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15 CLIMATE CHANGE

15.1 Introduction

15.1.1 This Chapter reports the likely significant effects of the proposed development in terms of climate change and risk mitigation in the context of the site, surrounding area and the wider environment, recognising that climate change is a global issue.

15.1.2 This climate change chapter will cover the following:

1. **Assessment of Impacts:** A conventional impact assessment that will focus on the potential effects of the proposed development (i.e. greenhouse gas (GHG) emissions on the climate). This will include an overview of how the proposed development aids in the mitigation of climate change.
2. **Assessment of Climate Resilience:** A review of the resilience of the proposed development to the potential effects arising from projected changes in future climate. This will include a qualitative discussion of the vulnerability and sensitivity of the proposed development to climate change impacts, with an assessment of the scale of effects.

15.1.3 This Chapter (and its associated figures and appendices) is not intended to be read as a standalone assessment and reference should be made to the front end of this Environmental Statement (ES) (Chapters 1 – 15), as well as Cumulative Effects (Chapter 18), and Summary & Conclusions (Chapter 19).

15.2 Legislation, Policy & Guidance

15.2.1 The relevant legislation, policy and guidance are listed below, with details provided in Appendix 15.1.

Legislative Framework

15.2.2 The applicable legislative framework is summarised as follows:

- Climate Change Act 2008 (2050 Target Amendment) Order 2019).
- Town & Country Planning (EIA) Regulations 2017.
- Building Regulations (Part L and Part F, proposed Part S).

Planning Policy

15.2.3 The applicable planning policy is summarised as follows:

- National Planning Policy Framework (NPPF 2021).

- Sunderland Core Strategy and Development Plan 2015-2033 (Adopted January 2020).
- IAMP Area Action Plan 2017-2032 (Adopted 2017).
- Draft Allocations and Designations Plan (ADP) (December 2020).
- Development Management Supplementary Planning Document (SPD).
- Sunderland City Council Low Carbon Framework (2020).
- Sunderland City Council Low Carbon Action Plan (2020).

Guidance

15.2.4 The applicable guidance is summarised as follows:

- The Institute of Environmental Management & Assessment (IEMA), 'Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating Their Significance' (2017).
- IEMA and European Commission, 'Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment' (2013); BSI - PAS 2080:2016 'Carbon Management in Infrastructure'.
- European Investment Bank (EIB) 'EIB Project Carbon Footprint Methodologies. Methodologies for the Assessment of Project GHG Emissions and Emission Variations' (2020).
- IEMA 'Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation' (2020).
- Royal Institute of Charted Surveyors (RICS), 'Whole life carbon assessment for the built environment' (2017).
- National House Building Council and European Commission reports and the UK Climate Change Risk Assessment (2017).

15.2.5 Whilst not specifically designed for EIA purposes, as it differs to the definition of a baseline scenario in other sections of the ES, the European Investment Bank guidance sets out a credible and viable definition for the baseline scenario in terms of climate change. This methodological approach is recommended by the European Commission in its guidance document 'Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment (2013)'.

15.2.6 In summary, the baseline scenario does not consider a "Do Nothing" scenario. As discussed within Chapter 5 of this ES, the 'Do Nothing' option would be contrary to the aims of the IAMP AAP, which allocates the site for development to help meet the identified needs for advanced manufacturing and automotive uses and to delivery of significant employment opportunities and, as the site already has planning permission for development it is unlikely that it would remain undeveloped. The assessment assumes that there is a demand for development and a supply is required for needs to be met. The assessment baseline scenario, therefore, can be considered to be a 'typical' development that:

- Delivers the same outputs as the proposed development.
- Is built to standard building regulations using normal construction practices.
- Is constructed in a nominal location.

15.2.7 A 2019 technical note from European Bank for Reconstruction and Development (EBRD) states that this type of baseline is appropriate since *"it is recognised that 'something' must be done"* and allows for a comparison of relative effect(s).

15.2.8 This differs from the from the IEMA guidance published in 'Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating Their Significance' that suggests that all emissions are significant and, therefore, unless a project is removing as much carbon from the atmosphere as it is emitting, its impacts will be considered as Significant. The IEMA method does not, however, enable the scale of effect to be identified and for which measurable mitigation measures can be identified that reduce the residual effects to within an acceptable level.

PART 1: ASSESSMENT OF IMPACTS

15.3 Assessment Methodology & Significance Criteria

Scope of the Assessment

15.3.1 Greenhouse gas (GHG) emissions are divided into 3 Scopes according the GHG Protocol.[1] Scope 1 (Direct) and Scope 2 (Indirect) emissions will be assessed. These are quantifiable and within the Applicant's reasonable control. In this instance, these emissions are taken to be that associated with the combustion of fossil fuels (e.g., natural gas in building heating systems) and the generation of electricity (i.e., associated with lighting and ventilation) during the operational phase of the built development.

[1] World Resources Institute and World Business Council for Sustainable Development. 'The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard.' (Revised Edition, 2004).

15.3.2 Given the scale of the development the construction process will inevitably require considerable amounts of materials to build and will use a significant amount of energy to complete the necessary works. This is also true when the site reaches the end of its useful life and needs to be decommissioned. Some project-specific information relating to on and offsite decommissioning activities is available, and a high-level quantification of deconstruction and demolition emissions for the proposed development has been undertaken based on the assumption that it will be a reverse of the construction process. In this context, deconstruction refers to the disassembly of building components to recover the maximum amount of reusable and recyclable materials in a safe, environmentally responsible, cost-effective manner. This can apply to both the enabling works to prepare the existing site for the new development, as well as to decommissioning of the proposed development at the end of the implied operational lifetime.

15.3.3 The assessment considers the embodied carbon within the materials being considered for the construction of the proposed development.

Effects Not Considered Within the Scope

15.3.4 Not included in the assessment are those emissions associated with the transport movements of goods and services, workers, supply chain and visitors to Site once the proposed development becomes operational. These are classed as Scope 3 (Indirect) emissions and are largely tied to actions outside the Applicant's control. As such, there is no publicly available information which allows for an assessment of these emissions.

15.3.5 Different greenhouse gases have different levels of impact on the climate. The assessment considers carbon dioxide equivalent (CO_2e) emissions. This is a metric measure used to compare the emissions from various greenhouse gases on the basis of their global-warming potential (GWP) by converting amounts of other gases to the equivalent amount of carbon dioxide (CO_2) with the same GWP. In practice, this is limited to consideration of CO_2 and Nitrous Oxide (N_2O), only. It is understood that there are other emissions that contribute to climate change, such as those found in refrigerants e.g., chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HFCs). These emissions are considered to be minimal in volume by comparison to the operational CO_2e emissions and have, therefore, not been considered in the analysis.

15.3.6 Not assessed are the embodied carbon within the materials used in production of the battery modules themselves as this information was not available.

Extent of the Study Area

15.3.7 The assessment focusses on the impact of an external factor (climate change) on the scheme, as well as the global impact of the scheme on climate change through carbon emissions. This is very different to impacts arising from other EIA topics, which consider spatially defined receptors within a limited geographical location.

Assessment Methodology

15.3.8 The method of baseline data collection and assessment is in accordance with current guidance and industry best practice. Full details are provided in Appendix 15.2.

Significance Criteria

15.3.9 The criteria listed in Table 15.1 has been used to assess the significance of the impacts of the proposed development on climate through the generation of GHG emissions.

Table 15.1: Significance Criteria – Assessment of Greenhouse Gas Impacts

Criteria	Impact	Significance
Relative CO_2e emissions are greater than in the baseline scenario	Negative	Significant
Relative CO_2e emissions are no different to the baseline scenario	Neutral	Not Significant
Relative CO_2e emissions are over 5% less than the baseline scenario	Positive	Significant

15.3.10 To avoid misinterpretation, it is important to understand the justification and the limitation behind the use of this significance criteria. It leads to a robust method for comparing likely emissions arising from the proposed development, relative to the baseline of a similar 'typical' development. For planning purposes, where it is important to weigh the benefits of one development against another, this is a useful and practical approach.

15.3.11 The alternative approach, which holds to a stricter interpretation of the absolute effects of the proposed development, is to take the baseline to be the 'do nothing' scenario. If the 'do nothing' approach were to be adopted, then almost any form of development would result in increased levels of GHG emissions and would be considered to deliver significantly adverse impacts.

15.3.12 The downside with this approach is that because all developments would deliver significant adverse impacts, it would be much more difficult to identify whether a developer was making a genuine attempt to reduce GHG emissions beyond the requirements of standard regulatory policy.

15.4 Baseline Conditions

15.4.1 The baseline operational energy demands have been modelled based on the maximum potential parameters defined in the Energy Strategy which has been produced separately to accompany the planning application (see Appendix 3.3).

