5.0 SOILS, LAND AND GEOLOGY

5.1 Introduction

This rEIAR chapter presents an assessment of potential impacts resulting from quarrying related activities that have been carried out at ECT Sand and Gravel's quarry at , Ballinabarny, Co. Wicklow ('the Site') on the land, soils and geology at the Site and in the wider Study Area.

The chapter has been prepared by Anna Goodwin who has 18 years of consultancy experience and holds an MSci in Geology and an MSc in Hydrogeology, and is Chartered through the Geological Society of London

5.1.1 Technical Scope

The technical scope of this assessment is to consider the potential impacts and effects on soils, land and geology that could have resulted as a consequence of the quarrying related activities that have been carried out at the Site (the 'Development'). The assessment considers the potential sources of change resulting from Development activities detailed in the project description (Chapter 2). Due to the nature of the rEIAR and Substitute Consent process, a 'Do Nothing Scenario' has not been considered.

The loss of agricultural soils will be considered, as will the potential impact on geologically important sites and land quality. Associated secondary potential impacts from changes to land quality on human health are also considered. It should be noted that this assessment does not, however, constitute a contaminated land risk assessment, a geotechnical/geohazard risk assessment, or detailed quantitative human health risk assessment.

Changes to the ground environment could have other secondary impacts to the water environment, people and ecology. The potential impacts and effects associated with hydrogeological and hydrological receptors are considered in Chapter 6 (Water). The potential impacts and effects of the Development on population and human health (other than those from land quality that are addressed in this chapter) are addressed in Chapter 3 (Population & Human Health). Potential secondary impacts and effects on ecology or biodiversity due to changes in land quality or habitat removal are considered in Chapter 4 (Ecology and Biodiversity).

5.1.2 Geographical and Temporal Scope

The geographical study area for the assessment covers the rEIA site boundary ('the Site') (identified on Figure 5.1) and a buffer zone of 500 m from the Site boundary, which together are referred to as the 'Study Area'. This Study Area has been selected because most potential effects to geological and soil receptors are anticipated to occur within the Development footprint or immediately adjacent to it.

The baseline for this rEIAR has been set at 01 February 1990, and the rEIAR assessment addresses potential environmental impacts that could feasibly have occurred from that date to the present (i.e. May 2022). This assessment period equates to 32 years and is identified as 'long-term' duration (those lasting fifteen to sixty years).

Figure 5.1: Location of the Site (rEIA Site Boundary)

5.2 Legislative and Policy Context

This section addresses the legislation and guidance that has been considered when preparing this chapter, and key policy context relevant to soils, land and geology that has guided the focus of the assessment. The overarching EIA legislation under which this assessment is required is addressed separately in Chapter 2 (Scope and Methodology).

5.2.1 Legislation and Guidance

In addition to the Regulations that underpin the EIA process (see Chapter 2), this assessment has been made with cognisance to relevant guidance, advice and legislation, including, but not limited to:

- The European Communities (Environmental Liability) Regulations 2008 (as amended) - These Regulations (SI 547/2008) transpose EU Directive 2004/35/CE on environmental liability with regard to the prevention and remedying of environmental damage. The purpose of these Regulations is to establish a framework of environmental liability based on the 'polluter-pays' principle, to prevent and remedy environmental damage. The Environmental Protection Agency (EPA) is designated as the competent authority for all aspects of these Regulations.
- The Environmental Protection Agency Act 1992 and the Protection of the Environment Act 2003 – which detail the requirements associated with general pollution control and activities that come under integrated pollution prevention and control.

- The EPA Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (May 2022) – which presents key topics of interest, high-level information on the interactions that should be considered in relation to EIA legislation, and overviews on the recommended approach to describing the baseline environment, completing impact assessments, describing effects, and addressing mitigation and monitoring.
- Department of Housing, Planning and Local Government. Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (August 2018).
- Gov.uk online guidance, Guidance on Land Contamination Risk Management (LCRM). Available at https://www.gov.uk/guidance/land-contamination-how-to-manage-the-risks. Uses a tiered approach to risk assessment, including preliminary risk assessment, generic quantitative risk assessment and detailed quantitative risk assessment.
- The National Roads Authority Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (2008) in relation to aspects to be considered and assessment approach (including relative receptor importance and cross discipline interactions).
- Institute of Geologists of Ireland. Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements (April 2013).
- The National Roads Authority Guidelines for the Creation, Implementation and Maintenance of an Environmental Monitoring Plan (undated) in relation to impact mitigation.
- CIRIA C741: Environmental Good Practice on Site (2015, Fourth Edition) in relation to source of impact and mitigation.

