TARMAC
A CRH COMPANY

Stanninghall Quarry

Horstead, Norfolk

Stanninghall Quarry Northern Extension and Consolidation Application

ENVIRONMENTAL STATEMENT

VOLUME 1

October 2020

ENVIRONMENTAL STATEMENT

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STANNINGHALL QUARRY EXTENSION

Horstead, Norfolk

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CONTENTS

CONTENTS

CONTENTS

TABLES (within ES Volume 1)

FIGURES (within ES Volume 1)

CONTENTS

APPENDICES (ES Volume 2)

Cultural Heritage

APPLICATION PLANS (Planning Application Statement)

1.0 INTRODUCTION

1.1 Background

This Environmental Statement (ES) sets out the results of an Environmental Impact Assessment (EIA) which has been undertaken to accompany a planning application submitted by Tarmac Trading Ltd (Tarmac) to Norfolk County Council (NCC).

The application seeks planning permission for a northern extension to Stanninghall Quarry, south of Horstead / Coltishall in Norfolk, and the integration of the existing quarry permitted area at Stanninghall Quarry with the northern extension area as an overall consolidation scheme. A plan showing the location of the existing quarry and proposed northern extension area is produced as **Figure 1.1**.

Planning permission for the extraction of sand and gravel at Stanninghall Quarry was granted by the Secretary of State in January 2006. Quarrying commenced in early 2015, and operations are proceeding in accordance with the approved scheme. The quarry contains remaining reserves of some 1.22 million (m) tonnes as at 1st January 2020. However, some 450,000 tonnes of the permitted reserve lies beneath the processing plant site area and will not be available until the processing plant and related infrastructure is removed. It would therefore be logical to exploit reserves present in land to the north of the existing quarry using the infrastructure at the existing plant site before the plant is removed.

A planning application is thus being submitted at this stage (autumn 2020) in the hope that permission will be in place in early 2021. This would provide for a smooth transition into the northern extension area as part of a revised overall working and restoration scheme. The scheme thus deals comprehensively with the future development and restoration of the overall quarry area, but also in the context of the limited 'available' reserve at the existing quarry.

There are additional reserves of some 3.8 m tonnes in land within the proposed norhern extension area, which could be worked as a logical extension to the exiting quarry as part of an updated comprehensive phased working and restoration scheme. The release of additional reserves would provide continuity of production to serve established markets.

The northern extension area was included as part of a comprehensive proposal for sand and gravel extraction at Stanninghall, which was submitted by Tarmac to NCC in March 2002. The scheme included both the existing quarry and the 'northern extension' area as one overall scheme covering some 106 hectares. The scheme would have involved the extraction of some 7.5 million tonnes over a period of 20 years, at an assumed rate of 400,000 tonnes per annum. The application was refused by Norfolk County Council in January 2003, solely on the basis that a reserve of that volume would have increased the landbank of permitted reserves in Norfolk to a level substantially above the minimum requirement of 7 years.

In response, Tarmac submitted a revised application in 2003, approved in 2006, confined to some 54 hectares within the southern area of the original site. This scheme involved the extraction of a reduced reserve of some 3 million tonnes which now comprises the existing quarry. The proposed northern extension and consolidation scheme would thus be similar in concept to the originally proposed 2002 scheme.

In July 2019, NCC published 'Preferred Options' for the Norfolk Minerals and Waste Local Plan (NMWLP). The document confirms a requirement for the release of additional reserves of some 20.3m tonnes of sand and gravel over the plan period to 2036. It is proposed to meet this requirement by the release of reserves at 19 defined 'specific site allocations' for future extraction. The identified sites include the Stanninghall northern extension as Specific Site Policy MIN65. The allocation is the largest of the site allocations (assumed 4.5m tonnes), where the reserve represents over 22% of the overall supply requirement for Norfolk. The Stanninghall northern extension is thus a key component of the emerging mineral supply strategy for the county.

The NMWLP contains a site description and appraisal of planning issues for each of the proposed allocated sites. With respect to Stanninghall, the appraisal provides advice on the need for assessments of the effects of the

development in terms of noise, dust, archaeology and the historic environment, landscape and visual amenity ecology, flood risk, hydrogeology, and bird strike hazard. This advice has been drawn upon in identifying the topics which it is proposed to address as part of the EIA, supplemented by a formal EIA scoping opinion issued by NCC, as discussed below.

The planning application is supported by an updated phased quarry development and restoration scheme for Stanninghall Quarry which reflects the enlarged surface area associated with the northern extension. The scheme integrates the proposed extension area into the remaining areas of the existing quarry which either remain to be worked or which will be required for operational purposes.

Subject to the spatial extent of these developments, there would be no material changes to the established operation at the quarry in terms of general working practices, hours of working, noise limits, dust controls, and ground and surface water controls.

The resulting proposed application site boundary and relationship to the existing permitted quarry site boundary is shown on **Figure 1.1**.

1.2 Planning History

Planning permission for the extraction of sand and gravel at Stanninghall Quarry was granted by the Secretary of State in January 2006 (ref APP/X2600/A/04/1166832) subject to 24 conditions regulating the working and restoration scheme, requiring the submission of details of a new quarry site access, and imposing controls over conventional environmental and amentity effects including noise limits, archaeology investigations, ground water pollution control, landscaping and use of soil resources.

The permission also imposed a time limit of 15 years for the completion of extraction (to 26th January 2021), based upon an assumption that the reserves of some 3m tonnes would be worked at an average output of 200,000 tonnes per annum. In practice, quarrying operations did not materially commence until 2015, and in practical terms, irrespective of the outcome of the current extension and consolidation application, it will not be possible to complete extraction within the currently imposed deadline.

In February 2016 an updated planning permission was granted by NCC (ref C/5/2015/5017) which amended conditions 4 and 10 imposed on the original appeal decision notice relating to the plant site layout and bund design. The updated permission re-imposed the conditions from the 2006 appeal permission, with updates to reflect schemes which had been submitted and approved pursuant to that permission. There has been no change to the end date for the completion of quarrying operations, which via the February 2016 permission remains at 26th January 2021.

1.3 The Application Site

The application site, comprising the existing Stanninghall Quarry and proposed northern extension area is situated within an open area of land between Horstead to the north east and Frettenham to the south west.

It lies within a broad triangular area of land formed by the B1150 Norwich Road to the east, from where access to the Quarry is gained, Horstead Lane to the west, and Hall Lane to the south, which links Frettenham to the B11150.

The overall application site is some 106.8 hectares in extent, of which the existing permitted quarry area is 53.6 ha, and the extension area 53.2 ha.

1.4 The Proposed Development

The scheme has been designed as a 5-phase operation, which includes a 'Phase 4B' within the currently permitted Stanninghall Quarry area, with then phases 5 – 8 to be worked in a clockwise direction within the proposed northern extension area. A final phase 9 would comprise the extraction of sand and gravel within the current plant site area as part of the final works within that area.

The overall site contains reserves of some 5.053 million(m) tonnes, comprising some 770,000 tonnes with the Phase 4B area, some 3.83m tonnes within the northern extension area, and some 450,000 tonnes within the plant site area (figures rounded). It has been assumed that the site would be worked at an output of some 300,000 per annum, which would give a working life for the development of just under 17 years.

The phasing arrangement has been designed to facilitate the progressive restoration of the site by using soils and overburden to profile and restore preceding phases as a rolling programme of soil stripping, placement in the preceding phase and progressive sand and gravel extraction by phase.

The phases within the proposed northern extension area would not provide equal volumes of sand and gravel, but rather, they have been designed partly to reflect the existing field pattern, but also importantly, the logistics of the soil stripping and handling to achieve an efficient programme of progressive restoration as part of the overall materials balance.

The site would be progressively restored to an agricultural landscape with a hedgerow field pattern, with a substantial area of native woodland and woodland glades together with areas of species rich grassland around the perimeter.

No changes are proposed to established working practices, the existing hours of working, or to the general pattern of output and traffic generation.

1.5 Environmental Impact Assessment

1.5.1 Context

An Environmental Impact Assessment (EIA) has been undertaken to consider the environmental effects of the proposed development, and the results are presented in this Environmental Statement (ES). The ES has been prepared in accordance with the requirements of the Town and Country Planning (Environmental Impact Assessment) Regulations 2017. The Regulations implement EC Directive No. 85/337 on the assessment of the effects of certain public and private projects on the environment. The Directive's main aim is to ensure that the decision-making authority determines a planning application in the knowledge of any likely significant effects on the environment.

The Regulations set out a procedure that must be followed for certain types of project before permission can be granted. This procedure, known as 'environmental impact assessment', is a means of drawing together in a systematic way, an assessment of the likely significant environmental effects of a particular development. This helps to ensure that predicted effects are identified, and the scope for minimising those effects are considered and properly understood at the time the decision is made.

The Regulations categorise a range of developments into 'Schedule 1', where EIA is always required, and 'Schedule 2', where EIA may be required, depending on certain thresholds and criteria. The Applicants accepted at the outset that the development qualifies for EIA under these criteria, and that an EIA is therefore required. Consequently, the Applicants have not requested a formal 'screening opinion' from NCC to confirm whether an EIA is required (Regulation 6).

1.5.2 Scope of the EIA

The EIA Regulations 2017 set out a procedure whereby Applicants can seek advice from the Planning Authority as to the issues which should be covered as part of an EIA. The advice is referred to as a 'Scoping Opinion' (ref Regulation 15) and, as the term implies, the opinion sets out the advice on the 'scope' of the EIA.

The Applicant was keen to obtain such an opinion from NCC, and in order to assist the exercise, the Applicant prepared a 'Scoping Report' which provided a summary of the proposed quarry development scheme, and which set out the Applicant's preliminary views on the issues which should be addressed as part of the EIA. The Scoping Report was submitted to NCC in December 2019, and a copy is produced as **Appendix 1.1** (ES Volume 2A).

NCC issued their 'Scoping Opinion' in February 2020 which reflected advice from consultees. The Opinion confirmed that the topics identified in the Scoping Report and the suggested approaches to the impact assessments were appropriate, but with additional comments and advice. A copy the Scoping Opinion is produced as **Appendix 1.2** (ES Volume 2A).

The issues have been addressed as part of the EIA and are reported in the ES. In order to assist the cross referencing of the requirements of the Scoping Opinion with the content of the ES, a schedule has been prepared

which confirms the scoping requirements, the response and the reference within the ES. This is set out in Table 1.1 at the end of this chapter.

In addition to this specific advice on the scope of the ES, more general advice is set out in Planning Practice Guidance to the National Planning Policy Framework (NPPF). This notes in relation to EIA that the emphasis is on the "*main or significant*" effects to which a development is likely to give rise. It confirms that an ES "*should be proportionate and not be any longer than is necessary to assess properly those effects. Where, for example, only one environmental factor is likely to be significantly affected, the assessments should focus on that issue only. Impacts which have little or no significance for the particular development in question will need only very brief treatment to indicate that their possible relevance has been considered*" (ref paragraph: 035 Reference ID: 4-035-20170728: Revision date: 28 07 2017)

The EIA which has been undertaken also benefits from an EIA undertaken in 2002 in support of a previous scheme incorporating the proposed northern extension site, and an updated EIA undertaken in 2003 in support of an application for what is now the current Stanninghall Quarry. Whilst these EIAs are considerably out of date, they are helpful in providing an insight into the environmental issues which were considered to be relevant to the area which is the subject of the current planning application and EIA. In particular, the 2002 EIA / ES covered the same site area as the extension / consolidation application site area which forms the subject of this EIA/ ES, where the studies build upon and update this established knowledge, but with the updated studies drafted to reflect current guidance and standards.

The Applicants thus have a sound appreciation of the environmental topics which are relevant to the EIA, and the issues which require attention as part of the respective studies. This appreciation has been further informed by the ongoing experience of environmental issues during the operation of the approved quarry development scheme at Stanninghall Quarry, and by experience of developments at similar quarries elsewhere.

1.5.3 Technical Studies

In order to ensure that the topics are comprehensively addressed, the Applicant has commissioned a number of specialist consultants to deal with the identified issues, namely:

- Landscape and Visual Impact and Restoration Design – Kedd Ltd;
- Ecology – Aecol Ltd;
- Hydrology and Hydrogeology – BCL Consultant Hydrogeologists Ltd;
- Agriculture and Soil Resources: Reading Agricultural Consultants Ltd
- Noise – WBM
- Air Quality – SLR Consulting Ltd;
- Traffic – Hurlstone Partnership;
- Cultural Heritage – Andrew Josephs Associates

In addition, technical inputs on geology, phased quarry development, working practices and operational mitigation measures have been prepared by in-house expertise available to the Applicant.

The EIA and preparation of the ES has been coordinated by SLR Consulting. SLR is a member of the Institute of Environmental Assessment and Management (IEMA) with an awarded 'Quality Mark' and has specialist capability in mineral planning.

The EIA Quality Mark is a scheme, operated by IEMA, through which EIA activity is independently reviewed, on an annual basis, to ensure it delivers excellence in the following areas:

- EIA Management
- EIA Team Capabilities
- EIA Regulatory Compliance
- EIA Context & Influence
- EIA Content
- EIA Presentation
- Improving EIA practice

1.6 The Environmental Statement (ES)

The ES has been prepared to fulfil the requirements set out in the Town and Country Planning (Environmental Impact Assessment) (Wales) Regulations 2017 regarding the content of environmental statements (ref Regulation 18 and Schedule 4).

The ES has been prepared to reflect these requirements. It has a clear structure and reads as a concise single document. It is sub-divided into a number of sections and Chapters, namely:

1.0 **Introduction** which sets out the background to the preparation of the ES and the procedural requirements.

2.0 **The site and its surroundings**, which provides a baseline description of the site from which the environmental effects of the development are assessed.

3.0 **The quarry development**, which describes the details of the phased quarry development scheme and the alternatives which have been considered.

4.0 **The Restoration Strategy**, which provides a description of the concept for the restoration of the overall site upon cessation of quarrying.

5.0 - 13.0 **Environmental effects and mitigation measures**, which describes, in detail, the potential effects of the development under the sub-headings of landscape and visual effects (6.0); ecology (7.0); agriculture and soil resources (8.0); hydrology / hydrogeology (9.0); noise (10.0); dust / air quality (11.0); traffic (12.0); and cultural heritage (13.0).

14.0 **Summary of Environmental Issues**, which draws upon the content of preceding chapters in identifying the principal findings and conclusions.

15.0 **Conclusions**, which provides a general overview of the EIA, and the key conclusions which are reached.

1.7 Submitted Documents

The ES seeks to provide an objective account of the environmental effects of the overall proposed development. The aims of the statement are to:

(a) Describe the baseline conditions at the site against which changes, and effects can be assessed.

(b) Describe the details of the respective elements of the overall scheme.

(c) Consider the potential environmental effects of the development.

(d) Describe the measures which are available to mitigate those effects.

(e) Assess the likely effectiveness of the mitigation measures.

(f) Draw conclusions which will assist in the drafting of planning conditions controlling the ongoing operations at the quarry.

The ES (Volume 1) draws together the inputs from the specialist technical consultants who have undertaken the EIA and is intended to be a self-contained document which covers all relevant topics. It does however cross-refer to a number of background documents and technical appendices prepared by the consultant team, which have been bound into Volume 2. The appendices have been numbered to accord with the ES chapter number such that, for example, appendices accompanying the LVIA Chapter 6.0 are numbered 6.1, 6.2 etc.

The ES reproduces a series of figures which have been prepared by the EIA project team as part of their inputs into the ES. These are referred to within the respective chapters of the ES and follow the chapter numbering sequence of the ES, such that, for example, figures within Chapter 6.0 are numbered 6.1, 6.2 etc. The respective figures are produced either within the chapter or in the appendix accompanying the technical study and chapter. A full list of figures included within the ES is provided within the contents schedule of the ES.

A Non-Technical Summary of the ES has been prepared as a separate document (Volume 3) as a means of enabling the findings and conclusions of the ES to be more readily understood.

The quarry development and restoration plans are produced within a Planning Application Statement. The Planning Application Statement includes a detailed description of the proposed quarry development and restoration scheme and represents the development which comprises the formal planning application. For ease of reference, and to formalise the ES, a summary of the quarry development and restoration scheme is provided within Chapters 3.0 and 4.0 of the ES and forms the basis of the EIA.

The Planning Application Statement also includes a review of national planning policy, and policy in the local development plan against which the application will be judged. The brief references to planning policy in the technical chapters of the ES are provided for reference purposes only as a context to the respective studies, with analysis of compliance with policy requirements confined to the Planning Application Statement.

Table 1-1 Scoping Compliance Schedule

Scoping Issue	Response	ES Reference
Biodiversity		
According to Natural England, the Scoping Request is for a proposal that does not appear, from the information provided, to affect any nationally designated ecological sites (Ramsar, SPA, SAC, SSSI, NNR). The County Ecologist is satisfied with the approach proposed to consider biodiversity. The correct Ecological Impact Assessment (EcAA) guidelines and stages are proposed to be followed, and the developer has proposed to undertake and submit all necessary information required to determine the EIA application including restoration and monitoring schemes for the proposed quarry. The only additional information required (unless this has already been undertaken as part of the Preliminary Ecological Assessment (PEA) or Scoping and evaluation of Valued Ecological Receptors)), would be an up to date search of the local biodiversity records to ensure that the assessments are being made using the most up to date information available. For Norfolk, the most comprehensive biodiversity records of protected and priority species and habitats for conservation are held by Norfolk Biodiversity Information Service www.nbis.org.uk and details of how to obtain records can be found on their website or by contacting enquiries.nbis@norfolk.gov.uk. Relevant information can then be used to guide the scoping and evaluation of Valued Ecological Receptors (VER). The proposed restoration of the site would provide enhanced wildlife habitat and planting of hedgerows between fields will increase the connectivity of habitats. The restoration strategy will be further informed by the results of the landscape and visual impact assessment and ecological studies which will form part of the EIA.	Noted, and EcIA confirms that there would be no effects on initernational or nationaly designetd ecological sites. Noted, and EcIA has been undertaken in accordance with the Chartered Institute of Ecology and Environemntal Management (CIEEM) guidance. NBIS data base used to inform the EcIA baseline. Noted, and EcIA confirms that the prposed restoration strategy would deliver 10.76ha (41%) greater surface area of Section 41 habitat above the baseline.	EcIA summarised in Chapter 7.0 of the ES, with the full EcIA produced as Appendix 7.1 to the ES supported by an excel spreadsheet with calculations and analysis produced as Appendix 7.2.
Soil and Agricultural Land Quality		
Some 50% of the proposed extension area falls within Grade 2 Agricultural Land Classification and is therefore considered the best and most versatile (BMV) agricultural land. On this basis and contrary to 6.35 of your Scoping Report, it is expected that an updated Agricultural Land Classification so a soil resources	The ALC survey confirms the extension area comprises a mixture of land of Gardes 2, 3a and 3b quality (ref ppan RAC2 within ES Appendix 8.1).	ES chapter 8.0, supported by ES Appendix 8.1 ALC and soil resources plans:

study should form part of the Environmental Statement. Impacts from the development should be considered in light of the Government's policy for the protection of the BMV as set out in paragraph 170 and 171 of the NPPF. Natural England recommends that soils should be considered under a more general heading of sustainable use of land and the valuing of the ecosystem services they provide as a natural resource, also in line with paragraph 170 of the NPPF.	The potential effect on bmv land has been assessed in the context of NPPF paragraph 170, and the supporting guidance relating to soils and agricultural land contained in PPG and local planning policy. The scheme makes provsion for the return of the same overall area of bmv land (69 ha) as existed pre-development, with this no loss of BMV land as part of the restoration scheme The potential impact on soil resources has been assessed, and the scheme ensures the sustainable use of soil resources.	Appendix 8.2 soil handling constraints; and 8.3 MAFF Good Practice Guidelines for handling soils.
Water (Flood Risk Managament)		
A Flood Risk Assessment will mandatorily be required on the basis that the site area exceeds 1 hectare in size. Along with the surface water drainage strategy, this should seek to address: • all sources of flood risk, including those from ordinary watercourses, surface water and groundwater to the development • how surface water drainage from the development will be managed on-site and show compliance with the written Ministerial Statement HCWS 161 by ensuring that Sustainable Drainage Systems (SuDS) are put in place • how any phasing (if proposed) of the development will affect the overall drainage strategy and what arrangements, temporary or otherwise, will need to be in place at each stage of the development in order to ensure the satisfactory performance of the overall surface water drainage system for the entirety of the development. This supporting information would assess the potential for the development to increase the risk of flooding from the proposal or how surface water runoff through the addition of hard surfaces will be managed. It will show how this will be managed to ensure that the development does not increase flood risk on the site or elsewhere, in line with National Planning Policy Framework (paragraph 103). In this particular case this would include appropriate information on: • Appropriate assessment and mitigation of sources of surface water flood risk as shown on the EA Risk of Surface Water Flooding mapping. • Sustainable Drainage Systems (SuDS) proposals in accordance with appropriate guidance including “Non-statutory technical standards for sustainable drainage systems” March 2015 by Department for Environment, Food and Rural Affairs. • At least one feasible proposal for the disposal of surface water drainage should be demonstrated and, in many cases, supported by the inclusion	Noted, and Flood Risk Assessment (FRA) undertaken as required.	FRA summarised in section 9.5.8 of the ES with the full FRA produced as Appendix 9.6 to the ES.

of appropriate information. It is important that the SuDS principles and hierarchies have been followed in terms of: ▪ surface water disposal location, prioritised in the following order: disposal of water to shallow infiltration, to a watercourse, to a surface water sewer, combined sewer / deep infiltration (generally greater than 2m below ground level), ▪ the SuDS components used within the management train (source, site and regional control) in relation to water quality and quantity. ▪ identifying multifunctional benefits including amenity and biodiversity • The drainage strategy should also contain a maintenance and management plan detailing the activities required and details of who will adopt and maintain all the surface water drainage features for the lifetime of the development.		
Water (Groundwater Quality)		
According to the Environment Agency (EA), the Hydrology and Hydrogeology sections (6.36 – 6.39) of the EIA scoping report are sufficiently comprehensive at this stage; dewatering requirements would have been already assessed in previous EIAs and will be updated in the Environmental Statement for this project. In terms of Section 6.38, the EA appreciates the need of liaising with them to agree the criteria for subsequent assessment, and the EA consider that assuming that numerical modelling will not be required is premature at this stage: predictive groundwater modelling is the only suitable way to assess long term future impacts on groundwater quantity and quality, groundwater dependent surface water bodies and ecosystems, as well as suitably estimated dewatering requirements for each extraction phase, and it is routinely employed in EIA studies for quarry or mining projects (new or extensions). As part of the HIA (section 6.37) Impact Assessment, you should also consider implementing a 'source - pathway - receptor' approach to potential environmental impacts from the expansion and restoration of the site.	The Hydrogeological Impact Assessment (HIA) confirms that, consistent with the exiting quarry, there would be no need for any dewatering within the extension area to extract the sand and gravel, which would be worked dry, above the water table. The potential impacts associated with the development are therefore assessed against this context, and, given the absence of dewatering, without the need for any numerical modelling.	HIA produced as Chapter 9.0 of the ES, supported by Appendices 9.1 – 9.6.
Cultural Heritage (Archaeology)		
The proposed application area is rich in cropmarks of field-systems, previous excavations have also produced charcoal clamps of probable Anglo-Saxon date and the site is in close proximity to the Horstead Roman Camp (a Scheduled Monument). The County Archaeologist would advise that the Historic Environment section of the EIA should consist of an archaeological desk-based	Comments noted and reflected in the cultural heritage assessment which has been undertaken.	Cultural Heritage Assessment produced as Chapter 13.0 of the ES supported by a series of figures and a

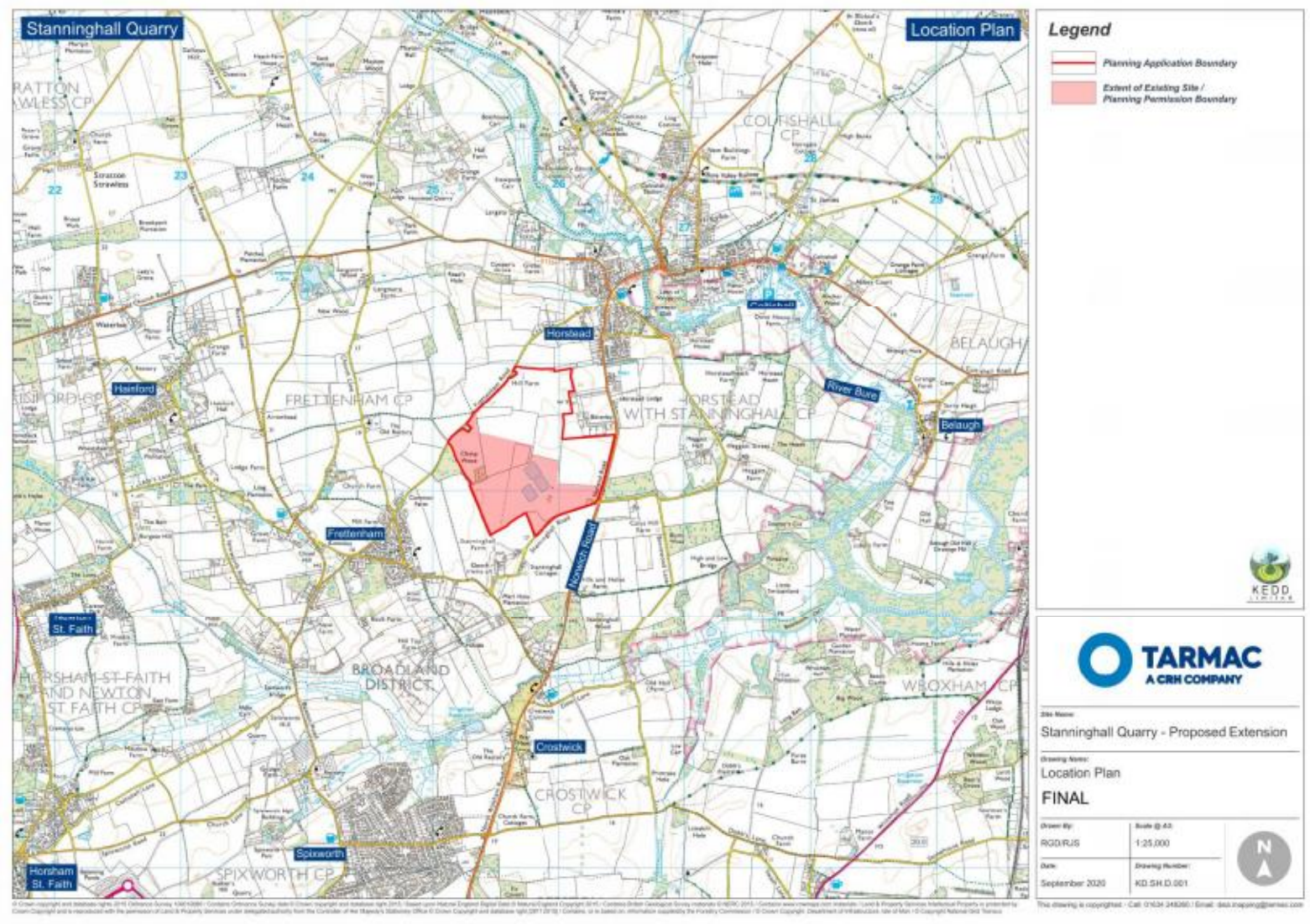
assessment including the results of a geophysical Survey of the extension area.		geophsylcs report produced within ES Appendix 13
Cultural Heritage (Setting)		
Historic England's principal concern relates to the impact of the development upon the setting and significance of the scheduled monument situated to the north of the PDA, which is known as the '*Roman camp and settlement site W of Horstead*' (List Entry Number 1003928). This represents the remains of a rare archaeological feature in the region and an important monument type nationally. Historic England (HE) has confirmed its view that historic environment represents a potentially significant issue in EIA terms, and agree with the applicant that the results of the assessment exercise should result in a specific Cultural Heritage chapter of the ES. HE notes the Scoping Report has identified and noted the presence of the scheduled monument in the landscape, and this is referenced in the Cultural Heritage Chapter (Chapter 6). The report also states that the applicant will undertake further analysis of this asset in the full ES, which we also support. Overall, HE also acknowledge the approach that is being considered in the Scoping Report in relation to both designated and non-designated heritage assets, and consider this will be sufficient to provide a considered heritage chapter in the ES. HE would also wish to ensure that this chapter also sets out to address the setting of designated heritage assets as set out in the relevant planning policy statements of the NPPF, and in their view heritage specific viewpoints with both photographs and photomontages will be useful to illustrate the ES. If these are to be presented in the Landscape and Visual chapter, then the assessment needs to be clearly set out and cross referenced with the heritage chapter. Historic England's published advice in relation to setting of heritage assets would be useful in that regard (see Good Practice Advice in Planning: 3 'The Setting of Heritage Assets'. The setting of heritage assets is not however just restricted to visual impacts and other factors should also be considered in particular noise, light, traffic and landscape assessments. Where relevant, the cultural heritage should therefore be cross-referenced to these other chapters, and we advise that all supporting technical information (desk-based assessments, geophysical surveys, evaluation and post-excavation reports etc.) are included as appendices. HE also strongly recommends that the applicant involve the County's specialist advisers on archaeological matters and we recognise that they are best placed to provide advice on non-designated heritage assets and to give advice on how the proposal can be tailored to avoid and minimise potential adverse impacts on	HE support for the intended approach to the cultural heritage setting assessment noted and weclomed. Setting Assessment with regard to potential effects on the 'Roman Camp' fully considered in the cultural heritage assessment, supported by plans, photograph and cross section (plan ref KD.SH.D.026). Disccussions have taken place withn the County Archaeologist as part of the study, and it is prposed that a Written Scheme of Investigation will be prepared and agreed with the County Archaeologist with respect to a further programme of archeological mitigation.	Cultural Heritage Assessment produced as Chapter 13.0 of the ES, with 'setting' specifically addressed in section 13.8.2.

the historic environment; and of any required mitigation measures; and opportunities for securing wider benefits for the future conservation and management of heritage assets. The assessment would need to be carried out in accordance with established policy and guidance, including the National Planning Policy Framework. The Planning Practice Guidance contains guidance on setting, amplified by the Historic England document Historic Environment Good Practice Advice in Planning Note 3, *The Setting of Heritage Assets*, which provides a thorough discussion of setting and methods for considering the impact of development on setting, such as the use of matrices. Whilst standardised EIA matrices or are useful tools, HE considers the analysis of setting (and the impact upon it) as a matter of qualitative and expert judgement which cannot be achieved solely by use of systematic matrices or scoring systems. HE therefore recommends that these should be seen primarily as material supporting a clearly expressed and non-technical narrative argument within the cultural heritage chapter. The EIA should use the ideas of benefit, harm and loss (as described in NPPF) to set out 'what matters and why' in terms of the heritage assets' significance and setting, together with the effects of the development upon them. Given the designated heritage asset within the area, HE would welcome further discussions with the applicant in order to discuss and consider the setting issues which will need to be addressed within the EIA. In particular, HE is concerned to work with the applicant on the design of the reinstatement, and would recommend a photomontage is produced from the scheduled monument which demonstrates the proposed reinstatement scheme.	Assessment undertaken in accordance with the guidance referenced (as confirmed in section 13.4.1 of the cultural heritage ES chapter 13.0). Agreed that standardised matrices should not be used in this instance. The use of a photomontage was considered, but in view of the intervening topography and features it was concluded that it would not provide a meaningful illustartion. A photograph and cross section has however been prepared (plan ref KD.SH.D.026).	
Landscape		
According to Natural England, the Scoping Request is for a proposal that does not appear, from the information provided, to affect any nationally designated landscapes (National Parks, AONBs, Heritage Coasts, National Trails). The proposed Landscape and Visual Impact Assessment (LVIA) methodology is acceptable and draws on current professional guidance. The conclusions of the LVIA should inform the screening proposals for the construction stage which are currently proposed on the Block Phasing Proposals and should also inform the restoration plan. The submitted EIA should include a tree survey and Arboricultural Impact Assessment (AIA) and Tree Protection Plan is accordance with BS5837:2012. There are a number of mature trees in field boundaries in the proposed northern	Noted, and LVIA confirms that there would be no affect on nationaly designated landscapes. Noted, and as indicated, the conclusions of the LVIA have informed the design of the landscape mitigation measures and restoration strategy which itself draws upon the 'landscape guidance' set out for the respective landscape character areas. Issues re tree protection addressed in the EcIA with specific standoff margins recommended.	

extension and also around the edge of the site. Where these trees can be retained, there should be an adequate stand- off stipulated in the AIA and Tree Protection Plan. The restoration scheme should take account of the loss of trees and ensure net gain. We would expect that the native mixed hedgerows incorporated in the restoration scheme should be planted with standard trees at a minimum of 12m centres. The species selected should reflect a consideration of landscape resilience to climate change and pests and diseases and therefore provide and appropriate mix of species.	Proposed tree planting details reflect advise set out in the EcIA with regard to biodiversity enhancements and within the LVIA with regard to landscape character. Full details set out in Section 7.0 of the Planning Application Statement.	
Transport		
Based upon the information submitted, I can confirm that the Highway Authority would require a Transport Statement (TS). The Transport Statement should include details of the amount of traffic associated with the development, an assessment of the surrounding highway network, an assessment of the recorded PIA history, the expected routing of traffic and any proposed wheel cleaning facilities / traffic management proposals.	Transport Statement included as Chapter 12.0 of the ES, which addresses all items referred to in the scoping opinion with repect to transportation..	ES chapter 12.0.
Human Health		
The EHO would scrutinize the ES and comment on likely impacts on amenity including those from both dust and noise and you have confirmed that both will be assessed within the scope of the Environmental Statement.	Noise and dust / air quality addressed as part of the ES, including an assessment of the potential effect of operations on human health from emissions of PM_{10}.	ES chapters 10.0 and 11.0
Schedule 4 Information		
In addition to the above information, please ensure that the Environmental Statement (ES) includes **all information** specified in Schedule 4: Information for Inclusion in Environmental Statements which, in addition to a description of the development covering points 1(a)-1(d), also which includes (but isn't limited to), a description of reasonable alternatives, a description of the relevant aspects of the current state of the environment and an outline of the likely evolution thereof without implementation of the development, a non-technical summary of the information, and a reference list detailing sources used for the descriptions and assessments included.	It is considered that the ES provides te necessary information to allow the Authority to consider the likely significant effects of the proposed development, as required by Regulation 18 of the EIA Regulations 2017. There is no requirement to include 'all information' set out in Schedule 4 to the Regulations: the requirtement is to provide '*any information specified in Schedule 4 relevant to the specific characteristics of the particular development and to the environmental features likely to be significantly affected*" [ref Regulation 18 (3((f)]. The ES has been prepared accordingly, but includes consideration of alternatives (ES section 3.8) and a NTS of the ES, as required.	

Regulation 18		
In accordance with Regulation 18(5), in order to ensure the completeness of the and quality of the ES, it must also be accompanied by a statement from the developer outlining the relevant expertise or qualifications of such exports who have prepared the ES.	The respective chapters of the ES include introductory sections setting out the qualifications and expertise of the persons responsible for undertaking the assessments. However, a separate 'statement of experience' has been prepared and accompanies the submission.	Regulation 18(5) (b) Statement of Experience submitted as part of the application documents.

Figure 1-1 Site Location



2.0 THE APPLICATION SITE

2.1 Site Location

The application site, comprising the existing Stanninghall Quarry and proposed northern extension area is situated within an open area of land between Horstead to the north east and Frettenham to the south west.

It lies within a broad triangular area of land formed by the B1150 Norwich Road to the east, from where access to the Quarry is gained, Horstead Lane to the west, and Hall Lane to the south, which links Frettenham to the B11150.

The River Bure flows from the northwest to southeast and passes to the north and east; at its closest *c.* 0.7 km from the Application Site boundary.

2.2 Application site

The overall application site is some 106.8 hectares in extent, of which the existing permitted quarry area is 53.6 ha, and the extension area 53.2 ha.

The existing quarry is comprised of the current operational working and progressive restoration areas, land awaiting extraction in the western area, a processing plant site (also including a ready mixed concrete batching plant), a series of lagoons used as part of the sand and gravel washing process, and perimeter screen bunds which contain soils stored for use in final restoration works.

The northern extension area comprises 5 large fields and one smaller filed in agricultural use, sub-divided by hedgerows of varying quality. The land has gently undulating topography, where the northern section of the extension area falls gently in a westerly direction from a high point of 23m AOD just north of the of the Water Tower to circa 17mAOD along the western boundary. In the south eastern area of the extension area the land rises gently from circa 10m AOD just south of the property at Beverley, to circa 18m AOD just north of the north eastern boundary of the existing quarry.

The site is located in a general rural setting with no public rights of way (PROW) or public vehicle access routes running through the site.

2.3 Landscape Context

The site lies with the 'Marsham and Hainford Wooded Estates' landscape character area, as defined in the Broadland District Council Landscape Character Assessment.

The area is characterised by gently rising slopes that extend from the Bure valley to a belt of woodland in the west. The majority of the landscape is in arable cultivation. There are varying field sizes of a medium to large scale with generally poor hedgerow coverage. Woodland coverage in the area is limited to small-scale woodlands and copses.

2.4 Ecology

No Statutory or non-statutory designated sites occur within the ecological study area. However, two wooded areas listed on the Ancient Woodland Inventory occur within the study area but outside the application site boundary (Clamp Wood which adjoins the south western boundary of the existing quarry).

The habitat baseline is taken to be the sum of the habitats currently present within the proposed extension area, and the habitats that would be present within the consented Stanninghall Quarry following the implementation of the approved restoration scheme for the existing quarry. On that basis the habitat baseline comprises the following main land uses / habitats:

- Broadleaved plantation woodland (10.2 ha);
- Mixed plantation woodland (9.25 ha);
- Scattered broadleaved trees (10 trees/ 0.14 ha);
- Semi-improved neutral grassland (3.89 ha);
- Arable farmland (79.28 ha);
- Intact hedges (1,380 m / 0.37 ha);
- Defunct hedges (760 m / 0.18 ha);

- Hedges with trees (4,435 m / 2.63 ha);

There are no grounds to predict the presence of legally protected species of invertebrate within the Application Site.

Operational lagoons are unsuitable for fish, and there are no other suitable aquatic habitats anywhere within the Application Site.

Detailed assessments demonstrate that there are no grounds to predict the presence of great crested newts or any other legally protected species of amphibian occurring within the Application Site.

A reptile survey Undertaken in 2019.proved negative.

The presence of hedgehog and badger has been confirmed and the presence of harvest mouse and brown hare has been accepted. The ecological impact assessment set out in Chapter 7.0 of the ES proceeds on the basis of assumed presence of these species. It also assumes the potential presence of 20 legally protected bird species.

Finally, bat surveys have established the presence of a maximum 12 species of bat occurring within the Application Site.

2.5 Agricultural Land Quality

An agricultural land quality survey undertaken of the overall application site, prior to the commencement of operations within the existing quarry confirmed that based upon a 106 ha site area, the area comprises some 69ha of best and most versatile land, of which some 45ha is subgrade 3a and 24ha in grade 2. There are also 36ha of lesser quality land in subgrade 3b, and circa 1 ha of woodland.

The majority of the sub grade 2 land lies within the existing quarry area.

The distribution of land grades are illustrated on plan ref RAC2 produced within **Appendix 8.1.**

2.6 Geology

The overburden is composed of dark brown, very sandy, gravelly, humic topsoil (some 0.3 m thick) overlying brown, firm silts and clays (averaging 1.7 m thick).

The economic mineral consists of:

- Yellow brown, clean to slightly silty, fine to fine/medium grained sand with some 30% gravel content. The unit averages 2.8 m in thickness.
- Dark (orange) brown, slightly silty to silty, fine/medium to medium grained sands with approximately 40% gravel content. The unit has an average thickness of 2.9 m.

Inter-burden is generally absent from the geological sequence but sporadic and laterally impersistent horizons of brown silts and clays do occur within the economic mineral.

The base of the economic deposit is marked by the gently undulating surface of the Upper Chalk, which is generally weathered to a white, soft, clayey chalk.

2.7 Hydrology

The largest watercourse in the vicinity is the River Bure, which lies some 700 m to the north east of the Site at its closest approach.

The river follows a meandering course from north west to south east. On a local scale, the meanders generally range in amplitude from less than 50 m up to 500 m. Downstream of the village of Belaugh (NGR TG 289 184), their amplitudes increase to some 1.5 km.

The valley floor is some 250 to 400 m in width and comprises water meadows and woodland draining via a network of ditches into the main river.

The Bure valley has Ramsar, SPA and SAC status downstream of Wroxham Broad (NGR TG 314 171), where the river is tidal.

Spixworth Beck lies some 1.1 km to the south of the Site, at its closest point. It flows from west to east, converging with Dobbs Beck (a tributary of the River Bure) at NGR TG 274 168. Continuing eastwards, some 1 km downstream, the beck reaches its confluence with the River Bure (NGR TG 284 172).

Water levels in Spixworth Beck decrease from some 5 maOD at Spixworth Bridge (NGR TG 239 165) to less than 1 maOD at its confluence with the River Bure (NGR TG 284 172).

Along the majority of its length, the valley of Spixworth Beck comprises water meadows, marsh and woodland, with extensive drains and ditches.

The most westerly reach of the Beck arises close to Church Farm near Felthorpe, some 8.25km to the west of the Application Area.

Due to the permeable nature of the sand and gravel substrate, there are no surface water features within the body of the Extension Area. Other than the man-made lagoons serving the mineral washing plant, there are no water bodies within the Existing Site and Extension Area.

In closest proximity are the farmyard pond at Stanninghall (some 200 m south of the Site at NGR TG 2550 1744), the reservoir at Common Farm (500 m west of the Site at NGR TG 2477 1798), the village pond at Horstead (550 m north of the Site at NGR TG 2632 1950) and the reservoir at Horstead Lodge (340 m east of the Site at NGR TG 2644 1890). The reservoirs generally occupy small, shallow, man-made excavations. They are utilised for irrigation and watering livestock.

There are no areas of wetland within the proposed extraction area.

Reference made to EA online mapping shows that there are no significant areas within the Site that reside within modelled surface water flood risk zones (*i.e.* flooding resulting from impeded drainage of incident rainfall or rainfall runoff).

The limited areas and extents of those areas that are shown at risk are associated with shallow hollows in the (current) topography of the Site. In particular, surface water flooding would collect in the broad, shallow, dry valley feature that extends across the eastern boundary of the Site. Ground elevations within this feature decrease in an easterly direction, from 15 maOD at the centre of the Site to less than 10 maOD at the boundary.

The proposed quarry operation is classed as a “Water-Compatible Development” in terms of fluvial flooding and this classification might be extended to cover for surface water flooding.

2.8 Hydrogeology

The glaciofluvial sands and gravels constituting the economic mineral of the currently consented operations, and Proposed Extension area, are designated by the EA as a "Secondary A" superficial aquifer.

The Chalk is classified as a Principal Aquifer.

Monitoring and recording of groundwater levels at the Existing Quarry has been carried out from 1999 onwards, generally on a monthly basis.

In order to examine groundwater levels within the sand and gravel deposit at the Site, three piezometers (water level monitoring boreholes) were installed during 1999 and a further four in 2001. They extend through the full thickness of the sand and gravel and terminate in the uppermost 1-3 m of the Chalk.

The four piezometers encircling the Existing Site and Northern Extension (T57/01/01, T57/01/02, T57/01/03 and T57/99/30, which extend to 9.2, 5.7 9.2 and 6.5 maOD respectively) are dry i.e. no watertable is encountered. This is consistent with the findings of the exploration drilling programme undertaken in January 2000 and May 2001, during which no watertable strikes were recorded within the 94 boreholes located on Site.

Thus, it is considered that the deposit will continue to be worked dry i.e. there will be no sub-watertable working.

During the monitoring period (October 1999 to date), water levels have ranged between 6.2-7.1 maOD in T57/99/31 and 5.5-6.7 maOD in T57/99/18.

It is considered that the groundwater flow direction in the vicinity of the Site is predominantly from west to east, towards the River Bure.

2.9 Access and Traffic

Stanninghall Quarry is served by a purpose-built access from the B1150, which was constructed in accordance with the approval of the Highway Authority specifically to serve the site.

The access to Stanninghall Quarry lies on the west side of the B1150, approximately 1.75km to the south of the mini-roundabout junction between Rectory Road and the B1150 Norwich Road at Horstead

The access route is called Quarry Road and continues northwest as the priority route from the B1150. Quarry Road itself is approximately 7.4m wide and has a tarmacadam surface extending into the Quarry beyond the access gates, which are set back 74.5m from the B1150 and 25m from the centreline of the Stanninghall Road priority junction.

Visibility at the Stanninghall Road junction is good in both directions, extending into the Quarry to the northwest and to the B1150 junction to the southeast.

Visibility at the Quarry Road / B1150 junction is also good, extending beyond 215m in both directions, in accordance with the approved design.

Within the site, the access is subject to a 10 mph speed limit. When leaving, signage confirms to drivers “NO RIGHT TURN TO STANNINGHALL LANE”.

The traffic movements associated with Stanninghall Quarry comprise the aggregate exports and concrete sales. In terms of aggregate sales, material is transported in a range of vehicles up to the larger articulated HGVs. Taking into account the range of vehicles, an average payload of 20 tonnes per vehicle has been identified.

Based on 250 working days, exporting 200,000, 300,000 and 400,000 tonnes per annum would result in an average of 40 loads / 80 HGV movements, 60 loads / 120 HGV movements and 80 loads / 160 HGV movements per day respectively.

When distributed over an 11 hour working day, these flows equate to rounded up averages of 4 loads / 8 HGV movements, 6 loads / 12 HGV movements and 8 loads / 16 movements per hour respectively.

However, as would be expected, there are day to day variations in activity, with some days attracting higher and some days lower than the average traffic flows.

In terms of the distribution of traffic travelling to / from Stanninghall Quarry, approximately 10% of production travels to / from the north via Horstead, whilst the remaining 90% travels to /from the south via Crostwick / Spixworth, with the majority of traffic travelling via the A1270 Broadland Northway (also referred to elsewhere in the ES as the Norwich Northern Distributor Road).

2.10 Cultural Heritage

There are no designated assets of cultural heritage importance lie within the boundary of the cultural heritage study area.

There are eighteen listed buildings and one Scheduled Monument within 1km of the site.

There are no World Heritage Sites, Heritage Coasts, Registered Historic Parks and Gardens or Registered Battlefields within this radius.

One Scheduled Monument lies within 1km of the site. This is a Roman military camp and associated settlement west of Horstead.

Based upon the knowledge of archaeology within the current extraction area to the south of the northern extension area and the general vicinity, it is likely that archaeological sites will be located within the northern extension area Whilst a geophysical survey only identified a small number of archaeological anomalies, one of which coincided with a recorded cropmark, it is apparent

that historically the area has been subjected to ploughing and that any archaeology will have been truncated to some extent.

There is no evidence of any archaeology of national significance that requires preservation *in situ*.

2.11 ES Baseline

The above summary of baseline conditions represents a brief overview of the much more detailed consideration of current circumstances set out in the environmental impact assessment chapters

However, this Chapter 2.0 provides a brief outline of current circumstances as a context for the description of the quarry development and restoration scheme which is described in the following chapters 3.0 and 4.0.

THE APPLICATION SITE 2

3.0 THE PROPOSED DEVELOPMENT

3.1 Introduction

The EIA Regulations require that ESs should include a description of the development, which then provides a context for the assessment of the aspects of the environment likely to be significantly affected by the development, and the measures available to prevent, reduce and where possible offset any significant effects on the environment (ref Schedule 4 to the EIA Regulations).

This chapter therefore provides a description of the development as an introduction to the environmental impact assessment chapters which follow as Chapters 6.0 – 13.0. For ease of reference, and for compliance with the requirements of Schedule 4 to the EIA Regulations, this chapter repeats parts of Sections 6.0 and 7.0 of the PAS in terms of the description of the development, with Chapter 3.0 of the ES summarising the key elements of the phased mineral extraction scheme which are described in Chapter 6.0 of the PAS, and Chapter 4.0 of the ES drawing upon the key elements of the restoration strategy which are described in Chapter 7.0 of the PAS. Other detailed elements of the development scheme relating to schedules of tree and shrub planting species etc are retained within the PAS as part of the more detailed description of the proposed development.

The current situation at the quarry is illustrated on plan ref KH.SH.D.006 within the Planning Application Statement which shows the current circumstances at the site, the processing plant site and existing operational area, the layout of the undisturbed agricultural fields within the proposed northern extension area, and the residential properties in the immediate vicinity of the site. The plan is reproduced in this chapter at a smaller scale as **Figure 3.1**

3.2 Design Objectives

The scheme has been designed to reflect seven key design principles, namely:

(i) To reflect the boundary of the proposed 'site specific allocation' set out in the 'Preferred Options' for the Norfolk Minerals and Waste Local Plan (NMWLP), July 2019;

(ii) To continue the phased working and restoration principles in place at the existing Stanninghall Quarry site across the overall site area including the northern extension area;

(iii) To design a phased extraction scheme which minimises the extent of the operational area at any one time, with land in advance of the working area temporarily continuing in agricultural use, and land behind the working area being progressively restored to the defined after uses;

(iv) To retain the processing plant in its current central location, where the plant, stockpiles and related operations are well screened from external vantage points;

(v) To retain the existing access onto the B1150 Norwich Road;

(vi) To sustainably use the on-site soil resources to restore the site to a predominantly agricultural landscape; and

(vii) To design a sustainable long-term restoration scheme which reflects the local landscape character, with new habitat creation.

3.3 Quarry Development Scheme

3.3.1 General Principles

The scheme has been designed as a 6-phase operation, as illustrated on the 'block phasing plan' ref KD.SH.D.008, reproduced at a smaller scale in this chapter as **Figure 3.2.** This includes a 'Phase 4B' within the currently permitted Stanninghall Quarry area, with then phases 5 – 8 to be worked in a clockwise direction within the proposed northern extension area. A final phase 9 would comprise the extraction of sand and gravel within the current plant site area as part of the final works within that area.

The overall site contains reserves of some 5.053m tonnes, comprising some 770,000 tonnes with the Phase 4 area, some 3.83m tonnes within the northern extension area, and some 450,000 tonnes within the plant site area (figures rounded). It has been assumed that the site would be worked at an output of some 300,000 per annum, which would give a working life for the development of just under 17 years

The phasing arrangement has been designed to facilitate the progressive restoration of the site by using soils and overburden to profile and restore preceding phases as a rolling programme of soil stripping, placement in the preceding phase and progressive sand and gravel extraction by phase. The scheme has been designed based upon a detailed materials balance by phase, which is set out in Chapter 6.0 of the Planning Application Statement.

The initial phase 4a lies within the existing Stanninghall Quarry, where progressive soil stripping would provide for restoration of the now worked out phase 3 area in the south western area of the site, together with progressive restoration within the phase 4B area behind the advancing working face

The phases within the proposed northern extension area would not provide equal volumes of sand and gravel, but rather, they have been designed partly to reflect the existing field pattern, but also importantly, the logistics of the soil stripping and handling to achieve an efficient programme of progressive restoration as part of the overall materials balance.

The limits of extraction defined on the block phasing plan (ref KD.SH.D.008) have been defined to reflect:

(i) Standoff margins of some 75m to the residential properties at The Hollies and Hill Farm along the western edge of the site, with temporary soil stockpiles to provide temporary screening;
(ii) A standoff margin of 40m to the Water Tower situated beyond the north eastern boundary of the northern extension area (Phase 7);
(iii) A substantial standoff margin to the residential property at Beverly to the north east of Phase 8 (circa 230m) which reflects to absence of mineral in the land to the north east of phase 8 (but also the need accommodate temporary soil stockpiles). ; and
(iv) Standoff margins to ensure the protection of the perimeter vegetation and the continued screening value which it provides, including a standoff margin to the ancient woodland block at Clamp Wood, to the west of Phase 4B.

Mineral would be hauled from the extraction phase to the existing processing plant by dump truck as a continuation of operations within the existing quarry. The proposed phased extraction and restoration scheme is described in detail in Chapter 6.0 of the Planning Application Statement, which includes details of the volumes of top soil, sub soil, and overburden to be used for restoration by phase. These details are not repeated in this chapter of the ES, but a summary of the main operations to be undertaken within the respective phases is provided below.

3.3.2 Phase 4B (Figure 3.3)

The remaining permitted extraction area within the existing Stanninghall Quarry lies to the north west of the processing plant site and has been defined as a new Phase 4B.

During this phase, restoration works would be completed within the previous south west phase 3 area using sub soils currently stored west of 'lagoon 3' and stripped from the phase 4 area, together with top soil currently stored in the north western area of phase 3 and top soils stripped from phase 4B.

Other soils released from the initial Phase 4B strip would be placed in temporary storage.

Extraction would then progress in phase 4B, working generally from east to west, with the resulting void regraded and profiled in to establish restoration levels in readiness to receive restoration soils. The remaining in situ soils from Phase 4B would then be progressively stripped and directly placed onto the restoration formation levels for progressive restoration behind the advancing working area. This restoration would comprise tree and shrub planting on the slope to be created along the western side of the restored Phases 3 and embracing the existing woodland block west of Phase 4B,

with the remaining restored area in the southern part of Phase 4B to be sown and brought back to an agricultural land use.

Some 7,400m3 of top soil would be used to create the temporary screen bund / soil storage bund to the east of The Hollies (Bund 13).

During the Phase 4B works, four new water management lagoons would be established within the plant site area.

Phase 4B would yield a reserve of some 770,000 saleable tonnes of sand and gravel, which at an assumed output of 300,000tpa would give a life of some 2.6 years.

3.3.3 Phase 5 (Figure 3.4)

Phase 5 would be stripped of soil in sub phases, with top soil from an initial strip used for direct placement to complete the restoration of Phase 4B, together with upper sub soil and lower sub soil / overburden from the initial Phase 5 soil strip.

Sand and gravel extraction would then progress within the initial soil strip area, with the mineral transferred to the plant site by dump truck.

Restoration formation levels would be progressively established within the central and western area of the Phase 5 void, in readiness for receiving overburden / lower sub soil, upper sub soil and top soil from the remainder of the Phase 5 area to be stripped. .

Additional top soil would be temporarily stored within Bund 14 in the south eastern area of Phase 5.

Following the completion of extraction in Phase 5, and the restoration of the central and western area of Phase 5, the temporary soil screen bund / storage bund east of The Hollies would be removed and the top soil transferred to Bund 14.

Phase 5 would yield a reserve of some 1.18m saleable tonnes of sand and gravel, which at an assumed output of 300,000tpa would give a life of some 3.7 years.

3.3.4 Phase 6 (Figure 3.5)

Phase 5 would similarly be stripped of soil in sub phases, with top soil from an initial strip used for direct placement to complete the restoration of Phase 5, together with upper sub soil and lower sub soil / overburden from the initial Phase 6 soil strip.

Some 4,600m3 of top soil would be used to create a temporary screen bund / soil storage Bund 15 to the east of the Hill Farm on the outer eastern side of an existing hedgerow to the east of the Farm

Sand and gravel extraction would then progress within the initial soil strip area, with the mineral transferred to the plant site by dump truck along a temporary haul road corridor through the centre of Phases 5 and 6.

Restoration formation levels would be progressively established within the western and south eastern area of the Phase 6 void, in readiness for receiving overburden / lower sub soil, upper sub soil and top soil from the remainder of the Phase 6 area to be stripped.

Phase 6 would yield a reserve of some 680,000 saleable tonnes of sand and gravel, which at an assumed output of 300,000tpa would give a life of some 2.3 years.

3.3.5 Phase 7 (Figure 3.6)

The same working principles would be adopted for Phase 7, with top soil from an initial strip used for direct placement to complete the restoration of Phase 6, together with upper sub soil and lower sub soil / overburden from the initial Phase 7 soil strip.

Following completion of restoration in the northern area of Phase 6, the temporary screen bund / soil Bund 15 east of Hill Farm would be removed

and placed within temporary soil Bund 16 along the northern side of the future Phase 8.

Sand and gravel extraction in Phase 7 would progress within the initial soil strip area, with the mineral transferred to the plant site by dump truck along the temporary haul road corridor through the centre of Phases 5 and 6.

Restoration formation levels would be progressively established within the northern area of the Phase 7 void, in readiness for receiving overburden / lower sub soil, upper sub soil and top soil from the remainder of the Phase 7 area to be stripped. In addition, lower sub soil / overburden stripped from the southern area of Phase 7 would be used to create restoration batter slopes / formation levels along the eastern side of Phase 7 in readiness for tree shrub planting on the northern and north eastern slopes of Phases 6 and 7.

Phase 7 would yield a reserve of some 980,000 saleable tonnes of sand and gravel, which at an assumed output of 300,000tpa would give a life of some 3.3 years.

3.3.6 Phase 8 (Figure 3.7)

Operations in Phase 8 would commence with the creation of a new access track linking Phase 8 to the plant site via the southern section of the track which provided access to phases 5 – 7.

Top soil from an initial strip in the northern area of Phase 8 would be used for direct placement to complete the restoration of Phase 7, together with some upper sub soil and lower sub soil / overburden from the initial Phase 8 soil strip. Soils would also be used to restore the previous internal access track through phases 5 and 6.

Sand and gravel extraction in Phase 8 would progress within the initial northern soil strip area, with the mineral transferred to the plant site by dump truck along the newly created access road to the plant site.

Restoration formation levels would be progressively established within the northern area of the Phase 8 void, in readiness for receiving overburden / lower sub soil, upper sub soil and top soil from the remainder of the Phase 8 area to be stripped. .

In addition, top soil would be placed in Bunds 17, 18 and 19 in the north eastern area of Phase 8.

Phase 8 would yield a reserve of some 1.04m saleable tonnes of sand and gravel, which at an assumed output of 300,000tpa would give a life of some 3.5 years.

3.3.7 Final Works Phase 9 (Figure 3.8)

The position at the end of Phase 8 is illustrated on plan ref KD.SH.D.014 (reproduced as Figure 3.8).

The final works would involve the extraction of the remaining reserves of sand and gravel situated beneath the plant site area requiring the decommissioning and removal of the plant and either processing the remaining sand and gravel using a mobile plant, or marketing the material ‘as raised. On cessation of mineral extraction and processing, all quarry plant, offices and associated infrastructure would be removed from the site.

The silt lagoons would be allowed to dry out and the fresh water lagoon would be drained.

The silt from the dried out lagoons would be used partly to create restoration formation levels within the residual area to be restored, and partly with the lagoons to be restored in situ via capping and profiling. When ground conditions permit, all remaining land would be re-graded to achieve the final restoration formation levels. This would include regrading previous silt lagoons to create land gradients which tie into adjoining land and which achieve the desired surface water drainage arrangements.

The soils available to complete the final restoration works are illustrated on Figure 3.9 with a total of some 202,00m3 of lower sub soil / overburden; 84,100m3 of upper sub soil; and 102,000m3 of top soil available to complete the restoration of the circa 34ha area with soil profiles of circa 0.3m of top soil; circa 0.25m3 of upper sub soil, and circa 0.3m of lower sub soil / overburden.

The final restoration works associated with sand and gravel extraction would yield a reserve of some 450,000 saleable tonnes of sand and gravel, which at an assumed output of 300,000tpa would give a life of some 1.5 years, although in practical terms this output may not be maintained if the residual sand and gravel is not fully processed. Overall, with the required soil movements to complete the restoration works, the final phase to include restoration is likely to be undertaken over a period of some 3 years.

3.4 Processing Plant

The existing Stanninghall Quarry has an installed modern, low level sand and gravel washing and screening plant within a defined plant site area.

The plant includes a hopper which receives material from dump trucks which are used to transport as dug sand and gravel from the extraction area to the plant site. The material is then fed from the hopper by conveyor to a washer barrel and series of screens which separates the gravel into different sizes and segregates the sand into concreting and building sand products. These are then discharged from the plant by conveyors to stockpiles, which are then collected by loading shovel into road going vehicles or placed into separate product stockpiles within the plant site area.

The plant also provides aggregate raw material to an on-site ready mix concrete batching plant located in the northern area of the plant site.

No changes to the plant site or existing arrangement are proposed in relation to the northern extension development.

3.5 Hours of Operation

The existing hours of working at Stanninghall Quarry are regulated by planning condition 9 of permission ref C/5/2015/5017 and are confined to:

- 07.00 - 18.00 Mondays to Fridays and
- 07.00 - 13.00 on Saturdays

No operations are to be carried out on Public or Bank Holidays or Sundays

No changes are proposed to these established working hours.

3.6 Output and Traffic Movements

Based on the exporting of 300,000 tonnes of aggregate in 20 tonne payloads over 275 working days per annum (50 weeks at 5.5 days per week), an average of 54.5 (say 55) loads / 110 HGV movements per day is established. By way of comparison, outputs of 200,000 tonnes and 400,000 tonnes per annum equate to averages of 36.3 (say 37) loads / 74 HGV movements and 72.7 (say 73) loads / 146 HGV movements per day respectively.

It is understood that working on Saturdays is rare. As a result, the number of working days per annum reduces to 250, which results in a corresponding increase in the average daily traffic flows.

Based on 250 working days, exporting 200,000, 300,000 and 400,000 tonnes per annum would result in an average of 40 loads / 80 HGV movements, 60 loads / 120 HGV movements and 80 loads / 160 HGV movements per day respectively.

When distributed over an 11-hour working day, these flows equate to rounded up averages of 4 loads / 8 HGV movements, 6 loads / 12 HGV movements and 8 loads / 16 movements per hour respectively.

Notwithstanding the foregoing, a proportion of the sand and gravel is diverted to the on-site concrete plant. Concrete production in 2019 was 16,478m^3. In order to produce this concrete, the plant consumed 29,660 tonnes of sand and gravel from Stanninghall Quarry.

In addition to sand and gravel, there were 9 loads of binder, 56 loads of Ground Granulated Blast-furnace Slag (BBGS) and 103 loads of cement imported to the site.

In terms of exported concrete, the average load volume is 5.5m^3, which resulted in 3045 loads per annum.

When adding all of the loads associated with the concrete plant, which also predominantly operates 5 days per week (Monday to Friday), with Saturday working being rare, an average of 12.9 (say 13) loads / 26 HGV movements per day is established.

It is anticipated that concrete production is likely to remain at around this level for the foreseeable future.

Based on the proposed average production of 300,000 tonnes per annum, of which 29,660 tonnes is diverted to the concrete plant, the remaining 270,340 tonnes of sand and gravel would attract an average of 54 loads / 108 HGV movements per day, assuming the distribution remains predominantly over a 5 day week (Monday to Friday). Adding the 13 loads / 26 HGV movements associated with the concrete production, results in an overall total of 67 loads / 134 HGV movements per average day, and 6 loads / 12 HGV movements per hour.

In terms of the distribution of traffic travelling to / from Stanninghall Quarry, it is understood that approximately 10% of sales travels to / from the north via Horstead, whilst the remaining 90% travels to /from the south via Crostwick / Spixworth, with the majority of traffic travelling via the A1270 Broadland Northway (also referred to elsewhere in the ES as the Norwich Northern Distributor Road).

3.7 Water Management

The existing and proposed quarrying operations involve extraction of sand and gravel from above the watertable.

In common with the existing operations, there is no requirement for dewatering or sub-watertable working at the extension site. The full depth of mineral reserve (sand and gravel) is above the watertable.

The free-draining nature of the sand and gravel allows works to proceed without the need for active surface water management.

The lagoon system is, and will continue to be, utilised as the source of water for the mineral washing and grading process for the duration of the proposed development.

This is a re-circulatory system, comprising 3 polythene-lined lagoons. Silt laden waters produced by the mineral washing process are and will continue to be decanted to the active silt lagoon, from where the circuit recommences. Following settlement of suspended solids within the silt lagoons, waters are and will continue to be decanted to the clean water lagoon.

Silt Lagoon L1 is at full capacity in terms of silt deposition. Lagoon L3 is currently being used for silt settlement; and Lagoon L2 for clean water. With Lagoon L1 reaching full capacity, the area immediately to the north of L1 (and to the west of Lagoon L3) has been set aside for 4 x replacement lagoons.

The Abstraction Licence AN/034/0009/014 allows for the topping up of the lagoons, as and when required. The permitted rate of abstraction is up to a maximum of 864 m^3/day (limited to 60,000 m^3/annum for topping up lagoons). Current experience on site demonstrates that the lagoons have only been topped up on two occasions since 2011.

There is no discharge requirement at the application site.

3.8 Alternatives

The Town and Country Planning (Environment Impact Assessment) Regulations 2017 indicate that an ES should include a "*description of the reasonable alternatives studied by the developer which are relevant to the proposed development and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects on the environment*" [ref Regulation 18 (3) (d)]

This requirement is reiterated in Planning Practice Guidance which accompanies the National Planning Policy Framework (NPPF) (updated 2019) confirms that "*where alternative approaches to development have been considered, the Environmental Statement should include a description of the reasonable alternatives studied which are relevant to the proposed development and its specific characteristics and provide an indication of the main reasons for the choice made, including a comparison of the environmental effects*" reference Paragraph: 035 Reference ID: 4-035-20170728:Revision date: 28 07 2017).

Thus, whilst the EIA Regulations require consideration of alternatives, the requirement is qualified by reference to 'reasonable alternatives' and confirmation that where alternatives have been studied, then they should be described.

In this instance, the Applicants have not explored the merits of alternative sand and gravel extraction sites since this has been an exercise carried out by NCC as part of the preparation of the Minerals and Waste Local Plan, currently at the Preferred Options stage (July 2019).

As discussed in detail in the Planning Application Statement, the Stanninghall northern extension site has emerged from that comprehensive review of alternative sites as a proposed site specific allocation for future sand and gravel extraction (ref site MIN65), as discussed further in Section 9.0 of the PAS.

The consideration of alternatives has thus not focussed on alternative sites, but rather on the alternative means by which the Stanninghall Quarry and northern extension area might be worked and restored.

In this context the three key alternatives comprise the following:

(i) Sequence of operations

In principle, it would be possible to progress the currently approved phasing and restoration scheme for Stanninghall Quarry to a substantial completion before embarking upon a northern extension to the quarry. However, in addition to a timescale issue alluded to in section 1.2 of the ES, this would not make practical sense in that the ongoing operation associated with the northern extension relies upon the use of the existing plant site and related infrastructure. The completion of the approved development prior to commencing the northern extension operation would not be sustainable in these terms.

It would also compromise the implementation of a phased overall restoration scheme if soils from existing storage bunds were used prematurely outside the context of the detailed overall restoration materials balance which has been undertaken. In addition, any removal of existing permitted soil screen bunds would remove the screening function which they perform and which they will need to continue to perform until the final restoration works are implemented.

In this context, Tarmac has concluded that it would be more appropriate to re-visit the working and restoration scheme as part of a comprehensive approach to quarrying and restoration encompassing the existing quarry and the northern extension area. This will avoid what would otherwise be a piecemeal approach of updating the phasing scheme and restoration plan for the existing quarry and then updating it again as part of the extension development.

It is also noted that the 'site specific' requirements for the MIN65 Stanninghall northern extension, as set out in the Preferred Options, requires that "*the site will need to be phased with the adjoining permitted site so that only one site is worked for extraction at a time in accordance with a phased working and restoration scheme*". This specifically requires a comprehensive approach to working and restoration of the overall area.

(ii) Phasing of the development

Based upon the sequence of extraction in the existing permitted quarry, and the progression into Phase 4B, it is logical to develop the quarry into the northern extension area from the northern boundary of Phase 4B where an established working face would be in place. It is also logical to use soils from a Phase 5, in juxtaposition to Phase 4B to progress restoration in Phase 4B. There is thus no practical phasing alternative other than to progress phasing northwards from Phase 4B into a Phase 5, which then for the same reasons lends itself to a continuation northwards to a Phase 6 before progressing southwards in the eastern area of the site as an overall clockwise sequence.

In contrast the original 2002 planning application proposed an anti-clockwise sequence commencing in the south east and working northwards through the eastern half of the site and then progressing southwards in phases down the western half of the site as an anti-clockwise sequence. This may have been logical at the time, using the same general principle of minimising soil handling by direct placement behind the advancing working

phase, but the option is not now available given the 'clockwise' progress which has been made with the current scheme.

As part of a refinement of the phasing scheme, further consideration has been given to the location of a temporary soil screen bund to the east of Hill Farm. The conceptual phasing plan accompanying the EIA scoping request indicated a screen bund in that area, but on the western property side of an existing hedgerow which runs north – south some 60m to the east of the Farm. It has been concluded that in amenity terms it would be preferable to retain the hedgerow and to locate a temporary screen bund on the eastern outside of the hedgerow where it would be partly screened by the hedgerow. This would lead to some loss of mineral, but it is considered to be a more sensitive screening solution in that area.

(iii) Restoration Land Uses

The 'site specific' requirements for the MIN65 Stanninghall northern extension, as set out in the Preferred Options, requires the submission of "*a progressive restoration scheme to an arable agriculture afteruse, with wide filed margins, grassland and woodland to provide landscape and biodiversity gains*".

This is a prescriptive requirement, but it follows the and use principles of the currently approved restoration scheme for the existing Stanninghall Quarry, and those included as part of a conceptual restoration scheme which accompanied the EIA scoping request.

However, the scheme has evolved to reflect the opportunities presented by the landform associated with the restored silt lagoon area to create a substantial body of native woodland and woodland glades centred on that area and linked to woodland to be established on the perimeter slopes. This would then allow a coherent block of agricultural land to be established in the restored central northern and eastern areas, subdivided by a new hedgerow field pattern. The scheme respects the land use objectives which have been set for site MIN65 and would deliver what is considered to be a better distribution of land uses compared to previous iterations

The scheme which has emerged is thus considered to represent the most appropriate design solution, and which is consistent with the design objectives which have been set.

These matters are reflected in the content of the proposed development scheme which forms the basis for this ES and the inbuilt mitigation measures which are embedded within the working and restoration scheme, and which are referred to in the respective assessment chapters.

Finally, there is a 'no development option' if for, whatever reason, the development does not proceed. However, this would not be consistent with the forward mineral planning strategy of the MWLP where the reserves at the Stanninghall northern extension site are relied upon as making a substantial contribution towards aggregate requirements over the Plan period.