15.4.2 The total annual energy and CO_2e emissions have been projected for the baseline development which assumes an all gas scenario. These are subsequently converted into CO_2e emissions in line with the baseline methodology described within Appendix 15.2.

15.4.3 A summary of the total annual energy and CO_2e emissions data is provided in Table 15.7 below.

Table 15.2: Baseline Annual Operational Energy Demands		
	Total Energy Demand (GWh/year)	**Total GHG Emissions (tCO_2e)**
Baseline (With All Gas)	470	91,178

15.4.4 The total baseline energy demand for the 60-year operational lifespan has been modelled as summarised in Table 15.3 below. It is noted that the proposed development does not have a predetermined end of life or demolition plan, however, for the purpose of the assessment a defined time period has been selected. This is a standard timeframe which WA uses to allow a realistic estimate of emissions over time and is the RICS (2017) recommended lifespan for non-residential development.

Table 15.3: Baseline Operational Energy Demands over 60-year Lifetime		
	Total Energy Demand (GWh)	**Total GHG Emissions (tCO_2e)**
Baseline (With All Gas)	28,222	3,835,043

15.4.5 It is assumed that the baseline conditions for emissions arising from decommissioning and construction will be the same as those estimated for the proposed development.

Sensitive Receptors

15.4.6 When considering the effects of the proposed development on climate, unlike other technical areas, assessment of individual receptors is not strictly applicable. Climate change is a global phenomenon and highly localised impacts as a direct result of emissions associated with this development are extremely unlikely.

15.4.7 It is understood that certain regions, populations and species are more sensitive to climate change than others, but it would not be reasonable to provide an assessment of the proposed development's potential impact on these receptors as any single development would have an indiscernible impact on global climate change overall.

15.4.8 It is still important, however, to undertake the assessment in order to ensure that the proposed development does not emit unacceptable levels of emissions, not only in an effort to reduce future climate change impacts, but also to contribute towards local and national emission targets.

Limitations

15.4.9 Unregulated energy use could vary substantially when the proposed development is operational, but it is not possible to accurately predict this energy use and a reasonable allowance has been made to account for this.

15.4.10 There are currently limited resources able to give the annual energy demand of given building types and uses with improvements made in their energy efficiency. Therefore, this assessment models an increase in energy efficiency of the proposed development based upon our experience of what is sensible and achievable.

Decommissioning Emissions

15.4.11 Decommissioning emissions include those from plant use and site facilities. There are also many offsite causes of emissions during the decommissioning process which vary depending on the amount of materials being recycled, sent to landfill or incineration. A high-level overview of the potential emissions from the deconstruction has been provided in paragraph 15.5.4 based on information supplied by the Applicant.

15.4.12 The emissions resulting from decommissioning are deemed to be negligible when compared to the emissions resulting from the operational energy use once the proposed development is operational. However, the level of impact has been assessed so that appropriate mitigation can be implemented wherever possible.

Construction Emissions

15.4.13 A high-level overview of the potential emissions from the construction process has been provided in paragraph 15.5.4 based on information supplied by the Applicant. During the construction process there will be emissions resulting from on-site machinery, plant equipment and site facilities. There will also be emissions resulting from the waste generated through the construction process and its treatment and disposal.

15.4.14 The emissions resulting from construction are deemed to be negligible when compared to the emissions resulting from the operational energy use once the proposed development is operational. However, the level of impact has been assessed so that appropriate mitigation can be implemented wherever possible.

Embodied Carbon Emissions

15.4.15 Embodied emissions (also referred to as embodied carbon or embodied energy) are the emissions associated with the manufacture and transportation of all materials and products, including those used in construction. The embodied emissions within the materials used at the site can make up a large proportion of the total emissions relating to the proposed development. This includes Scope 3 emissions, for instance, those emitted during the manufacturing process of materials such as concrete and steel[2] which are used to construct the building. The RICS guidance indicates that for a typical warehouse shed with office space and an operational life of 60 years, embodied emissions from the materials and on-site construction can make up 47 % of the overall carbon emissions. This highlights the importance of reducing the embodied carbon of the materials used wherever possible.

15.4.16 A high-level indicative assessment of the embodied carbon within the materials being considered for the construction of the proposed development is provided, using the RICS guidance for default values for materials commonly used in construction and the Inventory of Carbon and Energy (ICE) Database[3]. Insufficient information was available to enable an assessment of the embodied carbon within the materials used for production of the battery modules themselves.

15.5 Assessment of Effects

Design Solutions & Assumptions

15.5.1 The assessment considers the operational CO_2e emissions over a 60-year period, which is assumed to be representative of the development's 'lifetime'. It is not possible to fully understand, at this time, how energy use and emissions will vary within buildings during this period, but it has been assumed that energy use will remain the same, year on year, throughout the assessment period.

Embedded Mitigation

15.5.2 Embedded mitigation has been considered in the assessment as the Applicant wishes to be policy compliant with their approach. It will be necessary for the proposed development to incorporate various renewable and low carbon technologies to achieve the minimum target of 27% emissions reductions planned by the Future Buildings Standard. The models are, therefore, based on the assumption that the

[2] Embodied emissions are retained throughout the lifetime of a development', including when operational.
[3] ICE (Inventory of Carbon & Energy) Database Version 0.3 (MR) Beta – 7 Nov 2019.

proposed development will deploy solar PV on the roof-top and install heat pumps for space heating. Full details of the embedded mitigation can be found in the accompanying Sustainability Statement (Appendix 3.2) and the Energy Strategy (Appendix 3.4).

Assessment of Effects

Effects from Decommissioning and Construction Phase

15.5.3 The proposed development will require levelling and grading of the existing site, including excavation of an estimated 300 mm depth of topsoil from areas of agricultural land; construction of the new manufacturing building; construction of ancillary structures and infrastructure; and landscaping. It is expected that the majority of waste arisings will be sent for disposal to local landfill sites or to suitable offsite locations for re-use. The anticipated waste volumes form a small fraction of regional waste generation and capacity. Any hazardous waste arisings would be dealt with by a specialist hazardous waste operator.

15.5.4 The estimated emissions arising from decommissioning and construction are summarised in Table 15.4. It has been assumed that Decommissioning at End of Life will be a reverse of the construction processes. However, this presents a worse-case scenario as it does not account for potential decarbonisation of transportation methods.

Table 15.4: Estimated Emissions from Decommissioning

	Total Energy Demand (GWh)	Total GHG Emissions (tCO_2e)
Construction	9	50,593
Decommissioning	9	3,522
TOTAL	**18**	**54,115**

15.5.5 Based on information supplied by the Applicant, the total emissions arising from the deconstruction and construction phases have been estimated at 54,115 tCO_2e.

15.5.6 The combined level of effect from the decommissioning and construction phase, without mitigation, is deemed to be moderate adverse and significant in the short-term.

Effects from Operational Phase

15.5.7 The industrial unit will be of a modern design, set within a landscaped plot, with the necessary vehicle parking, loading/unloading and manoeuvring area(s). The building will be operated continuously for 24-hours a day, 7 days a week and, as such, external operational areas will require to be lit during the hours of darkness to the minimum levels required for their safe operational use. The building will incorporate the latest design specifications for energy efficiency and the use of sustainable resources.

15.5.8 It is assumed that the total annual energy demand will be the same as the baseline. The total projected energy demand for the 60-year operational lifespan has been modelled with the embedded mitigation for Scenario A and Scenario B as summarised in Table 15.5 below. Full details of the projected operational energy demands can be found in the accompanying Energy Strategy (Appendix 3.3).

Table 15.5: Projected Operational Energy Demands over 60-year Lifetime

	Total Energy Demand (GWh)	**Total Emissions – Scopes 1 and 2 (tCO_2e)**	**Total Emissions – Scope 3 (tCO_2e)**
Scenario A – With Gas Boilers	27,865	3,881,393	84,027
Scenario B – With All-electric Heating	27,771	1,513,289	84,105

15.5.9 The projected total energy use and CO_2e emissions for the development's 60-year operational lifespan has been modelled to produce:

- Scenario A (With Gas Boilers) – 3,965,420 tCO_2e.
- Scenario B (All-electric Heating) – 1,597,394 tCO_2e.

15.5.10 Modelling indicates that there will be a 0.63 % reduction in emissions for Scenario A and a 68 % reduction in emissions for Scenario B.

15.5.11 The level of effect from the operational phase with the embedded mitigation proposed is deemed to be negligible in the long-term for Scenario A, as there is still a reliance on the combustion of fossil fuel to meet the majority of the required energy demand.