5.2.2 Local Policy

The **National Planning Framework (Project Ireland 2040)** includes National Policy Objective 60 to “Conserve and enhance the rich qualities of natural and cultural heritage of Ireland in a manner appropriate to their significance”.

The current local plan is the Wicklow County Development Plan 2016 to 2022. A new development plan to cover 2022 to 2028 is currently in the consultation phase, which ends in May 2022; after which the Chief Executive will prepare a report for submission to the Elected Members for their consideration and then the Elected Members will make the Wicklow County Development Plan 2022-2028 with or without amendment. The date for adoption of the new plan is not confirmed.

The 2016 to 2022 development plan focusses on housing, but the overarching key strategic goals include:

- to protect and enhance the county’s rural assets and recognise the housing, employment, social and recreational needs of those in rural areas;
- to protect and improve the county’s transport, water, waste, energy and communities and maritime infrastructure, whilst having regard to our responsibilities to respect areas protected for their important flora, fauna and other natural features; and
- to protect and enhance the diversity of the count’s natural and built heritage.

Under these goals, there is an inherent requirement to consider that natural environment (including geology and soils) as part of development plans.

This concept is carried forward into the draft 2022 to 2028 development plan, where the balance between development and conservation needs are acknowledged in order to:

- Avoid negative impacts upon the natural environment;
- Mitigate the effects of harm where it cannot be avoided; and
- To promote the appropriate enhancement of the natural environment as an integral part of any development.

Objectives are set with regard to natural heritage (i.e. biodiversity and its physical or geological foundation) and the overall strategy with regard to the natural environment includes:

- Avoiding negative impacts upon the natural environment and promote appropriate enhancement of the natural environment as an integral part of any development; and
- Conserving and enhancing the County's geological heritage.

5.3 Assessment Methodology and Significance Criteria

5.3.1 Introduction

This section presents the method used to assess the impacts and effects of the Development on soils, land and geology, and to secondary associated human health receptors. It establishes the stages of the assessment, and the qualitative criteria used to assess impact magnitude and determine the level of effect significance.

5.3.2 Qualitative Assessment Method

The assessment of potential effects has been undertaken using the qualitative assessment method outlined below, and is supported by the baseline condition information, which has been collated using a desk-based approach. The assessment follows a staged approach. A summary of the stages involved is included below:

1) Confirm baseline conditions – determine baseline and develop conceptual site model by consideration of available records and data sets, site reports and published information. As this rEIAR covers the period from February 1990 to the present day, the baseline conditions will first be established for ca. 1990.
2) Confirm the key receptors and their value/importance.
3) Qualitatively characterise the magnitude of impacts on the receptors – describe what potential changes could have occurred to each receptor as a result of the Development, identify source-pathway receptor linkages, and assign the magnitudes of impact. This stage takes into account embedded design mitigation, historical and existing site practices including good practice in environment management and pollution prevention.
4) Determine the effect significance of each potential impact on each sensitive receptor.
5) Where significant impacts are identified, consider the need for additional mitigation (remedial measures) if it is considered necessary to reduce the magnitude of the impact and associated effect significance further.
6) Assess the residual impact magnitude and residual effect significance after all mitigation is applied.

Stages 1 and 2 have been completed using published literature and guidance and available information specific to the Development, which is presented in Chapters 1 and 2 of this rEIAR. For the identification of receptor value/importance that completes Stage 2, and for the description of impact magnitude (Stage 3), a common framework of assessment criteria and terminology has been used based on the EPA's Guidelines on the Information to be Contained in EIARs (EPA, 2022), with some modifications made to increase clarity. The descriptions for value (sensitivity) of receptors are provided in Table 5.1 and the descriptions for magnitude of impact are provided in Table 5.2.

The potential for an impact to occur at a receptor has been determined using the understanding of the baseline environment and its properties and consideration of whether there is a feasible linkage between a source of impact and each receptor (i.e. a conceptual site model). This follows the method of preliminary risk assessment that is widely presented in some of the guidance documents listed in Section 5.2.