Figure 3-1 Current Situation

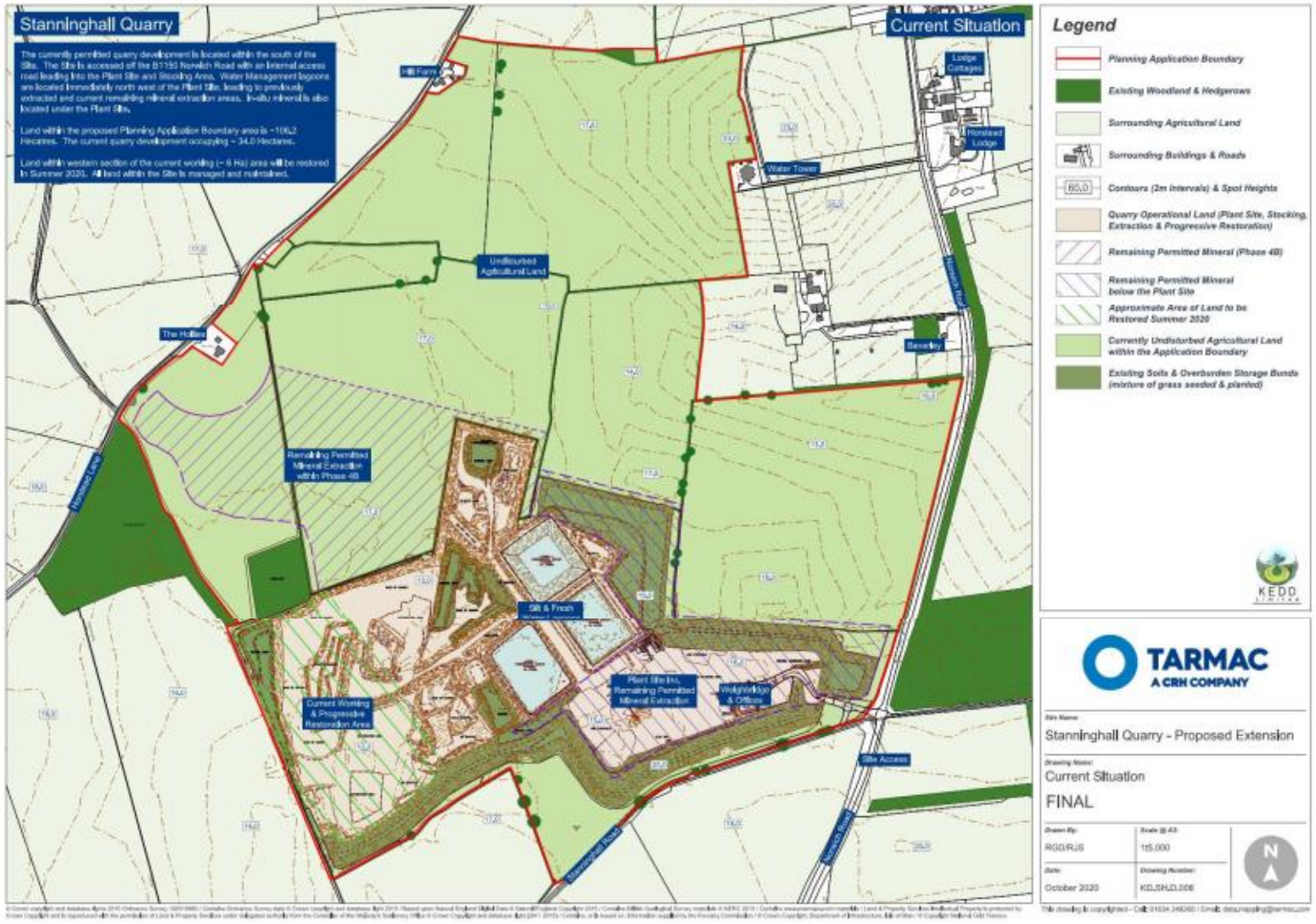


Figure 3-2 Block Phasing

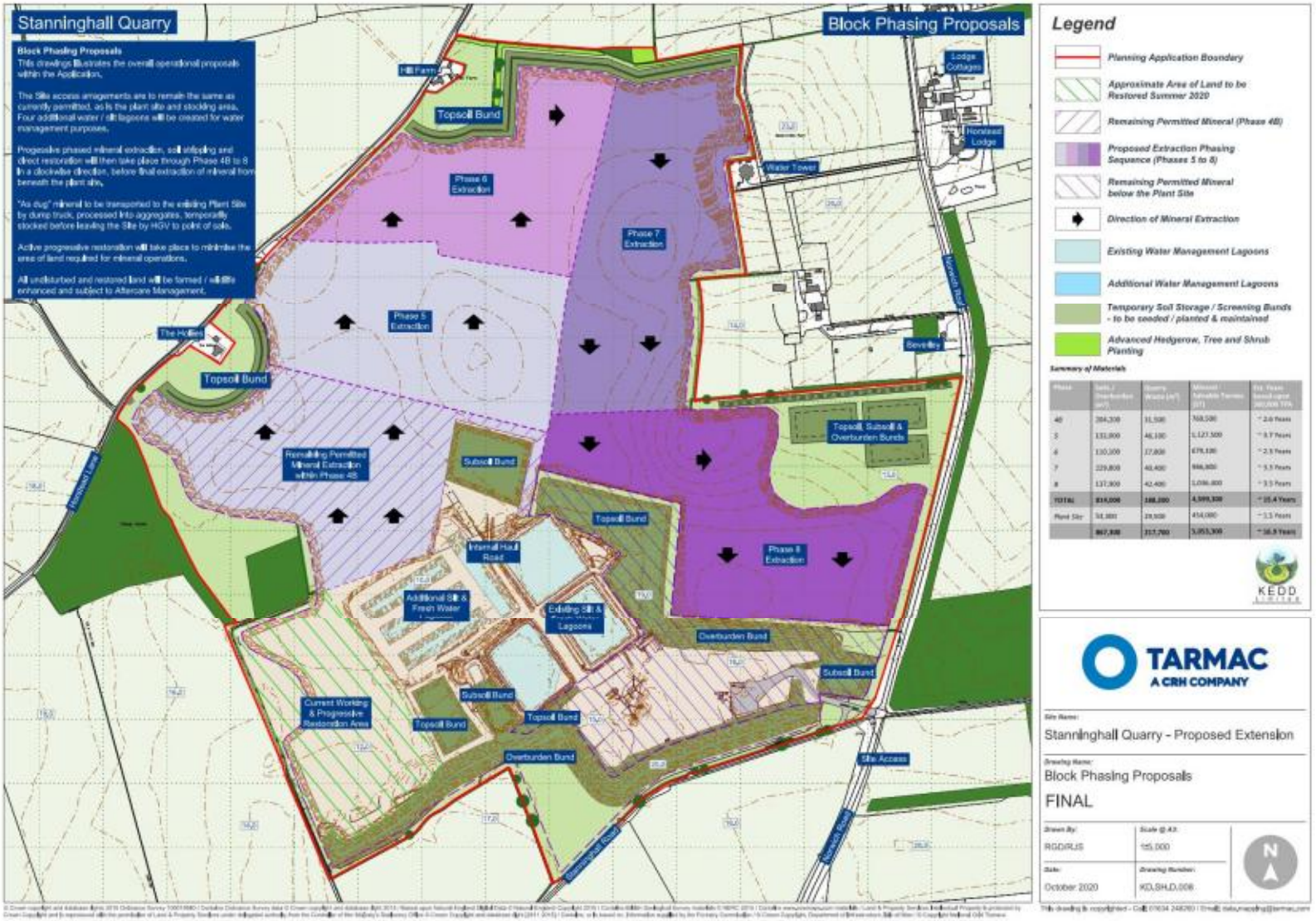


Figure 3-3 Phase 4B

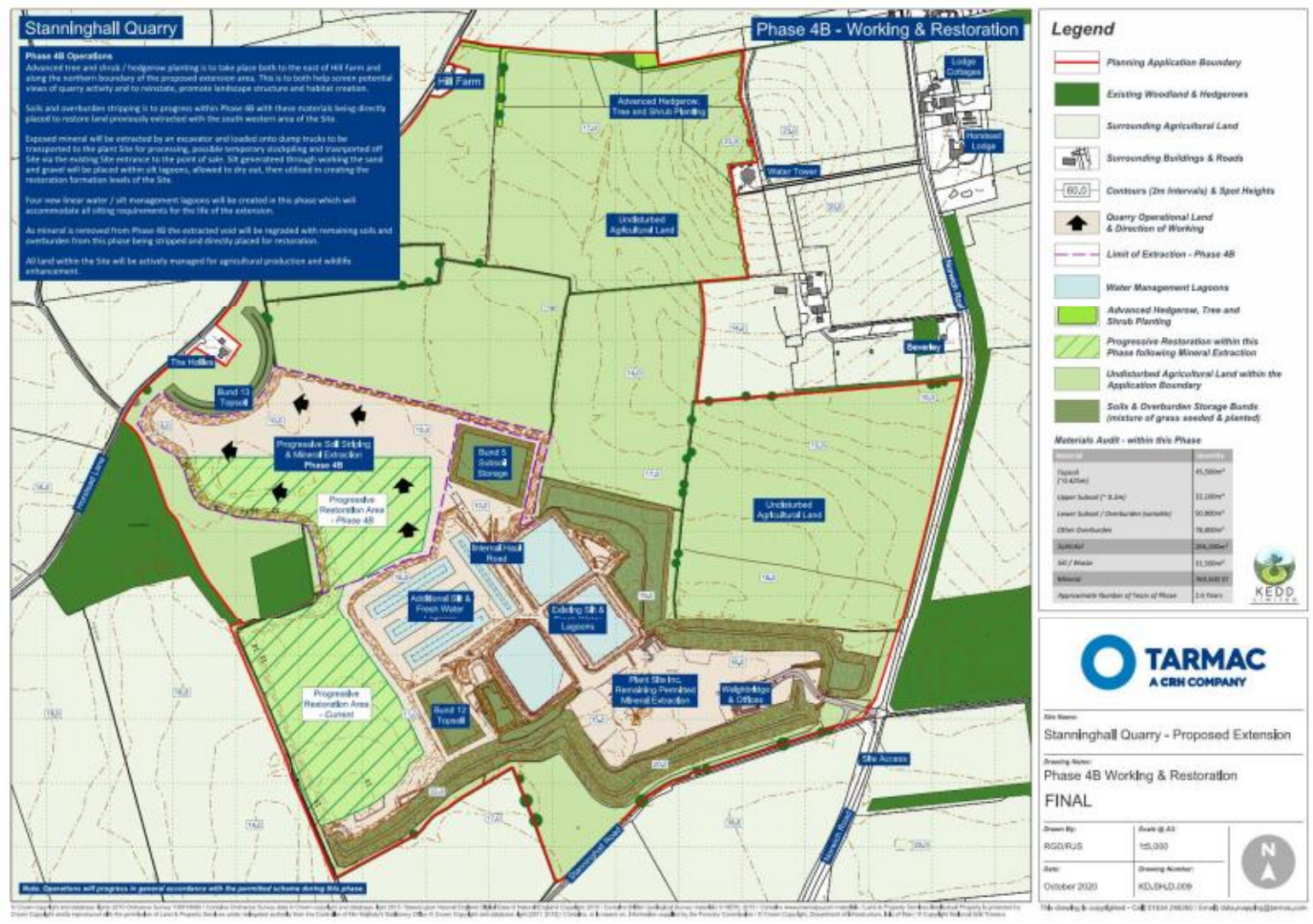


Figure 3-4 Phase 5

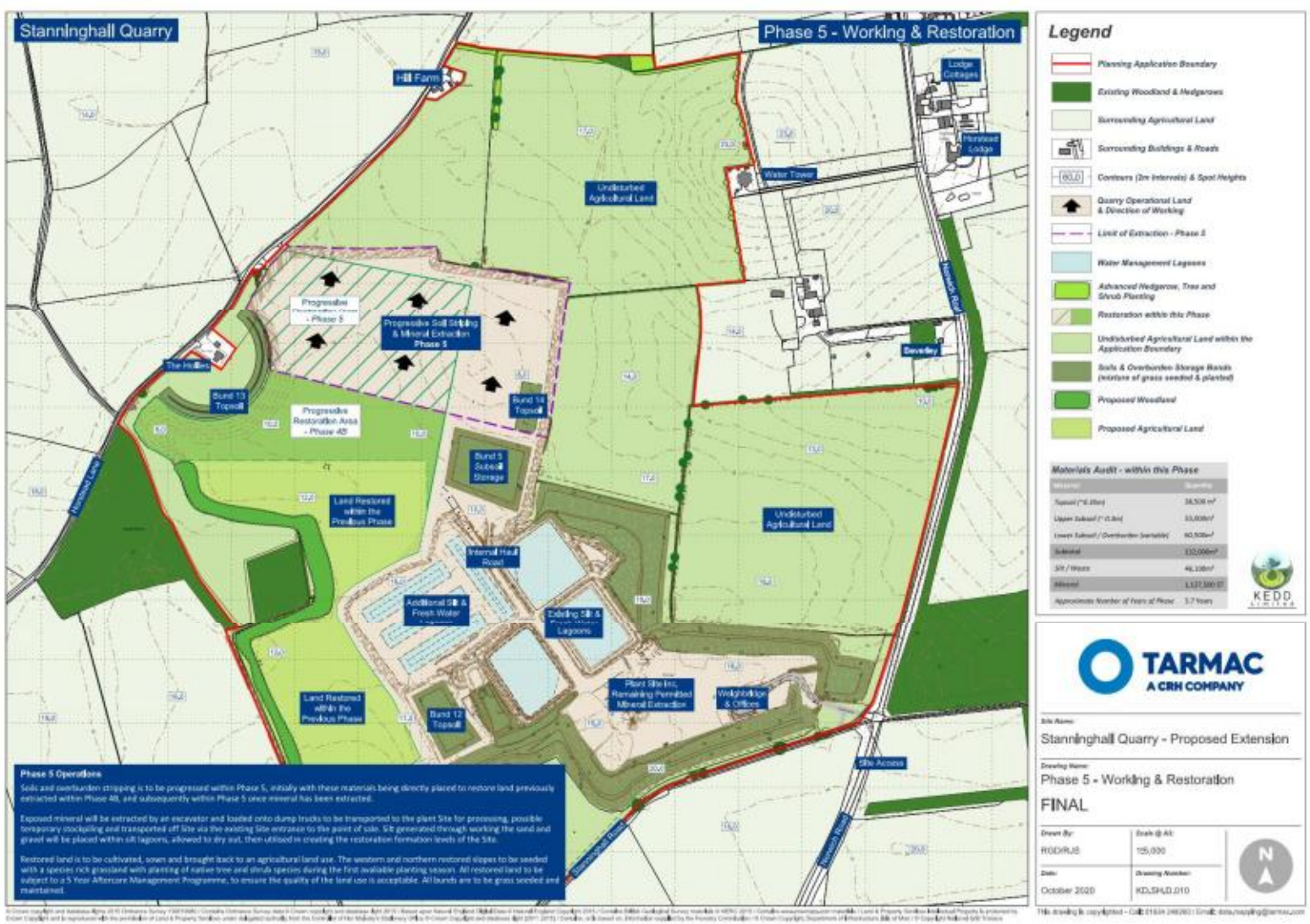


Figure 3-5 Phase 6

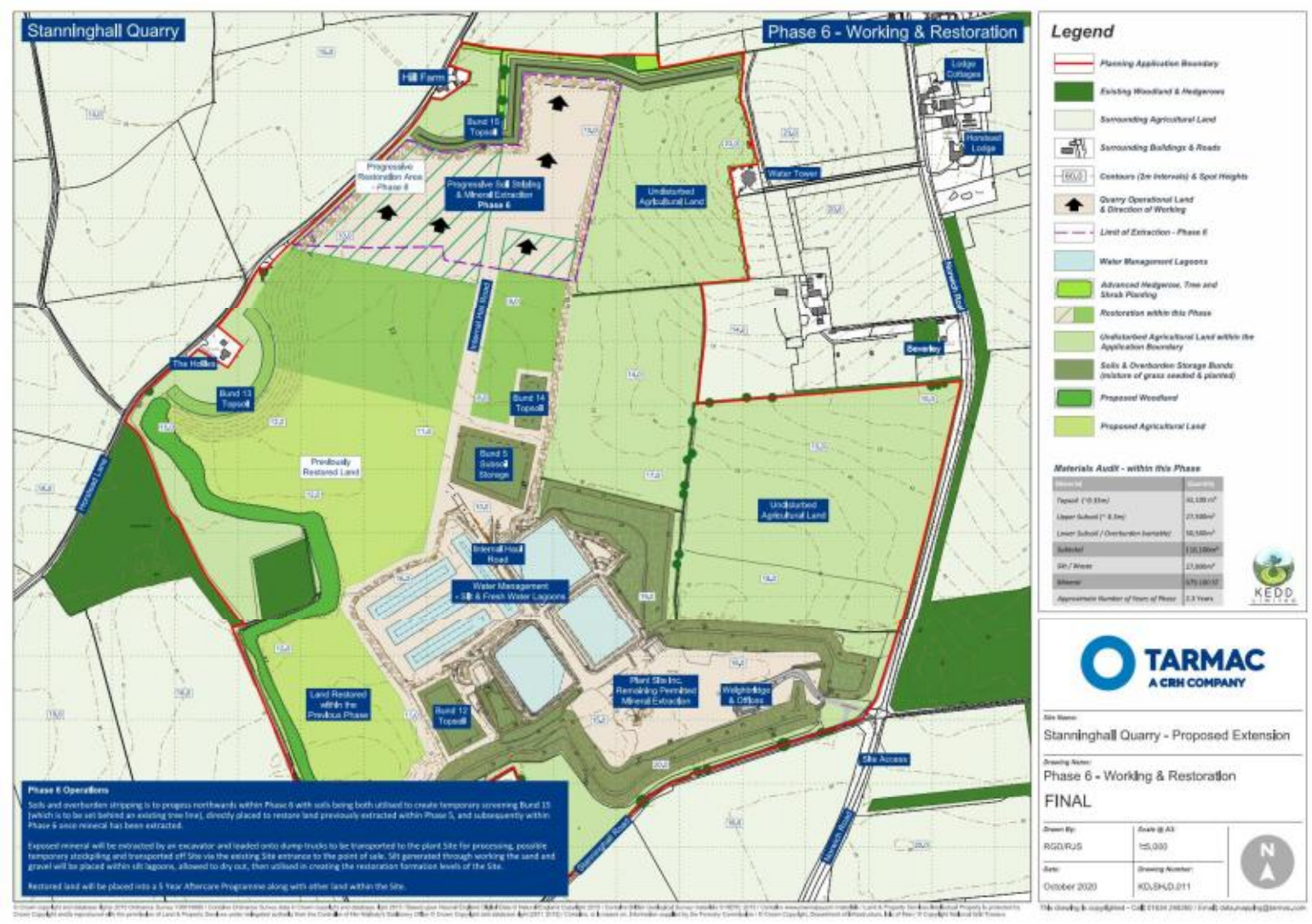


Figure 3-6 Phase 7

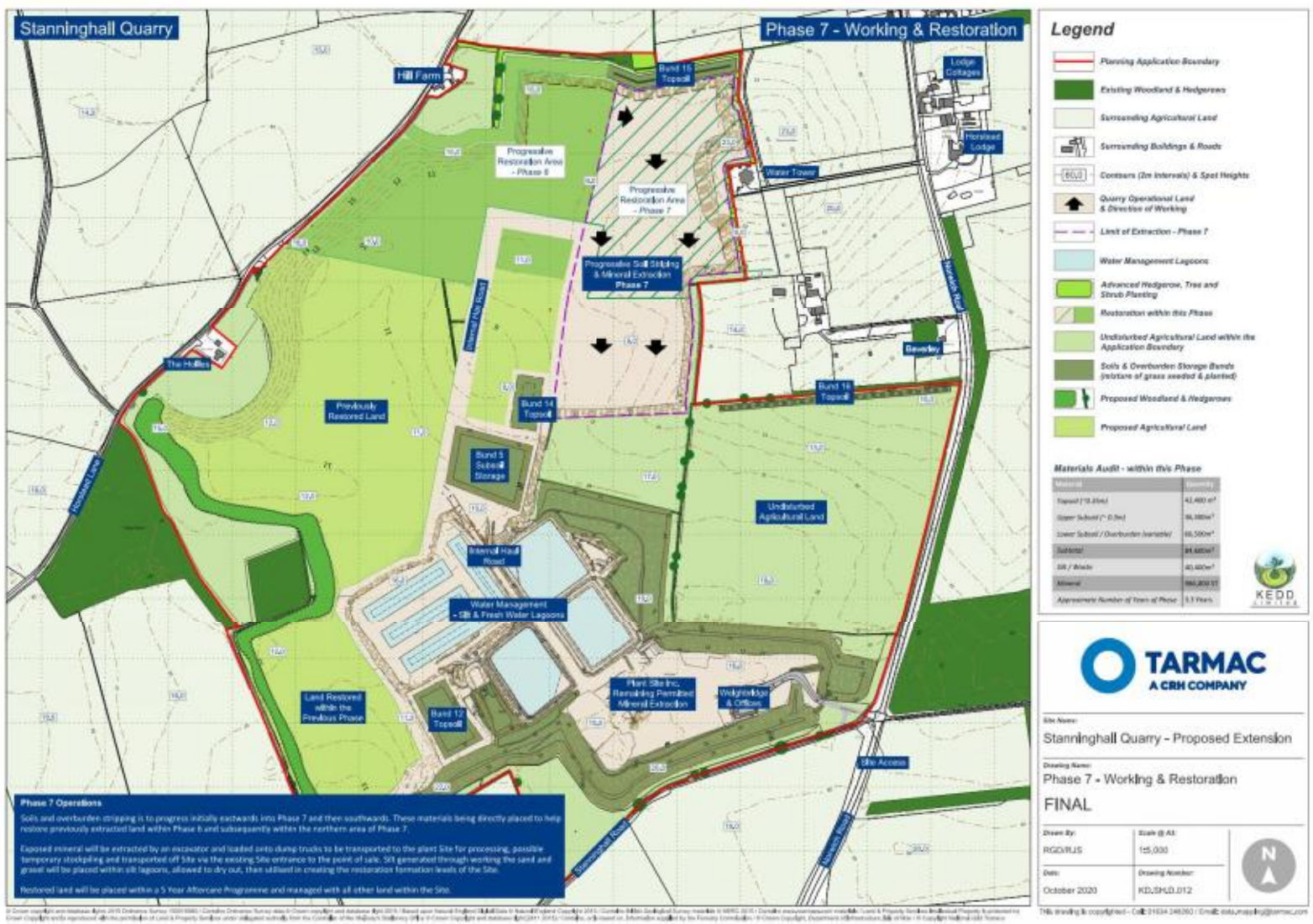


Figure 3-7 Phase 8

Figure 3-8 Phase 9 Final Works

4.0 RESTORATION STRATEGY

4.1 Introduction

This chapter describes the overall strategy for both the restoration of landform and subsequent land uses for the site. The strategy has been produced by a combination of Tarmac's estates, geological and restoration team along with the landscape architectural, ecologist and planning consultant input in full consultation with the landowners 'Trafford Estates'.

The collaborative approach has helped to ensure that the proposals for the establishment and aftercare of the restored site are both achievable and in accordance with the longer-term land management requirements of the landowner.

The progressive and final Concept Restoration proposals have been informed by the physical nature of the land and mineral within the site boundary.

The aim of the strategy is to ensure agricultural reinstatement and productivity of land to Best and Most Versatile Land capability, whilst creating and diversifying sustainable habitat or the promotion of biodiversity.

In addition to the principal restoration land use of agricultural land, the strategy seeks to also establish and manage the following key habitat types within the restored agricultural landscape:

- Native Woodland
- Native Species Hedgerow Planting
- Species Rich Grassland

The chapter provides a description of the issues which have informed the preparation of the restoration strategy, and the resulting restoration land uses which are proposed. The details of the restoration planting in terms of species mixes and aftercare management are set out in the Planning Application Statement which formalises the proposals.

The text below thus provides an overview of the restoration strategy and does not repeat the full details of the proposals as set out in the Planning Application Statement.

4.2 Design Principles

The proposed landform and landuse restoration proposals are illustrated on Drawing No KD.SH.D.015 Concept Restoration, reproduced in this chapter as **Figure 4.1**. This restoration scheme reflects and incorporates the original permitted restoration scheme for the southern part of the site is illustrated on Drawing No T57.52 (produced as **Figure 4.2**).

The Restoration Proposals for the site have been developed upon an understanding of four key aspects:

(i) The sites physical features, most notably:

- General land levels will be lowered through the extraction of mineral. There are no proposals to import any inert fill material for landform restoration.
- The nature of the mineral deposit of sand and gravel allows for the integration of base of extraction levels with varying landform gradients to integrate the restored quarry land with in-situ undisturbed ground.
- Areas of mineral extraction will not come into contact with ground water. The temporary water management lagoons utilised for quarry operations are to be removed from site.
- The chemical make-up of the on-site soils is of a neutral pH.
- The quarry is located within the Broadland Landscape Character Assessment under 'Wooded Estatelands'. This is an area of numerous copses, woodlands and small plantations associated with 'estates', punctuating a landscape of underlying, predominantly arable farmland. The area in which

the site is wholly situated in is E2 – Marsham and Hainsford Wooded Estates – comprised of gently rising slopes that extend from the Bure Valley to the belt of woodland in the west.

(ii) Local planning policies and designations, including:

- Consideration of the identified Landscape Character Area within which the site is located and its interconnection with adjoining landscape areas.
- Consideration of the Habitat, Species and Biodiversity Action Plan for Norfolk. To create appropriate habitats and attract and maintain key species in the county.

(iii) The landforms and management capability / objectives, notably:

- Tarmac are the operators of the existing Stanninghall Quarry and the proposed extension. Tarmac have a vast amount of successful experience of working and restoring quarries of this size and nature. Tarmac also have in-house and consultant support in respect of the Aftercare and Maintenance of land to a variety of agricultural production and wildlife habitat enhancement sites.
- Trafford Estates who own the land have confirmed their commitment to manage the retained site for agricultural and wildlife benefits.

(iv) Length of time associated with quarrying operations and management.

- Tarmac will be working the site for a period of ~17 years, together with a further 5 year aftercare period on final restoration land. This time aspect is key in allowing the company to plan and implement proposals and maintain and develop relationships with neighbours and local community.

4.3 Progressive restoration

It is important to note that the whole site will not be worked / disturbed at the same time. As with the permitted Stanninghall Quarry all soil stripping, mineral extraction and restoration will be carried out in a sequence of progressive phases. The integrated nature of the proposal is illustrated on Figures 3.2 – 3.11 produced within ES Chapter 3.0 above.

The key features of the progressive restoration works include:

- The retention and safeguarding of all site boundary hedgerows and woodland blocks which form the outer landscape structure of the existing site and northern extension area. These will be enhanced by further additional native planting along the eastern and northern boundaries of the site.
- Where possible utilising soils and overburden stripped to expose mineral in a direct single movement to restore previously exposed and extracted land. This will minimise the area of land disturbed/ required for mineral operations at any one period of time.
- The phasing proposals incorporating the Northern Extension allow for a consolidated approach to help ensure large blocks of land can be restored in localised geographical areas of the site through the direct placement of restoration soils from the adjoining operational phase.

The progressive restoration proposals have taken on board the opportunities for National Level -NCA – The Broads Character area SE03: "*to maintain a sustainable and productive agricultural landscape while expanding and connecting semi-natural habitats to benefit biodiversity*". This would be achieved through the concentration of higher quality soils in areas for agricultural productivity whilst developing approximately one third of the restored site for both landscape character enhancement and new wildlife habitat creation. The habitat would principally be native woodland with a diverse range of shrub and tree species of ~24.6 Ha, along with species rich grassland and meadow of ~12.3Ha. Landscape structure will also be

reinstated along with new habitats via the establishment of ~1,462 linear metres of hedgerows and hedgerow trees.

The restoration proposals also address Landscape Guidance specifically to area E2 of the Local level Broadlands DC– Landscape Character Assessment SPD including the conservation and strengthening of landscape structure around the promotion of significant site internal woodland structure and the creation of woodland and hedgerow corridors. The development has also considered and is assessed to maintain the setting of both historic assets and the landscape setting of local villages. This would be achieved through both re-establishing original landscape structure planting and the use of temporary screen bunding at appropriate and integrating levels which will be seeded planted and maintained to mitigate potential adverse changes in setting.

Norfolk's Core Strategy and Minerals and Waste Development Management Policies Development Plan Document 2010-2026 has a safeguarding aerodrome Policy DM7. The application site is located within the 13km radius of Norwich airport meaning that the development design must display appropriate mitigation measures in order to not increase the risk of bird strikes and general population of birds in the area. If seen to be necessary, a Bird Hazard Management Plan may need to be implemented. In this case, there are in-built mitigation measures in terms of the restored landscape not including any water bodies which may accommodate or promote flocking birds. Significant new woodland blocks are also proposed which will also locations for predatory birds to discourage settlement of flocking birds within restored fields.

4.4 Restoration/ Material Audit

The restoration of landform and associated topographical levels is to be achieved utilising only on-site "in situ" soils and overburden material combined with silt generated through the processing of sand and gravel. There is no requirement for the importation of materials to restore the site.

For the efficient operation of the proposed quarry it is proposed to minimise the amount of disturbed land at any one-time period though the progressive and direct placement of stripped soils and overburden material. This process is illustrated on the phased working and restoration plans. It is inevitable as part of this process that some soils / overburden will require temporary storage for later use in restoration. Locations of these storage bunds are also illustrated on the above plans, with the soils safeguarded for use in final restoration.

A summary of the progressive stripping, direct placement, temporary storage and final placement for restoration material is provided within Chapter 7.0 of the Planning Application Statement (PAS). The details confirm the volume and nature of soils and overburden to be stripped and whether they are directly placed for restoration or temporary storage for later placement as part of restoration works.

4.5 Restoration Planting, Establishment and Management

Full details of the restoration planting and seeding proposals are set out in Section 7.4 of the PAS, together with details of establishment and subsequent management.

All areas within the confines of the site that are to be managed for biodiversity, agricultural and amenity after uses will be subject to a detailed 5 year Aftercare Management Programme.

The Aftercare Programme will cover each of the habitat types to be created during the life of the development or following cessation of mineral extraction. The programme will allow for annual site meetings between the developer, landowners, the local planning authority and/or other statutory or non-statutory bodies, as agreed, to monitor the establishment of the various habitats to be managed, assess the success of the restoration habitats and determine the work to be progressed in the following year and any remedial action required to existing habitats.

4.6 Restoration proposals

The restoration land uses to be established at the site are set out in Table 4.1 below:

Table 4-1 Land use Restoration Proposals and Areas

Restoration Land usesProposed Landuse	Areas eas Ha / linear metres
Native Woodland Planting	24.5 Ha
Agricultural Land	69.8 Ha
Species Rich Grassland	11.9 Ha
Native Hedgerow Planting	1,462 linear m's
TOTAL	106.2Ha

Details for the proposed established and management of the above landuse are described below.

Native Woodland Planting

Advanced Woodland block planting is to be carried out to the northern and eastern boundaries of the site during the first available planting season. This will be followed by progressive planting of native woodland species during Phase 4B to the final restoration stage as illustrated on Drawing Nº KD.SH.D.009 to 014 to achieve the woodland proposals on the Concept Restoration Drawing Nº KD.SH.D.015.

New native woodland areas will have the following features:

- The species mixes will reflect local national vegetation classification (NVC) communities and soil type(s). Where possible, trees and shrubs of local provenance will be sourced as these are most likely to be suited to the local soils and climate and will offer the maximum benefit for biodiversity (Note – Ash is not to be planted due to current guidelines associated with potential Ash Dieback).
- Planting patterns will reflect the natural variation within semi-natural woodlands. Trees will be planted at varied, irregular spacings to encourage the development of a structurally diverse woodland.
- The woodland will have a graduated edge of scrub species, which will provide links to adjacent retained and new hedgerows.

Detailed species mixes will be included within the habitat creation plan for the woodland areas, but at this stage a suggested species mix, planting details and outline management proposals are set out in Section 7.4 of the PAS.

Agricultural Land

Agricultural Land will form a key part of the restoration of the north / central, eastern and south western areas of the site, with a total of approximately 70 ha of the site restored to this land use. The agricultural land will be restored at a full soil profile consisting of 0.3m of topsoil, 0.3m of upper sub soil, and 0.6m of lower subsoil / overburden capable of achieving Best and Most Versatile land characteristics of Agricultural Land Classification data (ALC) grade 3a soils or above

The area to be restored to agricultural land will be enhanced for wildlife by creating grassed headland margins of at least 6 metres in width. This unimproved neutral grassland margin will contain species that provide an abundance of seeds for invertebrate, bird and mammals.

Details of the soil handling associated with agricultural restoration, seeding and aftercare management are set out in Section 7.4 of the PAS.

Species Rich Meadow Grassland

Land around the periphery of the Site / and as woodland glades is to be sown with a base seed mix to promote species diversity.

Again, proposed details are set out in Section 7.4 of the PAS

Hedgerows

The proposals incorporate a total of 1462 linear metres of new hedgerows/ hedgerow lined trees. The majority of hedges would be planted as part of restoration to again comprise a diverse range of native species, typical of the local area. This will help ensure that the landscape character and context of the site integrates into the local area.

Details of the proposed species mix, planting details and outline management proposals are set out in Section 7.4 of the PAS.

4.7 Summary and Conclusions

The restoration strategy for the site is for a clear and distinctive set of land uses, ranging from agriculture to habitat creation and the sustainable promotion of biodiversity. The proposed land uses comprise elements and features that are either locally observed/ characterful and/ or are capable of successful integration into the local landscape setting. Although there are clear distinctions within the varying land uses they are fully integrated and complement each other. This will be achieved through three main areas:

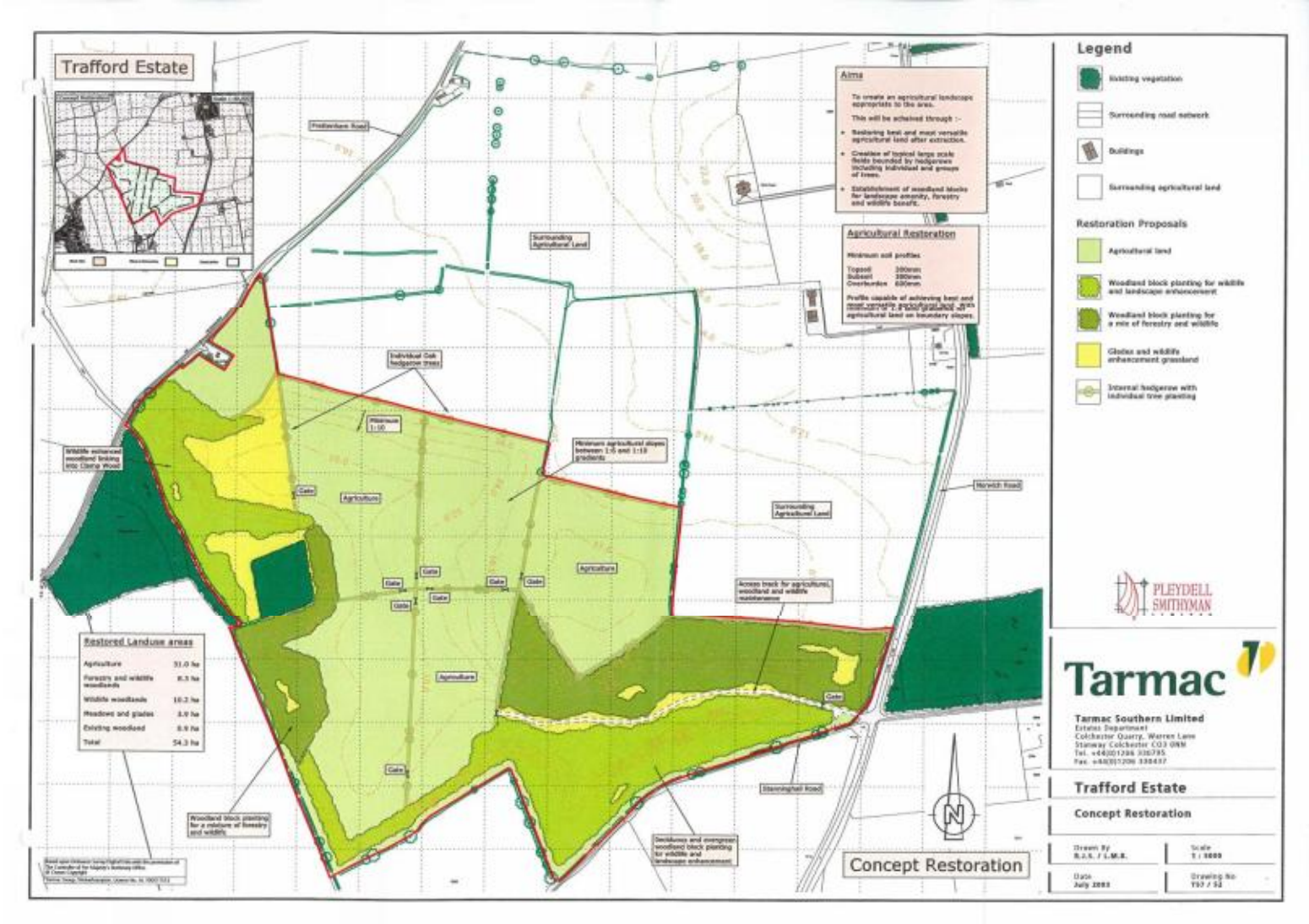
1. The re-establishment and strengthening of landscape structure based upon the current hedgerow pattern as well as managing agricultural units to also provide habitat and species diversity themselves.

2. The soil resource within the site will be protected and utilised within the agricultural areas to establish areas of best and most versatile land characteristics. This will provide the certainty to the landowners in terms of a consistency in soil profiles, potential for high productivity and a base for monitoring long term management of this resource.
3. The establishment of a substantial block of native woodland and glades, which builds upon the woodland area proposed as part of the restoration of the existing quarry site but with a larger area and enhanced linkages to adjoining woodland features.

The restoration strategy will be sustainably managed via agricultural and wildlife practices as part of a comprehensive aftercare management regime.

Figure 4-1 Restoration Strategy

Figure 4-2 Approved Restoration Strategy: Existing Stanninghall Quarry



RESTORATION STRATEGY 4

5.0 ENVIRONMENTAL IMPACT ASSESSMENT

5.1 Introduction

The potential environmental effects of the proposed northern extension and consolidation application at Stanninghall Quarry have been informed by (i) the formal scoping opinion issued by NCC; (ii) the Applicants' knowledge of the Stanninghall site and surrounding area; and (iii) experience of environmental and amenity issues associated with operating similar -sand and gravel quarries elsewhere.

Particular attention has been paid to the Scoping Opinion which has confirmed the key topics which have the potential to give rise to significant environmental effects and which require particular attention as part of the EIA.

The result has been a comprehensive study which has addressed each of the individual topics, and, where relevant, the inter-relationship between topics and the potential for indirect effects.

5.2 EIA and ES

The ES describes in detail the potential environmental effects of the ongoing development, with reference to:

- Landscape and visual impact (Chapter 6.0)
- Ecology (Chapter 7.0)
- Soils and agricultural land quality (Chapter 8.0)
- Hydrology and Hydrogeology (Chapter 9.0)
- Noise (Chapter 10.0)
- Air Quality (Chapter 11.0)
- Transportation (Chapter 12.0)
- Cultural Heritage (Chapter 13.0)

An overall summary of the environmental effects is set out in Chapter 14.0 which draws upon the main environmental issues set out in preceding chapters, and the recommendations for mitigation measures. This provides a link between the conclusions and recommendation of the topic studies, and the overall conclusions of the ES.

Further context is provided by the consideration of planning policy against which the application will be determined (Planning Application Statement), which highlights, inter alia, environmental issues which need to be addressed to satisfy planning policy requirements and advice.

5.3 Methodology

There are differences of approach in undertaking the respective assessments, which for certain topics are prescribed in detail by external guidance, but where others follow less prescriptive approaches.

The Chapters do however follow a generally common approach with, where appropriate, sections which deal with:

- **Baseline conditions**;
- **Key Receptors**;
- **Summary of development,** highlighting those issues of relevance to the technical topic;
- **Design Mitigation,** highlighting the 'built-in' or 'designed-in' mitigation measures;
- **Assessment,** relevant to the technical chapter and following specific technical guidance, but with a description of the sensitivity of receptors, character of impact, and significance;
- **Mitigation measures,** which are identified as a means of addressing identified impacts;
- **Residual impacts,** after taking into account in built and additional mitigation measures;

- **Summary of effects**
- **Recommendations,** which can be translated into planning conditions; and
- **Conclusions.**

5.4 EIA and ES

A key focus of the EIA has accordingly been to assess the comprehensive nature of the development and where relevant the inter-relationships between the main elements. The studies have sought to provide a sound level of understanding of the environmental effects, upon which reasoned assessments can be made regarding potential direct and indirect effects, and the mitigation measures which might be available to address any residual effects.

In undertaking the EIA and preparing the ES, it has been recognised that there is no statutory provision as to the form of the ES, but it must as a minimum contain the information specified in Regulation 18 (3) of the EIA Regulations 2017, and any additional information specified in Schedule 4 relevant to the specific characteristics of the particular development and to the environmental features likely to be significantly affected.

The ES must be based upon the scoping opinion issued, and it must include information reasonably required for reaching a reasoned conclusion on the significant effects of the development on the environment, taking into account current knowledge and methods of assessment (ref Regulation 17 ([4) (b)).

The ES may consist of one or more documents, but it must constitute a 'single and accessible compilation of the relevant information' (ref Berkeley v SSETR, 2000).

The ES has been prepared to ensure compliance with these requirements, with Volume 1 (this document) intended to be read as a single document, with cross references to technical appendices and data (ES Volumes 2A and 2B).

'Planning Practice Guidance' [PPG] which was originally introduced by central government in March 2014, with subsequent updates on-line, provides additional advice in support of the National Planning Policy Framework (NPPF) (updated February 2019). In relation to EIA, and the information to be included within an ES, it notes that whilst every ES should provide a full factual description of the development, "*the emphasis should be on the "main" or "significant" effects to which a development is likely to give rise*".

It further confirms that an ES "*should be proportionate and not be any longer than is necessary to assess properly those effects. Where, for example, only one environmental factor is likely to be significantly affected the assessment should focus on that issue only. Impacts which have little or no significance for the particular development in question will need only very brief treatment to indicate that their possible relevance has been considered*"

(ref Paragraph: 035 Reference ID: 4-035-20170728: Revision date: 28 07 2017)

The potential environmental and amenity effects associated with the proposed Stanninghall Quarry development have been considered in this context and in a proportionate way to the potential significance of the respective topics.

6.0 LANDSCAPE & VISUAL IMPACT

6.1 Introduction

This chapter addresses the Landscape and Visual Impact Assessment (LVIA) associated with the proposed Northern Extension and Consolidation Application at Stanninghall Quarry. The study has been undertaken by Kedd Limited, a specialist minerals and landscape architectural environmental practice. Liaison in respect of the nature and scope of the works produced within this report has been guided by the Scoping Opinion provided by Norfolk County Council.

The Planning Application Extension Boundary (the Extension Area) covers ~53.2 hectares (Ha). The existing permitted quarry (the quarry) is some 53.6 Ha. The combined existing quarry and the extension area forms 'The Site' area of 106.8ha.

The location of the application site boundary is illustrated on Drawing No. KD.SH.D.001 within **Appendix 6.1**.

The progressive Development Proposals for Phased Extraction and Restoration are illustrated on Drawing No KD.SH.D.008, with the Concept Restoration Scheme for the combined site illustrated on Drawing No KD.SH.D.015 both contained within the application. Oblique aerial images are also provided within **Appendix 6.1**, which from two elevated viewpoint locations illustrate the existing situation of the Site, along with a mid-Phase 6/7 scenario, and the Site at final restoration.

The aim of this chapter is to provide an understanding of the baseline Landscape and Visual resources within the local area, and to assess their sensitivity to change resulting from the proposed development type, together with their value.

From this baseline position, an assessment is made of the specific magnitude of effect of the proposed development on the resources, and the Level of Significance / Effect on Landscape and Visual matters resulting from the proposed development (potentially adverse and / or beneficial) is determined. Based upon this assessment, mitigation measures are proposed as appropriate.

6.2 Methodology

This Landscape and Visual Impact Assessment (LVIA) has been carried out in accordance with guidance produced by the Landscape Institute and the Institute of Environmental Management; Assessment Guidelines for Landscape and Visual Impact Assessment (GLVA 3); and Photography Technical Guidance Note TGN 06/19-Visual Representation of Development Proposals, published 17th September 2019.

LVIA is a tool used to identify and assess the significance of and the effects of change resulting from development on both the landscape as an environmental resource and on people's views and visual amenity" (ref GLVA3).

Data, collation and assessment has been carried out utilising both desktop and site survey works to identify the baseline landscape character and visual nature and condition of the site and its local area. Initial desktop survey analysis helped to identify the potential areas the proposed development may influence / change in respect of character and viability. A 1:25,000 Ordnance Survey map was used to identify potential areas of visibility from roads, properties, public rights of way and open access land. Utilising site and site context topographical 3D data, the 'Zone of Theoretical Visibility' (ZTVI) has been prepared based upon:

(i) the existing permitted development as part extracted (see Drg No. KD.SH.D.019 within **Appendix 6.1**);

(ii) the ZTVI of operations within Phase 7 (see Drg No KD.SH.D.020), this phase illustrating both the in-place plant site and progressive mineral extraction at its northern limit with subsequent progressive restoration; and

(iii) at Post Restoration when all land has been fully restored and all plant and machinery has been removed (see Drg No KD.SH.D.021).

These were then used to inform and help define a study area within which the proposed development could influence / change both Landscape Character and Visual Amenity. It is emphasised that the ZTVI are a worst-case scenario in assessing the geographical land area from where the existing / proposed site development could be observed / influence Landscape Character as this method of analysis does not account for existing built form or vegetation structure which would affect / could screen views towards the site from landscape and visual receptors.

The desktop appraisal helped form the basis for site survey works which were carried out in winter 2019.

A description of the full Methodology and Assessment Process used is detailed within **Appendix 6.2**.

In summary, and in highlighting the main assessment process, the GLVA3 states that when undertaking an LVIA, this should consider:

i. Landscape effects i.e. the effects on the landscape as a resource and
ii. Visual effects i.e. the effects on views and visual amenity.

It also states that; "*LVIA must deal with both and should be clear about the difference between them*". (ref GLVA 3 para 2.2.2 para 21).

The Guidelines explain that both landscape and visual effects are dependent upon the sensitivity of the landscape resource or visual receptors and the magnitude of impact based upon the following definitions.

Sensitivity – is the term applied to specific receptors, combining judgements of the susceptibility of the receptor to the type of change or development proposed and the value related to that receptor.

Susceptibility – is the ability of a defined landscape or visual receptor to accommodate the specific proposed development without undue negative consequences.

Landscape Value – is the relative value that is attached to different landscape by society. A landscape may be valued by different stakeholders for a whole variety of reasons including value attached to views, e.g. in relation to heritage assets or through planning designations.

Magnitude (of effect) –is the term that combines judgements about the size and scale of the effect, the extent of the area over which it occurs, whether it is reversible or irreversible and whether it is short or long term in duration.

Assessed Overall Level of Significance of Effect – is the term which relates to the final judgement about whether each effect identified is significant or not. It is a measure of the importance or gravity of the environmental effect, defined by the significance criteria specified within **Appendix 6.2**.

The assessment process and its findings are detailed within sections 6.4, 6.5 and 6.6 of this chapter.

6.2.1 Previous Studies

Landscape and visual matters were originally assessed as part of the initial proposals for the Stanninghall (Trafford) Site, both the original application / EIA in 2002 which comprised a proposal encompassing the entire site (existing quarry and northern extension area), and the subsequent 2003 application / EIA which was confined to the current quarry area in the southern part of the site. In summary, both EIAs concluded that the site landscape context was generally robust in respect of elements and features comprising the landscape resources, being of average to good quality. The studies further concluded that visually the proposed quarry would be relatively well screened by a combination of both variances in local landform and by extensive local tree cover.

6.2.2 Assessment Approach

The assessment process as stated has followed guidance suggested by The Landscape Institute and Institute of Environmental Management and Assessment within the (GLVA3).

6.2.3 Landscape and Visual Elements of the Development

It is important to note that the main physical/development attributes (elements and features) of Stanninghall Quarry are already present. These comprise the physical forms of lowered land levels where either soils and overburden have been stripped to expose mineral, and/or sand and gravel extraction areas/ faces. These appear as engineered man-made features which are set within or adjacent to undisturbed ground.

Other landscape and visual element and features of the development include:

I. The quarry processing and ancillary plant and associated built strategies/ offices/ weighbridge
II. “As dug” and processed mineral stockpiles
III. Soil storage bunds
IV. Entrance and access road
V. HGV movements both internally and onto the local road network
VI. Water management/ lagoon system
VII. The proposed extension will comprise the physical change in landuse from agricultural to quarrying and progressive restoration.

No further additional changed and/or introduction of landscape and visual elements and features are proposed under this application.

6.3 Policy Context

6.3.1 Landscape Designations

The site is located within 2km of several nationally designated landscapes, these being:

- The Broads National Park which runs from North to South within 1km of the eastern border of the quarry.
- There is a Ramsar site circa 1.4km south of the quarry called Broadland Ramsar.
- Located near to the Ramsar site is a Special Area of Conservation called ‘The Broads’. It is comprised of; inland water bodies, Bogs, Marshes, water fringed vegetation, Heathland, Grassland and Deciduous Woodland.

At a county level the site lies within an Airport Safeguarding zone for Norwich International Airport. Other designations that lie within a 2km radius from the centre of the site and which may be indirectly affected by the development area are listed below:

- Site of Special Scientific Interest (SSSI)- There is one SSSI circa 1.4km south of the site. It is in close proximity to the SAC and Ramsar Site. The site is called Crostwick Marsh and is in unfavourable condition. It is designated due to being species rich, particularly in species which are uncommon to the UK. It is also the habitat of many different Marshland birds.
- Scheduled Ancient Monument (SAM)- There is one SAM circa 1.3km north of the site. It is a Roman camp situated to the west of the settlement of Horstead. There are other SAMs in the area, but they are all over 2km away.

- Listed Buildings – There are circa 50 listed buildings within a 2km of the application boundary. These are comprised of a mix of Grade I, Grade II and Grade II* listings. The most common designation within the area being Grade II. The nearest group of listed building receptors within proximity to the site are ~200m south of the southern site boundary comprising of the Grade II listings – Stanninghall Farm Barn, Stanninghall Farm House and Ruined Church of St Peter. The nearest Grade II* receptor is the Church of St Swithin ~650m from the western boundary of the site.

- Conservation Area – The Colitshall and Horstead Conservation Area is ~335m north east of the site at the closest point. It is designated at district level by the Broadland District Council.

These designations are illustrated on Drawing No KD.SH.D.023.

6.3.2 Relevant Landscape Orientated Planning Policy

The applicant's site is controlled by various planning policies and documents from National Government and Local Government. The documents which affect the site are:

- National Planning Policy Framework (updated 2019)
- Core Strategy and Minerals and Waste Development Management Policies Development Plan Document (2010-2026);
- Joint Core Strategy for Broadland, Norwich and South Norfolk (Adopted 2011, updated 2014);
- Preferred Options for the Norfolk Minerals and Waste Local Plan: July 2019

National Planning Policy Framework 2019

Paragraph 10 of the NPPF explains that there is "a presumption in favour of sustainable development" and goes on to say in paragraph 170 that "planning policies and decisions should contribute to and enhance the natural and local environment" by a number of factors including "recognising the intrinsic character of the countryside".

Core Strategy and Minerals and Waste Development Management Policies Development Plan Document 2010-2026

This document is the overarching document, which alongside the supporting documents will be used for considering all mineral and waste development in the county over its plan period of 2010 till 2026. This assessment will focus on the policies which concern landscape.

Contained within the Spatial vision of the plan (paragraph 5.12) there is clear support for mineral workings which contain restoration schemes of high quality with new distinctive landscapes to enhance the biodiversity of Norfolk.

An aim of the plan is to minimise the impact of mineral extraction and associated development and waste management facilities on the environment by promoting opportunities to enhance and protect biodiversity, landscape and geodiversity, water supply, the wider countryside, and cultural heritage.

CS14- Environmental Protection. Protection and enhancement of Norfolk's built, and natural environment is a vital consideration for future minerals extraction and associated development. Developments must ensure that they do not create any adverse impacts on the character and quality of the landscape and townscape.

Norfolk is predominantly rural in nature and therefore protecting it is of importance. There will be no permitted mineral sites which cause inappropriate adverse effects. Outside of the Nationally Designated Areas (NCA 78 + 80) Norfolk contains landscapes and townscapes which reflect the local variation in physical factors such as geology, soils, building materials, relief and climate, together with other factors such as local land tenure and settlement patterns. These give the area a unique character and sense of place. These have been covered in the seven-district council Landscape Character Assessments, specific to the Stanninghall site is Broadland District Council LCA.

Policy DM7 is safeguarding aerodromes. The application site is located within the 13km radius of Norwich airport meaning it must abide by the

policy. The development design must display appropriate mitigation measures in order to not increase the risk of bird strikes and general population of birds in the area. If seen to be necessary, a Bird Hazard Management Plan may need to be implemented.

Policy DM8 focuses on Design, Local Landscape and Townscape Character. It will permit development providing it will not harm the conservation of, or prevent the enhancement of, key characteristics of its surroundings with regard to the character of the landscape. The application must show it will address the impacts on landscape and townscape. Reference must be given to any relevant landscape character assessment. In particular the potential individual and cumulative effects on the following issues must be addressed:

- Landscape and Townscape Character- visual intrusion, the layout + scale of buildings and designated spaces.
- Landscape and Townscape sensitivity and capacity

Development will only be permitted where it would be within sensitive areas (e.g. listed buildings or Special Areas of Conservation) if the applicant can demonstrate that the development would not adversely impact on the historic form, character or setting of these locations.

Joint Core Strategy for Broadland, Norwich and South Norfolk (Adopted 2011, amended January 2014)

This document is the local plan for three districts within Norfolk County which together form the Greater Norwich Development Partnership (GNDP). It sets out the long-term vision and objectives for the authoritative areas. Much like the Minerals and Waste plan, the joint core strategy sets out spatial visions. Objective 9 of the spatial visions focuses on protecting, managing and enhancing the natural, built and historical environment, including ley landscapes, natural resources and areas of natural habitat or nature conservation. Scale of development must be appropriate in order to avoid adverse effects on the environment and existing landscape.

Policy 1 of the plan addresses climate change but also protecting environmental assets. It acknowledges the areas wealth of assets with a goal of enhancing wildlife connectivity through allowing wildlife to move through the wider landscape in response to environmental change. Therefore, damaging development will not be permitted.

In order to comply with **policy 2** development proposals must respect **local distinctiveness** including as appropriate:

- The landscape setting of settlements including the urban/rural transition and the treatment of 'gateways'
- The landscape character and historic environment, taking account of conservation area appraisals and including the wider countryside and the Broads area.

The Broadland Landscape Character Assessment is referenced in Policy 2, this document is the local level landscape character for the Stanninghall site.

Preferred Options for the Norfolk Minerals and Waste Local Plan Review: July 2019.

This document aims to consolidate the three already adopted Development Plan Documents into one local plan and to ensure that the policies within the plan remain up to date and to extend the plan to the end of 2036. The consultation process has already taken place and pre submission publication is planned for November/December 2020. Under the 'Preferred Options' document, LAND NORTH of Stanninghall Quarry has been identified as a proposed allocation for future sand and gravel (Site Ref MIN 65).

A list of issues to be addressed and submitted with any planning application has been produced as part of the Preferred Options. Under Landscape it is identified that the site is fairly level and that it should be possible to design a scheme of working, incorporating screening, which would have an acceptable impact on the wider landscape. The following information is also a summary of the landscape related draft objectives and policies;

Policy MW6: Agricultural Soils – This policy seeks to protect soils of higher quality from damage caused by development. Mineral extraction proposed on land graded 1, 2 or 3a will only be permitted where provision is made for high standards of soil management and a restoration scheme where either the benefits outweigh the loss of agricultural land / or restores the agricultural land.

Policy MP6: Cumulative Impacts and Phasing of Workings – The cumulative impact of a proposal must be deemed acceptable. This is achieved through phasing a site so that it follows the completion of another, or demonstrating that adverse cumulative impacts can be appropriately mitigated. This can be achieved through pre-extraction planting for example.

Policy MP7: Progressive Working, Restoration and After-Use – Proposals must include a Phase Working and Restoration scheme which ensures that the land is reclaimed and restored at the earliest opportunity to reduce impact. The Phased Working and Restoration Scheme must mitigate potential impacts including amenity, landscape, natural and built environmental as well as the historic environment. Preference is given to sites which enhance the landscape of Norfolk through their restoration.

Policy MP8: Aftercare - Where the proposed restoration following mineral extraction is to an agriculture, forestry, amenity or ecology after-use; or includes a geological exposure, an outline aftercare strategy for at least five years is required prior to the determination of the planning application. The outline strategy should set out the land management proposed to bring the restored land up to the required standard for the proposed after-use.

Site Specific Policy MIN 65: Land north of Stanninghall Quarry – The application site is considered and assessed within the Preferred Options document. There are a list of conditions and assessment required for an application on the site as well as an overview of the site by different disciplines. These factors have been considered as part of the EIA and are commented upon in detail in the Planning Application Statement.

6.4 Landscape Assessment

6.4.1 Landscape Baseline

Landscape Character

Landscape Character is described at three levels within this section, namely National Level and Local Level, which provides a context to fully appreciate the component elements, features, and interactions of the Landscape and its susceptibility to change.

The National Landscape Character Area (NLCA) descriptions include 'Statements of Environmental Opportunities' which set out objectives for landscape conservation and enhancement. The Local Landscape Character Assessments provide a description of the landscape character of the respective areas, together with 'Landscape Guidance' which similarly sets objectives for landscape conservation and enhancement at a more local scale.

National Level- Central North Norfolk

The site is located within the Central North Norfolk number 78 National Character Area. This is one of 22-character areas within the east of England. Its north eastern boundary is however in proximity to The Broads number 80 National Character Area.

The Central North Norfolk area is described as a predominantly tranquil place, with isolated market towns and scattered villages. The area as a whole is well wooded for Norfolk and its gently undulating rural landscape is what characterises the area as a whole.

Statements of Environmental Opportunities:

- SEO 1: Work with the local farming community to safeguard future food production, while maintaining the traditional landscape character with its patchwork field system, mixed hedges and pastoral river valleys; enhancing biodiversity, especially in arable

margins and hedgerows, geodiversity, water quality and availability, pollination, soil quality, and managing soil erosion; and addressing the impacts of climate change.

- SEO 2: Maintain, enhance and restore priority habitats, including woodlands, areas of remnant heathland, and the nationally and internationally important Norfolk Valley Fens, chalk river systems (including the River Wensum) and maritime cliff habitats. Seek opportunities to connect fragmented habitats, improving the area for biodiversity and recreation, and enhancing landscape character and resilience to climate change.

- SEO 3: Conserve and enhance the historic character of the area while affording protection to heritage assets, biodiversity, geodiversity and water resources, and encouraging sustainable tourism and recreational use and also a sympathetic approach to development in coastal areas, around market towns and towards Norwich.

- SEO 4: Ensure the sustainable development of the coastline and its coastal towns and villages, while protecting and enhancing its important geodiversity, encouraging natural coastal processes where possible, improving access and interpretation, and encouraging sustainable recreational use and visitor enjoyment while conserving sites with high biodiversity value including maritime cliff habitats.

The text also notes that this NCA is an important producer of minerals, with many safeguarded sites protected from other development including potential new sites.

It further notes that all mineral working will be covered by progressive restoration schemes; the enhancement of Norfolk's biodiversity and the creation of new, high-quality, distinctive landscapes is strongly supported.

National Level- The Broads

As mentioned, The Broads NCA is within a relatively close proximity to the Stanninghall site, therefore it is appropriate to give some weight to the character of the landscape there. The Broads generally dominates the eastern edge of East Anglia however a branch of the area reaches north of Norwich. Almost 94% of the NCA is open countryside interspersed with shallow lakes called 'Broads'. The agricultural landscape is based on a long history of drainage to allow livestock grazing interspersed with arable cropping, mainly for cereals, which is supported by the moderately fertile river valley and flood plain soils.

Statements of Environmental Opportunities:

- SEO 1: Conserve and enhance the distinctive historic landscape of the Broads, which is of national and international significance for its heritage and biodiversity interest, through securing and expanding the open water, riverine and estuarine habitats which are vulnerable to abstraction, flooding, vegetation succession and altered land management. Manage the provision and quality of water in the whole catchment for human and ecological benefit.

- SEO 2: Conserve and manage the nationally significant coastal landscape, including that within the Area of Outstanding Natural Beauty (AONB) – between Sea Palling and Winterton-on-Sea – by implementing strategies to adapt to coastal change and sea level rise that are consistent with the current north-east Norfolk Shoreline Management Plan. Work with coastal processes as far as possible, while enhancing people's enjoyment of the area through improving its unique assemblage of coastal habitats and increasing opportunities for sustainably managed access to support recreation and education.

- SEO 3: Maintain a sustainable and productive agricultural landscape while expanding and connecting semi-natural habitats to benefit biodiversity and improve soil and water quality by promoting sustainable farming practices that are able to adapt to changing

agricultural economics and the considerable challenge of climate change and comply with regulations on nitrate vulnerable zones. Reedbeds and ponds on the Mid Yare National Nature Reserve shape the distinctive historic landscape of the Broads.

- SEO 4: Improve opportunities to enhance people's enjoyment of the area while protecting high levels of tranquillity by conserving intimate Broadland valleys and extensive coast and marshland views, which contribute to sense of place, and conserve and promote the geodiversity, archaeology and historical evidence of past human settlement and landscape change.

Sand and Gravel has been actively quarried in the area. Good quality heathland restoration has taken place at Norton Subcourse quarry where the site has been restored. Further opportunity for restoration and geodiversity is in acid grassland and woodland.

Local Level- Broadland District Council Landscape Character Assessment SPD

The Broadland District Council Landscape Character Assessment is the Supplementary document relating to landscape for the Joint Core Strategy Development Plan Document of Broadland, Norwich and South Norfolk adopted in 2011. The document itself was updated in 2013. See Drawing No. KD.SH.D.024 for local landscape character details.

The Stanninghall site is affected by several landscape types. This includes all four types of Wooded Estateland as well as A2 – River Bure and F1- Wroxham to Ranworth Marshes Fringe.

The general characteristics found across all four Wooded Estatelands Landscape Character Type are:

- A pattern of small manor houses, isolated halls and larger estates, with associated parkland extending across much of the area:
- These buildings impart a strongly ordered and human influence over the surrounding landscape;
- Numerous copses, woodlands and small plantations associated with these estates, punctuating a landscape of underlying predominantly arable farmland;
- Settlements have many historic buildings associated with them and a strong local vernacular;
- Strong historic dimension throughout the landscape;
- Woodland provides a sense of enclosure;
- Underlain by a mixed geology of Till, with loams and pebbly soils.

The strength of these Landscape Character types are seen as generally strong and distinctly recognisable with a sense of place throughout. Therefore, the landscape is considered to have a generally strong character. There is evidence of a decline in hedgerow field boundaries and loss of hedgerow trees.

Character Area – E2 Marsham and Hainford Wooded Estates

The area is which the site is wholly situated in is E2. This character area comprises the gently rising slopes that extend from the Bure valley to the belt of woodland in the west. The area is made up of a varied drift geology of sand and gravel which in areas is overlain by loam, particularly in the north which forms pockets of higher quality agricultural land.

The majority of the landscape is in arable cultivation. There are varying field sizes here of a medium to large scale with generally poor hedgerow coverage. Woodland coverage in the area is limited to small copses associated with halls and manors in the region sited in proximity to River Bure tributaries. An exception to this is in the south eastern area where there are small-scale woodlands and copses.

There are few features to this area which strengthen its visual fabric. Across the character area there are few settlements, mostly formed of small residential pockets with a minor central core. Most recent developments are found in the form of residential development along busy roads through the area. There is often an abrupt transition between built and natural environment in these pockets of development, however, they have maintained the nature of development in this area which is individual linear or nucleated.

In areas away from tributaries slopes are much gentle in nature affording wider reaching views, particularly over to character area B1 to the west. Variations in landscape character and caused by streams and river channels which form gentle wooded incisions, namely: The mermaid, Camping Beck and Stone Beck.

EVALUATION – Landscape Summary and Planning Guidance

To summarise the character of the area is:

- Pockets of pasture, open grassland, patterns of semi-natural vegetation lining tributaries, create interest and diversity in an otherwise arable landscape.
- Generally unified, rural character and recognisable landscape structure with fields defined by hedgerows in many areas.
- Landscape setting of historic halls, manors and churches.
- Landscape setting of villages.
- Characteristic westerly views across the farmland to distinct wooded horizons.

Landscape Guidance specific to area E2 are as follows:

- Seek to conserve and enhance the landscape structure within the area, including woodland, copses of woodland, mature trees associated with small halls and manors and intact hedgerows;
- Seek to ensure the sensitive location of development involving further tall structures (such as steel pylons and telecommunication masts) in relation to prominent skyline locations both within the character area and within adjacent character areas;
- Seek to ensure that potential new small-scale development within villages is consistent with the existing settlement pattern, density and traditional built form;
- Seek to conserve the landscape setting of historic halls, manors and churches;
- Seek to promote use of local vernacular buildings materials;
- Seek to ensure new development does not reduce the vertical significance of important historical and architectural features within the landscape, such as church towers.

Character Area – A2 Bure River Valley

Adjacent to the northern boundary of the site is area A2. This character area is Bure River Valley and may have characteristics which affect upon the site due to its proximity. The character area is located in the northern part of the district and is formed of a distinctive topography of narrow, flat floodplain contained by gentle convex slopes. The river cuts through both solid and drift geology as it travels south-easterly through the landscape. It is overlain by sand and gravel.

The area has a tradition of grazing along the valley floor and still remains. However, historical land uses in the area are quite limited due to its tendency to flood. There are pockets of enclosed arable land, although, the split of landuse is generally permanent grassland towards the valley floor and arable farmland in the drier areas. Unlike E2 this area sees robust hedgerows and hedgerow trees, as well as, blocks of wet woodland, willow, alder and in some areas, poplars.

There is a generally scattered settlement pattern to the area, and due to its tendency to flood, farmsteads and settlements are focused more the elevated land to the edge of the floodplain. Due to their location there is a strong visual character formed of features such as churches. Presence of small manor homes, many with moats, suggests a medieval origin.

Central and southern parts of the area have an intimate landscape. Woodland on the valley slopes and a mosaic of woodland on the valley floor creates enclosure. In the northern parts of the area there is a much wider expansive landscape with views across the valley floor. There is a strong sense of place and tranquillity throughout the area.

EVALUATION – Landscape Summary and Planning Guidance

To summarise the character of the area is:

- Natural meandering course of the River Bure and associated floodplain habitats provide a biodiversity resource; downstream of Wroxham, the valuable River catchment is part of the Bure Broads and Marshes SSSI/SAC.
- Diverse, mature landscape structure including blocks of wet woodland, mature trees and intact hedgerows;
- Mosaic of grassland and grazing marsh with blocks of wet woodland that punctuate valley floor, contribute to a generally unified corridor of open space that leads to the north western part of Broads Authority Area;
- Sense of intimacy and enclosure in central and southern parts;
- Sense of openness in northern parts;
- Distinctive character of small villages, comprising buildings that reflect use of locally sourced materials;
- Landscape setting of village churches, mills and historic manors;
- Traditionally managed grassland on the valley floor and related strong pastoral and historic character, contributes to an overwhelming sense of place;
- Strong sense of peace and tranquillity along the river valley floor;
- Its strength of character and diversity.

Landscape Guidance specific to area A2 are as follows:

- Seek to conserve the strong, predominantly rural character of the area and related strongly recognisable sense of place.
- Seek to ensure the sensitive location of development involving tall structures (such as telecommunication masts and wind turbines for example) in relation to prominent skyline locations both within the area and within adjacent character areas.
- Seek to conserve the landscape setting of existing villages;
- Seek to conserve the landscape setting of village churches, mills and historic manor houses;
- Seek to conserve the strong sense of openness in northern parts where long views can be seen along the valley floor;
- Seek to ensure that potential new small-scale development within the villages is consistent with existing settlement pattern, density and traditional built form;
- Seek to ensure that potential new developments comprise a fully integrated landscape and urban design strategy, which is consistent with the local landscape character and screen potential harsh settlement edges;
- Seek to promote use of local materials in new buildings;
- Seek to conserve the relatively strong sense of tranquillity and peace along the valley floor;
- Seek to conserve and enhance the setting of churches within historic villages and maintain their position as key landscape features.

Character Area – F1 Wroxham to Ranworth Marshes Fringe

To the west / south west of the site is character area F1. The area is characterised by a mosaic of arable fields, pocket pastures, woodland and parkland creating a diverse area. There is a mature landscape structure due to the belts of woodland and copses. Architecturally there is a pattern of historic houses, halls and churches dispersed across villages. There are nucleated historic market towns with a strong historic core rich in character and a strong sense of place.

Character Area – Upper River Valley Marshlands

Further away from the site (circa 1km north / north east) is the character area of Upper River Valley Marshlands, part of The Broads Character Assessment Area. This area is characterised by marshes divided into fields. The vegetation patterns are varied, and landscape is fragmented. There are often expansive views to areas outside The Broads.

6.4.2 Identification of Potential Landscape Receptors

The northern extension area and land immediately surrounding the site is within the E2 Marsham and Hainsford Wooded Estates, comprising:

i. Undulating agricultural land uses interspersed with woodland blocks and hedgerows defining field boundaries;

ii. Peripheral broadleaf woodland blocks and native planting hedgerows and hedgerow trees
iii. Large areas of open disturbed ground/active quarry operations, processing plant and water management lagoons.
iv. Agricultural land contained by hedgerows, woodland blocks and the local road network.

6.4.3 Sensitivity of Landscape Character

The methodology at **Appendix 6.2**, sets out how value, susceptibility and overall sensitivity is determined for landscape receptors. The value of the individual landscape elements takes into account the other baseline studies associated with this application which provides an indication of condition and quality and also includes an assessment of the rarity and representativeness of the individual features in the local landscape and its native conservation value. Other considerations include an understanding of:

- Scenic quality
- Recreational value
- Perceptual aspects including tranquillity
- Cultural and historic associations

Table 6.1 – below provides the assessed sensitivity of the identified character areas in respect of the proposed quarry development / extension with a summary comment as to the reasoning for the level of sensitivity.

Table 6-1: Landscape Sensitivity

Landscape Character Area	Assessed Level of Sensitivity	Reasoning / Comment
E2- Marsham and Hainsford Wooded Estate	Medium	This character area has a very strong and recognisable character comprising landscape and landuse features and elements. The resources are thus robust and geographically extensive.
A2 Bure River Valley	High	This area has a strong sense of localised place comprising free flowing organic elements, which an engineering form of quarry development could adversely effect
Upper River Valley Marshland	High	The character area is linear/ contained and subtle comprising many smaller scale elements including a segmenting drainage network again which an engineered quarry form could adversely affect.
F1 Wroxham to Ranworth Marsh Fringes	Medium/High	This transitionary character area of a narrow geographical band could be adversely affected due to proximity and scale.

6.4.4 Magnitude of Landscape Change

The development will have differing landscape effects at differing stages of its life cycle, namely, those associated with its Current Situation, the Proposed Extension and at Post Restoration.

The magnitude of change associated with the development has been assessed at section 6.5.2 of this chapter. To set the baseline for this assessment the magnitude of a quarry of this nature has been assessed in terms of its size/scale, the geographical extent of its area, its duration and potential for reversibility.

Table 6-2 Magnitude of Effects

Development	Mineral extraction will continue within the existing quarry and progress into the Northern Extension Area. Other operations will continue including the use of the site access, plant site and ancillary activities, sand and gravel extraction, stocking, and HGV movements to transport material from the plant to use/ point of sale. Progressive sequential restoration will occur on a phased basis.
Size/Scale	The size and scale of the site land unit and the elements and features which comprise the operations and resulting quarried landforms is large. The size and scale of the development will increase throughout the development period resulting in physical change, but active quarrying areas will remain similar to existing.
Geographical Extent	The physical geographical extent of the proposed development is cumulatively 106.8 Ha. This is therefore a large area of development. The development form is relatively consistent in width and length being ~0.5 to 1.2 km in width tapering southwards to ~1.3 km in length. It has the potential to influence a small to medium geographical visual receptor envelope area given its elevation and nature of manmade features and the surrounding confining landforms and vegetation.
Duration	The combined permitted and proposed extension mineral extraction and restoration would last ~17 years, taking the completion date to ~ 2037 with a further 12 months to complete restoration.
Reversibility	The nature of sand and gravel extraction combined with only utilising original in situ soil and overburden and naturally generated waste silt through processing and NOT imported inert material will result in the lowering of original ground level at restoration. The resulting change in landform is not reversible. The restored land uses include the original aspects of agriculture, hedges and individual trees and thus reversible with added landscape habitat enhancement aspects including vegetation structure and potential for biodiversity

The Magnitude of effects during the Quarry Operational Period is assessed as **Medium Adverse**. At Post Restoration the magnitude of effect is assessed as **Slight Beneficial**

6.5 Visual Assessment

6.5.1 Identification of Visual Receptors

Desktop and site survey works have identified the areas of visual receptor locations from which the existing site and the proposed development may be visible; the different groups of people who may experience views of the development and its specific elements and features; the viewpoints where they will be affected; and the nature of the views at these points.

This baseline and assessment work has been produced by initially mapping the geographical extent of the study area where receptors have the potential to view the current site, and then the proposed development. This was carried out digitally through the production of Zones of Theoretical Visual Influence (ZTVI). A ZTVI is a map usually digitally produced, showing areas of land within which, a development is theoretically visible. The model is based purely on topographical height/ landform features and does not include any surface land use features such as buildings or vegetation structure. Two ZTVI's were produced based upon the current situation and worst-case scenario involving the maximum area of operational and progressively restored/ exposed land (phases 6 and 7). The ZTVI's were set within a 5Km2 topographical and landform data grid.

The Current ZTVI can be seen on Drawing No. KD.SH.D.019. The computer model used to create this includes information from the current site survey, the existing processing plant of 5-10m in height, the concrete Plant at 15m in height, mineral stocks of up to 6m in height and other structures including offices, weighbridge and storage unit of between 2.4 to 4m in height. The model also includes existing peripheral soil storage/ screening bunds.

As can be seen from the drawing, the geographical areas of highest magnitude of impact are generally contained within the southern site bund where operations currently take place together with secondary higher magnitude principally within the site to the north and externally to the west, to the north east of Frettenham at ~1km from the site and to Caius Hill Farm at ~0.5km to the south east. Mid-range and lower magnitude of effect spread to ~3km to the west and north and 1 to 2km to the east and south.

The village of Horstead is not generally covered by the topographical ZTVI as a result of its lower elevation and contained visual envelope as a result of localised landform.

The ZTVI for the proposed development is illustrated on Drawing No. KD.SH.D.20 and is taken during the works of Phases 6 and 7 which is considered as a “worse case” scenarios including extraction of Phase 7, progressive restoration within Phase 6 and continued operation of the plant site and its associated activity combined with the maximum limit of northern extraction.

As can be seen from this drawing, the potential for external views of the development are very similar to those of the current situation. The reason for this is that the proposed additional quarrying activities are contained by in-situ similar and/or higher ground which will help screen proposed activities. Site internal visual levels of magnitude increase compared to the current situation as a result of both geographical changes in landform/disturbance and internal visibility opportunities.

A ZTVI of the post restoration scenario is illustrated on Drawing No KD.SH.D.021. This model excludes all mineral operations e.g. plant, and assumes that all land is restored to the proposed landform and topographical levels of the Concept Restoration Scheme illustrated on Drawing No KD.SH.D.015. The change in landform is highlighted as a potential source of visual change along with changes in gradient around the internal periphery of the quarry and the base restoration. This drawing illustrates that the potential for higher levels of visual magnitude resulting from the proposed development post restoration are minimal.

6.5.2 Visual Sensitivity and Magnitude of Change

Sensitivity of Visual Receptors

In identifying the significance of any visual effects which may be experienced by the identified visual receptors, it is first necessary to determine the sensitivity of the differing visual receptors to change from this type of development i.e. sand and gravel extraction and associated structures and operations and progressive restoration. The magnitude of the visual effect, its size/ scale, geographical extent, duration and reversibility can then be determined. The judgement on the sensitivity of visual receptors and magnitude of the predicted effect are then combined to assess the overall significance of the visual impact/effect.

The visual sensitivity of receptors is based upon combining judgements of the susceptibility of the receptor to the specific type of change or development proposed and the value related to that receptor.

The susceptibility of visual receptors to change in view and visual amenity is mainly a function of “the occupation or activity of people experiencing the view at particular locations and the extent to which their attention or interest many therefore be focussed on the views and visual amenity they experience at particular locations”. (GLVIA page 113)

In general, and unless stated otherwise the sensitivity of visual receptors varies according to the following categories.

Table 6-3 Sensitivity of Visual Receptors

Category	Description	Sensitivity
A	Residential receptors	High
B	Users of Public Rights of way / open spaces	Medium to High
C	Users of Local Road	Low

Magnitude of Visual Effect

The magnitude of existing and potential future visual effects resulting from the proposed development have been evaluated in terms of its size/scale, geographical extent, duration and reversibility using similar factors to those used in the landscape assessment.

Given the size and scale of the proposed development and the landscape setting it is located within, combined with existing and proposed mitigation screening bunds and vegetation structure, the main visual elements and features associated within the current and proposed development are the built structures of the plant site, mineral and soil stocking/ storage bunds and areas of active mineral extraction and disturbed ground awaiting restoration. The assessed magnitude of visual effects during the operational period is assessed as Low to High: Low due to existing and proposed landform and vegetation screening mitigation and progressive restoration, and potentially High to a limited number of receptors due to their proximity to the site.

Table 6-4 Magnitude of Visual Effect

Development	The main visual element of the development are currently in place. These include the mineral processing plant at 5-10m, the concrete plant at 15m, mineral stockpiles at between 5-8m, and the temporary site peripheral plant site screening bunds of between ~3 to 6m. HGV movement to transport processed mineral to point of sale will also continue. The main visual change within the proposed development is the extension of soil stripping, mineral extraction and restoration as it moves northwards. All of these operations have the potential to either maintain and/or increase the sources of visual impact to local receptors.
Size / Scale	Visually the potential overall size of the proposed development and its scale taken in total is large. The site occupies an area of 106.8Ha of land. The visual size and scale of disturbed/ operational land as any one point in time will, however, remain similar to the existing situation as a result of progressive restoration.
Geographical Extent	The physical geographical extent of the proposed development is cumulatively 106.8 Ha. This is therefore a large area of development. The development form is relatively consistent in width and length being ~0.5 to 1.2 km in width and ~1.3 km in length. It has the potential to influence a small to medium geographical visual receptor envelope area given its elevation and nature of manmade features and the surrounding confining landforms and vegetation.

Duration	The combined permitted and proposed extension mineral extraction and restoration would last ~17 years, taking the completion date to ~ 2037 with a further 12 months to complete restoration.
Reversibility	The nature of sand and gravel extraction combined with only utilising original in situ soil and overburden and naturally generated waste silt through processing and NOT imported inert material will result in the lowering of original ground level at restoration. The resulting change in landform is not reversible. The restored land uses include the original aspects of agriculture, hedges and individual trees and thus reversible with added landscape habitat enhancement aspects including vegetation structure and potential for biodiversity

On cessation of mineral extraction, the removal of all plant and operations and completion of restoration, there are only a very limited potential sources of visual discordant/ potential impact sources. These principally relate to the change in landform and topographical levels compared to the original situation.

Given that these morphological features will be integrated into the local landscape setting by proposed surface landuse elements of woodland, hedges, species rich grassland and meadow, opportunities to view discordant features will be limited.

It is assessed the potential magnitude of effect on visual receptors from the site post restoration will be Low.

Assessed Visual Impacts of the Development

Based upon desktop/ ZTVI works, a field survey was carried out to ascertain the actual potential for visual receptors views of the existing and proposed development.

The site survey considered the viewpoint from which the current situation and the proposal will actually be seen by differing groups of people. These groups included:

- Residential visual receptors in private properties
- Public viewpoints e.g. public rights of way, inland waterways and public open space (POS)
- Places where people work
- Transport routes where there may be views from private vehicles and from different forms of public transport.

Following the assessment of the nature of effect (Magnitude) an assessment of the Overall Significance of Effects was carried out by combining the level of the Nature of Effect with the assessed values of the Nature of Receptor (Sensitivity) present. The table was used to provide an indication of the level of the Overall Significance of Effects resulting from the development in relation to the locality's landscape character or visual amenity. The effects were considered according to whether they were adverse, neutral or beneficial.

The assessed visual impact on the receptors within the local area and how the existing quarry and proposed development affects the visual amenity is assessed and detailed. The assessed visual impact on receptors and how the existing quarry and proposed development affects visual amenity is discussed below including the integration of mitigation measures.

Table 6-5: Significance of Impacts - Correlation of Nature of Effect with Nature of Landscape or Visual Receptors

			NATURE of the Landscape/ Visual Receptor (Sensitivity)				
			Very High	High	Medium	Low	Very Low
NATURE OF Effect (magnitude)	Adverse	Very High	Severe	Major	Notable	Notable / Moderate	Moderate
		High	Major	Notable	Notable / Moderate	Moderate	Slight
		Medium	Notable	Notable / Moderate	Moderate	Slight	Very Slight
		Low	Notable / Moderate	Moderate	Slight	Very Slight	Minimal
		Very Low	Moderate	Slight	Very Slight	Minimal	Negligible
	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
	Beneficial	Very Low	Moderate	Slight	Very Slight	Minimal	Negligible

		Low	Notable	Moderate	Slight	Very Slight	Minimal
		Medium	Substantial	Notable	Moderate	Slight	Very Slight
		High	Major	Substantial	Notable	Moderate	Slight

6.6 Mitigation measures

The following landscape and visual measures have been integrated into the proposed development scheme to both mitigate potential adverse effects and enhance the general amenity value of the site. These measures also offer opportunities to enhance local landscape character.

The main mitigation measures incorporated within the application design are:

- The retention of existing soil storage/ screening bunds during the operational period which are positioned around the peripheral boundaries of the fixed plant, processing, stocking and dispatch areas of the development. This is where the fixed structures of the existing development are located and will continue to be located during the extension period. It is also the location where the majority of quarry activity/ movement takes place. The existing seeded and maintained bunds will continue to screen the majority of the plant site activities.

- Advanced native tree and shrub planting and strengthening of existing peripheral hedgerows is to take place during winter 2021/22 to western, northern and eastern boundaries of the site.

- Advanced planting together with existing and progressive restoration planting is to be managed and maintained within a 5-year Aftercare Management Plan and a subsequent longer-term woodland and hedgerow management plan.

- To reduce the potential area of operational/disturbed land the quarry will be subject to progressive restoration. On completion of mineral extraction from the phased extraction area, land will be regraded, and restoration formation levels created utilising on site overburden and quarry dry waste silt onto which a full soil profile will be placed. The soils would be directly placed from soil stripping of the next phase (to expose mineral) supplemented by previously stripped and stored soils when required. All restored land will be planted or seeded in accordance with the Concept Restoration Scheme as illustrated on Drawing No. KD.SH.D.015. All restored land and land uses will be placed under a 5-year Aftercare Management Programme.

- Additional temporary soil screening bunds will be placed in advance of mineral extraction when working in phases 4B and 5 to screen the works from residents of the Hollies, and during phase 6 to screen residents of Hill Farm. These bunds will be 3m in height, grass seeded and maintained. A further 3m high temporary soil screening bund will be placed behind the existing hedgerow/tree planting along the northern boundary. This bund will also be seeded and maintained to help visually contain northern quarrying activities within phases 6 and

7 to potential visual receptors located within the southern areas of Horstead.

- Higher quality soils are to be concentrated to ensure the retention of best and most versatile agricultural land characteristics for agricultural use.

- Significant areas of new habitat is to be created to both integrate into and strengthen local landscape character and also create opportunities to promote long term sustainable biodiversity. On completion of restoration over one third of the site will be utilised for landscape and wildlife enhancement involving ~24.6 Ha of native species planted woodland, 12.3 Ha of species rich grassland/ meadow habitat and 1,462 linear metres of hedgerow comprise seven woody species and hedgerow trees.

6.7 Oblique Aerial Images & Sight Line Sections

As part of the landscape and visual assessment and to illustrate the context of phased working and restoration proposals in respect of the wider geographical area, two viewpoint scenarios have been produced as oblique aerial views and are contained within **Appendix 6.1**.

Viewpoint 1 has been taken from above and north of Horstead, looking south. Firstly, the Existing Situation is illustrated looking down and across the site to the access off Norwich Road, where the operational plant site, the existing water management lagoons and current areas of mineral extraction can be seen. Also highlighted is the remaining permitted Phase 4A extraction area and the 'Red Line' planning application boundary.

Secondly, from the same Viewpoint 1 location, is an illustration of the progressive phased working and restoration position during a point within the proposed Phase 6 / 7. The quarry proposals can be seen to be extending northwards, separated from Horstead by agricultural fields. The phased position has been chosen as it is the closest point that quarry operations would be in the context of Horstead and properties off Horstead Lane. This image also illustrates the process of progressive restoration where the previous areas of extracted land are restored using a combination of directly placed soils and overburden, land has been stripped to expose a new mineral, and some of the soil resources placed to the limited number of temporary soil / screening bunds. Other land within the planning application boundary that has not been required for mineral extraction at this point is still undisturbed and farmed (to the south of Phase 7 and eastwards towards Phase 8). The access and plant site remain in place along with a restructured water management system.

Thirdly from the same Viewpoint 1, is an illustration of the completed restoration of the site. As can be seen, approximately two thirds of the area is to be restored back to agricultural production, with the remaining third providing a mix of landscape character and ecological enhancements, with the planting of a block of native trees and shrubs, and species rich grassland / meadows. Hedgerows are also reinstated which combine with the block woodland planting to reflect the wider structure of the green network within the local area.

Three further Oblique Aerial views are presented through the life of the proposed development from Viewpoint 2. This viewpoint has been taken from the south east of Frettenham, looking north.

Firstly, the Existing Situation is illustrated looking down and across to Stanninghall Quarry, bounded by Stanninghall Road and Norwich Road to the south east and east, agricultural fields to the south, south west and north, and Horstead Lane to the west. The planning application boundary can be seen following these boundaries. The quarry access is illustrated off Norwich Road, leading to the plant site, stocking areas and water management lagoons. Land to the south west is denoted as quarry operational land, which since the production of this image, is now being restored. The remaining permitted mineral extraction is contained within the area highlighted as Phase 4A.

Secondly, from the same Viewpoint 2 location, is an illustration of the progressive phased working and restoration position during a point within the proposed Phase 6 / 7. As can be seen, the quarry access, plant site and stocking areas remain in place, with additional water management lagoons developed adjacent. Progressive mineral extraction and direct placed restoration will have been completed along the western area of the site, with

mineral extraction taking place within Phase 7 to the north east. Temporary soil storage bunds are illustrated along with operational land for the movement of mineral from the extraction area to the plant site for processing. Undisturbed land to the south of Phase 7 and eastwards (Phase 8) towards Norwich Road can be seen to be managed under agriculture.

Thirdly, from the same Viewpoint 2, is an illustration of the completed restoration of the site. As can be seen, the vegetation structure is provided by a combination of native woodland (trees and shrubs), integrating into both existing woodland blocks and site peripheral hedgerows. The restored site is further subdivided by hedgerows / hedgerow trees. Species rich grassland / meadow will be established to help form wildlife corridors and management units to promote species movement and biodiversity. The remainder of the site wou8ld be returned to productive agricultural land.

In addition, two Site Context sight line sections and existing photoviews are provided within **Appendix 6.1 (**drawing ref KD.SH.D.018A and 18B). These have been produced to illustrate the general visual nature and context of potential views from the north of the Site, from around the periphery of Horstead. The overall assessed comment is that as a result of intermediate rising ground towards the site from potential visual receptors, combined with existing hedgerows (which are to be strengthened by new hedgerow planting), the proposed northern extension to Stanninghall Quarry will not be generally observed. This is further emphasised by land levels within the site falling away, lower than the extracted northern and eastern boundaries, and proposals for landscape structure measures to establish an advanced tree and shrub planting block of 10m width along the northern boundary of the site.

