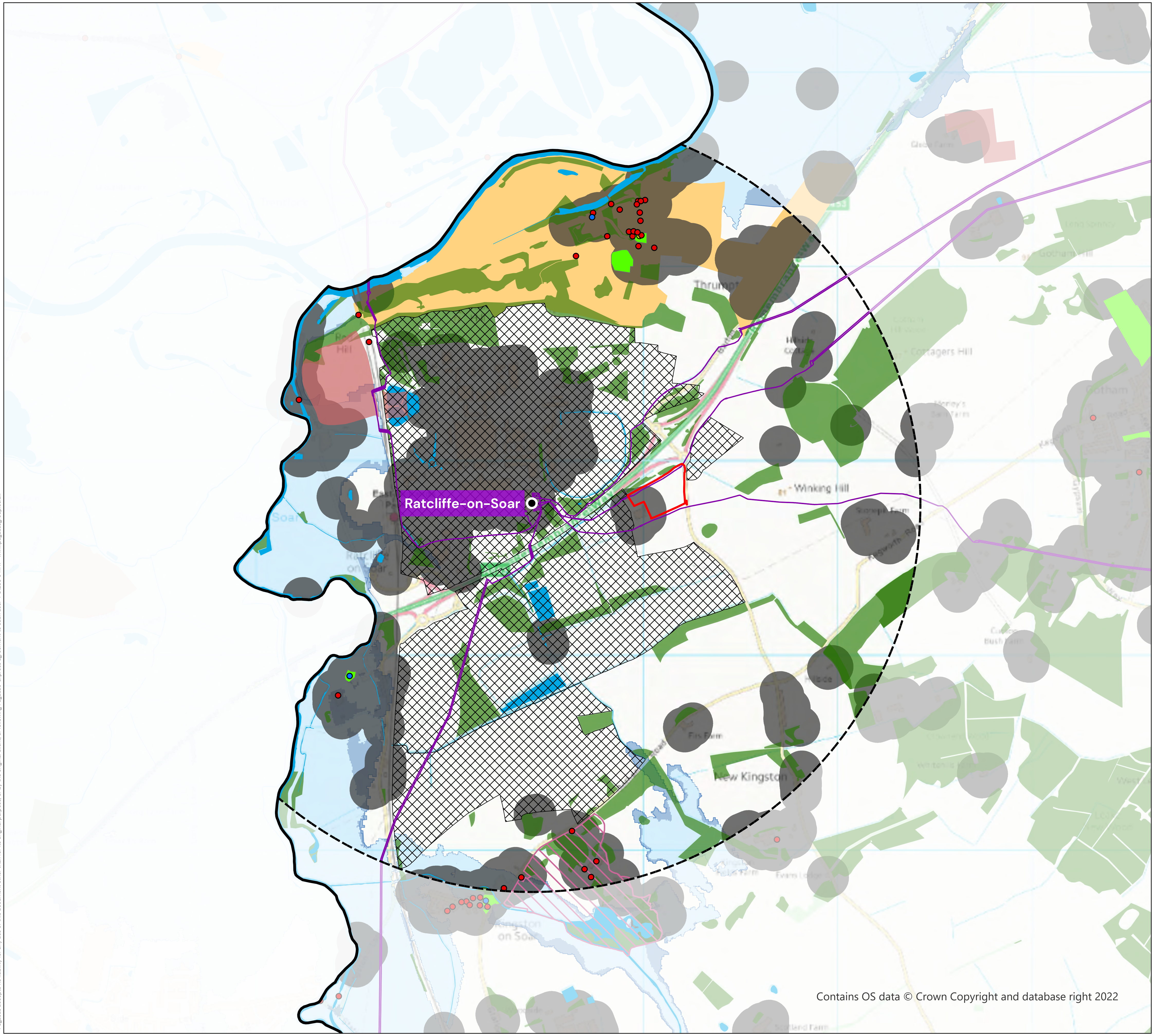
SHEET	REVISION
-	C

DRAWING NUMBER

P23-1398_EN_03

PEGASUS GROUP

Appendix 3 – Constraints Plan



KEY

- Rushcliffe Borough Boundary
- 132kv Substation
- Study Area - 2km from Substation
- 132kV Line
- Site Boundary
- Woodland (including Ancient Woodland)
- Buildings with 100m Buffer
- Greenspace Site
- Water Feature
- Grade I Listed Building
- Grade II* Listed Building
- Grade II Listed Building
- Registered Parks and Gardens
- Scheduled Monuments
- Conservation Area
- EA Flood Zone 3
- EA Flood Zone 2
- Planning Applications