Table 5.1: Environmental Value (sensitivity) and Descriptions

Value (sensitivity) of receptor / resource	Typical description
High	High importance and rarity, national scale, and limited potential for substitution. For example: Global/European/National designation Large volumes of nationally or locally important peat Well drained and highly fertile soils Proven economically extractable mineral resource Human health.
Medium	Medium or high importance and rarity, regional scale, limited potential for substitution. For example: Regionally important sites Moderately drained and/or moderate fertility soils.
Low	Low or medium importance and rarity, local scale. For example: Locally designated sites Poorly drained and/or low fertility soils.
Negligible	Very low importance and rarity, local scale.

Table 5.2: Magnitude of Impact and Typical Descriptions

Magnitude of Impact (change)		Typical Description
High	Adverse	Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements. Significant harm to human health - death, disease, serious injury, genetic mutation, birth defects or the impairment of reproductive functions. Significant harm to buildings/infrastructure/plant - Structural failure, substantial damage or substantial interference with any right of occupation.
	Beneficial	Large scale or major improvement of resource quality; extensive restoration; major improvement of attribute quality.
Medium	Adverse	Loss of resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements.
	Beneficial	Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality.
Low	Adverse	Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements.
	Beneficial	Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring.

Magnitude of Impact (change)		Typical Description
Negligible	Adverse	Very minor loss or alteration to one or more characteristics, features or elements.
	Beneficial	Very minor benefit to or positive addition of one or more characteristics, features or elements.

The assessment of magnitude of impact considers whether the change that causes the impact is positive (beneficial) or negative (adverse), and whether the impact is direct or indirect, short- medium- or long-term, temporary or permanent, and if it is reversible.

For the purposes of this assessment, a direct impact is one that occurred as a direct result of the Development and was likely to have occurred at or near the Development itself. Indirect impacts (or secondary/tertiary impacts) are those where a direct impact on one receptor has another knock-on impact on one or more other related receptor(s) (e.g. the Development results in a change in land quality, which then has an indirect impact on human health). Indirect impacts can occur within the Study Area or away from the Development.

For the purposes of this assessment, the following definitions of duration have been used:

- Temporary – effect likely to last less than 1 year without intervention (i.e. less than the construction phase);
- Short term – effect likely to last 1 to 7 years without intervention;
- Medium term – effect likely to last 7 to 15 years without intervention;
- Long term – effect likely to last 15 to 60 years without intervention; and
- Permanent – effect likely to last over 60 years without intervention.

An irreversible impact is defined as a change to the baseline that would not reverse itself naturally. Such impacts will usually be long-term and irreversible, such as the removal of best and most versatile agricultural soils. A reversible impact is defined as a change to the baseline conditions that would reverse naturally once the source of the impact is exhausted or has stopped.

5.3.3 Significance Criteria

The approach followed to derive effects significance from receptor value and magnitude of impacts (Stage 4) is shown in Table 5.3. Where Table 5.3 includes two significance categories, reasoning is provided in the text if the lower of the two significance categories is selected. A description of the significance categories used is provided in Table 5.4.

Table 5.3: Significance Matrix

	Magnitude of Impact (Degree of Change)				
Environmental value (Sensitivity)		Negligible	Low	Medium	High
	High	Slight	Slight or moderate	Moderate or large	Profound
	Medium	Imperceptible or slight	Slight or moderate	Moderate	Large or profound
	Low	Imperceptible	Slight	Slight	Slight or moderate
	Negligible	Imperceptible	Imperceptible or slight	Imperceptible or slight	Slight

Table 5.4: Significance Categories and Typical Descriptions

Significance Category	Typical Description
Profound	An effect which obliterates sensitive characteristics.
Large	An effect which, by its character, magnitude, duration or intensity alters a significant proportion of a sensitive aspect of the environment.
Moderate	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Imperceptible	An effect capable of measurement but without significant consequences.

Residual adverse effects of 'large' or 'profound' significance are considered to be 'significant' for the purposes of this assessment.

If required following the assessment of the current level of effect significance, additional mitigation measures (remedial measures) may be presented that will be used to avoid, prevent, or reduce the magnitude of the impact (Stage 5). The significance of the effect taking into account the additional mitigation is then assessed (Stage 6) to give the residual effect significance. Any monitoring that will be required to measure the success of the mitigation is included (Stage 7) (see Section 5.8).

The effects of the Development are also considered cumulatively with those that could have been foreseen as a result of other known developments in the assessment study area.

5.4 Baseline Conditions (1990 to 2022)

This Section presents baseline (ca. 1990) information on soils, land use, land quality and geology and subsequent conditions (up to May 2022). The site setting and Development activities are described fully in the Project Description (Chapter 2). This section highlights key elements that are pertinent to this assessment.