Drawing No. KD.SH.D.018A illustrates a photographic view from Frettenham Road, on the western boundary of Horstead; together with a typical sight line section (A-A'), taken from the height of a property which rises up and above the level of land within the site, which will be screened by existing and proposed planting.

Drawing No. KD.SH.D.018B illustrates a photographic view from adjacent to Norwich Road / south western properties within Horstead. An existing water tower is clearly visible in proximity to the proposed eastern boundary of extension Phase 7.. At the boundary of the water tower, existing land levels fall away westwards. This boundary will also be strengthened by new hedgerow planting which will mitigate potential views of the proposed operations.

6.8 Residual Impacts

In drawing together a conclusion about the significance of the assessed landscape and visual effects resulting from the proposed development during the operational and post operational stages of the scheme, the separate judgements about the sensitivity of the landscape receptors and the magnitude of the proposed development change are combined. The residual impacts have been assessed on the basis of the implementation of mitigation measures stated in 6.6 above.

6.8.1 Assessment of the Development on Landscape Character

The assessed significance of impact on the Site and local character has been determined by combining the assessed sensitivity of the Site, the NLCA's and Aspect Areas within which the application is located and/or which it may have a geographical influence over, with the predicted magnitude of effect associated with the development. This has provided an overall Significance of Effect which describes the potential overall impact the proposed retained development will have on the local landscape character.

Tables 6.6, 6.7 and 6.8 summarise the assessment of the current Site's effect on the Landscape on the identified Landscape Character Areas resulting from the Current Site, the Proposed Operational Development and Post Restoration of the Site, with a fuller description in the text below.

Table 6-6: Current Site's effect on Local Landscape Character

Landscape Character Area	Sensitivity	Current Site Activities / Assessed magnitude of effect	Assessed level of significance
Broadland Landscape Character Assessment Areas			
E2 Marsham and Hainford Wooded Estates	Medium	Low Adverse	Slight Adverse
A2 Bure River Valley	High	None	Neutral
F1 Wraxham to Ranworth Marsh Fringe	Medium/High	None	Neutral
North Norfolk Landscape character			
Upper River Valley Marshland	High	None	Neutral

Table 6-7: The Proposed Development Effect on Local Landscape Character during the Temporary Quarry Operational Period

Landscape Character Area	Sensitivity	Proposed Developments Assessed Magnitude of Effect	Assessed level of significance
Broadland Landscape Character Assessment Areas			
E2 Marsham and Hainford Wooded Estates	Medium	Low	Slight Adverse
A2 Bure River Valley	High	Very Low	Very Slight Adverse
F1 Wroxham to Ranworth Marsh Fringe	Medium/High	None	Neutral
North Norfolk Landscape character			
Upper River Valley Marshland	High	None	Neutral

Table 6-8: Post Restoration effect on Local Landscape Character

Landscape Character Area	Sensitivity	Post Restoration Magnitude of Effect	Assessed level of significance
Broadland Landscape Character Assessment Areas			
E2 Marsham and Hainford Wooded Estates	Medium	Medium Beneficial	Moderate Beneficial
A2 Bure River Valley	High	Very Low Beneficial	Moderate Beneficial
F1 Wroxham to Ranworth Marsh Fringe	Medium/High	None	Neutral
North Norfolk Landscape character			
Upper River Valley Marshland	High	None	Neutral

Current Site

The existing quarry and the proposed development have been identified as located within Central North Norfolk number 78 National character Area. With the north eastern boundary in proximity to The Broads NCA which dominates the regional eastern area of East Anglia. At the local area the site is located fully within Broadland Landscape Character Assessment Area of E2 Marsham and Hainford Woodland Estates, where the comprising landscape elements including woodland structure, agricultural land uses and varied landforms are considered generally strong and robust, with woodland providing a sense of enclose. It is noted however, that there is a decline in hedgerow field boundaries and loss of hedgerow trees. The sensitivity of this landscape character area is assessed to be Medium in respect of a minerals development.

The currently permitted Stanninghall Quarry includes a plant site, fixed processing plant, water/silt management lagoons, mineral stocking, soil storage and screening bunds, exposed/disturbed gravel, operational activities, movement and progressive and final restoration to a wooded and wildlife enhanced agricultural landscape. It is assessed that the current developments' magnitude of effect on the Marsham and Hainford Wooded Estates Character Area is Low.

When combining the character areas' sensitivity (medium) with the magnitude of effect (low), the current developments' Assessed Level of Significance is Slight Adverse which in terms of the LVIA methodology is not Significant. From desk based and site survey works within the study area it is assessed that the existing quarry does not affect other identified local character areas. It should be note that no new plant, machinery, built structures or digging operations currently associated with the existing quarry will be required for the proposed extension.

Proposed Development

The proposed development will involve the progressive soil stripping, mineral extraction and restoration of land northwards up the western half of the site and then southwards within the eastern area back to the plant site.

The magnitude of effect resulting from both the permitted plant site and the progressive working and restoration of the permitted phase 4B /plant site and the northern extension on the Marsham and Hainsford Wooded Estates Character Area is assessed as Low.

When combining the character areas sensitivity to change from a mineral development (medium) with the (low) magnitude of effect resulting from the proposed development during the operational period the Assessed Level of Significance is Slight Adverse, which is NOT Significant. It is considered that the general robustness of this character area combined with its geographical size combined with progressive restoration will allow the development to proceed without adverse significant effects.

As a result of the extension progressing northwards it has been identified that the proposed development may affect the A2 Bure River Valley Character Area to the south of Horstead. Based on desktop and site survey works it is assessed that the potential magnitude of effect is very low. It is noted that there is the potential for a small amount of inter-visibility between character areas and proposed quarry activities but there will be no physical change to the Bure River Valley as a result of the proposed development. The sensitivity of the Bure Valley is assessed as high to a quarry type development. When combining this high sensitivity with a very low magnitude of predicted effect a Slight Adverse effect may result, which in terms of the LVIA methodology is not Significant.

Post Restoration

At post restoration the original landform will be changed (lower) compared to the existing situation. The scheme has been designed to reflect locally observed landscape morphology and provides land gradient suitable for a mix of agricultural uses and wildlife/ landscape structure. The site comprising ~106.8 Ha is large enough to allow for general topographical and gradient changes allowing assimilation into the wider landscape setting. The restored principal agricultural land uses combined with strengthened native species hedgerow, woodland planting and meadow/species rich grassland, provides a balanced suitable afteruse with increased potential for long term landscape and biodiversity enhancement. Post restoration a Slight Beneficial level of significance is assessed which in terms of the LVIA methodology is not Significant. No other local character areas will be affected.

Cumulative Effects

The assessment has also considered the potential for cumulative landscape effects. The most recent definitions of Cumulative Effects have been defined by Scottish Natural Heritage (SNH), where Cumulative Effects 'can impact on either the physical fabric or character of the landscape, or any special values attached to it' (SNH 2012:10), with cumulative effects being defined as 'the additional changes caused by a proposed development in conjunction with other similar developments or as the combined effect of a set of developments, taken together' (SNH 2012:4). Potential known development which may act in combination with the application proposals include Spixworth Quarry to the south of the Site (Nr Norwich International Airport) and Horstead Quarry and the Mayton Wood Recycling Centre to the north.

The potential for a high magnitude of cumulative effect resulting from the existing quarries / landfill recycling /restoration in combination with Stanninghall Quarry and the proposed extraction is however limited. This relates to both the fabric of the landscape, in that the additional removal of or changes in individual elements or features, or the introduction of new elements and the aesthetics of the landscape, for example its scale, sense of enclosure, and diversity, or its experiential attributes including a sense of remoteness, naturalness or tranquillity, is not assessed to result in a likely significant cumulative effect due to the nature and scale of the local landscape character and the actual geographical siting of the quarries

6.8.2 Assessment of the development on Visual Amenity

In assessing and judging the overall significance of potential visual effects, the assessed sensitivity of the identified visual receptors within each zone has been combined with the individually assessed magnitude of change of the proposed development on each of the identified visual receptor zones.

A further assessment has then been made in respect of individual representative visual receptors contained within each of the zones.

In making the judgement about the significance of visual effects, the following points have been considered:

i. Effects on people who are particularly sensitive to changes in views and visual amenity are more likely to be significant;
ii. Effects on people at recognised and important viewpoints or from recognised scenic routes are more likely to be significant;
iii. Large-scale changes which introduce new, non- characteristic, discordant or intrusive elements into the view are more likely to be significant than small changes or changes involving features already present in the view.
iv. Duration and reversibility

The location of the description zones and individual representative visual receptors is illustrated on Drg. No KD.SH.D.022 within **Appendix 6.1**. Photosheets are also provided within Appendix 6.1, providing a photographic record from each of the 21 visual receptor viewpoint locations.

An assessment has been made of both the level of current visual significance which takes account of the existing permitted quarry development and the proposed extension development.

Table 6-9 Assessed Overall Significance of Visual Effects

Ref	Description of Visual Receptor	Assessed Sensitivity to change	Assessed Visual Magnitude of effect of existing current quarry	Assessed Significance of current visual impact	Assessed visual Magnitude of the proposed development	Assessed Significance of visual impact of the proposed development
1	Caius Hill Farm	High	Very Low	Slight Adverse	Very Low	Slight Adverse
2	Users of C class road Burntwood Lane	Low	Very Low	Minimal Adverse	Very Low	Minimal Adverse
3	Users of Norwich Road	Low	Low	Very Slight Adverse	Low	Very Slight Adverse
4	Users of Stanninghall Road	Low	Low	Very Slight Adverse	Low	Very Slight Adverse
5	Residents of Stanninghall Cottages	High	Low	Moderate Adverse	Low	Moderate Adverse
6	Residential property off Stanninghall Road including new Dairy	High	Low	Moderate Adverse	Low	Moderate Adverse
7	Residential properties/ barn conversions	High	Low	Moderate Adverse	Low	Moderate Adverse
8	Residential property to the east of Frettenham Village	High	Very Low	Slight Adverse	Very Low	Slight Adverse

9	Users of Frettenham Road	Low	Low	Very Slight Adverse	Low	Very Slight Adverse
10	Residents of the Hollies	High	Medium	Moderate Adverse	Medium	Moderate Adverse
11	Users of Frettenham Road	Low	Very Low	Minimal Adverse	Very Low	Minimal Adverse
12	Residents of Hill Farm	High	None	Neutral	Medium	Moderate Adverse
13	Residential properties off Frettenham Road	High	None	Neutral	Very Low	Slight Adverse
14	Residents of Common Farm	High	None	Neutral	None	Neutral
15	Residential receptors at The Paddocks	High	None	Neutral	None	Neutral
16	Residential receptors including 82 to 112 Norwich Road	High	None	Neutral	Very Low	Slight Adverse
17	Residents of property	High	None	Neutral	None	Neutral
18	Residential receptors at Lodge Cottage	High	None	Neutral	Very Low	Slight Adverse
19	Users of B1150 Norwich Road	Low	Very Low	Minimal Adverse	Very Low	Minimal Adverse
20	Residents of Beverley	High	Low	Moderate Adverse	Low	Moderate Adverse

21	Users of the B1150 Norwich Road	Low	Very Low	Minimal Adverse	Very Low	Minimal Adverse
22	Users of PROW	Medium	None	Neutral	None	Neutral
23	Users of Frettenham Road	Low	None	Neutral	Very Low	Minimal Adverse

As summarised in Table 6.10, of the 23 representative receptors, No visual receptor is currently experiencing or predicted to receive a significant Adverse Visual Effect, i.e. a notable adverse effect or above.

Table 6-10 Summary of current and predicted visual effects

Level of Effect	Current Visual Effects from the permitted development	Predicted Visual Effects from the Proposed Development
Severe Adverse	0	0
Major Adverse t	0	0
Notable Adverse	0	0
Moderate Adverse	5	6
Slight Adverse	2	5
Very Slight Adverse	3	3
Minimal Adverse	4	5
Negligible Adverse	0	0
Neutral	9	4
TOTALS	23	23

Current Site

The site survey of individual visual receptors determined that due to a combination of topography, surrounding landform, existing and proposed tree planting and screening landform, views of both the existing and the proposed development are relatively limited in respect of both the number of actual visual receptors with views of the existing quarry/ proposed development and the magnitude of effects if receptors do have views.

Five representative visual receptors currently receive a Moderate Adverse Effect from the quarry structure/ operations. These are all residential receptors having a high sensitivity to change resulting from quarry activities. The actual magnitude of effect emanating from the current Stanninghall Quarry development is either Low or Medium.

The location from where receptors are considered to be receiving the highest level of significance of effect (Moderate Adverse) is the residential property at The Hollies, from where views of the quarry operations are occurring from upper rear first floor windows. This property is located along the western boundary of the existing quarry permitted phase 4B area. A temporary soil storage bund is to be established at 3m in height between the property curtilage and the extraction area boundary, set behind a existing and strengthened hedge... The bund is to be seeded and maintained.

Receptors at the property may also view the existing plant site located some 600 metres to the east. It is assessed that residents from this property will continue to receive a similar view during the extraction of phase 5, at which point the majority of the previous phase 4 area will be restored. Post the mineral extraction and restoration of phases 4B and 5 the temporary soil storage bund will be removed whereupon receptors from this property will look onto restored land.

Of the other four residential receptors that currently receive a Moderate Adverse level of Significance (including residents at Stanninghall Cottages, Stanninghall Road, residents of Barn Conversions, and residents of Beverley), the main sources of visual impact result from the processing plant (and ready-mix plant) and associated stocks and screening bunds. This is assessed as remaining the same (moderate adverse effect) during the extension period of the proposed development.

Proposed Development

One additional residential receptor is predicted to receive a Moderate Adverse effect as a consequence of the proposed northern extension development, namely the residents of Hill Farm. This property is located along the north western boundary of the proposals, and residents currently having a view from ground and first floor windows of agricultural land and site internal hedgerow/ hedgerow trees. Phase 6 of the proposed development will progress northwards within ~100m of this property. The existing hedge/ hedgerow trees will part reduce the visual effect of the proposed mineral extraction and restoration works. It is considered that additional mitigation measures including advance tree and shrub planting to strengthen the existing hedge will provide additional vegetative screening to the south of the property (this planting is to be carried out winter 2020/21). Pre-commencement of mineral extraction within phase 6, a 3m high temporary soil screening bund will be established on the outer side of the existing hedge, with the hedge then providing an additional screen between the property and the screen bund. The bund to be seeded and maintained.

Once mineral extraction has been completed within phase 6 and the northern area of phase 7, the temporary bund is to be removed. At this point it is envisaged that the existing and new tree and shrub planting to supplement the existing hedgerow will be a solid block of vegetation. It is agreed with the landowners, Trafford Estate and the operator Tarmac, that at this time the owners of Hill Farm are to have the choice of retaining the strengthened hedge and/or to create vista view gaps within the planting to enable the residents to view the wider restored land to the south and east of the property. It is considered that the sensitivity of these residents to a quarry development to be High, and that the proposed development including the advanced planting and temporary soil screening bund will result in Medium Adverse visual effect during the phases 6 and 7, which in terms of the LVIA methodology is not significant.

Post Restoration

In respect of all representative visual receptors, it is assessed that at post restoration, with the establishment and management of the wildlife habitat and landscape structure enhanced agricultural landscape, the levels of visual significance will vary from Slight Adverse to Neutral to Slight Beneficial, none of which are significant. The slight adverse effects may result from the visual change in levels and landform morphology. These will only affect receptors at The Hollies and Hill Farm.

Cumulative Effects

Cumulative visual effects are effects that can be caused by combined visibility, 'which occurs where the observer is able to see two or more developments from one view – point and / or sequential effects which occur when the observer has to move to another viewpoint to see different developments' (SNH,2012:11).

Cumulative visual effects are the effects on views and visual amenity enjoyed by people, which may result either from adding the effects of the application development to the effects of the other projects on the baseline conditions. The Site and the other potential cumulative developments including quarries at Spixworth and Horstead together with the Mayton Wood Recycling Centre are located within separate visual envelopes to the Stanninghall Quarry Extension Site. There are no visual receptors with inter-visibility between these developments and the proposal. There will therefore not be a significant cumulative degradation of individual receptor views or visual amenity.

6.9 Conclusions

This chapter has considered the landscape and visual effects and changes to amenity of receptors resulting from the existing Stanninghall Quarry and the proposed Northern Extension. The application site boundary equates to ~106.8Ha of which the current permitted footprint is ~53.6Ha and the proposed Northern Extension is ~53.2Ha.

The remaining permitted development involves the extraction of sand and gravel from Phase 4B, and from beneath the plant site and subsequent restoration. The proposed development relates to a northern extension of mineral extraction and progressive restoration to a mix of landscape and wildlife enhanced agricultural land. The duration of the overall development would be ~17 years with a further year to complete restoration. No new plant

or equipment is required as part of the development. The existing plant site is to remain, as is its stocking and associated ancillary activities. The existing water management system is to be increased in size to help accommodate the placement of processed silt waste which will be integrated into the restoration of the site.

Additional mitigation measures are to include the strengthening of hedgerow planting along the western, northern and eastern boundaries of the overall site, together with additional temporary soil storage / screening bunds. The bunds to be located to help screen views of quarrying activities from residents of Hill Farm, residents and users of Frettenham Road and residents of Beverley (together with the temporary screen bund to the east of The Hollies, already included as part of the permitted scheme at the existing quarry). The site will also be progressively enhanced in respect of woodland structure plant and the creation of new habitats to promote Biodiversity with the creation of species rich grassland.

In respect of Landscape Character, the existing and proposed application development is wholly located within the Norfolk County defined Marsham and Hainsford Wooded Estate Character Area. It is assessed that the sensitivity of this area to a quarry type development is Medium as the landscape elements and features which comprise it are generally plentiful and robust. It is assessed that the magnitude of effect resulting from both the permitted plant site and the northern extension as Low. When combining the character area sensitivity to change from the proposed development during the operational period the Assessed level of significance is Slight Adverse which in terms of the LVIA methodology is not Significant.

The progressive restoration proposals have taken on board the opportunities for National Level -NCA – The Broads Character area SE03: “to maintain a sustainable and productive agricultural landscape while expanding and connecting semi-natural habitats to benefit biodiversity”. This would be achieved through the concentration of higher quality soils in areas for agricultural productivity whilst developing approximately one third of the restored site for both landscape character enhancement and new wildlife habitat creation. The habitat would principally be associated with native woodland with a diverse range of shrub and tree species of ~24.6 Ha, along with species rich grassland and meadow of ~12.3Ha. Landscape structure will also be reinstated along with new habitats via the establishment of ~1,462 linear m’s of hedgerows and hedgerow trees.

The restoration proposals also address Landscape Guidance specifically to area E2 of the Local level Broadlands DC– Landscape Character Assessment SPD including the conservation and strengthening of landscape structure around the promotion of significant site internal woodland structure and the creation of woodland and hedgerow corridors. The development has also considered and is assessed to maintain the setting of both historic assets and the landscape setting of local villages. This would be achieved through both re-establishing original landscape structure planting and the use of temporary screen bunding at appropriate and integrating levels which will be seeded, planted and maintained to mitigate potential adverse changes in setting.

At post restoration the original landform will be changed (lower) compared to the existing situation. The scheme has been designed to reflect locally observed landscape morphology and provides land gradient suitable for a mix of agricultural uses and wildlife/ landscape structure. The site comprising ~106.8 Ha is large enough to allow for general topographical and gradient changes allowing assimilation into the wider landscape setting. The restored principal agricultural land uses combined with strengthened native species hedgerow, woodland planting and meadow/species rich grassland, provides a balanced suitable after use with increased potential for long term landscape and biodiversity enhancement. Post restoration a Slight Beneficial level of significance is assessed which in terms of the LVIA methodology is not Significant. No other local character areas will be affected.

In respect of visual matters, the site survey of individual visual receptors has found that due to a combination of topography, surrounding landform, existing and proposed tree planting and screening landform, views of both the existing and the proposed development are relatively limited in respect of both the number of actual visual receptors with views of the existing quarry/ proposed development and the magnitude of effects if receptors do have views.

Of the 23 representative receptors, no visual receptor is currently experiencing or predicted to receive a Significant Adverse Visual Effect. Five representative visual receptors are assessed as currently receiving a Moderate Adverse effect from the existing development. These are all residential receptors (residents of Stanninghall Cottages, residents of Stanninghall Road, Barn conversions in Stanninghall, residents of The Hollies and residents of Beverley). Three receptors have a High sensitivity to change but a Low magnitude of effect from the existing development. It is assessed that these levels of magnitude will remain during the proposed extension application as they generally emanate from the mineral processing plant and screen mitigation bunding. It is predicted that only one additional receptor (Hill Farm) will receive a Moderate Adverse Significance Effect from the extension proposals which in terms of the LVIA methodology is not Significant. From Hill Farm receptors will have the opportunity to view soil stripping and mineral extraction during Phase 6 and 7, mainly screened behind an existing and strengthened tree lined hedgerow and temporary screening bund.

In respect of all representative visual receptors it is assessed that at post restoration with the establishment and management of the wildlife habitat and landscape structure enhanced agricultural landscape, the levels of visual significance will vary from Slight Adverse to Neutral to Slight Beneficial, none of which in terms of the LVIA methodology are significant. The slight adverse effects may result from the visual change in levels and landform morphology. These will only affect receptors at The Hollies and Hill Farm.

Understanding and consideration of landscape orientated land planning policies has taken place including Core Strategy and Minerals and Waste Development Management Policies Development Plan Document 2010 – 2026 policies CS14 (Environmental Protection), DM8 (Design), Local Landscape and Townscape Character and Joint Core Strategy for Broadland, Norwich and South Norfolk Policy 2 (Local Distinctiveness).

It is therefore considered that the Proposed Development scheme for the mineral extraction and restoration of Stanninghall Quarry is acceptable and appropriate in Landscape and Visual Effect terms.

7.0 ECOLOGY

7.1 Introduction

This chapter has been prepared by AEcol which is an independent ecological consultancy with competence in Preliminary Ecological Appraisal, species survey and habitat assessment, restoration, monitoring and management in the UK (see www.aecol.co.uk).

This chapter uses the following definitions:

a) the existing consented Stanninghall sand and gravel quarry is hereafter referred to as 'Stanninghall Quarry'; and,

b) an extension to that quarry into undeveloped farmland is hereafter referred to as 'The Proposed Extension'.

Where Stanninghall Quarry and The Proposed Extension are referred to as an individual land area, this is as the 'Application Site'.

7.2 Methodology

7.2.1 EcIA stages

The EcIA stages have been defined to suit the context of a quarry development, and comprise: -

1. Identification of the Zone(s) of Influence (ZoI);
2. Identification of Important Ecological Features (IEF) within the ZoI;
3. Impact Assessment of individual IEF, including compensation, avoidance and mitigation, in respect of: **a)** Wildlife Sites; **b)** S41 Habitats; **c)** invertebrates; **d)** fish; **e)** amphibians; **f)** reptiles; **g)** birds; **h)** mammals (not including bats); and, **i)** bats;
4. An enhancement strategy to make the outcome of the development wholly positive;
5. The definition of a monitoring scheme to ensure the success of compensation, avoidance, mitigation, and enhancement strategies;
6. A Cumulative Impact Assessment (CIA) to assess the effect of the development in the wider context; and
7. Summing up, to provide an objective account of the outcome, including the identification of any residual negative effects.

7.2.2 EcIA Format

This chapter is a summary of the full EcIA report produced as **Appendix 7.1** to the ES. The EcIA itself is performed in Excel format and on one overarching spreadsheet, produced as **Appendix 7.2** to the ES (ref AEcol 2020. *Stanninghall Quarry ECIA – Calculations & Analysis – V.1.* AEcol Bridgwater**).** The spreadsheet holds: **a)** all the data upon which the EcIA is based; **b)** all the calculations upon which the conclusions are based; and, **c)** all the reference material including a comprehensive Harvard reference list.

7.2.3 Definitions

Impacts and effects

For the removal of doubt; an 'impact' is taken to mean an action which results in changes to an Important Ecological Feature (hereafter abbreviated to IEF[1]). An 'effect' is taken to mean the outcome of the impact upon an IEF. The Chartered Institute of Ecology and Environmental Management (CIEEM) (CIEEM 2018) divide the two as follows: -

Impact – Actions or environmental factors that result in changes to an Important Ecological Feature. For example, quarrying activities which would

[1] Important Ecological Features (IEF) are ecological resources or features which are likely to be impacted by the proposed development and which are judged to be of conservation significance. IEF are identified through scoping, which is informed by the Preliminary Ecological Appraisal, and subsequent 'Phase 2' ecological surveys. The conservation significance (i.e. whether an ecological feature is 'Important' in this context) of the IEF is defined by considering the 'Value' of the feature.

require the grubbing out of a hedgerow, or which would result in airborne dust settling on the leaves of an off-site hedgerow, or which would result in a perceptible increase in noise and lighting in the vicinity of the hedgerow.

Effect – The knock-on result. For example, the loss of common dormouse *Muscardinus avellanarius* foraging habitat and a break in the arboreal connectivity resulting in an isolation effect, or fruit becoming unpalatable to common dormice off-site due to dust deposition, or nesting and foraging habitat being abandoned due to light-spill into wooded habitat at night.

Baseline

This is an extension to an existing quarry and the Application Site includes the existing quarry, which was consented subject to a conditioned restoration. The baseline habitat extent is taken to be the sum of the habitats currently present within the unconsented Proposed Extension, and the habitats that would be present within the consented Stanninghall Quarry at the close of the existing consent and following the restoration and aftercare period.

Compensation and enhancement

Stanninghall Quarry was consented subject to a conditioned restoration scheme. This restoration will be revised in order to provide additional enhancements for wildlife and will be fulfilled as a condition imposed on a permission for the proposed extension / consolidation development. This consented restoration includes S41 Habitats which would have been delivered even if there had been no application for an extension. Therefore, the approach taken ensures that the extent of S41 Habitats which would have been delivered by the consented restoration will not be considered as compensation for habitats lost in the Proposed Extension, nor will they be considered in the context of enhancements.

7.2.4 Assigning the Value of Ecological Features

Different Ecological Features have different Values

The scale against which the ecological resources and features were evaluated was decided by planning policy which values biodiversity on three levels: -

1. IEF of recognised **International** importance;
2. IEF of recognised **National** importance; and
3. IEF of perceived **County** importance.

The IEF at each level of importance are then further stratified into: **a)** those IEF which are legally protected; and, **b)** those IEF which are not legally protected. This ensures that mitigation, compensation and enhancements are proportionate and can be effectively implemented in line with relevant compelling mechanisms.

The value of IEF within this EcIA will therefore be determined within a defined geographical context as one of the following: -

- **International (i.e. European) importance:** European Statutory Wildlife Sites; Habitats which are listed under Annex I of the EC Habitats Directive; European Protected Species (EPS) under Schedules 2 and 5 of the *Conservation of Habitats and Species Regulations 2017*; and Annex II, IV and V species of the EC Habitats Directive and Annex I species of the EC Birds Directive.

- **National (i.e. UK) importance:** Statutory Wildlife Sites legally protected under the *Wildlife & Countryside Act 1981 (& as amended)*; Species which are legally protected under the *Wildlife & Countryside Act 1981 (& as amended)*; Ancient Semi-Natural Woodland (ASNW) sites; Plantation on Ancient Woodland Sites (PAWS); Section 41 Habitats of Principal Importance (S41 Habitats); and, Section 41 Species of Principal Importance (S41 Species).

- **County (i.e. Norfolk) importance:** Hedgerows that qualify as 'Important' under the *Hedgerows Regulations 1997*; Non-Statutory Wildlife Sites; and, Local BAP Habitats & Species (LBAP Habitats & LBAP Species).

7.2.5 EcIA Process

CIEEM (2018) criteria was adopted for the identification and assessment of potential effect to the integrity of Statutory or Non-Statutory Wildlife Sites or to the conservation status of legally protected IEF within the ZoI, as follows:

- First, the impacts identified and described within accounts of environmental studies were reviewed and put into a biological context; and
- Second, the likely effects of those impacts upon IEF were identified and described.

The impacts described by the environmental studies are considered in the light of scientific evidence that identifies where effects might be perceptible, and those effects are considered in terms of the: -

- Type of effect (habitat loss / degradation, injury / mortality, disturbance, attraction etc.);
- Extent of the effect (i.e. the surface area expressed as hectares or metres2);
- Direction of the effect (i.e. whether increase or decrease, positive or negative);
- Timing of the effect (i.e. when the effect will be perceptible);
- Duration of the effect (i.e. how long the effect can be predicted to last; in line with the impact, or for a length of time after the impact has ceased);
- Frequency of the effect (i.e. whether the effect will comprise one period, or a series of periods interspersed with quiescent periods);
- Magnitude of the effect (i.e. the size, amount, intensity and volume, quantified and expressed in relative terms (e.g. the amount of habitat lost, percentage change to habitat area or percentage decline of a species population));
- Reversibility of the effect (i.e. whether spontaneous recovery of the original baseline condition is possible through restoration of an area to its pre-development habitat and condition. An irreversible effect is one that: a) cannot or will not be compensated within the confines of the development design; or, b) cannot be compensated within the lifespan of IEF species or communities that rely upon it; and
- Likelihood of a significant negative effect (i.e. the confidence level of whether a significant effect is likely to occur as a result of the type, duration, frequency, magnitude and irreversibility of the effect).

The combination of: **a)** the ZoI; **b)** the anticipated impact within the ZoI; and, **c)** the known ecology of the individual IEF, are considered in order to scope-in those species for which there is any potential for an effect and scope-out those for which there really is not. All the certain (i.e. specific), identifiable and real effects are then considered in terms of their significance. This approach is used in order to adhere to the requirements of *The Town and Country Planning (Environmental Impact Assessment) Regulations 2017*, which state that the EIA should provide a description of 'significant' effects (Section 18, Para 3, Item b) that are likely to arise as the result of the proposed development (Section 26, Para 2).

For ease of reference, the significance of impacts identified within summary text and tabulations are colour-coded as follows: -

- Significant negative effect – Red text in bold;
- Non-significant negative – Red text of standard weight;
- Significant positive effect – Green text in bold;
- Non-significant positive effect – Green text of standard weight;
- Negative/Positive effect of negligible significance – Blue text of standard weight; and
- Benign action (i.e. no change/retention) – Black text of standard weight.

[2] Linear meterage is relatively easy to visualise in context, but surface areas are not. In order to provide a mental context to the habitat hectarage extents reported, the following are used: a tennis court occupies 0.026 ha; a basketball court occupies 0.043 ha; an Olympic swimming pool occupies 0.125 ha; a football pitch occupies 0.71 ha; and, a rugby field occupies 0.84 ha.

7.3 Significance thresholds

The significance thresholds applied in this EcIA consider: **a)** the magnitude of the effect identified; **b)** the British status of a species; **c)** the population trend of a species; **d)** the likely status of the species in the immediate locale; and, **e)** the manageability of the habitat/species.

In the absence of a universally accepted scale, **residual** effect magnitudes in terms of physical habitat losses were assessed using criteria based on that defined by Percival (2003): -

- **Very high** – Total loss or gain or very major alteration to key elements or features of the baseline conditions, such that the post-development character, composition and/or attributes will be fundamentally changed and may be lost from the site altogether (guide: ≤20% of the original extent of habitat or population remains (i.e. ≥80% loss) or there is a gain of 80% or above);
- **High** – Major loss or gain or major alteration to key elements or features of the pre-development baseline conditions, such that post-development character, composition and/or attributes will be fundamentally changed (guide: 20-80% of habitat or population lost or gained);
- **Medium** – Loss or gain or alteration to one or more key elements or features of the baseline conditions such that post-development character, composition and/or attributes of the baseline will be partially changed (guide: 5-20% of habitat or population lost or gained);
- **Low** – Minor shift away from the baseline conditions. Change arising from the loss or alteration will be discernible but underlying character, composition and/or attributes of baseline condition will be similar to pre-development circumstances/patterns (guide: 1-5% of habitat or population lost or gained); and
- **Negligible** – Very slight change from baseline condition. Change barely distinguishable, approximating to the "no change" situation (guide <1% of habitat or population lost or gained).

In the context of this EcIA the 'Very high' magnitude criterion is taken to represent the potential for a significant effect.

When considering individual species, a significant effect is taken to mean any effect that undermines biodiversity conservation objectives for an IEF or for biodiversity in general (CIEEM 2018). The assessment of whether an effect is likely to be significant should therefore also consider the conservation status and population trend of an IEF, as well as the reversibility of the effect and the predictability of the outcome, as follows:

British status significance threshold: Any effect upon a legally protected species and/or S41 Species with an International Union for Conservation of Nature (IUCN) Red List status of Near threatened (NT) or above has the potential to be significant unless the decline is historic and the species is now recovering and has an increasing population trend.

Population trend significance threshold: Regardless of its British status any likely effect upon a legally protected and/or S41 Species with a UK population trend that is negative (i.e. not stable or increasing) has the potential to be significant.

Reversibility significance threshold: Where there are grounds to suggest that it is unlikely a negative effect can be reversed; it has the potential to be significant. This includes, but is not limited to, **a)** any situation where a habitat cannot be translocated or re-created; and, **b)** any situation where the habitat can be re-created, but there are grounds to believe that populations of legally protected and/or S41 Species currently occupying it, cannot or will not be maintained in sufficient proximity to re-colonise the habitat within the interval of its loss, reinstatement and it subsequently achieving qualitative maturity.

Predictability significance threshold: Where there are grounds to predict the development would be likely to result in loss of, or degradation to, an independently functioning S41 Habitat ecosystem in totality (e.g. an individual mire system), and the effects cannot be meaningfully quantified and/or qualified, the precautionary principle will be applied and the effect considered significant. In addition, where an effect is predicted but its significance cannot be confidently predicted, it will be considered significant until surveillance has proven otherwise.

7.3.1 Approach to the threshold of 'likelihood' of a significant effect

The CIEEM suggests the use of a four-band scale against which to assess the probability of the predicted outcome of biophysical changes. The four bands comprise: **Certain/near-certain** – probability estimated at 95% chance or higher; **Probable** – probability estimated above 50% but below 95%; **Not likely** – probability estimated above 5% but less than 50%; and, **Extremely unlikely** – probability estimated at less than 5% (IEEM 2006).

The division of probability into percentage bands is only objective if the probability can be quantified within a pre-defined scale and data are collected to compare against that scale. This was attempted by BTHK (2018) for the probability that a specific feature on a specific tree might be exploited by bats as a roost. To our knowledge, no other scale exists in respect of any other habitat or species.

In most cases, the likelihood of a particular outcome resulting from a particular impact must inevitably apply deductive reasoning within a dichotomy.

Deductive reasoning is one of three approaches to the testing of a theory. Hanson (1958) describes reasoning as follows: **Deduction** proves that something must be; **Induction** shows that something actually is; and, **Abduction** merely suggests that something may be. Deduction therefore considers the available evidence to present a logical argument in the form of a theory that might be tested by an inductive experiment but is sufficiently strong for the outcome of the experiment to be confidently predicted.

An EcIA must by necessity attempt to divide each effect into 'likely' and 'not likely', but as that dichotomy is all that is required by planning law and policy, that is as far as this EcIA will go.

At the close of an impact assessment, the likely significance of the outcome may be considered by the application of deductive reasoning to build a theory. That theory is open to challenge, but only by reference to conflicting scientific evidence in a narrative that presents a rational argument.

7.4 Legal and Policy Considerations

A brief overview of planning policies and legislation that are relevant to this EcIA are provided below.

7.4.1 National Policy (NPPF, NPPG & ODPM Circular 06/2005)

The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these should be applied.

The NPPF highlights that the purpose of the planning system is to contribute to the achievement of sustainable development, protection and enhancement of the natural environment, as well as providing net gains for biodiversity. An important part of this aim is the establishment of coherent ecological networks. Decisions should therefore encourage development that would enable new habitat creation.

Paragraphs 174 through 177 attend specifically to habitats and biodiversity, which sets out that when determining planning applications, Local Planning Authorities should apply the following principles:

- *If significant harm to biodiversity resulting from development cannot be avoided, mitigated or compensated for, then planning permission should be refused;*
- *Development on land within or outside a Site of Special Scientific Interest, and which is likely to have an adverse effect on it, should not normally be permitted;*
- *Development resulting in the loss or deterioration of irreplaceable habitats should be refused, unless there are wholly exceptional reasons and a suitable compensation strategy exists; and*
- *Development whose primary objective is to conserve or enhance biodiversity should be supported; while opportunities to incorporate biodiversity improvements in and around developments should be encouraged, especially where this can secure measurable net gains for biodiversity.*

The NPPF accepts that *"…minerals are a finite natural resource, and can only be worked where they are found"* and states that *"great weight should be given to the benefits of mineral extraction"*. The Government therefore make it clear that *"Local Planning Authorities should approach decisions on proposed development in a positive and creative way."* Notwithstanding, Mineral Planning Authorities should: ensure there are no unacceptable adverse effects on the natural environment; and, ensure that any unavoidable noise, dust and particle emissions are controlled, mitigated or removed at source. However, even where a development is considered unacceptable *"Local Planning Authorities should consider whether otherwise unacceptable developments could be made acceptable through the use of conditions or planning obligations."*

Paragraph 016 of *National Planning Practice Guidance (NPPG): Natural Environment – Biodiversity and ecosystems* states:

"An ecological survey will be necessary in advance of a planning application if the type and location of development are such that the impact on biodiversity may be significant and existing information is lacking or inadequate."

Furthermore:

"Where an Environmental Impact Assessment is not needed it might still be appropriate to undertake an ecological survey, for example, where protected species may be present."

However:

"Local planning authorities should ***only require ecological surveys where clearly justified, for example if they consider there is reasonable likelihood of a protected species being present and affected by the development****. Assessments should be proportionate to the nature and scale of the development proposed and the likely impact on biodiversity."*

ODPM Circular 06/2005 states:

"The presence of a protected species is a material consideration when a planning authority is considering a development proposal that, if carried out, would be likely to result in harm to the species or its habitat."

Therefore:

"It is essential that the presence or otherwise of protected species, and the extent that they may be affected by the proposed development, is established before the planning permission is granted, otherwise all relevant material considerations may not have been addressed in making the decision."

However:

"Bearing in mind the delay and cost that may be involved, ***developers should not be required to undertake surveys for protected species unless there is reasonable likelihood of the species being present and affected by the development."***

7.4.2 International Legislation

The *Conservation of Habitats and Species Regulations 2017* transposes Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora ("the Habitats Directive") and certain aspects of Directive 2009/147/EC on the conservation of wild birds ("the Birds Directive"). These Regulations extend to England and Wales and provide for: -

- The designation and legal protection of 'European Sites';
- The legal protection of 'European Protected Species' (EPS); and
- The adaptation of planning and other controls for the protection of European Sites.

7.4.3 National Legislation

The *Wildlife & Countryside Act 1981 (& as amended)* is the principal mechanism for the legislative protection of wildlife sites and species in Great Britain.

Under the *Natural Environment and Rural Communities (NERC) Act 2006*, a Local Planning Authority has a duty to conserve biodiversity. This duty is set out at Section 40, which states:

"(1) Every public authority must, in exercising its functions, have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity.

(2) In complying with subsection (1), a Minister of the Crown, government department or the National Assembly for Wales must in particular have regard to the United Nations Environmental Programme Convention on Biological Diversity of 1992.

(3) Conserving biodiversity includes, in relation to a living organism or type of habitat, restoring or enhancing a population or habitat…"

Under Section 41 of the *NERC Act 2006*, the Secretary of State has a duty to publish a list of habitats and species of flora and fauna considered to be of principal importance for the purpose of conserving biodiversity. The list comprises an overall: -

- 56 Habitats of Principal Importance (hereafter referred to as S41 Habitats); and
- 943 Species of Principal Importance (hereafter referred to as S41 Species).

Badgers *Meles meles* and their setts are legally protected under the *Protection of Badgers Act 1992.*

Some hedgerows are protected by the *Hedgerows Regulations 1997*. Hedgerows are graded on a two-tier system; 'important' and 'unimportant'. In order to qualify as 'important', hedgerows must meet criteria set out within the *Regulations* encompassing wildlife, historic and landscape aspects.

7.4.4 Species Protection

The UK Biodiversity Action Plans (UK BAP) were written in order to provide detailed strategies for the most threatened habitats and species and following revision for the UK Post-2010 Biodiversity Framework forms the list of Section 41 Habitats and Species of Principal Importance. In addition, some counties have Local Biodiversity Action Plans (LBAP) with county or landscape-area specific objectives. Norfolk County Council has adopted a Biodiversity Action Plan which is considered within this EcIA.

The Department for Environment, Food & Rural Affairs (DEFRA 2016) have published guidance for competent authorities on how to support wild birds by protecting their habitat and avoiding pollution in light of amendments to the *Conservation of Habitats and Species Regulations 2017*. The guidance states that the Mineral Planning Authority must:

- "…take the steps [the Mineral Planning Authority] consider appropriate to preserve, maintain and re-establish habitat that is large and varied enough for wild birds to support their population in the long-term."
- "…use [their] powers so that any pollution or deterioration of wild bird habitat is avoided as far as possible."
- "…aim to provide habitat that allows bird populations to maintain their numbers in the area where they naturally live."
- "…focus on habitats for wild birds in decline but also maintain habitats supporting wild birds with healthier populations."

7.5 Ecological Baseline

7.5.1 Ecologically Designated Sites

No Statutory or non-statutory designated sites occur within the EcIA ZoI. Two wooded areas listed on the Ancient Woodland Inventory border the Application Site to the west, comprising: **1)** Clamp Wood Ancient Semi-Natural Woodland (ASNW); and, **2)** Clamp Wood Plantation on Ancient Woodland Site (PAWS). Although these two woodland blocks are not within the ZoI their root system is likely to extend into the ZoI and impacts on these have therefore be considered within the framework of the EcIA.

7.5.2 Pre-existing Records of Protected and Notable Species

One report documenting the results of historical botanical and invertebrate surveys of the full Application Site undertaken in 2001 is held by the applicant, comprising: -

Andrews Ward Associates 2002. *Ecological assessment: Proposed sand & gravel quarry and restoration scheme on land within the Trafford Estate at Horstead, Norfolk NR12 7LX*. Andrews Ward Associates, Huntingdon

The NBIS data-search returned no records of legally protected, S41 Species or LBAP Species of plant, invertebrate, fish, amphibian or reptile occurring historically within the Application Site or within 500 m of the site boundary.

The NBIS data-search returned records of 18 species of bird which are variously Schedule 1, S41 Species and/or LBAP Species occurring outside the Application Site but within a 500 m radius of the site boundary, comprising: - **1)** Bewick's swan *Cygnus columbianus*; **2)** Osprey *Pandion haliaetus*; **3)** Goshawk *Accipiter gentilis*; **4)** Marsh harrier *Circus aeruginosus*; **5)** Red kite *Milvus milvus*; **6)** green sandpiper *Tringa ochropus*; **7)** turtle dove *Streptopelia turtur*; **8)** cuckoo *Cuculus canorus*; **9)** barn owl *Tyto alba*; **10)** kingfisher *Alcedo atthis*; **11)** hobby *Falco subbuteo*; **12)** Cetti's warbler *Cettia cetti*; **13)** fieldfare *Turdus pilaris*; **14)** redwing *Turdus iliacus*; **15)** song thrush *Turdus philomelos*; **16)** spotted flycatcher *Muscicapa striata*; **17)** black redstart *Phoenicurus ochruros*; and, **18)** brambling *Fringilla montifringilla*.

The NBIS data-search returned records of four legally protected, S41 Species and/or LBAP Species of terrestrial mammal occurring within the Application Site or the surrounding 500 m, comprising: **1)** water vole *Arvicola amphibius*; **2)** brown hare *Lepus europaeus*; **3)** hedgehogs *Erinaceus europaeus*; and**, 4)** badgers *Meles meles*.

The NBIS data-search returned no records of bats occurring within the Application Site but did demonstrate that eight species have been recoded within their respective Core Sustenance Zones (CSZ) (i.e. the nightly foraging range) of the Application Site, these comprise: **1)** barbastelle *Barbastella barbastellus*; **2)** serotine *Eptesicus serotinus*; **3)** Daubenton's bat *Myotis daubentonii*; **4)** Natterer's bat *Myotis nattereri*; **5)** noctule *Nyctalus noctula*; **6)** common pipistrelle *Pipistrellus pipistrellus*; **7)** soprano pipistrelle *Pipistrellus pygmaeus*; and **8)** brown long-eared bat *Plecotus auritus*.

7.5.3 Habitat Baseline

Because the application is an extension to an already permitted mineral development, the Habitat Baseline for the Application Site comprises the habitat types and extents which would be delivered in the absence of the current application. This comprises: -

a. The current habitat extents within the Proposed Extension; and
b. The consented restoration for Stanninghall Quarry[3].

Habitat types currently present within the Proposed Extension (52.26 ha) were recorded during a Phase 1 survey (JNCC 2010) conducted in April 2019 by AEcol, and comprise: -

- A3.1 – Scattered broadleaved trees (10 trees/ 0.14 ha);
- J1.1 – Miscellaneous / Cultivated/disturbed land / Arable (50.91 ha);
- J2.1 – Intact hedges (820 m / 0.17 ha);
- J2.2 – Defunct hedges (760 m / 0.18 ha);
- J2.3 – Hedges with trees (2,290 m / 0.78 ha); and
- J2.8 – Earth bank (195 m / 0.07 ha);

[3] The existing consented restoration is detailed in: - Tarmac South Ltd. 2003. *Trafford Estate Concept Restoration – T57 / 52*. Tarmac South Ltd., Colchester.

Phase 1 (JNCC 2010) habitat types within the consented Stanninghall Quarry (54.33 ha) which would have been delivered by the consented restoration in the absence of the current application, comprise: -

- A1.1.2 – Woodland and scrub / Woodland / Broadleaved / Plantation (10.2 ha);
- A1.3.2 – Woodland and scrub / Woodland / Mixed / Plantation (9.25 ha);
- B2.2 – Grassland and marsh / Neutral grassland / Semi-improved (3.89 ha);
- J1.1 – Miscellaneous / Cultivated/disturbed land / Arable (28.37 ha);
- J2.1 – Intact hedges (560 m / 0.20 ha);
- J2.3 – Hedges with trees (2,145 m / 1.85 ha);
- J4 – Miscellaneous / Bare ground (0.57 ha).

In the current situation, five hedgerows qualify as 'Important' under the criteria set out within the *Hedgerows Regulations 1997* and three Phase 1 habitat types qualify as one S41 Habitat; Hedgerows, and one LBAP Habitat; Hedgerows.

7.5.4 Protected Species (Fauna) Baseline

Invertebrates

A review of the available evidence performed within the Preliminary Ecological Appraisal (PEA) (AEcol 2019a) concluded that there are no grounds to predict the presence of any legally protected species of invertebrate within the Application Site and that the presence of 49 S41 Species of invertebrate are potential but their presence within the site has not been tested through structured survey. These comprise:

1) Scarce four-dot pin-palp *Bembidion quadripustulatum;* **2)** Ghost moth *Hepialus humuli;* **3)** Pale eggar *Trichiura crataegi;* **4)** Lackey *Malacosoma neustria;* **5)** Oak hook-tip *Watsonalla binaria;* **6)** Blood-vein *Timandra comae;* **7)** Dark-barred twin-spot carpet *Xanthorhoe ferrugata;* **8)** Shaded broad-bar *Scotopteryx chenopodiata;* **9)** Dark spinach *Pelurga comitata;* **10)** Small phoenix *Ecliptopera silaceata;* **11)** Streak *Chesias legatella;* **12)** Broom-tip *Chesias rufata;* **13)** August thorn *Ennomos quercinaria;* **14)** Dusky thorn *Ennomos fuscantaria;* **15)** September thorn *Ennomos erosaria;* **16)** Brindled beauty *Lycia hirtaria;* **17)** Figure of eight *Diloba caeruleocephala;* **18)** Garden tiger *Arctia caja;* **19)** White ermine *Spilosoma lubricipeda;* **20)** Buff ermine *Spilosoma lutea;* **21)** Cinnabar *Tyria jacobaeae;* **22)** White-line dart *Euxoa tritici;* **23)** Garden dart *Euxoa nigricans;* **24)** Double dart *Graphiphora augur;* **25)** Autumnal rustic *Eugnorisma glareosa;* **26)** Small square-spot *Diarsia rubi;* **27)** Dot moth *Melanchra persicariae;* **28)** Broom moth *Ceramica pisi;* **29)** Powdered quaker *Orthosia gracilis;* **30)** Shoulder-striped wainscot *Leucania comma;* **31)** Minor shoulder-knot *Brachylomia viminalis;* **32)** Sprawler *Asteroscopus sphinx;* **33)** Deep-brown dart *Aporophyla lutulenta;* **34)** Green-brindled crescent *Allophyes oxyacanthae;* **35)** Flounced chestnut *Agrochola helvola;* **36)** Brown-spot pinion *Agrochola litura;* **37)** Beaded chestnut *Agrochola lychnidis;* **38)** Centre-barred sallow *Atethmia centrago;* **39)** Sallow *Cirrhia icteritia;* **40)** Grey dagger *Acronicta psi;* **41)** Knot grass *Acronicta rumicis;* **42)** Mouse moth *Amphipyra tragopoginis;* **43)** Dusky brocade *Apamea remissa;* **44)** Large nutmeg *Apamea anceps;* **45)** Rosy minor *Litoligia literosa;* **46)** Ear moth *Amphipoea oculea;* **47)** Rosy rustic *Hydraecia micacea;* **48)** Rustic *Hoplodrina blanda*; and, **49)** Mottled rustic *Caradrina Morpheus*.

Survey for these 49 species was not considered to be proportionate to the level of risk and no survey was therefore undertaken. The potential for these species to occur within the Application Site was simply accepted and the EcIA proceeds on the basis of assumed presence. The extent to which all 49 species might be affected by the impacts of the development has been quantified within the framework of the EcIA.

Fish

There are no suitable aquatic habitats within the Application Site. As a result, there are no grounds to suggest a "*reasonable likelihood*" that any legally protected, S41 Species or LBAP Species of fish will occur within the Application Site and fish are hereafter scoped-out of the EcIA.

Amphibians

A review of the available evidence performed within the PEA (AEcol 2019a) concluded that there are no grounds to predict the presence of great crested newts or any other legally protected species of amphibian occurring within the Application Site and that the presence of one S41 Species of amphibian; common toad, is potential. Survey for common toad was not considered to be proportionate to the level of risk and no survey was therefore undertaken. The potential for common toad *Bufo bufo* to occur within the Application Site is accepted and the EcIA proceeds on the basis of assumed presence. The extent to which common toads might be affected by the impacts of the development has been quantified within the framework of the EcIA.

Reptiles

A review of the available evidence performed within the PEA (AEcol 2019a) suggested that the presence of four reptile species within the Proposed Extension was potential but untested through historic survey. These comprise; **1)** slow-worm *Anguis fragilis*; **2)** common lizard *Zootoca vivipara*; **3)** grass snake *Natrix natrix*; and, **4)** adder *Vipera berus* (AEcol 2019a). Survey for reptiles was considered to be proportionate to the level of risk and a reptile survey was undertaken in 2019. The survey proved negative for any species of reptile occurring within the Proposed Extension (AEcol 2019b). All species of reptiles are hereafter scoped out from further consideration within the EcIA.

Birds

A review of the available evidence performed within the PEA (AEcol 2019a) concluded that 20 bird species variously listed on Schedule 1 and/or S41 or LBAP Species of birds is either likely or potential but untested through historic structured survey. These comprise: **1)** grey partridge *Perdix perdix*; **2)** quail *Coturnix coturnix*; **3)** red kite; **4)** lapwing *Vanellus vanellus*; **5)** little ringed plover *Charadrius dubius*; **6)** herring gull *Larus argentatus*; **7)** cuckoo; **8)** hobby; **9)** skylark *Alauda arvensis*; **10)** starling *Sturnus vulgaris*; **11)** song thrush; **12)** spotted flycatcher; **13)** house sparrow *Passer domesticus*; **14)** tree sparrow *Passer montanus*; **15)** dunnock *Prunella modularis*; **16)** bullfinch *Pyrrhula pyrrhula*; **17)** linnet *Carduelis cannabina*; **18)** lesser redpoll *Carduelis cabaret*; **19)** corn bunting *Emberiza calandra*; and, **20)** yellowhammer *Emberiza citrinella* (AEcol 2019a).

Survey for birds was not considered to be proportionate to the level of risk and no survey was therefore undertaken. The potential for these 20 species of bird to occur within the Application Site is accepted and the EcIA proceeds on the basis of assumed presence. The extent to which all 20 bird species might be affected by the impacts of the development has been quantified within the framework of the EcIA. The potential for impacts to effect nesting birds has been anticipated through a proposed safe-guarding strategy.

It should be noted that no suitable habitat is present within the Application Site for Bewick's swan, goshawk, marsh harrier, turtle dove, barn owl, kingfisher, hobby, Cetti's warbler or black redstart, which were identified within the data-search. Furthermore, osprey, green sandpiper, fieldfare, redwing and brambling, which are listed on Schedule 1 only, are not known to breed in Norfolk and their non-breeding presence identified in the data search is irrelevant in the context of this EcIA. No further consideration is therefore given to these species.

Mammals (excluding bats)

A review of the available evidence performed within the PEA (AEcol 2019a) suggested that the presence of two mammal species could be accepted as present, comprising: **1)** hedgehog; and, **2)** badger; and the presence of a further two S41 species of mammal (excluding bats) was potential but untested through historic survey, comprising: **3)** harvest mouse *Micromys minutus* ; and, **4)** brown hare (AEcol 2019a).

A badger sett survey was conducted in conjunction with the PEA in 2019 and recorded a disused two-hole sett within woodland which will be retained throughout the development. Survey for hedgehog, harvest mouse and brown hare was not considered to be proportionate to the level of risk and no survey was therefore undertaken. The potential for these three species within the Application Site is accepted and the EcIA proceeds on the basis of assumed presence. The extent to which hedgehogs, harvest mice and brown hare might be affected by the impacts of the development has been quantified within the framework of the EcIA.

The extent to which badgers might be affected by the impacts of the development has been considered in relation to impacts on setts (and the badgers within them) alone. Badgers have a positive population trend and are a common and widespread species. There is no potential for this development to have a significant negative impact upon the species. The *Badger Act 1992* protects the animals themselves against persecution and extends to any sett that is currently occupied. The legislation does not extend to wider areas of habitat, regardless of how the animals use them. They are considered no further than their legislative context in this EcIA.

Bats

A review of the available evidence performed within the PEA concluded that the presence of seven bat species roosting within the EcIA ZoI and eight bat species foraging within the EcIA ZoI was either confirmed or likely (AEcol 2019a). A survey was therefore conducted to assess the potential for a significant negative effect upon an overall eight bat species.

The survey established the presence of a maximum 12 species of bat occurring within the Application Site, comprising: **1)** barbastelle; **2)** serotine; **3)** Brandt's bat *Myotis brandtii*; **4)** Daubenton's bat; **5)** whiskered bat *Myotis mystacinus*; **6)** Natterer's bat; **7)** Leisler's bat *Nyctalus leislerii*; **8)** noctule; **9)** Nathusius' pipistrelle *Pipistrellus nathusii*; **10)** common pipistrelle; **11)** soprano pipistrelle; and, **12)** brown long-eared bat (AEcol 2019b). The survey recorded four roosts in trees attributable to three species of bat, comprising: **1)** Natterer's bat; **2)** noctule; and **3)** brown long-eared bat. The tree roosts are all located within woodland which is within the Application site but will be retained throughout the development.

A comprehensive desk-study, habitat truthing and survey demonstrated that impacts resulting from physical habitat loss are **not likely** to result in a significant negative effect upon any species of bat. However, all 12 bat species will be assessed within the framework of the EcIA to quantify the impacts of habitat losses and gains upon foraging habitat and to determine whether the development will result in a net gain in habitat extent for bats. The effect of lighting and noise impacts upon the bat fauna is also assessed.

7.6 The Environmental Zone of Influence (potential impacts)

7.6.1 Overview

To determine the Zone of Influence (ZoI), the following were identified: -

1. The topographical impacts resulting from the quarry development;
2. Any physical impacts upon off-site trees and hedgerows;
3. Direct and indirect impacts upon: -
   a. The water environment; and
   b. Air quality.
4. Direct and indirect impacts in respect of: -
   a. Noise; and
   b. Lighting.

7.6.2 Topographical Zone of Influence

Topographical impacts will encompass both: **a)** one-off construction / restoration impacts; and, **b)** repeated operational impacts.

Construction impacts

Construction impacts will relate to: **1)** the grubbing out of four intact hedges, one of which has mature trees, and five defunct hedges all with mature trees; **2)** soil stripping across arable farmland; and, **3)** soil and overburden placement into three screening bunds around residential properties and three soil storage mounds.

Operational impacts

Operational impacts will relate to: **1)** extraction of mineral using an excavator; **2)** transport of mineral to the existing plant site via dumper; and **3)** operation of plant and machinery.

Restoration impacts

Restoration impacts will relate to: **1)** transport and placement of soils and overburden in worked out areas; **2)** landscaping using the soil; and, **3)** tree planting and seed sowing.

The potential for negative effects resulting from impacts identified

Excavation, soil storage and vehicular movements all have the potential to damage the root systems of off-site trees and shrubs and reduce the rainwater catchment of ponds and running water. Compaction of ground has the potential to alter surface water flows, and the creation of soil storage bunds also has the potential to obstruct surface water to or from off-site habitats.

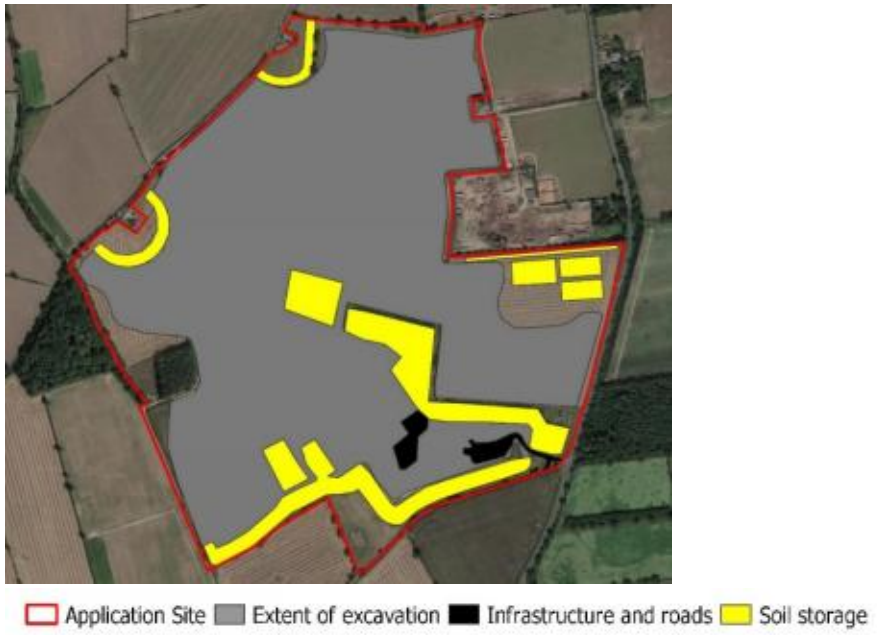
All have the potential to impact upon faunal species that live at surface level or below ground level (e.g. hedgehogs *Erinaceus europaeus*, polecats *Mustela putorius* etc.). In order to assess the risk of negative effects upon off-site habitats that might result from excavation, vehicular movements and soil placement etc., the maximum extent of the excavation, and all soil storage and vehicular tracks were investigated to see whether potentially sensitive habitats might exist within the immediate locale, or transmission pathways might exist within the ZoI. Sensitive habitats were defined as: **a)** all wooded habitat; **b)** all aquatic and hydrologically sensitive habitat (e.g. flush, bog etc.); and, **c)** all burrows etc. Transmission pathways comprised: **i)** watercourses; and, **ii)** ditches etc.

The results are shown at Figure 7-1. In summary, the results conclude that: **a)** the excavation will come close to retained hedgerows along the site boundaries in the northwest, north and east of the site; **b)** one soil bund around the residential property in the north of the site is against mature trees which are due to be retained; **c)** stored soil in the east of the site is against a hedgerow which will be retained; and, **d)** excavation in the west off the Application Site comes close to offsite woodland which is listed on the Ancient Woodland Inventory (AWI).

A sufficient buffer will have to be adopted to ensure the root systems are not damaged through severance, compacted or suffocated.

To our knowledge there are no sensitive aquatic habitats that might be affected or act as a transmission pathway for surface water run-off into another sensitive off-site habitat.

Figure 7-1. The maximum extent of working and all soil storage and vehicular tracks shown in relation to the Application Site.



Imagery©Google2020

Excavation, soil placement and vehicular trackway Zone of Influence

Direct impacts brought about by the physical act of the development proposal are confined to the Application Site boundary. There are, however,

intact hedgerows along the site boundaries and an area of woodland listed on the AWI which borders the Application Site to the west. The excavation will work up to the site boundaries in some areas and has the potential to result in a negative effect on off-site habitats resulting from impacts to the root system of off-site trees and shrubs.

Considering the potential for indirect effects, there is: **a)** no hydrologically sensitive habitat that might be affected; and, **b)** no potential water communication pathways within the ZoI.

Topographical / physical Zone of Influence considered by the EcIA

As there is the potential for an off-site effect, the topographical / physical ZoI considered by the EcIA has been extended to include Clamp Wood ASNW and Clamp Wood PAWS.

7.6.3 Hydrological Zone of Influence

Changes in the water environment can be damaging to hydrologically sensitive habitats, for example: **a)** putting trees under stress by drought and flooding; **b)** desiccation and loss of flush communities; and, **c)** suffocating the roots of other species. These can occur both due to alterations in ground water, and also alterations in catchment and surface flows (including rainfall). Changes in the water environment can also have both displacement and attraction effects upon fauna; the latter particularly pertinent in the case of drawing great crested newts into quarry sites. Changes in the water environment have been identified in Chapter 9 – Hydrology and Hydrogeology.

In summary, the hydrology and hydrogeology impact assessment concluded the following: -

1. Groundwater levels and flows – No impact identified;

2. Ground water quality – Three potential pathways by which groundwater might be affected have been identified: -

   a. A reduction in attenuation capacity – concluded to have an insignificant effect;

   b. Accidental spillage and / or long-term undetected leakage of potential contaminants – has the potential to adversely affect the River Bure and/or Spixworth Beck, in which the Crostwick Marsh SSSI is situated. The SSSI is part of The Broads SAC and also Broadland SPA / Ramsar. However, the highly localised and very short-term occurrence of any spillage in the quarry; together with the considerable and increasing standoff between the workings and SSSI (approximately 1.1 km to the south of the Existing Quarry, increasing to circa 1.4 km at the Proposed Extension) means that there is negligible risk of impact on a catchment-wide scale (bearing in mind that the upstream catchment of Spixworth Beck, leading to the SSSI, is 45km^2 - based upon FEH Web Service mapping); and

   c. Recommencement of agricultural practices following restoration of farmland;

3. Surface water levels and flow – No impact identified;

4. Surface water quality - Accidental spillage and / or long-term undetected leakage of potential contaminants might become entrained within the groundwater system – has the potential to adversely affect the River Bure and/or Spixworth Beck, in which the Crostwick Marsh SSSI is situated. The SSSI is part of The Broads SAC and also Broadland SPA / Ramsar. However, the highly localised and very short-term occurrence of any spillage in the quarry; together with the considerable and increasing standoff between the workings and SSSI (approximately 1.1 km to the south of the Existing Quarry, increasing to circa 1.4 km at the Proposed Extension) means that there is negligible risk of impact on a catchment-wide scale (bearing in mind that the upstream catchment of Spixworth Beck, leading to the SSSI, is 45km^2 - based upon FEH Web Service mapping)

A mitigation strategy has been proposed to remove the potential for an impact upon off-site designated sites. With the implementation of the proposed mitigation, there are no grounds to extend the hydrological ZoI

beyond the Application Site boundary. The hydrological Zone of Influence is taken to be the application boundary.

7.6.4 Dust Zone of Influence

Changes in the dust environment can be damaging to hydrologically sensitive habitats, for example: **a)** clogging leaf stomata; **b)** desiccation and loss of flush communities; and, **c)** altering the surface chemistry on which lichens depend. Changes in the dust environment can also have a displacement effect upon fauna. Changes in the dust and air quality environment have been identified in Chapter 11 – Air Quality.

The air quality impact assessment concluded that there is the potential for a negative effect from dust impacts on Clamp Wood ASNW and PAWS. However, the magnitude of the effect is predicted to be 'negligible'. This is largely due to the receptor being 'upwind' of the Application Site and dust generating activities; and therefore, the pathway effectiveness is 'ineffective'. Furthermore, whilst the AW is within 100m of the existing quarry boundary, in terms of its distance to dust generating activities, it is only classified as 'close' (i.e. within 100m) to Phase 4B and therefore it's dust impact risk is considered 'negligible' in accordance with the IAQM guidance.

Notwithstanding, a mitigation strategy has been proposed to further reduce the impact of dust. With the implementation of the proposed mitigation, there are no grounds to extend the dust ZoI beyond the Application Site boundary. The ZoI within the application boundary was therefore investigated further.

The likely negative effects from dust impacts were identified by reference to the best available scientific evidence, and by investigation of perceptible effects that have already resulted from, and continue to result from, the existing quarry operation.

The full assessment is included within the EcIA report which is provided at **Appendix 7.1**. In summary, no potential for a likely significant negative effect is immediately apparent in respect of the current operation, and there are no grounds to predict such an effect will occur as a result of the development proposed. As a result, a ZoI in respect of dust is concluded to be functionally imperceptible and therefore immaterial.

7.6.5 Noise Zone of Influence

Changes in the noise environment can result in displacement of fauna within the ZoI. Changes in the noise environment have been identified in Chapter 10 – Noise.

The noise impact assessment was functionally an environmental health assessment and did not define the Zone of Influence in a format that might be applied in the context of an EcIA. However, noise readings of the existing fixed processing plant and cement plant were taken during the noise assessment (included as Chapter 10.0 to the ES) and these readings were used to define the worst-case-scenario noise ZoI (i.e. in the absence of noise attenuation features) in respect of ecological IEF. The amplitude recorded was as follows: -

- Maximum 61 dB(A) recorded at c. 130 m from the plant;
- Maximum 65 dB(A) recorded at c. 80 m from the plant; and
- Maximum 80 dB (A) recorded within 10 m of the plant.

The noise Zone of Influence in respect of IEF will be different for different groups and species, and each should be considered individually. A full review of the potential impacts of noise upon faunal groups in the context of a quarry development is included within the EcIA report which is provided at Appendix 7.1.

In summary, no noise-sensitive invertebrate IEF are predicted to occur within the habitats present in the Application Site or immediate locale. Natterjack toads do not occur within 1 km of the Application Site. Therefore, in the context of this EcIA the following thresholds have been adopted:

- ***Birds:***
  - **55-68 dB(A)** – perceptible but non-significant negative effect upon nesting birds (Dooling & Popper 2007);
  - **>68 dB(A)** – significant negative effect upon avifauna while noise persists (based on noise of rainfall in woodland but no wind).

- ***Bats:***
  - **Any constant noise** – predictable avoidance by so-called 'whispering' species by masking of pre-generated sounds – Bechstein's bat and brown long-eared bat;
  - **10-65 dB(A)** – perceptible but non-significant negative effect upon foraging bats up to 50 m from noise source (Stone *et al.* 2009, 2012, Bennett & Zurcher 2013, Zeale *et al.* 2018);
  - **66-87 dB(A)** – potential for avoidance by foraging bats if it is newly introduced noise (Bennett & Zurcher 2013); and
  - **>87 dB(A)** – significant negative effect upon foraging bats with comprehensive avoidance (Bennett & Zurcher 2013).

In the case of bats the noise would have to be within the frequency of their hearing.

The noise impact assessment concludes that the noise mitigation in place with Stanninghall Quarry is effective and limits noise above 66 dB(A) to within the existing consented Stanninghall Quarry. Recordings taken of the fixed plant at Stanninghall suggest that the significance thresholds are restricted to the following distances from fixed plant; -

- >87 dB(A) – within a c. 10 m radius from fixed plant;
- >68 dB(A) – within a c. 80 m radius from fixed plant.

The noise impacts from mobile plant operating in the working phases is subordinate to the impact of habitat loss and therefore irrelevant in the context of an EcIA. Any faunal IEF which may be displaced by noise impacts can be predicted to have already been displaced by habitat loss and the impact of noise generated by mobile plant is not considered further.

7.6.6 Lighting Zone of Influence

A specific lighting impact assessment was not conducted as the lighting environment will not change as a result of the proposed development. However, in order to assess the impact of the current lighting environment of ecological IEF, the lighting ZoI has been calculated as a worst-case-scenario by assuming that all structures and fixed plant are illuminated.

Lighting impacts can be broadly divided in two as follows: -

1. **Light-spill** situations, where light will illuminate and thus make the environment lighter (i.e. improve visibility for diurnal organisms that are active during daylight hours but potentially impede visibility for nocturnal organisms); and

2. **Light-draw** situations, where light will not illuminate, but will be nevertheless be visible and draw attention, affecting eye function, and making the wider environment appear darker (i.e. impeding visibility for diurnal species). As this would impede scoptic vision (i.e. full night vision mode), it can be predicted that it would affect the behaviour of nocturnal species; particularly those that need to see to be able to fly, such as moths and owls.

A full review of the potential impacts of lighting upon faunal groups in the context of a quarry development is included within the EcIA report which is provided at Appendix 7.1.

In summary, the development proposal will not require additional fixed artificial lighting to that already present. Notwithstanding, the following assumptions can be made: **a)** that fixed lighting will be restricted to the existing plant and infrastructure and, all lighting is directed downwards at 45 degrees and screened by bunding, the lighting will not be visible from outside the Application Site boundary; and, **b)** lighting will only be required in the seasons that the operational hours fall within hours of darkness. The ZoI for light-spill is deemed to be 23 m, and that of light-draw is arbitrarily accepted as the maximum; i.e. the Application Site boundary.

The timing of lighting effects will be dictated by the hours of operation. These will be 0700hrs through 1800hrs on Monday through Friday and 0700hrs through 1300hrs on Saturdays. In the morning, the impact of lighting within the Zone of Influence will only be perceptible prior to sunrise. In the evening, the impact of lighting will only be perceptible following civil twilight. In order to determine the months and temporal period in which lighting might be

perceptible within the Zone of Influence, morning sunrise and evening civil twilight time ranges were collated and reviewed.

The EcIA has assessed the likelihood of a significant negative effect within the ZoI as a result of impacts of lighting generally.

7.6.7 Summary of Zone of Influence upon which the EcIA is based

The Zones of Influence in respect of hydrology, noise and lighting impacts is judged to be the Application Site boundary, the ZoI in respect of physical impacts is judged to be the Application Site boundary and Clamp Wood ASNW and PAWS, and the EcIA proceeds on that basis.

As the information already collated demonstrates that there are no grounds to predict a significant negative effect upon any IEF in respect of dust, this impact is scoped-out from the EcIA.

7.7 Summary of Ecological Receptors

Scoping has identified the IEF which should be considered within the ZoI. In summary, IEF within the ZoI comprise: -

- One Non-statutory wildlife site – Clamp Wood ASNW & PAWS ;
- One S41 Habitat type – Hedgerows;
- One LBAP Habitat – Hedgerows;
- Five 'important' hedgerows;
- A maximum 49 S41 Species of invertebrates;
- One S41 Species of amphibian – Common toad;
- A maximum 20 legally protected and S41 Species of bird;
- A maximum three S41 Species of mammals (not including bats);
- One legally protected mammal (excluding bats) species - badger; and
- 12 bat species.

In order to anticipate and guard against the potential for legislative conflict and reduce the potential for a significant negative effect, due-diligence safeguarding strategies in the form of draft planning conditions are offered for review by the Mineral Planning Authority. These are in respect of: **1)** Ancient Semi-natural Woodland & Plantation on Ancient Woodland Site; **2)** S41 species of amphibians; **3)** nesting birds; **4)** S41 Species of mammals; **5)** badger setts; and, **6)** roosting bats. It should be noted that the potential effects discussed in section 7.7.1 below represent circumstances in the absence of mitigation.

7.7.1 Clamp Wood ASNW & PAWS EcIA

Type of effect

The type of effect relates to the potential for an impact upon habitats within Clamp Wood ASNW and PAWS resulting from severance or damage to tree roots of compaction of soil around tree roots resulting from operational actions.

Extent of effect

Based upon the planning application site boundary, there is the potential for an effect on *c.* 155 m of the ASNW edge and *c.* 115 m of the PAWS edge. It is considered unlikely that the effect would reach further than 30 m back from the woodland edge and the maximum potential extent of the negative effect is therefore *c.* 0.47 ha of Clamp Wood ASNW and *c.* 0.35 ha of Clamp Wood PAWS.

Timing of effect

The potential effect will occur during Phase 4B only which is already consented and which will be partly stripped of soil and extracted in the second half of 2020, with the remainder of Phase 4B to be stripped of soils during the spring and summer of 2021.

Duration of effect

The duration of Phase 4B will be 2.6 years.

Magnitude of effect

The potential negative effect based upon the application site boundary (as opposed to the approved limits of extraction) would be realised across *c.* 33% of the Clamp Wood ASNW and *c.* 16% of Clamp Wood PAWS.

Reversibility of the effect

The potential negative effect is mortality to trees and vegetation as a result of severance, damage or compaction of roots. If the effect occurs it is not likely to be reversible.

Likelihood of a significant negative effect

In the absence of mitigation, impacts upon ASNW and PAWS are likely to be significant because the negative effects are not reversible.

7.7.2 Habitats EcIA (Important hedgerows, S41 habitats & LBAP habitats):

Type of effect

The type of the effects comprises physical loss and then compensation through restoration of habitats.

Extent of effect

Of the five hedgerows which are 'important' under the *Hedgerows Regulations 1997*, two will be retained within the proposed development and three will be lost. A strategy for the avoidance of a significant negative effect upon retained 'important' hedgerows is presented at sub-section 7.7. The extent of effects on 'important' hedgerows which will be lost is considered further.

S41 Habitats/LBAP Habitats will experience alterations to the extent of surface area as a result of the proposed development. The extent of effects is therefore considered further in relation to impacts upon S41/LBAP Habitats; Hedgerows.

Reference to the EcIA Spreadsheet calculations demonstrates that losses will be phased. A full breakdown of the extent of habitat losses associated with each phase of the development is provided in the EcIA report which is provided at Appendix 7.1. In summary; -

- Important hedgerows will experience the greatest loss during Phase 9 when the resource will be 0.32 ha less than the baseline. Restoration will see an overall increase of 1.08 ha in the extent of Important hedgerows; and

- S41 & LBAP Hedgerows will experience the greatest loss during Phase 8 when the resource will be 1.85 ha less than the baseline. Restoration will not fully reinstate the baseline extent of S41 & LBAP Hedgerows and a 1.5 ha negative residual effect has been identified.

Timing of effect

The timing of the negative effects of habitat loss and the compensatory effect of habitat reinstatement will be determined by each phase of the development, as follows: **a)** Phase 5 in Year 1; **b)** Phase 6 in Year 4; **c)** Phase 7 in Year 7; **d)** Phase 8 in Year 10; **e)** Phase 9 in Year 13; and, **f)** Restoration Phase in Year 15 & 16.

Duration of effect

Crosher *et al.* (2019) suggest that hedgerows take one, five or 10 years to be recreated to a 'Poor', 'Medium' or 'Good' condition, respectively. The duration of the negative effects will therefore be: -

- Important hedgerows - minimum of 10 years following recreation of hedgerow habitat;
- S41/LBAP habitat (hedgerows) – minimum of one year following recreation of hedgerow habitat.

Magnitude of effect

The magnitude of the effects comprises the surface area of the habitat loss, considered in combination with the time of loss and the interval between the loss and the compensatory provision becoming fully established. Therefore, the overall magnitude of effects is:

- **Important Hedgerows:**
  - A maximum loss of 0.32 ha of important hedgerows during Phase 9;
  - A maximum period of 25 years during which important hedgerows will be reduced in extent (15 years during the development and 10 years for newly planted hedgerows to achieve 'Good' condition (Crosher *et al.* 2019)).

- **S41/LBAP Hedgerows:**
  - A maximum loss of 1.85 ha of S41/LBAP hedgerows during Phase 8;
  - A maximum period of 16 years during which S41/LBAP hedgerows will be reduced in extent (15 years during the development and 1 year for newly planted hedgerows to achieve even 'Poor' condition (Crosher *et al.* 2019)). Note: the baseline extent of S41 & LBAP Hedgerows will not be reinstated and a 1.5 ha negative residual effect has been identified.

Reversibility of the effect

Hedges recreated within the restoration will be designed to accord with the criteria for 'important' under the *Hedgerows Regulations (1997).* Although it will take time (*c.* 10 years (Crosher *et al.* 2019)) for the newly created hedgerows to become established and be considered to be in a 'Good' condition. With the proposed aftercare management, the hedge condition will improve year on year, and it is anticipated that the compensatory habitat will then remain in perpetuity. The negative effect on 'important' hedgerows brought about by habitat losses during the development will be reversed; 0.59 ha will be temporarily lost, only to be reinstated and increased to an overall 1.67 ha.

Despite the increase in the diversity of planting within the greater proportion of hedgerow restoration, the final provision will be 1.68 ha; a 1.5 ha decrease in that originally present. this is to accommodate a greater surface area of three additional S41 habitats, comprising: -

- 23.6 ha of newly planted broadleaved woodland which will accord with the S41 habitat Lowland Mixed Deciduous Woodland;
- 9.6 ha of species rich neutral grassland which will be managed to accord with the S41 habitat Lowland Meadows; and
- 1.5 ha of species rich neutral grassland will be created at the margins of arable agricultural land and will be managed to accord with the S41 habitat Arable field margins.

Likelihood of a significant negative effect

The 1.5 ha decrease in hedgerows comprises species-poor hedges of unexceptional structure. There are no grounds to suggest these hedges support uncommon assemblages of taxa or species. The development will very nearly treble the area of species-rich hedges, which will be sympathetically managed for wildlife, and effectively exchange a degraded example of one S41 / LBAP habitat for a smaller area of a qualitatively better example. Overall, there are no grounds to predict a significant negative effect as a result of this strategy.

7.7.3 Invertebrate EcIA

Type of effect

Negative effects will comprise: a) reduction of range due to physical habitat loss; b) potential mortality of larvae and adults resulting from vegetation clearance; c) attraction into inhospitable situations in response to lighting; d)

displacement from habitat by lighting; and, e) interference to activity through lighting.

Extent of effect

Physical habitat losses

A calculation was made in the EcIA Spreadsheet to identify how much of the original baseline habitat resource is lost to each invertebrate IEF during each phase of the development, and how much habitat resource is reinstated within the progressive (phased) restoration. This allows the cumulative habitat resource to be calculated by summing the extent of habitat which will be retained with the extent of habitat which will be reinstated.

A full breakdown of the extent of habitat losses associated with each phase of the development is provided in the EcIA report which is provided at Appendix 7.1. In summary: **a)** no S41 invertebrate species will experience total loss of habitat from within the Application Site as a result of the proposed development; **b)** no S41 invertebrate species will experience net reduction in habitat available to them; **c)** three S41 invertebrate species will have the same extent of habitat available to them as a result of the development; and **d)** 46 S41 invertebrate species will experience a net gain in the extent of habitat available to them as a result of the proposed development.

However, in order to ensure that the predicted increase in surface area available to each invertebrate IEF is delivered, species specific larval food plants will be included within the proposed restoration habitats. Details of the larval food plants are provided at sub-section 7.8.