15.5.12 If Scenario B is implemented, then the proposed development will result in a major beneficial impact which is Significant in the long term. The shift to all electric to meet the energy demands for the proposed development will also benefit from the decarbonisation of the national grid. The proposed development has set a target to be zero carbon by 2025, and therefore, Scenario B will be the preferred option as far as is reasonably practicable.

15.5.13 This means that in both Scenarios, there are emissions savings or costs associated with the proposed development achieved through Building Regulations and the additional low carbon measures proposed. Without mitigation, the proposed development would closely resemble a typical development that has met Building Regulations but has not actively pursued additional efforts to reduce climate change impacts.

15.5.14 The level of impact for both Scenarios should not be interpreted as the proposed development having no contribution towards climate change. It is purely in relation to the Applicant meeting Building Regulations and emissions targets within policy, and pursuing some further action and commitment to sustainable development. The development will still contribute to climate change and global warming.

Solar Photovoltaics

15.5.15 The proposed development intends to deploy roof-mounted Solar Photovoltaic (PV) arrays at the Site which will be used to offset the projected energy demand. It is estimated that PV technology will generate approximately 5 GWh of electrical energy per year, saving 13,821 tCO_2e over the 60-year operational lifespan.

Air Source Heat Pumps

15.5.16 Air Source Heat Pumps (ASHP) are being considered for the proposed development. ASHP are expected to provide a considerable saving in CO_2e emissions to support the general domestic water heating to the offices and process loads. The estimated emissions savings from ASHP at the Site is 5,276 tCO_2e over the 60-year operational lifetime of the proposed development.

Scope 3 Emissions

15.5.17 It is not considered viable to include all Scope 3 emissions associated with the proposed development in the impact assessment. This is due to the extent and current uncertainties associated with the upstream and downstream supply chain for the proposed development. However, a select few Scope 3 emission sources have been considered where data was available and supplied by the Applicant. These figures for Scope 3 emissions are presented in Table 15.5 and are included in the overall assessment of impact for both operational scenarios.

Embodied Carbon Emissions

15.5.18 As previously mentioned, the embodied carbon emissions within construction materials can make up a large proportion of the total emissions relating to the proposed development. The materials to be used at the Site are indicative at this concept stage of design, however, a detailed assessment of the embodied carbon was undertaken based on the information supplied by the Applicant. It is not confirmed at this stage whether the proposed development will use all raw materials or a mixture of raw materials and recycled materials. A high-level assessment of both options was undertaken and the results are summarised in Table 15.6.

Table 15.6: Estimated Embodied Carbon (tCO_2e)	
All Raw Materials	58,449
Mixture of Raw and Recycled Materials	46,873

15.5.19 The percentage reduction in embodied carbon emissions when including recycled materials is 19.81% and, therefore, this option should be considered wherever feasibly possible. This demonstrates how the choices made during detailed design can influence the overall reduction in carbon emissions for the proposed development.

15.6 Mitigation

15.6.1 There is scientific agreement that carbon emissions resulting from human activities must be reduced to mitigate the risks associated with the more severe long-term impacts of climate change. Renewables are projected to need to supply 70-85% of electricity in 2050 to achieve targets of limiting global warming to 1.5°C. Average annual investment in low carbon energy technology and energy efficiency needs to be upscaled by a factor of five by 2050, compared to 2015. The potential risks associated with climate change will increase if these technologies are not implemented and the national grid is not decarbonised as far as possible.

Construction Phase

15.6.2 There are numerous standards that a contractor is expected to commit to during the construction phase, such as Common Minimum Standards (CMS), Construction (Design and Management) Regulations (CDM), or the Considerate Constructors Scheme (CCS). Prior to construction commencing, a Construction Environmental Management Plan (CEMP) and Waste Management Plan can be secured by condition which brings together these standards with site specific prescriptions. This can reduce the impacts on the environment during the construction and operation processes and ensure the design allows capacity for effective waste management for the site.

Operational Phase

15.6.3 In addition to the embedded mitigation, there are additional measures that could be implemented or pursued in the design and construction of the proposed development to further reduce impacts on climate change during the operational phase. These include, but are not limited to:

- Incorporating improvements in fabric efficiency above Building Regulations;

- Utilising wastewater heat recovery technology;
- Use of energy efficient materials for construction, lighting, appliances, and production equipment;
- Minimised use of building materials with high lifecycle CO_2 emissions, most notably concrete, steel and cement;
- Reuse and recycling of materials on-site e.g., topsoil;
- Optimising solar gain and natural daylight;
- Installing a high level of insulation;
- Minimising the chance of cold bridging;
- Increasing air tightness; and
- Increasing the opportunity for natural ventilation.

15.6.4 Energy efficient design is being considered for the proposed development in order to gain credits to meet BREEAM 'Very Good' standards and comply with local planning policy.

15.6.5 It is worth mentioning that in addition, subject to the results of the Future Buildings Standard consultation, the proposed development will be required to achieve a 27% reduction in emissions for new non-residential buildings. Overall, the proposed development has been modelled to meet these requirements.

15.7 Residual Effects

15.7.1 The proposed development will result in the emission of GHGs, which is a long term and permanent effect contributing to global warming and climate change. If mitigation measures are implemented in the form of an energy efficient build standard and renewable energy sources, then the magnitude of this effect is minimised.

15.7.2 A negligible impact for Scenario A is purely in relation to the Applicant meeting Building Regulations and should not be interpreted as the proposed development having no contribution towards climate change. The same can be said of developments with a beneficial impact, such as with Scenario B, where the Applicant meets emissions targets within policy or pursues further action and commitment to sustainable development. In both cases the development will still contribute to climate change and global warming.

15.7.3 As noted in paragraph 15.3.4, this assessment has not included quantification of emissions from workers commuting to the proposed development once it becomes operational. These will have a residual effect, but these emissions are deemed to be largely outside of the Applicant's direct control. A Travel Plan designed to reduce the number of employees commuting by single occupancy car (see paragraph 15.12.11) has been prepared by Systra and submitted to accompany this detailed planning application. It should be highlighted that the production of EV batteries will enable emission savings of around 117,211 tCO_2e each year through the removal of the equivalent number of fossil fuel powered vehicles from the roads.

15.7.4 There will be GHG emissions arising from the decommissioning and construction of the proposed development. The high-level estimated figure of 54,115 tCO_2e for decommissioning and construction, will have an immediate impact on the local area and is deemed significant. The proposed development should actively seek to reduce the level of residual impact from the decommissioning and construction phases by reusing or recycling materials onsite wherever possible and employing good construction methods.

PART 2: ASSESSMENT OF CLIMATE RESILIANCE

15.8 Assessment of Vulnerability

15.8.1 Not only do the EIA Regulations require an assessment of the potential impacts of a proposed development on climate change, but it also requires an assessment of a proposed development's vulnerability to potential impacts of climate change. This will ensure that the risk of the proposed development to climate change effects are identified and mitigated if required.

15.9 Assessment Methodology and Significance Criteria

15.9.1 Assessing the impacts of climate change on a scheme varies from the assessment of impacts arising from the scheme in other EIA topics as it focusses on the global impact of an external factor (climate change) on the scheme, rather than the local impact of the scheme on receptors in a confined geographical location. The resilience of the proposed development to climate change is assessed based upon the susceptibility and vulnerability of a range on different receptors. The magnitude of the effects is deemed to be significant based on a matrix of likelihood and consequence. Full details of the methodology can be found within Appendix 15.2.

Limitations

15.9.2 The IEMA guidance (2020) explains how our climate is changing but there remains uncertainties in the magnitude, frequency and spatial occurrence (either as changes to average conditions or extreme conditions) that generally makes it difficult to assess the impacts of climate change in relation to a specific project. Therefore, scientific assumptions must be made in order to assess the resilience of new developments to any future changes in climate.

15.10 Baseline Conditions

15.10.1 England is classified under Köppen-Geiger[4] as having a 'Cfb' climate, more commonly known as a temperate oceanic climate. These are typically mid-latitude climates with warm summers and mild winters. The average temperature in all months will be below 22°C and there is not an identifiable dry/wet season (i.e., precipitation rates are similar year-round). The City of Sunderland, where the site is located, is located approximately 34 metres (m) above sea level. The average annual rainfall in the area is around 718 millimetres (mm) and the average annual temperature is 9.5 °C[5].

Global Climate Change Projections

15.10.2 Global probabilistic projections provide a wider sampling of uncertainty and are useful for considering the wider context of future changes in climate. Table 15.7 highlights the main projected global climate change issues.