5.4.1 Site Setting and Land Use

Sources of Information

There are several sets of historical imagery available for the area (Ordnance Survey of Ireland, 2022; Google Earth 2022) that relate to the operational years that are the subject of this rEIAR, including:

- 1993, 1995, 2000 and 2005 aerial imagery (OSI); and
- 30 September 2009, 21 June 2010, 5 November 2011, 21 April 2015, 20 January 2017, 26 March 2017, 22 April 2019, 23 March 2020, 8 March 2021 and 21 July 2021 aerial imagery (Google Earth); plus
- February 2022 survey of the quarry area.

Selected imagery is shown in Figure 5.2 to Figure 5.6, which provide an overlay of the rEIA Project Site boundary on available OSI aerial photographs from 1993, 1995, 2000, 2004, 2009 and Google Earth imagery from 2011, 2015 and 2021.

In addition to establishing the baseline in 1990, consideration has also been given to older mapping sources from both the GSI and OSI including:

- 6" historical map (1837-1842);

- 25'' OSI maps (1888-1913);
- 6" Cassini Map (1830s to 1930s); and
- GSI's aggregate potential mapping online viewer (2022, historical pits and quarries layer).

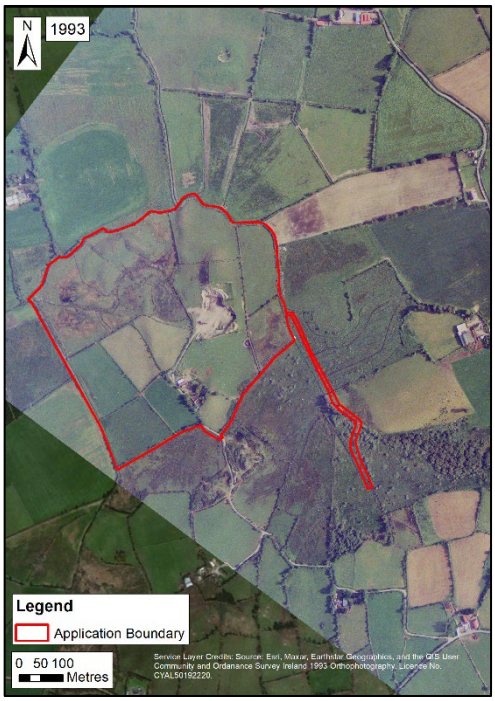


Figure 5.2: Aerial Photo of the Site in 1993

Figure 5.3: Aerial Photos of the Site in 1995 and 2000

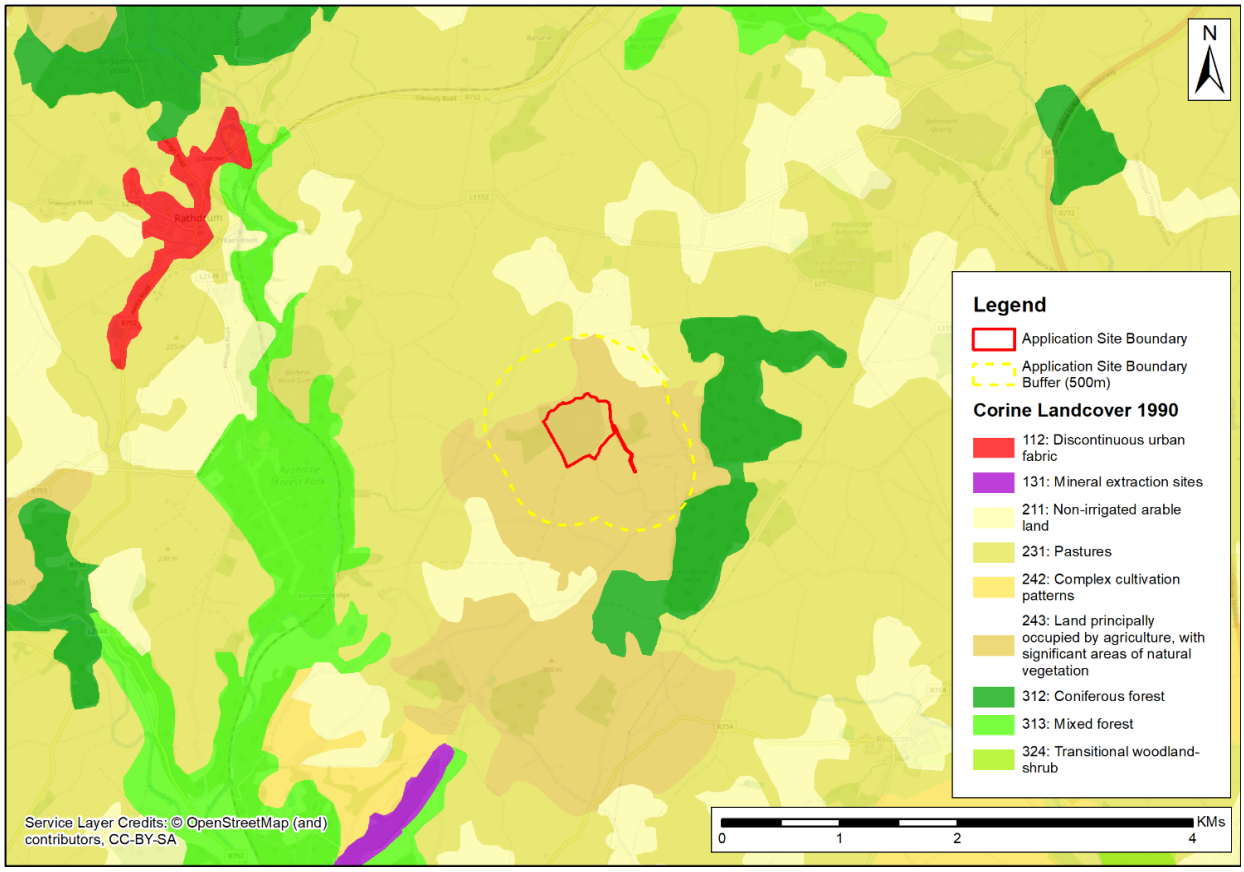
Figure 5.4: Aerial Photos of the Site in 2004 and 2009