ALTERNATIVE SITE ASSESSMENT - CONSTRAINTS

WINKING HILL FARM BESS

RES LTD

N

0 0.5 km

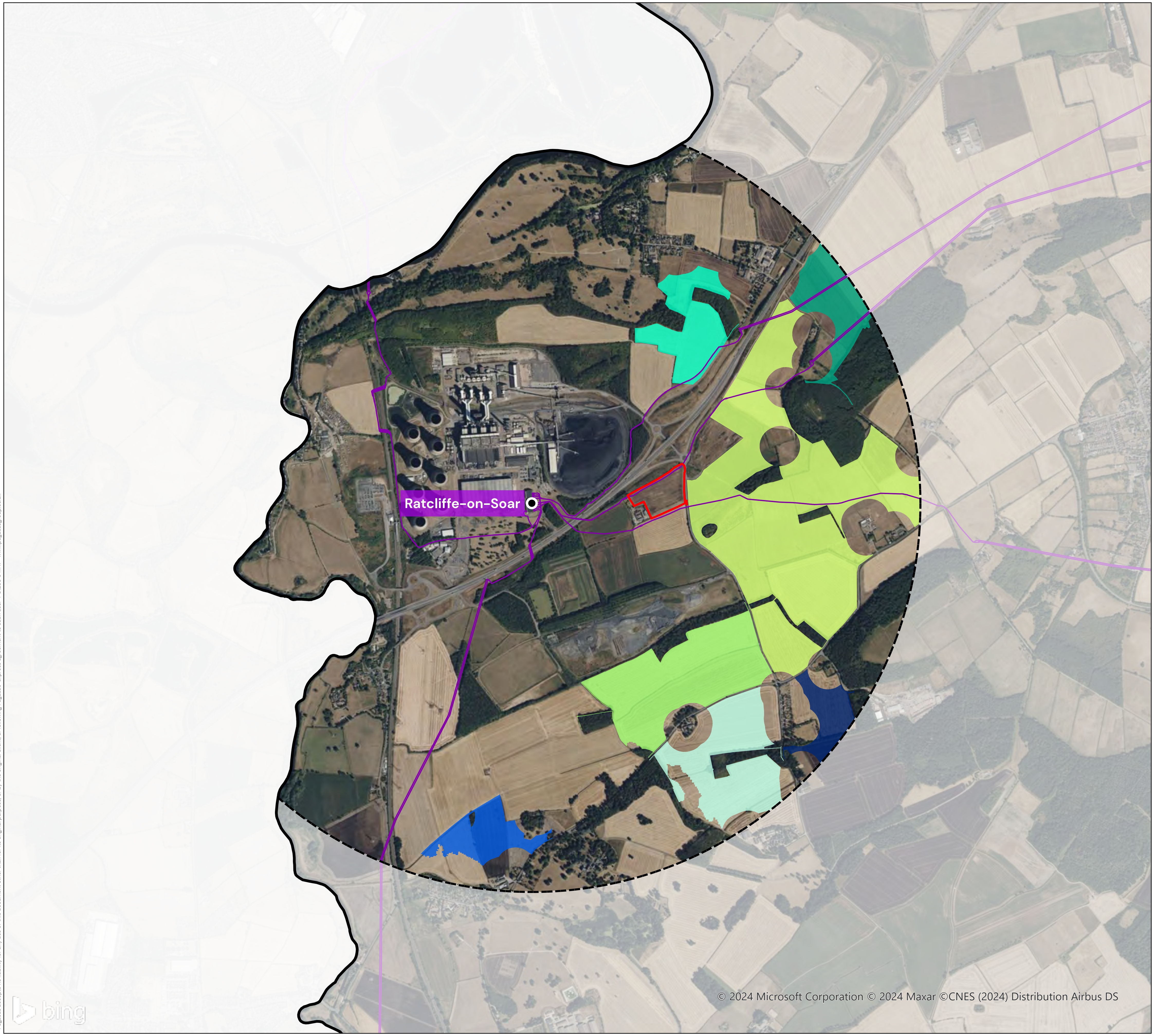
DATE	SCALE	TEAM	APPROVED
19/12/2024	1:20,000@A3	CS	DT

SHEET	REVISION
-	C

DRAWING NUMBER
P23-1398_EN_04

PEGASUS GROUP

Appendix 4 – Alternative Sites



KEY

- Rushcliffe Borough Boundary
- 132kv Substation
- Study Area - 2km from Substation
- 132kV Line
- Site Boundary

Sites >5ha

- Site 1 - 7ha
- Site 2 - 10ha
- Site 3 - 13ha
- Site 4 - 15ha
- Site 5 - 23ha
- Site 6 - 32ha
- Site 7 - 91ha

ALTERNATIVE SITE ASSESSMENT - FINDINGS

WINKING HILL FARM BESS

RES LTD

N

0 0.5 km

DATE	SCALE	TEAM	APPROVED
19/12/2024	1:20,000@A3	CS	DT

SHEET	REVISION
-	C

DRAWING NUMBER
P23-1398_EN_06

PEGASUS GROUP

Town & Country Planning Act 1990 (as amended)
Planning and Compulsory Purchase Act 2004

Leeds
Pavilion Court, Green Lane, Garforth,
Leeds, LS25 2AF
T 0113 2878200
E Leeds@pegasusgroup.co.uk
Offices throughout the UK & Ireland

Expertly Done.

DESIGN | ECONOMICS | ENVIRONMENT | HERITAGE | LAND & PROPERTY | PLANNING | TRANSPORT & INFRASTRUCTURE