Table 15.7: Projected Global Impacts of Climate Change

Climate Change Issue	Projected Global Impacts
Solar Radiation	Long term projected changes in surface solar radiation, as a result of global warming, would suggest a decrease in available solar power due to a decrease in downwelling shortwave radiation, likely linked to the increase of water vapour. This is considered to be anthropogenic strengthening of "natural" decadal variability in irradiance, known as global dimming and brightening, which is influenced by synoptic weather patterns, cloud variations and atmospheric aerosols.
Heat Waves	The Intergovernmental Panel on Climate Change (IPCC) predict that temperature extremes will increase more rapidly than global mean surface temperature, with the number of hot days projected to increase in most land regions. In the 1.5°C warming scenario heat waves in mid latitudes could warm by up to 3°C.
Extreme Rainfall and Flooding	IPCC and Met Office both suggest a general uncertainty in the projection of changes in heavy precipitation for the UK due to position in the transition zone between north and south Europe's contrasting projected changes. It is generally agreed the

[4] Kottek, M., J. Grieser, C. Beck, B. Rudolf, and F. Rubel, 2006: World Map of the Köppen-Geiger climate classification updated. Meteorol. Z., 15, 259-263. DOI: 10.1127/0941-2948/2006/0130.
[5] https://en.climate-data.org/europe/united-kingdom/england/sunderland-77/

Table 15.7: Projected Global Impacts of Climate Change	
Climate Change Issue	**Projected Global Impacts**
	northern parts of the UK will experience overall increases of up to 10%, whilst southern areas may experience decreases of up to 5%. Overall, the UK is expected to see a general increase in precipitation trends up to the year 2100.
Rising Sea Levels	The most recent modelling indicates global sea level rise of 0.26-0.77m by 2100, under a 1.5°C warming scenario. Risk is amplified on small islands and in low lying coastal areas and deltas.
Storms and Winds	Atmospheric circulations have large variability across interannual through to decadal time scales, which makes forming projections with any reasonable confidence very difficult. There is more robust evidence in the Northern Hemisphere that since the 1970s there has been a general poleward shift of storm tracks and jet streams and near-surface terrestrial wind speeds have been declining by approximately 0.1-0.14 m s-1 per decade across land. Despite anemometers being used for decades to measure near surface wind speed, the data has rarely been used to analyse trends and lacks important instrumentation meta data. In general, confidence is low in wind speed projections due to large uncertainties across global data sets.
Cold Spells and Snow	It has been observed the spring snow cover has been continuing to decrease in extent in the Northern Hemisphere and that cold temperature extremes are projected to decrease along with the number of frost days

Regional Climate Change Projections

15.10.3 Climate change will have both direct (operational and performance-based) and indirect (securing of supplies and rising energy costs) impacts on manufacturing operations at the site. To study the regional impacts of climate change on the proposed development, the Climate Change projections for the UK (UKCP18)[6] are used. Regional and Local projections represent small scale climate changes through a narrower sampling of uncertainty and provide the detail needed to inform local decision-making regarding adaptation.

15.10.4 The UKCP18 dataset provides future climate change projections for land and marine regions as well as observed climate data for the UK. Analysing time series plume data from UKCP18 provides an indication of climate projections for the regional 25 km grid that encompasses the site at East Boldon. The following graphs are based on the four Representative Concentration Pathways (RCP) and show how the climate in the region could change up to the year 2100, compared to a 1982-2000 baseline. The RCPs are used to analyse how different emission scenarios could affect climate projections (Figure 15.1, Figure 15.2, Figure 15.3). These range from RCP2.6 where atmospheric emission concentrations are strongly reduced through to the worst-case scenario,

[6] https://www.metoffice.gov.uk/research/approach/collaboration/ukcp/key-results

RCP8.5, where emission concentrations continue to rise unmitigated.

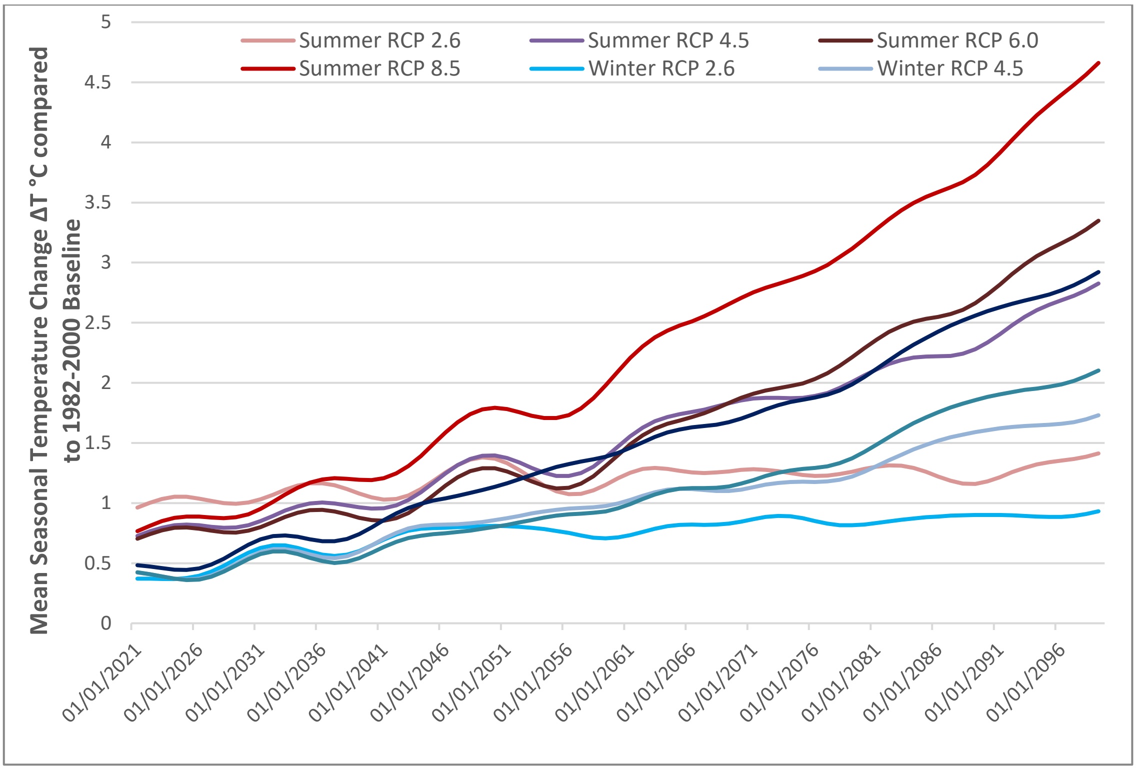

Figure 15.1: Projected changes in seasonal Mean Air Temperature across four RCP scenarios, from 2021-2049 compared to the 1981-2000 baseline, using the probabilistic projections (50th percentile) for a 25 Km Grid around Sunderland, England.

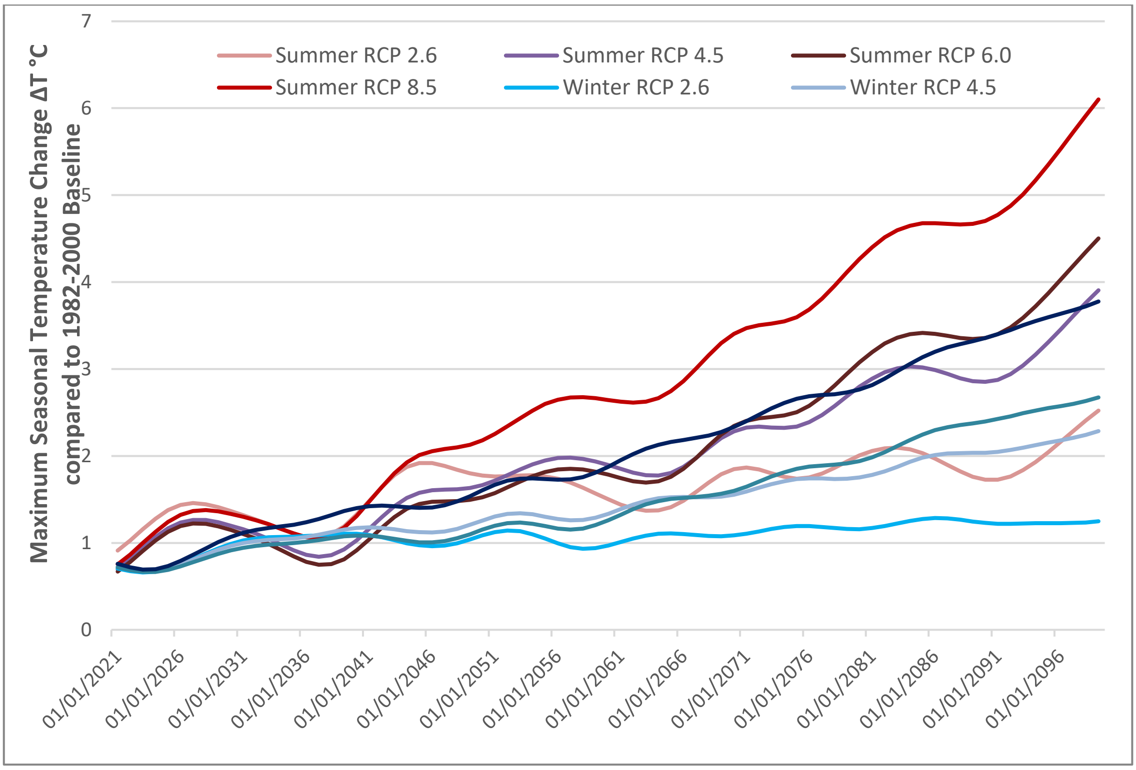

Figure 15.2: Projected changes in seasonal Maximum Air Temperature across four RCP scenarios, from 2021-2049 compared to the 1981-2000 baseline, using the probabilistic projections (50th percentile) for a 25Km Grid around