Figure 5.5: Aerial photos of the Site in 2011 and 2015

Figure 5.6: Aerial Photo of the Site in 2021

The Corine landcover classification (EPA, 2022) has also been considered in this assessment. The Corine Land Cover (CLC) inventory is a Pan-European land-use and landcover mapping programme and is run in Ireland by the EPA. The Irish EPA CLC inventory is available for years commensurate with Ordnance Survey aerial photography used in this rEIAR to illustrate the development of the quarry since baseline. CLC data from 1990 and 2012 is presented in

Figure 5.7 and the most recent 2018 is presented at Figure 5.8.



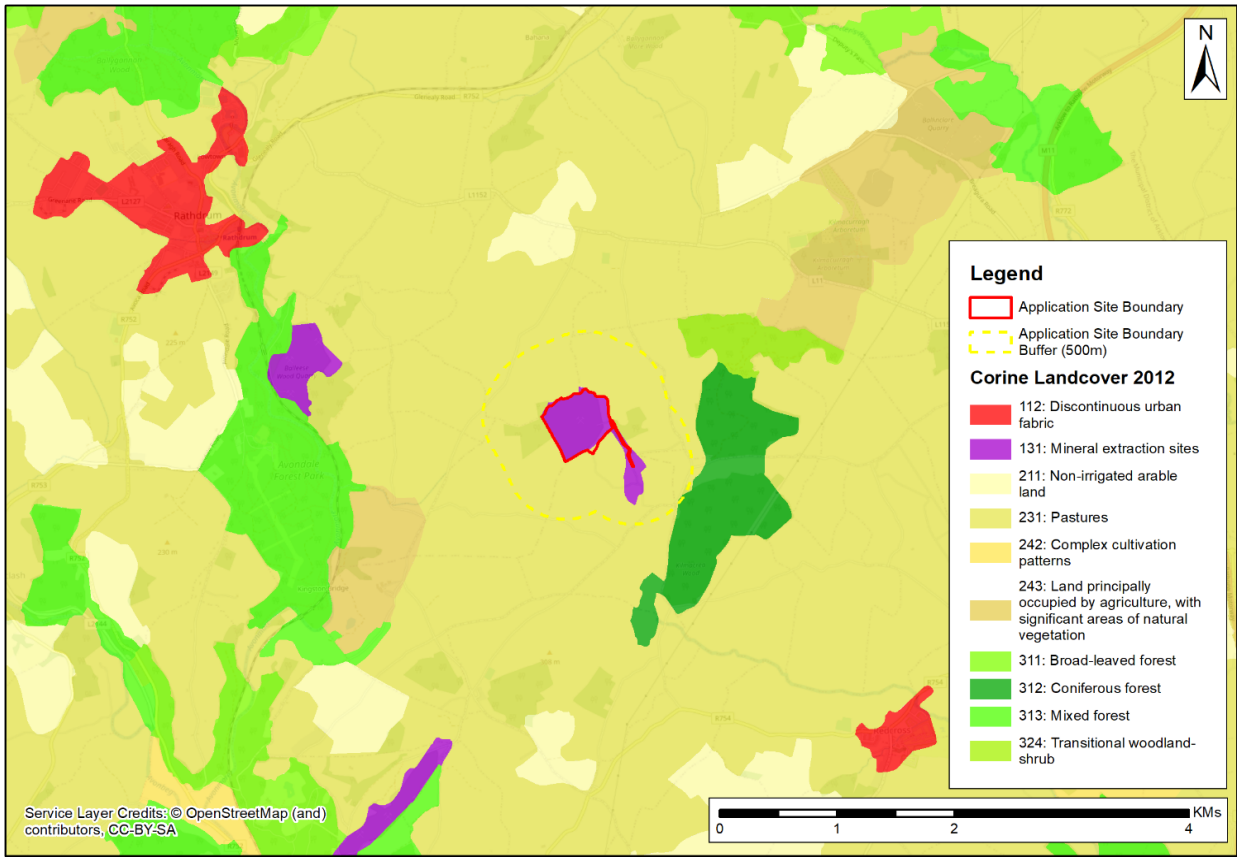


Figure 5.7: 1990 and 2012 Corine Land Use mapping (EPA, 2022).