Lighting impacts

The maximum extent to which lighting impacts can be predicted to have the potential to have an attraction effect on invertebrate fauna is a zone measuring a *c.* 23 m (Degen *et al.* 2016) radius around each fixed lighting unit. This effectively restricts the impacts brought about by lighting to *c.* 1.41 ha of land within the consented Stanninghall Quarry alone, and relating to six Phase 1 habitats types, as follows: -

1. A1.1.2 – Broadleaved plantation woodland (0.01 ha);
2. G1 – Open standing water (0.04 ha);
3. I2.1 – Quarry (0.97 ha);
4. J1.3 – Ephemeral/short perennial (0.16 ha);
5. J3.6 – Miscellaneous / Buildings (0.06 ha); and
6. J4 – Bare ground (0.17 ha).

Timing of effect

Physical habitat losses

The timing of the negative effects of habitat loss and the compensatory effect of habitat reinstatement will be determined by each phase of the development, as follows: **a)** Phase 5 in Year 1; **b)** Phase 6 in Year 4; **c)** Phase 7 in Year 7; **d)** Phase 8 in Year 10; **e)** Phase 9 in Year 13; and, **f)** Restoration Phase in Year 15 & 16.

Lighting impacts

The invertebrates that might be at risk of a negative effect as a result of anthropogenic lighting would have to be active within the period the lighting was in operation. The nocturnal and diurnal species and the months in which they were active were identified and compared with the hours in which the lighting can be predicted to be required. The results are provided for review in the EcIA Spreadsheet and in summary:

- 1 beetle species is active in the day and will therefore experience no negative effects;
- 37 moth species are not active in the months, in habitats, or at times when lighting will be in operation and will therefore experience no negative effects; and
- 11 moth species will be active in the period that lighting will be in operation for up to 49 minutes at dusk in October and 1 hour and 20

minutes at dusk in November, comprising: 1) streak; 2) dusky thorn; 3) September thorn; 4) figure of eight; 5) autumnal rustic; 6) deep-brown dart; 7) green-brindled crescent; 8) brown-spot pinion; 9) beaded chestnut; 10) sallow; and, 11) rosy rustic.

Duration of effect

Physical habitat losses

In-line with the proposed phasing, in summary: -

- Five species will not experience any contraction of habitat from baseline extents throughout the development; and
- The remaining 44 species will experience a contraction of habitat for the duration of the development; a minimum of 15 years. However, all 44 species will see an increase in habitat from baseline extents following final restoration and the aftercare period.

Lighting impacts

Lighting impacts will occur up until 2038 which is c. 15 years longer than already consented.

Frequency of the effects

Lighting impacts

The frequency of the lighting impact will be weekly, comprising five evenings out of seven in October and November.

Magnitude of effect

Physical habitat losses

No permanent habitat loss effect has been identified for any invertebrate IEF, and as such the magnitude of the effect is not quantifiable.

Lighting impacts

The magnitude of the attraction effect caused by lighting impacts relates to the percentage of habitat available to each invertebrate species and the proportion that will be subject to a lighting impact. The magnitude of the lighting impact is fully quantified in the EcIA report which is provided at Appendix 7.1. In summary, of the 11 invertebrate IEF which are vulnerable to lighting impacts: -

- Five species will experience a negative effect of Low magnitude, comprising: 1) Dusky thorn; 2) September thorn; 3) Figure of eight; 4) Deep-brown dart; and 5) Green-brindled crescent; and
- Six species will experience a negative effect of Negligible magnitude, comprising: 1) Streak; 2) Autumnal rustic; 3) Brown-spot pinion; 4) Beaded chestnut; 5) Sallow; and, 6) Rosy rustic.

Reversibility of the effect

Physical habitat losses

The negative effects brought about by physical habitat losses during the development can and will be compensated by the reinstatement of habitats within the restoration. All negative effects are reversible and will be reversed.

The reversibility of negative effects in respect of mortality relies upon there being a population of the species in the wider locale, that might re-colonise the site following the development. The restoration will see the site restored to agricultural land with extensive broadleaved woodland, species rich grassland and hedgerows. As all the habitats which will be lost have a

superabundance within the wider locale, there is no reason to suppose the effects will not be reversed.

Lighting impacts

The negative effects of lighting can be reversed simply by decommissioning the lighting (i.e. switching off the lights).

Likelihood of a significant negative effect

Physical habitat losses

No residual habitat losses have been identified in respect of invertebrate IEF. Therefore, there are no grounds to predict a significant negative effect upon invertebrate IEF as a result of physical habitat loss.

Lighting impacts

Eleven invertebrate IEF will experience lighting impacts. The magnitudes of light-spill impacts are negligible for six invertebrate IEF and low for five invertebrate IEF. Furthermore, over two nights out of every seven the lighting will not be in operation at all, and the lighting is never on all night. Therefore, although moths might be attracted to the light, it will be extinguished while all species are still active, and they will therefore move away from sterile areas for the remaining period of the night.

Applying a process of deductive reasoning, in terms of the 11 moth species, for there to be an effect of sufficient magnitude for it to be significantly negative, there would first have to be a population resident within the existing consented Stanninghall Quarry that could perceive the lighting. As the lighting has been present within the quarry for the life of the development, it pre-exists the habitats that have developed in worked-out margins and on restored ground. Therefore, if the species is still present, it must co-exist and sustain its populations despite any attraction effect. Science has yet to establish, what a significant population size would be within a specific surface area for the individual moth species. As a result, predicting a numerical magnitude is impossible. However, it can reasonably be assumed that if the species do occur within the quarry at all, the magnitude of the negative effect is not significantly deleterious.

On balance a significant negative effect as a result of lighting is considered **not likely**.

7.7.4 Amphibian EcIA

Type of effect

Negative effects upon common toads will comprise: a) reduction in range due to physical habitat loss; and, b) potential mortality resulting from vegetation clearance. As common toads do not use sound to locate mates and do not appear to be negatively affected by light, anthropogenic noise and lighting are scoped-out in this context.

Extent of effect

A calculation was made in the EcIA Spreadsheet to identify how much of the original baseline habitat resource is lost to common toads during each phase of the development, and how much habitat resource is reinstated within the progressive (phased) restoration. This allows the cumulative habitat resource to be calculated by summing the extent of habitat which will be retained with the extent of habitat which will be reinstated.

The cumulative resource assessment demonstrates that although existing habitat will be lost as habitats within the Proposed Extension are lost to quarrying, land will be progressively restored and made available to common toads. Overall common toads will not see a reduction in habitat extent available to them from the baseline extent in any phase of the proposed development and will see an overall net gain of 10.79 ha of habitat available to them at the end of the development. Negative effects on common toads resulting from habitat losses are therefore not considered further.

Notwithstanding the fact that the overall surface area available to common toads will not decrease, there remains a potential for injury and mortality to this S41 Species when existing habitat is stripped in Phases 5, 6, 7, 8 and 9 and when soil bunds are taken down for the final restoration.

Timing of effect

The potential for mortality to occur will be during soil-stripping and restoration operations in the following years: **a)** Phase 5 in Year 1; **b)** Phase 6 in Year 4; **c)** Phase 7 in Year 7; **d)** Phase 8 in Year 10; **e)** Phase 9 in Year 13; and, **f)** Restoration Phase in Year 15 & 16.

Duration of effect

Soil-stripping will occur in discrete operations lasting for a few weeks at a time. The duration of the effect will therefore be short and bares no relevance to the effect of mortality.

Frequency of effect

The frequency of mortality risk would be in-line with each soil-strip and restoration operations and therefore five-fold.

Magnitude of effect

The magnitude of potential mortality cannot be meaningfully quantified in the absence of a population estimate. However, the absence of a breeding pond within the Application Site suggests magnitude would not be significant.

Reversibility of the effect

The reversibility of negative effects in respect of mortality relies upon there being a population of the species in the wider locale, that might re-colonise the site following the development. As all the habitats present within the Application Site have a superabundance within the wider locale, there is no reason to suppose the effects will not be reversed. Notwithstanding, the potential for mortality can be anticipated and safeguarded against by an appropriate avoidance strategy, which is offered at sub-section 7.8. All negative effects are therefore reversible.

Likelihood of a significant negative effect

The potential negative effect identified will be fully reversible and a significant negative effect upon common toads is therefore not likely.

7.7.5 Bird EcIA

Type of effect

Negative effects upon avifauna will comprise: **a)** reduction in range due to physical habitat loss; **b)** potential mortality of dependent young resulting from vegetation clearance; **c)** fear induced desertion of dependent young through the noise effect of quarry plant; **d)** reduced recruitment due to the distraction effect of noise; **e)** masking of mating song; **f)** disturbance through sleep deprivation due to noise; and, **g)** displacement of nesting territories due to light-spill.

Extent of effect

Physical habitat losses

A calculation was made in the EcIA Spreadsheet to identify how much of the original baseline habitat resource is lost to each species of bird during each phase of the development, and how much habitat resource is reinstated within the progressive (phased) restoration. This allows the cumulative habitat resource to be calculated by summing the extent of habitat which will be retained with the extent of habitat which will be reinstated.

A full breakdown of the extent of habitat losses associated with each phase of the development is provided in the EcIA report which is provided at Appendix 7.1. In summary: **a)** no species will experience total loss of habitat as a result of the proposed development; **b)** 11 S41 bird species will experience a net gain in the extent of habitat available to them; **c)** two S41 bird species will have the same extent of habitat available to them; and **d)**

six S41 bird species will experience a residual net loss in habitat extent available to them, comprising: **1)** Grey partridge – 4.54 ha loss; **2)** Quail – 3.04 ha loss; **3)** Lapwing – 3.04 ha loss; **4)** Skylark – 3.04 ha loss; **5)** House sparrow – 11.73 ha loss; and, **6)** Corn bunting – 3.04 ha loss.

Noise impacts

The extent to which noise impacts have the potential to affect birds is a distance equivalent to a *c.* 68 dB(A) sound level; beyond this bird song is equal in amplitude (AEcol own data). Quarry sound is attenuated to below this level by the bunds, which means that there will be no off-site noise effects. This effectively restricts the impacts brought about by noise to *c.* 2.69 ha of land within the Application Site, and relating to 10 Phase 1 habitats types, as follows: -

1. A1.1.2 – Broadleaved plantation woodland (0.14 ha);
2. A2.1 – Dense scrub (0.01 ha);
3. B6 – Poor semi-improved grassland (0.06 ha);
4. C3.1 – Tall ruderal vegetation (0.01 ha);
5. G1 – Standing water (0.24 ha);
6. I2.1 – Quarry (1.84 ha);
7. J1.1 – Arable land (0.004 ha);
8. J1.3 – Ephemeral/short perennial (0.34 ha);
9. J2.3 – Hedge with trees (0.01 ha); and
10. J3.6 – Buildings (0.04 ha).

Lighting impacts

The extent to which lighting impacts have the potential to increase predation for ground-nesting birds is a *c.* 20 m radius (AEcol own data) around the fixed plant and ancillary structures. This effectively restricts the impacts brought about by lighting to *c.* 1.18 ha of land within the Application Site, and relating to six Phase 1 habitats types, as follows: -

1. A1.1.2 – Broadleaved plantation woodland (0.001 ha);
2. G1 – Standing water (0.02 ha);
3. I2.1 – Quarry (0.81 ha);
4. J1.3 – Ephemeral/short perennial (0.13ha); and
5. J3.6 – Buildings (0.06 ha); and
6. J4 – Bare ground (0.15 ha).

Timing of effect

Physical habitat losses

The timing of the negative effects of habitat loss and the compensatory effect of habitat reinstatement will be determined by each phase of the development, as follows: a) Phase 5 in Year 1; b) Phase 6 in Year 4; c) Phase 7 in Year 7; d) Phase 8 in Year 10; e) Phase 9 in Year 13; and, f) Restoration Phase in Year 15 & 16.

Noise impacts

The negative effects of noise will be most acute in the mating season, and the significance determined by a deleterious effect upon recruitment. The bird mating/nesting season is generally accepted to last from March through August, although some species (e.g. corn bunting) nest in September (Reade & Hosking 1974). The daily peak in singing is sometimes incorrectly thought of as sunrise, but in fact the peak in singing activity across all species is at dawn (hence the term 'dawn chorus'), which is typically *c.* 40 minutes before sunrise.

Although the peak in the amount of singing performed by different bird species occurs at different points in the overall nesting season, the broad period of twilight to sunrise represents the peak of song activity across all species (e.g. Mace 1987, Staicer *et al.* 1996 and see also an extensive review by Bruni (2013)). In some species there is also a lesser peak at dusk (e.g. great tit; see Hinde 1952). In order that the extent of the effect could be assessed, the range in which morning civil twilight begins and sunrise occurs, and that in which sunset occurs and civil twilight ends was investigated and is provided in the EcIA report available at Appendix 7.1.

Singing birds that might be at risk of negative effects as a result of anthropogenic noise would have to be singing within the period the quarry

noise was perceptible. The results are provided for review in the EcIA Spreadsheet and in summary: -

- One species will be potentially singing in areas overlapping the noise impact for up to 14 minutes at dusk in March, comprising 1) song thrush; and
- Two species will be potentially singing in areas overlapping the noise impact for up to 6 minutes at dawn in September, comprising: 1) quail; and, 2) corn bunting.

Lighting impacts

Ground-nesting birds that might be at risk of increased predation as a result of anthropogenic lighting would have to nest in the period of the year that the lighting will be in operation. The results of the lighting impact assessment on nesting birds are provided for review in the EcIA Spreadsheet, but in summary: -

- Two species are not predicted to occur in the Application Site during the breeding season and will therefore experience no negative effects, comprising: 1) lapwing; and, 2) lesser redpoll.
- 10 species do not nest on or near the ground and will therefore experience no negative effects, comprising: 1) red kite; 2) herring gull; 3) hobby; 4) starling; 5) song thrush; 6) spotted flycatcher; 7) house sparrow; 8) tree sparrow; 9) dunnock; and, 10) bullfinch.
- Eight species nest on or near the ground but not at a time of year when the lighting impact may have an effect, comprising: 1) grey partridge; 2) quail; 3) little ringed plover; 4) cuckoo; 5) skylark; 6) linnet; 7) corn bunting; and, 8) yellowhammer.

There are therefore no grounds to predict a negative effect on bird IEF as a result of lighting impacts.

Duration of effect

Physical habitat losses

Habitat losses are phased and the effects therefore have different durations; in summary: -

- Two species will not experience a contraction of habitat from baseline extents throughout the development.
- 12 species will experience a contraction of habitat for the duration of the development; a minimum of 15 years, although all 12 will see an increase in habitat extent from the baseline following final restoration and the aftercare period. These comprise: 1) red kite; 2) cuckoo; 3) hobby; 4) song thrush; 5) song thrush; 6) spotted flycatcher; 7) tree sparrow; 8) dunnock; 9) bullfinch; 10) linnet; 11) lesser redpoll; and, 12) yellowhammer.
- Six species will experience a contraction of habitat in perpetuity: 1) grey partridge; 2) quail; 3) lapwing; 4) skylark; 5) house sparrow; and, 6) corn bunting.

Noise impacts

Noise impacts will occur up until 2038 which is c. 15 years longer than already consented.

Lighting impacts

Lighting impacts will occur up until 2038 which is *c.* 15 years longer than already consented.

Frequency of effect

Noise impacts

The frequency of the plant noise impact will be weekly, comprising a maximum of five evenings out of seven in March and a maximum of six mornings out of seven in September.

Lighting impacts

The frequency of the lighting impact will be weekly, comprising five evenings out of seven in September only.

Magnitude of effect

Physical habitat losses

The magnitude of permanent habitat losses experienced by each species of bird as a result of the proposed development is quantified within the EcIA report which is available at Appendix 7.1. In summary, of a total six bird species which will experience a permanent habitat loss: -

- Two species will experience habitat loss of a Medium magnitude, comprising: 1) grey partridge; and, 2) house sparrow; and
- Four species will experience habitat loss of a Low magnitude, comprising: 1) quail; 2) lapwing; 3) skylark; and 4) corn bunting.

Noise impacts

The magnitude of the effect of noise experienced by each species of bird as a result of the proposed development is quantified within the EcIA report which is available at **Appendix 7.1**. In summary, of a total three bird species which will experience noise impacts: -

- One species will experience habitat loss of a Low magnitude, comprising: 1) song thrush; and
- Two species will experience habitat loss of a Negligible magnitude, comprising: 1) quail; and, 2) corn bunting.

Lighting impacts

No bird IEF will experience lighting impacts within Stanninghall Quarry.

Reversibility of the effect

Physical habitat losses

Negative effects brought about by habitat losses during the development can be compensated by their reinstatement within the restoration. Therefore, negative effects upon 14 bird IEF are reversible. However, the negative effects upon the six bird IEF which will experience a residual loss of habitat extent will not be reversed.

The reversibility of negative effects in respect of displacement through habitat loss relies upon there being a population of the species in the wider locale, that might re-colonise the site following the development. As all the habitats present within the Application Site have a superabundance within the wider locale, there is no reason to suppose the reinstated habitats will not be recolonised.

Noise impacts

The negative effects of noise can be reversed simply by decommissioning the plant.

Lighting impacts

The negative effects of lighting can be reversed simply by decommissioning the lighting (i.e. switching off the lights).

Likelihood of a significant negative effect

Physical habitat losses

Six bird IEF will experience residual habitat losses. The residual effect identified in respect of all six bird IEF is in relation to an overall reduction of arable land available at the end of the proposed development. This effect is of Medium magnitude for grey partridge and house sparrow and of Low magnitude for quail, lapwing, skylark and corn bunting. Notwithstanding, all

six species will continue to have a significant habitat resource available to them within the Application Site boundary (in excess of 70 ha in all cases). Furthermore, the post-development landscape will provide a more varied mosaic of habitats which are predicted to support greater biodiversity in general and management will be sympathetic.

Therefore, although each species will experience a reduction of habitat extent available to them, the quality of the habitats in terms of structure, diversity and the availability of food will be improved. The potential for the proposed development to result in a significant negative effect upon any bird IEF is therefore considered to be **not likely** on any geographic scale.

Noise impacts

Three bird IEF will experience noise impacts. Even accepting that for one day out of every seven the noise will not be emitted at all; the magnitude of the noise effect is negligible upon two bird IEF and low on one bird IEF. Notwithstanding, applying a process of deductive reasoning, in terms of the one bird species, for there to be an effect of sufficient magnitude for it to be significantly negative, there would first have to have been a population resident within Stanninghall Quarry that could perceive the noise. As the noise has been present within the quarry for the life of the development, it pre-exists the habitats that have developed in worked-out margins and on restored ground.

Furthermore, the noise does not preclude birds visiting the habitats to feed and collect food for dependent young in nesting territories outside or collect nest material. The presence of the quarry will not therefore have a deleterious effect upon nesting in the wider locale and a significant effect is **not likely.**

7.7.6 Mammals (not including bats) EcIA

Type of effect

Negative effects will comprise: **a)** reduction in range due to physical habitat loss; and, **b)** potential mortality resulting from vegetation clearance.

Extent of effect

A calculation was made in the EcIA Spreadsheet to identify how much of the original baseline habitat resource is lost to each mammal IEF during each phase of the development, and how much habitat resource is reinstated within the progressive (phased) restoration. This allows the cumulative habitat resource to be calculated by summing the extent of habitat which will be retained with the extent of habitat which will be reinstated.

A full breakdown of the extent of habitat losses associated with each phase of the development is provided in the EcIA report which is provided at Appendix 7.1. In summary: a) no S41 mammal species (excluding bats) will experience total loss of habitat as a result of the proposed development; b) no S41 mammal species will experience net reduction in habitat available to them; d) three S41 mammal species will experience a net gain in the extent of habitat available to them as a result of the proposed development.

Timing of effect

The timing of the negative effects of habitat loss and the compensatory effect of habitat reinstatement will be determined by each phase of the development, as follows: a) Phase 5 in Year 1; b) Phase 6 in Year 4; c) Phase 7 in Year 7; d) Phase 8 in Year 10; e) Phase 9 in Year 13; and, f) Restoration Phase in Year 15 & 16.

Duration of effect

The duration of habitat losses are the same for all species; in summary: all three species will experience a contraction of habitat available to them for the duration of the development; minimum of 15 years. All three species will thereafter see an increase from baseline habitat extents following final restoration and the aftercare period.

Frequency of effect

The frequency of negative effects brought about by habitat loss will comprise individual campaigns occurring at the start of each phase of extraction in: Year 1; Year 4; Year 7; Year 10 and, Year 13.

The frequency of mortality risk would be in line with each soil-strip and therefore five-fold.

Magnitude of effect

No permanent habitat loss effect has been identified for any mammal IEF (excluding bats), and as such the magnitude of the effect is not quantified.

The magnitude of mortality cannot be meaningfully quantified in the absence of a population estimate. Notwithstanding a safeguarding strategy is offered at sub-section 7.8.

Reversibility of the effect

Negative effects brought about by habitat losses during the development can be compensated by the reinstatement of semi-natural habitats within the restoration. All negative effects are reversible and will be reversed.

The reversibility of negative effects in respect of mortality relies upon there being a population of the species in the wider locale, that might re-colonise the site following the development. As all the habitats present within the Application Site have a superabundance within the wider locale and there is no reason to suppose the effects will not be reversed. Notwithstanding, the potential for mortality can be anticipated and safeguarded against by an appropriate avoidance strategy, which is offered. All negative effects are therefore reversible.

Likelihood of a significant negative effect

No residual habitat losses have been identified in respect of mammal IEF (excluding bats). There are therefore no grounds to predict that impacts will result in a significant negative effect.

7.7.7 Bats EcIA

Type of effect

Negative effects will comprise: a) reduction in range due to physical habitat loss; b) potential mortality during vegetation clearance; c) masking of sonar and prey-generated sounds by quarry noise; and, d) displacement due to light-spill.

Extent of effect

Physical habitat losses

A calculation was made in the EcIA Spreadsheet to identify how much of the original baseline habitat resource is lost to each bat IEF during each phase of the development, and how much habitat resource is reinstated within the progressive (phased) restoration. This allows the cumulative habitat resource to be calculated by summing the extent of habitat which will be retained with the extent of habitat which will be reinstated.

A full breakdown of the extent of habitat losses associated with each phase of the development is provided in the EcIA report which is provided at Appendix 7.1. In summary: a) there will continue to be a habitat resource available within the ZoI for all bat species throughout the development; and, b) compensation will return the extent of habitats exploited by all ten bat species to baseline extents. No negative residual habitat loss has been identified.

Noise impacts

Bennet and Zurcher (2013) identified the potential for 87 dB(A) noise to have a significant negative effect upon foraging bats. Noise levels only exceed 87 dB(A) within 10 m of the fixed processing plant and ready-mix concrete batching plant. No habitats potentially exploited for foraging were recorded within this 10 m buffer from the fixed plant noise emitters at Stanninghall Quarry. Therefore, the potential for noise impacts to affect forging bats is restricted to brown long-eared bats (the only ‘whispering’ bat species

potentially present) and only then in respect of suitable foraging habitats within the confines of the screening/noise attenuation bunds which surround the existing working quarry, beyond which no quarry noise is perceptible above the background noise level.

The noise ZoI in respect of brown long-eared bats therefore encompasses c. 5.44 ha of land within the Application Site which is potential foraging habitat for the species, comprising: -

A1.1.2 – Broadleaved plantation woodland (3.72 ha);
J2.1 – Intact hedge (0.27 ha);
J2.2 – Defunct hedge (0.18 ha); and
J2.3 – Hedge with trees (1.27 ha).

Notwithstanding, a brown long-eared bat has been recorded roosting within the mixed plantation woodland on the edge of the noise ZoI, which demonstrates that the species has not been excluded from the wider Application Site.

Lighting impacts

The extent to which lighting impacts have the potential to result in avoidance behaviour is a radius around fixed lighting of between *c.* 10 - 50 m depending on the bat species (Azam *et al.* 2018). Of those species that exhibit avoidance behaviour, *Myotis* species appear most sensitive, and barbastelle and serotine the least. In the context of this application, this effectively restricts the lighting ZoI to either *c.* 0.56 ha (based on the 10 m effect for *Myotis* spp.) or *c.* 3.75 ha (based on the 50 m effect for barbastelle and serotine) of land within Stanninghall Quarry alone, and relating to 11 Phase 1 habitat types, as follows (**Note:** habitat surface areas are presented as a range between the minimum impact of 10 m radius and the maximum impact of 50 m radius): -

1. A1.1.2 – Broadleaved plantation woodland (0 - 0.13 ha);
2. A2.1 – Continuous scrub (0 - 0.01 ha);
3. B6 – Poor semi-improved grassland (0 - 0.04 ha);
4. C3.1 – Tall ruderal vegetation (0 - 0.01 ha);
5. G1 – Open standing water (0 - 0.22 ha);
6. I2.1 – Quarry (operational sand and gravel) (0.37 - 2.44 ha);
7. J1.1 – Arable land (0 - 0.01 ha);
8. J1.3 – Ephemeral/short perennial vegetation (0.04 - 0.55 ha);
9. J2.3.2 – Hedge with trees (0 - 0.01 ha);
10. J3.6 – Buildings (quarry structures) (0.06 - 0.06 ha); and
11. J4 – Bare ground (asphalt) (0.10 - 0.29 ha).

Timing of effect

Physical habitat losses

The timing of the negative effects of habitat loss and the compensatory effect of habitat reinstatement will be determined by each phase of the development, as follows: **a)** Phase 5 in Year 1; **b)** Phase 6 in Year 4; **c)** Phase 7 in Year 7; **d)** Phase 8 in Year 10; **e)** Phase 9 in Year 13; and, **f)** Restoration Phase in Year 15 & 16.

Noise and lighting impacts

In western Europe bats follow a relatively stable annual cycle with activity from March through October and long periods of torpor in the period November through February (Dietz et al. 2011). During the active period bats are nocturnal and emerge each evening to hunt. Navigation is achieved through a combination of sight and ultrasonic echolocation through vocalisation. In order to define the temporal 'window' within which individual species emerge from their roost to forage, and return to the roost before sunrise, Andrews & Pearson (2016) reviewed empirical data reported for bat species occurring in the UK. In order to assess whether noise might impair any bat species' ability to navigate and hunt by the use of echolocation, or lighting might displace any species from even the immediate vicinity of the plant, the range in which sunset occurs and in which morning sunrise occurs was used to identify the earliest in the evening and latest in the morning bats would be likely to be on the wing.

Noise impacts summary

Brown long-eared bats are the only bat species which might be at risk of negative effects as a result of anthropogenic noise. Brown long-eared bats

would have to be active within the period the noise was perceptible for there to be a negative effect. The results are provided for review in the EcIA Spreadsheet and in summary: -

Brown long-eared bat will be potentially active in periods overlapping the noise impact for up to 54 minutes at dusk in March; and, up to 2 hours and 3 minutes at dusk in October.

Lighting impacts summary

Bats that might be at risk of negative effects as a result of anthropogenic lighting would have to be active within the period lighting is operational. The results are provided for review in the EcIA Spreadsheet and in summary: -

Six species (barbastelle, serotine, Brandt's bat, Daubenton's bat, whiskered bat, and Natterer's bat) will be potentially active in areas overlapping the lighting impact for up to 26 minutes at dusk in March; and, up to 1 hour and 35 minutes at dusk in October.

Duration of effect

Physical habitat losses

In-line with the proposed phasing, all ten bat species will experience a contraction of habitat for the duration of the development; minimum of 15 years. All ten species will see an increase in habitat from baseline extents following final restoration and the aftercare period.

Noise impacts

Noise impacts will occur up until 2038 which is c. 15 years longer than already consented.

Lighting impacts

Lighting impacts will occur up until 2038 which is c. 15 years longer than already consented.

Frequency of effect

Physical habitat losses

The frequency of negative effects brought about by habitat loss will comprise individual campaigns occurring at the start of each phase of extraction in Year 1, Year 4, Year 7, Year 10 and Year 13.

The frequency of mortality risk would be in line with each soil-strip and infilling phase and therefore five-fold.

Noise impacts

The frequency of the plant noise impact will be weekly, comprising six mornings and five evenings out of seven in March, September and October.

Lighting impacts

The frequency of the lighting impact will be weekly, comprising six mornings and five evenings out of seven in March, September and October.

Magnitude of effect

Physical habitat losses

No bat species will experience residual habitat loss as a result of the proposed development and all known roost trees are to be retained within the full extent of their woodland context. However, there remains a potential for a significant negative effect caused by the delay in time between foraging habitat loss and reinstatement. This is therefore assessed further.

Habitat losses will be experienced by bats at the start of each working phase (Phases 5 through 9). In addition to this, the habitat loss calculation in the EcIA Spreadsheet takes into consideration the change in habitat extent from the Baseline situation to the current situation. This is not a 'real' loss of habitat; rather it represents the extent of habitat which will not be re-instated, due to the extension of time required by the proposed extension. The

calculation of habitat loss in the EcIA Spreadsheet identifies that the greatest 'loss' in foraging habitat extent for seven species is caused by this delay of habitat creation and is not a 'real' loss of habitat. In order to quantify the greatest magnitude of habitat loss experienced by each species, the change in habitat extent between the baseline and the current situation is disregarded and the magnitude of the next greatest extent of habitat loss is quantified.

Phase 5 of the development will see the greatest extent of habitat loss for seven bat species, comprising: 1) barbastelle; 2) Brandt's bat; 3) whiskered bat; 4) Natterer's bat; 5) noctule; 6) Nathusius' pipistrelle; and, 7) brown long-eared bat.

Phase 7 of the development will see the greatest extent of habitat loss for seven bat species, comprising: 1) serotine; 2) Leisler's bat; 3) common pipistrelle; and, 4) soprano pipistrelle.

Following this, bat foraging habitat will be progressively restored, and the extent of foraging habitat available to each species will be returned to at least baseline extents.

The magnitude of maximum negative effect upon bat IEF is quantified in the EcIA report which is provided at Appendix 7.1. In summary, all 11 bat species will experience habitat loss of High magnitude at some point during the development, although the habitat will be fully reinstated at the restoration stage.

The magnitude of mortality cannot be meaningfully quantified in the absence of a population estimate. Notwithstanding a safeguarding strategy will be offered at sub-section 7.8 to avoid this eventuality (within reasonable limits).

Noise impacts

The magnitude of the negative effect caused by noise impacts relates to the percentage of habitat available to each bat species which will experience impacts from noise. Noise impacts will only effect brown long-eared bats only, and the magnitude of the impact is Very high. The magnitude of maximum negative effect upon bat IEF is quantified in the EcIA report which is provided at **Appendix 7.1**. Notwithstanding, the noise impacts identified only relate to the periods at dusk and dawn when bats are active during operational hours.

Lighting impacts

The magnitude of the negative effect caused by lighting impacts relates to the percentage of habitat available to each bat species which will experience impacts from lighting. The magnitude of maximum negative effect upon bat IEF is quantified in the EcIA report which is provided at Appendix 7.1. In summary, two bat species will experience a negative effect of Low magnitude, comprising: **1)** barbastelle; and, **2)** serotine. Notwithstanding, this would only relate to the periods at dusk and dawn when bats are active during operational hours.

Reversibility of the effect

Physical habitat losses

Negative effects brought about by habitat losses during the development can be compensated by the creation of semi-natural habitats within the restoration.

The reversibility of negative effects in respect of mortality relies upon there being a population of the species in the wider locale that might re-colonise the site following the development.

As all the habitats present within the Application Site have a superabundance within the wider locale, there is no reason to suppose the effects will not be reversed.

Notwithstanding, the potential for mortality can be anticipated and safeguarded against by an appropriate avoidance strategy, which is offered at sub-section 7.8. All negative effects are therefore reversible.

Noise impacts

The negative effects of noise can be reversed simply by decommissioning the plant.

Lighting impacts

The negative effects of lighting can be reversed simply by decommissioning the lighting (i.e. switching off the lights).

Likelihood of a significant negative effect

Physical habitat losses

No residual loss of bat foraging habitat has been identified for any species of bat. However, all bat IEF will experience habitat loss of high magnitude at some point during the proposed development due to the delayed restoration of the quarry and the phased working scheme. Notwithstanding, compensation will return the extent of habitats exploited by all bat IEF to baseline extents, although this will take *c.* 15 years longer than that already consented.

The barbastelle has a British IUCN status of Vulnerable (Mathews *et al.* 2018) and data is deficient on their population trend (Bat Conservation Trust 2019). The status of barbastelle within the Application Site was determined during the 2019 bat survey (AEcol 2019c). Foraging contacts were recorded on one hedgerow out of nine sampled, on a single night during an eight-night survey (AEcol 2019c). The restoration strategy will see the creation of *c.* 25 ha of species rich woodland and *c.* 1.7 ha (relating to c. 6.7 km) of species rich hedgerows. Both habitat types can be predicted to be of High value to foraging barbastelles. Therefore, although it is possible that low numbers of barbastelles might be displaced from the Application Site during the development, as this negative impact is fully reversible and the resulting landscape will be of greater value to the species than in the current situation, a significant negative effect upon barbastelles is considered to be **not likely** at any geographic scale**.**

The serotine has British IUCN status of Vulnerable (Mathews *et al.* 2018) but a stable population trend (Bat Conservation Trust 2019). On the basis of the available evidence, the negative effect of physical habitat loss identified will be fully reversible and a significant negative effect upon serotine is considered to be **not likely.**

Brandt's bats have a British IUCN status of Data Deficient (Mathews *et al.* 2018) but a stable population trend (Bat Conservation Trust 2019). On the basis of the available evidence, the negative effect of physical habitat loss identified will be fully reversible and a significant negative effect upon Brandt's bats is considered to be **not likely.**

Whiskered bats have a British IUCN status of Data Deficient (Mathews *et al.* 2018) but a stable population trend (Bat Conservation Trust 2019). On the basis of the available evidence, the negative effect of physical habitat loss identified will be fully reversible and a significant negative effect upon whiskered bats is considered to be **not likely.**

Natterer's bats have a British IUCN status of Least Concern (Mathews *et al.* 2018) and an increasing population trend (Bat Conservation Trust 2019). On the basis of the available evidence, the negative effect of physical habitat loss identified will be fully reversible and a significant negative effect upon Natterer's bats is considered to be **not likely.**

Leisler's bats have a British IUCN status of Near Threatened (Mathews *et al.* 2018) and data is deficient on their population trend (Bat Conservation Trust 2019). The status of Leisler's bat was determined during the 2019 bat survey (AEcol 2019c). The presence of Leisler's bat was confirmed within the Application Site by foraging contacts recorded on one hedgerow out of nine sampled, on a single night during an eight-night survey (AEcol 2019c). The survey and analysis concluded that habitats within the Application Site are of the Lowest value to foraging Leisler's bat (AEcol 2019c).

The restoration strategy will see the creation of *c.* 25 ha of species rich woodland and *c.* 1.7 ha (relating to c. 6.7 km) of species rich hedgerows. Both habitat types can be predicted to be of High value to foraging Leisler's bats. Therefore, although it is possible that low numbers of Leisler's bat might be displaced from the Application Site during the development, as this

negative impact is fully reversible and the resulting landscape will be of greater value to the species than in the current situation, a significant negative effect upon Leisler's bats is considered to be **not likely** at any geographic scale**.**

Noctules have a British IUCN status of Least Concern (Mathews *et al.* 2018) and a stable population trend (Bat Conservation Trust 2019). On the basis of the available evidence, the negative effect of physical habitat loss identified will be fully reversible and a significant negative effect upon noctules is considered to be **not likely.**

Nathusius' pipistrelle have a British IUCN status of Near Threatened (Mathews *et al.* 2018) and an unknown population trend (Bat Conservation Trust 2019). The status of Nathusius' pipistrelle within the Application Site was determined during the 2019 bat survey, with foraging contacts recorded on one hedgerow out of nine sampled, on three nights during an eight-night survey (AEcol 2019c). The restoration strategy will see the creation of *c.* 25 ha of species rich woodland and *c.* 1.7 ha (relating to c. 6.7 km) of species rich hedgerows. Both habitat types can be predicted to be of High value to foraging Nathusius' pipistrelle. Therefore, although it is possible that low numbers of Nathusius' pipistrelle might be displaced from the Application Site during the development, as this negative impact is fully reversible and the resulting landscape will be of greater value to the species than in the current situation, a significant negative effect upon Nathusius' pipistrelle is considered to be **not likely** at any geographic scale**.**

Common pipistrelles have a British IUCN status of Least Concern (Mathews *et al.* 2018) and an increasing population trend (Bat Conservation Trust 2019). On the basis of the available evidence, the negative effect of physical habitat loss identified will be fully reversible and a significant negative effect upon common pipistrelle is considered to be **not likely.**

Soprano pipistrelles have a British IUCN status of Least Concern (Mathews *et al.* 2018) and a stable population trend (Bat Conservation Trust 2019). On the basis of the available evidence, the negative effect of physical habitat loss identified will be fully reversible and a significant negative effect upon soprano pipistrelle is considered to be **not likely.**

Brown long-eared bats have a British IUCN status of Least Concern (Mathews *et al.* 2018) and a stable population trend (Bat Conservation Trust 2019). On the basis of the available evidence, the negative effect of physical habitat loss identified will be fully reversible and a significant negative effect upon brown long-eared bat is considered to be **not likely.**

Noise impacts

Potential noise impacts upon bats will only effect brown long-eared bats, but at their greatest may be of **Very High** magnitude. However, the impacts identified can only result in a negative effect on brown long-eared bats during the periods at dusk when the bats are active during operational hours: this restricts the impact to March and October at dusk only. The impact identified is at its greatest at dusk in October for a period of up to 2 hours hour and 3 minutes. After this period the full extent of the Application Site is available to foraging brown long-eared bats.

Lighting impacts

Two bat IEF will potentially experience lighting impacts, comprising: **1)** barbastelle; and, **2)** serotine. The assessment of the significance of this impact is performed in the EcIA report which is available at Appendix 7.1.

In summary, lighting impacts upon bats are at their greatest of low magnitude. However, the impacts identified will only effect bats during the periods at dusk when bats are active during operational hours in March and October. This impact is therefore at its greatest at dusk in October for a period of 1 hour and 35 minutes. After this period the full extent of the Application Site is available to foraging bats.

Notwithstanding, barbastelle is a 'Vulnerable' species with an unknown population trend and Serotine as a 'Vulnerable' species with a stable population (Bat Conservation Trust 2019).

Applying a process of deductive reasoning, in terms of the barbastelle and serotine, for there to be an effect of sufficient magnitude for it to be significantly negative, there would first have to be a population in dependent upon the habitats within the existing consented quarry that could perceive

the lighting. As the lighting has been present within the quarry for the life of the development, it pre-exists the habitats that have developed in worked-out margins and on restored ground. Therefore, as the two species are still present (AEcol 2019c), they must co-exist and sustain their populations despite any effect. It can therefore reasonably be accepted that if the species do occur within the quarry, the magnitude of the negative effect is not significantly deleterious.

There are certainly no grounds to predict the lighting effect would be significant at a national or county level, and both common sense and deductive argument lead to the rational conclusion that a significant negative effect is **not likely**.

7.8 Proposed Mitigation – Habitats

7.8.1 Strategy for the avoidance of a significant negative effect upon Ancient Semi-natural Woodland and Plantation on Ancient Woodland Site

In order to avoid impacts to the ASNW and PAWS a physical stand-off has been calculated using the Derived Root System Radius (DRSR) (Andrews *et al.* 2019) which will be maintained throughout the proposed development. The stand-off has been calculated using measurements of trees and shrubs along the woodland edge, taken by Gemma Holmes in June 2020, and processing of the data using the DRSR. The full results are set out within the EcIA report which is provided at Appendix 7.1.

In summary, to ensure the stand-off is sufficient to avoid impacts to all tree species, an appropriate tree-specific stand-off will be applied in which no heavy plant will operate, no soil or overburden will be stored, and no excavation will occur. The recommended stand-off is shown at Figure 7-2 and the stand-off distances from each mature tree along the woodland edge are detailed in Table 7-1.

Figure 7-2. The recommended ASNW and PAWS stand-off

With the implementation of the stand-off, the potential for a significant negative effect upon Clamp Wood ASNW and PAWS is considered to be **not likely.**

Table 7-1. The recommended stand-off from trees along the ASNW and PAWS woodland edge. N.B. Trees are numbered from 1 in the north to 11 in the south.

Tree number	Tree species	Tree location	Recommended stand-off (DRSR) (m)
1	Ash *Fraxinus excelsior*	TG 25141 18363	30
2	Pedunculate oak *Quercus robur*	TG 25151 18342	27
3	Aspen *Populus tremulous*	TG 25159 18321	24
4	Aspen	TG 25170 18295	30
5	Ash	TG 25178 18275	21
6	Pedunculate oak	TG 25185 18253	39
7	Ash	TG 25197 18232	30
8	Ash	TG 25211 18208	21
9	Ash	TG 25221 18185	27
10	Ash	TG 25231 18166	27
11	Ash	TG 25241 18146	39

7.8.2 Strategy for the avoidance of a significant negative effect upon retained hedgerows

The two 'important' hedgerows which will be retained throughout the proposed development comprise: **a)** Hedgerow 1; and, **b)** Hedgerow 11 (see Figure 7.3).

Figure 7-3 Important hedgerows which will be retained throughout the development

These hedgerows are boundary hedgerows located on the northern and western site boundary respectively. In order to avoid the potential for

degradation to these hedgerows for the duration of the development, the following strategy is recommended:

Prior to any operation taking place within the extension land, a 2.5 m wide root protection area will be demarked with post and wire fencing from the maximum extent of the woody growth on the hedgerow that is to be retained on the northern and western boundary. The root protection area will be extended to provide an appropriate stand-off from mature trees where they are present, in-line with the tree protection plan. Thereafter this stand-off fence will be maintained for the duration of the development, and no excavation, compaction or placement of soils will occur within this corridor. ***Reason:*** *To safeguard hedgerows which are Important under the Hedgerows Regulations (1997).*

7.8.3 Strategy for the establishment and management of restored S41 habitats

The restoration will see the creation of four habitat types which will be managed to create habitats which accord with the following S41 Habitats: **1)** Lowland mixed deciduous woodland; **2)** Lowland meadows; **3)** Arable field margins; and, **4)** Hedgerows, which will be planted to accord with the criteria for 'important' hedgerows under the *Hedgerows Regulation 1997*. In order that all four habitats accord with the criteria for S41 Habitats, the following strategy is recommended:

Lowland mixed deciduous woodland

Woodland will be planted to the species composition, size and spacings as detailed in the restoration proposals. Trees will be protected from damage by rodents and deer using tree guards and each area of woodland will be stock fenced. Planting will be maintained by the use of chemical spray containing Glyphosate to supress competitive grasses and permit rapid establishment. A 1.0m diameter weed free area will be maintained around each tree and shrub. Any plants dying during the planting aftercare period will be replaced with a size and species to accord with the condition of the woodland at the time to maintain 100% stocking rate during the aftercare period and to achieve a minimum 90% stocking rate upon final restoration. Any plants loosened by frost or wind will be firmed up and any damaged branches will be removed using a sharp pruning knife. At the end of the aftercare period, or before, should the tree growth warrant it, the shelters will be removed from the planting.

Lowland meadow

Lowland meadows will be seeded with the species rich grassland mix proposed in the restoration scheme and managed to encourage rapid establishment. Annual management will be as a hay meadow. In the first year the grass sward will be mown to a height of 100 mm in June/July and again in August/September to promote establishment (unless growth rates or climatic conditions indicate otherwise). In following years, the sward will be cut to 150 mm in May followed by a second cut in October. Grass cuttings will be removed from site as a hay crop.

Arable field margins

Arable field margins will be in a crop rotation which includes an arable crop, even if in certain years the field is in temporary grass, set-aside or fallow. Arable field margins will be situated on the outer 10 m margin of the arable field. Margins will provide permanent grass strips with mixtures of tussocky and fine-leaved grasses.

Hedgerows

Hedgerows will be planted to deliver: a) one standard pedunculate oak Quercus robur every 50 m; and, b) deliver nine 'woody' species in every 30 m length, comprising: 1) field maple Acer campestre; 2) hazel Corylus avellana; 3) crab apple Malus sylvestris; 4) holly Ilex aquifolium; 5) grey willow Salix cinerea; 6) dogwood Cornus sanguinea; 7) elder Sambucus nigra; 8) spindle Euonymus europaeus; and, 9) dog rose Rosa canina. N.B. hawthorn and blackthorn have been intentionally omitted because neither responds well to flailing or coppicing.

7.9 Proposed Mitigation - Species

7.9.1 Strategy for the enhancement of restoration habitats for the benefit of S41 species of invertebrate

In order to ensure food plants are available for each invertebrate species within the restoration, the species detailed in Table 7-2 will be included within the restoration.

In addition to those species which will be included within the planting/seed mix, 'weed' species which are already present within the Application Site and can be predicted to remain as a constant within the restored habitats, comprise: bramble; broadleaved dock; stinging nettle; common ragwort; dandelions; groundsel; fat hen; common couch; and, annual meadow grass.

Table 7-2. The larval food plants which will be included within the restoration to ensure predicted enhancements are realised.

Restoration habitat	Plant species which will be provided
Woodland	**Canopy and main body:** Downy/silver birch, pedunculate oak, beech, ash, common lime, rowan. **Edges:** goat/grey willow, hazel, hawthorn, blackthorn, wild plum, elder, dog/field rose, broom, honeysuckle, enchanter's nightshade, black current, tufted hairgrass.
Hedgerows	Crab apple, elder, dog/field rose, honeysuckle, hop, hedge bedstraw, greater stitchwort, hedge woundwort, ground ivy.
Grassland	Red clover, white clover, greater plantain, ribwort plantain, cock's foot, common sorrel.

7.9.2 Strategy for the avoidance of injury and mortality to common toads

The mitigation strategy comprises: -

1. The identification of an appropriate Amphibian Conservation Area;
2. The trapping and translocation of common toads out of situations where they might be killed or injured and into the Amphibian Conservation Area; and
3. The maintenance of the Amphibian Conservation Area in such condition as to maximise carrying capacity and function for the life of the development and aftercare period.

Amphibian Conservation Area

Prior to the implementation of the amphibian mitigation strategy, an appropriate receptor area will be identified and brought into a condition suitable to receive translocated common toads. This will form the Amphibian Conservation Area which will be safeguarded and managed for common toads for the life of the proposed development.

Trapping and translocation method

In order to safeguard common toads against mortality, the following safeguarding strategy will be adopted: -

Any operation that enters areas of superficially suitable common toad habitat will be subject to the following control: -

NB. This strategy is confined to the period April through October.

***Stage 1:** Prior to any operation that may disturb common toad habitat and thereby have the potential to injure or kill common toads, a grid of artificial amphibian refuges (carpet tiles or equivalent) will be deployed at 2 m spacing over the totality of the area of habitat that is to be disturbed. This grid will then be left for a minimum of 14 days in order for common toads to find them and adopt them;*

Stage 2: *Trapping and translocation will be performed on a single morning visit (0830-1100 hrs), with air temperature above 9.0 ℃. Whilst no trapping will take place on days of excessive wind, warm days with intermittent sunshine and light (but warm) rain may be included at the discretion of the Appointed Ecologist. All amphibians encountered will be hand-captured and released within the Amphibian Conservation Area.*

Proposed condition

The following planning condition is offered in respect of this strategy:

Prior to any works taking place within areas of amphibian habitat as identified within the ES, an Amphibian Conservation Area will be identified and enhanced for the benefit of common toads. Thereafter, the Conservation Area will be retained for the duration of the development and aftercare period. Prior to every operation that might destroy or degrade amphibian habitat in areas to be worked, or have the potential to result in mortality or injury to common toads, trapping and translocation will be performed in line with the strategy as described in the ES and the results submitted to Norfolk Biodiversity Information Service (NBIS). ***Reason:*** *To safeguard populations of Section 41 Species of Principal Importance.*

7.9.3 Strategy for the mitigation of residual habitat losses, and the avoidance of injury and mortality to birds

The mitigation strategy comprises: -

1. Wherever possible, the destruction of nesting habitat outside the nesting season; and
2. Due-diligence survey and safeguarding where nesting habitat is to be destroyed within the nesting season.

Avoidance of injury, mortality, nest destruction and disturbance in respect of nesting birds

A generic due-diligence strategy is offered to mitigate the potential for negative effects and legislative conflict with nesting birds in general within the Application Site. In addition, the potential presence of the Schedule 1 species of birds in gravel pits; quail, red kite, little ringed plover, and hobby is also anticipated with a species-specific safeguarding strategy.

Common nesting birds

Vegetation will be retained for as long as is reasonably practicable and soil stripping will only occur immediately prior to it being worked. As far as possible, vegetation clearance will take place outside the nesting season, in the period 1st September through end February. Where it is impractical to perform an operation that will destroy nesting habitat outside the nesting season, and works have to take place in the period 1st March through 31st August, the following mitigation strategy will be applied: -

Step 1: *The extent of the operation will be clearly marked on a plan by the Quarry Manager (QM) and provided to an Appointed Ornithologist.*

Step 2: *A walkover survey will be performed by an Appointed Ornithologist. If no nesting birds are present, works will continue with no further constraint. If nesting birds are encountered, a stand-off of 5 m around the nest will be marked with steel rods and orange barrier-fencing of the type shown at Figure 7-4 (or an equivalent), and this area will be retained undisturbed until young have fledged.*

Upon completion, a report setting out the findings of the survey and any stand-off adopted will be compiled as a formal letter and provided to the QM and NBIS. If an overall Ecological Management Plan (EMP) is deemed to be necessary, then this letter will also be appended to the Ecological Management Plan (EMP) as a record of the action taken.

Figure 7-4. Barrier-fencing.

N.B. *It should be noted that the bird nesting season is dependent on weather conditions and therefore varies between years and between species but is generally accepted to last from the 1st March through 31st August. However, a bird's nest occupied outside this period is still subject to legal protection. In the absence of the Appointed Ornithologist, it will be the QM's responsibility to brief contractors performing vegetation clearance outside the typical bird nesting period that, should any occupied birds' nests be discovered, regardless of the month, works should cease immediately, and the Appointed Ecologist should be informed in order that they may advise on how and when to proceed.*

Quail

The safeguarding strategy in respect of quail will be as follows: -

No vegetation clearance or landscaping operations will be performed within the accepted bird breeding season (1st March through 31st August) unless a survey by an experienced ornithologist has determined that nesting quail are not present.

Step 1: *The extent of the operation will be clearly marked on a plan by the QM and provided to an Appointed Ornithologist.*

Step 2: *A species-specific survey will be performed comprising an individual visit in the period mid-May through September (Reade & Hosking 1974). If no nesting quail are present, works will continue with no further constraint. If quail are found to be nesting the broad location of the nest site will be identified on the habitat assessment plan and the updated plan provided to the site operator by the Appointed Ornithologist. Thereafter, no operation will be performed within a 30 m radius of the nest site until the young have fledged.*

Upon completion, a report setting out the findings of the survey and any stand-off adopted will be compiled as a formal letter and provided to the QM and NBIS. This letter will also be appended to the EMP as a record of the action taken.

Red kite and hobby

The safeguarding-strategy in respect of red kite and hobby will be as follows:

No tree felling operations will be performed within the accepted bird breeding season (1st March through 31st August) unless a survey by an experienced ornithologist has determined that nesting red kite or hobby are not present.

Step 1: *The extent of the operation will be clearly marked on a plan by the QM and provided to an Appointed Ornithologist.*

Step 2: *Following the initial inspection, a species-specific survey will be performed in advance of each Phase of working. This survey will comprise an individual visit in the period late-April through mid-May, to the method described by Hardey et al. (2006). If no nesting red kite or hobby are present, works will continue with no further constraint. If red kites or hobby are found to be nesting, the location of the nest site will be identified on the habitat assessment plan and the updated plan provided to the site operator by the Appointed Ornithologist. Thereafter, no operation will be performed within a 30 m radius of the tree in which the nest is located until the young have fledged.*

Upon completion, a report setting out the findings of the survey and any stand-off adopted will be compiled as a formal letter and provided to the QM

and HBIC. *This letter will also be appended to the EMP as a record of the action taken.*

Little ringed plover

As far as possible the infilling of water-filled voids and any other landscaping operation will take place outside the nesting season, in the period 1st September through end February. Where it is impractical to perform such an operation outside the nesting season, and in order to meet restoration timescales works have to take place in the period 1st March through 31st August, the following mitigation strategy will be applied: -

Step 1: *The extent of the operation will be clearly marked on a plan by the QM and provided to an Appointed Ornithologist.*

Step 2: *A species-specific survey will be performed comprising an individual visit in the period early-April through mid-May, to the method described for waders by Gilbert et al. (1998). If no nesting little ringed plover are present, works will continue with no further constraint. If little ringed plovers are found to be nesting the broad location of the nest site will be identified on the habitat assessment plan and the updated plan provided to the site operator by the Appointed Ornithologist. Thereafter, no operation will be performed within a 30 m radius of the entire waterbody until the young have fledged.*

Upon completion, a report setting out the findings of the survey and any stand-off adopted will be compiled as a formal letter and provided to the QM and HBIC. *This letter will also be appended to the EMP as a record of the action taken.*

Proposed condition

The following planning condition is offered in respect of this strategy:

Prior to every operation that might destroy or degrade nesting habitat in areas to be worked, or have the potential to result in mortality or injury to any wild bird, or have the potential to disturb nesting birds, including the Schedule 1 species: quail; red kite; little ringed plover; and/or, hobby, the strategy as described in the ES will be implemented and the results submitted to NBIS.

Reason: To safeguard populations of Section 41 Species of Principal Importance and guard against legislative conflict.

7.9.4 Strategy for the avoidance of injury and mortality to S41 Species of mammals and badgers

Harvest mouse preamble

In summer, harvest mice occupy three broad structures, comprising: **1)** beds of strong grass, reeds or corn; **2)** tall rank herbage on the sloping banks of shallow field ditches; and, **3)** hedgerows fringed with brambles and tall grass (Barrett-Hamilton & Hinton 1916). The nests are woven balls of linear vegetation and found in strong grass, wheat, reeds, large sedge species, common knapweed *Centaurea nigra*, dock, willowherb, bramble, broom, blackthorn (Barrett-Hamilton & Hinton 1916). The mice do not hibernate and winter nests of moss are also found in reeds, as well as in the vacant nests of aquatic warblers (Barrett-Hamilton & Hinton 1916).

Brown hare preamble

Brown hares occupy surface nests (known as 'forms') and females may rear an average of three litters of young (known as 'leverets') each year, usually in the period February through October (exceptionally into December) (Harris & Yalden 2008). From a safeguarding perspective, although they are nocturnal, adults will disperse without risk of harm but although the young are born furred, eyes open and mobile (Harris & Yalden 2008) they may nevertheless be vulnerable for several days.

Hedgehog preamble

In summer and winter hedgehogs occupy surface and subterranean nests (Reeve 1994). Surface nests comprise closely packed dry broad leaves up to 20 cm thick, typically in brambles, under tree stumps and fallen logs etc.

(Reeve 1994). Subterranean nests comprise simple dead-ended burrows, up to a metre in length with a small chamber at the end (Reeve 1994).

Badger preamble

The presence of badger setts has been identified, the holes mapped and the results are discussed within a freestanding report (see AEcol 2018d).

Safeguarding approach

There is a superabundance of habitat in the wider landscape, and no suggestion that the development might impact on any S41 Species of mammals to such an extent that it might be unable to maintain its populations in the immediate locale. The approach to safeguarding will therefore be to avoid injury and mortality by identifying nests, forms, dens and setts and taking responsible action. Badgers are not conservation significant. Nevertheless, the species is legally protected and a safeguarding strategy is appropriate in order to anticipate the potential for legislative conflict.

Harvest mice and brown hare occupy surface nests alone. Hedgehogs occupy surface and subterranean nests that can be investigated with an endoscope. Badgers occupy dens / setts that can be mapped and checked for occupancy using olfactory cues, a camera-trap, sand-trap and tell-tales.

The safeguarding strategy in respect of S41 Species of mammals and badger setts will be as follows: -

Stage 1: *Prior to the commencement of all phases the extent of the working phase/operation will be clearly marked on a plan by the QM and provided to an Appointed Ecologist. The strategy will then proceed to Stage 2;*

Stage 2: *A walkover survey will be performed by an Appointed Ecologist who will search for:* ***a)*** *harvest mouse nests;* ***b)*** *natal forms of brown hare;* ***c)*** *hedgehog surface nests and burrows; and,* ***d)*** *badger setts. If no potential sites are present, works will continue with no further constraint. If any such resting site is found, the strategy will proceed to Stage 3;*

Stage 3: *The Appointed Ecologist will assess the status of the nest / form / burrow / sett using an appropriate suite of survey methods (e.g. endoscope (N.B. not suitable for badgers), camera-trap; sand-trap, 'tell-tale' sticks etc.). If the resting site can be conclusively demonstrated to be vacant, the site will be destroyed under the supervision of the Appointed Ecologist in order that they can monitor the situation throughout and take appropriate remedial action if required. If the resting site cannot be conclusively demonstrated to be vacant the strategy will proceed to Stage 4:*

Stage 4:

S41 Species *– The QM will attend in order that the Appointed Ecologist can show them the resting site and the evidence upon which they have drawn their conclusion. An appropriate stand-off will then be marked round the resting site, using steel rods and orange barrier-fencing of the type show at Figure 7-4 (or an equivalent). If a mitigation strategy cannot be defined that would safeguard the resting site from damage and the means of access from severance then an exclusion method that will allow the animal to exit but not re-enter must be designed and the habitat taken down when the resting site is vacant.*

Badgers *– The QM will attend in order that the Appointed Ecologist can show them the sett(s). An appropriate stand-off will then be marked round each sett, using steel rods and orange barrier-fencing of the type show at Figure 12.1 (or an equivalent). If a mitigation strategy cannot be defined that would safeguard the sett from damage and any badgers therein from disturbance, a Development Licence may be required from Natural England in order to close the sett and allow works to proceed within the legislation. This situation, or the potential mitigation and/or compensation that might be required cannot however be predicted in advance of the walkover survey.*

Reporting (all species) *– Upon completion, a report setting out the findings of the survey will be compiled by the Appointed Ecologist. This will include the details of any stand-off adopted to avoid the need to destroy any occupied sett, or the full details of any method statement to be included within a Natural England licence application. The letter will be provided to the QM and NBIS and appended to the EMP as a record of the action taken.*

Proposed condition

The following planning condition is offered in respect of this strategy:

Prior to every operation that might destroy or degrade mammal habitat in areas to be worked, or have the potential to result in mortality or injury to S41 Species or badgers, or damage to a badger sett, or disturbance to badgers occupying any sett, safeguarding will be implemented in line with the strategy as described in the ES and the results submitted to *NBIS*. **Reason:** To safeguard populations of Section 41 Species of Principal Importance and guard against legislative conflict in respect of badgers.

7.9.5 Strategy for the avoidance of injury, mortality, disturbance and roost loss to bats

All roost trees are to be retained in the context of the full extent of their woodland context. Notwithstanding, British bat species do not make the features in which they roost. Those species that exploit trees as roost sites, are dependent upon trees being decayed, diseased or damaged. This may be brought about by woodpeckers, lightning strikes, wind, pathogens and just the natural decay processes of UV ageing. Once such a feature does form, bats may immediately exploit it. As a result, Potential Roost Features (PRF) are failing and forming all the time, and the status of bats within an area of habitat cannot be certain from one year to the next. Therefore, although structures within Stanninghall Quarry exclude roosting bats and will continue to do so, the future presence of roosting bats in hedgerow trees to be removed cannot be ruled-out, and a safeguarding strategy is offered.

The safeguarding strategy in respect of the potential for bats to exploit trees as roosts will be as follows: -

Stage 1: *Prior to the felling of or surgery to any tree, the work proposed will be set out in writing with accompanying photographs and a plan by the QM, and provided to a Licenced Ecologist. The strategy will then proceed to Stage 2;*

Stage 2: *All trees to be felled or made-safe will be subject to close-inspection by a Licenced Ecologist in order to assess whether they hold Potential* [bat] *Roost Features (PRF). If no such features are present, then no further action will be necessary in respect of roosting bats. Upon completion, a report setting out the findings of the survey will be compiled as a formal letter by the Appointed Ecologist and provided to the Quarry Manger and NBIS. The letter will also be appended to the EMP as a record of the action taken. If, however PRF are present then safeguarding will proceed to Stage 3;*

Stage 3: *All PRF will be subject to survey in accordance with current good practice by a Licenced Ecologist. If no bats or any field-signs that are associated with historic bat presence are recorded, the PRF will be closed by the Licenced Ecologist and works may proceed without constraint. Upon completion, a report setting out the findings of the survey and action taken will be compiled as a formal letter by the Licenced Ecologist and provided to the QM and NBIS. The letter will also be appended to the EMP as a record of the action taken. If, however, bats or positive evidence of roost-presence is recorded the safeguarding will proceed to Stage 4;*

Stage 4: *The QM will attend in order that the Licenced Ecologist can show them the roost(s). An appropriate stand-off will then be marked round each roost, using steel rods and orange barrier-fencing of the type show at Figure 7-4 (or an equivalent). If a mitigation strategy cannot be defined that would safeguard the roost from damage and any bats therein from disturbance, a Mitigation Licence will be sought from Natural England in order to close the roost and allow works to proceed within the legislation. This situation, or the potential compensation that might be required cannot however be predicted in advance of the survey.*

Upon completion, a report setting out the findings of the survey will be compiled by the Licenced Ecologist. This will include the details of any stand-off adopted to avoid the need to destroy any roost, or the full details of any method statement to be included within a Natural England Mitigation Licence application. The letter will be provided to the QM and NBIS and appended to the EMP as a record of the action taken.

Proposed condition

The following planning condition is offered in respect of this strategy:

Prior to every tree-felling operation or tree surgery, bat roost safeguarding will be implemented in line with the strategy as described in the ES and the results submitted to NBIS. **Reason:** To safeguard populations of legally protected and Section 41 Species of Principal Importance and guard against legislative conflict in respect of roosting bats.

7.10 Residual effects

Residual effects have been identified within the relevant the EcIA for each group of IEF. With the implementation of the proposed mitigation, there are no grounds to predict a significant negative effect upon any IEF as a result of the proposed development.

7.11 Cumulative Impact Assessment

Cumulative effects are changes to the environment that are caused by an action in combination with other past, present and future actions (CEAA 1999).

It should be noted that there is no materially useful guidance setting out a rational recommendation for the scope, temporal framework or division of responsibilities within Cumulative Impact Assessments (CIA) in support of planning in England. For any CIA to be meaningful it would need historic data showing a trend in the status of each specific IEF. For example, a point in time would have to be defined with a baseline inventory of each IEF (i.e. the surface area of each habitat type and the number of populations of each faunal species). Following this, the changes in the surface area / number of populations would have to be reviewed at a pre-set temporal interval as part of a surveillance program. From this data, it would be possible to define a trigger threshold for action. For example, if the baseline surface area of broadleaved semi-natural woodland was known, and each EcIA that followed provided empirical data in respect of the surface area of habitat that would be lost, it would be possible to identify a trend in habitat loss as the result of each subsequent development. This might provide a meaningful threshold beyond which further habitat loss would be unacceptable. This would logically be defined by the individual Local Planning Authority.

As no baseline has been defined, and no trend data is available, this CIA has assessed the situation in respect of concurrent developments alone.

The approach adopted within this CIA is as follows: -

1. Scoping;
2. Identification of a ZoI in respect of IEF identified within the ZoI of this Application Site;
3. The identification of the potential for cumulative effects upon habitats/flora and fauna as a result of all the developments identified; and
4. An appraisal of whether there are grounds to suggest that there is a *"reasonable likelihood"* that any of the cumulative effects might result in a significant negative effect.

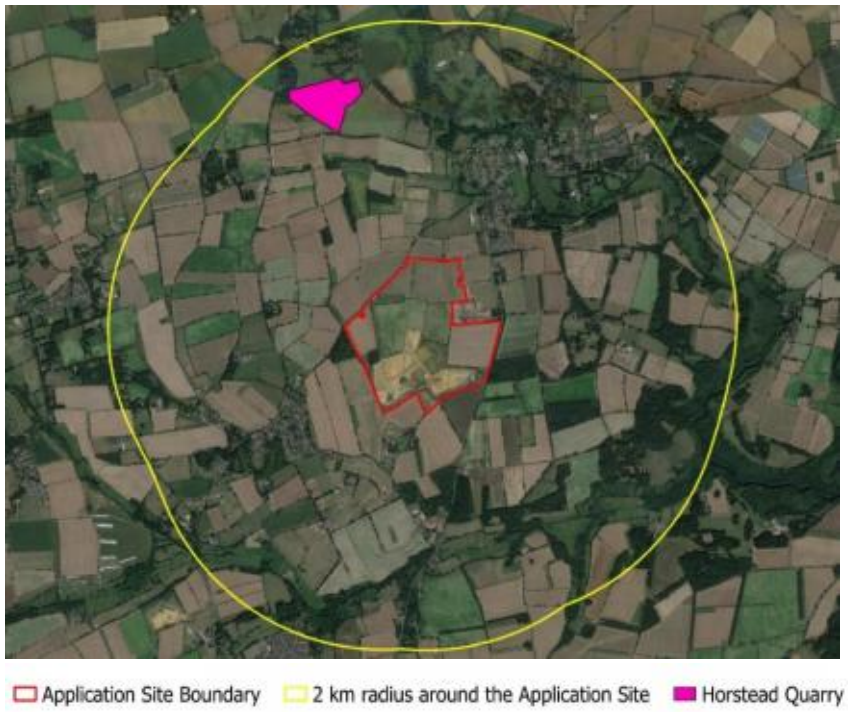
Scoping comprised: -

1. The identification of concurrent developments within an arbitrarily chosen radius of 2 km;
2. The identification of IEF for which a residual effect (either significant or non-significant) was identified as a result of the development of Stanninghall Quarry; and
3. The identification of IEF for which a residual effect (either significant or non-significant) has been identified as a result of concurrent developments.

Concurrent developments within 2 km of Stanninghall Quarry comprise one development: -

1. Horstead Sand and Gravel Quarry: Mineral extraction and restoration to to agriculture as an extension to Horstead Quarry. Decision status; Granted 12th November 2012 - ref. C/5/2011/5017;

Figure 7-5. The location of concurrent developments within a 2 km radius of the Application Site.



Imagery © 2020 Google

Negative residual effects as a result of the proposed quarry development within Stanninghall Quarry have been identified within this EcIA.

A search of the Norfolk County Council Planning Portal did not show the ecological assessment that must have been performed in support of the planning application. In addition, the Planning Permission document issued by Norfolk County Council makes no reference to any ecological planning conditions. There is therefore insufficient information available in the public domain to assess the cumulative impacts of the two developments on Ecological IEF.

There is therefore insufficient evidence available to predict that cumulative impacts would result in a significant negative residual effect upon any IEF identified within Stanninghall Quarry or the Proposed Extension.

7.12 Enhancement

7.12.1 Approach to enhancement

It is important to be aware at the outset that measures to off-set residual habitat losses are 'compensation' and cannot be considered 'enhancement' in the context of an EcIA. In this context, enhancement comprises what the development will deliver over and above the compensation for losses.

In order to assess the net gains delivered, a basic measure of the surface area of S41 Habitat offered by the baseline and revised restoration were compared, and Natural England's Biodiversity Metric 2.0 was applied (albeit in a modified approach that fits the context of an extension to a quarry, rather than a new quarry, or a housing estate).

7.12.2 Biodiversity Metric 2.0 – (beta test)

Biodiversity Metric 2.0 (beta test) comprises an Excel framework that enables developers and land managers to better understand and quantify the current value of a place for nature and how proposed changes to that site (either from development or land management practice) might affect that value. In short, it provides a way of calculating biodiversity gains and losses, which is determined by subtracting the number of pre-intervention biodiversity units (i.e. those originally existing on-site and off-site) from the number of post-intervention units (i.e. those projected to be provided).

Whilst the Metric does not consider individual species of flora and fauna specifically, and the outputs are not absolute values, the Metric uses habitat type and condition as a proxy for the relative biodiversity worth of a site pre- and post-intervention. As different habitat types support different species communities, the habitats may therefore be scored according to their relative

biodiversity value. This value can then be adjusted depending on the condition and location of the habitat, to calculate 'biodiversity units' for that specific project or development. In addition, the Metric also accounts for some of the risks associated whenever new habitat is created or existing habitat is enhanced.

The Metric includes all terrestrial habitats including linear habitats (hedgerows, lines of trees, rivers and streams), the biodiversity value of which are calculated separately to the main Metric calculation.

Application of the Metric in the context of this development

The Metric uses habitat (i.e. the places in which species live) as a proxy to describe biodiversity. These habitats are converted into measurable biodiversity units. These biodiversity units are the 'currency' of the Metric (Crosher *et al.* 2019).

In order that the biodiversity value of the final restoration design can be compared, with a meaningful baseline[4], the following process was applied:

Step 1 – Calculate the surface area of S41 Habitat and the Metric value of the existing compensation scheme (the consented restoration[5]) and the habitats that are currently present within the Proposed Extension as a single aggregated baseline.

Step 2 – Calculate the surface area of S41 Habitat and the Metric value of the new overarching restoration upon completion of the aftercare period.

Step 3 – Compare the two values to see which is the greater and what the difference is in both unit value and percentage increase/decrease.

Note: *in order to apply the Metric in this way, some smoothing of the data was necessary. In this context, all the habitats are assigned moderate quality.*

7.12.3 S41 Habitat surface area and Metric 2.0 Results

S41 Habitats

The extent of S41 Habitats offered by the baseline and the restoration are compared at Table 7-3. It should be noted that the figures in Table 7.3 differ slightly from those set out in Table 4.1 in the Restoration Chapter 4.0 above in that Table 7.3 is focussed solely on priority habitats rather than the overall restoration land uses.

Table 7-3. The surface areas of S41 Habitats offered by the baseline and delivered by the restoration design.

S41 HABITAT	BASELINE AREA (ha)	RESTORATION (ha)
Lowland mixed deciduous woodland	19.45	24.5
Lowland meadows	3.89	9.6
Hedgerows	3.18	1.68
Arable Field Margins	0	1.5
Total area of S41 Habitat	26.52	37.28

In summary, the restoration will deliver 10.766 ha / 41% greater surface area of S41 Habitat above the baseline situation. Metric 2.0

and the habitats that would be present within the consented Stanninghall Quarry at the close of the existing consent and following the restoration and aftercare period.

[4] This is an extension to an existing quarry and the Application Site includes the existing quarry, which was consented subject to a conditioned restoration. The baseline habitat extent is taken to be the sum of the habitats currently present within the unconsented Proposed Extension,

[5] The existing consented restoration is detailed in: - Tarmac South Ltd. 2003. *Trafford Estate Concept Restoration – T57 / 52.* Tarmac South Ltd., Colchester.

The results of the application of the Metric provide a relative measure of the biodiversity value of each scenario once restoration has been completed and the habitats are established. The relative biodiversity value of each scenario is presented at Table 7-4.

Table 7-4. The results of the application of the Biodiversity Metric 2.0 (beta test).

BIODIVERSITY METRIC	BASELINE	RESTORATION
Biodiversity units	493.37	588.25

The restoration will therefore deliver 19% greater biodiversity units than the baseline.

7.12.4 Enhancement conclusion

The conclusion is that the restoration will offer 20% greater surface area of S41 Habitat and 19% greater Metric units than the baseline. The restoration therefore satisfies the requirement for new developments to deliver a net biodiversity gain.

7.13 Ecological Impact Assessment Summary

In summary, the Ecological Impact Assessment has identified the following: -

- There is the potential for a significant negative effect upon Clamp Wood ASNW and PAWS resulting from physical impacts to the root system of trees at the woodland edge. An avoidance strategy has been offered to safeguard the root system and mitigate the potential for a significant negative effect to within reasonable limits;
- There are no grounds to predict a significant negative effect upon 'Important' hedges as a result of the proposed development. Notwithstanding an avoidance strategy has been offered to safeguard those 'Important' hedgerows that will be retained;
- With the implementation of the restoration strategy and aftercare scheme, there are no grounds to predict a significant negative effect upon S41 Habitats and LBAP Habitats as a result of the proposed development;
- With the implementation of the restoration strategy and aftercare scheme which will ensure the provision of species-specific larval food plants, there are no grounds to predict a significant negative effect upon invertebrate Important Ecological Features (IEF) as a result of the proposed development;
- With the implementation of the restoration strategy and aftercare scheme, there are no grounds to predict a significant negative effect upon the S41 Species; common toad, as a result of the proposed development. Notwithstanding a mitigation strategy has been offered to safeguard common toads against mortality;
- Six bird IEF will experience residual habitat losses. However, with the implementation of the restoration strategy and aftercare scheme, there are no grounds to predict a significant negative effect upon any species as a result of the proposed development. Notwithstanding a mitigation strategy has been offered to safeguard all birds and nests against mortality, damage, destruction or disturbance (latter in respect of nesting Schedule 1 species only);
- With the implementation of the restoration strategy and aftercare scheme, there are no grounds to predict a significant negative effect upon the S41 Species; harvest mice, hedgehogs or brown hare, as a result of the proposed development. Notwithstanding a mitigation strategy has been offered to safeguard these three species against mortality;
- There is no potential for this development to have a significant negative impact upon badgers. Notwithstanding a mitigation strategy has been offered to avoid killing or injuring the species or destroying, damaging of disturbing any badger sett;
- With the implementation of the restoration strategy and aftercare scheme, there are no grounds predict a significant negative effect upon any bat species through habitat loss as a result of the proposed development;

- Brown long-eared bat will potentially experience noise impacts. However, there are no grounds to predict that this will have a significant negative effect; and
- Barbastelle and brown long-eared bat will potentially experience lighting impacts. However, there are no grounds to predict that these will have a significant negative effect upon either species.

The potential for cumulative impacts from concurrent developments to result in a significant negative effect upon IEF impacted by the proposed development has been investigated. However, the evidence available gives no grounds to predict that cumulative impacts would result in a significant negative residual effect upon any IEF identified within Stanninghall Quarry or the Proposed Extension.

An assessment of the biodiversity value of the Application Site pre and post development has been made by assessing the change in extent of S41 habitats and by using the DEFRA Metric 2.0 (beta test). The conclusion is that the restoration will offer 41% greater surface area of S41 Habitat and 19% greater Metric units than the baseline. The restoration therefore satisfies the requirement for new developments to deliver a net biodiversity gain.

7.14 Conclusions

The conclusion of the PEA, Protected Species Surveys and this EcIA are that there are no grounds to predict that the development proposed will result in significant negative residual effects upon on- or off-site IEF, nor are there grounds to suggest potential cumulative negative effects in combination with concurrent developments. Notwithstanding, the potential for **non**-significant negative residual effects have been identified in respect of six IEF as a result of the proposed development; grey partridge, quail, lapwing, skylark, house sparrow and corn bunting

The restoration scheme, mitigation and enhancements measures proposed will result in a net increase in habitat extent for legally protected species, S41 Habitats, S41 Species, LBAP Habitats and LBAP Species which are present within Stanninghall Quarry and the Proposed Extension and will ensure all IEF are maintained at favourable conservation status within the Application Site and wider area. The restoration habitats will be created within a reasonable timeframe and managed and maintained as high quality, species rich, habitats as detailed in the outline aftercare strategy. It is therefore concluded that the development satisfies the National Planning Policy Framework and *NERC Act 2006* by contributing to, and enhancing the natural and local environment, by providing a net gain in habitat provision and biodiversity in general.

Notwithstanding, to ensure (within reasonable limits) the potential for legislative conflict is anticipated and avoided/mitigated and the restoration is effectively managed, due-diligence safeguarding strategies and aftercare management strategies have been proposed and which could be made the subject of planning conditions, as suggested.

If it is deemed necessary, the respective mitigation measures and strategies could be brought together within an Ecological Management Plan (EMP) covering the development and aftercare period which could be made the subject of a planning condition requiring submission and approval by the Mineral Planning Authority. This would include the definition of responsibilities for each aspect, and the provision of summary reports to the Mineral Planning Authority upon completion of each quarry phase. This EMP would also ensure the restoration and aftercare deliver the required compensation and maximise the opportunities for biodiversity enhancement.

8.0 AGRICULTURAL LAND QUALITY AND SOIL RESOURCES

8.1 Introduction

This chapter of the ES considers the potential for the proposed development to impact upon Agricultural Land Quality and Soil Resources. Initially, it considers the scope, legislation, assessment methodology and baseline data relevant to the application area.

It then considers any potential significant impacts and mitigation measures designed to prevent, reduce or offset any adverse effects, and the likely residual impacts after these measures have been taken.

The chapter is based upon an agricultural land classification survey and soil resources study undertaken by Reading Agricultural Consultants in 2001 as part of the 2002 EIA / ES undertaken in support of a planning application for sand and gravel extraction at the Stanninghall site (as discussed in section 1.1 of the ES). The study area encompassed essentially the same site area as that which comprises the current application site, and the raw data obtained as part of the study in terms of land quality and soil resources is not considered to have changed in the intervening period. The study has however been updated to reflect changes in the planning policy and legislative context which have taken place over that period.

The development which is the subject of this application and ES comprises a northern extension to Stanninghall Quarry and the integration of the extension area with the existing quarry as an overall phased extraction and restoration scheme.

The application site extends to approximately 102 hectares, which compares to a site area of some 106 hectares surveyed in 2001, the difference relating to a rectangular block of land along the eastern side of the site adjacent to the Water Tower, which as a result of works recently undertaken by Anglian Water is no longer available for extraction and is thus excluded from the site area.

It is proposed to extract some 5m tonnes from the overall site area (existing quarry and extension area combined), in a further 6 phases over a period of approximately 17 years. The site will be restored at a low level (i.e. without imported fill) to mixed after uses comprising agricultural land, meadow grassland, and broadleaved woodland. The restoration scheme includes a detailed audit of the available soil resources to ensure the delivery of the restoration land uses, as discussed further below.

8.2 Planning Policy and Legislative Context

8.2.1 National Planning Policy Framework (NPPF) (2019)

Section 15 of the NPPF dealing with 'Conserving and Enhancing the Natural environment' emphasises that *Planning policies and decisions should contribute to and enhance the natural and local environment by:*

(a) protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils…..(ref para 170)

Section 17 of the NPPF dealing with minerals further notes that in considering proposals for mineral extraction, mineral planning authorities "should provide for restoration and aftercare at the earliest opportunity, to be carried out to high environmental standards, through the application of appropriate conditions:" (ref para 205).

8.2.2 Planning Practice Guidance (PPG)

This general advice is developed further in PPG which notes that:

Restoration and aftercare of mineral sites involves a number of key stages, which mineral planning authorities should take into account as appropriate when preparing restoration and aftercare conditions:

1. *stripping of soils and soil-making materials and either their storage or their direct replacement (ie 'restoration') on another part of the site;*

2. *storage and replacement of overburden;*
3. *achieving the landscape and landform objectives for the site, including filling operations if required, following mineral extraction;*
4. *restoration, including soil placement, relief of compaction and provision of surface features;*
5. *aftercare*

Paragraph: 038 Reference ID: 27-038-20140306

Revision date: 06 03 2014

It continues by noting that:

The level of detail required on restoration and aftercare will depend on the circumstances of each specific site including the expected duration of operations on the site. It must be sufficient to clearly demonstrate that the overall objectives of the scheme are practically achievable, and it would normally include:

- *an overall restoration strategy, identifying the proposed afteruse of the site;*
- *information about soil resources and hydrology, and how the topsoil/subsoil/overburden/soil making materials are to be handled whilst extraction is taking place;*
- *where the land is agricultural land, an assessment of the agricultural land classification grade; and*
- *landscape strategy*

Where working is proposed on the best and most versatile agricultural land the outline strategy should show, where practicable, how the methods used in the restoration and aftercare enable the land to retain its longer term capability, though the proposed after-use need not always be for agriculture.