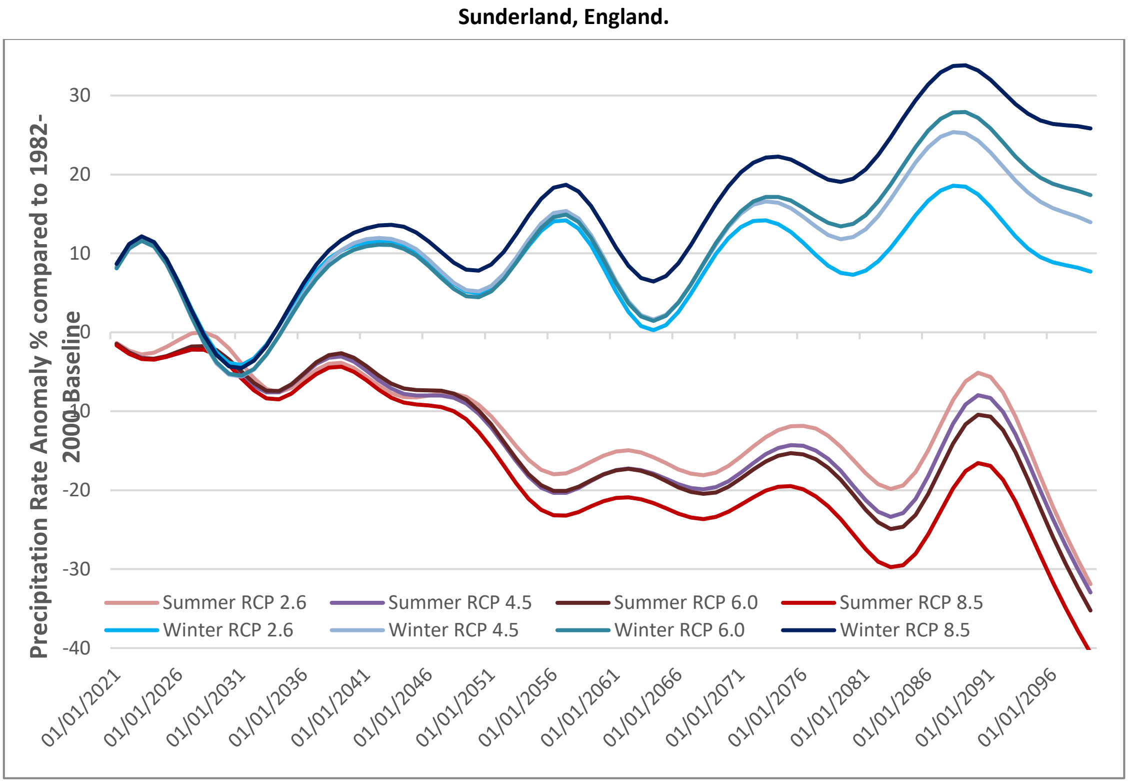

Figure 15.3: Seasonal average Precipitation rate anomaly (%) for 2021-2049 compared to the 1981-2000 baseline for all RCP scenarios using probabilistic projections (50th percentile) for a 25Km Grid around Sunderland, England.

15.10.5 Figure 15.1 and Figure 15.2 show that temperature is set to rise in summer and winter, even in a best-case scenario (RCP2.6), over the assumed 60-year lifetime of the project. The average temperature rise by 2100 could be between 1.4 °C and 4.7 °C in the summer and 0.9 °C and 2.9 °C in the winter. Maximum temperatures in 2100 could range between 2.5 °C and 6.1 °C in the summer and 1.2 °C and 3.8 °C in the winter. Figure 15.3 shows that summer precipitation rates are reducing over the assumed 60-year lifetime of the project from between -31.90 mm to -40.61 mm by 2100. Climate projections indicate that winter precipitation rates are increasing from between 7.70 mm to 25.85 mm by 2100.

Climate Scenarios & Timelines Considered

15.10.6 Climate projections for the 2030s, 2050s, 2070s and 2090s time periods were selected to correspond with the proposed timescales for the proposed development's construction and operational phases.

15.10.7 The conservative approach recommended as best practice by the IEMA guidance (2020) is to use the central estimate (50th percentile) for the high emissions scenario (RCP8.5) to establish the likely worst-case changes to climatic conditions. This assessment considers the regional variations in Tyne and Wear during these periods.

A reference range is provided for possible outcomes and their relative likelihoods, using the 10 % probability level as a lower limit and the 90 % probability level as an upper limit.

15.10.8 These scenarios and probability levels were used to provide credible projected changes to climate variables including an indicative level of uncertainty for the future climate baseline (Table 15.8).

Future Climate Baseline

15.10.9 Table 15.8 provides a summary of a range of projected changes to climate variables. This can be used to build-up a holistic view of future climate and assess potential impacts to determine a future climate baseline, using RCP8.5 as a conservative approach. According to UKCP18, relative probabilities for specific outcomes are typically much higher near the 50 % cumulative probability level (median) of the distribution, than for outcomes lying either below the 10 % cumulative probability level or above the 90 % cumulative probability level. The worst-case scenario indicates an increase in mean temperature in both summer and winter, which corresponds with seasonal precipitation increasing in winter and decreasing in summer. This highlights the need for the proposed development to be able to deal with the potential risks for both increased flooding and increased heatwaves.

Table 15.8: Quantitative Summary of the Future Baseline for Key Climatic Variables in Sunderland

Season	Variable	Time Period*	Projected Change at				
			Lower Probability		Median	Higher Probability	
			5th percentile	10th percentile	50th percentile	90th percentile	95th percentile
Winter	Mean Temperature (ºC)	2030s	-1.01	-0.65	0.60	1.87	2.23
		2050s	-0.58	-0.21	1.13	2.50	2.89
		2070s	-0.39	0.07	1.71	3.40	3.89
		2090s	0.05	0.60	2.53	4.55	5.15
	Mean Precipitation (%)	2030s	-38.6	-29.9	4.5	54.6	71.7
		2050s	-33.6	-24.4	12.9	63.3	79.4
		2070s	-37.1	-26.1	15.5	64.0	78.9
		2090s	-29.5	-17.7	27.5	84.7	106.5
Summer	Mean Temperature (ºC)	2030s	-0.72	-0.34	0.99	2.33	2.71
		2050s	-0.33	0.11	1.62	3.22	3.68
		2070s	0.22	0.74	2.66	4.69	5.29
		2090s	0.87	1.51	3.87	6.42	7.18
	Mean Precipitation (%)	2030s	-58.8	-45.8	-4.6	48.7	67.4
		2050s	-61.6	-52.2	-14.1	32.4	49.6
		2070s	-66.4	-57.9	-21.6	30.8	46.0
		2090s	-77.8	-66.8	-26.2	16.9	29.8

Table 15.8: Quantitative Summary of the Future Baseline for Key Climatic Variables in Sunderland							
Season	Variable	Time Period*	Projected Change at				
			Lower Probability		Median	Higher Probability	
			5th percentile	10th percentile	50th percentile	90th percentile	95th percentile
*UKCP18 provides 20-year time slices, hence averages taken for: 2030s (2020-2039), 2050s (2040-2059), 2070s (2060-2079), 2090s (2080-2099) under RCP 8.5.							

15.11 Assessment of Effects

Climate Change Vulnerability

15.11.1 The Design of Future Climate Report published in 2010 identified three broad risk categories to buildings from future climate change in the UK. These are as follows:

- Risk to comfort and energy performance: warmer winters will reduce heating requirements, however the increased use of cooling systems in the summer will present a challenge to energy consumption and carbon emissions.
- Risk to construction: resistance to extreme conditions, detailing, and the behaviour of materials.
- Risk to water management: management of water during both flooding and drought events, and changes in soil composition.