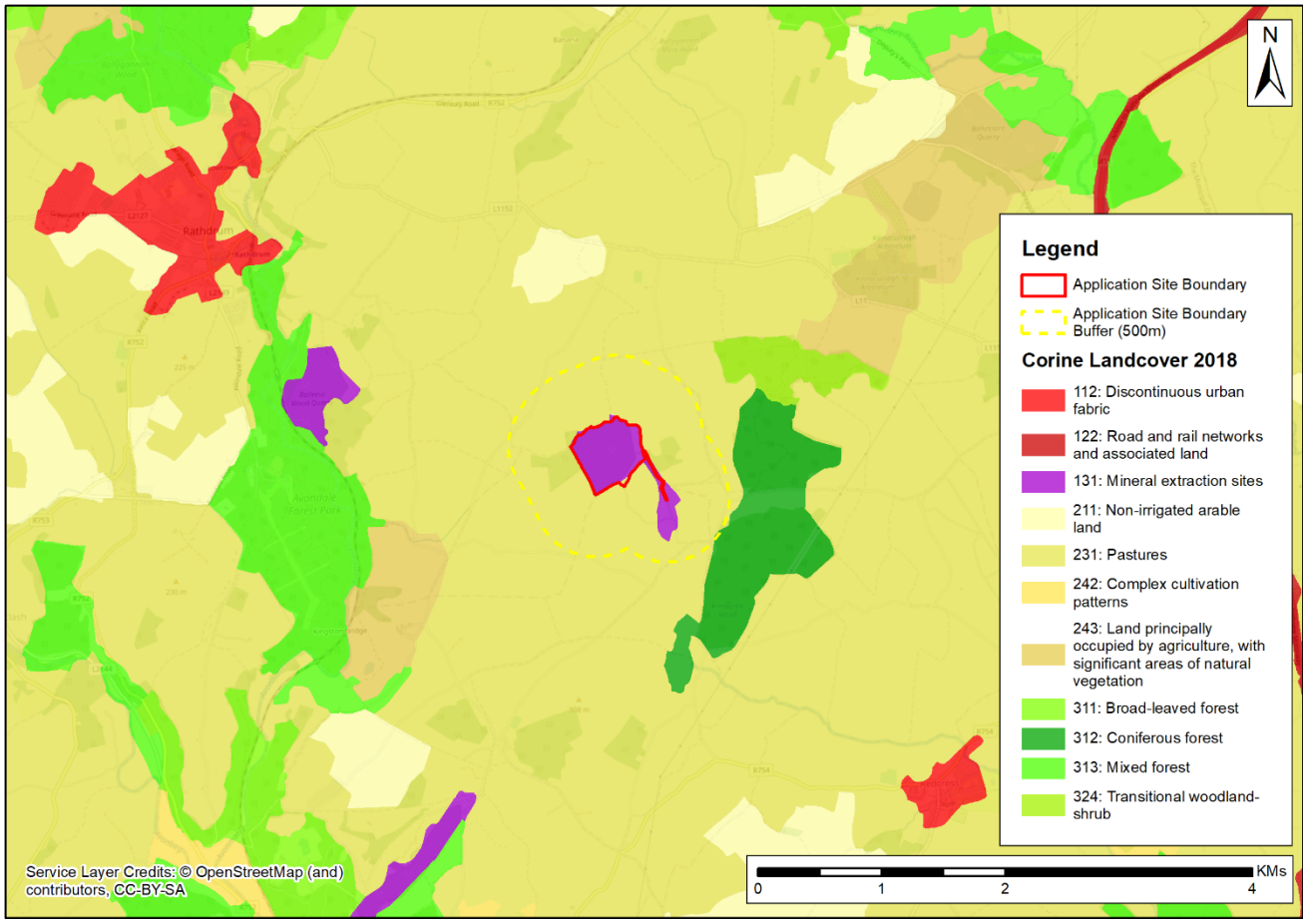


Figure 5.8: 2018 Corine Land Use mapping (EPA, 2022)

Historical

The 6" historical maps (1837 -1842) shows that the Site was fields with some buildings, which are likely to have been a farmstead, at the south of the Site. The buildings appear to be in a similar location as the current main administrative quarry buildings. The wider Study Area included fields and some scattered houses/farmsteads. Marshland occupied the Study Area to the east of the Site.

The 25" inch map and composite Cassini map provide similar details as the 6" historical maps with the addition of a stream/ditch entering the Site from the north before flowing westwards across the Site.

Quarrying has taken place at the Site since around the 1940s (Land Registry Declaration D-98-4054, Folio 4227, 3 August 1999). A review of the GSI's aggregate potential mapper identifies a mid-late 20th century pit at the Site, which is the quarry that is the subject of this rEIAR. A second pit is mapped to the immediate north of the Site within the Study Area. The GSI identifies this second pit as a mid-late 20th century pit that was not active day-to-day, but had 'good equipment, stockpiles on site' at the time of the field checks (July and September 2003). However, OSI aerial imagery in both 2000 and 2005 show a well-established agricultural field around this time. The 1993 aerial imagery also shows a field. It is considered more likely that the second pit to the north of the Site was active prior to 1993 and has since been restored to farmland.

Baseline (1990)

The oldest available aerial imagery closest to the baseline date of 1990 for the area is a 1993 OSI orthophotography survey (Figure 5.2), which has been used to approximate the 1990 baseline footprint of the quarry. The area of the quarry in 1990 is estimated to be 0.75 ha (see Chapter 2 for full details). The surrounding land use is agricultural with some patches of woodland.

The lower basal elevation of the working in 1993 (the proxy year used to develop the baseline – see Chapter 2 for more details) was approximately 124 mAOD.