Restoration may, in some cases, need to be undertaken in phases so as to minimise local disturbance and impacts.

Paragraph: 040 Reference ID: 27-040-20140306

Revision date: 06 03 2014

In terms of the level of detail required for restoration and aftercare, PPG notes that:

For mineral extraction sites where expected extraction is likely to last for many years, early agreement on the details of at least the later stages of aftercare may not be appropriate. In such cases, it would still be appropriate:

- *for the applicant to provide a general outline of the final landform and intended after-use;*
- *for the mineral planning authority to agree at the outset outlines of requirements covering the main stages of reclamation of a site (eg filling, restoration and aftercare), together with detailed schemes for stripping and storage of soil materials*

The level of detail provided by the applicant to the mineral planning authority must be sufficient to clearly demonstrate that the overall objectives of the scheme are practically achievable.

Planning conditions for proposals with a longer term duration should:

- *normally require the submission of a detailed scheme or schemes for restoration and aftercare, for agreement, by some specific stage towards the end of the life of the permission;*
- *where progressive reclamation is to be carried out, require submission of schemes for agreement from time to time as appropriate.*

Paragraph: 044 Reference ID: 27-044-20140306

Revision date: 06 03 2014

8.2.3 Legislative Context

Schedule 4(y) of the Town and Country Planning (Development Management Procedure (England) Order 2015 (as amended) explains that planning authorities must consult Natural England on certain development proposals affecting best and most versatile agricultural land, i.e. land of grades 1, 2 and 3a quality.

The consultation obligations with Natural England apply where a proposal:

- includes agricultural afteruse
- leads to the loss of 20 hectares of more of BMV land where the land is not already allocated in a development plan; and
- the development affects other environmental factors, such as protected sites.

When consulted, Natural England will in turn provide advice on whether agriculture is an appropriate afteruse and the restoration and aftercare requirements for the development scheme.

A related requirement is set out in the Town and Country Planning Act 1990 (as amended) where Schedule 5 of the Act requires mineral planning authorities to consult Natural England to make sure that after mineral working:

- agriculture is an appropriate after use,
- restoration meets the required standard (normally to the same physical characteristics as before or for lower grade land it meets a reasonable standard for agricultural use, and
- aftercare conditions are appropriate.

8.2.4 Norfolk CC Core Strategy and Minerals and Waste Development Management Policies Development Plan Document 2010-2026

The Minerals Core Strategy, adopted by NCC in September 2001 notes that "*Norfolk is predominately rural in nature and agriculture plays a significant role in the local economy and heritage….. Continuing to preserve good quality agricultural land is important as it will benefit the economy as well as Norfolk's landscape*" (ref para 7.72).

With respect to mineral extraction it notes that "*minerals development is, in almost all cases, a temporary use of land, followed by restoration. It is therefore normally possible to remove and store topsoils and subsoils during an operational phase, and then to replace them afterwards to bring a site back into agricultural use, if desired" (*ref para 7.3*).*

In this context, 'Policy DM16: Soils' states that:

> "Where development is proposed on agricultural land, the County Council has a clear preference for locating new mineral extraction and associated activities, and composting facilities, on land of agricultural grades 3b, 4 and 5.
>
> Development proposals affecting Grade 1 agricultural land will only be permitted in exceptional circumstances, where it is demonstrated that there are no alternative locations for the development.
>
> In addition to the above, when minerals development, particularly extraction, is proposed on agricultural land of grades 1, 2 or 3a it will only be permitted where:
>
> - Provision is made for high standards of soil management that would enable restoration to a condition at least as good as its previous agricultural quality. To demonstrate this, the County Planning Authority will expect soil and land quality surveys and soil handling and replacement strategies to be submitted (the latter based upon Defra's 'Good Practice Guide for Handling Soils'); or
>
> - The benefit of restoring the land to another after-use can be shown to outweigh the loss of the agricultural use of the land.

8.2.5 Preferred Options for the Norfolk Minerals and Waste Local Plan Review: July 2019.

The Minerals Plan Review preferred options identifies the proposed Stanninghall Quarry northern extension as a proposed allocated site for future sand and gravel extraction (ref site MIN 65|).

In the site description of allocation MIN 65, it is noted that the site is currently in agricultural use and that it contains a mixture of land of grades 2, 3a and 3b quality. It also confirms that a future application to develop the site should include the submission of a progressive restoration scheme to an arable agriculture after use, with wide field margins, grassland and woodland to provide biodiversity gains.

In relation to soils, the document re-iterates the comment in the Minerals Core Strategy that "*minerals development is, in almost all cases, a temporary use of land, followed by restoration. It is therefore normally possible to remove and store topsoils and subsoils during an operational phase, and then to replace them afterwards to bring a site back into agricultural use, if appropriate*" (ref para 12.2).

Policy MW6 of the Preferred Options repeats the Soils policy DM16 of the Minerals Core Strategy, as referred to in section 8.2.4 above.

8.3 Agricultural Land Classification

Agricultural Land Classification (ALC) is a system used in England and Wales to grade the quality of land for agricultural use, according to the extent by which physical or chemical characteristics impose long-term limitations.. The system classifies land into five grades:

- Grade 1 - excellent quality agricultural land with no or very minor limitations, where a very wide range of agricultural and horticultural crops can be grown. Yields are high and less variable than on land of lower quality.

- Grade 2 - very good quality agricultural land with minor limitations which affect crop yield, cultivations or harvesting. A wide range of agricultural and horticultural crops can usually be grown. On some land in the grade there may be reduced flexibility due to difficulties with the production of the more demanding crops, such as winter harvested vegetables and arable root crops. The level of yield is generally high but may be lower or more variable than grade 1.

- Subgrade 3a – good quality agricultural land with moderate limitations that affect the choice of crop, timing and type of cultivation/harvesting or level of yield. This land can produce moderate to high yields of a narrow range of crops or moderate yields of a wide range of crops.

- Subgrade 3b – moderate quality agricultural land with strong limitations that affect the choice of crop, timing and type of cultivation/harvesting or level of yield. This land produces moderate yields of a narrow range of crops, low yields of a wide range of crops and high yields of grass.

- Grade 4 – poor quality agricultural land with severe limitations which significantly restrict the range and level of yield of crops. It is mainly suited to grass with occasional arable crops.

- Grade 5 - very poor quality agricultural land with very severe limitations which restrict use to permanent pasture or rough grazing with the exception of occasional pioneer forage crops.

Grades 1, 2 and subgrade 3a are considered within the 'best and most versatile' (BMV) land category.

8.4 Baseline Conditions

8.4.1 Survey Methodology

The ALC and soil survey was undertaken based upon a network of hand augers on a 100m grid, as illustrated on plan ref RAC1 produced within **Appendix 8.1**. This involved examining 111 soil profiles, supplemented by four soil inspection pits which allowed an examination of the soil profile characteristics in more detail.

The soil data was interpreted in accordance with the Agricultural Land Classification System of England and Wales (revised guidelines and criteria for grading the quality of agricultural land) MAFF 1988.

8.4.2 Agricultural Land Classification

Assessment of the land's quality was carried out according to MAFF's 1988 revised guidelines and criteria for Agricultural Land Classification (ALC).

The local climate is based on about 650mm average annual rainfall, giving relatively large summer moisture deficits but allowing reasonably flexible seasonal access for landwork.

Draughtiness is the principal and most extensive limitation to land's quality, since not only are summer moisture deficits relatively large, but soil moisture holding capacity is also restricted by the extensive development of coarse-textured subsoils.

Some subsoils are finer-textured and less permeable. Where these occur, there is also a secondary - and slight - seasonal wetness/workability limitation.

The findings of the original land quality survey based upon a 106 ha site area (prior to the commencement of operations in the existing quarry) were that the application area contains 69ha of best and most versatile land, comprising 45ha in subgrade 3a and 24ha in grade 2. There are also 36ha of lesser quality land in subgrade 3b, and about 1 ha of woodland.

The majority of the sub grade 2 land lies within the existing quarry area.

The distribution of land grades are illustrated ion plan ref RAC2 produced within **Appendix 8.1.**

8.4.3 Soil Resources

Topsoils are predominantly sandy loam with a small area of loamy sand to the north- east, and it is not necessary to separate the two for purposes of soil storage and restoration.

Topsoils within the proposed northern extension area range between 300mm and 375mm with an average of 350mm, as illustrated on plan RAC3 within **Appendix 8.1**.

Upper subsoils are predominantly sandy loam to loamy sand, with a thickness of 300mm within the northern extension area, as illustrated on plan RAC4 within **Appendix 8.1**.

Lower subsoils are variable, having textures from sand to clay, and comprising sandy clay loams in the northern extension area, with thicknesses ranging from 300mm to 500mm in the northern extension area, as illustrated on plan RAC5 within **Appendix 8.1**.

In addition, overburden and inter-burden are found across the site, and would be carefully examined and characterised according to their re-use potential. Suitable material would be used for forming batters, for tree planting areas, and for forming lower-subsoil substitute materials on parts of the agricultural land restoration.

Top soil and sub soil has been stripped from the currently operational area within the existing quarry, and has been placed in a series of temporary storage bunds, as illustrated on plan ref KD.SH.D.007, and shown in table 8.1 below. This material is earmarked for use in the restoration of the final ‘Phase 9’ of the proposed development, comprising the existing plant site and adjoining areas.

Table 8-1 Current Temporary Store of Restoration Material

Existing Bunds	Topsoil Store (m^3)	Subsoil Store (m^3)	Lower Subsoil / Overburden Store (m^3)
Bund 1	45,700		
Bund 2	7,300		
Bund 3	3,000		
Bund 4	500		
	Subtotal – 56,500		
Bund 5		12,000	
Bund 6		15,500	
Bund 7/8		22,000	
Bund 9		22,000	
		Subtotal – 71,600	
Bund 10			45,700
Bund 11			139,000
			Subtotal – 184,700

Table 8.2 below illustrates the quantity of subsoil and overburden to be stripped in phases from the northern extension area along with processing waste generated, which combined with existing stored materials listed within Table 8.1 provide the overall restoration material.

Table 8-2 Soils and Overburden / Waste Material to be utilised for restoration from currently un-stripped land

Stanninghall Quarry	Topsoil (m^3)	Subsoil (m^3)	Lower Subsoil / Overburden (m^3)	Quarry Waste (m^3)	
Phase 4B	45,500	32,100	126,600	31,500	
Phase 5	38,500	33,000	60,500	46,100	
Phase 6	32,100	27,500	50,500	27,800	
Phase 7	42,400	36,300	151,200	40,400	
Phase 8	40,200	34,500	63,200	42,400	
Plant Site	12,000	12,000	29,200	29,500	
Totals	**210,700**	**175,400**	**481,200**	**217,700**	**1,085,000**

8.5 Assessment of Effects

8.5.1 Elements of the development relevant to land quality and soil resources

As described in chapter 3.0 above, working and restoration is proposed to take place progressively in phases, as illustrated on Figures 3.3 – 3.9 within that Chapter.

The key focus of soil handling within the extension phases will be on stripping and direct placement of soils on the re-profiled restoration formation levels of the preceding phase. This will have the effect of minimising the net amount of land unavailable for agriculture at any given time. It also minimises the risk of damage to most of the soil resource that might accrue from prolonged storage.

The restored land would be reinstated to a predominant agricultural after use with some 69.8ha or agricultural land, 11.9 ha of species rich grassland, and 24.5 ha of native woodland planting. The agricultural land will be restored to standards suitable for arable cropping, subdivided into six large field units, with the central and northern areas defined by new hedgerows (1462 linear metres).

The minimum target soil profile specification is 300mm of topsoil over 300mm of good quality upper subsoil over 600mm of lower sub soil, selected overburden or loosened chalk that lies beneath the mineral resource. This would restore the land to at least subgrade 3a quality and would potentially achieve grade 2 quality where good quality overburden is used.

8.5.2 Impacts on land quality

The potential impacts on agricultural land quality are most significant where they affect BMV agricultural land.

There would be a significant direct and permanent impact in policy terms if there was no intention to restore agricultural land to high-quality standards.

Equally significant would be the indirect impact that would result from poor quality restoration failing to meet the specified standards for intended high-quality land.

However, with an original pre-development area of some 69ha of BMV land, the restoration scheme which proposes the reinstatement of 69.8 ha of agricultural land would ensure that there would be no overall loss of BMV land provided the soil target profiles are adhered to and there is no damage to soil resources during soil handling.

In addition, the restored BMV land would be concentrated in the areas to be restored to agricultural use which will provide a consistent soil profile and land quality for future cropping.

8.5.3 Impacts on soil resources

The principal adverse impacts on soil would derive from the loss of the resource; loss of quality by gross mixing of the different components identified; and by compaction and smearing if the materials were handled under poor (wet) weather, ground and soil moisture conditions.

In addition, there is a risk of long-term damage to soil structure, and the loss of potentially valuable soil, if there is uncontrolled trafficking of land and soil by heavy machinery, especially wheeled machinery. Damage to, and loss of topsoil would also occur if other dissimilar materials such as subsoil or overburden were stockpiled directly on it.

Biodegradation of topsoil also occurs when it is compacted in storage, when stockpiled wet and when stockpiled in the medium - to long-term.

Predicted Permanent Impacts

Provided that the soil resource, including subsoil substitutes (overburden and inter-burden), is carefully handled under good weather, ground and low soil moisture conditions, there should be no direct permanent adverse impacts on the soil resource, nor indirect impacts on the quality and use potential of the restored land.

Predicted temporary impacts

The principal predicted temporary impact is biodegradation of stockpiled topsoil. This is inevitable but provided that the topsoil is properly managed after replacement, principally to encourage the re-activation of biological activity, the direct, but temporary, adverse impact should not be significant beyond the short-term.

8.6 Mitigation Measures

8.6.1 Soil Handling: General Principles

The key mitigation measure to address potential impacts on land quality so that restoration objectives are met is to ensure the careful handling of soil.

The aim of the restoration is to recreate the same overall area of BMV land as existed prior to the commencement of the initial quarry development (circa 69ha). The soil movement and handling scheme in this proposal intends to avoid soil compaction and smearing problems by ensuring that soil handling protocols are adhered to at all times. These issues are summarised in the restoration chapter 7.0 of the PAS which emphasises that low moisture content in the soil is critical for avoiding damage. Further guidelines for safe handling are provided within the MAFF guidelines for the handling of soil referred to below and produced within **Appendix 8.2**.

A suitably trained operator will ascertain when ground and soil conditions are suitable for soil movements. Soil movements for storage or restoration will normally take place as short summer campaigns and will open the area to be worked in the following 12 months, utilising soils to best effect to restore the areas already worked. Operations will be suspended when wet soil conditions predispose to damage, including during significant rainfall.

All soils will be stripped to the required thicknesses using excavators and dump trucks as per the MAFF guidelines given in **Appendix 8.2 (**ref Good Practice Guidelines for Handling Soils: Sheet 1 Soil Stripping with Excavators and Dump Trucks).

Topsoil, upper subsoil and lower subsoil will be removed in sequence in strips, the width of which will be determined by the size of machinery being used. As much soil as possible will be direct placed on the restoration formation levels of the previous worked out phase.

The soil replacement operations will be undertaken in accordance with the MAFF guidelines given in **Appendix 8.3 (**ref Good Practice Guidelines for Handling Soils: Sheet 4 Soil Replacement with Excavators and Dump Trucks).

In the defined circumstances where soil is to be temporarily stored in bunds awaiting use in final restoration, the process will be undertaken in accordance with the MAFF guidelines given in **Appendix 8.4** (ref Good Practice Guidelines for Handling Soils: Sheet 2 Building soil storage mounds with excavators and dump trucks).

The removal and use of the soil from the temporary storage bunds will be undertaken in accordance with the MAFF guidelines given in **Appendix 8.5** (ref Good Practice Guidelines for Handling Soils: Sheet 3 Excavation of soil storage mounds with excavators and dump trucks).

Other than during initial opening of areas to be stripped, and placement of soils in storage bunds, all machinery movements will take place on overburden or mineral, with no traversing of soils. All soil stores will be clearly marked as to the type and nature of the soil they contain, both on the site and on a plan. The sequential strip and direct restoration will follow the pattern of soil movements given in the phased working plans produced within Chapter 3.0 of the ES.

8.7 Residual Effects

Provided that soil handling is carefully carried out, and the restoration soil profile is replaced to the thicknesses specified, there should be no long-term adverse effect on agricultural land quality or the overall extent of BMV land.

Similarly, and linked to restored land quality, provided that the soils are properly handled according to the defined good practice, there should be no adverse residual impact on the soil resource.

8.8 Conclusions

All the mitigation measures proposed to minimise the physical impact on soil resources are in accordance with long established and now conventional soil handling methods (ref MAFF Good Practice Guide for Handling Soils).

All soil resources would be used sustainably to deliver the restoration after uses

The development would result in an overall loss of agricultural land within the original undisturbed 106ha site area. However, there would be no loss of BMV agricultural land within the restored area (69 ha), and for landscape and biodiversity reasons, the restoration strategy has consciously proposed the introduction of a wider range of restoration after uses (species rich grassland and native woodland) compared the original pre development predominant agricultural land use.

Overall, there would thus be no adverse effect on BMV land quality or on soil resources available to ensure the deliverability of the restored BMV land.

9.0 HYDROLOGY AND HYDROGEOLOGY

9.1 Introduction

This chapter of the ES considers the hydrological and hydrogeological issues associated with the proposed northern extension (the Proposed Extension) to the existing sand and gravel extraction at Stanninghall Quarry (the Site).

The chapter provides a description of the hydrological and hydrogeological regimes of the Site and surrounding area and undertakes an assessment of the potential impacts of the Proposed Extension upon those regimes. It also outlines the requirements for mitigation needed to minimise those impacts to an acceptable level. The preliminary results from the study have informed the development of the project design.

9.1.1 Competence of Persons Undertaking Assessment

This chapter of the EIA was prepared by Henry Lister, Director and Principal Hydrogeologist with BCL Consultant Hydrogeologists Limited (BCL).

Mr. Lister holds a Bachelor of Science Degree (Applied Geology) conferred by Plymouth University in 1992 and a Master of Science Degree (Groundwater Engineering; Newcastle University, 1994).

BCL have provided specialist services to the extractive industry since 1990, during which time experience has been gained from involvement with planning matters within varying hydrogeological terrains at over 250-no. quarries throughout the British Isles.

BCL have been involved with the study of water environment within and surrounding Stanninghall Quarry since 1999, having completed the hydrological and hydrogeological EIA relating to Planning Permission granted under Appeal Ref: APP/X2600/A/04/1166832 (26th January 2006) made in respect of quarrying at the Site.

9.1.2 Technical Difficulties

No significant technical difficulties were identified during assessment.

9.1.3 Methodology

Assessment and calculation methodologies referenced as part of this report are listed at **Appendix 9-1**.

Collection and interpretation of published data, in conjunction with site specific information provided by Tarmac, has facilitated a detailed understanding of the nature of, and interactions between, the groundwater and surface water systems operating at and around the Site.

The understanding of hydrological and hydrogeological conditions has been applied to assess the likely impacts of the Proposed Development upon the water environment.

In its ideal application, the assessment process is iterative; initial study aiming to identify significant adverse environmental effects associated with early-draft project design.

Where significant effects are identified, alterations to the project design and / or specific mitigation measures are recommended to eliminate, reduce or compensate for those effects.

Assessment concludes by examining the significance of the residual effects of the Proposed Development upon the water environment assuming the recommended alterations to project design and / or adoption of mitigation measures.

9.1.4 Data Sources

Previous hydrogeological and / or hydrological reports published and site specific data sources, together with site authorisations that have been examined as part of the assessment are listed at **Appendix 9-2**.

9.2 Scope

The scope of assessment has been informed by national and local planning policies and their associated guidance, which are listed here at **Appendix 9-3.**

These policies, together with conditions of extant water-related regulatory authorisations, all reinforce the need to pay due regard to the likely effect of the proposed and existing operations upon various aspects of the water environment.

Attention has also been paid to the EIA scoping opinion issued by Norfolk County Council on 11th February 2020 and the specific comments made regarding flood risk / management and groundwater.

9.2.1 Norfolk Minerals and Waste Local Plan

In July 2019, NCC published 'Preferred Options' for the Norfolk Minerals and Waste Local Plan (NMWLP). The document confirms a requirement for the release of additional reserves of some 20.3m tonnes of sand and gravel over the plan period to 2036, which it is proposed to meet by the release of reserves at 19 defined 'specific site allocations' for future extraction. The identified sites include the Stanninghall northern extension as Specific Site Policy MIN65. The allocation is the largest of the site allocations (4.5m tonnes), where the reserve represents over 22% of the overall supply requirement for Norfolk. The Stanninghall northern extension is thus a key component of the emerging mineral supply strategy for the county.

Policy MW2: Development Management Criteria

Policy MW2 states that the following (potentially) water related matters should be addressed by planning applications for mineral extraction. Proposals for minerals development will be permitted where sufficient information is submitted to demonstrate that the development would not have an unacceptable impact (including cumulative impact in combination with other existing or permitted development) on:

> "*The quantity of water for resource purposes within water bodies, and the quality of surface waterbodies and groundwater, with particular regard to preventing the deterioration of their existing status, and their associated ecosystems that may be affected by water quantity and quality*";
>
> "*The capacity of existing drainage systems*", and;
>
> "*Flood risk on site or an increase in flood risk elsewhere, as demonstrated by a Flood Risk Assessment (where required by the National Planning Policy Framework) and making an allowance for climate change.*"

Policy MW4: Climate change mitigation and adaption

There is a need to reduce the contribution to climate change from minerals development and waste management facilities, while also adapting to its potential effects. Policy MW4 advises that:

> "*New minerals sites and waste management facilities (including extensions to existing sites) will, through their construction and operation, be expected to: minimise their potential contribution to climate change through reducing carbon and methane emissions, incorporate energy and water efficient design strategies and be adaptable to future climatic conditions*", and;
>
> *Proposals for new minerals and waste developments (including extensions to existing sites) will be expected to demonstrate the use of sustainable drainage systems, water harvesting from impermeable surfaces and layouts that accommodate waste water recycling".*

Specific Site Policy MIN65: land north of Stanninghall Quarry

Specific Site Policy MIN65 includes the following paragraphs relating to the water environment:

> "***M65.12 Flood Risk:*** *The site is in Flood Zone 1 (lowest risk) for flooding from rivers. The site has a low probability of surface water flooding, with a few locations of surface water pooling in a 1 in 1000 year*

rainfall event. Sand and gravel extraction is considered to be a 'water compatible' land use that is suitable in all flood zones. The site is not in an Internal Drainage Board area.

" ***M65.13 Hydrogeology:*** *The site is partially located over a Secondary B aquifer and a Secondary A aquifer (superficial deposits) and a principal aquifer (bedrock). The majority of the site is within groundwater Source Protection Zone 3... A planning application for mineral extraction at this site would need to include a Hydrogeological Risk Assessment to identify any potential impacts to groundwater and appropriate mitigation measures*", and;

"***M65.14 Water Framework Directive:*** *The site is approximately 700 metres from the River Bure which is the nearest Water Framework Directive waterbody. The groundwater level in this area is several metres below ground level and therefore overland flows are not expected from the site towards the River Bure. The site proposal indicates that the working would not require dewatering, the current permitted site to the south has been worked 'dry'. MIN 65 and the existing adjacent processing plant, which the sand and gravel would be transported to by internal haul route, are both some distance west of the River Bure. Therefore the sand and gravel to be processed would not be transported across this waterbody. Due to the distance of the site from the River Bure, it is not expected that there would be a pathway for silt ingress into this waterbody from any future sand and gravel extraction within site MIN 65".*

9.2.2 Site Authorisations

Planning Permissions and water related authorisations governing operations at the Site that have been examined and informed the scope of assessment include:

Planning Permission granted under Appeal Ref: APP/X2600/A/04/1166832 (26th January 2006)

Planning permission for the extraction of sand and gravel at Stanninghall Quarry was granted by the Secretary of State in January 2006. Quarrying commenced in early 2015, and operations are proceeding in accordance with the approved scheme.

Planning Permission Ref: C/5/2017/5001 (28th September 2017)

The Decision Notice for Planning Ref: C/5/2017/5001 includes the most recent "Schedule of Conditions and Reasons".

Conditions 12, 14 and 21 of the planning permission mandate:

C4: "*Any oil storage tanks on the site shall be sited on impervious bases and surrounded by oil tight bund walls; the bunded areas shall be capable of containing 110% of the tank volume and shall enclose all fill and draw pipes. To safeguard hydrological interests, in accordance with Policy DM3 of the Norfolk Minerals and Waste Core Strategy DPD 2010-2026 (NMWCS)";*

C14: "*No dewatering of excavations shall be carried out. To safeguard hydrological interests, in accordance with Policy DM3 of NMWCS", and;*

C21: "*The development shall only be carried out in accordance with the schemes for (a) the provision and implementation of pollution control to the water environment and (b) the provision and implementation of dust, soil and silt minimisation, including measures to avoid the deposition of mud or other loose material on the public highway, approved pursuant to condition no.22 of Appeal Ref: APP/X2600/A/04/1166832 and held on that file reference. To safeguard hydrological interests, in accordance with Policy DM3 of NMWCS."*

Abstraction Licence AN/034/0009/014

This licence, first granted October 2011, authorises abstraction from the inland water known as Norton's Broad at Wroxham, the means of abstraction being 3 electric pumps installed at NGR TG 2908 1682, to be used for the purpose of filling and topping up lagoons for mineral washing.

The Licence mandates the following principal conditions:

The permitted rate of abstraction is up to a maximum of 864 m^3/day (100,000 m^3/annum for initial filling of lagoons, reducing to 60,000 m^3/annum for topping up lagoons);

The instantaneous rate of abstraction is limited to 10 l/s; and;

The abstraction shall be metered and recorded.

The licence includes the following Hands-Off Flow Condition (HOF) for the protection of the wider water environment: The abstraction will be temporarily suspended when the flow rate in the River Bure at NGR TG 2670 1940 is less than or equal to 1,603 l/s.

9.3 Proposed Development

A full description of the Proposed Development is provided at Chapter 3 of the ES; a summary of its key elements, where relevant to assessment of impacts upon the water environment is given below.

9.3.1 Mineral Extraction

The current circumstances at the quarry are illustrated on plan ref KD.SH.D.006. This illustrates the location of the processing plant site, the perimeter soil storage / screen bunds; the silt and fresh water lagoons; the current working and progressive restoration area, and the remaining area to be worked in the western area of the Existing Site (phase 4B). The plan illustrates the constrained nature of the Existing Site and the area of mineral reserve currently sterilised by the plant site, bunds and related infrastructure.

The northern extension area represents the 'undisturbed agricultural land', as shown on the Current Situation Plan. The development would be integrated into the phasing scheme for the existing quarry, with a clockwise phased approach to extraction and progressive restoration progressing from the existing phase 4B in the Existing Site northwards in the western area of the Extension Site as phases 5 and 6 and then southwards towards the plant site as phases 7 and 8.

The proposed phasing of operations is illustrated at drawing no's KD.SH.D.009 to KD.SH.D.016 (showing proposed working Phase 4B through to Phase 8; followed by Final Works, Concept Restoration and Technical Sections).

The overall quarry development, comprising reserves in the existing quarry (as a 1st January 2020) and proposed northern extension, would provide a reserve of some 5.05 million tonnes, of which some 0.77m tonnes represents the available reserve within the existing quarry; 3.83m tonnes the reserve in the northern extension area; and a maximum of 0.45m tonnes which would be recoverable from beneath the existing plant site area.

9.3.2 Restoration

Progressive restoration would be undertaken behind the advancing working phase using soils and overburden stripped from the advancing working area for direct placement behind the working area. This will ensure that only the minimum part of the Site forms part of the operational area at any one time.

The proposed restoration strategy is illustrated on plan ref KD.SH.D.015. The aim of the scheme is to re-create an agricultural landscape with enhanced wildlife habitat with the potential for increased biodiversity. The intention is that the local character of the landscape would be strengthened through native hedgerow and woodland planting. Wildlife buffer strips would help to protect and integrate agricultural production into the existing peripheral vegetation structure of the site. Restored land gradients would be appropriate for agricultural production along with the replacement of soil profiles.

All land would be subject to a minimum 5-year aftercare management period, under the control of the Applicant, to ensure the successful delivery of the restoration land uses.

9.3.3 Water Management during Quarry Operations

No Requirement for Dewatering

The lands comprising the Proposed Extension and existing consented quarry have effectively identical hydrogeological and hydrological characteristics.

Consideration of water management issues and methods to be applied for the working of the Proposed Development is therefore usefully informed by experience gained from the working of the existing quarry, supplemented by hydrometric data collected from monitoring infrastructure installed at the Site.

The existing and proposed quarrying operations involve extraction of sand and gravel from above the watertable.

In common with the existing operations, there is no requirement for dewatering or sub-watertable working at the Extension Site. The full depth of mineral reserve (sand and gravel) is above the watertable.

The free-draining nature of the sand and gravel allows works to proceed without the need for active surface water management.

Mineral Washing

The lagoon system is, and will continue to be, utilised as the source of water for the mineral washing and grading process for the duration of the Proposed Development. The current layout of the lagoons is illustrated on plan ref KD.SH.D.006.

This is a re-circulatory system, comprising 3 polythene-lined lagoons. Silt laden waters produced by the mineral washing process are and will continue to be decanted to the active silt lagoon, from where the circuit recommences.

Following settlement of suspended solids within the silt lagoons, waters are and will continue to be decanted to the clean water lagoon.

Silt Lagoon L1 is at full capacity in terms of silt deposition. Lagoon L3 is currently being used for silt settlement; and Lagoon L2 for clean water. With Lagoon L1 reaching full capacity, the area immediately to the north of L1 (and to the west of Lagoon L3) has been set aside for replacement lagoons.

The Abstraction Licence AN/034/0009/014 allows for the topping up of the lagoons, as and when required. The permitted rate of abstraction is up to a maximum of 864 m^3/day (limited to 60,000 m^3/annum for topping up lagoons). Current experience on Site demonstrates that the lagoons have only been topped up on two occasions since 2011.

Off-Site Discharge

There is no discharge requirement at the Application Site.

9.3.4 Water Management following Restoration

A formal stand-alone Flood Risk Assessment (FRA) of the Proposed Development has been carried out in accordance with the requirements of the NPPF[6] and is included here at **Appendix 9-6.**

The drainage proposals at the restored landform will be measured against the existing performance of the Site, such that there is no increase in flood risk to neighbouring land.

[6] "National Planning Policy Framework" (NPPF), Department for Communities and Local Government (DCLG), March 2012.

9.4 Baseline Conditions

9.4.1 Potentially Contaminating Activities at the Extension Area

Historical

A comprehensive drilling programme has been undertaken to prove the sand and gravel reserves in the proposed Application Area.

This has elucidated no historical activities at the Extension Area that would ordinarily be anticipated to have the potential to cause significant contamination of soils or groundwater.

Present Day

Other than issues pertaining to handling and storage of fluids (fuels, lubricating & hydraulic oils), there are no activities currently undertaken at the Extension Area that have the potential to significantly contaminate soils or groundwater.

9.4.2 Designated Sites

Searching within 3km radius of the Site boundary, the closest statutorily protected site[7] of ecological interest is Crostwick Marsh Site of Special Scientific Interest (SSSI). It is included within the Broads SAC, Broadland SPA and Ramsar schemes. The SSSI is located approximately 1.1 km to the south of the Existing Site, at its closest approach i.e. the Existing Site is closer to the SSSI than the Extension Area.

The SSSI lies in the valley of the Spixworth Beck. It comprises unimproved valley meadow, with damp neutral grassland, fen grassland and tall fen. A spring line on the valley slopes provides irrigation water for the marsh, which drains via a series of dykes to the Spixworth Beck. There are locally-developed calcareous flushes (supported by spring seepage) and the site is characterised by a number of rare plant and bird species.

The EA undertakes a programme of hydrometric monitoring at the SSSI. This includes three piezometers, referred to as P1, PA and PB (at NGR TG 263 166).. Monthly measurements, taken from April 1996 to date, have averaged some 1.7 to 1.9 maOD.

Approximately 0.9 km to the north of the proposed extension area is County Wildlife Site CWS 1409 (Adj. All Saints' Church). This lies adjacent to the River Bure and includes damp semi-improved neutral-acidic grassland with oak and sycamore woodland.

CWS 2298 (Upper Common, Coltishall) is 0.8 km standoff to the northeast of the Site, separated by the River Bure. This CWS is described as a "large area of moderate to species-rich grassland, often marshy and with ditches. Soils are neutral to slightly acidic; light and stony in the east but becoming peatier towards the river. Occasional patches of open water remain on the site and hold some of the more unusual plant species".

CWS 2016 (Frettenham Old Lime Pit) is 0.9 km to the southwest of the Existing Site. The citation notes that "this site lies in the remains of an old mineral working. The steep sides and some edges are covered by recent woodland. On lower ground there is a mosaic of scrub and species-rich unimproved neutral grassland. Three deeper pits seem likely to be ponds at least for part of the year".

9.4.3 Permitted Installations and Waste Operations

Historic Landfill

There are 3 historic landfill areas lying within 2 km radius of the Site, all of which are located to the southwest of the Existing Site.

[7] Including Sites of Special Scientific Interest (SSSI's), Special Areas of Conservation (SAC's), existing or proposed Special Protection Areas (SPA's) and existing or proposed RAMSAR sites.

The closest is the Lime Pit at Frettenham (Howes Lime Company Limited), which accepted inert, commercial and special waste from 1990 to 1997 (Site Reference WR 761, NFK/LS/016/0). It is 0.9 km standoff from the Site. As outlined above, it is now classed as a county wildlife site (CWS 2016).

Operational

Mayton Wood Landfill (EA/EPR/CP3795SH/T001) is a Co-Disposal Landfill Site (Type A01) licensed to Norfolk County Council. It is some 2.15 km standoff to the northwest of the Extension Area.

There are no other active landfills within 3 km radius of the Site.

9.4.4 Administrative Units

Water Framework Directive (WFD) River Basin Districts

The entirety of the existing consented operations and Proposed Extension are situated within the Anglian River Basin District.

Catchment Abstraction Management Strategy

This area is covered by the Broadland Abstraction Licensing Strategy (CAMS[8]).

CAMS areas, including that pertaining to the Site, are generally divided into surface water Assessment Points (AP's) and Groundwater Management Units (GWMU's).

Surface Water Resource Availability

The Site overlaps with 3 CAMS group areas: the Bure, Spixworth and Broads Groups.

Surface water resource availability for the Site area is guided by flow values for the River Bure established at the Assessment Point No.3 (AP3); and the Spixworth Beck at AP4. In both cases, this is the point at which the watercourse enters the Broads Group.

The local CAMS defines surface water resource availability under four differing flow conditions, namely: Q30 (the flow rate that is exceeded for 30% of the time, *i.e.* a measure of "high flow"), intermediary Q50, Q70 flow rates and Q95 (the flow rate that is exceeded for 95% of the time, *i.e.* a measure of "low-flow").

Review of the CAMS indicates that the following conditions apply for proposed surface water abstractions:

- "*Water available for licensing*" from the Bure catchment when river flows at the AP are above the Q70 rate;
- "*Restricted water available for licensing*" from the Bure catchment when river flows at the AP are above the Q95 rate;
- "*Water available for licensing*" from the Spixworth and Broads catchment when river flows at the AP are above the Q50 rate;
- "*Restricted water available for licensing* " from the Spixworth and Broads catchment when river flows at the AP are above the Q70 rate, and;

"*Water available for licensing*" implies that:

- There is more water than required to meet the needs of the environment; and;
- New licences can be considered depending on local and downstream impacts.

" *Restricted water available for licensing*" implies that:

- Full licensed flows are below those required to meet the needs of the environment, and;
- No further consumptive licences will be granted, although water may be available via licence trading.

[8] "Broadland Abstraction Licensing Strategy", EA, May 2017.

The low-flow restrictions applying within the Bure catchment for new licensed surface water abstractions imply that such abstraction should be available for 331-days per annum during an average rainfall year. In the Spixworth catchment, this reduces to 248-days per annum.

Groundwater Resource Availability

In areas where there is unconfined chalk, or other, shallower aquifers in continuity with surface water, the groundwater status is linked to the surface water status.

Where groundwater abstractions from solid or drift geology are likely to impact surface water features, or reduce baseflow to a river, the impact is measured at the surface water AP and a Hands off Level (HoL) condition may be applied to the abstraction. The HoL is a groundwater level below which an abstractor is required to reduce or stop abstraction.

The confined chalk groundwater in the Broadland area is fully committed and no further consumptive abstraction can be considered.

9.4.5 Aquifer Classification

The glaciofluvial sands and gravels constituting the economic mineral of the currently consented operations, and Proposed Extension area, are designated by the EA as a "Secondary A" superficial aquifer.

This designation implies: "*...permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.*"

The Secondary A designation is essentially economic; the extent, transmittal and storage potential typical of such strata implying that groundwater will generally be available in quantities and rates to be of importance as a source of water supply and / or river base flow on a local rather than regional scale.

The Chalk of South and East England is classified as a Principal Aquifer. Flow within the aquifer is predominantly through fissures and other discontinuities. Good yields from wells are possible, in the region of 150 litres/second (l/s). These depend upon the intersection of fissures, which are common and tend to occur in the upper 80 m of the saturated zone.

9.4.6 Groundwater Vulnerability Zonation

The glaciofluvial sands and gravels constituting the economic mineral of the Proposed Extension are designated by the EA as having "*Medium-High Vulnerability*" to anthropogenic contamination from surface activities. The risk decreases to "*Medium-Low*" in the southeast corner of the Extension.

9.4.7 Source Protection Zones

The Site falls within the outermost zone (Total Catchment / Zone 3) of the EA-designated groundwater Source Protection Zone (SPZ) for the closest public water supply boreholes.

The Outer SPZ (Zone 2) associated with these abstraction boreholes is situated c1.4km from the Site's eastern boundary (figure 9-1 ES Appendix 9).

The boreholes are in the Belaugh area (to the east of the River Bure), at Juby's Farm (NGR TG 285 179, some 2.1 km east of the Site) and at Grange Farm (NGR TG 287 189, 2.3 km east). The operators are Essex and Suffolk Water and the licensed abstraction rate for each borehole is 10,000 Ml/a from the Chalk.

9.4.8 Abstractions

Data has been obtained from the EA and Broadland District Council (BDC) concerning licensed and deregulated abstractions within 3km radius of the Site. The locations of these abstractions are illustrated at figure 9-1 (ES Appendix 9).

The closest licensed surface water supplies include: the irrigation reservoir adjacent to Spixworth Beck (NGR TG 253 161, 1.5 km south, using 112.9 Ml/a); and various abstractions from the River Bure (the closest being NGR TG 27985 17833, 1.6 km east, using 45.4 Ml/a).

There are two licensed groundwater abstractions within 1 km radius of the Site. Abstracting from the Chalk, these include the borehole at Horstead Lodge (NGR TG 2642 1889, 300 m east of the Site, utilising 30.9 Ml/a) and the Cooper's Grove abstraction (NGR TG 2562 1964, 700 m north, using 78.1 Ml/a).

The private water supplies register held by Broadland District Council's Environmental Management Department has been consulted.

The following supplies (listed as boreholes but with aquifer details unknown) are in closest proximity to the Site: the Caius Hill Farm abstraction (NGR TG 2661 1789, 365 m east of the Site); the Bungalow, Horstead (465 m north of the Site at NGR TG 262 194); Mill Farm, Frettenham (750 m west at NGR TG 246 178); Bluebell Cottage, Stanninghall (620 m south at NGR TG 261 171); and Heggatt Hall (750 m east at NGR TG 272 183).

9.4.9 Topography

The Site is characterised by flat, subdued relief. Ground elevations average between 16 to 18 metres above Ordnance Datum (maOD) across the majority of the Site.

There is a slightly raised area of land at the north east corner of the Site, with a summit elevation of 24 maOD.

A broad, shallow, dry valley feature extends across the eastern boundary of the Site. Ground elevations within this feature decrease in an easterly direction, from 15 maOD at the centre of the Site to less than 10 maOD at the boundary.

To the north and east of the Site, the land slopes gently down to the valley of the River Bure (less than 5 maOD).

At its closest approach, the valley is some 700 metres (m) to the north east of the Site boundary.

The valley of Spixworth Beck (which drains into Dobbs Beck, a tributary of the River Bure) lies to the south of the Site.

The valley lies some 1.1 km to the south of the Site boundary, at its closest point. Ground elevations within the valley do not exceed 5 maOD.

The flat, subdued topography encountered upon the Site extends for several kilometres to the west and northwest, with no marked variation in ground levels.

The topography of the Site area is illustrated at figure 9-2 (ES Appendix 9 drawing no. KD.SH.D.006 "Current Situation").

9.4.10 Geology

A summary of the published (BGS) stratigraphic sequence present in the area of the Site is presented below at table 9-1.

An extract from the published 1:50,000-scale BGS geological map of the area (Sheet 147 "Aylsham") is reproduced at figure 9-3 with keys included at figure 9-4 (ES Appendix 9).

The published drift is necessarily simplified; the field situation is complex, vertical relationships between differing materials varying from area to area in the vicinity of the Site.

The overburden is composed of dark brown, very sandy, gravelly, humic topsoil (some 0.3 m thick) overlying brown, firm silts and clays (averaging 1.7 m thick).

Table 9-1 Generalised Stratigraphic Sequence (after BGS)

Age	Formation / Lithology	Description
Pleistocene	Happisburgh Glacigenic	SANDS & GRAVELS (the economic mineral). Glaciofluvial sand and gravel. Includes Happisburgh Till Member (sand-rich clay matrix with flint clasts).
Quaternary	Wroxham Crag	SANDS & GRAVELS, SILTS and CLAYS
Cretaceous	Upper Chalk	BASE OF ECONOMIC DEPOSIT. Generally weathered to a white, soft, clayey chalk.

The economic mineral consists of:

- Yellow brown, clean to slightly silty, fine to fine/medium grained sand with some 30% gravel content. The unit averages 2.8 m in thickness.
- Dark (orange) brown, slightly silty to silty, fine/medium to medium grained sands with approximately 40% gravel content. The unit has an average thickness of 2.9 m.

Interburden is generally absent from the geological sequence but sporadic and laterally impersistent horizons of brown silts and clays do occur within the economic mineral.

The base of the economic deposit is marked by the gently undulating surface of the Upper Chalk, which is generally weathered to a white, soft, clayey chalk.

9.4.11 Rainfall

The Standard Average Annual Rainfall for the Site in the period 1961 to 1990 (SAAR6190) provided by the CEH FEH web-service[9] is 620mm.

Long-term MAFF[10] data indicate an annual average rainfall depth for the area of 623 mm (MAFF Rainfall Area 24).

The disparities between the various data sources are minimal and considered insignificant.

Average monthly rainfall data have been obtained from the EA rainfall gauging station at Belaugh (NGR TG 29358 18459), which is some 2.9 km to the east of the Site.

Long-term monthly average potential evaporation statistics (MAFF) are given at table 9-2 below.

Table 9-2: Area Long Term Average Monthly Rainfall and Potential Evaporation

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Tot
Potential Evaporation (MAFF)	1	10	32	57	85	95	95	78	50	22	5	0	530

[9] Centre for Ecology & Hydrology Flood Estimation Handbook Web Service (https://fehweb.ceh.ac.uk/), August 2017.

[10] "Climate & Drainage", Technical Bulletin No. 34, Ministry of Agriculture Fisheries & Food (MAFF), September 1976.

These data have been used to derive estimates of monthly average effective rainfall for bare earth and crops, using the method of Grindley[11]; the results are presented at tables 9-3 and 9-4 below.

Table 9-3: Derivation of Effective Rainfall: Bare Ground

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
ERF	58	32	20	0	0	0	0	0	0	0	37	76	223

Rf: Rainfall, Pe: Potential Evaporation, Psmd: Potential Soil Moisture Deficit, Asmd: Actual Soil Moisture Deficit, Ae: Actual Evaporation, ERF: Effective Rainfall. All units other than correction constants are millimetres

Table 9-4: Derivation of Effective Rainfall: Crops

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
ERF	58	32	20	0	0	0	0	0	0	0	0	44	154

Rf: Rainfall, Pe: Potential Evaporation, Psmd: Potential Soil Moisture Deficit, Asmd: Actual Soil Moisture Deficit, Ae: Actual Evaporation, ERF: Effective Rainfall. All units other than correction constants are millimetres

9.4.12 Hydrology

The low-lying land of east Norfolk and northern Suffolk (including the lower valleys and tributaries of the Bure, Yare and Waveney rivers) forms the Broadland region. This comprises a series of shallow lakes created in medieval times by extensive excavation of peatlands then flooded following a rise in sea level. The resultant wetland habitats include open water, reedbeds, fen meadow, wet grazing marsh and carr woodland.

In recognition of habitat diversity, Broadland comprises parcels of land that have been assigned Special Protection Area (SPA), Special Area of Conservation (SAC) and Ramsar (European) status – each with component Sites of Special Scientific Interest (SSSI sites).

The Broads Authority (BA) has produced a water management plan for the area – "The Broads Plan", 2017. This plan proposes a set of policies for managing the water resources, flood defence and water quality of the Broads. The policies include protecting or improving the hydrology of the fens and marsh dykes, maintaining river flow and water quality objectives, reviewing abstraction licences and maximising flood protection e.g. providing washlands to accommodate flood water.

Catchment Sensitive Farming (CSF) and Water Sensitive Farming (WSF) schemes are in place to protect and, where possible, enhance the distinctive pastoral landscape character of Broadland and its wildlife and historic resources. These schemes encourage a reversion from arable farming to traditional management, such as summer grazing of marshes and cutting of fens for thatching materials.

The hydrology of the Site and its surrounding area has been characterised by reference to:

- Published OS mapping;
- EA data-sets, and;
- Water Features Surveying & general walk-over reconnaissance surveying, BCL, various, 1999 to March 2020.

[11] "The Calculation of Actual Evaporation and Soil Moisture Deficit over Specified Catchment Areas", Grindley J, November 1969, Hydrological Memorandum 38, Meteorological Office (MO), Bracknell, UK.

Arterial Watercourses

The surface watercourses of the area are illustrated at figure 9-5 (drawing no. KD.SH.D.001 “Stanninghall Quarry - Location Plan”).

River Bure

The largest watercourse in the vicinity is the River Bure, which lies some 700 m to the north east of the Site at its closest approach.

The river follows a meandering course from north west to south east. On a local scale, the meanders generally range in amplitude from less than 50 m up to 500 m. Downstream of the village of Belaugh (NGR TG 289 184), their amplitudes increase to some 1.5 km.

The valley floor is some 250 to 400 m in width and comprises water meadows and woodland draining via a network of ditches into the main river.

The Bure valley has Ramsar, SPA and SAC status downstream of Wroxham Broad (NGR TG 314 171), where the river is tidal.

Flow and Stage Characteristics

Looking upstream of the Site, the River Bure has a catchment area of some 330 km^2.

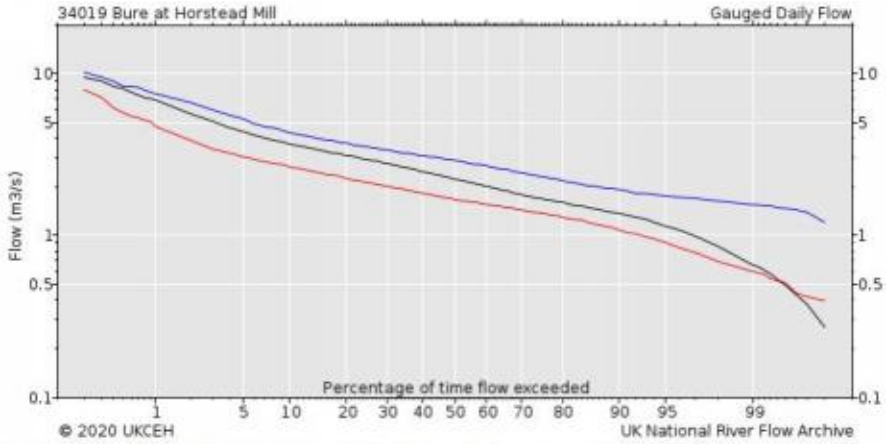
The National River Flow Archive includes “Gauged Daily Flow” data for the River Bure at Horstead Mill (Station No. 34019; NGR TG 266 193). For the period 1974 to 2018, the mean flow rate equates to 2.452 cumecs.

Flow percentiles (Q values) for the Bure at Horstead Mill are computed using gauged daily flow data only for those years with five days, or less, missing on the NRFA.

Period of Record:	1974 - 2018
Percent Complete:	99 %
Base Flow Index:	0.81
Mean Flow:	2.452 m^3/s
95% Exceedance (Q95):	1.15 m^3/s
70% Exceedance (Q70):	1.79 m^3/s
50% Exceedance (Q50):	2.235 m^3/s
10% Exceedance (Q10):	3.69 m^3/s
5% Exceedance (Q5):	4.38 m^3/s

The Q95 flow is a significant low flow parameter particularly relevant in the assessment of river water quality consent conditions. Q95 is the 5 percentile flow: The flow in cubic metres per second which was equalled or exceeded for 95% of the flow record. At this location, the Q95 flow rate is 1.15 cumecs.

The flow duration curve is presented below:



Key: Black line - annual; blue line - December to March; red line - June to September.
Underlying data supplied by the Environment Agency

Water Quality

According to EA mapping (Catchment Data Explorer), the Bure (Horstead Mill to St Benet's Abbey; Waterbody ID: GB105034050931) is listed as having “Good Chemical Status” and “Moderate Ecological Status” during the 2016 review-cycle period.

The Northern Extension falls entirely within the catchment area for this stretch of the Bure (Horstead Mill to St Benet's Abbey).

No specific reasons have been identified for failure to achieve “good” ecological status for the Bure operational catchment. The principal issues on this stretch of river are likely to be agriculture / rural issues.

The water quality analysis schedule for the River Bure focuses on the following parameters: Dissolved Oxygen, pH, Acid Neutralising Capacity, Temperature, Biochemical Oxygen Demand, Ammonia and Phosphate; Specific pollutants including Copper and Iron; and Priority Substances (Lead and Nickel).

The RBMP Cycle 2 classifications are summarised below.

Classification Item	2013	2014	2015	2016
Overall Water Body	Good	Good	Moderate	Moderate
Ecological	Good	Good	Moderate	Moderate
Supporting elements (Surface Water)	-	-	Moderate	Moderate
Biological quality elements	-	Good	Good	Good
Hydromorphological Supporting Elements	Supports Good	Supports Good	Supports Good	Supports Good
Physico-chemical quality elements	Good	Good	Moderate	Moderate
Acid Neutralising Capacity	-	High	High	High
Ammonia (Phys-Chem)	High	High	High	High
Biochemical Oxygen Demand (BOD)	High	High	High	High
Dissolved oxygen	Good	Good	Moderate	Moderate
pH	High	High	High	High
Phosphate	High	High	High	High
Temperature	High	High	Moderate	Moderate
Specific pollutants	High	High	-	High
Triclosan	High	High	-	-
Copper	High	High	-	High
Iron	-	-	-	High
Zinc	High	High	-	-
Chemical	Good	Good	Good	Good
Priority substances	Good	Good	Does not require assessment	Good
Lead and its Compounds	Good	Good	-	Good
Nickel and its Compounds	Good	Good	-	Good
Other Pollutants	Does not require assessment	Does not require assessment	Does not require assessment	Does not require assessment
Priority hazardous substances	Good	Good	Does not require assessment	Does not require assessment

Spixworth Beck

Spixworth Beck lies some 1.1 km to the south of the Site, at its closest point. It flows from west to east, converging with Dobbs Beck (a tributary of the River Bure) at NGR TG 274 168. Continuing eastwards, some 1 km downstream, the beck reaches its confluence with the River Bure (NGR TG 284 172).

Water levels in Spixworth Beck decrease from some 5 maOD at Spixworth Bridge (NGR TG 239 165) to less than 1 maOD at its confluence with the River Bure (NGR TG 284 172).

Along the majority of its length, the valley of Spixworth Beck comprises water meadows, marsh and woodland, with extensive drains and ditches.

The most westerly reach of the Beck arises close to Church Farm near Felthorpe, some 8.25km to the west of the Application Area. The upstream catchment area measures 45km^2 (based upon FEH Web Service mapping).

Flow and Stage Characteristics

The EA have collected data logger and spot flow measurements, recorded in cumecs, at several locations along the beck.

At Spixworth Bridge (NGR TG 239 165), the average flow rate for the period 2003-2020 is some 0.15 cumecs. The lowest recorded flow was 0.018 cumecs.

In the Crostwick area (at NGR TG 255 162, some 1.5 km downstream of Spixworth Bridge), historic data is available for the low flow periods that occurred during the summer of 1976 and 1977. The lowest recorded flow was 0.012 cumecs.

A further 1 km downstream (at NGR TG 265 166), a preliminary spot flow measurement was taken in August 1989 followed by monthly visits from September 1990 through to January 1991. The flow rate for this period averaged some 0.1 cumecs. It is not possible to make a direct comparison with the Spixworth Bridge data, because there are no contemporaneous measurements.

Water Quality

Spixworth (and Dobbs) Beck (Waterbody ID: GB105034050970) is listed as having “Good Chemical Status” and “Moderate Ecological Status” during the 2016 review-cycle period.

The Existing Site has a partial overlap with the catchment area of Spixworth Beck.

The issues preventing the Beck from reaching “good” status (and the sectors identified as contributing to them) are tabulated below:

	Agriculture and rural land management	Domestic General Public	Industry	Local and Central Government	Mining and quarrying	Navigation	Recreation	Urban and transport	Waste treatment and disposal	Water Industry	Other	No sector responsible	Sector under investigation	Total
Changes to the natural flow and levels of water	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Pollution from rural areas	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Pollution from abandoned mines	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Pollution from waste water	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Physical modifications	1	-	-	1	-	-	-	-	-	-	1	-	-	3
Pollution from towns, cities and transport	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Non-native invasive species	-	-	-	-	-	-	-	-	-	-	-	-	-	0

The water quality analysis schedule for the Spixworth Beck focuses on the Physico-chemical quality elements: Dissolved Oxygen, pH, Temperature, Ammonia and Phosphate.

Classification Item	2013	2014	2015	2016
Overall Water Body	Moderate	Moderate	Moderate	Moderate
Ecological	Moderate	Moderate	Moderate	Moderate
Supporting elements (Surface Water)	Moderate	Moderate	Moderate	Moderate
Biological quality elements	Moderate	Moderate	Moderate	Moderate
Hydromorphological Supporting Elements	Supports Good	Supports Good	Supports Good	Supports Good
Physico-chemical quality elements	High	Good	Good	Good
Ammonia (Phys-Chem)	-	High	High	High
Dissolved oxygen	-	Good	Good	Good
pH	High	High	High	High
Phosphate	-	High	High	High
Temperature	-	High	High	High
Specific pollutants	High	High	-	-
Chemical	Good	Good	Good	Good
Priority substances	Good	Good	Does not require assessment	Does not require assessment
Other Pollutants	Does not require assessment	Does not require assessment	Does not require assessment	Does not require assessment
Priority hazardous substances	Good	Good	Does not require assessment	Does not require assessment

Site Surface Water Drainage

Due to the permeable nature of the sand and gravel substrate, there are no surface water features within the body of the Extension Area.

Greenfield Runoff Rate

Site-specific parameters[12] have been computed using methodologies described in current lead technical guidance[13] to determine a range of Greenfield Runoff Rates (GRR's) for differing magnitude storm events for the lands comprising the 43.65ha extraction area within the Proposed Extension.

The results of calculation are summarised below at table 9-5 with input parameters and model output included at **Appendix 9-4**.

Table 9-5: Greenfield Runoff Rates

	Greenfield Runoff Rate (l/s)	
Return	**FEH Method**	**ReFH2 Method**
Qbar*	22.35*	
1: 1-year	19.44	19.6
1:30-years	54.76	59.8
1:100-years	79.57	89.1

* Both calculated using FEH methodology (http://www.uksuds.com/drainage-tools-members/greenfield-runoff-rate-tool.html

Water Bodies

The surface water bodies of the area are illustrated at figure 9-5 (ES Appendix 9); other than the man-made lagoons serving the mineral washing plant, there are no water bodies within the Existing Site and Extension Area.

In closest proximity are the farmyard pond at Stanninghall (some 200 m south of the Site at NGR TG 2550 1744), the reservoir at Common Farm (500 m west of the Site at NGR TG 2477 1798), the village pond at Horstead (550 m north of the Site at NGR TG 2632 1950) and the reservoir at Horstead Lodge (340 m east of the Site at NGR TG 2644 1890). The reservoirs generally occupy small, shallow, man-made excavations. They are utilised for irrigation and watering livestock.

[12]"ReFH2, The revitalised Flood Hydrograph Modelling Tool", Version 3.1.7439.12207, Wallingford HydroSolutions, 2019 and "Greenfield Runoff Estimation for Sites", HR Wallingford (HRW), on-line calculation tool, UK Sustainable Drainage, Guidance & Tools (http://www.uksuds.com/drainage-tools-members/greenfield-runoff-rate-tool.html).

[13] "Rainfall Runoff Management for Developments", R Kellagher, October 2013, joint DEFRA / EA Flood and Coastal Erosion Risk Management R&D Programme, Report SC030219.

There are numerous ponds along the valleys of the River Bure, Spixworth Beck and their un-named tributaries. Some of the ponds are interconnected by small streams and ditches, elsewhere they occur as isolated features within dry valleys. Cooper's Grove, which lies due west of Horstead village centre, is a dry valley along the majority of its length. The ponds are generally small (less than 10 m in diameter) and shallow (less than 1 m in depth).

Isolated ponds occur upon the higher ground between the valleys. These are located within small shallow depressions, storing rainfall run-off.

There is a larger-scale (50 m by 125 m) irrigation reservoir adjacent to Spixworth Beck, at NGR TG 253 161. It is located some 1.5 km south of the Site.

Abandoned gravel workings, located 1.5 km north west of the Site at NGR TG 2405 1970, have flooded to form a series of fishing lakes. These measure up to 200 m in diameter.

Wetland

There are no areas of wetland within the proposed extraction area.

Crostwick Marsh lies some 1.1 km to the south of the Site, at its closest point. It is a Site of Special Scientific Interest (SSSI). It is included within the Broads SAC, Broadland SPA and Ramsar scheme.

As outlined earlier, the SSSI lies in the valley of the Spixworth Beck. It comprises unimproved valley meadow, with damp neutral grassland, fen grassland and tall fen. A spring line on the valley slopes provides irrigation water for the marsh, which drains via a series of dykes to the Spixworth Beck. There are locally-developed calcareous flushes (supported by spring seepage) and the site is characterised by a number of rare plant and bird species.

The EA has installed three piezometers at the marsh, referred to as P1, PA and PB (at NGR TG 263 166). Monthly measurements, taken from April 1996 to date, have averaged some 1.7 to 1.9 maOD.

Approximately 1 km to the north of the proposed extraction area are County Wildlife Sites 1409 and 2298. These are adjacent to the River Bure; full descriptions are provided in section 9.4.2.

Woodland

There are two areas of ancient woodland (semi-natural and replanted) in close proximity to the Site: Clamp Wood (adjacent to the western boundary) and Stanninghall Wood (some 0.5 km to the south of the Site).

There are no surface water features within these woods.

Flooding Characteristics

Information regarding the flooding characteristics of the area has been taken from:

- "Flood Map for Planning (Rivers and Sea) centred on NGR TG 25887 18271", EA drawing, 24th June 2020;
- "Risk of Flooding from Surface Water", EA mapping, 24th June 2020;
- "Risk of Flooding from Reservoirs", EA mapping, 24th June 2020.

Fluvial Flooding

Extant Flood Risk Zonation

Figure 9-6 (EA Flood map for planning, 24th June 2020, ES Appendix 9) illustrates the extent of land in the vicinity of the Site defined by the EA as being liable to fluvial flooding.

The EA mapping shows 100% of the proposed extraction area to reside within fluvial Flood Risk Zone (FRZ) 1 (*i.e.* the lowest risk flood zone; having

an Annual Exceedance Probability [AEP] of fluvial flooding of 1:1,000 or less frequent).

The extents of FRZ2 (AEP of between 1:1,000 and 1:100) and FRZ3 (AEP of 1:100 or more frequent) are effectively confined to the valleys of the River Bure (700 m to the north east of the Site at its closest approach) and Spixworth Beck (1.1 km to the south).

Climate Change

Due to the topography of the river valleys, the extent of EA mapped FRZ2 and FRZ3, when taking account of currently accepted climate change forecasts, are virtually indistinguishable from those shown for present day conditions.

Therefore, the predicted future risk of fluvial flooding to the Site, when taking account of climate change forecasts, are no greater than currently exists.

Surface Water Flooding

Reference made to EA online mapping shows that there are no significant areas within the Site that reside within modelled surface water flood risk zones (*i.e.* flooding resulting from impeded drainage of incident rainfall or rainfall runoff).

The limited areas and extents of those areas that are shown at risk are associated with shallow hollows in the (current) topography of the Site. In particular, surface water flooding would collect in the broad, shallow, dry valley feature that extends across the eastern boundary of the Site. Ground elevations within this feature decrease in an easterly direction, from 15 maOD at the centre of the Site to less than 10 maOD at the boundary.

The proposed quarry operation is classed as a “Water-Compatible Development” in terms of fluvial flooding and this classification might be extended to cover for surface water flooding.

Flood Risk from Reservoirs

Reference made to EA online mapping shows that there is no flood risk from reservoirs at this location.

9.4.13 Hydrogeology

The hydrogeological regime of the area has been elucidated on the basis of:

- Review of published and site specific geological data;
- Review of hydrogeological reports prepared in support of previous planning applications for quarrying development at the Site;
- Groundwater level measurements made within piezometers installed within and surrounding the Site by Tarmac and the EA;
- The occurrence and elevation of local groundwater dependent features such as stream issues and rivers;
- Inspection of quarry faces, BCL, March 2020, and;
- Experience of similar hydrogeological terrains within the British Isles.

Definition of Aquifer Units

The glaciofluvial sands and gravels constituting the economic mineral of the currently consented operations, and Proposed Extension area, are designated by the EA as a "Secondary A" superficial aquifer.

The Chalk is classified as a Principal Aquifer.

Aquifer Boundaries

Vertical Boundaries

The upper surface of the sand and gravel forms an unconfined boundary for autochthonous rainfall recharge of the Secondary Aquifer.

As will be demonstrated below, the full thickness of the drift deposits at the Application Site is unsaturated.

The watertable is at or near the upper surface of the Chalk. Rainfall drains through the sand and gravel and recharges the underlying, unconfined Chalk aquifer.

Lateral Boundaries

BGS mapping (Hydrogeological map of Northern East Anglia Sheet 1; Regional hydrological characteristics and explanatory notes) illustrates that the groundwater divide in the Chalk Aquifer runs through the Felthorpe area. Thus, the up-gradient boundary is some 8km to the west of the Application Site.

Groundwater level contours for the Chalk aquifer (BGS mapping) show that the local stretch of main river and its tributaries (e.g. Spixworth Beck) are receiving baseflow from the Chalk aquifer. Therefore, the lateral boundaries of the local section of aquifer (looking across and down-gradient of the Site) are delimited by the valleys of the River Bure and Spixworth Beck.

Groundwater Flow Mechanism

Flow within the Chalk aquifer is predominantly through fissures and other discontinuities. Good yields from wells are possible, in the region of 150 l/s. These depend upon the intersection of fissures, which are common and tend to occur in the upper 80 m of the saturated zone.

Groundwater Level Data

Groundwater Monitoring

Monitoring and recording of groundwater levels at the Existing Quarry has been carried out from 1999 onwards, generally on a monthly basis.

Monitoring Infrastructure

In order to examine groundwater levels within the sand and gravel deposit at the Site, three piezometers (water level monitoring boreholes) were installed during 1999 and a further four in 2001. They extend through the full thickness of the sand and gravel and terminate in the uppermost 1-3 m of the Chalk. The locations of the piezometers are illustrated at figure 9-7 (ES Appendix 9).

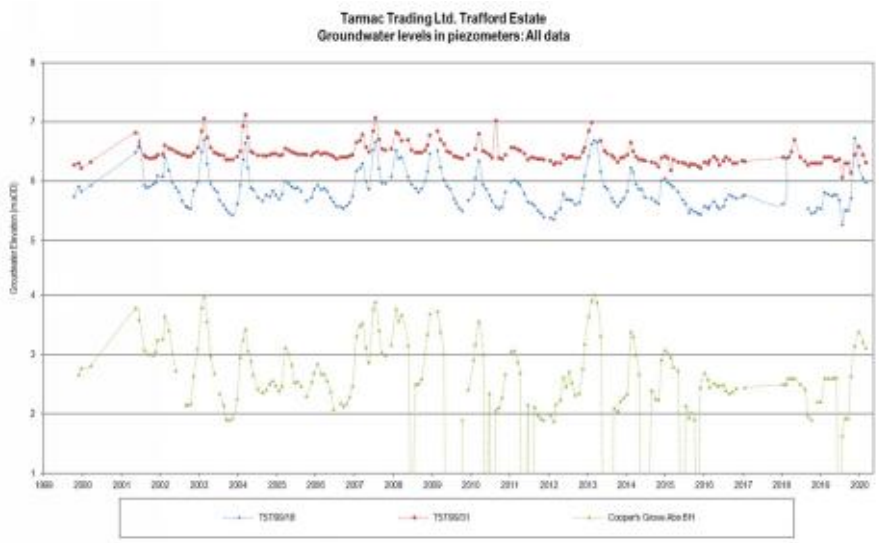
Piezometric Distribution & Temporal Range

The four piezometers encircling the Existing Site and Northern Extension (T57/01/01, T57/01/02, T57/01/03 and T57/99/30, which extend to 9.2, 5.7 9.2 and 6.5 maOD respectively) are dry i.e. no watertable is encountered. This is consistent with the findings of the exploration drilling programme, during which no water strikes were recorded.

Piezometers T57/99/31 and T57/99/18 (550 m and 900 m north west of the Site respectively) indicate that the sand and gravel is dry but that the watertable is at or near the upper surface of the Chalk.

During the monitoring period (October 1999 to date), water levels have ranged between 6.2-7.1 maOD in T57/99/31 and 5.5-6.7 maOD in T57/99/18.

Groundwater level measurements have been obtained from the abstraction borehole at Cooper's Grove during the period from November 1999 to date. The borehole, which lies some 700 m to the north of the Site, is installed within the Chalk. Rest water levels, excluding those taken when the pump was in operation, varied between 2-4 maOD during the monitoring period.



Piezometer T57/01/04 is located between the Site and Crostwick Marsh (some 450 m to the south of the Site, approximately 650 m to the north of the marsh).

The piezometer extends through the full thickness of the sand and gravel and terminates in the upper 1 m of the Chalk (equating to a basal elevation of 9.3 maOD). No watertable is encountered.

EA Data

The EA has previously provided data for 4 piezometers in the vicinity of the Site, all of which are located within the valley of the Spixworth Beck. These include the Spixworth Bridge piezometer (at NGR TG 2400 1657) and three Crostwick Marsh piezometers, referred to as P1, PA and PB (at NGR TG 263 166).

Groundwater levels within the Spixworth Bridge piezometer are at circa 5.0 maOD. Aquifer details at this location have not been specified.

Groundwater level within the Chalk underlying Crostwick Marsh averages 1.9 maOD (as recorded within Piezometer P1). The seasonal range is from 1.25 maOD up to 2.65 maOD.

Aquifer details for the other two piezometers at Crostwick Marsh (PA and PB) are unknown. Groundwater levels within these piezometers averaged 1.72 and 1.82 maOD respectively during the monitoring period. The seasonal range at PA is from 1.15 maOD up to 2.05 maOD; and the range at PB is 1.15 maOD up to 2.10 maOD.

The difference between contemporaneous readings in Piezometers PA and PB is negligible; and they show less seasonal variation than P1..

Therefore, it is considered that Piezometers PA and PB are installed within the superficial deposits at the marsh.

Conceptual Model

The information detailed above (section 9.4 onwards) informs an assessment of the interaction between groundwater and surface water bodies in the vicinity of the Site.

The Site piezometers indicate that the sand and gravel deposit is dry but that the watertable is at or near the upper surface of the Chalk. Rainfall drains through the sand and gravel and recharges the underlying, unconfined Chalk aquifer.

It is considered that the groundwater flow direction in the vicinity of the Site is predominantly from west to east, towards the River Bure. This is based upon comparison of average groundwater levels in west-east piezometer pairings. Water levels in the Chalk decrease from 6.0 maOD in Piezometer T57/99/18 to 3.0 maOD in the abstraction borehole at Cooper's Grove (750 m to the east). Within the valley of the Spixworth Beck, water levels in the Chalk decline from 5.0 maOD in the EA's Spixworth Bridge piezometer to 1.9 maOD at Crostwick Marsh (some 2.25 km to the east).

Groundwater elevations in the monitoring piezometers (as recorded by the Applicant and the EA) have been compared with surface water levels in adjacent streams, ponds and field ditches (taken from OS and LIDAR mapping).

Within the valleys of the Spixworth Beck and Cooper's Grove, groundwater and surface water levels are in concordance. This indicates that the streams, ponds and field ditches in these valleys are in hydraulic continuity with the groundwater in the Chalk. At Spixworth Bridge, water level in the EA's monitoring piezometer (some 5.0 maOD) is consistent with that in the beck. The same applies to water level in the Cooper's Grove abstraction borehole (3.0 maOD) and adjacent field ditch.

Upon the intervening higher ground between Cooper's Grove and Spixworth Beck, there are isolated ponds within small shallow depressions, with surface water levels of 15-20 maOD. Comparison with groundwater elevations (which average 6.5 maOD in Piezometer T57/99/31) indicates that these are perched features.

Dry Working

Data collected from groundwater level monitoring piezometers installed on Site indicate that, within the proposed extraction area, the sand and gravel deposit is dry.

This is consistent with the findings of the exploration drilling programme undertaken in January 2000 and May 2001, during which no watertable strikes were recorded within the 94 boreholes located on Site.

Thus, it is considered that the deposit will continue to be worked dry i.e. there will be no sub-watertable working.

The free-draining nature of the sand and gravel allows works to proceed without the need for active surface water management.

Groundwater Quality

According to EA mapping (Catchment Data Explorer), the entire Site falls within the catchment area of Groundwater Body GB40501G400300: Broadland Rivers Chalk & Crag. This is listed as having "Poor Quantitative Status" and "Poor Chemical Status".

	Agriculture and rural land management	Domestic General Public	Industry	Local and Central Government	Mining and quarrying	Navigation	Recreation	Urban and transport	Waste treatment and disposal	Water Industry	Other	No sector responsible	Sector under investigation	Total
Changes to the natural flow and levels of water	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Pollution from rural areas	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Pollution from abandoned mines	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Pollution from waste water	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Physical modifications	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Pollution from towns, cities and transport	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Non-native invasive species	-	-	-	-	-	-	-	-	-	-	-	-	-	0

The RBMP Cycle 2 classifications are summarised below.

Classification Item	2013	2014	2015	2016
Overall Water Body	Poor	Poor	Poor	Poor
Quantitative	Good	Good	Poor	Poor
Quantitative Status element	Good	Good	Poor	Poor
Quantitative Saline Intrusion	Good	Good	Good	Good
Quantitative Water Balance	Good	Good	Good	Good
Quantitative GWDTEs test	Good	Good	Poor	Poor
Quantitative Dependent Surface Water Body Status	Good	Good	Good	Good
Chemical (GW)	Poor	Poor	Poor	Poor
Chemical Status element	Poor	Poor	Poor	Poor
Chemical Drinking Water Protected Area	Poor	Poor	Poor	Poor
General Chemical Test	Good	Good	Good	Good
Chemical GWDTEs test	Good	Good	Good	Good
Chemical Dependent Surface Water Body Status	Good	Good	Good	Good
Chemical Saline Intrusion	Good	Good	Good	Good

9.5 Effects & Impacts

9.5.1 Background

Baseline assessment has facilitated conceptualisation of the extant groundwater and surface water regimes operating within and around the Site.

This conceptualisation has been utilised to inform assessment of the impacts that are potentially posed by the Proposed Development to the water environment.

9.5.2 Terminology

The terminology used by impact assessment makes a distinction between potential effects, potential primary impacts and potential secondary impacts.

Although any given effect will, by definition, cause a change to the existing water environment, that change, or secondary consequential changes, are considered as impacts only when they are both adverse and of significant scale.

For example, if rising groundwater levels happen to be caused by development, where nothing of consequence is caused by this effect, then no impact is deemed to have occurred.

9.5.3 Generic Potential Effects & Potential Impacts

Quarrying operations of the type and scale described by the Proposed Development, working and subsequent restoration of the Site have the potential to cause the following primary effects upon the water environment:

- Derogation of groundwater resources, levels or flows;
- Derogation of groundwater quality;
- Derogation of surface water resources, levels or flows;
- Derogation of surface water quality; and
- Exacerbation of existing flood risk.

The effects outlined above may, in-turn, lead to secondary impacts upon:

- Volumes and / or quality of surface water available to existing or potential abstractions;
- Volumes and / or quality of groundwater available to support of floral and / or faunal communities;
- Volumes and / or quality of surface water available to support of floral and / or faunal communities, and;
- Flooding risk posed to human safety, property and infrastructure.

These generic effects will not apply in all cases, and their relevance and applicability to the Proposed Development at the Site is examined further below.

9.5.4 Groundwater Resources, Levels and Flows

Data collected from groundwater level monitoring piezometers installed on Site indicate that, within the proposed extraction area, the sand and gravel deposit is dry.

Floor level in the extraction area will equate to 8-10 maOD.

During the monitoring period (October 1999 to date), water levels have ranged between 6.2-7.1 maOD in T57/99/31 and 5.5-6.7 maOD in T57/99/18; declining eastwards to 2-4 maOD in the abstraction borehole at Cooper's Grove.

Thus, the workings will maintain 1-3 m standoff above the peak groundwater levels recorded at the up-gradient piezometer. Moving eastwards across the Site, the standoff above the watertable increases to 4-6 m.

As with the Existing Site, it is considered that the deposit will continue to be worked dry i.e. there will be no sub-watertable working and no requirement for dewatering. There will be no lowering of the watertable as a result of the quarrying activities and no drawdown-related impact upon groundwater levels and flow.

Therefore, the principal means by which existing groundwater resources, levels or flows may be affected by operation of the Proposed Development, would involve: Modification of groundwater recharge due to stripping of overburden and extraction of unsaturated zone materials.

Modification of Groundwater Recharge: Overburden Removal and Mineral Extraction within the Unsaturated Zone

Background & Effects

Preparatory works preceding mineral extraction involve the stripping of soil cover to reveal the sand and gravel.

Groundwater recharge will increase over lands stripped of soils and awaiting mineral extraction and subsequent restoration. Runoff, evaporation and soil moisture deficit in these areas will be virtually eliminated.

The absence of well-developed field drainage within the current Site implies very little present-day runoff.

In turn, this implies that the rate of rainfall recharge through the unsaturated zone of the deposit to the watertable is extremely rapid. The hydraulic conductivity of the sands and gravels would be expected to be very high.

Both these factors indicate very limited retardation for incident rainfall in its transit to the watertable.

As there is minimal extant retardation exerted by the unsaturated zone, it follows that removal of a section of that unsaturated zone by the Proposed Development will have insignificant effect upon groundwater behaviour.

Primary Impacts

There will be no significant adverse modification of the current pattern of groundwater recharge, thus no mechanism exists in this respect to cause discernible impact upon groundwater levels and flows.

Secondary Impacts

As primary impacts are not anticipated, there is no mechanism to cause any secondary impacts in this regard.

Mitigation, Planning Controls and / or Surveillance Monitoring

Neither primary nor secondary impacts are anticipated; mitigation measures, planning controls and / or surveillance monitoring are therefore unnecessary in this regard.

Residual Impacts

Neither primary nor secondary impacts are anticipated; therefore there will be no residual impacts in this regard.

9.5.5 Groundwater Quality

There are 3-no. potential means by which existing groundwater quality may be affected by operation of the Proposed Development, namely:

- A reduction in attenuation capacity due to removal of soils and unsaturated zone materials;
- Accidental spillage or leakage of potential contaminants;
- Recommencement of agricultural practices at the restoration landform.

Reduction of Attenuation Capacity

Background & Effects

By attenuating downward percolation from the ground surface, the soil cover and the underlying unsaturated zone of an aquifer (taken together) control the rate at which rainfall recharge contributes to groundwater.

Naturally attenuating processes within this zone can reduce potential contaminant concentrations prior to entry to the watertable.

It follows that any significant reduction in attenuation by removal of soils and extraction from the unsaturated zone can increase the vulnerability of a groundwater body to contamination.

The Aquifer lying beneath the Economic Deposit of the Site is unconfined and, for the most part, is already classified by the EA as being of "medium to high vulnerability"[14].

Primary Impacts

The soils to be stripped in advance of mineral extraction and any low permeability overburdens and interburdens that may be encountered by operations will not be exported from the Site, but instead be used in Site restoration.

Therefore, following restoration, the bulk attenuation effect currently lent by such materials to the characteristics of aquifer recharge at the Site will be re-established to present-day levels.

The appreciable hydraulic conductivity of the sands and gravels implies that the rate of rainfall recharge through the unsaturated zone of the deposit to the watertable is extremely rapid.

The area of unsaturated zone that will be removed by the Proposed Development is extremely limited in relation to the overall outcrop area of the Aquifer.

These factors imply minimal extant retardation attributable to the soil cover and underlying unsaturated zone, this being further evidenced by the lack of well-developed surface drainage at the Site.

[14] It is important to recognise that, regardless of the vulnerability zonation applying prior to the commencement of a given quarrying operation, the substantial areas of soil and overburden stripping and extraction from the unsaturated zone associated with mineral extraction and the fact that the volumetric majority of UK mineral extraction occurs within potentially water bearing geological materials, means that almost all quarries are operated within "highly vulnerable" groundwater systems This parity renders prevailing vulnerability zonation immaterial to consideration of comparative ("sequential") impacts. The zonation system is also redundant when considering acceptability of impacts; the key test instead being: (i) the existence of a potentially contaminating source, (ii) the existence of a pathway for transport of contamination to (iii) an important receptor for impact.

As there is minimal retardation within the unsaturated zone, it follows that removal of a section of that zone by working of the Proposed Development will have insignificant effect upon extant groundwater vulnerability.

Secondary Impacts

As primary impacts are not anticipated, there is no mechanism to cause any secondary impacts in this regard.

Mitigation, Planning Controls and / or Surveillance Monitoring

Neither primary nor secondary impacts are anticipated; mitigation measures, planning controls and / or surveillance monitoring are therefore unnecessary in this regard.

Residual Impacts

Neither primary nor secondary impacts are anticipated; therefore there will be no residual impacts in this regard.

Accidental Spillage and / or Leakage of Potential Contaminants

Background & Effects

As at the Existing Site, potential contaminants present within the Proposed Development will be limited to diesel fuel, lubricating and hydraulic oils serving fixed and mobile plant.

Quarrying is a historical and on-going activity at the Site; the operation of the Proposed Development will be carried out in an equivalent manner, and within the same hydrostratigraphic environment, as current operations.