15.11.2 Combined, these categories can be considered climate change threats that could result in increased energy demands, economic losses and loss of life.

15.11.3 Climate change may result in variations in approach to general building design and construction in order to offer a higher degree of protection against the identified risks. Many of these improvements will be brought about using existing off-the-shelf components that are in common use in other places around the world, but which may not previously have been considered necessary in parts of the UK.

15.11.4 As well as seeking improvements in the construction techniques for the proposed development, there will also be a need to improve various aspects of the operational performance to provide more resilience against climate change.

15.11.5 At more localised levels, the effects themselves can manifest in different ways and, therefore, the most appropriate strategies should be selected on a site-specific basis. A coastal village may be at most risk from sea-level rises and storm surges, whilst the threat of heat waves or high winds might be more significant at inland locations. Adaptation involves developing a resilience and a preparedness to deal with the likely consequences of climate change. The proposed development needs to consider and mitigate against the likely impacts of increased overheating events in summer months and intense precipitation events in winter months.

15.11.6 Table 15.9 highlights the impacts on the proposed development that could arise from climatic effects, reproduced from data in reports by the National House Building Council[7] and European Commission[8] and the UK Climate Change Risk Assessment Report[9]. The level of reduction in global emissions will alter the likelihood of these effects as the climatic conditions will vary, this is shown within the range of temperatures and precipitation levels seen across the RCPs in Table 15.8. The climatic projections shown in the above figures are seasonal averages and therefore there is potential for even higher temperatures within that season.

15.11.7 The UK Climate Change Risk Assessment identifies flooding and high temperatures as posing the greatest risks to the built environment. In the interest of completeness, and to account for potential irregular, adverse extreme weather, this section will also cover reducing risk to snow and ice, however, projections suggest that, overall, these will become a decreasing risk with climate change.

Table 15.9: Potential Impacts on Proposed Development

Climatic Factor	General Impact	Component / Sub-Structure Impact
Soil Drying	Increase will affect water tables and could affect foundations in clay soils.	Increased risk of basement heave or subsidence, water ingress, consequential damage to finishes and stored items. Ground shrinkage can lead to failure of electrical, gas and water pipes, foundations and sub-structures.
Temperature Increase	Maximum and minimum changes will affect heating and cooling. Frequency of cycling through freezing point will affect durability. Daily maximum and minimum temperature will affect thermal air movement. Increased temperatures may cause an increase in leachate gases.	Overheating of mechanical and electrical equipment effecting lifespan, reliability and potential health and safety issues. Plastic materials will have a reduced lifespan. Structure/cladding/roofing membranes, sealants, pavements and roads have increased risk of cracking. Reduced capacity of overheated power lines. Building overheating (due to increased fabric efficiency and incorrect implementation). Solar PV modules work slightly less efficiently at high temperatures and some studies[10] have shown that high temperatures can age at a faster rate. Decreased labour productivity.
Relative Humidity	Increase will affect condensation and associated damage or mould growth.	Increase in respiratory diseases amongst site workers.

[7] National House Building Council Foundation (NHBC) (2007). Climate change and innovation in house building: designing out risk (NF3).
[8] European Commission (2013). Adapting infrastructure to climate change.
[9] HM Government. (2017) 'UK Climate Change Risk Assessment 2017.'
[10] Patt, A., Pfenninger, S. and Lilliestam, J., (2013). Vulnerability of solar energy infrastructure and output to climate change. Climate Change 121 pp93-102 IPCC SPECIAL REPORT: GLOBAL WARMING OF 1.5 ºC[10]

Precipitation & Water Availability	Increase and decrease will affect water tables; cleaning costs will be increased in winter, with associated redecoration requirements; durability and risk of water ingress will be affected by combination of precipitation increase and gales.	Increased damage to capping system and higher risk of failure, increased chances of flooding. Structure/cladding/roofing membranes and sealants have increased risk of cracking due to different moisture movements. Damage to foundations and basements. Delays in construction and increased costs. Increased risk of subsistence.
Snow and Ice	Increase will affect need for weather tightness, risk of water ingress, effectiveness of air conditioning, energy use, risk of roof failures.	Increased damage to roofing and higher risk of failure.
Gales, Storms and Extreme Weather	Increase may affect need for solar glare control.	Window specification and glare control requirement.
Solar Radiation	Increase/decrease in seasonal lighting needs.	Changes in lighting systems and glare control requirement.

Sensitivity of Receptors

15.11.8 The sensitivity of receptors has been determined through an assessment of the susceptibility and vulnerability of the site to future climate changes. Full details of the definitions used to determine susceptibility and vulnerability can be found within Appendix 15.2.

15.11.9 The results of the assessment of the susceptibility and vulnerability of receptors are given in Table 15.10 below. The level of likelihood for the climate change issue was also identified in Table 15.10 according to the future climate baseline outlined in Table 15.8. The future baseline shows that at certain points in the site's lifetime certain impacts are more likely than others.

Table 15.10: Assessment of Susceptibility & Vulnerability of the Proposed Development to Future Climate Baseline

Climate Change Issue	Receptors Impacted	Susceptibility	Vulnerability	Likelihood
Soil Drying	Building Structure, Species and Habitats	Low	Low	Medium
Temperature Increase	Workers, Building Structure, Species and Habitats	High	High	High
Relative Humidity	Workers	Medium	Medium	Medium
Precipitation & Water Availability	Workers, Building Structure, Species and Habitats	Medium	Medium	High

Snow and Ice	Workers, Building Structure, Species and Habitats	Low	Low	Low
Gales, Storms and Extreme Weather	Workers, Building Structure, Species and Habitats	Medium	Medium	High
Solar Radiation	Workers, Building Structure, Species and Habitats	Medium	Medium	Medium
Cloud Cover	Workers	Low	Low	Low

Magnitude of Effects

15.11.10 A qualitative assessment has been undertaken based on the data from UKCP18 identified in Table 15.8 to assess the magnitude of the effects of climate change (see Appendix 15.2 for full details). In line with the IEMA guidance, a combination of probability and consequence is used to reach a reasoned conclusion on the magnitude of the effect of Climate Change on the proposed development (see Table 15.11). The guidance indicates that the greater the probability of an effect, the more likely it is to occur, and the higher significance it will have on the proposed development if these projected changes in climate are not considered at the outset of the project.

Table 15.11: Assessment of Magnitude of Effects on Proposed Development from Future Climate Baseline			
Climate Change Issue	**Likelihood**	**Consequence**	**Magnitude of Effects**
Soil Drying	Medium	Minor Adverse	Minor Adverse
Temperature Increase	High	Moderate Adverse	Moderate Adverse
Relative Humidity	Medium	Moderate Adverse	Moderate Adverse
Precipitation & Water Availability	High	Moderate Adverse	Moderate Adverse
Snow and Ice	Low	Minor Adverse	Minor Adverse
Gales, Storms and Extreme Weather	High	Moderate Adverse	Moderate Adverse
Solar Radiation	Medium	Moderate Adverse	Moderate Adverse
Cloud Cover	Low	Minor Adverse	Minor Adverse

15.11.11 The impact of changes to the future climate baseline for the proposed development (summarised in Table 15.11) has been assessed to be within the medium to high likelihood and have moderate adverse consequences if not mitigated against. Taking into account the control mechanisms and mitigation measures in place through Building Regulations, which the proposed development would be expected to comply with as a minimum standard, the overall magnitude of effects is considered to be moderate adverse for the 60-year lifetime of the project. This does not take into account that the factory will produce car batteries that will power electric vehicles to make this form of transport more sustainable.

Significance Assessment

15.11.12 The significance of the magnitude of effects on the proposed development has been determined using the Significance Matrix for Climate Resilience (see Appendix 15.2), which is summarised in Table 15.12, below.

Table 15.12: Assessment of Significance		
Climate Change Issue	**Magnitude of Effect**	**Significance**
Soil Drying	Minor Adverse	Not Significant
Temperature Increase	Moderate Adverse	Significant
Relative Humidity	Moderate Adverse	Significant
Precipitation & Water Availability	Moderate Adverse	Significant
Snow and Ice	Minor Adverse	Not Significant
Gales, Storms and Extreme Weather	Moderate Adverse	Significant
Solar Radiation	Moderate Adverse	Significant
Cloud Cover	Minor Adverse	Not Significant

15.11.13 The significance of the magnitude of effects on the proposed development is assessed in conjunction with the Significance Criteria for determining the impact of the proposed development on climate change. The overall significance of future climate change on the proposed development prior to mitigation is deemed to be Significant (refer to Appendix 15.2). This assessment is based on the reasonable assumption that the proposed development will meet the minimum standards required by Building Regulations. The proposed development should implement mitigation measures to further reduce GHG emissions and build in resilience to future changes in climate.