The Corine Land use mapping for 1990 shows that the Site and surrounding land was classified as being "principally occupied by agriculture with areas of natural vegetation". Areas of pasture were mapped in the northwest of the Study Area and areas of non-irrigated arable land are mapped in the northeast of the Study Area. No arable land (i.e. irrigated on non-irrigated food crops) or permeant crops (e.g. orchards) was mapped.

Baseline to Present (2022)

Between the period 1990 and 2022 the land use within the Study Area has remained largely unchanged. Conifer forestry within the Study Area has become established on former scrubland to the immediate east and west of the Site from ca. 2000 onwards.

Quarrying activities have expanded within the Site boundary. Quarrying progression can be seen in Figure 5.2 to Figure 5.6 and an estimation of the tonnage extracted between 1990 and 2021 has been made and is presented in full in Chapter 2 – Project Description.

Based on available aerial imagery and contour mapping, the extraction area expanded over this period first in a westerly and northerly direction up to 2000, then expansion occurred in all directions between 2000 and 2009. Some agricultural fields/scrubland have been lost within the Site as the has quarry expanded over time. Based on the aerial photographs, extraction below the water-table in the northwest of the Site started at some point between 2000 and 2004. This ceased in 2008, resulting in a waterbody being created within the Site footprint to the northwest of the processing plant.

The 2012 and 2018 Corine Land Use mapping indicates that the Site itself was occupied by a mineral extraction site and the surrounding land within the Study Area comprised pasture. No arable land (i.e. irrigated on non-irrigated food crops) or permeant crops (e.g. orchards) was mapped.

At present, the most recent aerial imagery indicates that four general main land uses have been identified within the Site and the Study Area (500 m from the Site boundary), these are agricultural, single-house residential, forestry and the quarry site.