Therefore, the potential scale, likelihood of occurrence, or consequences of groundwater pollution by accidental or unwitting release of potentially contaminating fluids will not materially increase as a result of the operation of the Proposed Development.

These factors and the extent to which they apply to the Proposed Development are effectively identical to those associated with numerous similar operations sited throughout the region.

Primary Impacts

Should either accidental spillage or leakage of potentially contaminating fluids used within quarry operations occur, this would have potential to adversely impact existing groundwater quality within the localised section of Chalk Aquifer beneath the economic mineral.

Secondary Impacts

The highly localised and very short-term occurrence of any spillage or leakage in the quarry; together with the considerable standoff between the workings and local watercourses (approximately 0.7 km to the River Bure and 1.1 km to Spixworth Beck and Crostwick Marsh) means that there is negligible risk of impact on a catchment-wide scale (bearing in mind that the upstream catchment of the River Bure is 330 km^2; and Spixworth Beck is 45 km^2).

On this basis, the risk of impact at the local stretch of the River Bure and its tributaries (Spixworth Beck) can be discounted.

Notwithstanding this, mitigation measures are already in place at the Existing Site to ensure protection of the localised section of Chalk aquifer beneath the economic reserves.

Mitigation and Planning Controls

Operation of the Proposed Development involves exposure and working of the sand and gravel deposits, which are in close proximity to groundwater contained within the localised section of underlying Chalk Aquifer.

As this is an unavoidable requirement, the pre-existing and proposed means by which groundwater pollution risk may be satisfactorily mitigated during the operational phase of the Proposed Development are:

- Precautionary measures to prevent of the release of potentially contaminating fluids in the first instance, and;
- Adoption of contingency measures for treatment of such releases should they occur.

In recognition of the potential for groundwater quality derogation of a localised section of aquifer as a result of accidental spillage or leakage of fuel, lubricating or hydraulic oils, measures to minimise these risks are already in place at the Existing Site, as outlined below.

- Fuel-oil powered mobile plant shall be restricted to that necessary to undertake soil stripping, construction and removal of soil mounds, mineral extraction, remedial measures and subsequent restoration of the Site;
- A code of practice shall be followed for the refuelling and maintenance of machinery. This code shall be incorporated into a formal Environmental Management System (EMS, or similar) that should be incorporated into the overall Site management system. Such work should be carried out only by trained personnel and take place within a surfaced area equipped with hydrocarbon interceptors;
- All oil storage tanks will be located within the existing plant site and sited upon impermeable bases enclosed by oil-tight walls. The enclosure should remain at a volume of at least 110% of the capacity of the oil tank and maintained free of accumulations of rainwater;
- All fill and draw pipes emanating from oil storage tanks should be provided with locking mechanisms and be contained within the impermeable enclosure;
- No refuelling or maintenance should be carried out in areas of mineral working;
- Operators should check their vehicles on a daily basis before starting work to confirm the absence of leakages. A reporting system should be implemented to ensure that repairs are undertaken to that vehicle before it enters the working area;
- Sufficient oil sorbant material (3M Oil-Sorb or similar) should be available on Site to cope with a loss equal to the total fluid content of the largest item of plant. Following the use of such oil sorbant material, any contaminated materials should be disposed of from Site in accordance with current waste disposal legislation, and;
- Hydraulic & fuel oil lines on all plant operated within the extraction areas shall be renewed at the manufacturer's recommended service intervals to minimise the potential for contamination following failure of hoses or lines.

The foregoing measures are consistent with existing practice. The fluids handling, storage and remediation protocol is presented at **Appendix 9-5**.

Residual Impacts

Assuming appropriate application of the proposed mitigation measures, impacts will not occur, and therefore, residual impacts are not anticipated in this regard.

Recommencement of agricultural practices at the restoration landform

Background and Effects

Agricultural practices currently occurring on Site, such as the application of fertilisers, will re-commence following restoration. These have potential to impact upon groundwater quality, as the quarry development will result in a reduced thickness of unsaturated zone beneath the restored workings. In order to prevent groundwater contamination, the measures outlined below will be adopted.

The restoration techniques and associated soil profiles will be defined in accordance with the British Standards relating to quality of workmanship and materials. At the time of restoration, samples of soil will be taken over the Site and analysed in order to determine the correct quantities and types of fertiliser, lime and other nutrients required to promote normal plant growth.

This will prevent surplus application of such products and thus protect groundwater quality.

All land would be subject to a minimum 5-year aftercare management period, under the control of the Applicant, to ensure the successful delivery of the restoration land uses.

Primary Impacts

In view of the foregoing, it is considered that the proposed Development has insignificant potential to impact upon the groundwater system.

Secondary Impacts

As primary impacts are not anticipated, there is no mechanism to cause any secondary impacts in this regard.

Residual Impacts

Neither primary nor secondary impacts are anticipated; therefore there will be no residual impacts in this regard.

9.5.6 Surface Water Resources, Levels and Flows

Primary Impacts

As with the Existing Site, it is considered that the deposit will continue to be worked dry. There is no dewatering operation; and no requirement for off-site discharge.

It is considered that the proposed quarry development will not impact upon groundwater levels and flow; and therefore it follows that there will be no derogation of surface water levels and flow. Preparation of a scheme of mitigation is not deemed necessary.

Secondary Impacts

As primary impacts are not anticipated, there is no mechanism to cause any secondary impacts in this regard.

Residual Impacts

Neither primary nor secondary impacts are anticipated; therefore there will be no residual impacts in this regard.

9.5.7 Surface Water Quality

As with the groundwater system, the primary means by which existing surface water quality may be affected by operation the Proposed Development involves: Accidental spillages and / or leakage of potential contaminants;

Accidental Spillage and / or Leakage of Potential Contaminants

Background & Effects

The risk of hydrocarbon spillages will be minimised by enforcing working procedures that conform to the EA Oil Care Code. Trained personnel will undertake all re-fuelling and maintenance, following relevant environmental standards, and in continuation of current practice at the Existing Site.

Primary Impacts

The highly localised and very short-term occurrence of any spillage or leakage in the quarry; together with the considerable standoff between the workings and local watercourses (approximately 0.7 km to the River Bure and 1.1 km to Spixworth Beck and Crostwick Marsh) means that there is negligible risk of impact on a catchment-wide scale (bearing in mind that the upstream catchment of the River Bure is 330 km^2; and Spixworth Beck is 45 km^2).

On this basis, the risk of impact at the local stretch of the River Bure and its tributaries (Spixworth Beck) can be discounted.

Secondary Impacts

No secondary impacts are envisaged.

Mitigation and Planning Controls

Notwithstanding the above assessment, mitigation measures are already in place at the Existing Site to deal with the risk of hydrocarbon spillage/leakage.

In the unlikely event of a hydrocarbon spillage/leakage, in accordance with existing practice on site, a contingency plan is followed for containing and safely disposing of any contaminant. It is considered that the proper application of these existing measures will continue to provide appropriate mitigation against the risks posed by the operation of plant and machinery.

The continued implementation of the pre-existing treatment systems, engineering measures and fluids handling protocol are judged to be effective means of mitigation.

Residual Impacts

Residual impacts are not anticipated in this regard.

9.5.8 Flood Risk Assessment

Background

A formal stand-alone Flood Risk Assessment (FRA) of the Proposed Development has been carried out in accordance with the requirements of the NPPF[15] and is included here at **Appendix 9-6**.

The FRA has involved:

- Review of existing published information;
- Qualitative appraisal of the flood risk posed to the Proposed Development, and;
- Qualitative appraisal of the potential impact of the Proposed Development on flood risk elsewhere.

Summary Findings of Assessment

In accordance with paragraph 030 of the NPPG[16] the FRA has demonstrated compliance with the following key tests:

- That the Proposed Development represents Appropriate Development in the context of prevailing Flood Risk Zonations;
- That neither the operational nor post-restoration stages of the Proposed Development will increase flood risk elsewhere, and;
- That the Proposed Development is safe and that there is no requirement to apply the Exception Test.

Secondary Impacts

As primary impacts are not anticipated, there is no mechanism to cause any secondary impacts in this regard.

Mitigation, Planning Controls and / or Surveillance Monitoring

The principal findings of the FRA, that neither the extraction nor post-restoration stages will increase flood risk elsewhere and that the planned operations are safe from flood risk, are both contingent upon adherence of operations to the detail of the proposed Development as described by the Application.

[15] "National Planning Policy Framework" (NPPF), Department for Communities and Local Government (DCLG), March 2012.

[16] "Flood Risk and Coastal Change, Planning Practice Guidance" (NPPG), DCLG / Department for the Environment Food and Rural Affairs (DEFRA), 6th March 2014.

Therefore, should the Proposed Development be permitted, a mechanism will exist (enforceable via the Town and Country Planning Act 1990) to ensure that Site operations are carried out in a manner that will not affect the findings of the FRA.

Further mitigation measures, planning controls and / or surveillance monitoring are therefore considered unnecessary in this regard.

Residual Impacts

Assuming implementation of the Proposed Development in the manner described by the Application, then neither primary nor secondary impacts are anticipated and therefore there will be no residual impacts in this regard.

9.5.9 Responding to the Scoping Opinion

Attention has also been paid to the EIA scoping opinion issued by Norfolk County Council on 11th February 2020 and the specific comments made regarding flood risk / management and groundwater.

The flood risk assessment examines all sources of flood risk; and demonstrates how surface water drainage from the development will be managed on-site. This includes disposal of water to shallow infiltration, prioritised in line with SuDS principles and hierarchies.

The hydrological and hydrogeological risk assessment methodology takes a tiered approach. The quarry does not extend below the watertable and there will be no dewatering. There are no surface water receptors on site. There is no requirement for off-site discharge and the above assessment has demonstrated that there is negligible risk to the water environment. Thus, it is considered that the assessment has proceeded to the appropriate level.

9.6 Summary of Mitigation, Control & Monitoring Measures

The measures and procedures specifically incorporated into or implicit to the design of the Proposed Development for the minimisation of impact upon the water environment, together with extant or recommended controls and / or surveillance monitoring as identified by this assessment are summarised overleaf at table 9-6.

Table 9-6: Summary Impact, Mitigation, Planning Control and / or Surveillance Monitoring Schedule

	Potential Mechanisms for Impacts	Mitigation, Planning Controls and / or Surveillance Monitoring	Residual Effects
Groundwater Levels & Flows	The Site will be worked dry. There will be no dewatering and thus there is no risk of drawdown-related impact upon groundwater levels and flow. The report examines the risk of modification of groundwater recharge due to stripping of overburden and extraction of unsaturated zone materials.	The absence of well-developed field drainage within the current Site implies very little present-day runoff. In turn, this implies that the rate of rainfall recharge through the unsaturated zone of the deposit to the watertable is extremely rapid. The hydraulic conductivity of the sands and gravels would be expected to be very high. Both these factors indicate very limited retardation for incident rainfall in its transit to the watertable. As there is minimal extant retardation exerted by the unsaturated zone, it follows that removal of a section of that unsaturated zone by the Proposed Development will have insignificant effect upon groundwater behaviour.	Neither primary nor secondary impacts are anticipated; therefore there will be no residual impacts in this regard.
Groundwater & Surface Water Quality	The potential scale, likelihood, or consequences of groundwater or surface water contamination will not be materially increased by implementation of the proposed development; these risks being no greater than apply at the Existing Site and numerous quarry operations throughout the region. The risk of groundwater and / or surface water contamination relates to (i) the potential for accidental hydrocarbon spillages from mobile plant and machinery; and (ii) recommencement of agricultural practices at the restoration landform.	Procedures have been advanced for the protection of water quality; by minimising the likelihood of occurrence in the first instance, and specification of reactive measures for the management of accidental spillage and / or leakage of fuel, lubricating or hydraulic oils should this occur. At the time of restoration, samples of soil will be taken over the Site and analysed in order to determine the correct quantities and types of fertiliser, lime and other nutrients required to promote normal plant growth. This will prevent surplus application of such products and thus protect groundwater quality. All land would be subject to a minimum 5-year aftercare management period, under the control of the Applicant, to ensure the successful delivery of the restoration land uses.	None Anticipated.

9.7 Residual Effects

Assuming implementation of the mitigation measures described herein, the Proposed Development is not anticipated to have any significant residual Effects upon the water environment, either during its operational or post-operational restoration stages.

9.8 Conclusions

A detailed assessment has been undertaken to examine the potential for the Proposed Development to impact upon the water environment.

Assessment has involved the collection, correlation and interpretation of a wide-ranging and detailed site-specific suite of geological, hydrogeological and hydrological data.

The understanding of baseline hydrological and hydrogeological conditions has been applied to assess the likely impacts of the Proposed Development upon the water environment.

Where assessment has identified significant potential for impact upon the water environment, mitigation measures have been formulated to limit any such impact to acceptable levels (as outlined at table 9-6).

In view of the findings of assessment and the planned approach to the Proposed Development, which includes specific measures for the protection of the water environment, there are considered to be no over-riding hydrogeologically or hydrologically based reasons why the planned development should not proceed in the manner described by the Planning Application.

This conclusion assumes that any permission, if granted, should be conditioned by implementation and adherence to any relevant recommendations advanced within this chapter and other such conditions that may be reasonably imposed by the Mineral Planning Authority.

10.0 NOISE

10.1 Introduction

A study of the noise effects of the proposed northern extension and consolidation scheme at Stanninghall Quarry has been undertaken by the Walker Beak Mason Partnership (WBM).

WBM personnel were involved with noise measurements, assessments, mitigation and reports for the planning application for the original Stanninghall Quarry, and have undertaken routine site noise monitoring for the existing quarry since 2015. They are thus fully conversant with the noise circumstances at the site and adjoining area.

Site noise limits at dwellings, for noise arising from the northern extension and existing processing plant site, are suggested based on current advice from the government contained in the web document "*Planning Practice Guidance*" for Minerals, dated March 2014. The suggested site noise limits also have regard to examination of the existing site noise limits, data from routine site noise monitoring reports and the results of noise surveys conducted in January 2020 to obtain noise data at additional locations.

This chapter sets out the calculated noise levels arising from the workings and compares these calculated noise levels with the suggested site noise limits at the nearest dwellings to the proposed northern extension site. Mitigation measures, namely perimeter bunds around the proposed northern extension, have been explored to reduce site noise levels.

Appendix 10.1 in ES Volume 2 contains a "*Glossary of Acoustic Terms*".

10.2 NPPF and Planning Practice Guidance

The National Planning Policy Framework (NPPF) 2019 (first published in 2012) sets out the Government's planning policies for England. At the heart of the National Planning Policy Framework is a presumption in favour of sustainable development.

Section 15 of the NPPF (Conserving and enhancing the natural environment) refers specifically to noise in the following paragraphs:

"170. Planning policies and decisions should contribute to and enhance the natural and local environment by…

(e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability..."

"180. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;

b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason…"

Paragraph 180 (a) refers to the Explanatory Note to Noise Policy Statement for England, 2010.

Paragraph 182 refers to the integration of new development with existing businesses and facilities:

"182. Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing

business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed."

Paragraphs 19 to 22 inclusive of the "*Minerals*" chapter of the Planning Practice Guidance March 2014 are under the heading "Noise emissions" within the section "*Assessing environmental impacts from mineral extraction*". These paragraphs are subsequently referred to as PPG(M).

Paragraph 19 (Reference ID: 27-019-20140306) states:

"How should minerals operators seek to control noise emissions?

Those making mineral development proposals, including those for related similar processes such as aggregates recycling and disposal of construction waste, should carry out a noise impact assessment, which should identify all sources of noise and, for each source, take account of the noise emission, its characteristics, the proposed operating locations, procedures, schedules and duration of work for the life of the operation, and its likely impact on the surrounding neighbourhood.

Proposals for the control or mitigation of noise emissions should:

- *consider the main characteristics of the production process and its environs, including the location of noise-sensitive properties and sensitive environmental sites;*
- *assess the existing acoustic environment around the site of the proposed operations, including background noise levels at nearby noise-sensitive properties;*
- *estimate the likely future noise from the development and its impact on the neighbourhood of the proposed operations;*
- *identify proposals to minimise, mitigate or remove noise emissions at source;*
- *monitor the resulting noise to check compliance with any proposed or imposed conditions."*

Paragraph 20 (Reference ID: 27-020-20140306) states:

"How should mineral planning authorities determine the impact of noise?

Mineral planning authorities should take account of the prevailing acoustic environment and in doing so consider whether or not noise from the proposed operations would:

- *give rise to a significant adverse effect;*
- *give rise to an adverse effect; and*
- *enable a good standard of amenity to be achieved.*

In line with the Explanatory Note of the Noise Policy Statement for England, this would include identifying whether the overall effect of the noise exposure would be above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation. As noise is a complex technical issue, it may be appropriate to seek experienced specialist assistance when applying this policy."

Paragraph 21 (Reference ID: 27-0021-20140306) states:

"What are the appropriate noise standards for mineral operators for normal operations?

Mineral planning authorities should aim to establish a noise limit, through a planning condition, at the noise-sensitive property that does not exceed the background noise level (LA90,1h) by more than 10dB(A) during normal working hours (0700-1900). Where it will be difficult not to exceed the background level by more than 10dB(A) without imposing unreasonable burdens on the mineral operator, the limit set should be as near that level as practicable. In any event, the total noise from the operations should not exceed 55dB(A) LAeq, 1h (free field). For operations during the evening (1900-2200) the noise limits should not exceed the background noise level (LA90,1h) by more than 10dB(A) and should not exceed 55dB(A) LAeq, 1h (free field). For any operations during the period 22.00 – 07.00 noise limits should be set to reduce to a minimum any adverse impacts, without imposing unreasonable burdens on the mineral operator. In any event the noise limit should not exceed 42dB(A) LAeq,1h (free field) at a noise sensitive property.

Where the site noise has a significant tonal element, it may be appropriate to set specific limits to control this aspect. Peak or impulsive noise, which may include some reversing bleepers, may also require separate limits that are independent of background noise (e.g. Lmax in specific octave or third-octave frequency bands – and that should not be allowed to occur regularly at night.)

Care should be taken, however, to avoid any of these suggested values being implemented as fixed thresholds as specific circumstances may justify some small variation being allowed."

Paragraph 22 (Reference ID: 27-022-20140306) states:

"What type of operations may give rise to particularly noisy short-term activities and what noise limits may be appropriate?

Activities such as soil-stripping, the construction and removal of baffle mounds, soil storage mounds and spoil heaps, construction of new permanent landforms and aspects of site road construction and maintenance.

Increased temporary daytime noise limits of up to 70dB(A) LAeq 1h (free field) for periods of up to eight weeks in a year at specified noise-sensitive properties should be considered to facilitate essential site preparation and restoration work and construction of baffle mounds where it is clear that this will bring longer-term environmental benefits to the site or its environs.

Where work is likely to take longer than eight weeks, a lower limit over a longer period should be considered. In some wholly exceptional cases, where there is no viable alternative, a higher limit for a very limited period may be appropriate in order to attain the environmental benefits. Within this framework, the 70 dB(A) LAeq 1h (free field) limit referred to above should be regarded as the normal maximum."

10.3 Measured Noise Levels near Dwellings

WBM has undertaken routine site noise monitoring ten times for the quarry since 2015 with a total of 97 fully attended 15-minute measurements at eight locations listed in Condition 6 of a planning permission dated 26th January 2006 relating to the Trafford Estate in Norfolk, Application No. C/5/2003/5004, Appeal No. APP/X2600/A/04/1166832. From examination of each noise monitoring report, completed as specified in the approved Scheme of Noise Monitoring, the site noise levels have always been determined to comply with the site noise limits for dwellings at all locations.

Visits were made by WBM personnel on Monday 20 January 2020 and Tuesday 21 January 2020 to obtain baseline data for dwellings in the area surrounding the proposed northern extension with attended sample measurements at six locations and a sound level meter installed at The Hollies on Frettenham Road for a period of 21 hours.

Appendix 10.2 in ES Volume 2 is a plan and tabulated list of "*Baseline Noise Survey Locations January 2020*". Locations 1, 2, 5 and 6 are essentially the same as for four of the eight routine site noise monitoring locations, albeit with different numbering to that contained in the approved Scheme of Noise Monitoring. Location 3 was selected to represent the nearest dwellings in Horstead, adjacent to Norwich Road, to the proposed northern extension area. Location 4 was selected to represent the nearest dwellings on Frettenham Road west of Horstead, to the proposed northern extension area.

Appendix 10.3 in ES Volume 2 provides "*Baseline Noise Survey Details January 2020*" and **Appendix 10.4** presents "*Baseline Noise Survey Results January 2020*" for the attended sample measurements at six locations. **Appendix 10.5** provides "*Installed Sound Level Meter Details January 2020*" and **Appendix 10.6** presents "*Installed Meter Noise Survey Results January 2020*" in tabulated and graphical form for the data obtained from the sound level meter installed at The Hollies for a period of 21 hours.

Two further samples were obtained at Locations 3 and 4 on Tuesday 19 May 2020, to supplement the data obtained in January 2020.

10.4 Suggested Site Noise Limits

The suggested site noise limits have regard to the PPG(M) as well as examination of the existing site noise limits, data from the routine site noise monitoring reports and the results of noise surveys in January 2020.

Appendix 10.7 in ES Volume 2 provides a "*Summary Including Routine Noise Monitoring*" since 2015 of measured noise levels at locations near to dwellings. The "*Position*" numbering in the tables corresponds to the measurement locations listed in the approved Scheme of Noise Monitoring and as shown on the plan in Appendix 10.7 copied from "*Trafford Quarry, Norfolk: Scheme of Noise Monitoring*".

Condition 6 of a planning permission dated 26th January 2006 relating to the Trafford Estate contains the existing site noise limits at eight locations.

"Except for temporary operations, the noise level due to operations at the site shall not exceed the noise limits specified below at each dwelling. Measurements taken to verify compliance shall have regard to the effects of extraneous noise and shall be corrected for such effects."

1	Hill Farm, Frettenham Road:	48 dB LAeq,15min, free field
2	The Hollies, Frettenham Road:	48 dB LAeq,15min, free field
3	Common Farm, Frettenham:	45 dB LAeq,15min, free field
4	New Farm Cottages:	48 dB LAeq,15min, free field
5	Stanninghall Farm:	48 dB LAeq,15min, free field
6	Caius Hill Farm House:	45 dB LAeq,15min, free field
7	Beverley Farm House:	52 dB LAeq,15min, free field
8	Horstead Lodge:	55 dB LAeq,15min, free field

The numbers 1 to 8 have been added to allow for identification of the site noise monitoring locations as shown on the plan in **Appendix 10.7**. The results for site noise monitoring locations 3, 4 and 5 have not been presented in the tables as they are remote from the northern extension.

For Hill Farm and The Hollies, the average background noise level presented in Appendix 10.7 is 35 dB LA90, T. Analysis of the data from the installed sound level meter at The Hollies gives an average background noise level of 35 dB LA90, T for the proposed hours of operation of the quarry (07:00 to 18:00). For Hill Farm and The Hollies the suggested site noise limit, based on PPG(M) is thus 45 dB LAeq, 1 hour, free field.

For Common Farm, New Farm Cottages and Stanninghall Farm no change is suggested for the existing site noise limits at these locations and potentially they would not be included at all in a revised noise monitoring scheme for the proposed northern extension (subject to approval).

For Caius Hill Farm House, the average background noise level presented in Appendix 10.7 is 42 dB LA90, T and the suggested site noise limit, based on PPG(M) is thus 52 dB LAeq, 1 hour, free field.

For Beverly Farm House, the average background noise level presented in Appendix 10.7 is 46 dB LA90, T and the suggested site noise limit, based on PPG(M) is thus 55 dB LAeq, 1 hour, free field.

For Horstead Lodge, the average background noise level presented in Appendix 10.7 is 49 dB LA90, T and the suggested site noise limit, based on PPG(M) is thus 55 dB LAeq, 1 hour, free field.

For the location selected to represent the nearest dwellings in Horstead, adjacent to Norwich Road, the average background noise level presented in Appendix 10.7 is 38 dB LA90, T and the suggested site noise limit, based on PPG(M) is thus 48 dB LAeq, 1 hour, free field.

For the location selected to represent the nearest dwellings on Frettenham Road west of Horstead, the average background noise level presented in Appendix 10.7 is 34 dB LA90, T and the suggested site noise limit, based on PPG(M) is 45 dB LAeq, 1 hour, free field (as for Hill Farm and The Hollies).

The suggested site noise levels are for noise arising from all site activity "*Except for temporary operations*". Calculated site noise levels are

presented in the next section and compared with these suggested site noise limits.

10.5 Calculated Site Noise Levels

The noise output from the proposed site operations and noise levels received at off-site receptors depends on the method of working and the plant chosen to work the site as much as on the distance to the neighbouring properties and the effects of intervening landform.

Proper allowance can be made for noise decay with distance from the various noise sources and for the effects of ground absorption or screening due to topography and the existing and proposed perimeter bunds.

In order to calculate the noise levels for the proposed site operations, the contribution from each significant specific noise source has been evaluated separately and then combined together to give the overall noise level.

The calculations in this chapter are based on the methods contained in BS5228-1: 2009 "*Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*" + A1: 2014, Annex F.

Further details of the calculation methods are set out in **Appendix 10.9** in ES Volume 2. A summary site noise calculation sheet for one of the nearest dwellings to the extension area is included in **Appendix 10.9**.

For the purposes of examining a reasonable worst case, the various items have been assumed to operate at the closest and highest practical position of the proposed extraction operations to each dwelling.

It has also been assumed that all mobile and fixed plant items work 100% of one hour for the PPG(M) daytime assessment period (07:00 to 19:00).

10.5.1 Noise Sources and Sound Power Levels

The plant items used in the calculations are listed in the table below along with descriptions and the Sound Power Level dB L_{WA} (noise output) values. The noise source terms for the calculated site noise levels are based on a plant list provided by Tarmac and measurements by WBM of similar plant items and experience of many sites and operating quarries. In particular, measurements were made of the processing plant at Stanninghall Quarry on Tuesday 21 January 2020 at two locations shown on the plan in **Appendix 10.2** with the results presented in **Appendix 10.4.**

Table 10-1Stanninghall Quarry Plant Items

Plant Item	Description	dB L_{WA}
Excavator digging 50% of 1 hour	Komatsu / Volvo 360º	104
Excavator loading 50% of 1 hour	Komatsu / Volvo 360º	104
Dump trucks to processing plant site	Volvo A25 / Volvo A30	104
Concrete batching plant	Plant noise database	108
Existing processing plant	Measured on site	108
Existing processing plant	Measured on site	108
Excavator	Temporary operations	103
Dump truck	Temporary operations	104
Dozer	Temporary operations	108

10.5.2 Calculated (Routine) Site Noise Levels

The distances to the respective dwellings, from the various items of plant, have been used in spreadsheet calculations for the nearest excavator in the proposed northern extension area to calculate the reasonable worst case dB LAeq,1 hour, free field site noise levels at eight receiver locations. **Appendix 10.8** contains "*Site Noise Calculation Locations Plan and List*".

Table 10-2 Calculated Noise Levels and Suggested Noise Limits

Receiver Location (Routine Operations)	Calculated Site Noise Levels dB $L_{Aeq,1hour, free field}$	Suggested Site Noise Limit dB $L_{Aeq,1hour, free field}$
1. The Hollies	45	45
2. Hill Farm	45	45
3. Frettenham Road	45	45
4. Frettenham Road Horstead	42	48
5. Norwich Road Horstead	46	48
6. Horstead Lodge	45	55
7. Beverley	46	55
8. Caius Hill Farm	46	52

The calculated site noise levels for routine operations, with Mitigation Measures as described in section 10.6, comply with the suggested site noise limits at all of the receiver locations.

10.5.3 Calculated (Temporary) Site Noise Levels

The calculated reasonable worst-case site noise levels for temporary operations are set out below for soils and overburden removal / placement and bund formation and removal at the nearest approach to the eight receiver locations.

Table 10-3 Calculated Temporary Noise levels and Suggested Noise Limit

Receiver Location (Temporary Operations)	Calculated Site Noise Levels dB $L_{Aeq,1hour, free field}$	PPG(M) Site Noise Limit dB $L_{Aeq,1hour, free field}$
1. The Hollies	67	70
2. Hill Farm	67	70
3. Frettenham Road	49	70
4. Frettenham Road Horstead	45	70
5. Norwich Road Horstead	50	70
6. Horstead Lodge	47	70
7. Beverley	63	70
8. Caius Hill Farm	47	70

The calculated site noise levels for temporary operations comply with the PPG(M) site noise limit at all of the receiver locations. The material movement associated with bund formation and removal can take place within the conventional 8 week period in any 12 months for temporary operations in the vicinity of any of the receiver locations.

10.6 Noise Mitigation Measures Examined

For all locations apart from The Hollies and Hill Farm, the calculated site noise levels for routine operations in the proposed northern extension comply with the existing / suggested site noise limits taking account of the separation distances and with no allowance for bunds / barrier attenuation due to the intervening ground.

For The Hollies, the calculated site noise level is 48 dB LAeq, 1 hour, free field with a 3 m high Topsoil Bund. The existing site noise limit at The Hollies is 48 dB LAeq, 1 hour, free field.

The "*Phase 5 Extraction*" boundary is no closer to The Hollies than "*Remaining Permitted Mineral Extraction within Phase 4B*".

The 'suggested' site noise limit at The Hollies, based on 10 dB(A) above background levels from samples and an install, is 45 dB LAeq, 1 hour, free field. For The Hollies, the calculated site noise level is 45 dB LAeq, 1 hour, free field with a 4 m high bund.

For The Hollies, the calculated site noise level of 45 dB LAeq, 1 hour, free field is achieved at a separation distance of 320 m with no barrier attenuation, so it is appropriate to remove The Hollies bund in Phase 7 as shown on the phasing drawings.

For Hill Farm, the calculated site noise level is 47 dB LAeq, 1 hour, free field with a 3 m high Topsoil Bund. The existing site noise limit at Hill Farm is 48 dB LAeq, 1 hour, free field.

The 'suggested' site noise limit at Hill Farm, based on 10 dB(A) above background levels from samples, is 45 dB LAeq, 1 hour, free field. For Hill Farm, the calculated site noise level is 45 dB LAeq, 1 hour, free field with a 3.5 m high bund.

For Hill Farm, the calculated site noise level of 45 dB LAeq, 1 hour, free field is achieved at a separation distance of 280 m with no barrier attenuation, so it is acceptable to remove The Hill Farm bund in Phase 8 as shown on the phasing drawings.

10.7 Recommendations

The routine site noise monitoring undertaken by WBM since 2015 has obtained approximately 100 measurements at eight locations. From examination of each noise monitoring report, completed as specified in the approved Scheme of Noise Monitoring, the site noise levels have always been determined to comply with the site noise limits for dwellings at all locations. It is recommended that a revised Scheme of Noise Monitoring be prepared for the proposed northern extension to include additional receiver locations in and near to Horstead and set with appropriate site noise limits.

For The Hollies and Hill Farm, the existing site noise limit is 48 dB LAeq, 1 hour, free field and calculations demonstrate that this could be achieved with 3 m high Topsoil Bunds as shown on the phasing drawings for these two isolated dwellings. If a site noise limit of 45 dB LAeq, 1 hour, free field were to be imposed by the Mineral Planning Authority this would need to be in the context of increased perimeter bund heights of 4 m for The Hollies and 3.5 m for Hill Farm.

10.8 Summary and Conclusions

Tarmac Trading Ltd proposes a northern extension to their existing Stanninghall Quarry in Norfolk. WBM personnel were involved with noise measurements, assessments, mitigation and reports for previous planning applications, one of which now comprises the existing quarry. WBM has undertaken routine site noise monitoring for the existing quarry since 2015.

Paragraphs 19 to 22 inclusive of the "*Minerals*" chapter of the Planning Practice Guidance March 2014 are under the heading "Noise emissions" within the section "*Assessing environmental impacts from mineral extraction*". These paragraphs are subsequently referred to as PPG(M).

WBM has undertaken routine site noise monitoring ten times for the quarry since 2015 with a total of 97 fully attended 15-minute measurements at eight locations listed in Condition 6 of a planning permission dated 26th January 2006 relating to the Trafford Estate in Norfolk, Application No. C/5/2003/5004, Appeal No. APP/X2600/A/04/1166832. From examination of each noise monitoring report, completed as specified in the approved Scheme of Noise Monitoring, the site noise levels have always been determined to comply with the site noise limits for dwellings at all locations.

Visits were made by WBM personnel on Monday 20 January 2020 and Tuesday 21 January 2020 to obtain baseline data for dwellings in the area

surrounding the proposed northern extension with attended sample measurements at six locations and a sound level meter installed at The Hollies on Frettenham Road for a period of 21 hours.

Suggested site noise limits have regard to the PPG(M) as well as examination of the existing site noise limits, data from the routine site noise monitoring reports and the results of noise surveys in January 2020.

The distances to the respective dwellings, from the various items of plant, have been used in spreadsheet calculations for the nearest excavator in the proposed northern extension area to calculate the reasonable worst case dB LAeq,1 hour, free field site noise levels at eight receiver locations.

For all locations apart from The Hollies and Hill Farm, the calculated site noise levels for routine operations in the proposed northern extension comply with the existing / suggested site noise limits taking account of the separation distances and with no allowance for bunds / barrier attenuation due to the intervening ground.

For The Hollies and Hill Farm, the existing site noise limit is 48 dB LAeq, 1 hour, free field and calculations demonstrate that this could be achieved with 3 m high Topsoil Bunds as shown on the phasing drawings for these two isolated dwellings. If a site noise limit of 45 dB LAeq, 1 hour, free field were to be imposed by the Mineral Planning Authority this would need to be in the context of increased perimeter bund heights of 4 m for The Hollies and 3.5 m for Hill Farm.

It is recommended that a revised Scheme of Noise Monitoring be prepared for the proposed northern extension to include additional receiver locations in and near to Horstead and set with appropriate site noise limits.

11.0 AIR QUALITY

11.1 Introduction

This chapter has been prepared by SLR Consulting Ltd and considers the potential of the proposed northern extension and consolidation scheme ('Proposed Development') at Stanninghall Quarry ('Application Site') to impact upon air quality.

The chapter describes the scope, relevant legislation, assessment methodology and the baseline conditions currently existing at the Application Site and its surroundings. It then considers any potentially significant environmental effects that the Proposed Development would have on this baseline environment and the mitigation measures required to prevent, reduce or offset any significant adverse effects; and the likely residual impacts after these measures have been employed.

A full description the Application Site and the Proposed Development can be found in Chapter 2 and Chapter 3 of this ES, respectively.

11.2 Scope

The scope of this assessment has been undertaken in accordance with the Institute of Air Quality Management (IAQM) guidance, and addresses the following:

- baseline review – identification of relevant receptors, background pollutant concentrations and meteorological conditions;
- potential impacts arising as a result of dust deposition i.e. effects on amenity and ecological receptors;
- potential human health impacts arising as a result of suspended airborne dust with an aerodynamic diameter of less than 10 microns (PM_{10});
- a traffic emissions screening assessment; and
- a review of the existing dust control measures employed and recommendations for additional controls, as required.

11.3 Legislation, Guidance and Industry Good Practice

11.3.1 Air Quality Standards Regulations

The Air Quality Standards Regulations 2010 (the regulations) transpose the Ambient Air Quality Directive (2008/50/EC), and transpose the Fourth Daughter Directive (2004/107/EC) within UK legislation. The regulations include Limit Values, Target Values, Objectives, Critical Levels and Exposure Reduction Targets for the protection of human health and the environment (collectively termed Air Quality Assessment Levels (AQAL) throughout the remainder of this chapter). Those relevant to this air quality chapter are presented within **Table 11-1**.

Table 11-1 – Air Quality Assessment Levels

Pollutant	Standard	Measured as
Particles (PM_{10}) (gravimetric)	40µg/m^3	Annual Mean
	50µg/m^3	24 Hour Mean. Not to be exceeded more than 35 times per calendar year
Particles ($PM_{2.5}$) (gravimetric)	25µg/m^3	Annual Mean
Nitrogen Dioxide (NO_2)	40µg/m^3	Annual Mean

Pollutant	Standard	Measured as
	200µg/m^3	1 Hour Mean. Not to be exceeded more than 18 times per calendar year

11.3.2 Air Quality Strategy

The United Kingdom Air Quality Strategy (UK AQS) for England, Scotland, Wales and Northern Ireland[17], last updated in 2007, sets out the Government's policies aimed at delivering cleaner air in the United Kingdom (UK). It sets out a strategic framework within which air quality policy will be taken forward in the short to medium term, and the roles that Government, industry, the Environment Agency (EA), local government, business, individuals and transport have in protecting and improving air quality.

11.3.3 Local Air Quality Review & Assessment

Section 82 of the Environment Act 1995 (Part IV) requires Local Authorities (LAs) to periodically review and assess the quality of air within their administrative area. The reviews have to consider the present and future air quality and whether any AQALs prescribed in regulations are being achieved or are likely to be achieved in the future.

Where any of the prescribed AQALs are not likely to be achieved the authority concerned must designate an Air Quality Management Area (AQMA). For each AQMA the LA has a duty to draw up an Air Quality Action Plan (AQAP) setting out the measures the authority intends to introduce to deliver improvements in local air quality in pursuit of the AQAL. As such, LAs have formal powers to control air quality through a combination of LAQM and by use of their wider planning policies.

The Department for Environment, Food and Rural Affairs (Defra) has published Local Air Quality Management Technical Guidance (LAQM.TG(16))[18]; designed to support LAs in carrying out their duties under the Environment Act, 1995 and subsequent regulations.

11.3.4 General Nuisance Legislation

Part III of the Environmental Protection Act (EPA) 1990 (as amended) contains the main legislation on Statutory Nuisance and allows LAs and individuals to take action to prevent a statutory nuisance. Section 79 of the EPA defines amongst other things, smoke, fumes, dust and smells emitted from industrial, trade or business premises so as to be prejudicial to health or a nuisance, as a potential Statutory Nuisance. It also defines as a nuisance accumulation or deposit which is prejudicial to health.

In contrast to suspended particulate matter, there are no UK or European statutory standards that define the point at which deposited dust causes annoyance or disamenity. There are a number of 'custom and practice' thresholds in use, however 'nuisance' is a subjective concept and its perception is highly dependent upon the existing conditions and the change which has occurred.

11.3.5 National Planning Policy

The National Planning Policy Framework[19] (NPPF) describes the policy context in relation to pollutants, with specific reference to air quality its states:

> *"Para 170: Planning policies and decisions should contribute to and enhance the natural and local environment by:*
>
> *e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of […] air […] pollution […]. Development*

[17] Defra, The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Volume 1), July 2007.

[18] Defra, Local Air Quality Management Technical Guidance (TG16), February 2018.

[19] Ministry of Housing, Communities and Local Government, The National Planning Policy Framework, 2019.

should, wherever possible, help to improve local environmental conditions such as air […] quality […]"

"Para 180: Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development."

Specifically, in terms of development with regards to air quality:

"Para 181: Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan."

The NPPF is accompanied by supporting Planning Practice Guidance[20] (PPG) which includes guiding principles on how planning can take account of the impacts of new development on air quality. In regard to air quality, the PPG states:

"The Department for Environment, Food and Rural Affairs carries out an annual national assessment of air quality using modelling and monitoring to determine compliance with relevant Limit Values. It is important that the potential impact of new development on air quality is taken into account where the national assessment indicates that relevant limits have been exceeded or are near the limit, or where the need for emissions reductions has been identified."

"Whether air quality is relevant to a planning decision will depend on the proposed development and its location. Concerns could arise if the development is likely to have an adverse effect on air quality in areas where it is already known to be poor, particularly if it could affect the implementation of air quality strategies and action plans and/or breach legal obligations (including those relating to the conservation of habitats and species). Air quality may also be a material consideration if the proposed development would be particularly sensitive to poor air quality in its vicinity."

The PPG sets out the information that may be required within the context of a supporting air quality assessment, stating that "*Assessments need to be proportionate to the nature and scale of development proposed and the potential impacts (taking into account existing air quality conditions), and because of this are likely to be locationally specific […] Mitigation options will need to be locationally specific, will depend on the proposed development and need to be proportionate to the likely impact.*"

The policies within the NPPF and accompanying PPG in relation to air pollution are considered within this chapter.

11.3.6 Local Planning Policy

Norfolk Minerals and Waste Local Development Framework

As part of the Norfolk Minerals and Waste Local Development Framework, Norfolk County Council (NCC) adopted the Core Strategy and Minerals and Waste Development Management Policies Development Plan Document

[20] Ministry of Housing, Communities and Local Government, Planning Practice Guidance Air Quality, 2019 update. [accessed: https://www.gov.uk/guidance/air-quality--3].

2010 – 2026[21] in September 2011. The document contains '*Development Management Policy DM13 – Air Quality*', as follows:

> *"Applicants for planning permission will be required to submit information to demonstrate that proposals effectively minimise harmful emissions to air and would not impact negatively on existing Air Quality Management Areas, nor lead to the declaration of a new AQMA. Development will be permitted if adequate measures can be agreed through planning conditions to mitigate potentially harmful air quality impacts to human health.*
>
> *Planning permission will only be granted in areas nearing AQMA threshold limits if an Air Quality Impact Assessment shows that the development in question and its associated activities would not increase air pollution to unacceptable levels, as defined in the National Air Quality Strategy."*

Broadland District Council Local Plan

The Development Management DPD[22], which was adopted in August 2015, forms part of the Broadland District Council (BDC) Local Plan. It contains '*Policy EN4 – Pollution*' which is of relevance to this assessment, as follows:

> "*Development proposals will be expected to include an assessment of the extent of potential pollution. Where pollution may be an issue, adequate mitigation measures will be required. Development will only be permitted where there will be no significant adverse impact upon amenity, human health or the natural environment.*"

The above policies have been given due consideration within this chapter.

11.3.7 Assessment Guidance

The Mineral Industry Research Organisation (MIRO)

A 'Good Practice Guide'[23] issued on behalf of MIRO was released in 2011. The purpose of the Guide is to assist in the identification, control and management of dust arising from the extractive industries. The guidance provides a useful reference for available methods of mitigation and monitoring.

IAQM 'Guidance on the Assessment of Mineral Dust Impacts for Planning'

The IAQM published the document *Guidance on the Assessment of Mineral Dust Impacts for Planning*[24] in June 2016. Designed specifically for the planning process, the guidance sets out a structured methodology for the assessment of mineral dust impacts and consideration of their significance.

EPUK-IAQM 'Land-Use Planning and Development Control: Planning for Air Quality'

Environmental Protection UK (EPUK) and the IAQM have together published guidance[25] to help ensure air quality is properly accounted for in the development control process. It clarifies when an air quality assessment should be undertaken, what it should contain, and recommendations on how impacts should be described and assessed.

Defra Local Air Quality Management Technical Guidance

Defra LAQM.TG(16) was published for use by LAs in their LAQM review and assessment work. The document provides key guidance in aspects of air

[21] Norfolk County Council, Core Strategy and Minerals and Waste Development Management Policies Development Plan Document 2010 – 2026, September 2011.

[22] Broadland District Council, The Development Management DPD, August 2015.

[23] MIRO, Good practice guide: control and measurement of nuisance dust and PM_{10} from the extractive industries, Issue 1 February 2011.

[24] IAQM, Guidance on the Assessment of Mineral Dust Impacts for Planning, v1.1 2016.

[25] Environmental Protection UK and Institute of Air Quality Management, 'Land-Use Planning and Development Control: Planning for Air Quality', V1.1 2017.

quality assessment, including screening, monitoring, use of monitoring data, use of background data that are applicable to all air quality assessments.

11.4 Assessment Approach

11.4.1 Dust Assessment

The assessment has been undertaken in accordance with the IAQM *Guidance on the Assessment of Mineral Dust Impacts for Planning* document. The methodology is summarised below and available to download on the IAQM website[26] and therefore not reproduced in full within this assessment.

The IAQM method is a risk-based approach based on the source-pathway-receptor conceptual model, i.e. the hypothetical relationship between the source (S) of the pollutant, the pathway (P) by which exposure might occur, and the receptor (R) that could be adversely affected.

The key steps are:

- Assess Application Site Characteristics and Baseline Conditions. Incorporates a review of baseline conditions including PM_{10} background, existing dust deposition data, and dust complaints; a description of activities to inform the Source Term; and characterisation of the Application Site setting in terms of the location and sensitivity of representative receptors, and meteorological conditions (wind patterns and rainfall);
- Estimate Dust Impact Risk. The Dust Impact Risk for each representative receptor is determined from the Source Term (residual dust risk after embedded mitigation) and Pathway. The 'pathway effectiveness' is based upon the distance of the receptor from the dust source and the frequency at which it is down-wind from the source (factoring out the frequency of wet days). The assessment of impact considers emissions from the Application Site as a whole and is assessed against a baseline that assumes no quarrying activities; and
- Estimate Likely Magnitude of Effect. The risk predicted at each representative receptor is considered together with the sensitivity of that receptor, to give the likely magnitude of the effect that will be experienced.

With respect to PM_{10}, if backgrounds are less than 17µg/m^3, it is considered there is little risk of the Process Contribution (PC) from the quarry complex causing an exceedence of the annual mean AQAL. Where backgrounds are greater than 17µg/m^3, the PC is estimated and total Predicted Environmental Concentration (PEC) used to assess the potential significance of effects on the surrounding receptors.

The IAQM uses a distance-based screening criterion for both airborne concentrations and deposited dust. The guidance states *"from the experience of the working group, adverse dust impacts from sand and gravel sites are uncommon beyond 250m and beyond 400m from hard rock quarries, measured from the nearest dust generating activity".*

In accordance with the IAQM methodology for sand and gravel sites, if there are sensitive receptors within 1km and 250m of the Application Site then further assessment of potential dust impacts for PM_{10} and deposited dust, respectively, will be required.

11.4.2 Traffic Emissions Screening Assessment

Atmospheric emissions from road vehicles relating to the Proposed Development are primarily associated with emissions from Heavy Duty Vehicles (HDVs). The EPUK-IAQM guidance *Land-Use Planning and Development Control: Planning for Air Quality* sets out 'indicative criterion for assessment', above which the change in vehicle trips cannot be defined as 'insignificant' and therefore a detailed assessment would be required.

[26] IAQM, Guidance on the Assessment of Mineral Dust Impacts for Planning, v1.1 2016, https://iaqm.co.uk/text/guidance/mineralsguidance_2016.pdf, accessed May 2020.

The criterion measured as Annual Average Daily Traffic (AADT) are set out in Table 11-2. For HDVs, if the change in AADT associated with the Proposed Development is less than 100 (outside an AQMA) then a detailed assessment of traffic emissions is not required and would 'screen out' of further assessment.

Table 11-2 – Traffic Emissions Screening Criterion

Vehicle Type	Relevant Criterion for the Application Site
Light Duty Vehicle (LDV)	Change of 500 or more AADT outside an AQMA
	Change of 100 or more AADT within an AQMA
Heavy Duty Vehicle (HDV)	Change of 100 or more AADT outside an AQMA
	Change of 25 or more AADT within an AQMA

11.5 Baseline Conditions

11.5.1 Application Site and Surroundings

A full description of the Application Site is provided in Chapter 2 of this ES. The sections below set out those aspects of the environment relevant to this air quality chapter.

Stanninghall Quarry is located approximately 10km to the north of Norwich city centre. The locale surrounding the Application Site is characterised by agricultural land with isolated properties; these being situated along Norwich Road which runs adjacent to the eastern Application Site boundary and Frettenham Road which runs adjacent to the western Application Site boundary. The village of Horstead is approximately 1.5km north-east of the Application Site and the village of Frettenham is approximately 1.4km south-west of the Application Site.

The proposed northern extension area will move activities, potentially dust generating, closer to properties situated along Norwich Road to the north of the existing, permitted area and properties situated within Horstead and other villages to the north of Application Site. Human receptor locations are considered further in the following section and the dust assessment.

Access to the Application Site is gained via the purpose-built entrance, Quarry Road, which adjoins Norwich Road.

Human Receptor Locations

AQALs apply to locations where members of the public may be reasonably likely to be exposed to air pollution for the duration of the relevant AQAL. Therefore, the annual mean should apply only at locations where people are likely to be present for long periods (examples given are residential properties, schools, hospitals and care homes). In the case of the 24-hour AQAL a relevant location would be one where the individuals may be exposed for eight hours or more in a day. As such, all residential and work places within 1km are considered of relevance to the assessment of potential PM_{10} impacts.

With respect to amenity impacts, the sensitivity will relate to the level of amenity that can be reasonably expected. For example, residential dwellings and schools are more sensitive than industrial units or farms typically. Receptor locations have been characterised as high, medium or low sensitivity according to IAQM guidance. The IAQM screening distance for sand and gravel quarries is 250m for deposited dust and 1km for PM_{10}.

The twelve human receptors (DR1 to DR12), including the nearby Frettenham FP4 Public Right of Way (PRoW)[27], considered to be representative of the local area for the assessment of dust and PM_{10} impacts are presented in Figure 11-2 and detailed in **Table 11-3**. For the purposes

[27] Norfolk County Council, http://maps.norfolk.gov.uk/highways/ accessed May 2020.

of this assessment, all receptors with the exception of DR12 are considered of high sensitivity to dust amenity impacts.

Table 11-3 – Summary of Receptors: Human

Ref.	NGR (x, y)	Approx. Distance to Existing Site (m) (A)	Approx. Distance to Proposed Extension (m) (A)	IAQM Sensitivity
DR1 The Hollies	625286, 318477	90	70	High
DR2 Hill Farm	625635, 318901	510	70	High
DR3 Lodge Cottages	626393, 318901	820	290	High
DR4 Lodge Cottages	626381, 318876	800	280	High
DR5 Horstead Lodge	626427, 318802	780	300	High
DR6 Norwich Road	626333, 318990	860	240	High
DR7 Norwich Road	626312, 319042	870	240	High
DR8 Frettenham Road	625801, 319222	840	275	High
DR9 Saint Peter	625553, 317511	220	720	High
DR10 Caius Heath Lane	626604, 317867	990	340	High
DR11 Beverley Farm	626413, 318503	650	220	High
DR12 Frettenham FP4 PRoW	625311, 318617	150	50	Low

Table note:
(A) approximate distances are measured to the nearest extraction area within the existing, permitted area and the proposed northern extension area.

Given the number of receptors and their locations, the overall sensitivity of the area is considered to be low. The northern extension area results in the extraction areas of the Application Site moving closer to the majority of considered receptors (all except DR9); however, only DR1, DR2 and DR12 are defined as 'close' (i.e. <100m).

Ecological Receptor Locations

There are no statutory designated nature conservation sites (e.g. Special Area of Conservation (SAC)) within 250m of the Application Site.

The nearest is the Special Area of Protection (SPA) / SAC / Site of Special Scientific Interest (SSSI) / Ramsar known as Broadland, The Broads, and Crostwick Marsh collectively; which is located approximately 1.2km south of the Application Site and therefore has not been considered further in this assessment.

In terms of non-statutory designated nature conservation sites[28], there are three County Wildlife Sites (CWS) within 1km of the Application Site but none within 250m. The Ancient Woodland (AW) known as Clamp Wood lies adjacent to the western boundary of the Application Site.

The ecological receptors considered within this assessment are presented in **Table 11-4** and are classified as 'low' sensitivity; this is in line with IAQM guidance for locally designated sites with no specific sensitivity to dust.

Table 11-4 – Summary of Receptors: Ecological

Ref.	NGR (x,y)	Approx. Distance to Existing Site (m) (A)	Approx. Distance to Proposed Extension (m) (A)	IAQM Sensitivity
ECO1 Clamp Wood AW	625187, 318239	60	270	Low

Table note:
(A) approximate distances are measured to the nearest extraction area within the existing, permitted area and the proposed northern extension area.

In terms of potential physical effects of dust deposition on habitats, an Interim Advice Note prepared as a supplement for the Design Manual for Roads and Bridges (and now incorporated into HA207/07[29]) suggests that only dust deposition levels above 1,000mg/m^2/day are likely to affect sensitive ecological receptors. It states that most species appear to be unaffected until dust deposition rates are at levels considerably higher than this. This level of dust deposition is approximately five times greater than the level at which most dust deposition may start to cause a perceptible nuisance to humans. As such ecological receptors are considered of comparative low sensitivity.

11.5.2 Local Air Quality Management

As required under Section 82 of the Environment Act 1995 (Part IV), BDC jointly with South Norfolk District Council (SNDC) has conducted an on-going exercise to review and assess air quality within their administrative areas.

A review of their most recently published Air Quality Annual Status Report (ASR)[30] indicates that the AQALs for NO_2 and PM_{10} are not exceeded within the districts. As such, no AQMAs have been declared for exceedences of the AQALs. The closest AQMA is the Central Norwich AQMA, located within the adjacent administrative area of Norwich District Council, declared on the basis of annual mean NO_2 concentrations and located approximately 6.6km to the south-west of the Application Site.

11.5.3 Baseline Air Quality

Routine air quality monitoring in the UK is typically undertaken by Local Authorities as part of their LAQM responsibilities or Defra as part of the UK Automatic Urban and Rural Network (AURN) which is a country-wide network of air quality monitoring stations.

AURN Monitoring Data

Monitoring data for AURN sites is available from the UK Air Information Resource website (UK AIR)[31]. The closest AURN monitor to the Application Site is within Norwich city centre over 10km south of the Application Site and is therefore not considered representative of conditions at the Application Site or surrounding area.

[28] Norfolk Biodiversity Information Service, http://www.nbis.org.uk/local-sites-2018-update, accessed June 2020.

[29] Design Manual for Roads and Bridges. Volume 11, Section 3. Part 1 HA207/07. Annex F.

[30] Broadland District Council and South Norfolk District Council, 2019 Air Quality Annual Status Report (ASR), May 2019.

[31] Defra, UK-AIR website, http://uk-air.defra.gov.uk/, accessed May 2020.

Local Authority Monitoring Data

Monitoring of PM_{10} is not presently undertaken by either BDC or SNDC.

Monitoring of nitrogen dioxide (NO_2) is undertaken across both districts using passive diffusion tubes, and no exceedences of the NO_2 annual mean AQAL of 40µg/m^3 were recorded over the five-year period 2014 to 2018.

Defra Mapped Background Concentrations

Defra provide modelled background pollutant concentration data on a 1km x 1km spatial resolution across the UK that is routinely used to support LAQM and Air Quality Assessments.

Background pollutant concentrations can be downloaded from UK AIR[31] and are based upon the 2017 base year Defra update and projected forward.

Mapped background concentrations of PM_{10}, $PM_{2.5}$ and NO_2 were obtained for the grid square containing the Application Site (x625500, y318500) and surrounding receptors for 2020 and are displayed in **Table 11-5**.

Table 11-5 – Annual Mean Background Concentrations

Pollutant	2020 (µg/m^3)
$PM_{2.5}$	8.5 – 8.8
PM_{10}	13.7 – 15.5
NO_2	8.6 – 9.3

It is noted that the background concentrations of the pollutants in the locale of the Application Site are 'well below' the relevant AQALs.

Baseline Dust

Dust Complaints

The Application Site has not received any complaints directed at the quarry relating to dust emissions during the last 3 years.

11.5.4 Meteorological Conditions

The most important climatic parameters governing the release and dispersal of fugitive emissions from the Application Site are wind speed, direction and rainfall:

- wind direction determines the broad direction of dispersal;
- wind speed affects ground level concentrations by increasing the initial dilution of pollutants in the emission. It will also affect the potential for dust entrainment; and
- rainfall naturally supresses dust release.

A windrose from Norwich meteorological station, located approximately 5.5km to the south-west of the Application Site is presented in **Figure 11-1**. It is evident that winds from the south-west quadrant are predominate in the area with winds from the east being infrequent.

Relevant rainfall data applicable to the Application Site has been obtained from the Meteorological Office website[32] of UK mapped climate averages for 1981-2010. The average annual rainfall >0.2mm/day for the area of the Application Site is 160 to 170 days per year, comprising 44% to 47% of the year.

[32] Met Office, http://www.metoffice.gov.uk/public/weather/climate, accessed May 2020

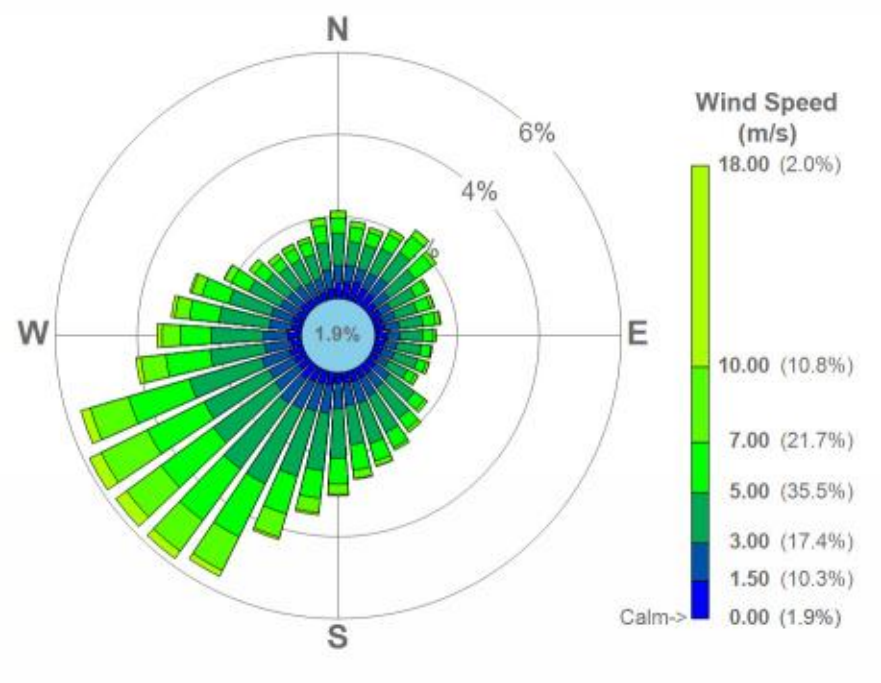


Figure 11-1 – Windrose of Norwich Meteorological Station

11.6 Assessment of Effects and Significance: Dust Emissions

This section describes the assessment of dust effects from the Application Site. The assessment considers the whole Application Site and consolidation scheme.

11.6.1 Screening Assessment: PM_{10} and Deposited Dust

On the basis of the adopted screening criteria, an assessment of deposited dust and particulate matter (PM) is required at human receptors within 250m and 1km, respectively. In terms of ecological receptors, an assessment of dust deposition on the Clamp Wood AW is also required as this is located within 250m of the Application Site.

11.6.2 Further Assessment: PM_{10}

The IAQM minerals guidance states that if the PM_{10} background concentration is less than 17µg/m³ it is considered unlikely that any process contribution from the additional activities proposed at the Application Site would lead to an exceedence of the annual mean AQAL. Utilising the Defra background maps (see **Table 11-5**), the maximum annual mean concentration in 2020 is 15.5µg/m³ and therefore less than 17µg/m³. In addition, background concentrations are predicted to decrease year on year.

It is therefore considered that in the absence of additional mitigation, the effect of proposed operations on human health from emissions of PM_{10} at the Application Site will be negligible.

11.6.3 Further Assessment: Deposited Dust (Disamenity)

An assessment of potential dust impacts has incorporated all activities of the Proposed Development and considered the whole Application Site.

The proposed Application Site boundary, which incorporates the current permitted area and the northern extension area, covers an area of approximately 106.8 hectares (ha). The current quarry development (i.e. the operational areas) occupies approximately 34ha of this within the southern section of the Application Site.

Current Site Operations

Access to the Application Site is via the main access road off B1150 Norwich Road. The access road continues onto an internal road which leads to the Plant Site area. The silt and freshwater lagoons are located to the north-west of the Plant Site, within the centre of the permitted quarry area and therefore easily accessed by all working areas.

The current operational hours, are as follows:

- Monday to Friday 0700 – 1800
- Saturday 0700 – 1300
- Sunday No operations

At present, the active working and progressive restoration area is located within the south-west of the permitted quarry area.

Mineral is excavated with a long arm excavator before being loaded onto dump trucks and transported to the Plant Site, located in the south-east section of the Application Site, where material undergoes a washing and screening process.

The current permission for Stanninghall Quarry includes the extraction and restoration scheme and the operation of the on-site ready-mix Concrete Batching Plant (CBP).

Since 2015, the quarry operations have had an average output of 223,800tpa, with sales ranging from 337,000 tonnes in 2017 to 145,000 tonnes in 2019. The current northern extension consolidation application assumes average sales of 300,000 tpa for the duration of the development, with an allowance for fluctuations around that figure. For the purposes of the air quality study, and an assessment of 'increases' in activity, a 'worst case' has been taken as a baseline which adopts the lowest 2019 sales figure of 145,000tpa, including a total of 29,660t which was diverted to the onsite ready-mix Concrete Batching Plant. Without taking into account the additional traffic activity as a result of the concrete production, the quarry operations during 2019 generated in the region of 40 HDV Annual Average Daily Traffic (AADT) movements on the local road network. The concrete production generated an additional 8 HDV AADT movements.

Proposed Site Operations

The activities within and access to the Application Site are not proposed to change, albeit activities will be undertaken across an extended area at an average output rate of approximately 300,000tpa.

The proposed northern extension area occupies a distinct parcel of land immediately north of the existing permitted quarry area. The proposed consolidation scheme of the quarry will see the progressive phased working scheme move from the existing permitted area then into the northern extension, where it will progress in a clockwise direction.

The scheme is due to begin in Phase 4B; located within the west of the current permitted quarry area. Phase 4B mineral reserves are estimated at approximately 769,500 tonnes. At an extraction rate of approximately 300,000tpa, the extraction within Phase 4B is predicted to take 2.6 years.

The 204,200m^3 of soils and overburden stripped from Phase 4B will be used in progressive restoration activities, to construct storage bunds and to construct new water management lagoons; to be established within the western extent of the Plant Site.

From Phase 4B, the scheme will move north to Phase 5 then move clockwise through Phases 6 to 8. A full description of the Proposed Development is detailed within Chapter 3 of this ES.

Due to the proposed 300,000 tpa output associated with the proposed scheme, the number of HDV movements generated on the local road network as a result of the Proposed Development are expected to be 94 HDV AADT. This takes into account the additional trip generation associated with the continuation of the onsite CBP activity (based on a continuation of the 2019 throughput of 29,660tpa).

The Plant Site will remain in-situ throughout the proposed working scheme.

The restoration of the quarry under the proposed consolidation scheme will follow the current approach, whereby newly stripped soils and overburden are placed directly onto the re-profiled previous working area, thereby minimising the double handling of material.

Sources of Dust

Activities or sources associated with the Proposed Development that have the potential to result in the release of dust include:

- site preparation and restoration;
- mineral (sand and gravel) extraction;
- mineral processing;
- storage of material;
- on-site transportation; and
- off-site transportation.

Site Preparation and Restoration

The proposed scheme would comprise of progressive phased mineral extraction, soil stripping and direct restoration; therefore, minimising the area of exposed surface and the amount of material stored at any one time. This helps to reduce the potential for erosion and subsequent generation of dust emissions.

Preparation of each Phase will be undertaken prior to mineral extraction, and the phased working will begin in Phase 4B then consecutively through Phase 5, Phase 6, Phase 7 and Phase 8.

During preparation, soils and overburden will be stripped using a hydraulic excavator to access the mineral reserves below. Some of this soil and overburden will be used directly in restoration activities whilst a certain amount will be stored in bunds.

The removal of soils and overburden usually takes place over a large area and can be considered an intense activity. Although temporary and phased, the removal of soils and overburden in the absence of mitigation presents a high dust emission potential, which can be exacerbated by dry and windy meteorological conditions.

In terms of material storage bunds, during Phase 4B a topsoil bund (no. 13) is to be constructed around 'The Hollies' residential property, located to the west of the Application Site boundary, and during Phase 6 a topsoil bund (no. 15) is to be constructed around 'Hill Farm' residential property, located to the north-west of the Application Site boundary.

The bunds will act to protect these properties from dust generated during the extraction and restoration works. Soil bund formation is potentially a high intensity activity with high dust emission potential. However, the activity is short-term in nature and the bunds will be grass seeded and maintained. This seeding greatly reduces the dust emission potential as the bund naturally re-vegetates and stabilises. In addition, soil bund construction would be timed to avoid adverse weather conditions (i.e. dry/windy) therefore decreasing dust emissions.

In terms of restoration, this would be undertaken in the Phase behind the advancing working Phase using soils and overburden stripped from the working area. These materials will be loaded onto an articulated dump truck and transported for direct use in restoration.

Restoration activities involve placement, tipping, shaping and compaction activities with potentially dust material and are therefore of high dust emission potential in the absence of mitigation.

The proposed restoration of the Application Site follows the principles of the approved restoration scheme for the existing quarry with the concept including mainly agricultural land with native woodland and hedgerows. The restoration and extraction works are integrated to minimise the double handling of material.

Overall and given the above, site preparation and restoration present a medium to large dust emission potential, but activities are temporary and short-term in nature.

Mineral Extraction

The proposed scheme would comprise of progressive phased mineral extraction, soil stripping and direct restoration; therefore, minimising the area of exposed surface and the amount of material stored at any one time.

This phased working is proposed to commence in Phase 4B within the existing permitted area before continuing clockwise through Phase 5 to 8 within the northern extension area.

Mineral is dug using hydraulic excavator, then 'as dug' mineral is loaded onto dump trucks and transported to the Plant Site for processing.

Conceptual stand-off margins are maintained between sensitive receptors and temporary screen bunds around properties to the west of the Application Site are to be established prior to the mineral extraction within the nearby Phases.

Based on the available plant, it is predicted that no more than 5 mobile plant will be operating at any one time.

Overall and given the above, the mineral extraction activities present a medium dust emission potential.

Mineral Processing

The 'as dug' mineral is loaded onto dump trucks and transported to the Plant Site where it undergoes processing into aggregates.

The key equipment of the Plant Site includes a washing and screening plant and a ready-mix CBP. Pre-processed and processed material is stockpiled within the Plant Site in designated areas. Wheeled loading shovels are used to feed the mineral into the plant, manage the stockpiles adjacent to the plant and load processed mineral onto vehicles for onward transportation to point of sale.

Screening operations are regulated under an Environmental Permit and are inherently of high dust emission potential. Water is abstracted from the on-site lagoons to be used for dust suppression within the Plant Site.

The Plant Site is level and compacted and located within the south-east section of the quarry which is largely surrounded by agricultural land. In addition, the Plant Site is within the quarry void and surrounded by soil and overburden bunds which help to shelter the equipment from winds and decrease the potential for the generation of dust emissions.

Overall and given the above, the processing of mineral presents a medium dust emission potential.

Storage of Material

The majority of stripped soil and overburden is immediately used within the progressive restoration scheme which minimises the amount of material being stored. However, a certain amount of material and extracted mineral is subject to temporary storage within the Application Site, which varies in duration, including:

- extracted, pre-processed mineral and processed mineral is temporarily stockpiled in the designated area within the Plant Site;
- soil and overburden storage bunds surround the Plant Site and Application Site boundary peripheries; and
- topsoil bunds are to be created around the residential properties 'The Hollies' and 'Hill Farm' which lie along the western boundary of the quarry.

The exposed surfaces of materials present a potential source of dust emission by erosion.

For the storage bunds on the periphery of the Plant Site and Application Site boundary and those protecting the residential properties, this potential is reduced by grass seeding and natural re-vegetation which acts to stabilise the bunds and prevent erosion of surfaces.

For the pre-processed and processed mineral stockpiles, this potential is reduced as the stockpiles are short-term (i.e. in situ for less than 1 month); located within the quarry void; stand on a level and compacted surface within the Plant Site; and cover a small area in total (i.e. <2.5ha).

The formation of the soil and overburden bunds is an intense activity with high dust emission potential; however, the activity is short-term in nature and

should be undertaken when the weather conditions are not adverse (i.e. dry/windy). The on-site tractor and bowser unit is used to dampen the surface for dust suppression, if necessary.

Overall and given the above, the storage of mineral, soils and overburden presents a medium dust emission potential, however the potential is often short-term in nature prior to re-vegetation and dependent on the duration and timing of the activity.

On-site Transportation

On-site transportation presents a high dust emission potential in the absence of mitigation. The potential for dust emissions from unpaved haul roads can depend on the moisture content of the road and vehicle speed; which can be controlled by effective operational measures.

Unpaved haul roads commence at the western extent of the Plant Site. From there, a central internal haul road runs through the water management area then north through the middle of the quarry to access each mineral extraction Phase.

The designated haul roads are positioned away from the Application Site boundary and therefore maintain minimum stand-off distances between the haul road and sensitive receptors. This helps to eliminate potential impacts on the sensitive receptors from potential dust emissions generated on the haul roads.

A 10mph speed limit is enforced across the Application Site and a tractor and bowser is available to dampen the haul roads to suppress dust.

Overall and given the above, on-site transportation presents a medium dust emission potential.

Off-site Transportation

Extracted and processed material (product) is transported off-site. This presents potential risk of trackout; when dust and dirt is transported onto the public road network, where it may be deposited and then re-suspended by vehicles using the network.

Vehicles exit the Application Site via the purpose-built entrance off Norwich Road which is >200m in length from the wheel wash facility and is paved. The wheel wash, which will remain in place and functional throughout the Proposed Development, is located adjacent to the Plant Site and adjoins the weighbridge. All HDVs exiting are required to use the wheel wash and a 10mph speed limit is enforced on the access road. Therefore, the risk of dust emission from trackout is considered small.

Environmental Design and Mitigation Measures

Existing measures to mitigate dust have been addressed in two sections:

- mitigation measures that apply to day to day quarry operations; and
- environmental design mitigation measures (such as aspects of Application Site phasing, layout, and other specific design measures).

Operational Mitigation Measures

Operations are undertaken in line with industry good practice. The control measures implemented, and equipment utilised as part of the existing, baseline activities are as follows:

- clear designation of stockpile area to prevent tracking over;
- all storage bunds are to be grass seeded;
- 10mph speed limit enforced on haul routes;
- tractor and bowser available for use in dust suppression;
- progressive phased working scheme reduces the storage and double handling of material; and
- wheel wash adjoins the weighbridge and is used by all HDVs leaving the Application Site.

The operational mitigation measures listed above are proposed to continue throughout the Proposed Development. Equipment utilised at present would also be maintained in good working order.

Environmental Design Measures

The Application Site would be worked on a phased basis, with progressive restoration to minimise the exposed surface areas that may be subject to erosion and lead to dust generation. This is in line with practises adopted in the current working scheme.

Given the location of receptors in relation to potential dust generating activities a number of specific mitigation measures have been incorporated into the Application Site layout and design, these measures include:

- processing plant is located within the quarry void in the south-east section of the Application Site – which is largely surrounded by agricultural land free from sensitive receptors;
- a hard-surfaced haul road exists between the Application Site entrance off Norwich Road and the Plant Site;
- mature hedgerows and vegetation on the periphery of the proposed northern extension would be retained to protect sensitive receptors;
- topsoil bunds are incorporated into the Application Site design to shield sensitive off-site receptors; and
- internal haul roads are positioned within the centre of the Application Site and therefore positioned away from sensitive receptors.

11.6.4 Assessment of Effects – Disamenity Dust

Summary of Residual Source Emissions

The residual source emission magnitude (i.e. the potential magnitude of dust emission after the designed in environmental measures have been taken into account) for each of the dust generating activities is presented in **Table 11-6**.

Table 11-6 – Residual Source Emissions Magnitude

Potential Dust Generating Activity	Factors and Assumptions	IAQM Residual Source Emissions
Site Preparation and Restoration	Progressive phased mineral extraction, soil stripping and direct restoration. Minimise double handling of material. Tractor and bowser available for dust suppression. <5 mobile plant operating within Phase.	Medium
Mineral Extraction	Low energy extraction method i.e. using excavators. Tractor and bowser available for dust suppression. Proposed extraction rate of approx. 300,000tpa. <5 mobile plant operating within Phase.	Medium
Mineral Processing	Plant Site is located in the south-east section of the quarry, away from sensitive receptor locations. Plant Site is level and compacted. Water abstracted from on-site lagoons for dust suppression. <5 mobile plant operating within the Plant Site.	Medium
Storage of Material (exposed surfaces)	Stockpiles are located within the Plant Site which is level and compacted. Soil bunds on the Application Site periphery are grass seeded and re-vegetated. Storage bunds are limited to a height of circa 3m. Tractor and bowser available for dust suppression.	Medium

Potential Dust Generating Activity	Factors and Assumptions	IAQM Residual Source Emissions
On-site Transportation	10mph speed limit on internal haulage routes. Tractor and bowser available to dampen haul roads. Designated internal haul roads through the centre of the Application Site – therefore minimum stand-off distances are maintained.	Medium
Off-site Transportation	10mph speed limit on access road. Wheel wash adjoins to the weighbridge. Access road >200m in length.	Low

The overall residual source emissions magnitude for the Application Site is considered to be 'medium', in accordance with the IAQM guidance.

Summary of Screening Assessment

The IAQM screening distance of 250m has been applied to receptors in relation to their distance to dust generating activities as detailed in Table 11-7 and displayed in Figure 11-2.

Only those activities and Phases of the scheme that are within 250m of the receptor have been considered as potentially impacting on that receptor.

Table 11-7 – Summary of Screening Assessment

Ref.	NGR (x, y)	Activities or Phases within 250m	Further Assessment?
DR1	625286, 318477	Topsoil Bund 13, Phase 4B, Phase 5, Phase 6	Yes
DR2	625635, 318901	Topsoil Bund 15, Phase 5, Phase 6, Phase 7	Yes
DR3	626393, 318901	None within 250m	No
DR4	626381, 318876	None within 250m	No
DR5	626427, 318802	None within 250m	No
DR6	626333, 318990	Phase 7	Yes
DR7	626312, 319042	Phase 7	Yes
DR8	625801, 319222	None within 250m	No
DR9	625553, 317511	Current Working Area, Overburden Bund 11	Yes
DR10	626604, 317867	None within 250m	No
DR11	626413, 318503	Phase 8, Topsoil Bund 16, Bunds 17/18/19	Yes
DR12	625311, 318617	Topsoil Bund 13, Phase 4B, Phase 5, Phase 6	Yes
ECO1	625187, 318239	Current Woking Area, Topsoil Bund 13, Phase 4B	Yes

Summary of Pathway Effectiveness

The pathway effectiveness at each receptor has been assigned in accordance with the IAQM criteria and is based on the distance of the receptor to the stated dust generating activity or Phase and the frequency of potentially dusty winds (>5m/s and dry). A summary of pathway effectiveness is displayed in Table 11-8.

Summary of Dust Effects

On the basis of the source term, receptor sensitivity and pathway effectiveness, the magnitude of effect due to potential dust deposition at

each receptor has been estimated. Table 11-9 presents a summary of the magnitude of effect at the human and ecological receptor locations.

Figure 11-2 – Dust Receptors and IAQM Screening Distance

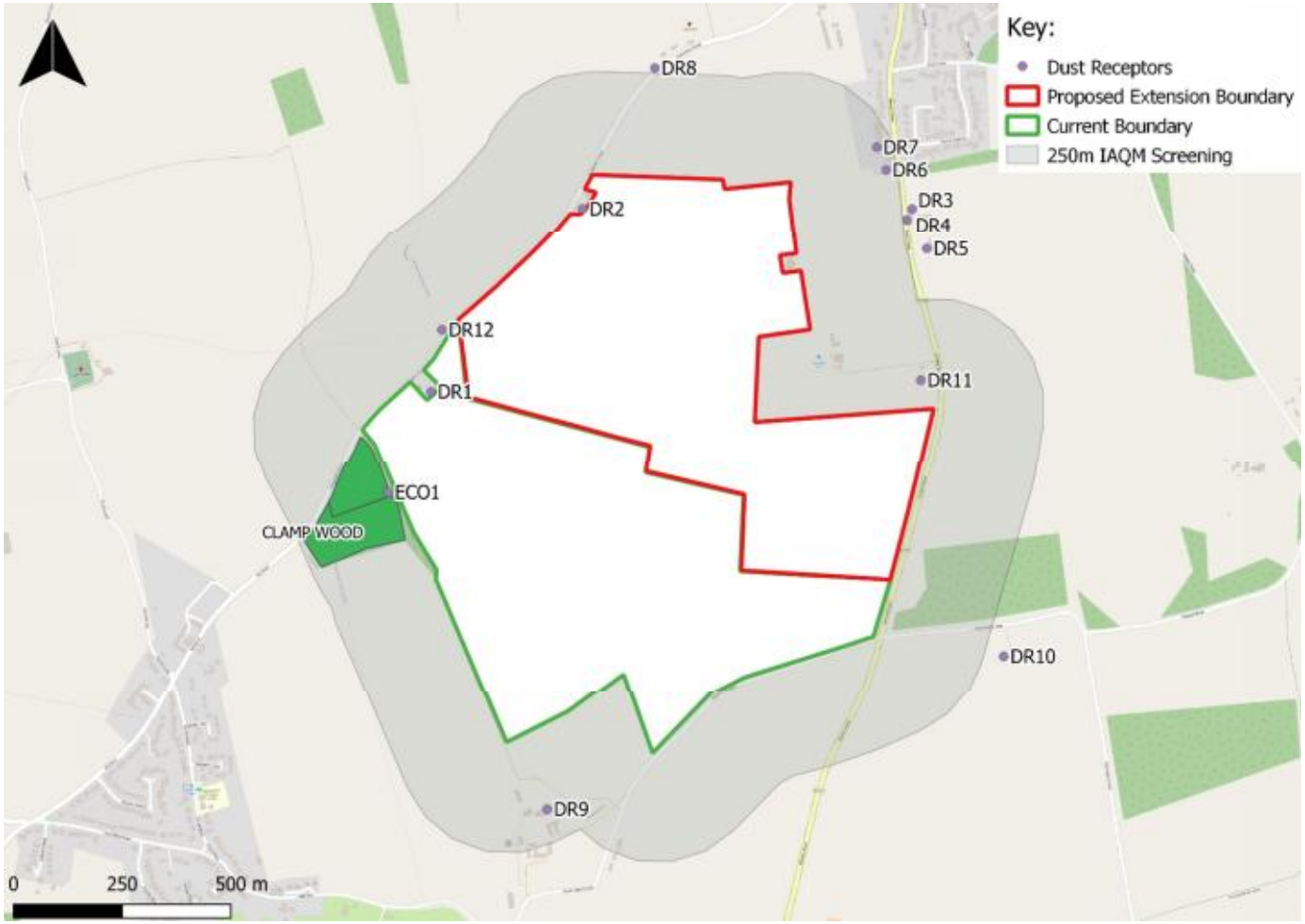


Table 11-8 – Summary of Pathway Effectiveness

Ref. and Activity	Approx. Distance to Activity (m)	Distance Category	Frequency of Potentially Dusty Winds (%)	Frequency Category	Pathway Effectiveness
DR1					
Topsoil Bund 13	40	Close	13.5	Frequent	Highly Effective
Phase 4B	70	Close	8.3	Moderately Frequent	Moderately Effective
Phase 5	90	Close	2.2	Infrequent	Ineffective
Phase 6	220	Distant	1.7	Infrequent	Ineffective
DR2					
Topsoil Bund 15	40	Close	9.6	Moderately Frequent	Moderately Effective
Phase 5	250	Distant	7.5	Moderately Frequent	Ineffective
Phase 6	70	Close	9.1	Moderately Frequent	Moderately Effective
Phase 7	250	Distant	2.1	Infrequent	Ineffective
DR6					
Phase 7	240	Distant	9.4	Moderately Frequent	Ineffective
DR7					
Phase 7	240	Distant	9.4	Moderately Frequent	Ineffective
DR9					
Current Working Area	220	Distant	1.9	Infrequent	Ineffective
Overburden Bund 11	180	Intermediate	1.6	Infrequent	Ineffective
DR11					
Phase 8	220	Distant	10.2	Moderately Frequent	Ineffective
Topsoil Bund 16, A: 'Close'	70 to 100	Close	5.3	Moderately Frequent	Moderately Effective
Topsoil Bund 16, B: 'Intermediate'	100 to 200	Intermediate	6.3	Moderately Frequent	Moderately Effective
Topsoil Bund 16, C: 'Distant'	200 to 250	Distant	1.5	Infrequent	Ineffective
Bunds 17/18/19	90	Close	9.2	Moderately Frequent	Moderately Effective
DR12					
Screening Bund	60	Close	4.4	Infrequent	Ineffective
Phase 4B	150	Intermediate	5.0	Infrequent	Ineffective
Phase 5	50	Close	2.1	Infrequent	Ineffective
Phase 6	120	Intermediate	1.4	Infrequent	Ineffective
ECO1					

Ref. and Activity	Approx. Distance to Activity (m)	Distance Category	Frequency of Potentially Dusty Winds (%)	Frequency Category	Pathway Effectiveness
Current Working Area	230	Distant	1.2	Infrequent	Ineffective
Screening Bund	180	Intermediate	1.2	Infrequent	Ineffective
Phase 4B	60	Close	3.9	Infrequent	Ineffective

Table 11-9 – Summary of Dust Effects

Ref. and Activity	Receptor Sensitivity	Pathway Effectiveness	Dust Impact Risk	Magnitude of Effect
DR1				
Screening Bund	High	Highly Effective	Medium Risk	Moderate Adverse Effect
Phase 4B		Moderately Effective	Low Risk	Slight Adverse Effect
Phase 5		Ineffective	Negligible Risk	Negligible Effect
Phase 6		Ineffective	Negligible Risk	Negligible Effect
DR2				
Screening Bund	High	Moderately Effective	Low Risk	Slight Adverse Effect
Phase 5		Ineffective	Negligible Risk	Negligible Effect
Phase 6		Moderately Effective	Low Risk	Slight Adverse Effect
Phase 7		Ineffective	Negligible Risk	Negligible Effect
DR6				
Phase 7	High	Ineffective	Negligible Risk	Negligible Effect
DR7				
Phase 7	High	Ineffective	Negligible Risk	Negligible Effect
DR9				
Current Working Area	High	Ineffective	Negligible Risk	Negligible Effect
Topsoil Bund		Ineffective	Negligible Risk	Negligible Effect
DR11				
Phase 8	High	Ineffective	Negligible Risk	Negligible Effect
Topsoil Bund 16, A: 'Close'		Moderately Effective	Low Risk	Slight Adverse Effect
Topsoil Bund 16, B: 'Intermediate'		Moderately Effective	Low Risk	Slight Adverse Effect
Topsoil Bund 16, C: 'Distant'		Ineffective	Negligible Risk	Negligible Effect
Bunds 17/18/19		Moderately Effective	Low Risk	Slight Adverse Effect
DR12				

Ref. and Activity	Receptor Sensitivity	Pathway Effectiveness	Dust Impact Risk	Magnitude of Effect
Screening Bund	Low	Ineffective	Negligible Risk	Negligible Effect
Phase 4B		Ineffective	Negligible Risk	Negligible Effect
Phase 5		Ineffective	Negligible Risk	Negligible Effect
Phase 6		Ineffective	Negligible Risk	Negligible Effect
ECO1				
Current Working Area	Low	Ineffective	Negligible Risk	Negligible Effect
Screening Bund		Ineffective	Negligible Risk	Negligible Effect
Phase 4B		Ineffective	Negligible Risk	Negligible Effect

The magnitude of effect predicted at the ecological receptor (ECO1) is 'negligible'; this is largely due to the AW being 'upwind' of the Application Site and dust generating activities; and therefore, the pathway effectiveness is 'ineffective'. Further, whilst the AW is within 100m of the existing quarry boundary, in terms of its distance to dust generating activities, it is only classified as 'close' (i.e. within 100m) to Phase 4B and therefore it's dust impact risk is considered 'negligible' in accordance with the IAQM guidance.