15.12 Mitigation

15.12.1 Key points are noted below regarding potential mitigation measures that could be considered for each receptor and climate variable as assessed, but this is not an exhaustive list. If planning permission is approved, it is anticipated that these aspects will be finalised as the detailed concept design progresses.

Temperature, Relative Humidity & Solar Radiation

15.12.2 Following the IPCC Fifth Assessment on Climate Change Report series, key findings for the building sector were summarised into a briefing called Climate Change: Implications for Buildings. It found that increased temperatures, precipitation and weather extremes pose a direct threat to building construction through delays, changes to building seasons and the increased likelihood of rebuilding and repair work. The Carbon Trust found that energy costs and associated CO_2 emissions are 30 % higher in an air-conditioned building compared to natural ventilation, on top of increased capital and maintenance costs. The UK Climate Change Risk Assessment 2017 states that buildings will need to be carefully designed to reduce heat loss during winter, reduce solar gain during summer, and maximise the effectiveness of natural ventilation.

15.12.3 The increasing number of heatwaves associated with an increase in temperature could result in periods of dry environments, where the fire risk will increase significantly. The proposed development will be built to current Building Standards and will also be designed to meet the Future Buildings Standards, which includes for fire safety measures. All materials used in the linings, materials and finishes of buildings will limit the heat release through strict compliance with national fire regulations. The use of fire and smoke alarms in all buildings is mandatory and the implementation of basic fire preparation and response plans will significantly reduce the risks to human life. The proposed development will also incorporate good design and technologies to reduce the risk of solar radiation exposure for site workers and visitors to the site, as well as the overall residual risk associated with building overheating.

Precipitation & Water Availability

15.12.4 Water resources availability presents a challenge that is expected to be exacerbated by a changing climate. UKPC18 projects an increase of up to 50% change in rainfall values by 2099. An increase in rainfall could affect runoff across the site and may alter river processes (e.g., erosion, deposition and the frequency and intensity of river and groundwater flooding and ponding in depressions). A decrease in rainfall could lead to seasonal and prolonged drying out of watercourses and drains, which may affect aquatic ecology. In addition, a reduction in rainfall may also affect groundwater recharge time and decrease groundwater elevations.

15.12.5 A Flood Risk Assessment (FRA) has been carried out within Appendix 10.1, the result of which are summarised in Chapter 10 of this ES. The Chapter indicates that the same embedded mitigation measures stated within the IAMP ONE 2018 ES are considered for this proposed development and include:

- Incorporation of freeboard to design flood levels.
- Finished floor levels set 600 mm above design flood levels.
- Ground raising/embankment.
- Flood storage compensation area.
- Development catchments to mimic baseline catchments.

- Attenuation of run-off to greenfield run-off rate using sustainable drainage.
- Provision of pollution hazard reduction by sustainable drainage.
- Sediment settlement prior to drainage discharge.
- Pollution incident response plans.
- Sediment run-off containment.

15.12.6 Climate change impacts are estimated to have potential medium to high flood risks within the northern corners of the Site, associated with fluvial flooding. These are mitigated by the introduction of a set development platform. The mitigation of impacts upon flow rates and volumes of watercourses within the surface water catchments would be achieved through design of a suitable surface water drainage scheme for the site, which takes into account climate change. The surface drainage approach for this scheme will rely upon underground storage tanks, porous paving for parking areas, filter drains for internal roads and proprietary oil separators to prevent pollution hazards. Rainwater harvesting was considered but has not been included within the drainage system due to the limited attenuation space in water storage.

15.12.7 Other sustainable aspects could be incorporated into the future development, ensuring it is energy efficient and facilitating the reduction of CO_2 emissions, including:

- Water efficiency, reducing water demand through low usage / water-efficient fittings.
- Water recycling systems.

Extreme Weather

15.12.8 It is difficult to attribute human induced climate change to any particular extreme weather event. In the absence of observed trends, there have been no met office studies so far providing a link between UK storminess and climate change. However, UKCP18 projects an increase in near surface wind speed in the second half of the 21st century during winter, although the increase in wind speed is modest compared to monthly and seasonal variability. Storm damage will typically involve the damage or removal of roof slates/tiles or potentially the whole roof structure.

15.12.9 Wind loading can apply significant lateral forces to buildings and modelling to ensure that adequate bracing is in place to deal with these forces will be necessary. Eaves and roof structures that overhang external walls may be particularly susceptible to the effects of wind loading and sufficient consideration will be required to ensure that problems are avoided. A suitable margin of error should be used within the loading calculations to ensure the roof materials remain fixed in position during extremely severe wind conditions.

15.12.10 Although projections suggest an overall decrease in cold spells, it is still important to consider risk mitigation in the event of adverse extreme weather. Appropriate design measures to reduce the risk to human health have been considered for the proposed development.

Air Quality & Transport

15.12.11 The relationship between air quality and climate change is highly complex, but is an important consideration due to the direct risk to human health. For example, when atmospheric pressure increases, pollutants are concentrated to the ground, resulting in increased respiratory health issues. Climate variations across regions will affect air quality differently. Increased precipitation aids the clearing of pollutants from air, whilst warmer, drier conditions stalls air that is saturated in pollutants (e.g., smog).

15.12.12 The impact of the proposed development on local transport infrastructure likely to be affected has been assessed in Chapter 13 (Access and Transport). New pedestrian links and footways are to be provided within the consented IAMP ONE development to promote sustainable modes of transport. A Travel Plan can be implemented to reduce the number of employees commuting by single occupancy car and includes mitigation measures relating to:

- encouraging walking, cycling and public transport;
- encouraging greener car travel (car sharing/ultra-low emissions vehicles/car clubs);
- encouraging smart business travel; and
- minimising the need for travel by sourcing locally.

15.12.13 A Service & Delivery Strategy can also be implemented to ensure freight movements are carefully managed and includes mitigation measures relating to:

- encouraging sustainable freight;
- sourcing products and service locally (where possible);
- restricting delivery times during shift change over periods; and
- offset of operational shift patterns to limit traffic congestion.

15.12.14 The inclusion of EV charging points will help encourage the uptake of electric vehicles within the proposed development, potentially leading to a greater number of zero emission vehicles and improved air quality for site workers and local residents in the surrounding area.

15.12.15 The Air Quality Assessment (Chapter 6) has assessed emissions from operational road traffic, taking into consideration baseline pollutant concentrations of NO_2, PM_{10} and $PM_{2.5}$. The assessment concluded that there would be no additional vehicle flows above those assessed as part of the 2018 IAMP ONE Phase one and 2020 IAMP ONE Phase Two assessments and, therefore, there will be no adverse air quality changes arising from road vehicle emissions.

15.12.16 During the construction phase, the implementation of effective mitigation measures will substantially reduce the potential for nuisance dust and particulate matter to be generated. Best practice dust control measures are recommended to be set out in more detail in a Dust Management Plan (DMP), prepared as part of the Construction Environmental Management Plan (CEMP)) for the site, in advance of development commencing. A Travel Plan has also been prepared and submitted to accompany this detailed planning application.

15.12.17 The air quality effects of the operational phase were assessed as part of the wider IAMP ONE consent, although this did not consider any emissions to air from the proposed battery manufacturing processes. NO_2 is a nitrogen containing pollutant and a potent greenhouse gas. Its deposition to ground can promote eutrophication and acidification, both of which exacerbates the impacts of climate change. Both eutrophication and acidification can cause substantial alterations in soil chemistry (including nutrient status) and plant community composition. Critical loads define the maximum amount of an atmospheric pollutant that can be deposited onto soils, waters or vegetation without causing adverse harmful effects in the long term.

15.12.18 The battery manufacturing processes taking place at the site will make use of two different types of solvent: N-Methyl-2-Pyrrolidone (NMP) and Ethyl Carbonate (EC). As there are no specific air quality objectives for these solvents, they have been considered as total Volatile Organic Compounds (VOCs). A consequence of the uncontrolled emission of VOCs and solvents is that they may act as greenhouse gases and hence may impact on climate change. The Air Quality Assessment demonstrates that mitigation measures to control the release of VOCs from the proposed development is being considered, however, the precise design of the proposed battery manufacturing process is yet to be finalised.