In addition, this is in line with the conclusions of Chapter 7 – Ecology which stated the following in relation to the AW and the EcIA: "*no potential for a likely significant negative effect is immediately apparent in respect of the current operation, and there are no grounds to predict such an effect will occur as a result of the development proposed.*"

The majority of effects predicted within the assessment of sensitive human receptors are 'negligible'. This was the case at receptors DR6, DR7, DR9 and DR12. Receptors DR1, DR2 and DR11 are discussed below.

Receptor DR1

At receptor DR1, one 'moderate adverse' effect is predicted during the construction and removal of topsoil bund 13, and one 'slight adverse' effect is predicted during the working of Phase 4B, which is closest to the receptor. The construction of the topsoil screening bund is of high dust emission potential; however, the bund is grass seeded and therefore this potential significantly decreases as the bund re-vegetates. Once in place, it acts to shield the property from potential dust generated by other nearby activities. This moderate adverse effect would be temporary and short-term in nature and would only materialise if the bund construction was carried out during adverse weather conditions (i.e. dry/windy).

A 'slight adverse' effect is predicted at receptor DR1 in relation to extraction and restoration activities undertaken within Phase 4B as some of this area is within 100m of the property. As mentioned above, the topsoil bund (no. 13) will protect the property and therefore with effective mitigation (discussed in Section 11.6.3) in place, it is considered unlikely that this slight adverse effect will materialise or be significant.

Receptor DR2

At receptor DR2, one 'slight adverse' effect is predicted during the construction and removal of topsoil bund 15, and one 'slight adverse' effect is predicted during the working of Phase 6, which is closest to the receptor. The construction of the topsoil screening bund is of high dust emission potential; however, the bund is grass seeded and therefore this potential significantly decreases as the bund re-vegetates. Once in place, it acts to shield the property from potential dust generated by other nearby activities. This slight adverse effect would be temporary and short-term in nature and would only materialise if the bund construction was carried out during adverse weather conditions (i.e. dry/windy).

A 'slight adverse' effect is predicted at receptor DR2 in relation to extraction and restoration activities undertaken within Phase 6 as some of this area is within 100m of the property. As mentioned above, the topsoil bund (no. 15) will protect the property and therefore with effective mitigation (discussed in Section 11.6.3) in place, it is considered unlikely that this slight adverse effect will materialise or be significant.

Receptor DR11

There are several storage bunds located within 250m of receptor DR11; topsoil bund 16 and bunds 17/18/19.

The assessment of effects from topsoil bund 16 was split into three distinct sections determined by their distance to receptor DR11; a section of the bund is classified as 'close' (i.e. <100m), a section as 'intermediate' (i.e. 100-200m) and a section as 'distant' (i.e. >200m). Bunds 17/18/19 were assessed collectively as these are constructed in the same Phase.

For receptor DR11, three 'slight adverse' effects were predicted during the construction and removal of the section of topsoil bund 16 which is 'close', the section of topsoil bund 16 which is 'intermediate' and bunds 17/18/19.

However, activities to construct and remove material storage bunds are short-term and therefore the potential 'slight adverse' effects would be temporary in nature. In addition, with the effective implementation of mitigation the risk of a 'slight adverse' effect occurring would be significantly reduced.

Overall, the assessment is considered 'worst-case' as it does not account for the timing and duration of dust generating activities; which are likely to be short-term in nature, resulting in temporary effects. In addition, the distance categories used within the assessment are assumed to the nearest point of the dust generating activity; which is not the case for the entirety of a Phase, for example.

Given the dust suppression measures currently implemented, which are proposed to continue throughout the proposed scheme, it is considered unlikely that significant adverse impacts will materialise.

Considering all of the above, the overall effect of the Proposed Development is considered to be 'not significant'.

11.6.5 Assessment of Effects and Significance: PM_{10}

With respect to PM_{10}, the maximum predicted background concentration in the area is 15.5µg/m^3 as an annual mean for the year of 2020, with these concentrations predicted to decrease year on year (see Section 11.5.3).

The recommended screening value in accordance with IAQM guidance[33] and evidence provided by the Minerals Guidance Working Group is 17µg/m^3; based on the relationship between annual mean concentrations and the risk of the 24-hour PM_{10} AQAL being exceeded. Given that the predicted PM_{10} background concentrations are below 17µg/m^3 at the nearby receptor locations, it is considered that there is little risk of the contribution from the quarry causing an exceedence of the PM_{10} annual mean AQAL. The overall effect of the Proposed Development on PM_{10} concentrations in the local area is considered to be 'not significant'.

11.7 Assessment of Effects and Significance: Traffic Emissions

The 'baseline' position of the lowest sales in 2019 confirms that the number of HDV movements are in the region of 40 HDV movements as AADT, increasing to 48 HDV movements when the CBP activities are taken into account.

Under the proposed consolidation scheme, and assumed average sales of 300,000tpa, the number of HDV movements are expected to increase above

[33] IAQM, Guidance on the Assessment of Mineral Dust Impacts for Planning, v1.1 2016.

the baseline to 94 HDV movements as AADT, therefore presenting a maximum net increase above the baseline of 54 movements[1].

The change in vehicle movements generated on the local road network as a result of the quarry operations is below the EPUK-IAQM 'indicative criterion for assessment' of <100 HDV movements outside an AQMA.

Therefore, it is not considered that further detailed assessment of vehicle emissions is required. In line with EPUK-IAQM guidance, the change in vehicle emissions resulting from the proposed scheme can be said to have a 'negligible effect' on air quality.

Based upon the trip distribution around the local network, 90% of the site generated traffic distributes immediately to the south with the remaining 10% to the north.

Of the 90% heading to the south of Quarry Road, the majority heads east around the Broadland Northway, thereby avoiding the centre of Norwich and the Central Norwich AQMA.

11.8 Mitigation Measures

11.8.1 Traffic Emissions

The predicted effects on local air quality are considered to be negligible on the basis that the change in the level of vehicle movements compared to the existing, baseline scenario screen below the EPUK-IAQM 'indicative criterion for assessment' (i.e. change of <100 HDV movements in AADT).

HDVs accessing the Application Site would continue to use the existing access road which adjoins Norwich Road. The trip distribution would remain as per the current situation with 90% of the HDV trips distributed to the south and the remaining 10% to the north off Quarry Road. Further information can be found within Chapter 12 - Transportation.

11.8.2 Dust Control Measures

The working of the Application Site presents a continuation of the current working scheme at Stanninghall Quarry, albeit within an extended area and over an extended time period. With the working quarry being already established, the routine dust controls have been included in the dust assessment and are assumed to continue throughout the Proposed Development.

The assessment had predicted negligible effects from PM_{10} concentrations resulting from the Proposed Development.

In terms of disamenity from deposited dust, negligible effects predicted at several of the receptors within 250m of dust generating activities; DR6, DR7, DR9 and DR12, and the ecological receptor ECO1.

The proposed working of the Application Site is predicted to have the potential to increase the risk of dust effects at receptors DR1, DR2 and DR11 when compared to the existing, baseline.

The effects, are for the majority, predicted during the construction of soil screening bunds which are in close proximity to the receptors. Potential adverse effects are also predicted during the working of Phase 4B and Phase 6 at receptors DR1 and DR2, respectively. However, it is considered unlikely that these effects will materialise once the soil screening bunds are in place to shield the properties.

The dust control measures below are recommended for inclusion during the construction of the soil bunds around the boundaries of the Application Site; the implementation of such measures would act to significantly reduce the potential for dust generation at the source, including:

- avoid construction of soil bunds within 100m of a receptor when winds are blowing in the direction of the receptor;

[1] It is noted that under the maximum end range of production output of 400,000tpa, the expected increase in HDV movements remains below the indicative criterion, with a maximum trip generation of 122 HDV AADT (an increase of 82 AADT based on the worst case baseline of 40 HDV AADT).

- ensure water suppression is used to dampen the material during periods of dry or windy conditions and continued in use until vegetation is well established;
- undertake daily visual monitoring of dust emissions travelling off-site from the area of activity;
- cessation of the activity during prolonged periods of dry / windy conditions whilst continuing to dampen down exposed surfaces; and
- ensure surfaces are vegetated with quick growing plants to minimise the period of exposed surfaces.

11.9 Residual Effects

Residual effects are those impacts that cannot be reasonably mitigated. As set out in Section 11.6.3, appropriate dust mitigation and management measures have been identified and set out for the proposed working scheme. Such measures are generally accepted by regulatory bodies and the minerals industry as providing effective control against the impacts of airborne dust.

Assuming the continuation of the dust control methods on-site and the implementation of the recommended measures during the construction of the soil screening bunds, there are not considered to be any significant residual effects as a result of the proposed working of the Application Site.

11.10 Cumulative Effects

The Application Site is located in an area largely free from other operations with the potential to generate dust and contribute to the potential effects at the receptors identified within the IAQM assessment.

Through consideration of both on- and off-site sources of dust, there are not considered to be any instances where the 250m IAQM screening distance from other dust sources would overlap with those used within this assessment.

As such, cumulative effects in terms of dust and air quality are considered 'not significant'.

11.11 Recommendations

On the basis of the risk assessment completed, it is recommended that the environmental design measures and standard industry best practise as described in Section 11.6.3 are applied.

In addition, the dust control measures highlighted in Section 11.8.2 are recommended for implementation during construction and removal of the storage bunds on the Application Site peripheries; as this was highlighted as the activity most likely to result in risk of adverse dust effects.

11.12 Summary

The assessment has considered the potential significance of effects on local air quality, dust and amenity as a result of the proposed working of the Application Site. Undertaken in line with the IAQM minerals guidance, the assessment considered a total of twelve human receptor locations and one ecological receptor within the 250m IAQM screening distance for sand and gravel sites.

The proposed scheme at Stanninghall Quarry is considered unlikely to cause adverse effects with correct mitigation measures in place and all potential dust impacts are considered to be reversible i.e. the risk of impact will cease on completion of the extraction and restoration activities at the Application Site.

11.13 Conclusion

The conclusions of this air quality assessment, undertaken using the IAQM *'Guidance on the Assessment of Mineral Dust Impacts for Planning'* are that:

- the effect on amenity is considered to be 'not significant';

- the effect on PM_{10} concentrations at receptors is considered to be 'not significant';
- the effect from dust on ecological receptors are considered to be 'not significant'; and
- emissions from road vehicles associated with scheme are considered to be 'negligible'.

These conclusions rely on the continuation of the operational mitigation measures and the environmental design measures throughout the Proposed Development.

With this continuation, the overall conclusion of the assessment is that effects on local air quality are 'not significant' during the operation or following completion of the Proposed Development.

The Proposed Development is therefore in line with the criteria contained within the Norfolk Minerals and Waste Local Development Framework and Broadland District Council local policy.

12.0 TRANSPORTATION

12.1 Introduction

This chapter of the ES has been prepared by the Hurlstone Partnership Limited. The Author of the Transport chapter of the ES has been involved with assessing the transport impacts of the Quarry since 1999 as part of the preparation of the initial planning application and ES submitted in 2002. During this period, the transport assessments have considered output levels of up to 400,000 tonnes per annum on the local highway network; noting that such levels were acceptable to the Highway Authority. Jeremy Hurlstone of the Hurlstone Partnership also prepared and presented highway evidence at the planning inquiry in 2005, the outcome of which established the existing quarry.

The original assessment was based on the development site covering a larger area of 106 hectares, which includes that currently proposed as the extension. Due to concerns over the extent of the minerals 'land bank', a reduced scheme covering an area of 54 hectares was ultimately approved, which forms the established Stanninghall Quarry.

The Quarry has been supplying local markets since 2015. The permitted reserves are being depleted and the reserves at the beginning of 2020 within the permitted working area were around 1.22 million tonnes. However, a significant proportion of this, some 454,000 tonnes, is beneath the existing plant area.

In order to maintain supplies to the established markets, planning permission is sought for a northern extension, which contains a reserve of approximately 3.83 million tonnes of sand and gravel.

Based on an average annual output of 300,000 tonnes per annum, when added to the remaining reserves within the permitted working area of the Quarry, this would allow supplies to be maintained for a period of around 17 years, taking the end date for exports to 2037.

During the final years of the project programme, the reserves beneath the plant site would be extracted and sold 'as-raised' from the site, rather than being processed prior to export.

In terms of transport matters, the proposed development represents a continuation of permitted operations for an additional period of time.

The permitted operating hours and the purpose-built access from the B1150 to Stanninghall Quarry would remain. Similarly, the vehicles serving the site and their distribution around the local road network are not anticipated to change significantly during the operational life of the Quarry.

The proposed extension area is identified as Specific Site Policy MIN65 in Norfolk County Council's Preferred Options for the Norfolk and Waste Mineral Local Plan, which seeks to identify sites for the supply of 20.3 million tonnes of Sand and gravel to the end of the 2036 plan period. The allocation at Stanninghall Quarry is the largest of the allocated sites, which confirms its strategic importance within the County.

12.2 Site Access

As noted above, Stanninghall Quarry is served by a purpose-built access from the B1150, which was constructed in accordance with the approval of the Highway Authority specifically to serve the site.

The access to Stanninghall Quarry lies on the west side of the B1150, approximately 1.75km to the south of the mini-roundabout junction between Rectory Road and the B1150 Norwich Road at Horstead

The access route is called Quarry Road and continues northwest as the priority route from the B1150. Approximately 49.5m from the B1150, there is a priority junction on the southern side of Quarry Road, which provides access to Stanninghall Road. Stanninghall Road itself continues initially southwest then west-southwest as the minor arm from the priority junction. The Stanninghall Road junction with Quarry Road has a kerbed bellmouth extending approximately 23.7m between its tangent points.

The original line of Stanninghall Road remains; but is restricted to pedestrian and cycle use only. Signage at either end of the remaining link, which extends approximately 50m, confirms a Traffic Regulation Order preventing its use by motor vehicles. The signs at each end is supplemented by a post mounted in the centre of the carriageway to physically restrict access.

The eastern end of the restricted section of Stanninghall Road meets Quarry Road approximately 8.3m from the edge of the B1150, whilst the western end meets the continuation of the vehicular carriageway where it resumes its original line, approximately 29m from the Quarry Road priority junction.

A Traffic Regulation Order also restricts access to Stanninghall Road from Quarry Road for vehicles over 7.5 tonnes except for loading. A supplementary sign beneath advises "QUARRY VEHICLES PROHIBITED" with a no-entry sign above the text.

Both the Stanninghall Road junction with Quarry Road and that between Quarry Road and the B1150 are controlled by Give Way markings with associated signage.

Quarry Road forms a crossroads with Caius Heath Road, which lies to the east of the B1150.

The bellmouth of the Quarry Road junction extends approximately 38m between its tangent points on the west side of the B1150. The radii of the bellmouth forming the junction are kerbed, as is the continuation of Quarry Road into the site.

Quarry Road itself is approximately 7.4m wide and has a tarmacadam surface extending into the Quarry beyond the access gates, which are set back 74.5m from the B1150 and 25m from the centreline of the Stanninghall Road priority junction.

Visibility at the Stanninghall Road junction is good in both directions, extending into the Quarry to the northwest and to the B1150 junction to the southeast.

Visibility at the Quarry Road / B1150 junction is also good, extending beyond 215m in both directions, in accordance with the approved design.

Within the site, the access is subject to a 10 mph speed limit. When leaving, signage confirms to drivers "NO RIGHT TURN TO STANNINGHALL LANE".

12.3 Development Proposals

12.3.1 Application Details

The proposed development represents a northern extension to the Stanninghall Quarry, which would allow supplies to established markets to continue for a period of approximately 17 years, based on the predicted average output of 300,000 tonnes per annum.

In transport terms, the proposed development represents a continuation of the permitted operations for an additional period of time. Whilst the sand and gravel would be extracted from a different area, it would be transported overland to the existing processing plant and either sold as processed aggregate or diverted to the on-site concrete plant, as per the existing, permitted operations. As previously described, the final remaining reserves beneath the plant site would be extracted and sold as-raised following the removal of the plant itself.

The proposed operating hours will remain as approved between 07:00 – 18:00 Monday to Friday and 07:00: - 13:00 on Saturdays, with no working on Sundays or Public Holidays.

12.3.2 Trip Generation

The traffic movements associated with Stanninghall Quarry comprise the aggregate exports and concrete sales. In terms of aggregate sales, material is transported in a range of vehicles up to the larger articulated HGVs. Taking into account the range of vehicles, an average payload of 20 tonnes per vehicle has been identified.

Based on the exporting of 300,000 tonnes of aggregate in 20 tonne payloads over 275 working days per annum (50 weeks at 5.5 days per week), an average of 54.5 (say 55) loads / 110 HGV movements per day is established. By way of comparison, outputs of 200,000 tonnes and 400,000 tonnes per annum equate to averages of 36.3 (say 37) loads / 74 HGV movements and 72.7 (say 73) loads / 146 HGV movements per day respectively.

It is understood that working on Saturdays is rare. As a result, the number of working days per annum reduces to 250, which results in a corresponding increase in the average daily traffic flows.

Based on 250 working days, exporting 200,000, 300,000 and 400,000 tonnes per annum would result in an average of 40 loads / 80 HGV movements, 60 loads / 120 HGV movements and 80 loads / 160 HGV movements per day respectively.

When distributed over an 11 hour working day, these flows equate to rounded up averages of 4 loads / 8 HGV movements, 6 loads / 12 HGV movements and 8 loads / 16 movements per hour respectively.

However, as would be expected, there are day to day variations in activity, with some days attracting higher and some days lower than the average traffic flows. To place these flows in context, Tarmac provided weighbridge data for the period 07 June to 04 July 2019. During this period, the daily flows varied between 44 and 203 HGV movements during the Monday to Friday period, with 2 movements on one Saturday within the dates provided.

The corresponding hourly flows recorded at the weighbridge ranged between 0 and 42 movements.

During 2019 the annual output from Stanninghall Quarry was approximately 145,000 tonnes, which was the lowest since sales began in 2015, when 159,000 tonnes were sold. The peak production since the site opened occurred in 2017 when approximately 337,000 tonnes were sold from the site.

It is therefore apparent that there is a significant range in terms of annual output and traffic flow variations per hour/day.

Based upon the daily and annual flows observed at the weighbridge, it is apparent that whichever annual output is considered between the range of 200,000 to 400,000 tonnes assessed above, the corresponding daily and hourly flows fall within the normal range of day to day and hour to hour variations arising from the current activities.

Effectively, the range of hourly flows is not anticipated to change significantly between the lower and higher annual production levels; but at the higher annual outputs, there would be more hours of the day where the flows are above those resulting from the lower annual production.

Notwithstanding the foregoing, a proportion of the sand and gravel is diverted to the on-site concrete plant. Concrete production in 2019 was 16,478m^3. In order to produce this concrete, the plant consumed 29,660 tonnes of sand and gravel from Stanninghall Quarry.

In addition to sand and gravel, there were 9 loads of binder, 56 loads of Ground Granulated Blast-furnace Slag (BBGS) and 103 loads of cement imported to the site.

In terms of exported concrete, the average load volume is 5.5m^3, which resulted in 3045 loads per annum.

When adding all of the loads associated with the concrete plant, which also predominantly operates 5 days per week (Monday to Friday), with Saturday working being rare, an average of 12.9 (say 13) loads / 26 HGV movements per day is established.

It is anticipated that concrete production is likely to remain at around this level for the foreseeable future.

By way of comparison, exporting 29,660 tonnes of sand and gravel in 20 tonne average payloads over 250 working days per annum would result in an average of 6 loads / 12 HGV movements per day.

It is therefore apparent that the production of concrete results in more traffic activity than would occur as a result of direct aggregate sales.

Based on the proposed average production of 300,000 tonnes per annum, of which 29,660 tonnes is diverted to the concrete plant, the remaining 270,340 tonnes of sand and gravel would attract an average of 54 loads / 108 HGV movements per day, assuming the distribution remains predominantly over a 5 day week (Monday to Friday). Adding the 13 loads / 26 HGV movements associated with the concrete production, results in an overall total of 67 loads / 134 HGV movements per average day, and 6 loads / 12 HGV movements per hour.

By way of comparison, assuming the same concrete production levels within a reduced annual output of 200,000 tonnes results in 34 loads / 68 movements associated with aggregate export plus 13 loads / 26 movements associated with the concrete sales; giving a total of 47 loads / 94 HGV movements per day and 5 loads / 10 HGV movements per hour.

Repeating the calculation based on an overall output of 400,000 tonnes results in 74 loads / 148 HGV movements associated with direct aggregate sales plus 13 loads / 26 HGV movements associated with concrete production, resulting in 87 loads / 174 HGV movements per day and 8 loads / 16 HGV movements per hour.

It is apparent that the difference in hourly traffic movements between the lower and higher production levels is 6 HGVs, which equates to 1 movement every 10 minutes.

When comparing these average daily and hourly flows with those observed at the weighbridge during June/July 2019, it is apparent that the calculated flows under the various scenarios considered, all fall within the range of existing day to day and hour to hour variation at the site access.

As a result, in practical terms, there would be no discernible difference between the various scenarios when compared with current activities at the site.

In terms of the distribution of traffic travelling to / from Stanninghall Quarry, it is understood that approximately 10% of production travels to / from the north via Horstead, whilst the remaining 90% travels to /from the south via Crostwick / Spixworth, with the majority of traffic travelling via the A1270 Broadland Northway (also referred to elsewhere in the ES as the Norwich Northern Distributor Road).

12.4 Highway Infrastructure

As described in section 12.2 above, the site access runs directly onto Quarry Road as the priority route, passing Stanninghall Road, before reaching the B1150 at a priority crossroads junction as a minor arm, opposite Caius Heath Lane.

The junction lies on a straight section of the B1150, which has a width of approximately 7.4m and is subject to the national speed limit of 60 mph. It is a typical rural route with no footways or street lighting in the vicinity of the junction.

The B1150 benefits from wide verges along the carriageway, which is generally level as it continues south from the crossroads. Approximately 0.7km to the south, just before reaching Hill Farm's Farm Shop, the speed limit reduces to 50 mph, which continues through Crostwick for approximately 2.5km before reverting to 60 mph as it continues to the roundabout junction with the A1270 Broadland Northway, approximately 0.5km distant. Signs are provided within the 50 mph area alerting drives to the presence of speed cameras.

The A1270 Broadland Northway is a recently constructed dual carriageway route which forms a partial bypass around Norwich City. It was opened in April 2018 following commencement of construction in 2016. The route provides two carriageways with 2 No. 3.65m wide traffic lanes on each side of the central reservation.

Although the route around the City via the A1270 is physically longer than that along the continuation of the B1150 to the south, it offers significant time-savings for drivers when compared to the alternative route towards the City centre.

The A1270 is used by HGVs servicing Stanninghall Quarry to access the majority of the markets is serves, which reflects the traffic distribution weighting of 90% to/from the south of the Quarry Road / Caius Heath Lane crossroads.

By heading north from the crossroads, the B1150 continues for approximately 13.25 km to a traffic signal controlled junction with the A149 at North Walsham. The B1150 passes through Horstead, Coltishall, Sco Ruston, Scottow and Westwick before reaching North Walsham.

Approximately 1.1km to the north of Quarry Road, there is a gateway sign when entering Horstead, which confirms the village is part of the Broads National Park. Signage also advised that Community Speedwatch operates to enforce the speed limit, which is reduced to 30mph. Street-lighting is introduced to the route and footways are provided intermittently on both sides of the B1150 as it continues through the village.

A mini-roundabout forms the junction of the B1150 and B1354, outside the Recruiting Sergeant public house, approximately 0.6km into the village. The mini-roundabout balances priorities at the junction and provides pedestrian refuges on the existing desire lines. As part of the junction improvements when the mini-roundabout was installed, the central white lining has been changed to hatching. This has the effect of narrowing the through lanes on the B1150 approaches.

Approximately 260m beyond the roundabout, the speed limit reduces to 20 mph as the B1150 enters Coltishall, via a bridge crossing over the River Bure. Beyond the bridge the B1354 continues in an easterly direction towards Wroxham via a priority T junction.

Beyond the junction the B1150 turns left as the priority route and continues through Coltishall High Street, where roadside parking is provided on both sides of the route in designated bays before double-yellow lines are introduced as the route heads out of the village via an increased speed limit of 30 mph beyond the Great Hautbois Road junction.

The 30 mph limit continues beyond the crossroads junction with Ling Way and The Hill, on the north side of Coltishall, before increasing back to the national limit of 60 mph. Warning signs alert drivers to the potential for speed cameras to be operational in the 60 mph area, which extends approximately 1.4km before reducing to 50 mph when entering Sco Ruston.

The 50 mph limit continues for approximately 1.8km before reducing to 40 mph for around 1km as the B1150 passes through Scottow. The speed limit then reverts to 50 mph, which remains in force up to the historic market town of North Walsham, where the speed limit reduces to 30 mph as it becomes more urban in character.

Before reaching the traffic signal controlled junction with the A149, the B1150 passes beneath a bridge carrying the railway line, which has a restricted height limit of 3.9m/12’9’’.

12.4.1 Traffic Flows

In order to establish existing traffic flows on the local road network, survey data was obtained from Norfolk County Council. To the north of the site, an Automatic Traffic Count (ATC) survey in Horstead, to the northeast of the Recruiting Sergeant on the B1150, undertaken between 06 – 12 June 2019, revealed daily traffic flows ranging between 11906 and 17057 vehicles over the 7 day period, giving a variation of 5151 vehicles from day to day. The larger HGV movements (3 axles and above) were found to range between 63 and 210 per day, giving a daily variation of 147.

An observed 12 hour (07:00 – 19:00) turning count at the roundabout junction between the B1150 and A1270 Broadland Northway on 15 October 2019 revealed a total flow on the B1150 north of the roundabout to be 15034 vehicles including 635 HGVs.

It is apparent from the survey results that the flows to the south of the site on the B1150 are higher than those to the north, both in terms of overall traffic volumes and HGV activity.

By way of comparison, the flow on the A1270 Broadland Northway to the east of the roundabout was 23683 vehicles including 1649 HGVs, whilst that to the west was 18526 vehicles including 1239 HGVs. The flow on the continuation of the B1150 to the south of the roundabout was 9705 vehicles including 230 HGVs.

The peak hours of activity at the roundabout occurred between 07:45 – 08:45 and 16:45 – 17:45, when 3977 and 4152 total movements were recorded.

The weighbridge data for Stanninghall Quarry revealed that in terms of the total daily activity at the site, approximately 8% occurred between 08:00 – 09:00 and 1% between 17:00 – 18:00. Based on the 20 working days activity occurred during these periods, Stanninghall Quarry attracted an average of 7.35 (say 8) HGV movements during the AM peak period and 0.8 (say 1) HGV movement during the PM peak period.

This equates to just 0.2% of the AM peak hour and 0.02% of the PM peak hour flows at the junction.

The highest number of movements at the site recorded during the peak hour periods were 32 AM and 4 respectively, which equate to 0.8% and 0.1% of the total movements at the junction during the AM and PM peak periods respectively.

In terms of the traffic flow on the B1150, between 07:45 – 08:45 a total of 1552 movements were recorded, which compares with 1608 between 16:45 – 17:45. For comparison purposes, the 08:00 – 09:00 and 17:00 – 18:00 flows on the B1150 were 1559 and 1605 respectively.

The peak flows associated with Stanninghall Quarry during the 08:00 – 09:00 period represent approximately 2%, whilst the peak during the 17:00 – 18:00 period represents approximately 0.2% of the observed flow.

In terms of link capacity, reference to TA79/99 "*Traffic Capacity of Urban Roads*" indicates a 7.3m wide single carriageway carrying predominantly through-traffic has an hourly capacity of some 2650 vehicles per hour. Based on the peak hourly flow of 1608 movements recorded on the B1150 during the junction survey, this represents just 60.6% of the design capacity, which indicates a margin of 39.4% and 1042 vehicle movements before the comparable capacity is breached.

Traffic flows are predicted to increase over the proposed duration of extraction at Stanninghall Quarry. Between 2019 and the 2037 predicted end date, based on the corrected local growth factors for the Middle Super Output Areas Broadland 003 and 005, through which the busier section of the B1150 between Quarry Road and the A1270 Broadland Northway passes, the highest predicted increase during the AM peak period is 24% in Broadland 003. The comparable PM peak period predicted increase is 25.38%.

Should these growth predictions be realised, the AM peak hour flow on the B1150 would increase to 1933 movements, whilst the PM peak would reach 2016 movements.

When compared with the hourly capacity of 2650 vehicle movements previously identified, it is apparent that in the 2037 design year, the B1150 would retain a reserve or spare capacity of between 634 and 717 vehicle movements, which represent between approximately 24% to 27% respectively.

Having established the low proportions of the overall flow the Stanninghall Quarry traffic represents, together with the ability of the local road network to accommodate the continued activity together with predicted traffic growth, it is apparent that in terms of impact on the network during the period of peak demand, the proportion of the quarry traffic within the overall traffic volume is insignificant and acceptable.

The fact that the majority of traffic activity associated with Stanninghall Quarry occurs outside the network peak hours is considered to be beneficial in terms of reducing overall impact on the efficient operation of the local roads.

12.4.2 Safety Risks: Accident Statistics

In order to review the safety performance of the local highway network, collision data was obtained from Norfolk County Council, which covered the most recent 5 year period available between 2015 – 2019 inclusive.

The data provided by the Council included the length of the B1150 between its junction with the A149 at North Walsham to the A1270 Broadlands Northway junction.

The data provided was analysed to establish incidents involving HGVs over 7.5 tonnes, as it is the larger HGVs which are typically associated with quarry activities.

It was found that there was a single, slight personal injury accident recorded involving an HGV over 7.5 tonnes. This occurred in October 2018 at the A149 junction in North Walsham. The data indicates the HGV collided with the rear of a stationary car at the traffic lights when both vehicles were heading southbound through the junction.

The data was also reviewed to establish whether there had been any accidents at the Quarry Road junction with the B1150. A single, slight accident was recorded at the crossroads in March 2015. However, it did not involve any turning movements. The details indicate a car heading north along the B1150 hit a kerb on the nearside of the carriageway, then moved across the carriageway to collide with a goods vehicle (between 3.0 – 7.5 tonnes) travelling in the opposite direction.

In the event there is a particular feature of the local road network that results in compromised safety for its users, it is normal to find a number of incidents at a location which share common characteristics.

The absence of incidents involving the larger HGVs and the use of the access junction in this case provide evidence that the existing infrastructure is suitable to accommodate the routine HGV movements associated with Stanninghall Quarry and other activities in the area.

There is no reason to conclude that the good safety record demonstrated at the access and on the local roads would be adversely affected by the continuation of approved operations at Stanninghall Quarry as proposed. It is therefore concluded that the predicted impact on highway safety associated with the proposed extension to Stanninghall Quarry is not significant and is therefore acceptable.

12.5 Mitigation Measures

Having completed the review of the existing site access, local road network and proposed development, it is established that the recent traffic activity associated with Stanninghall Quarry has been satisfactorily and safely accommodated on the local road network.

The proposed development is predicted to maintain the recently experienced traffic activity associated with Stanninghall Quarry for an additional period of time.

Due to the proportion of the overall traffic volume associated with Stanninghall Quarry, any traffic growth that may occur on local roads as a result of other development would further reduce the proportion of Quarry traffic, and could only arise having taken the Quarry traffic into account when assessing and approving those other development proposals.

Taking this into account, no new mitigation measures are considered necessary in this case, beyond routine maintenance of the site access and continuing the management protocols adopted by Tarmac.

12.6 Residual Impacts

During the working of the proposed time extension, there would be a continuation of traffic movements to / from Stanninghall Quarry. Notwithstanding this, the access and local road network can demonstrably accommodate the proposed continuation of activities.

When activity at the site ceases, there would be no residual highway impact associated with the scheme beyond the existence of the site access, which would remain available to serve the proposed after-use following restoration of the Quarry.

12.7 Recommendations

Based on the safety record of the site access and local road network, together with their ability to accommodate the continuation of activities at Stanninghall Quarry for the predicted duration of operations, it is apparent that the proposal would be acceptable in terms of its highway and transport impact when assessed against the test imposed by the National Planning Policy Framework, which confirms at paragraph 109:

"Development should only be prevented or refused on highway grounds if there would be an unacceptable impact on highway safety, or the residual cumulative impacts on the road network would be severe."

In the absence of an unacceptable impact on highway safety of a severe residual cumulative impact on the road network, in accordance with national policy guidance, permission should not be refused on highway grounds. It is therefore recommended that insofar as transport matters are concerned, the proposed extension to Stanninghall Quarry should be approved.

12.8 Summary

Stanninghall Quarry has been supplying local markets since 2015. As the permitted reserves are being depleted planning permission is sought for a northern extension, which contains a reserve of approximately 3.83 million tonnes of sand and gravel, which would allow supplies to be maintained until around 2037 based upon the predicted average output of 300,000 tonnes per annum.

In terms of transport matters, the proposed development represents a continuation of permitted operations for an additional period of time.

The permitted operating hours and the purpose-built access from the B1150 to Stanninghall Quarry would remain. Similarly, the vehicles serving the site and their distribution around the local road network are not anticipated to change significantly during the extended operational life of the Quarry.

The proposed extension area is identified as Specific Site Policy MIN65 in Norfolk County Council's Preferred Options for the Norfolk and Waste Mineral Local Plan, which seeks to identify sites for the supply of 20.3 million tonnes of Sand and gravel to the end of the 2036 plan period. The allocation at Stanninghall Quarry is the largest of the allocated sites, which confirms its strategic importance within the County.

The Author of the Transport chapter of the ES has been involved with assessing transport impacts of the Quarry since 1999 and has prepared reports considering the impacts associated with output levels of up to 400,000 tonnes per annum on the local highway network, which were acceptable to the Highway Authority. He also prepared and presented highway evidence at the planning inquiry which led to the extant planning permission.

The proposed extension area falls within that previously assessed, albeit planning permission was ultimately granted for a smaller area due to concerns over the extent of the minerals 'land bank'.

A review of the impact of the proposal has been undertaken based on current guidance, taking into account the existing site access and road geometry, traffic flow information for Stanninghall Quarry and the wider highway network. The road safety impacts associated with the proposal have also been considered by reviewing recent collision records provided by Norfolk County Council.

The review found that the range of output at Stanningall Quarry has fluctuated between around 145,000 and 337,000 tonnes in recent years and that this range of activity could be accommodated on the road network for the 17 year extension period proposed.

For comparison with previous assessments for the site, the impact associated with an output of up to 400,000 tonnes per annum was

considered. The difference between this and the predicted average output of 300,000 tonnes per annum was not found to be significant in terms of transport impact, as the change in associated traffic activity was found to fall well within the existing day to day and hour to hour variations at the site respectively.

The local road network has a good safety record with no accidents involving vehicles turning to/from the site access and only a single, slight personal injury accident involving a HGV over 7.5 tonnes along the entire length of the B1150 between the A149 at North Walsham and the A1270 Broadland Northway junction within the last 5 years, which included the full range of recent annual outputs from Stanninghall Quarry.

This demonstrates that the site access and local road network are able to safely accommodate vehicle movements associated with the typical activities at Stanninghall Quarry, which are anticipated to be maintained at similar levels into the future.

The ability of the local road network to accommodate the ongoing activity has been assessed by projecting baseline traffic data to the future year 2037 in order to assess the available road capacity at that time.

It was found that the local highway network retained significant levels of reserve or spare capacity, ranging between approximately 24 – 27% in the 2037 design year. This confirmed that highway capacity should not be considered a constraint to the proposed extension to Stanninghall Quarry.

12.9 Conclusions

Having considered the ability to retain and maintain a safe access to the site onto a road network which is able to safely accommodate the continuation of HGV traffic travelling to / from Stanninghall Quarry, when assessed against national planning policy, it is concluded that the transport and highway impact of the proposal would be acceptable and therefore planning permission should not be refused on highway grounds.

13.0 CULTURAL HERITAGE

13.1 Introduction

This chapter assesses the potential effects of the proposed development on archaeological and cultural heritage assets. The assessment has been carried out by Andrew Josephs, David Robertson and Ian Meadows of Andrew Josephs Associates.

Andrew has extensive experience of all periods and facets of cultural heritage, including the authorship of over 800 Heritage Statements. He was previously Principal Consultant (Director of Heritage and Archaeology) at AMEC and Wardell Armstrong, where he started in 1992, becoming one of the UK's first consultants in the post-PPG16 era of developer-funded archaeology. Prior to 1992, he worked as a field-based archaeologist and researcher for universities and units in the UK, Europe and the USA. He lectures widely and was previously a tutor to the WEA and visiting lecturer in EIA at the University of Nottingham.

David joined Andrew Josephs Associates in 2018 and is an archaeologist with over twenty years' experience in commercial and curatorial archaeology and heritage management. Between 2006 and August 2018 he worked in Norfolk County Council's historic environment planning team, providing archaeological advice to local planning authorities, developers, land managers and statutory organisations, while overseeing the work of archaeological contractors. Prior to this he worked for archaeological contractors across England and further afield and was a part-time tutor for the University of East Anglia and the WEA; he has continued his passion for education by working on community archaeology projects. He has managed a broad range of projects, including the Norfolk Monuments Management Project, the scientific dating of the Holme II timber circle and the Norfolk Coastal Heritage Project.

Ian Meadows is an archaeologist with over 30 years' experience in a variety of professional areas. He was Senior Project Officer with Northamptonshire Archaeology (now MOLA) from 1992 until 2014 when he joined AJA. Ian is highly experienced project manager of large landscape projects such as long running quarries, including the current Stanninghall Quarry. He has a particular interest in the Roman period and is Director of the excavations at Irchester Roman town. In addition to his fieldwork he is engaged in regular outreach sessions to both professional and amateur groups. He has been teaching archaeology and landscape history to adults and children since the late 1980s, previously being engaged as a tutor by Cambridge University, Anglia Ruskin University, Bath University and the WEA and feels it is important to disseminate the information derived from projects to a wider audience.

13.2 Scope of Assessment

Cultural heritage is represented by a wide range of assets that result from past human use of the landscape. These include historic structures, many still in use, above ground and buried archaeological monuments and remains of all periods, artefacts of anthropological origin and evidence that can help reconstruct past human environments. In its broadest form cultural heritage is represented by the landscape and townscape itself.

This assessment considers both direct and indirect effects upon cultural heritage within the vicinity of the Application Site and with particular emphasis on the Proposed Extension Area (PEA).

Direct effects result from, for example, the stripping of soils and overburden, the creation of storage and screening bunds, and the installation of infrastructure.

Indirect effects can occur as a result of changes to the setting of a landscape or asset, whether permanent or temporary. This is particularly relevant to designated cultural heritage assets, such as Scheduled Monuments, Listed Buildings, Conservation Areas and Registered Parks and Gardens.

The scope of this assessment has followed the advice set out in a Scoping Opinion dated 11th February 2020 (NCC reference SCO/2019/0003).

It stated that:

"*The proposed application area is rich in cropmarks of field-systems, previous excavations have also produced charcoal clamps of probable Anglo-Saxon date and the site is in close proximity to the Horstead Roman Camp (a Scheduled Monument). The County Archaeologist would advise that the Historic Environment section of the EIA should consist of an archaeological desk-based assessment including the results of a geophysical survey of the extension area."*

"*Historic England confirmed its view that historic environment represents a potentially significant issue in EIA terms, and agree with the applicant that the results of the assessment exercise should result in a specific Cultural Heritage chapter of the ES. HE notes the Scoping Report has identified and noted the presence of the scheduled monument in the landscape. Overall, HE also acknowledges the approach that is being considered in the Scoping Report in relation to both designated and non-designated heritage assets, and consider this will be sufficient to provide a considered heritage chapter in the ES."*

13.3 Previous Cultural Heritage Studies

A desk-based assessment that included the PEA was written by Entec in 2001[34] and archaeological investigations have been ongoing within the current quarry since 2004.

13.4 Policy, Guidance and Methodology

The importance of cultural heritage is clearly recognised at both national and local levels. Certain features that are deemed to be of particular importance are given legal protection through the Ancient Monuments and Archaeological Areas Act 1979 (Scheduled Monuments), the Town and Country Planning Act 1990 (Listed Buildings and Conservation Areas) and the Hedgerows Regulations 1997 (Hedgerows of Historic Importance).

13.4.1 National Policy and Guidance

In accordance with the Town and Country (Environmental Impact Assessment) Regulations 2017, the significance of an effect should be identified as part of heritage assessments. This is achieved using a combination of the following published guidance and professional judgement.

- National Planning Policy Framework, updated 2019. Department for Communities and Local Government.
- Planning Practice Guidance: *Conserving and Enhancing the Historic Environment* http://planningguidance.planningportal.gov.uk
- Historic England[35] 2008. *Conservation Principles: Policies and Guidance for the Sustainable Management of the Historic Environment.*
- Historic England 2017. *The Setting of Heritage Assets (GPA3)*
- Historic England 2020 Mineral Extraction and Archaeology (HE Advice Note 13)

National Planning Policy Framework

National planning policy on how cultural heritage should be assessed is given in the National Planning Policy Framework, updated in 2019. This covers all aspects of heritage and the historic environment, including listed buildings, conservation areas, registered parks and gardens, battlefields and archaeology.

Of particular relevance to this application are paragraphs 189-199

189. In determining applications, local planning authorities should require an applicant to describe the significance of any heritage assets affected, including any contribution made by their setting. The level of detail should

[34] Entec 2001. Trafford Estate Proposed Quarry. Cultural heritage Desk-based Assessment for Tarmac Southern Ltd.

[35] Historic England includes its former name English Heritage

be proportionate to the assets' importance and no more than is sufficient to understand the potential impact of the proposal on their significance. As a minimum the relevant historic environment record should have been consulted and the heritage assets assessed using appropriate expertise where necessary. Where a site on which development is proposed includes, or has the potential to include, heritage assets with archaeological interest, local planning authorities should require developers to submit an appropriate desk-based assessment and, where necessary, a field evaluation.

190. Local planning authorities should identify and assess the particular significance of any heritage asset that may be affected by a proposal (including by development affecting the setting of a heritage asset) taking account of the available evidence and any necessary expertise. They should take this into account when considering the impact of a proposal on a heritage asset, to avoid or minimise any conflict between the heritage asset's conservation and any aspect of the proposal.

191. Where there is evidence of deliberate neglect of, or damage to, a heritage asset, the deteriorated state of the heritage asset should not be taken into account in any decision.

192. In determining applications, local planning authorities should take account of:

a) the desirability of sustaining and enhancing the significance of heritage assets and putting them to viable uses consistent with their conservation;

b) the positive contribution that conservation of heritage assets can make to sustainable communities including their economic vitality; and

c) the desirability of new development making a positive contribution to local character and distinctiveness.

Considering potential impacts

193. When considering the impact of a proposed development on the significance of a designated heritage asset, great weight should be given to the asset's conservation (and the more important the asset, the greater the weight should be). This is irrespective of whether any potential harm amounts to substantial harm, total loss or less than substantial harm to its significance.

194. Any harm to, or loss of, the significance of a designated heritage asset (from its alteration or destruction, or from development within its setting), should require clear and convincing justification. Substantial harm to or loss of:

a) grade II listed buildings, or grade II registered parks or gardens, should be exceptional;

b) assets of the highest significance, notably scheduled monuments, protected wreck sites, registered battlefields, grade I and II listed buildings, grade I and II* registered parks and gardens, and World Heritage Sites, should be wholly exceptional.*

195. Where a proposed development will lead to substantial harm to (or total loss of significance of) a designated heritage asset, local planning authorities should refuse consent, unless it can be demonstrated that the substantial harm or total loss is necessary to achieve substantial public benefits that outweigh that harm or loss, or all of the following apply:

a) the nature of the heritage asset prevents all reasonable uses of the site; and

b) no viable use of the heritage asset itself can be found in the medium term through appropriate marketing that will enable its conservation; and

c) conservation by grant-funding or some form of not for profit, charitable or public ownership is demonstrably not possible; and

d) the harm or loss is outweighed by the benefit of bringing the site back into use.

196. Where a development proposal will lead to less than substantial harm to the significance of a designated heritage asset, this harm should be weighed against the public benefits of the proposal including, where appropriate, securing its optimum viable use.

197. The effect of an application on the significance of a non-designated heritage asset should be taken into account in determining the application.

In weighing applications that directly or indirectly affect non-designated heritage assets, a balanced judgement will be required having regard to the scale of any harm or loss and the significance of the heritage asset.

198. Local planning authorities should not permit the loss of the whole or part of a heritage asset without taking all reasonable steps to ensure the new development will proceed after the loss has occurred.

199. Local planning authorities should require developers to record and advance understanding of the significance of any heritage assets to be lost (wholly or in part) in a manner proportionate to their importance and the impact, and to make this evidence (and any archive generated) publicly accessible. However, the ability to record evidence of our past should not be a factor in deciding whether such loss should be permitted.

Historic England: The Setting of Heritage Assets (2017)

This Good Practice Advice Note (GPA3) observes that amongst the Government's planning objectives for the historic environment is that conservation decisions are based on the nature, extent and level of a heritage asset's significance and are investigated to a proportionate degree. Historic England recommends the following broad approach to assessment, undertaken as a series of steps that apply proportionately to complex or more straightforward cases:

- Step 1: Identify which heritage assets and their settings are affected;
- Step 2: Assess the degree to which these settings and views make a contribution to the significance of the heritage asset(s) or allow significance to be appreciated;
- Step 3: Assess the effects of the proposed development, whether beneficial or harmful, on the significance or on the ability to appreciate it;
- Step 4: Explore ways to maximise enhancement and avoid or minimise harm;
- Step 5: Make and document the decision and monitor outcomes.

These steps have been followed in the following assessment.

13.4.2 Norfolk County Council Minerals and Waste Policy

The Norfolk Minerals and Waste Development Plan (2010-2026) consists of three documents:

1. The Norfolk Core Strategy and Minerals and Waste Development Management Policies Development Plan Document (DPD) (the 'Core Strategy'), which was adopted in September 2011.
2. The Norfolk Minerals Site Specific Allocations DPD, which was adopted in 2013. In December 2017 this was amended by the adoption of a Single Issue Silica Sand Review.
3. The Norfolk Waste Site Specific Allocations DPD, which was also adopted in 2013.

The 2010-2026 Core Strategy includes policies directly relating to cultural heritage. These are set out below:

Policy CS14 – Environmental protection (taken from Norfolk County Council 2011, 61-62)

"The protection and enhancement of Norfolk's natural and built environments is a vital consideration for future minerals extraction and associated development and waste management facilities in the county. In particular, developments must ensure that there are no unacceptable adverse impacts on, and ideally improvements to:

- Natural resources, including water, air and soil;
- The character and quality of the landscape and townscape, including nationally designated landscapes (the Norfolk Coast Area of Outstanding Natural Beauty and the Norfolk and Suffolk Broads);
- Biodiversity and geodiversity, including nationally and internationally designated sites and species, habitats and sites identified in Biodiversity and Geodiversity Action Plans;
- Heritage assets and their setting, and cultural assets; and
- Residential amenity e.g. noise, vibration, dust, lighting, and visual intrusion.

Where any development proposals would potentially have adverse impacts on any of the assets listed above, the adequacy of any proposed mitigation measures will be assessed on a case-by-case basis.

The highest standards of design, operation and (where relevant) restoration and aftercare of sites must be practised."

Development Management Policy DM8 – Design, local landscape and townscape character (taken from Norfolk County Council 2011, 81)

Development will be permitted if it will not harm the conservation of, or prevent the enhancement of, key characteristics of its surroundings with regard to the character of the landscape and townscape, including consideration of its historic character and settlement pattern, taking into account any appropriate mitigation measures.

In line with PPS1, new development, including ancillary landscaping and car parking areas, must promote good design which is compatible with the existing or planned built form of the local area and the surrounding landscape.

Applicants will be expected to show how their proposals will address impacts on landscape and townscape. This would normally be undertaken through a study and evaluation of local landscape and townscape character and an assessment of how the proposal will impact on it, with reference to any relevant landscape character assessment or design guide. Alternatively, it could be carried out through a local assessment using a suitable methodology, appropriate to the scale of the development proposed. In particular the potential individual and cumulative effects on the following issues must be addressed:

- landscape and townscape character, e.g. visual intrusion, the layout and scale of buildings and designated spaces, the built fabric, public access; and
- landscape and townscape sensitivity and capacity, e.g. local distinctiveness,
- condition, historic patterns of development, semi-natural habitats, remoteness and tranquillity, and noise and light pollution.

Development will only be permitted where it would be within, or could affect the setting of, nationally or locally registered Historic Parks or Gardens, registered battlefields, conservation areas, listed buildings or the North Norfolk Heritage Coast, where the applicant can demonstrate that the development would not adversely impact on the historic form, character and/or setting of these locations, taking into account any mitigation measures."

Development Management Policy DM9 – Archaeological sites

(taken from Norfolk County Council 2011, 82)

"*Applicants whose proposals could potentially affect heritage assets, or which are in areas with high potential for archaeological interest, will be required to prepare and submit an appropriate desk-based assessment and, where necessary, a field evaluation with their application to the County Council.*

Development will only be permitted where it would not adversely affect the significance of heritage assets (and their settings) of national and/or regional importance, whether scheduled or not. Where proposals for mineral extraction or waste management facilities would affect Scheduled Monuments and/or other assets of national and/or regional importance (including their settings), there will be a presumption in favour of their preservation in situ.

Following the results of a site evaluation, development which would potentially affect other heritage assets (not of national or regional importance) could be acceptable if subject to appropriate mitigation measures – such as physical preservation of the archaeology in situ, or preservation by record (including appropriate publication and archiving)."

Norfolk County Council is currently reviewing the three DPDs. The intention is to produce one Local Plan which will continue until the end of 2036. As part of this review the PEA covered by this proposal has been put forward for allocation for sand and gravel extraction (as MIN65). Norfolk County Council's report on the initial site allocation consultation includes the following historic environment requirements:

"The site is allocated as a specific site for sand and gravel extraction. Development will be subject to compliance with the Minerals and Waste Local Plan policies and… the following requirements:

- Submission of a Heritage Statement to identify heritage assets and their settings, assess the potential for impacts and identify appropriate mitigation measures if required;

- An appropriate archaeological assessment must be prepared in consultation with Norfolk County Council; this may initially be desk-based but may need to be followed up with field surveys and trial-trenching. The archaeological assessment will be used by Norfolk County Council/Historic Environment Service to agree appropriate mitigation measures" (Norfolk County Council 2019, 165).

13.5 Designations

There are no designated heritage assets within the Application Site. Those in the vicinity are described below.

13.5.1 Designated Heritage Assets

In accordance with Historic England guidance, the first step is to identify which heritage assets could be affected. This has been achieved through map and aerial photographic regression and site reconnaissance.

After analysis of the current infrastructure, depth of the current workings, topography and the screening effects of intervening development and vegetation, a Study Area of 1km from the boundary of the PEA was considered the appropriate distance to assess potential effects upon the setting of designated heritage assets, and the environmental effects from dust, noise and traffic.

No designated assets of cultural heritage importance lie within the boundary of the PEA.

There are eighteen listed buildings and one Scheduled Monument within 1km of the PEA. These are discussed below and shown on **Figure 13-1**. There are no World Heritage Sites, Heritage Coasts, Registered Historic Parks and Gardens or Registered Battlefields within this radius.

Scheduled Monuments

One Scheduled Monument lies within 1km of the PEA. This is a Roman military camp and associated settlement. It is summarised in **Table 13-1** and shown in relation to the PEA on **Figure 13-2**.

The potential impact upon the monument is assessed in Section 13.8.2.

Table 13-1 Scheduled Monuments within 1km of the PEA

National Heritage List reference	Description	Reference on Fig 13-1	Distance from PEA boundary
1003928	**Roman camp and settlement site west of Horstead** The National Heritage List **s**ummary, reasons for designation and history are 'Not currently available for this entry' (https://historicengland.org.uk/listing/the-list/list-entry/1003928; accessed 6 May 2020). The NHER entry describes the site as a 'Roman camp visible as cropmarks on aerial photographs. The site occupies a fairly prominent position on a gravel terrace, overlooking a tributary of the River Bure to its north and the Bure itself a short distance to its northeast. The full extent of the camp is visible, encompassing an area measuring approximately 360m long and 260m wide (c. 9.3ha). It has been suggested as a marching camp for a half legion or large vexillation and auxiliary unit, but in the absence of further evidence its precise function must remain uncertain. The relationship of the camp with a small D-shaped enclosure (NHER 50776) – possibly of Iron Age or Romano-British date – visible as a cropmark within its circuit, raises interesting questions as to the relationship of the camp with the landscape that existed before its establishment, or that which grew up after its disuse. Similarly, a trackway (NHER 50777) which appears to roughly follow or be followed by the western side of the camp, and various field boundaries and other linear features visible in the vicinity (NHER 50778) again have potential to provide a great deal of information relating to landscape development during this period' (NHER 4379, used courtesy of Norfolk County Council).	1	c.110m

Listed Buildings

There are eighteen listed buildings within 1km of the PEA, as set out in **Table 13-2** below and shown on **Figure 13-1**. A nineteenth is more than 1.04km from the PEA but may have a view of it and was also assessed (Fretttenham Cornmill).

Table 13-2 Listed Buildings within 1km of PEA

Description	Grade	National Heritage List reference	Reference on Fig 13-1	Distance from PEA boundary (in order of proximity)
Horstead Lodge 'House, C18, extended in mid C19. Built of colourwashed brick, gault brick with slate roof. Irregular 'L' shaped plan of 2 storeys. Principal C19 facade to south of 3 bays, the outer bays forming shallow projections. Central aedicule with paired Roman Ionic columns supporting the entablature. Central part glazed 2 leaf door with eared architrave. Outer ground floor sash windows have glazing bars, brick reveals and semi-circular gauged brick arches. First floor sash windows have glazing bars and flat gauged brick arches. Wide bracketed eaves. Hipped roof. Wing to north, possibly C18, 3 windows with central half glazed porch with panelled pilasters, shallow cornice and pediment. Sash windows with glazing bars' (https://historicengland.org.uk/listing/the-list/list-entry/1050857; accessed 6 May 2020).	II	1050857	2	c.300m
The Old Forge, Norwich Road, Horstead 'Blacksmith's house, dating from 1581, and extended, probably in 1732. Pebble- dashed timber frame on flint plinth and brick with thatched roof. 'L'-shaped plan, based on extended 3 bay plan, of 2 storeys with lean-to to west. Irregular fenestration of C20 casement windows. Roof steps up, coincidental with axial stack. East gable wall with flint panels, brick kneeler, date stone, brick tumbling in and parapet verge with internal gable stack. Open brick fireplace with timber bressuwers. C16 wall framing with jowled posts. Inserted axial bridging joist in Hall, supported over fireplace by C17 moulded timber bracket. Close spaced, stopped and chamfered floor joists add beams. Roof rebuilt, possibly in early C18.' (https://historicengland.org.uk/listing/the-list/list-entry/1178221; accessed 6 May 2020).	II	1178221	3	c.560m
Mill House, Mill Road, Horstead 'House, early C19, of gault brick, and red brick with black pantile roof. 'L' shaped plan of 2 storeys, with lean-to conservatory to south. Facade to Mill Road, 3 bays with slightly projecting central bay, with pediment above eaves level, and double entrance doors with fanlight. Timber doors surround, with fluted pilasters and plain entablature. Sash windows with glazing bars and flat gauged brick arches. Timber modillion eaves and hipped roof. Gault brick stacks. Conservatory has gault brick dado, and close set timber mullions and glazing bars' (https://historicengland.org.uk/listing/the-list/list-entry/1295186; accessed 6 May 2020).	II	1295186	4	c.630m

Description	Grade	National Heritage List reference	Reference on Fig 13-1	Distance from PEA boundary (in order of proximity)
Barn approximately 30m to southeast of Mill House, Mill Road, Horstead 'Barn converted to coach house and stables. C18, of colourwashed brick and thatch. Two storeys with single storey lean-to on the north east. Asymmetrical distribution of stable doors, coach house doors and windows, and two sash windows with glazing bars and segmental brick arches. External gable chimney stack to north. Off centre axial louvred ventilation. Included for group value with Mill House' (https://historicengland.org.uk/listing/the-list/list-entry/1050856; accessed 6 May 2020). Now converted to residential.	II	1050856	5	c.660m
Stanninghall Farm Barn 'Barn, late C17, built of red brick and knapped flint, with asbestos roofs. "Monumental" barn of cross shaped plan, formed by porches, centrally placed to north and south. Random bonded brickwork. Flint or brick plinth, with blind arcades with segmental arches. 4 bays to either side of 1 bay porches. Vent slits within the arches. Clasping pilasters. Porch doors now infilled, but retaining oak lintels and double revealed semi-circular brick arches. South porch has moulded brick platband above the lintel, with platband above, and stepped blank panel within the gable. The clasping pilasters here have capitals. West gable of knapped flint with 3 vent slits, and raised blocked opening. Eaves level platband, tie irons and owl hole. East gable has 3 blocked vent slits, hayloft door with segmental arch in recessed arched opening, with eaves level platband stepped over it. Tie irons and owl hole. Parapet gables with moulded brick kneelers and gable peak finials. Inserted barn doors, either side of porches, to north and south. 14 bay staggered butt purlin roof with 8 tie beams. Estate owned by Sir Charles Harbord, Surveyor General to Charles 11, died 1687, and by his Son, William Harbord, Surveyor General, Land Revenues of the crown in 1682' (https://historicengland.org.uk/listing/the-list/list-entry/1178260; accessed 6 May 2020). Now converted to residential.	II	1178260	6	c.670m
Horstead War Memorial 'First World War memorial, 1921, with Second World War additions. DESCRIPTION: Horstead War Memorial is located on the village green at the junction of Norwich Road and Mill Road. To the north of the memorial is the Grade II-listed Recruiting Sergeant Inn. It is of limestone and takes the form of a Latin cross bottonée beneath a gabled canopy. The cross-head has a cusp to each angle with ornamental rays between. This crowns a slender octagonal shaft with decorative collar bearing floral motif carvings in relief; the shaft terminates in a square base with	II	1450546	7	c.690m

Description	Grade	National Heritage List reference	Reference on Fig 13-1	Distance from PEA boundary (in order of proximity)
inverse chamfered stops. This rises from a four-sided plinth which is chamfered to the top and corner edges, with inverse chamfered stops to the corners. The plinth has a four-sided chamfered foot, which surmounts a two-stepped octagonal base. The principal inscription is to the west face of the plinth and reads, TO THE MEMORY/ OF THE MEN OF/ HORSTEAD/ WHO DIED FOR/ KING AND COUNTRY/ IN THE GREAT WAR/ 1914-1918/ MAY THEY REST IN PEACE. The 17 names are listed on the remaining sides of the plinth. The Second World War dedication is to the west face of the plinth foot, directly below the principal inscription. This consists of the two names of the men who died between the dates 1939 and 1945. All lettering is incised and painted black' (https://historicengland.org.uk/listing/the-list/list-entry/1450546; accessed 6 May 2020).				
Barn adjoining Heggatt Hall, to west, Hegggatt Street 'Barn and stables, C18, but with earlier core. Built of brick and flint with pantiled roof. 3 stead barn, extended to the north with continuous outshut to west. East elevation of flint, with inserted C19 windows and doors. Northern end built of brick. Honey comb vents in north gable wall, with platband at eaves level. Brick Lumbling in on south gable. Parapet verges. Outshut not of special interest. Barn forms boundary of courtyard. Included for group value' (https://historicengland.org.uk/listing/the-list/list-entry/1372975; accessed 6 May 2020).	II	1372975	8	c.710m
Heggatt Hall, Heggatt Street 'Former manor house, built in C17, refaced and extended in 1841. Knapped flint with brick dressings and plain tiled roofs. 'L' shaped plan, of 2 storeys and attics, with additional 2 storey lean-to pile and polygonal stair turret within the internal angle. Single storey hipped roof extension and C20 sun room to south west. Asymmetrical entrance facade to east, with gable end of south wing to left and 3 windows to right including central 2½ storey gabled porch with brick pediment over entrance doors, first floor and attic windows. Oriel window with battlemented parapet, central on ground floor gable wall, with a terra cotta panel above. Window with brick pediment in gable. Garden elevation to south possibly conceals the C17 house. 3 windows plus off centre 2½ storey gabled porch. Entrance to porch has moulded brick reveals and 4 centred gauged brick arch. Brick pediments over entrance and first floor and attic windows. 2 canted bays to right of porch with 5-light windows and battlemented parapets. Ground floor windows-on principal facades, generally with stone mullions and transoms with timber casements. First floor windows have timber mullions, with casements with glazing bars. Flint plinths, brick string courses at first floor level, stepped gables with finials on brick kneelers, and gable stacks with polygonal shafts, bases and caps on west and north gables. C20 flat roofed dormers on north and south slopes of south wing. Off centre axial stack with 4 polygonal shafts with bases and caps in south wing. "Panelled dining room with elaborate arcaded	II	1050853	8	c.730m

Description	Grade	National Heritage List reference	Reference on Fig 13-1	Distance from PEA boundary (in order of proximity)
overmantle and discreet fluted pilasters. Good staircase with 2 balusters to each tread" from Burke's and Savills Guide to Country Houses. Vol. III Michael Sayer. "Overmantle bearing the arms of George Warde of Brooke of 1663." from a History of Horstead and Stanninghall. Percy Millican' (https://historicengland.org.uk/listing/the-list/list-entry/1050853; accessed 6 May 2020).				
Outbuildings adjoining Heggatt Hall to the north, Heggatt Street Outbuildings converted to flat and offices. C17 core rebuilt in C18. Built of brick and flint with pantiled roof. 1½ storeys with single storey range to west. Inserted C19 doors and windows to south. C17 brickwork to north with 2-light ovolo moulded timber casement to left. Line of C17 verge visible in east gable. Forms north side of courtyard. Included for group value' (https://historicengland.org.uk/listing/the-list/list-entry/1050854; accessed 6 May 2020).	II	1050854	8	c.730m
Recruiting Sergeant Inn, Norwich Road, Horstead 'Public house, C18, with earlier core dating from late C16. Colourwashed brick, brick and flint with pantiled roof. 2 storeys and attics, 2 storeys with continuous rear outshut. Asymmetrical facade of 3 windows, with off centre porch. Brick plinth, platbands at first floor level and attic floor level on gable. Pilaster to right of porch. Brick dentil eaves. Inserted windows mainly C19, of 4-lights with transoms Parapet gables with central axial and gable stacks. 2 gabled dormers with 2-light casement windows. Brick porch with central door with semi-circular arch, and curved gables with brick kneelers. Eastern 2 storey section possibly earlier, with asymmetrical facade of 3 windows. The central window has segmental brick arch with key block. Brick diaper patter on flint ground forming east gable wall' (https://historicengland.org.uk/listing/the-list/list-entry/1372977; accessed 6 May 2020).	II	1372977	9	c.740m
Stanninghall Farm House 'Farm house, mid C19, built of red brick with pantiled roof. 2 storeys, with lower wing to north, forming 'L' shaped plan. Principal facade to south, 5 windows, with central timber doorcase with pilasters and entablature. Part glazed entrance door with side lights and glazing bars, with wide semi-circular fanlight with decorated radial glazing bars. Sash windows with glazing bars and segmental gauged brick arches. Wide eaves and hipped roof. 2 set back axial stacks. Lower wing to west and north not of special interest' (https://historicengland.org.uk/listing/the-list/list-entry/1372978; accessed 6 May 2020).	II	1372978	10	c.780m
Ruined church of St Peter, Stanninghall 'Ruined church tower and north nave wall. Tower obscured by vegetation. Flint with stone dressings, and C16 brick. Said to be ruined prior to 1602 and to be mainly Early English in detail' (https://historicengland.org.uk/listing/the-list/list-entry/1050858;	II	1050858	11	c.800m

Description	Grade	National Heritage List reference	Reference on Fig 13-1	Distance from PEA boundary (in order of proximity)
accessed 6 May 2020). Some vegetation removed recently; some associated consolidation work may have been undertaken.				
Church of St Swithin, Frettenham 'Parish Church. Fabric mainly of C14, with chancel rebuilt in 1869 by R.M. Phipson. Flint, partly knapped and coursed, with limestone dressings. Slate roofs; lead over aisles. West tower, nave, chancel, north and south aisles, south porch. West tower has staged buttresses with stone quoins and flushwork panels, Coped tower parapet with simple corner pinnacles and brick quoins. Western parapet dated 'T 1672 . R' in dark brick.lettering. Louvred belfry openings with C14 traceried heads, square Decorated ringing chamber opening. West window with C19 panel tracery. Small quatrefoil stair windows on south side. Quatrefoil clerestorey windows; knapped and squared flintwork to upper nave walls. Nave roof lowered : small blocked triangular headed opening above new ridge line in east tower wall. Chancel entirely C19, but with a three light Decorated window re-set in the south wall. Two light north and south windows with simple geometrical tracery. Priest's door in south wall; blocked doorway with segmental head in north wall. Aisles have angle buttresses with flushwork panels; two and three light Decorated windows. South porch has gable of knapped and squared flints with stone dressings and coping. South doorway with demi-quatrefoil piers with keeled fillets, matching arcade piers. Interior: Good three bay arcades with quatrefoil piers with keeled fillets; arches with double wave-mouldings. Poppy-head bench ends in north aisle. High level opening to rood stairs at south east corner of north aisle. Piscina with cusped arched head. Tall blank opening with semi-circular arched head on east side of north door. Octagonal font of Purbeck marble with blank arcading : base and stem renewed. Blocked mediaeval north doorway in chancel, probably re-set. Dropped-cill sedilia to south-east chancel window; fragments of-mediaeval glass in tracery heads. Piscina with cusped head. C19 roof structures : King post over nave, arch-braced collar with collar-runner and wall posts over chancel' (https://historicengland.org.uk/listing/the-list/list-entry/1443388; accessed 6 May 2020).	II*	1372955	12	c.830m
Frettenham War Memorial 'MATERIALS: Stone obelisk. DESCRIPTION: Frettenham War Memorial stands in the churchyard of the Church of St Swithin's (Grade II*-listed). It is situated at the foot of the church tower, adjacent to the south porch. The memorial comprises a slender stone obelisk, square on plan, on a tapering four-sided plinth with three-stepped base below. The south face of the plinth bears the inscriptions in incised lettering. A small metal plaque repeating the First World War names and recording Second World War names is fixed to the west face of the plinth. The principal dedicatory inscription reads IN MEMORY/ OF/ OUR BRAVE DEAD/ WHO FELL IN THE	II	1443388	12	c.860m

Description	Grade	National Heritage List reference	Reference on Fig 13-1	Distance from PEA boundary (in order of proximity)
GREAT WAR/ 1914 - 1918/ (10 NAMES). The later plaque reads 1914 – 1918/ (10 NAMES)/ 1939 – 1945/ (3 NAMES)' (https://historicengland.org.uk/listing/the-list/list-entry/1443388; accessed 6 May 2020).				
Horstead House and outbuildings 'Former manor house, dating from 1620, with early C18 and C19 alterations and additions. Of knapped flint with brick dressings and red brick, with black and red pantiled roofs. C17 and C18 phases have 'L' shaped plan, of 2 storeys and attics, with the C19 additions of cellar and 2 storeys within the eastern internal angle. North south wing probably C17, re-styled in the early C18, and then shortened by one third, c.1960. Its west elevation forms the entrance facade, with 3 bays of knapped flint, alternating with two slightly projecting bays of brickwork. Central rubbed brick doorcase, with rusticated pilasters and plain moulded entablature. Raised and fielded 6 panel door with oak frame and architrave. C19 windows within the brick bays, of stone with timber case- ments, and with transoms at ground floor level. C19 single storey canted bay to left, with plinth, moulded brick string course and battlemented parapet. High brick plinth, and rubbed brick cornice at attic floor level, C19 battlemented parapet, and curved gables with windows above the brick bays. North gable wall, 2 windows; C19 sashes, with glazing bars and flat gauged brick arches. Rubbed brick cornice at attic floor level. Blind window in gable. Rebuilt south gable contains sundial repositioned from former gable. 2 rear external chimney stacks, now contained within the C19 fabric. South east wing, extends the original wing, now of one window, and marked by its gable parapet and chimney, by 4 windows. Flint plinth, C18 cross windows with wrought iron casements, leaded lights and gauged brick arches at ground floor and brick on edge at first floor. Moulded timber eaves. East gable has window in earlier larger opening with segmental arch, platband at attic floor level and witches window below gable stack. Tie irons dated 1735. Dormers with timber pedimented gables and 2-light casements with lead glazing. Wing continues on one storey to east, and contains to south, a re-set C17 panelled and studded oak door and moulded frame. C19 wing on north east in matching style with casement windows, flat gauged arches, battlemented parapets. Attached out buildings to north east, C18, 'L' shaped plan of knapped flint with steeply pitched hipped roof. Good mid C18 marble fireplace. Sundial dated 1747. Henry Palmer, former owner married Elizabeth Langley in 1735' (https://historicengland.org.uk/listing/the-list/list-entry/1372976; accessed 6 May 2020).	II	1372976	13	c.940m
Garden wall to northeast of Horstead House 'Garden wall, C18, of red brick, extending to north and east for 18½ bays, with 2 gateways, plinth, shallow buttresses and canted brick coping. Included	II	1178182	13	c.990m

Description	Grade	National Heritage List reference	Reference on Fig 13-1	Distance from PEA boundary (in order of proximity)
for group value' (https://historicengland.org.uk/listing/the-list/list-entry/1178182; accessed 6 May 2020).				
Parish Church of All Saints, Horstead 'Parish church, early C14, restored by R.M. Phipson in 1879. Flint with stone dressings, lead and plain tile roofs. West tower, nave, south aisle, south porch, chancel and south choir chapel. West tower with base course, diagonal stepped buttresses and stair turret. West window, 1-light with transom above a cusped niche. Sound hole and 2-light belfry opening with reticulated tracery and parapet above. 3 bay nave with C19 2-light windows in north wall. 4 bay south aisle with early C14 doorway with hood mould decorated with fleurons and carved heads for label stops. 3 C19 2-light windows. Perpendicular doorway to south porch with attached shafts. 2-light windows to north and south, with rectangular heads with hood moulds. Parapet and flush work base course. 2- light C19 window in north chancel wall. 4-light C19 east window. Re-located priest's door in C19 south choir aisle wall with keel mouldings. C19 4-light east window. Parapet gables with carved stone kneelers. Interior mainly C19. South door, early C14, with intersecting tracery. Piscina to its left. C19 4 bay arcase piscina in chancel. South aisle, east window, Morris glass, designed by Burne-Jones. Monument to George Warren, died 1728 by James Barrett. Corinthian column in front of a black obelisk. Octagonal font bowl, possibly C13 on 5 columns. Some medieval bench ends with poppyheads in nave and chancel' (https://historicengland.org.uk/listing/the-list/list-entry/1178235; accessed 6 May 2020).	II*	1178235	14	c.990m
Church Cottages, Church Close, Horstead 'Former C18 Poor Houses, with rendered walls and slate roof. 2 storeys with single storey outshut extended at each end in the C20. Facade facing church of 3 windows, separated by 2 doors. Windows with 'Y' tracery, wrought iron lights and pointed arches. Doors have pointed arches and intersecting tracery. Wide eaves and gable chimney stacks' (https://historicengland.org.uk/listing/the-list/list-entry/1372974; accessed 6 May 2020).	II	1372974	14	c.990m
Cornmill, Frettenham 'Former cornmill. Mid C19, probably c1880. Tapering tarred brick tower. Circular plan. 5 storeys. Ground floor stable door to south-east has one horizontal pivot window with glazing bars; remains of double door on first floor with one horizontal pivot window with glazing bars; one gallery door opening on second- floor and one horizontal pivot window with glazing bars; remains of cast-iron gallery bearers and vertical rails; one window opening on third-floor and one horizontal pivot window on fourth floor; complete curb and cast-iron track and rack. Interior has virtually complete set of machinery: First floor has wooden clasp arm, great spur wheel with wooden teeth and cast-iron crown wheel with wooden teeth, drive shaft to auxiliary machinery formerly placed in adjoining barn	II	1372988	15	c.1040m

Description	Grade	National Heritage List reference	Reference on Fig 13-1	Distance from PEA boundary (in order of proximity)
(not included) and two underdriven stone nuts; second floor has two French burr stones and one runner stone stored on floor, and wooden chute to first - floor; wooden chamfered drive shaft on second and third floors; fourth floor section of drive shaft remains' (https://historicengland.org.uk/listing/the-list/list-entry/1372988; accessed 6 May 2020).				

13.5.2 Archaeological background

The Norfolk Historic Environment Record (NHER) was searched for archaeological sites located within 1km of the PEA. This was chosen as being an appropriate area of search in order recover information on archaeological sites and features which can place the PEA into its local context. The search and its results have generated an event number CNF48906.

Peter Watkins, Historic Environment Officer (Records), Norfolk County Council Environment Service, kindly supplied the Norfolk Historic Environment Record (NHER) data. This includes 42 records of historic environment features and discoveries **Figure 13-3** and **Figure 13-4,** a number of events (F**igure 13-5)**, five of which relate to the work in the existing quarry (NHER 95515, 95518, 122599, 143406, 145794) and one (NHER147483) that relates to the geophysical survey undertaken as part of this planning application

In addition to the crop mark of the possible Roman camp (NHER4379) 110m north of the PEA (see **Table 13-1**), almost half of the records in the study area are of crop mark features, predominantly elements of possible field systems of various dates up to and including the post-medieval period. There are also records of artefacts found during systematic fieldwalking and metal detecting by members of the public.

Within The PEA

Four entries are located within the PEA or extend into it. One covers the medieval fields and settlement enclosures (NHER39859) which were partially explored in the 2008 excavations but whose extent is visible in the broader landscape as crop mark features. An intermittent crop mark of a ditch extends into the PEA from the south (NHER50787) running from the corner of a current field and therefore may be a recent boundary line. In the northern part of the PEA a further crop mark ditch (NHER50779) appears to match a boundary shown on the parish tithe map.

In addition to the traces of former field systems, two crop marks of curvilinear form occur at the west and northern margins of the PEA (NHER 24977, 50782 respectively). Both are described as being possibly hengiform or a ring ditch and perhaps being Neolithic or Bronze Age in date. However, the nature of the geology in this area is also cited as being '*conducive to forming curvilinear marks*' and the two features may be of natural origin. This likelihood was considered more likely by S Tremlett during the Norfolk National Mapping Programme in 2008.

The Wider Study Area

Prehistoric

A Neolithic polished stone axe (NHER8060) was found in 1954 to the northeast of the PEA, close to the edge of the 1km study area, but otherwise no other surface finds of prehistoric date are recorded apart from a few flints, including cores, trimming flakes, waste flakes, scrapers and a bladelet, within a multiperiod scatter northeast of the PEA (NHER13420) that included a sherd of Roman pottery.

The remaining prehistoric presence in the study area is focussed in the crop marks near to the Scheduled Monument to the north of the PEA. The remains comprise a D-shaped enclosure, that is possibly the remains of a small farmstead, (NHER50776) and a trackways and field boundaries (NHER50778), both of which are assigned and Iron Age or Roman date, presumably partly based upon morphology and partly by association with the other monument. The only other feature assigned a prehistoric date is a probable ring ditch (NHER50775) to the northwest of the PEA. This feature had a diameter of about 12m and was sited overlooking a tributary of the River Bure a short distance away. Within it centrally, although possibly geological, there appears to be a pit that could be the grave pit.

Roman

In addition to the suggested camp, at a separate location on the southern edge of Horstead, a length of mortared flint wall was examined in 1953 that was struck by ploughing. The footing had a width of 0.45m and when excavated it was found to be associated with Roman pottery and may be the remains of a Roman building.

In addition, at three separate locations on the southern edge of Horstead Roman coins have been recorded dating from the third and fourth centuries. The coins included a silver washed issue of Postumus (257-267), a copper alloy issue of Constantine I (307-337) and a coin of Victorinus (268-70) (NHER8032, 8034 and 8038 respectively). Pottery sherds have been recovered at three locations around the village, one as part of a multiperiod scatter mentioned above (NHER13420), a single worn sherd from an allotment area (NHER28976) found in 1991 and half a dozen sherds found associated with undated ironworking waste to the northeast of the PEA. The concentration of Romano-British finds around the present settlement may be a reflection of people looking rather than indicating a focus of activity but the absence from the remainder of the study area is striking.

Medieval

The only Saxon material within the study area comprised some late Saxon pottery sherds recovered in 1950 from the southwest of Horstead House (NHER8035). Similarly the later medieval period is only sparsely represented by a medieval coin (NHER58438), the site of Stanninghall village (NHER8-59) of which no trace survives apart from the church tower (NHER44213), and the extensive fields and settlement enclosures across the Trafford Estate land (NHER39859) that are presumed to have continued in use until the fourteenth century.

Post-medieval

Almost half of the entries in the HER relate to post-medieval or recent records. Several are of buildings including Horstead Lodge (NHER43095), Mill House and barn (NHER43096) and Stanninghall Farm Barn (NHER44214), all of which date from the eighteenth or nineteenth century. The Old Forge (NHER20137) is a house that originates from 1581 but was extended and re-roofed in 1732. There was also a water mill of eighteenth century date (NHER8067) that was possibly built on the site of a sixteenth century mill but burnt down in 1963.

The majority of the post-medieval features are elements of previous field systems that occupied the area, many, but not all of which, appear on early Ordnance Survey maps (NHER50779, 50780, 50783- 50789) and most of which have been observed as crop marks. It is possible some of the crop mark features might relate to specific agricultural practices rather than boundaries but they are all felt to be of post medieval date.

The remaining entries in the NHER cover a length of canal built to avoid Horstead Mill (NHER28753), a school erected in 1875 that has been a private home since 1960 (NHER57205) and the unusual Stanninghall water tower (NHER40219) whose design may have been inspired by a snowflake. Near to the water tower there is also an area of disturbance and structures visible on 1946 aerial photographs that might reflect a WWII military presence (NHER50773) In the same area in 1957 a Royal Observer Corp post was opened to measure fall out in the event of a nuclear attack (NHER35402)

In addition to the above records there were three undated crop mark sites (NHER50790) which might be the result of agricultural process, another of linear marks (NHER18240) and a sinuous trackway that overlies the line of the western side of the possible Roman camp (NHER50777). An additional record was of the recovery of part of a human skull found while fishing near to the mill in 1998 (NHER34867).

Recent archaeological work in the vicinity of the PEA

The most recent observations during quarrying to the south of the PEA have been carried out over a number of seasons (2008, 2015 and 2017). The results include the recording of a number of ditches and pits. In the 2015 season there were four ditches of post medieval date and eight undated pits.

In 2017, in the western part of the quarry, nineteen small pits and elements of an undated ditch system were excavated. The most significant discoveries were eight large steep-sided and flat-based pits identified as relating to probable clamps for the production of charcoal. The clamp pits yielded little dating evidence apart from a single worked flint flake that was recovered showing generally Neolithic to early Bronze Age characteristics with thermal fracturing likely from incorporation into the firing of clamp [223]. Based on the radiocarbon results on the charcoal remains from two of the clamp pits, it showed a sporadic continuance of the activity from the late 7th to at least late 10th centuries AD (mid to late Saxon).

The charcoal clamps had diameters of *c*2-3m and depths *c*0.4-0.7m and were cut into the natural yellow-orange brown sand. They showed similarities in construction with steep sides and generally flat/level bases and displayed scorched red interfaces as a result of a heat source. There were no remains of the superstructure or the turf clamp that would have covered the stack, although any surface remains are likely to have been removed by later plough activity, leaving only the pits.

Examples of such clamps represented at Horstead have been identified on other sites, with a trend to occur in similarly dated groups. Like the Horstead site they also yielded little datable artefacts and invariably dating relied on radiocarbon evidence. Examples can be found across the UK and Europe, with prominent local examples such as Rockingham Forest (Northants) and Mousehold Heath near Norwich. A group of charcoal kilns identified in the Veluwe area in the Netherlands in 2016 also exhibited similarities to the Horstead site.

The results have been reported and are included in the NHER[36].

13.5.3 Historical background

The Norfolk Record Office and Local Studies Library were closed due to COVID-19 restrictions. Documentary research carried out in 2001, and that included the current PEA, is however of relevance and this is included at **Appendix 13-1**.

The Ordnance Survey consistently shows that (**Figure 13-6)** the PEA was under agricultural use. Clamp Wood to the west of the PEA is an interesting place name, given the discovery of Saxon charcoal clamps within the current quarry, although the placename more probably relates to brick making given the prevalence of marl pits in the area.

[36] Archaeological observation and excavation of land on the Trafford Estate, Horstead, Norfolk. November 2017. MOLA Report No 18/45

13.5.4 Geophysical survey

As required by the scoping opinion, a geophysical survey was carried out by Tigergeo. The report[37] is appended (**Appendix 13-2).**

Survey was undertaken using an array of caesium vapour magnetometers to prospect for buried features possibly of archaeological interest across the vast majority of the PEA.

The results of the survey included a series of linear features, ditches and drains, many of which were identified also on aerial photographs. Some known crop marks did not translate into magnetically visible features. A series of five anomalies, presumed to be the indication of the former location of telegraph poles or similar, were also identified.

Of greatest interest was survey over the two curvilinear crop marks (NHER 24977, 50782) of which only the one on the western margin (NHER24977) produced a magnetic response. It appeared as an open-ended oval and was felt to be of anthropogenic origin as the readings across ditch infills were distinct from the background. The second curvilinear feature (NHER50782) close to the northern margin had no magnetic trace perhaps reflecting a non-anthropogenic origin.

However, overall Tigergeo concluded "*that few potential features of likely archaeological interest [were] identified*".

13.6 Visit to Designated Assets

Mineral extraction can indirectly affect the significance of heritage assets and their settings in a broad range of ways. These can include altering views (including principal or key views) from and to heritage assets, and disturbance to the asset's environment including from increased plant movement, noise, vibration, dust and light.

A site walkover and visits to the majority of designated assets within 1km of the PEA was undertaken by David Robertson in March 2020. Due to Covid-19 restrictions all assessments were made from publicly accessible places or from the PEA. No private land was entered. One designated asset just over 1km away was also assessed (Frettenham Cornmill), on the basis it may have views of the PEA.

The conclusions are set out in **Table 13-3.**

[37] Roseveare, A, 2020. *Stanninghall Quarry Horstead. Geophysical Survey Report (Caesium Vapour Magnetic – Archaeology)* Project code: SQH201

Table 13-3 Baseline Assessment of Designated Heritage Assets

Name (listed in order of proximity)	Grade - sensitivity	National Heritage List reference	Distance from PEA boundary	Existing impacts on setting
Roman camp and settlement site west of Horstead Figures 13-7 – 13-10	Scheduled Monument -high	1003928	C110m	Houses towards the centre of site (some dated 1931). Minor road through site. Noise from existing quarry and B1150. South of road: stables, horse jumps, overhead cables, mound of soil, historic quarry (which is shown on Ordnance Survey 1st edition 6 inch map; Norfolk County Council 2012), water tower on skyline. North of road: stables, numerous fencing lines (of varying types), section in arable cultivation, section of ungrazed long grass, section of hard-standing.
Horstead Lodge Figures 13-11 and 13-12	II - medium	1050857	c.300m	Noise from the existing quarry. Noise (and possibly fumes) from the B1150. The road is immediately to the west; noise from this can mask the noise from the existing quarry. Modern farm buildings to the north, including noise and smell.
The Old Forge, Norwich Road, Horstead	II - medium	1178221	c.560m	Noise from B1150. Modern houses adjacent.
Mill House, Mill Road, Horstead	II – medium	1295186	c.630m	Noise from B1150. Modern buildings associated with listed building's current use as a care home. Modern houses to northwest, west and southwest.
Barn approximately 30m to southeast of	II – medium	1050856	c.660m	Noise from B1150.

Name (listed in order of proximity)	Grade - sensitivity	National Heritage List reference	Distance from PEA boundary	Existing impacts on setting
Mill House, Mill Road, Horstead				
Stanninghall Farm Barn Figure 13-13 and 13-14	II – medium	1178260	c.670m	Noise from existing quarry to the north. Direct and un-obstructed view from listed building of screening bund on the southwest of the existing quarry.
Horstead War Memorial	II – medium	1450546	c.690m	Noise from B1150.
Barn adjoining Heggatt Hall, to west, Hegggatt Street	II – medium	1372975	c.710m	Not possible to see from public rights of way. During visit to adjacent areas parkland woods, hedges and tree belt to east of B1150 appeared to block noise from B1150 and existing quarry.
Heggatt Hall, Heggatt Street Figure 13-15	II – medium	1050853	c.730m	During visit to adjacent areas parkland woods, hedges and tree belt to east of B1150 appeared to block noise from B1150 and existing quarry.
Outbuildings adjoining Heggatt Hall to the north, Heggatt Street	II – medium	1050854	c.730m	Not possible to see from public rights of way. During visit to adjacent areas parkland woods, hedges and tree belt to east of B1150 appeared to block noise from B1150 and existing quarry.
Recruiting Sergeant Inn, Norwich Road, Horstead	II – medium	1372977	c.740m	Noise from B1150 and B1354.
Stanninghall Farm House	II – medium	1372978	c.780m	Not possible to see from public rights of way. Noise from existing quarry to the north.

Name (listed in order of proximity)	Grade - sensitivity	National Heritage List reference	Distance from PEA boundary	Existing impacts on setting
				Possible view from listed building of screening bund on the southwest of the existing quarry (this view might be blocked by other buildings, including Stanninghall Farm Barn).
Ruined church of St Peter, Stanninghall	II – medium	1050858	c.800m	Noise from existing quarry to the north. View from listed building of screening bund on the southwest of the existing quarry.
Church of St Swithin, Frettenham Figures 13-16 13-18	II* - high	1372955	c.830m	View from the top of church tower to the western part of the existing quarry (but not from the belfry or ground level). The top of the church tower is not visible from the western edge of the existing quarry; this view is blocked by tall hedges. Large modern extension to the rear of Glebe Farm House. No noise from the existing quarry was heard during the site visit.
Frettenham War Memorial	II – medium	1443388	c.860m	None observed.
Horstead House and outbuildings	II – medium	1372976	c.940m	None observed.
Garden wall to northeast of Horstead House	II – medium	1178182	c.990m	Not possible to see from public rights of way.
Parish Church of All Saints, Horstead	II* - high	1178235	c.990m	Noise from B1354 and B1150.

Name (listed in order of proximity)	Grade - sensitivity	National Heritage List reference	Distance from PEA boundary	Existing impacts on setting
Church Cottages, Church Close, Horstead	II – medium	1372974	c.990m	Noise from B1354 and B1150.
Cornmill, Frettenham Figures 13-19 and 13-20	II – medium	1372988	c.1040m	Noise from traffic on adjacent road. Modern housing to the east. View from the fourth- floor window to the western part of the existing quarry. The mill tower is not visible from the western edge of the existing quarry; this view is blocked by tall hedges.

13.7 Direct impacts upon archaeology

Based upon our knowledge of archaeology within the current extraction area to the south of the PEA and the general vicinity, it is likely that archaeological sites will be located within the PEA. The geophysical survey however located only a handful of archaeological anomalies, one of which coincided with a recorded cropmark, confirming that the geophysical was successful.

It is also clear that historically the PEA has been subjected to ploughing and that any archaeology will have been truncated to some extent.

There is no evidence of any archaeology of national significance that requires preservation *in situ*.

13.8 Indirect Impacts

Indirect impacts are those that do not physically affect a cultural heritage asset or landscape, but that alter the context or setting. They may be beneficial or adverse. Such impacts can be difficult to define and should draw on guidance, in particular that published by Historic England in GPA 3 (2017). GPA 3 recommends a broad approach to assessment of setting, undertaken as a series of steps that apply proportionately to complex or more straightforward cases.

Setting is defined in the National Planning Policy Framework (NPPF) as:

"The surroundings in which a heritage asset is experienced. Its extent is not fixed and may change as the asset and its surroundings evolve. Elements of a setting may make a positive or negative contribution to the significance of the asset, may affect the ability to appreciate that significance or may be neutral."

GPA3 states that:

"The setting itself is not designated. Every heritage asset, whether designated or not has a setting. Its importance, and therefore the degree of protection it is offered in planning decisions, depends entirely on the contribution it makes to the significance of the heritage asset or its appreciation."

These comments are all relevant to the current proposals.

13.8.1 Assessed Designated Assets

A field-based assessment of designated assets that could be affected by the proposed development was undertaken in March 2020 by David Robertson.

Consideration was given to the current situation including existing impacts upon setting (the baseline), the proposed development and working methodology, mitigation measures embedded into the scheme and the proposed restoration.

Key to the field-based assessment was understanding topographical position and visibility in the landscape during both the operational phase and after restoration. Effects were considered under a range of factors as set out in **Table 13-4**.

Table 13-4 Factors considered in the assessment of designated heritage assets

Location and siting of the development
• Proximity
• Extent
• Position in relation to landscape
• Physical or visual isolation of asset or group of assets
• Position in relation to key view
Form and appearance of the development
• Prominence, dominance or conspicuousness
• Competition with or distraction from the asset
• Dimensions, scale, massing and proportions
Other effects of the development
• Introduction of movement or activity
• Change to skyline
• Noise, odour, vibration, dust, lighting
• Changes to land use
• Change to communications and accessibility
Permanence of the development
• Restoration design
• Reversibility

The results of the field-based assessment are set out in **Table 13-5.** Only the scheduled monument to the north of the PEA is considered to experience any adverse effects and this is discussed in more detail in **Section 13.8.2.**

Table 13-5 Assessment of potential impacts upon listed buildings

Name (listed in order of proximity	Grade - sensitivity	National Heritage List reference	Potential indirect impacts and existing mitigating factors	Mitigation measures relevant to the proposed development
Horstead Lodge	II - medium	1050857	Well-established tall trees on the western boundary of the listed building's curtilage mean there is unlikely to be any inter-visibility between it and the PEA.	Extraction will take place on the western side of hill, with the listed building downslope to the east. The hill is expected to help dampen noise from the quarry.
The Old Forge, Norwich Road, Horstead	II - medium	1178221	None Trees, tall hedge, houses and land slopes up to the south and southwest of the listed building – no inter-visibility with the PEA.	
Mill House, Mill Road, Horstead	II – medium	1295186	None Located within or on edge of historic quarry (shown on Ordnance Survey 1st edition 6 inch map. Land slopes up to the southwest of the listed building – no inter-visibility with the PEA.	
Barn approximately 30m to southeast of Mill House, Mill Road, Horstead	II – medium	1050856	None Located within or on edge of historic quarry (shown on Ordnance Survey 1st edition 6 inch map. Land slopes up to the southwest of the listed building – no inter-visibility with the PEA.	
Stanninghall Farm Barn	II – medium	1178260	Noise from the existing quarry will be reduced as extraction moves further away to the north and northeast.	Existing screening bund to remain during extraction. Restoration of existing extraction areas and plant site to woodland and arable.

Horstead War Memorial	II – medium	1450546	None Land slopes up to the southwest of the listed building – no inter-visibility with the PEA	.
Barn adjoining Heggatt Hall, to west, Hegggatt Street	II – medium	1372975	No inter-visibility with or noise disturbance from the PEA due to tree belt and parkland woods	
Heggatt Hall, Heggatt Street	II – medium	1050853	Noise from excavators, vehicles and plant within the PEA should be blocked by existing landscape features. Tree belt and parkland woods - no inter-visibility with the PEA.	
Outbuildings adjoining Heggatt Hall to the north, Heggatt Street	II – medium	1050854	Noise from excavators, vehicles and plant within the PEA should be blocked by existing landscape features. Tree belt and parkland woods - no inter-visibility with the PEA.	
Recruiting Sergeant Inn, Norwich Road, Horstead	II – medium	1372977	None Land slopes up to the southwest of the listed building – no inter-visibility with the PEA.	
Stanninghall Farm House	II – medium	1372978	Noise from the existing quarry will be reduced as extraction moves further away to the north and northeast.	Existing screening bund to remain during extraction. Restoration of existing extraction areas and plant site to woodland and arable.
Ruined church of St Peter, Stanninghall	II – medium	1050858	Noise from the existing quarry will be reduced as extraction moves further away to the north and northeast.	Existing screening bund to remain during extraction. Restoration of existing extraction areas and plant site to woodland and arable.

Church of St Swithin, Frettenham	II* - high	1372955	Some extraction areas within PEA visible from top of the church tower. Existing tall hedge on western edge of PEA and tall well-established trees to the east of the church and Glebe Farm House will prevent views at ground level	.
Frettenham War Memorial	II – medium	1443388	None The porch at the Church of St Swithin blocks views to/from the east – no inter-visibility with the PEA.	
Horstead House and outbuildings	II – medium	1372976	None Land rises up steeply to the south of the listed building – no inter-visibility with the PEA.	
Garden wall to northeast of Horstead House	II – medium	1178182	None Land rises up steeply to the south of the listed building – no inter-visibility with the PEA.	
Parish Church of All Saints, Horstead	II* - high	1178235	None Tall trees and land slopes up to the south of the listed building – no inter-visibility with the PEA.	
Church Cottages, Church Close, Horstead	II – medium	1372974	None Buildings, tall trees and land slopes up to the south of the listed building – no inter-visibility with the PEA.	
Cornmill, Frettenham	II – medium	1372988	It may be possible to see some extraction areas within the PEA from the fourth-floor window. If this is the case, the views will be across the existing quarry with Clamp Wood blocking some views to the PEA	Woodland planting when southwest of the existing quarry is restored.

13.8.2 Assessment of the impacts on the setting of Roman camp and settlement Scheduled Monument

Table 13-6 summarises the existing impacts upon the setting of the monument, mitigation measures incorporated into the proposed development and potential residual effects.

During operational phase

Existing hedgerows on the southern boundary of the scheduled monument and on the northern boundary of the PEA provide a visual barrier that would prevent views of mineral extraction. Views are likely during creation of the temporary screening bund (3m above current ground level). The duration of this is estimated at one week. Once in place there would be no views of soil stripping associated with mineral extraction or of the extraction itself.

The existing hedgerow on the northern edge of the PEA will be supplemented by a native woodland block that will be planted well in advance of works reaching the northern phases. Woodland is in keeping with the historic landscape. Excavations in the current quarry have shown that the area was covered in trees in the Saxon period and sustained a charcoal industry. This suggests that it was highly likely that during the period of occupation of the Roman camp, the land and views southwards (towards the PEA) were wooded and that the key views were northwards over the River Bure valley which it overlooks from higher ground.

The woodland will further reduce the visual and noise related impacts on the scheduled monument from mineral related activities.

This is illustrated on **Figure 13-21** (plan ref KD.SH.D.026).

After restoration

Ground levels in the restored quarry will be lower than currently by 6m on the northern boundary. This would be 150m south of the scheduled monument. Between the lowered ground and the scheduled monument the maturing native woodland will prevent any views once the temporary bund is removed.

Table 13-6 Potential impacts upon Horstead Roman camp scheduled monument

Name (listed in order of proximity)	Grade - sensitivity	Existing indirect impacts and mitigating factors	Mitigation: operational phase	Potential impacts: operational phase
Roman camp and settlement site west of Horstead	Scheduled Monument - high	Figures 13-7 to 13-10 Houses within the centre of monument Minor road through site. Noise from B1150. South of road: stables, horse jumps, overhead cables, mound of soil, historic quarry (which is shown on Ordnance Survey 1st edition 6 inch map), water tower on skyline. North of road: stables, numerous fencing lines (of varying types), section in arable cultivation, section of ungrazed long grass, section of hard-standing. Field separates the scheduled monument from the PEA. Existing hedgerow and trees on northern edge of PEA. Existing hedge of southern edge of scheduled monument. Existing tall hedges along the minor road that passes through the scheduled monument. Tall existing hedges along the minor road that passes through the scheduled monument mean there is no inter-visibility between the northern part of the scheduled monument and the PEA.	Gaps in the hedge on the northern boundary of the PEA to be planted at outset of project Temporary bund to east and south of Hill Farm orientated 'end-on' to the monument to minimise visual intrusion and will be seeded/planted and maintained	• Visual effects of moving machinery during initial construction • Noise • Dust
			Mitigation: operational phase	**Potential impacts: After restoration**
			Native woodland planting along northern boundary of PEA	Changes in topography circa 150m south of monument boundary

13.9 Mitigation Measures

13.9.1 Archaeology

In accordance with planning policy, loss of archaeology needs to be offset by a programme of mitigation. There is no evidence of archaeology of such importance as to require preservation in situ. Consultations should be held with NCC Historic Environment Service to agree the scope of mitigation that would be required post-consent. Given the success of the current strategy within the permitted quarry, a Strip Map and Sample approach during soil-stripping would appear appropriate and this would ensure that all archaeology within the PEA is recorded in advance of quarrying.

An archaeological contractor would be appointed to carry out the fieldwork with an experienced and appropriately qualified supervisor in charge of day-to-day site-based work.

Soils would be stripped using a backacting 360° machine equipped with a toothless bucket to a level agreed with the monitoring archaeologist. No tracking or movement of plant may take place on the exposed surface until it has been signed-off by the archaeologist. Machinery may need to be halted or diverted to allow archaeologists safe access to examine the stripped surface.

Details of methodologies will be formalised in a Written Scheme of Investigation, agreed with Norfolk County Council, prior to development commencing.

13.9.2 Designated Assets

No additional mitigation measures are considered necessary and the assessment of predicted residual effects is based upon the embedded mitigation

13.10 Assessment of Residual Effects

13.10.1 Criteria used in Assessment

In accordance with the EIA Regulations the significance of an effect should be identified. This is achieved using a combination of published guidance and professional judgement, as set out in Section 13-4 above.

Four criteria have been considered in evaluating the significance of the predicted residual effects of the proposed development, based upon the impacts and mitigation measures identified in Sections 13.8 and 13-9.

Type of effect

Effects may be positive, negative, neutral (i.e. no discernible effect) or none. They may be permanent or temporary, direct or indirect. They may also be cumulative with other effects occurring in the vicinity.

Probability of the effect occurring

An assessment is made as to the probability of the identified effect occurring. Probability is considered as certain (to happen), likely or unlikely.

Sensitivity

Three categories of sensitivity are identified: high, medium and low. These are expanded upon in **Table 13-7.**

Table 13-7 Sensitivity Categories

Sensitivity	Definition
High	Sites and settings of *national importance*. Scheduled Monuments. Registered Battlefields. Grade I and Grade II* Listed Buildings and Registered Historic Parks and Gardens. Registered Historic Landscapes. Sites may also be discovered as a result of new research that are also of national importance and are candidates for scheduling.
Medium	Sites and settings of *regional importance*. Archaeological sites and features that are not considered sufficiently important or well-preserved to be protected as Scheduled Monuments. Grade II Listed Buildings and Grade II Registered Historic Parks and Gardens. Conservation Areas.
Low	Archaeological sites and structures, and other components of the historic environment that contribute to the local landscape. Locally designated assets.

Magnitude

The magnitude of change to a cultural heritage asset or landscape is considered in terms of its vulnerability, its current condition and the nature of the impact upon it.

With respect to sub-surface archaeology, there may be a degree of uncertainty of the magnitude of change, and where this is the case it is noted.

Magnitude is assessed as considerable, medium, small or none and the criteria used in this report are set out in **Table 13-8**.

Table 13-8 Magnitude Categories

Magnitude of Change	Description of Change
High	Complete destruction of a well-preserved archaeological site, historic structure or element of the cultural heritage landscape Change to the setting of a cultural heritage asset such that our ability to understand the resource and its historical context is permanently changed
Medium	Destruction of an archaeological site or other cultural heritage asset already in degraded condition Change to the setting of a cultural heritage asset such that our ability to understand the resource and its historical context is partly or temporarily changed
Small	Destruction of an archaeological site or other cultural heritage asset already in highly degraded condition Change to the setting of a cultural heritage asset such that our ability to understand the resource and its historical context is slightly or temporarily changed
None	No physical effect upon an archaeological site or other asset of the cultural heritage landscape No discernible effect upon the setting of a cultural heritage asset, or our ability to understand the resource and its historical context

Table 13-9 presents a matrix of the inter-relationship of sensitivity with magnitude.

Table 13-9 Inter-relationship of sensitivity with magnitude

Magnitude → / Sensitivity ↓	High	Medium	Small	None
High	**Significant**	**Moderately Significant**	Not significant	Neutral
Medium	**Moderately Significant**	Not significant	Not significant	Neutral
Low	Not significant	Not significant	Not significant	Neutral

13.10.2 Assessing Significance

The four criteria are considered together to reach a conclusion upon the significance of an effect taking into account any measures that are proposed to mitigate the effect.

In accordance with the EIA Regulations these are quantified as significant, moderately significant, not significant or neutral (i.e. no change to the existing situation).

In some cases it may not be possible to quantify the significance of an effect, for example due to a gap in information, and this is noted.

The results of the assessment are presented in **Table 13-10.**

Table 13-10 Assessment of Significance

	Type of Effect	Probability of Effect Occurring	Sensitivity	Magnitude of Effect	Significance	Rationale
Direct effects upon statutorily designated assets of the historic environment	None	Certain	High/Medium	None	Neutral	There will be no adverse direct effects upon statutorily designated heritage assets.
Effects upon buried archaeology within PEA	Negative Permanent	Certain	Low	Medium	Not significant	Although the PEA lies within an area of high archaeological potential, notably from the presence of Roman camp and settlement to the north, based upon the results of the archaeological evaluation the potential of the PEA is similar to that which exists in the existing quarry, which, aside from regionally important Saxon charcoal clamps, has been sparse. There is also clear evidence that the PEA has been ploughed for many years and that any archaeological remains will have been truncated. In accordance with planning policy, loss of archaeology needs to be offset by a programme of mitigation. Should planning consent be forthcoming, an archaeological project compromising archaeological excavation and recording would take place. The resultant analysis and publication would contribute to the knowledge of archaeology in Norfolk.
Indirect effects upon setting of Horstead scheduled Roman camp and settlement • During site establishment and at the commencement of Phase 6 and 7	Negative Short-term Temporary	Certain	High	Medium	Moderately significant	Movement of plant would be discernible during the construction of the Hill Farm bund and during soil stripping for Phase 6 and 7, although this would be filtered by existing and enhanced hedgerows bounding both the PEA and the southern boundary of the scheduled

• During extraction • After restoration	Negative Medium-term Neutral Permanent	Certain Likely	High High	Slight None	Not significant Neutral	monument. This would cause only a temporary change to setting. Visibility of movement would decrease as the quarry workings descend. Although the ground within the restored application site will be about 6m lower this will not be perceptible from the scheduled monument (the n=boundary being about 150m north) even in the absence of the intermediate vegetation that currently exists. The restoration proposals include the planting of native woodland along the northern boundary of the PEA and this would be in keeping with the landscape of the Roman period based upon evidence from excavations in the current quarry.
Indirect effects upon setting of other designated heritage assets (listed buildings)	None	Certain	High/Medium	None	Neutral	There are no effects upon the visual or contextual setting due to distance, topography, and intervening development and vegetation.

13.11 Recommendations

No recommendations, further to the mitigation measures set out in section 13.9, are considered necessary.

13.12 Summary

13.12.1 Scope of Work

This Chapter has been written by Andrew Josephs Associates. It presents the findings of a cultural heritage assessment that considers both direct and indirect effects upon cultural heritage. Direct effects are those that physically affect a cultural heritage asset. Indirect effects can occur as a result of significant changes to the setting of a cultural heritage landscape or asset, whether permanent or temporary. This is particularly relevant to designated features of national importance, such as Scheduled Monuments, Listed Buildings, Conservation Areas and Registered Parks and Gardens.

A geophysical survey was requested by Norfolk County Council at the scoping stage to inform the EIA and accompany a desk-based assessment that included, in particular, assessment of potential impacts upon designated heritage assets.

13.12.2 Direct Effects upon Archaeology and Mitigation

Based upon our knowledge of archaeology within the current extraction area to the south of the PEA and the general vicinity, it is likely that archaeological sites will be located within the PEA. The geophysical survey located only a handful of archaeological anomalies, one of which coincided with a recorded cropmark, confirming that the geophysical was successful.

It is also clear that historically the PEA has been subjected to ploughing and that any archaeology will have been truncated to some extent.

In accordance with planning policy, loss of archaeology needs to be offset by a programme of mitigation. There is no evidence of archaeology of such importance as to require preservation *in situ*. Consultations should be held with NCC Historic Environment Service to agree the scope of mitigation that would be required post-consent. Given the success of the current strategy within the permitted quarry, a Strip Map and Sample approach during soil-stripping would appear appropriate and this would ensure that all archaeology within the PEA is recorded in advance of quarrying.

An archaeological contractor would be appointed to carry out the fieldwork with an experienced and appropriately qualified supervisor in charge of day-to-day site-based work.

Soils would be stripped using a backacting 360° machine equipped with a toothless bucket to a level agreed with the monitoring archaeologist. No tracking or movement of plant may take place on the exposed surface until it has been signed-off by the archaeologist. Machinery may need to be halted or diverted to allow archaeologists safe access to examine the stripped surface.

Details of methodologies will be formalised in a Written Scheme of Investigation, agreed with Norfolk County Council, prior to development commencing.

13.12.3 Indirect Effects

An assessment of the effects of the proposed development was carried out based upon criteria published by Historic England.

One scheduled monument is situated within 1km of the PEA: Horstead Roman camp and settlement that covers an area of 11.7ha and straddles the Frettenham Road. The boundary of the southern part is approximately 110m north of the Application Site and 150m from the proposed extraction area.

Within approximately 1km of the Application Site sit nineteen listed structures all Grade II except two Grade II* churches. Based upon field survey, no adverse effects upon visual or contextual setting are predicted from the proposed development due to distance, topography, and intervening development and vegetation.

It was concluded that only the scheduled Roman camp could potentially experience adverse effects from the proposed development.

The assessment concluded the following:

- Movement of plant would be discernible during the construction of the Hill Farm bund and during soil stripping for Phase 6 and 7, although this would be filtered by existing and enhanced hedgerows bounding both the PEA and the southern boundary of the scheduled monument. This would cause only a temporary change to setting of moderate significance. Visibility of movement would decrease as the quarry workings descend.

- Although the ground within the restored application site will be about 6m lower this will not be perceptible from the scheduled monument (the boundary being about 150m north) even in the absence of the intermediate vegetation that currently exists. The restoration proposals include the planting of native woodland along the northern boundary of the PEA and this would be in keeping with the landscape of the Roman period based upon evidence from excavations in the current quarry. There would be no residual effect upon the setting of the monument.

13.12.4 Conclusions

The proposed development would have no significant adverse effects upon known assets of cultural heritage, and those adverse effects that would occur would be offset by the opportunity, funded by Tarmac Ltd, to add to our knowledge of the archaeology of the Application Site and its landscape, that is currently being truncated by ploughing.

Restoration of the Application Site would include planting of native woodland that would be in keeping with the landscape of the Roman period, in particular in views southwards from the scheduled Roman camp.

Having regard to the baseline conditions and the assessment carried out against professional guidance, the proposed development therefore accords with both local and national cultural heritage policy.

CULTURAL HERITAGE 13

14.0 SUMMARY OF ENVIRONMENTAL EFFECTS

14.1 Introduction

The preceding chapters 6.0 to 13.0 have considered the potential environmental effects of the proposed extension and consolidation scheme at Stanninghall Quarry and related elements of the overall development scheme, including the restoration of the overall application site. Based upon the studies and content of the individual chapters, the underlying conclusion of the EIA is that there is no single topic, or combination of issues which should objectively prevent the development from proceeding.

The respective environmental studies have paid due regard to the environmental issues identified in the scoping exercise undertaken with Norfolk County Council relating to environmental effects. Where relevant, the studies have made a series of recommendations for measures which could minimise effects.

These issues are summarised below as a brief resumé of the preceding chapters and the conclusions which are drawn. For each topic, the summary describes the key elements of the study which has been undertaken, the mitigation measures which have been incorporated into the development scheme or which will be implemented as part of the ongoing development, and conclusions on the assessed residual effects taking into account the mitigation measures.

14.2 Landscape and Visual Effects

14.2.1 LVIA Study

The Landscape and Visual Impact Assessment (LVIA) has been carried out in accordance with guidance produced by the Landscape Institute and the Institute of Environmental Management; Assessment Guidelines for Landscape and Visual Impact Assessment (GLVA 3); and Photography Technical Guidance Note TGN 06/19-Visual Representation of Development Proposals, published 17th September 2019.

LVIA is a tool used to identify and assess the significance of and the effects of change resulting from development on both the landscape as an environmental resource and on people's views and visual amenity" (ref GLVA3).

Data, collation and assessment has been carried out utilising both desktop and site survey works to identify the baseline landscape character and visual nature and condition of the site and its local area. Utilising site and site context topographical 3D data, the 'Zone of Theoretical Visibility' (ZTVI) has been prepared based upon:

(iv) the existing permitted development as part extracted;

(v) the operations within Phase 7 illustrating the in-place plant site and progressive mineral extraction at its northern limit with subsequent progressive restoration; and

(vi) at Post Restoration when all land has been fully restored and all plant and machinery has been removed.

These were then used to inform and help define a study area within which the proposed development could influence / change both Landscape Character and Visual Amenity. It is emphasised that the ZTVI are a worst-case scenario in assessing the geographical land area from where the existing / proposed site development could be observed / influence Landscape Character as this method of analysis does not account for existing built form or vegetation structure which would affect / could screen views towards the site from landscape and visual receptors.

The Guidelines explain that both landscape and visual effects are dependent upon the sensitivity of the landscape resource or visual receptors and the magnitude of impact, from which an overall level of significance is then assessed.

14.2.2 Landscape Impact

In respect of Landscape Character, the existing and proposed application development is wholly located within the Norfolk County defined Marsham and Hainsford Wooded Estate Character Area E2. It is assessed that the sensitivity of this area to a quarry type development is Medium as the landscape elements and features which comprise it are generally plentiful and robust. It is assessed that the magnitude of effect resulting from both the permitted plant site and the northern extension as Low. When combining the character area sensitivity to change from the proposed development during the operational period the Assessed level of significance is Slight Adverse which in terms of the LVIA methodology is not Significant.

The progressive restoration proposals have taken on board the opportunities for National Level -NCA – The Broads Character area SE03: "to maintain a sustainable and productive agricultural landscape while expanding and connecting semi-natural habitats to benefit biodiversity". This would be achieved through the concentration of higher quality soils in areas for agricultural productivity whilst developing approximately one third of the restored site for both landscape character enhancement and new wildlife habitat creation. The habitat would principally be associated with native woodland with a diverse range of shrub and tree species of ~24.6 Ha, along with species rich grassland and meadow of ~12.3Ha. Landscape structure will also be reinstated along with new habitats via the establishment of ~1,462 linear m's of hedgerows and hedgerow trees.

The restoration proposals also address Landscape Guidance specifically to Landscape Character Area E2 including the conservation and strengthening of landscape structure around the promotion of significant site internal woodland structure and the creation of woodland and hedgerow corridors. The development has also considered and is assessed to maintain the setting of both historic assets and the landscape setting of local villages. This would be achieved through both re-establishing original landscape structure planting and the use of temporary screen bunding at appropriate and integrating levels which will be seeded, planted and maintained to mitigate potential adverse changes in setting.

At post restoration the original landform will be changed (lower) compared to the existing situation. The scheme has been designed to reflect locally observed landscape morphology and provides land gradient suitable for a mix of agricultural uses and wildlife/ landscape structure. The site comprising ~106.8 Ha is large enough to allow for general topographical and gradient changes allowing assimilation into the wider landscape setting. The restored principal agricultural land uses combined with strengthened native species hedgerow, woodland planting and meadow/species rich grassland, provides a balanced suitable after use with increased potential for long term landscape and biodiversity enhancement. Post restoration a Slight Beneficial level of significance is assessed which in terms of the LVIA methodology is not Significant.

14.2.3 Visual Impact

In respect of visual matters, the site survey of individual visual receptors has found that due to a combination of topography, surrounding landform, existing and proposed tree planting and screening landform, views of both the existing and the proposed development are relatively limited in respect of both the number of actual visual receptors with views of the existing quarry/ proposed development and the magnitude of effects if receptors do have views.

Of the 23 representative receptors assessed, no visual receptor is currently experiencing or predicted to receive a Significant Adverse Visual Effect. Five representative visual receptors are assessed as currently receiving a Moderate Adverse effect from the existing development. These are all residential receptors (residents of Stanninghall Cottages, residents of Stanninghall Road, Barn conversions in Stanninghall, residents of The Hollies and residents of Beverley). Three of the receptors have a High sensitivity to change but a Low magnitude of effect from the existing development. It is assessed that these levels of magnitude will remain during the proposed extension application as they generally emanate from the mineral processing plant and screen mitigation bunding.

It is predicted that only one additional receptor (Hill Farm) will receive a Moderate Adverse Significance Effect from the extension proposals which in terms of the LVIA methodology is not Significant. From Hill Farm receptors

will have the opportunity to view soil stripping and mineral extraction during Phase 6 and 7, mainly screened behind an existing and strengthened tree lined hedgerow and temporary screening bund.

In respect of all representative visual receptors it is assessed that at post restoration with the establishment and management of the wildlife habitat and landscape structure enhanced agricultural landscape, the levels of visual significance will vary from Slight Adverse to Neutral to Slight Beneficial, none of which in terms of the LVIA methodology are significant. The slight adverse effects may result from the visual change in levels and landform morphology. These will only affect receptors at The Hollies and Hill Farm.

14.2.4 Landscape Mitigation measures

The main mitigation measures incorporated within the application design are:

- The retention of existing soil storage/ screening bunds during the operational period which are positioned around the peripheral boundaries of the fixed plant, processing, stocking and dispatch areas of the development. This is where the fixed structures of the existing development are located and will continue to be located during the extension period. It is also the location where the majority of quarry activity/ movement takes place. The existing seeded and maintained bunds will continue to screen the majority of the plant site activities.

- Advanced native tree and shrub planting and strengthening of existing peripheral hedgerows is to take place during winter 2021/22 to western, northern and eastern boundaries of the site.

- Advanced planting together with existing and progressive restoration planting is to be managed and maintained within a 5-year Aftercare Management Plan and a subsequent longer-term woodland and hedgerow management plan.

- To reduce the potential area of operational/disturbed land the quarry will be subject to progressive restoration. On completion of mineral extraction from the phased extraction area, land will be regraded, and restoration formation levels created utilising on site overburden and quarry dry waste silt onto which a full soil profile will be placed. The soils would be directly placed from soil stripping of the next phase (to expose mineral) supplemented by previously stripped and stored soils when required. All restored land will be planted or seeded in accordance with the Concept Restoration Scheme as illustrated on Drawing No. KD.SH.D.015. All restored land and land uses will be placed under a 5-year Aftercare Management Programme.

- Additional temporary soil screening bunds will be placed in advance of mineral extraction when working in phases 4B and 5 to screen the works from residents of the Hollies, and during phase 6 to screen residents of Hill Farm. These bunds will be 3m in height, grass seeded and maintained. A further 3m high temporary soil screening bund will be placed behind the existing hedgerow/tree planting along the northern boundary. This bund will also be seeded and maintained to help visually contain northern quarrying activities within phases 6 and 7 to potential visual receptors located within the southern areas of Horstead.

- Higher quality soils are to be concentrated to ensure the retention of best and most versatile agricultural land characteristics for agricultural use.

- Significant areas of new habitat is to be created to both integrate into and strengthen local landscape character and also create opportunities to promote long term sustainable biodiversity. On completion of restoration over one third of the site will be utilised for landscape and wildlife enhancement involving ~24.6 Ha of native species planted woodland, 12.3 Ha of species rich grassland/ meadow habitat and 1,462 linear metres of hedgerow comprise seven woody species and hedgerow trees.

14.2.5 Landscape and Visual Impact Conclusions

On the basis of the findings and conclusions of the assessment of the effects of the development on landscape character and on visual amenity, the study concludes that the proposed northern extension development and consolidation scheme is considered to be acceptable and appropriate in Landscape and Visual Effect terms.

14.3 Ecology

14.3.1 Ecology Study

The Ecological Impact Assessment (EcIA) has been undertaken in accordance with guidance issued by the Chartered Institute of Ecology and Environmental Management (CIEEM).

The EcIA stages have comprised: -

(i) Identification of the Zone(s) of Influence (ZoI);
(ii) Identification of Important Ecological Features (IEF) within the ZoI;
(iii) Impact Assessment of individual IEF, including compensation, avoidance and mitigation, in respect of: **a)** Wildlife Sites; **b)** S41 Habitats; **c)** invertebrates; **d)** fish; **e)** amphibians; **f)** reptiles; **g)** birds; **h)** mammals (not including bats); and, **i)** bats;
(iv) An enhancement strategy to make the outcome of the development wholly positive;
(v) The definition of a monitoring scheme to ensure the success of compensation, avoidance, mitigation, and enhancement strategies;
(vi) A Cumulative Impact Assessment (CIA) to assess the effect of the development in the wider context; and
(vii) Conclusions, which provide an objective account of the outcome, including the identification of any residual negative effects.

The study has considered the nature and significance of identified effects, drawing upon legal and policy guidance regarding protected habitats and species.

The ecological baseline in terms of existing habitat and species has been described, and potential impacts on the ecological receptors have been identified.

In addition to mitigation measures designed to minimise effects on the receptors (discussed below) the study also considers the biodiversity enhancements which the scheme could deliver. It concludes that the restoration will offer 20% greater surface area of important habitat compared to the baseline and that the restoration strategy thus satisfies the national planning policy requirement for new developments to deliver a net biodiversity gain.

14.3.2 Ecology Mitigation measures

The primary ecological mitigation measure is the restoration strategy and the proposals to incorporate substantial areas of native woodland, species rich grassland and hedgerows which will have the potential to provide considerable biodiversity enhancements. Other measures have been integrated into the proposed development scheme or would be implemented as additional mitigation measures. These recognise that whilst surveys have been undertaken as part of the EIA, circumstances can change over the duration of the development scheme, and, in certain cases, updated surveys are thus proposed on a phase by phase basis, as discussed below::

- A standoff margin would be applied to operations in the vicinity of the Clamp Wood Ancient Woodland to avoid physical impacts to the root system of trees at the woodland edge.

- The defined ‘important’ hedges present along the northern and western boundaries of the site would similarly be protected by standoff margins.as a result of the proposed development.

- Prior to any works taking place within areas of amphibian habitat as identified within the ES, an Amphibian Conservation Area will be identified and enhanced for the benefit of common toads. Thereafter, the Conservation Area will be retained and maintained for common toads over the entirety of the duration of the development and restoration aftercare period. Prior to every operation that might

destroy or degrade amphibian habitat in areas to be worked, or have the potential to result in mortality or injury to common toads, trapping and translocation to the Conservation area will be performed in line with the strategy described in the ES

- There is an abundance of habitat in the wider landscape, and no suggestion that the development might impact on any S41 Species of mammals (harvest mice, brown hare and hedgehogs) to such an extent that it might be unable to maintain its populations in the immediate locale. A safeguarding strategy is however proposed to avoid injury and mortality to 'Section 41' protected species by undertaken further pre-development surveys, on a phase by phase basis, to identify any nests, forms, dens and setts which may be present and taking responsible action with temporary standoffs prior to exclusion measures.

- Invertebrate species will be safeguarded by the details of the restoration planting scheme which will ensure that food plants are available for each invertebrate species within the restoration scheme.

- In relation to nesting birds, vegetation will be retained for as long as is reasonably practicable and soil stripping will only occur immediately prior to it being worked. As far as possible, vegetation clearance will take place outside the nesting season, in the period 1st September through to the end of February. Where it is impractical to perform an operation that will destroy nesting habitat outside the nesting season and works have to take place in the period 1st March through 31st August, a walkover survey will be performed by an Appointed Ornithologist. If no nesting birds are present, works will continue with no further constraint. If nesting birds are encountered, a stand-off of 5 m around the nest will be marked and this area will be retained undisturbed until young have fledged.

- Pre-development surveys, on a phase by phase basis, will be undertaken to identify any badger setts which may be impacted by the development. An appropriate stand-off will then be marked round each sett, and if a mitigation strategy cannot be defined that would safeguard the sett from damage and any badgers therein from disturbance, then a Development Licence may be required from Natural England in order to close the sett and allow works to proceed within the legislation.

- Based upon surveys undertaken as part of the EcIA, there are no trees containing bat roosts which would need to be removed as part of the development scheme. However, in view of the duration of the scheme, and the possibility that bats may utilise other existing trees for roosts, re-surveys will be undertaken on a phase by phase basis to check for the presence of any new bat roosts, and in the event of roots being identified, this would be addressed in the conventional way via the Natural England licencing regime.

14.3.3 Ecology Conclusions

The conclusion of the EcIA is that there are no grounds to predict that the development proposed will result in significant negative residual effects upon on important ecological features, nor are there grounds to suggest potential cumulative negative effects in combination with concurrent developments.

The restoration scheme, mitigation and enhancements measures proposed will result in a net increase in habitat extent for legally protected species and habitats and local biodiversity action plan habitats and species which are present within Stanninghall Quarry and the proposed extension area, and will ensure all important ecological features are maintained at favourable conservation status within the application site and wider area.

The restoration habitats will be created within a reasonable timeframe and managed and maintained as high quality, species rich, habitats as detailed in the outline aftercare strategy. It is therefore concluded that the development satisfies the national planning policy requirement by providing a net gain in habitat provision and biodiversity in general.

Due diligence safeguarding strategies and aftercare management strategies have been proposed and which could be made the subject of planning conditions, as suggested.

14.4 Soils and Agricultural Land

14.4.1 Soils and ALC Study

The ALC and soil survey was undertaken based upon a network of hand augers on a 100m grid. This involved examining 111 soil profiles, supplemented by four soil inspection pits which allowed an examination of the soil profile characteristics in more detail.

The soil data was interpreted in accordance with the Agricultural Land Classification (ALC) System of England and Wales (revised guidelines and criteria for grading the quality of agricultural land) MAFF 1988.

The ALC system grades the quality of land for agricultural use, according to the extent by which physical or chemical characteristics impose long-term limitations. The system classifies land into five grades (1,2 3a,3b,4 and 5), of which Grades 1, 2 and subgrade 3a are considered within the 'best and most versatile' (BMV) land category.

The findings of the original land quality survey based upon a 106 ha site area (prior to the commencement of operations in the existing quarry) were that the area contains 69ha of best and most versatile land, comprising 45ha in subgrade 3a and 24ha in grade 2. There are also 36ha of lesser quality land in subgrade 3b, and about 1 ha of woodland.

The majority of the sub grade 2 land lies within the existing quarry area.

Topsoils are predominantly sandy loam with a small area of loamy sand to the north- east. Topsoils within the proposed northern extension area range between 300mm and 375mm with an average of 350mm.

Upper subsoils are predominantly sandy loam to loamy sand, with a thickness of 300mm within the northern extension area.

Lower subsoils are variable, having textures from sand to clay, and comprising sandy clay loams in the northern extension area, with thicknesses ranging from 300mm to 500mm in the northern extension area.

In addition, overburden and inter-burden are found across the site, and would be carefully examined and characterised according to their re-use potential. Suitable material would be used for forming batters, for tree planting areas, and for forming lower-subsoil substitute materials on parts of the agricultural land restoration.

Top soil and sub soil has been stripped from the currently operational area within the existing quarry, and has been placed in a series of temporary storage bunds. This material is earmarked for use in the restoration of the final 'Phase 9' of the proposed development, comprising the existing plant site and adjoining areas.

A detailed audit has been carried out of the available soil resources within the northern extension area, which together with the processing waste generated and existing top soil and sub soil in storage bunds would provide the overall restoration material.

The potential impacts on agricultural land quality are most significant where they affect BMV agricultural land. There would be a significant direct and permanent impact in policy terms if there was no intention to restore agricultural land to high-quality standards.

Equally significant would be the indirect impact that would result from poor quality restoration failing to meet the specified standards for intended high-quality land.

However, with an original pre-development area of some 69ha of BMV land, the restoration scheme which proposes the reinstatement of 69.8 ha of agricultural land would ensure that there would be no overall loss of BMV land provided the soil target profiles are adhered to and there is no damage to soil resources during soil handling.

In addition, the restored BMV land would be concentrated in the areas to be restored to agricultural use which will provide a consistent soil profile and land quality for future cropping.

The principal potential adverse impacts on soil would derive from the loss of the resource; loss of quality by gross mixing of the different components identified; and by compaction and smearing if the materials were handled under poor (wet) weather, ground and soil moisture conditions.

In addition, there is a risk of long-term damage to soil structure, and the loss of potentially valuable soil, if there is uncontrolled trafficking of land and soil by heavy machinery, especially wheeled machinery. Damage to, and loss of topsoil would also occur if other dissimilar materials such as subsoil or overburden were stockpiled directly on it.

Biodegradation of topsoil also occurs when it is compacted in storage, when stockpiled wet and when stockpiled in the medium - to long-term.

However, provided that the soil resource, including subsoil substitutes (overburden and inter-burden), is carefully handled under good weather, ground and low soil moisture conditions, there should be no direct permanent adverse impacts on the soil resource, nor indirect impacts on the quality and use potential of the restored land.

14.4.2 Soils Mitigation Measures

The key mitigation measure to address potential impacts on land quality is to ensure the careful handling of soil.

The aim of the restoration is to recreate the same overall area of BMV land as existed prior to the commencement of the initial quarry development (circa 69ha). The soil movement and handling scheme in this proposal intends to avoid soil compaction and smearing problems by ensuring that soil handling protocols are adhered to at all times.

A suitably trained operator will ascertain when ground and soil conditions are suitable for soil movements. Soil movements for storage or restoration will normally take place as short summer campaigns and will open the area to be worked in the following 12 months, utilising soils to best effect to restore the areas already worked. Operations will be suspended when wet soil conditions predispose to damage, including during significant rainfall.

All soil stripping, handling, storage and placement will be undertaken using excavators and dump trucks in accordance with well-established MAFF Good Practice Guidelines for Handling Soils.

Topsoil, upper subsoil and lower subsoil will be removed in sequence in strips, the width of which will be determined by the size of machinery being used. As much soil as possible will be direct placed on the restoration formation levels of the previous worked out phase.

Other than during initial opening of areas to be stripped, and placement of soils in storage bunds, all machinery movements will take place on overburden or mineral, with no traversing of soils. All soil stores will be clearly marked as to the type and nature of the soil they contain, both on the site and on a plan.

14.4.3 Soils Conclusions

Provided that soil handling is carefully carried out, and the restoration soil profile is replaced to the thicknesses specified, there should be no long-term adverse effect on agricultural land quality or the overall extent of BMV land.

Similarly, and linked to restored land quality, provided that the soils are properly handled according to the defined good practice, there should be no adverse residual impact on the soil resource.

All the mitigation measures proposed to minimise the physical impact on soil resources are in accordance with long established and now conventional soil handling methods (ref MAFF Good Practice Guide for Handling Soils).

All soil resources would be used sustainably to deliver the restoration after uses

The development would result in an overall loss of agricultural land within the original undisturbed 106ha site area. However, there would be no loss of BMV agricultural land within the restored area (69 ha), and for landscape and biodiversity reasons, the restoration strategy has consciously proposed the introduction of a wider range of restoration after uses (species rich grassland and native woodland) compared the original pre development predominant agricultural land use.

Overall, there would thus be no adverse effect on BMV land quality or on soil resources available to ensure the deliverability of the restored BMV land.

14.5 Hydrology and Hydrogeology

14.5.1 Hydrology and Hydrogeology Study

The Hydrological Impact Assessment has been assisted by background hydrological and hydrogeological studies prepared as part of the EIAs undertaken in support of the quarry development schemes submitted to NCC in 2002 and 2003. This has included groundwater monitoring at 4 x piezometers encircling the existing quarry and northern extension area which has been carried out from 1999 onwards, generally on a monthly basis.

As a further context, the study notes that the existing and proposed quarrying operations involve extraction of sand and gravel from above the watertable. In common with the existing operations, there is no requirement for dewatering or sub-watertable working at the extension site where the full depth of mineral reserve (sand and gravel) is above the watertable. In addition, the free-draining nature of the sand and gravel allows works to proceed without the need for active surface water management. As a result, there is no need for off-site discharge from the application site.

The study describes the baseline hydrological and hydrogeological conditions, and identifies five generic potential impacts which might arise from the extraction and restoration works, namely:

- Derogation of groundwater resources, levels or flows;
- Derogation of groundwater quality;
- Derogation of surface water resources, levels or flows;
- Derogation of surface water quality; and
- Exacerbation of existing flood risk.

In response, the study concludes that:

- There will be no significant adverse modification of the current pattern of groundwater recharge, and thus no mechanism exists in this respect to cause discernible impact upon groundwater levels and flows.
- As at the existing site, potential contaminants present within the proposed development will be limited to diesel fuel, lubricating and hydraulic oils serving fixed and mobile plant. Nevertheless, there remains potential for accidental spillage or leakage of potentially contaminating fluids which would have potential to adversely impact existing groundwater quality within the localised section of Chalk Aquifer beneath the economic mineral.
- As with the existing site, the deposit will continue to be worked dry. There is no dewatering operation; and no requirement for off-site discharge. In these circumstances, the proposed development will not impact upon groundwater levels and flow; and there will be no derogation of surface water levels and flow.
- As with the groundwater system, the primary means by which existing surface water quality may be affected by operation the proposed development involves accidental spillages and / or leakage of potential contaminants.
- The Flood Risk Assessment (FRA) has demonstrated that the proposed development represents appropriate development in the context of prevailing flood risk zonations, and that neither the operational nor post-restoration stages of the proposed development will increase flood risk elsewhere.

14.5.2 Mitigation Measures:

In the light of these findings, the mitigation measures are confined to procedures for the protection of water quality by minimising the likelihood of spillage or leakage of contaminants in the first instance, and a specification of

reactive measures for the management of accidental spillage and / or leakage of fuel, lubricating or hydraulic oils should this occur.

14.5.3 Hydrology and Hydrogeology Conclusions

In view of the findings of assessment and the planned approach to the proposed development, which includes specific measures for the protection of the water environment, there are considered to be no over-riding hydrological or hydrogeological reasons why the planned development should not proceed in the manner proposed.

14.6 Noise

14.6.1 Noise Study

A study of the noise effects associated with the proposed extraction and processing of sand and gravel has been undertaken in accordance with a methodology set out in Government Guidance (National Planning Policy Framework [NPPF]) and Planning Practice Guidance (PPG).

It draws upon routine noise monitoring surveys which have been undertaken on ten occasions at Stanninghall Quarry since 2015 with a total of 97 fully attended 15-minute measurements at eight locations as required by the current planning conditions. From examination of each noise monitoring report, completed as specified in the approved Scheme of Noise Monitoring, the site noise levels have always been determined to comply with the site noise limits for dwellings at all locations.

Further noise measurements were taken in January 2020 to obtain baseline data for dwellings in the area surrounding the proposed northern extension with attended sample measurements at six locations and a sound level meter installed at The Hollies on Frettenham Road for a period of 21 hours.

Suggested noise limits for extraction and processing of sand and gravel in the application area have been based on the requirements and advice contained in the “Planning Practice Guidance’ (PPG) which accompanies the NPPF. This suggests noise limits should “not exceed the background noise level (LA90,1h) by more than 10dB(A) during normal working hours (0700-1900)…..and that …. In any event, the total noise from the operations should not exceed 55dB(A) LAeq, 1h (free field)”.

Separate noise limits are recommended in PPG for temporary operations, such as those associated with topsoil and overburden stripping, bund formation and the final restoration processes. These activities are often noisier than extraction, as they tend to be closer to sensitive properties and are usually unscreened. Temporary operations are exempted from the nominal daytime noise limit in the PPG but should conform with a site noise limit of 70 dB LAeq, at dwellings. In addition, the operations should not exceed a total of eight weeks duration at any noise sensitive properties in any twelve month period.

The study has calculated noise anticipated to arise from operations at the site based upon confirmation of the plant items which would be employed and measurements of sound power levels of the plant.

The study confirms that in the absence of mitigation, the calculated site noise levels comply with the suggested site noise limits at all locations apart from The Hollies and Hill Farm.

The calculated site noise levels for temporary operations comply with the PPG site noise limit at all of the receiver locations. The material movement associated with bund formation and removal can take place within the conventional 8 week period in any 12 months for temporary operations in the vicinity of any of the receiver locations.

14.6.2 Noise Mitigation Measures

The existing site noise limit at The Hollies imposed on the current quarry planning permission is 48 dB LAeq, 1 hour, free field. As is the case with the noise mitigation measures embedded within the current permitted scheme, this noise limit could be adhered to with the temporary creation of a 3m high screen bund between the property and the operational area.

The proposed 'Phase 5 extraction" boundary is no closer to The Hollies than remaining permitted mineral extraction within 'Phase 4B'.

The 'suggested' site noise limit at The Hollies, based on 10 dB(A) above background levels is 45 dB LAeq, 1 hour, free field, which could be adhered to with a slightly higher 4m temporary screen bund.

For The Hollies, the calculated site noise level of 45 dB LAeq, 1 hour, free field is achieved at a separation distance of 320 m with no barrier attenuation, so it is appropriate to remove The Hollies bund in Phase 7 as shown on the phasing drawings.

The existing site noise limit at Hill Farm is 48 dB LAeq, 1 hour, free field, which could be adhered to with the temporary creation of a 3m high screen bund between the property and the operational area.

The 'suggested' site noise limit at Hill Farm, based on 10 dB(A) above background levels is 45 dB LAeq, 1 hour, free field, which could be adhered to with a slightly higher 3.5 m bund.

For Hill Farm, the calculated site noise level of 45 dB LAeq, 1 hour, free field is achieved at a separation distance of 280 m with no barrier attenuation, so it is acceptable to remove The Hill Farm bund in Phase 8 as shown on the phasing drawings.

14.6.3 Noise Conclusions

For all locations apart from The Hollies and Hill Farm, the calculated site noise levels for routine operations in the proposed northern extension comply with the existing / suggested site noise limits taking account of the separation distances and with no allowance for bunds / barrier attenuation due to the intervening ground.

For The Hollies and Hill Farm, the existing site noise limit is 48 dB LAeq, 1 hour, free field and calculations demonstrate that this could be achieved with 3 m high Topsoil Bunds as shown on the phasing drawings for these two isolated dwellings. If a site noise limit of 45 dB LAeq, 1 hour, free field were to be imposed by the Mineral Planning Authority this would need to be in the context of increased perimeter bund heights of 4 m for The Hollies and 3.5 m for Hill Farm.

It is recommended that a revised Scheme of Noise Monitoring be prepared for the proposed northern extension to include additional receiver locations in and near to Horstead and set with appropriate site noise limits.

14.7 Air Quality

14.7.1 Air Quality Study

The air quality study describes the scope, relevant legislation, assessment methodology and the baseline conditions currently existing at the application site and its surroundings. It then considers any potentially significant environmental effects that the proposed development would have on this baseline environment; the mitigation measures required to prevent, reduce or offset any significant adverse effects; and the likely residual impacts after these measures have been employed.

The assessment has been undertaken in accordance with the Institute of Air Quality Management (IAQM) *Guidance on the Assessment of Mineral Dust Impacts for Planning* document.

The IAQM method is a risk-based approach based which assess the characteristics and baseline conditions at the application site, estimates the dust impact risk for each nearby receptor, and estimates the likely magnitude of risk based upon the sensitivity of the receptors.

The Guidance indicates that large dust particles, coarser than 30µm, which constitute the greatest proportion of dust emitted from mineral workings, will largely deposit within 100m of the source. Finer particles, which constitute only a small proportion of the dust emitted from most operations, are deposited more slowly, although the concentrations decrease rapidly from the source due to dispersion and dilution.

The IAQM minerals guidance presents a simple distance-based screening process to identify those mineral sites where the dust impacts are likely to

be significant and require further assessment. Where a more detailed assessment is required, a basic assessment framework is presented which employs the Source – Pathway – Receptor approach to evaluate the risk of dust impacts and effects.

This indicates that dust impacts from sand and gravel sites are considered to occur mainly within 250m of the operations, and that if there are relevant receptors within 250m and 1km then a dust impact assessment for both dust deposition and PM_{10} respectively will be required. In this case, 12 human receptors and 1 ecological receptor surrounding the application site boundary were selected for further assessment. These have been listed and assessed as part of the study.

In terms of the National Air Quality Objectives, background concentration data produced by Defra confirms that the existing air quality in the locality of the site is considered to be good for all pollutants considered. Concentrations are all 'well below' the annual objective of 40µg/m³ for PM_{10} and NO_2 and 25µg/m³, for $PM_{2.5}$.

The IAQM minerals guidance states that if the PM_{10} background concentration is less than 17µg/m³ it is considered unlikely that any process contribution from the additional activities proposed at the application site would lead to an exceedence of the annual mean AQAL. Utilising the Defra background maps (see **Table 11-5**), the maximum annual mean concentration in 2020 is 15.5µg/m³ and therefore less than 17µg/m³. In addition, background concentrations are predicted to decrease year on year.

It is therefore considered that in the absence of additional mitigation, the effect of proposed operations on human health from emissions of PM_{10} at the application site will be negligible.

In relation to atmospheric emissions from road vehicles the guidance indicates that if a change in annual average daily traffic movements is less than 100 per day (outside an Air Quality Management Area) then a detailed assessment of traffic emissions is not required and would 'screen out' of further assessment.

Activities or sources associated with the proposed development that have the potential to result in the release of dust include:

- site preparation and restoration;
- mineral (sand and gravel) extraction;
- mineral processing;
- storage of material;
- on-site transportation; and
- off-site transportation.

14.7.2 Air Quality Mitigation Measures

Operational Mitigation Measures

Operations are undertaken in line with industry good practice. The control measures implemented, and equipment utilised as part of the existing, baseline activities are as follows:

- clear designation of stockpile area to prevent tracking over;
- all storage bunds are to be grass seeded;
- 10mph speed limit enforced on haul routes;
- tractor and bowser available for use in dust suppression;
- progressive phased working scheme reduces the storage and double handling of material; and
- wheel wash adjoins the weighbridge and is used by all HDVs leaving the Application Site.

Environmental Design Measures

The application site would be worked on a phased basis, with progressive restoration to minimise the exposed surface areas that may be subject to erosion and lead to dust generation. This is in line with practises adopted in the current working scheme.

Given the location of receptors in relation to potential dust generating activities a number of specific mitigation measures have been incorporated into the application site layout and design, these measures include:

- processing plant is located within the quarry void in the south-east section of the application site – which is largely surrounded by agricultural land free from sensitive receptors;
- a hard-surfaced haul road exists between the application site entrance off Norwich Road and the plant site;
- mature hedgerows and vegetation on the periphery of the proposed northern extension would be retained to protect sensitive receptors;
- topsoil bunds are incorporated into the application site design to shield sensitive off-site receptors; and
- internal haul roads are positioned within the centre of the application site and therefore positioned away from sensitive receptors.

The dust control measures below are recommended for inclusion during the construction of the soil bunds around the boundaries of the application site; the implementation of such measures would act to significantly reduce the potential for dust generation at the source, including:

- avoid construction of soil bunds within 100m of a receptor when winds are blowing in the direction of the receptor;
- ensure water suppression is used to dampen the material during periods of dry or windy conditions and continued in use until vegetation is well established;
- undertake daily visual monitoring of dust emissions travelling off-site from the area of activity;
- cessation of the activity during prolonged periods of dry / windy conditions whilst continuing to dampen down exposed surfaces; and
- ensure surfaces are vegetated with quick growing plants to minimise the period of exposed surfaces.

14.7.3 Air Quality Conclusions

With the exception of three receptors / nearby properties, the assessment concludes that the effects of the development on nearby human and ecological receptors would be 'negligible'.

At receptor DR1 (The Hollies), one 'moderate adverse' effect is predicted during the construction and removal of topsoil bund 13, and one 'slight adverse' effect is predicted during the working of Phase 4B, which is closest to the receptor. The construction of the topsoil screening bund is of high dust emission potential; however, the bund would be grass seeded and therefore this potential significantly decreases as the bund re-vegetates. Once in place, it would act to shield the property from potential dust generated by other nearby activities. This moderate adverse effect would be temporary and short-term in nature and would only materialise if the bund construction was carried out during adverse weather conditions (i.e. dry/windy).

A 'slight adverse' effect is predicted at receptor DR1 in relation to extraction and restoration activities undertaken within Phase 4B as some of this area is within 100m of the property. As mentioned above, the topsoil bund (no. 13) will protect the property and therefore with effective mitigation in place, it is considered unlikely that this slight adverse effect will materialise or be significant.

It is also noted that these operations are already permitted as part of the current quarry planning permission.

At receptor DR2 (Hill Farm), one 'slight adverse' effect is predicted during the construction and removal of topsoil bund 15, and one 'slight adverse' effect is predicted during the working of Phase 6, which is closest to the receptor. The construction of the topsoil screening bund is of high dust emission potential; however, the bund would be grass seeded and therefore this potential significantly decreases as the bund re-vegetates. Once in place, it would act to shield the property from potential dust generated by other nearby activities. This slight adverse effect would be temporary and short-term in nature and would only materialise if the bund construction was carried out during adverse weather conditions (i.e. dry/windy).

A 'slight adverse' effect is predicted at receptor DR2 in relation to extraction and restoration activities undertaken within Phase 6 as some of this area is within 100m of the property. As mentioned above, the topsoil bund (no. 15) will protect the property and therefore with effective mitigation (discussed in Section 11.6.3) in place, it is considered unlikely that this slight adverse effect will materialise or be significant.

There are several storage bunds located within 250m of receptor DR11 (Beverley), where 'slight adverse' effects are predicted during the construction and removal of the sections of topsoil bund 16 which are within 200m of the property, and the construction and removal of bunds 17/18/19 which are within 100m. However, activities to construct and remove material storage bunds are short-term and therefore the potential 'slight adverse' effects would be temporary in nature. In addition, with the effective implementation of mitigation the risk of a 'slight adverse' effect occurring would be significantly reduced.

Given the dust suppression measures currently implemented, which are proposed to continue throughout the proposed scheme, it is considered unlikely that significant adverse impacts will materialise.

Considering all of the above, the overall effect of the proposed development is considered to be 'not significant'.

14.8 Traffic

14.8.1 Traffic Study

In transport terms, the proposed development represents a continuation of the permitted operations for an additional period of time. Whilst the sand and gravel would be extracted from a different area, it would be transported overland to the existing processing plant and either sold as processed aggregate or diverted to the on-site concrete plant, as per the existing, permitted operations. As previously described, the final remaining reserves beneath the plant site would be extracted and sold as-raised following the removal of the plant itself.

The proposed operating hours will remain as approved between 07:00 – 18:00 Monday to Friday and 07:00: - 13:00 on Saturdays, with no working on Sundays or Public Holidays.

The traffic movements associated with Stanninghall Quarry comprise the aggregate exports and concrete sales. Based on the exporting of 300,000 tonnes of aggregate in 20 tonne payloads over 275 working days per annum (50 weeks at 5.5 days per week), an average of 54.5 (say 55) loads / 110 HGV movements per day is established. By way of comparison, outputs of 200,000 tonnes and 400,000 tonnes per annum equate to averages of 36.3 (say 37) loads / 74 HGV movements and 72.7 (say 73) loads / 146 HGV movements per day respectively.

It is understood that working on Saturdays is rare. As a result, the number of working days per annum averages 250 (50 weeks at 5 days per week), which based on exporting 300,000 tonnes per annum would result in an average of 60 loads / 120 HGV movements movements per day. The corresponding figures assuming a 200,000 and 400,000 tonnes per annum output would be 40 loads / 80 HGV movements and 80 loads / 160 HGV movements per day respectively

When distributed over an 11 hour working day, these flows equate to rounded up averages of 4 loads / 8 HGV movements, 6 loads / 12 HGV movements and 8 loads / 16 movements per hour respectively.

Based on the proposed average production of 300,000 tonnes per annum, of which 29,660 tonnes is diverted to the concrete plant, the remaining 270,340 tonnes of sand and gravel would attract an average of 54 loads / 108 HGV movements per day, assuming the distribution remains predominantly over a 5 day week (Monday to Friday). Adding the 13 loads / 26 HGV movements associated with the concrete production, results in an overall total of 67 loads / 134 HGV movements per average day, and 6 loads / 12 HGV movements per hour.

In terms of the distribution of traffic travelling to / from Stanninghall Quarry B1150 Norwich Road, it is understood that approximately 10% of production travels to / from the north via Horstead, whilst the remaining 90% travels to

/from the south via Crostwick / Spixworth, with the majority of traffic travelling via the A1270 Broadland Northway (also referred to elsewhere in the ES as the Norwich Northern Distributor Road).

Traffic flow data on the B1150 and A1270 has been obtained, which reveals that Stanninghall Quarry traffic represents an insignificant proportion of overall flows and HGV movements, and the local road network is readily able to accommodate the continued activity together with overall predicted traffic growth.

In addition, a review of accident statistics confirms an absence of incidents involving the larger HGVs at the site access junction and local highway network, which demonstrates that the existing infrastructure is suitable to accommodate the routine HGV movements associated with Stanninghall Quarry and other activities in the area.

14.8.2 Traffic Mitigation Measures

The review of the existing site access, local road network and proposed development, has established that the recent traffic activity associated with Stanninghall Quarry has been satisfactorily and safely accommodated on the local road network.

The proposed development is predicted to maintain the recently experienced traffic activity associated with Stanninghall Quarry for an additional period of time.

Due to the proportion of the overall traffic volume associated with Stanninghall Quarry, any traffic growth that may occur on local roads as a result of other development would further reduce the proportion of quarry traffic, and could only arise having taken the quarry traffic into account when assessing and approving those other development proposals.

Taking this into account, no new mitigation measures are considered necessary in this case, beyond routine maintenance of the site access and continuing the management protocols adopted by Tarmac.

14.8.3 Traffic Conclusions

A review of the impact of the proposal has been undertaken based on current guidance, the existing site access and road geometry, and traffic flow information for Stanninghall Quarry and the wider highway network. The road safety impacts associated with the proposal have also been considered by reviewing recent collision records provided by Norfolk County Council.

During the working of the proposed time extension, there would be a continuation of traffic movements to / from Stanninghall Quarry. Notwithstanding this, the access and local road network can demonstrably accommodate the proposed continuation of activities.

Based on the safety record of the site access and local road network, together with their ability to accommodate the continuation of activities at Stanninghall Quarry for the predicted duration of operations, it is apparent that the proposal would be acceptable in terms of its highway and transport impact.

Having considered the ability to retain and maintain a safe access to the site onto a road network which is able to safely accommodate the continuation of HGV traffic travelling to / from Stanninghall Quarry, when assessed against national planning policy, it is concluded that the transport and highway impact of the proposal would be acceptable and therefore planning permission should not be refused on highway grounds.

14.9 Cultural Heritage

14.9.1 Cultural Heritage Study

The cultural heritage assessment considers both direct and indirect effects upon cultural heritage within the vicinity of the application site and with particular emphasis on the proposed extension area (PEA).

Direct effects result from, for example, the stripping of soils and overburden, the creation of storage and screening bunds, and the installation of infrastructure.

Indirect effects can occur as a result of changes to the setting of a landscape or asset, whether permanent or temporary. This is particularly relevant to designated cultural heritage assets, such as Scheduled Monuments, Listed Buildings, Conservation Areas and Registered Parks and Gardens.

The scope of the assessment has followed the advice set out in a Scoping Opinion issued by NCC, including advice from the County Archaeologist and Historic England.

It also draws upon a desk-based cultural heritage assessment that included the proposed extension area prepared in 2001, and the results of archaeological investigations which have been ongoing within the current quarry since 2004.

No designated assets of cultural heritage importance lie within the boundary of the PEA.

After analysis of the current infrastructure, depth of the current workings, topography and the screening effects of intervening development and vegetation, a study area of 1km from the boundary of the PEA was considered the appropriate distance to assess potential effects upon the setting of designated heritage assets, and the environmental effects from dust, noise and traffic.

There are eighteen listed buildings and one Scheduled Monument within 1km of the PEA. There are no World Heritage Sites, Heritage Coasts, Registered Historic Parks and Gardens or Registered Battlefields within this radius.

One Scheduled Monument lies within 1km of the PEA. This is a Roman military camp and associated settlement which lies to the north of the PEA.

The Norfolk Historic Environment Record (NHER) was searched for archaeological sites located within 1km of the PEA. This includes 42 records of historic environment features and discoveries, five of which relate to the work in the existing quarry and one that relates to a geophysical survey undertaken as part of this planning application

In addition to the crop mark of the possible Roman camp north of the PEA, almost half of the records in the study area are of crop mark features, predominantly elements of possible field systems of various dates up to and including the post-medieval period. There are also records of artefacts found during systematic fieldwalking and metal detecting by members of the public.

Four entries are located within the PEA or extend into it, principally crop mark features of ditches.

The most recent observations during quarrying to the south of the PEA have been carried out over a number of seasons (2008, 2015 and 2017). The results include the recording of a number of ditches and pits. In the 2015 season there were four ditches of post medieval date and eight undated pits.

In 2017, in the western part of the quarry, nineteen small pits and elements of an undated ditch system were excavated. The most significant discoveries were eight large steep-sided and flat-based pits identified as relating to probable clamps for the production of charcoal.

As required by the scoping opinion, a geophysical survey was carried out which identified a series of linear features, ditches and drains, many of which were identified also on aerial photographs, but where the study noted that *few potential features of likely archaeological interest were identified.*

Based upon the knowledge of archaeology within the current extraction area to the south of the PEA and the general vicinity, it is likely that archaeological sites will be located within the PEA. The geophysical survey however located only a handful of archaeological anomalies, and it is also clear that historically the PEA has been subjected to ploughing and that any archaeology will have been truncated to some extent.

There is no evidence of any archaeology of national significance that requires preservation *in situ*.

Indirect impacts are those that do not physically affect a cultural heritage asset or landscape, but that alter the context or setting. Only the scheduled

monument to the north of the PEA is considered to experience potential adverse effects.

14.9.2 Mitigation measures

Direct Effects

In accordance with planning policy, loss of archaeology needs to be offset by a programme of mitigation. There is no evidence of archaeology of such importance as to require preservation in situ. Consultations should be held with NCC Historic Environment Service to agree the scope of mitigation that would be required post-consent. Given the success of the current strategy within the permitted quarry, a Strip Map and Sample approach during soil-stripping would appear appropriate and this would ensure that all archaeology within the PEA is recorded in advance of quarrying.

An archaeological contractor would be appointed to carry out the fieldwork with an experienced and appropriately qualified supervisor in charge of day-to-day site-based work.

Soils would be stripped using a backacting 360° machine equipped with a toothless bucket to a level agreed with the monitoring archaeologist. No tracking or movement of plant may take place on the exposed surface until it has been signed-off by the archaeologist. Machinery may need to be halted or diverted to allow archaeologists safe access to examine the stripped surface.

Details of methodologies will be formalised in a Written Scheme of Investigation, agreed with Norfolk County Council, prior to development commencing.

Indirect Effects

Within approximately 1km of the Application Site sit nineteen listed structures all Grade II except two Grade II* churches. Based upon field survey, no adverse effects upon visual or contextual setting are predicted from the proposed development due to distance, topography, and intervening development and vegetation.

One scheduled monument is situated within 1km of the PEA: Horstead Roman camp and settlement that covers an area of 11.7ha and straddles the Frettenham Road. The boundary of the southern part is approximately 110m north of the Application Site and 150m from the proposed extraction area.

Movement of plant would be discernible during the construction of the Hill Farm bund and during soil stripping for Phase 6 and 7, although this would be filtered by existing and enhanced hedgerows bounding both the PEA and the southern boundary of the scheduled monument. This would cause only a temporary change to setting of moderate significance. Visibility of movement would decrease as the quarry workings descend.

Although the ground within the restored application site will be about 6m lower this will not be perceptible from the scheduled monument (the boundary being about 150m north) even in the absence of the intermediate vegetation that currently exists. The restoration proposals include the planting of native woodland along the northern boundary of the PEA and this would be in keeping with the landscape of the Roman period based upon evidence from excavations in the current quarry. There would be no residual effect upon the setting of the monument.

14.9.3 Cultural Heritage Conclusions

The proposed development would have no significant adverse effects upon known assets of cultural heritage, and those adverse effects that would occur would be offset by the opportunity, funded by Tarmac Ltd, to add to our knowledge of the archaeology of the application site and its landscape, that is currently being truncated by ploughing.

Restoration of the application site would include planting of native woodland that would be in keeping with the landscape of the Roman period, in particular in views southwards from the scheduled Roman camp.

Having regard to the baseline conditions and the assessment carried out against professional guidance, the proposed development therefore accords with both local and national cultural heritage policy.

15.0 CONCLUSIONS

This ES provides a detailed and objective analysis of the potential environmental effects which would be associated with a proposed northern extension and consolidation scheme at Stanninghall Quarry, south of Horstead, Norfolk.. Each environmental topic has been assessed in accordance with advice received from NCC regarding the nature of the EIA which should be undertaken, and the individual assessments have been undertaken in accordance with up to date guidance and standards.

The ES has been prepared in order to assist NCC and other interested parties to reach a decision on the merits of the development and the environmental and amenity effects which would be associated with it.

The ES describes the details of the phased quarry development scheme, the progressive restoration scheme which would implemented, and the restoration strategy for the quarry with the range of restoration after uses which are proposed.

It sets out the results of very careful, detailed and systematic research into each of the potential environmental effects of the development and, where relevant, sets out modern and well-designed methods of mitigating the effects.

These include measures which have been incorporated into the design of the working scheme as in-built mitigation measures, relating in particular to the measures to minimise the landscape and visual effects of the development; the noise attenuation measures inherent in the phased working scheme; and the implementation of dust management controls.

Based upon the studies and content of the individual chapters, the underlying conclusion of the EIA is that there is no single topic or combination of issues which should objectively prevent the development from proceeding.

This in part reflects the fact that the principle of a northern extension to the quarry has been assessed by NCC as part of the preparation of an updated Minerals and Waste Local Plan, where the 'Preferred Options' document published in July 2019 proposes to allocate the northern extension site as a site for future sand and gravel extraction.

All quarry developments will give rise to some degree of environmental effects, and this is inevitable given the nature of the operations which are involved. However, the requirement of national and local planning policy is to ensure that effects are minimised and maintained within acceptable limits rather than be eliminated. The general conclusion reached by the ES is that with the implementation of the in-built and additional mitigation measures, the proposed scheme would successfully minimise the environmental effects.

Planning policy issues are explored further in the Planning Application Statement. The key conclusions from this analysis are that there is an acknowledged need for the development in terms of maintaining supplies of sand and gravel to the construction industry; the development could proceed in a way which "minimises" environmental effects; and the effects from operations can be maintained within acceptable limits.

In the light of the above considerations, it is concluded that the development could proceed in accordance with the underlying objectives of policies relating to the extraction of aggregate. The planning policy analysis also concludes that the development could proceed in accordance with adopted and emerging development plan policies for the area.

In all these circumstances it is considered that there should be a firm presumption in favour of planning permission being granted.