Landscape & Biodiversity

15.12.19 The site is relatively flat with higher elevation within the central and western regions of the site, and lower elevations towards the north-east. The Landscape and Visual Impact Assessment (LVIA) describes how the landscape surrounding the site is not ascribed any value from formal designations and does not provide a backdrop to settlements. However, land surrounding the IAMP development area is within the Green Belt and contributes to the separation of the settlement areas of Washington and north-west Sunderland. The condition of the existing landscape is considered moderate, with some well-maintained farmland and interspersed hedges.

15.12.20 Impacts on biodiversity can include, but are not limited to, mortality, biome shifts, ecosystem change, water scarcity/flooding, pest exacerbation and ecosystem feedback capabilities, including carbon sequestration. In the establishment of landscapes and ecological habitats the proposed development will need to consider the climate resilience of ecological enhancements that are used. Limiting the times that security lights are on will reduce obtrusive light and provide some dark periods for wildlife.

15.12.21 Mitigation has already been defined for the adjacent IAMP ONE site and it is anticipated that the indicative landscape design for the site will include some boundary planting and will reflect the measures proposed for IAMP ONE, where these are relevant to this Site. The Ecology & Biodiversity Assessment (Chapter 12) describes the mitigation measures proposed for the wider IAMPS development scheme. A comprehensive on-plot landscape strategy is proposed, to include a diverse range of habitats consisting of native species. The Ecological and Landscape Mitigation Area (ELMA) to the north and northwest of the site will deliver significant biodiversity enhancements for the wider IAMP scheme. These measures will ensure that there is Biodiversity Net Gain within the site, in accordance with local planning policy and emerging legislation.

15.12.22 Key aspects suggested for consideration when designing climate resilient landscaping are:

- Species selection: Drought tolerant species (e.g. enzymic resilience to warmer temperatures).

- Sensitivity to watering (e.g. induced root hypoxia and rot from oversaturation).
- Growth inhibition (e.g. pollution tolerance).
- Wind tolerance (e.g. strong, deep root structures).
- Year-round ecosystem services (e.g. forage and shelter capability during difficult seasons to continually support ecology and human needs).
- Avoiding fragmentation of green spaces, landscapes and ecological habitats where possible.
- Control use and ongoing spread of invasive and alien species that may impede native species ability to adapt or be in competition for resources during times of decreased availability e.g., as a response of extreme weather.

15.12.23 The species chosen for the screen planting and other plants across the site can be selected by choosing those that have the best tolerance to changeable climate and a possible increase in extreme weather events. This will ensure that the trees and other plants have the best chance of reaching maturity and increase the proposed development's resilience to changes in climate variables.

15.13 Residual Effects

15.13.1 The proposed development should implement mitigation measures to reduce GHG emissions and build-in resilience to future changes in climate, which would then result in the residual effects being deemed Not Significant.

15.13.2 According to the IPCC's 2018 Special Report on Global Warming of 1.5 °C[11], there is high confidence that climate-related risks for natural and human systems depend on the magnitude and rate of warming, geographic location, levels of development and vulnerability, and on the choices and implementation of adaptation and mitigation options. The report states *"Pathways limiting global warming to 1.5 °C with no or limited overshoot would require rapid and far-reaching transitions in energy, land, urban and infrastructure (including transport and buildings), and industrial systems (high confidence). These systems transitions are unprecedented in terms of scale, but not necessarily in terms of speed, and imply deep emissions reductions in all sectors, a wide portfolio of mitigation options and a significant upscaling of investments in those options (medium confidence)."* The Applicant can implement measures to reduce the impacts and increase climate resilience according to global and regional climate

https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Headline-statements.pdf projections with relevance to the scale of the proposed development. However, the uncertainties associated with probabilistic climate projections are outside of the Applicant's control and cannot be fully mitigated against.

15.13.3 It is assumed that, with the mitigation, each individual discipline throughout the ES has recorded that there will not be a significant impact on the development as a result of climate change in the long-term.

Table 15.13: Residual Effects of Future Climate Change on Proposed Development

Description of Effect	Potential Impact including significance	Mitigation	Residual Effect (including significance)
Construction Phase			
Air Quality	Moderate Adverse – Significant	Best Practices	Minor Adverse - Not Significant
Operational Phase			
Soil Drying	Minor Adverse – Not Significant	Good Design	Minor Adverse - Not Significant
Temperature Increase	Moderate Adverse – Significant	Good Design	Minor Adverse - Not Significant
Relative Humidity	Moderate Adverse – Significant	Good Design	Minor Adverse - Not Significant
Precipitation & Water Availability	Moderate Adverse – Significant	Good Design	Minor Adverse - Not Significant
Snow and Ice	Minor Adverse – Not Significant	Good Design	Negative – Not Significant
Gales, Storms and Extreme Weather	Moderate Adverse – Significant	Good Design	Minor Adverse - Not Significant
Solar Radiation	Moderate Adverse – Significant	Good Design	Minor Adverse - Not Significant
Cloud Cover	Minor Adverse – Not Significant	Good Design	Minor Adverse - Not Significant

15.14 Assessment of Cumulative Effects

Inter-cumulative effects

15.14.1 In terms of Climate Change, which is a global issue, a comprehensive consideration of inter-cumulative effects (i.e., effects of this proposed development in combination with other developments) would need to account for every other development and activity that generates carbon emissions or releases other greenhouse gas effects. As this encompasses, to varying degrees, most of the activity on the globe it is not practical to consider inter-cumulative effects, beyond recognising that it is necessary to reduce carbon emissions across the board and each and every development has a duty to minimise its own emissions as far as technically viable.

15.14.2 It is unreasonable for the purposes of a planning application to quantify all sources of emissions from other third-party developments for the following reasons:

- The emissions from other developments fall under Scope 3, which do not form part of the assessment under the methodology outlined.

- Large technical data requirements from other developments are not accessible.
- It would require a huge interlinking scope of assessment that would exceed that expected of a planning application for any one development.
- It is not feasible to undertake a high-level chemical assessment to analyse likely synergistic impacts between different emissions from varying developments.
- Complicated, unpredictable chemical reactions driven by atmospheric, climatic and behavioural factors are beyond the Applicant's control.

Intra-cumulative effects

15.14.3 Intra-cumulative effects (i.e. climate change effects in combination with other environmental effects on a common receptor) are also unrealistic to appraise. Climate change effects manifest as effects considered within other environmental disciplines, for example air quality and flood risk (and these have been assessed within the relative chapters of this ES), but do not have a quantifiable direct effect on local receptors. The effects act on a global receptor but the individual contribution from a single development of this scale is almost indistinguishable. It is the additive effects from all the other development going on around the world that poses the potential catastrophic threat.

15.15 Summary

Assessment of Impacts from Emissions

15.15.1 The proposed development's absolute emissions with embedded mitigation were modelled to be less than 1 % below the baseline emissions in Scenario A. This is deemed to have a Negligible impact which is **Not Significant** in the long-term.

15.15.2 The proposed development's absolute emissions with embedded mitigation were modelled to be 68 % below the baseline emissions in Scenario B. This is deemed to have a Major Beneficial impact which is **Significant** in the long-term.

15.15.3 In both scenarios, the emission savings achieved over the 60-year project lifetime were reduced when taking into account the decarbonisation of the national grid which negates any additional savings over a longer timeframe. The Applicant is considering measures to exceed the minimum standards required by Building Regulations as well as meeting the Future Buildings Standard. The proposed development has set a target to be zero carbon by 2050, and therefore, Scenario B where the plant is entirely electric is the preferred option to be implemented, if it is technically viable and affordable to do so. There will also be potential for additional onsite renewables to be added to the energy supply.

15.15.4 This should not be interpreted as the proposed development having no impact on climate change through greenhouse gas emissions. It signifies that the proposed development is taking measures that will improve the overall impact above a development of the same size, with comparable facilities, constructed to Building Regulations. No account has been taken of the fact that the car batteries produced will improve the long-term sustainability of vehicles by reducing fossil fuel emissions.

Assessment of Climate Resilience

15.15.5 The overall significance of future climate change on the proposed development is deemed to be **Not Significant**. This assessment is based on the reasonable assumption that the proposed development will meet the minimum standards required by Building Regulations in place at the time of construction and will implement mitigation measures to reduce GHG emissions and build in resilience to future changes in climate.

15.15.6 It will not be possible to eliminate every risk associated with climate change but through intelligent design, preparation and responsible construction, these risks will be minimised. Discussion and recommendations have detailed reducing these risks in key areas such as overheating, flooding and extreme weather, which has taken into consideration not only the health and safety of the users of the proposed development, but the resilience of the proposed development itself. It is assumed that with the mitigation each individual discipline throughout the ES has suggested, there will not be a significant impact on the development as a result of climate change in the long-term.