The quarry Site comprises land that is currently used for quarrying activities, which include: excavation areas; haul roads; stockpiles; processing plant; administration, maintenance, storage and welfare facilities; and the lake formed from historical below water-table mineral extraction. The current extent of the quarry (including extraction, plant and ancillary areas) extends to approximately 23.7 ha. The current extracted quarry area is 20.16 ha. Sand and gravel extraction is taking place in the central area of the Site. The typical lower basal elevation of quarrying in 2022was 114 mAOD, except for in the northwest corner of the Site where below water table excavation has taken place and the basal elevation is c.111 mAOD.

The land adjacent to the Site is rural and used for agricultural purposes (including grazing pasture and tillage). Plantations of trees are located along the western and eastern edges of the Site. An area of 'heath' and scrub is located immediately adjacent to the south of the Site. Farmyards and individual residential properties are also present in the vicinity of the Site within the Study Area.

There are no licenced waste facilities within the Study Area shown on the EPA mapping (EPA, 2022). The waste facilities that are covered by this mapping include licensed, applied, surrendered and rejected waste facilities such as landfills, transfer stations, hazardous waste disposal and other significant waste disposal and recovery activities. There are also no Industrial Emissions Licensing facilities, Integrated Pollution Control (IPC) facilities or Integrated Pollution Prevention Control (IPPC) facilities shown on the same EPA mapping. The applicant operates a permitted Waste Facility to the southeast of the Site that accepts construction and demolition waste for recovery and recycling.

5.4.2 Soils

The presence and thickness of soils on Site is not known. No soils were logged or described in the boreholes logs that are included in the Resource Estimation report (Minerex Geophysics Limited, 2008). This may be because there were none (i.e. they had already been removed), or that the focus of the work was on the resource material beneath and any soils encountered were not reported.

The soils mapped in the area (EPA, 2022) include the following:

- Clonroche – a fine loamy drift with siliceous stones described as well draining. Part of the Brown Earth soils group. Overlying land use is described as improved grassland (fertiliser and ploughing). Thicknesses of soils are stated as greater than 80 cm.
- River – described as poorly draining river alluvium. Thicknesses of soils are stated as greater than 80 cm.

Clonroche soils will dominate areas away from the immediate river corridor, so it is reasonable to assume Clonroche soils would have been present over most of the Site prior to the initial excavation of the sands and gravels (i.e. pre-1990) and prior to the subsequent expansion of the quarry from 1990 onwards. Parts of the northern and eastern areas where the Newbawn watercourse flows past the Site may have, or have had, alluvial River soils cover.

In 1990, and onwards until present as the quarry expanded, soils located within the quarry footprint will have been removed in a programme aligned with production needs in order to expose the underlying material. Between 1990 and the present, the quarried area (and, therefore, the amount of soils stripped) has increased from 0.75 ha to 20.16 ha (an increase of 19.41 ha). Using a worst-case scenario of 1 m of soil being stripped over this time, ca. 194,100 m^3 of soils will have been removed. The soil has been placed in stockpiles in other parts of the Site (mainly on the eastern boundary) for future use in restoration activities.

5.4.3 Quaternary Superficial Geology

Superficial deposits that underlie the Site comprise glaciofluvial sand and gravels of sandstone and shale origin, undifferentiated alluvium and clayey till (EPA, 2022). The sands and gravels dominate the central part of the Site (Figure 5.9). Alluvium is mapped in the north, northwest and southeast of the Site. Smaller areas of till are mapped in the east and southwest.

The superficial deposits mapped in the wider Study Area are similar (i.e. a patchwork of glaciofluvial sand and gravels, undifferentiated alluvium and clayey till), but also include lacustrine (lake) sediments in the southwest of the Study Area. Although there is a mixture of deposits in the wider Study Area, till is the dominant superficial deposit within the 500 m buffer zone around the Site.

A site walkover conducted as part of previous work (Soils, Water and Geology Assessment - part of P.D Lane, 2014) indicates that the excavated material comprises grey-brown, lightly gravelly, fine to medium grained sand with occasional angular to rounded cobbles. Site investigation works (Minerex Geophysics Limited, 2008) indicate that the superficial deposits comprise greater than 8 m of interlayered sand and gravels with clay rich material, and that the sand and gravel lenses within this range in thickness from 1 m to 10 m. The total thickness

of superficial deposits at the Site is up to 13 m, and the thickness of gravels remaining at the Site typically ranges between 5 m and 8 m (WYG, 2009).

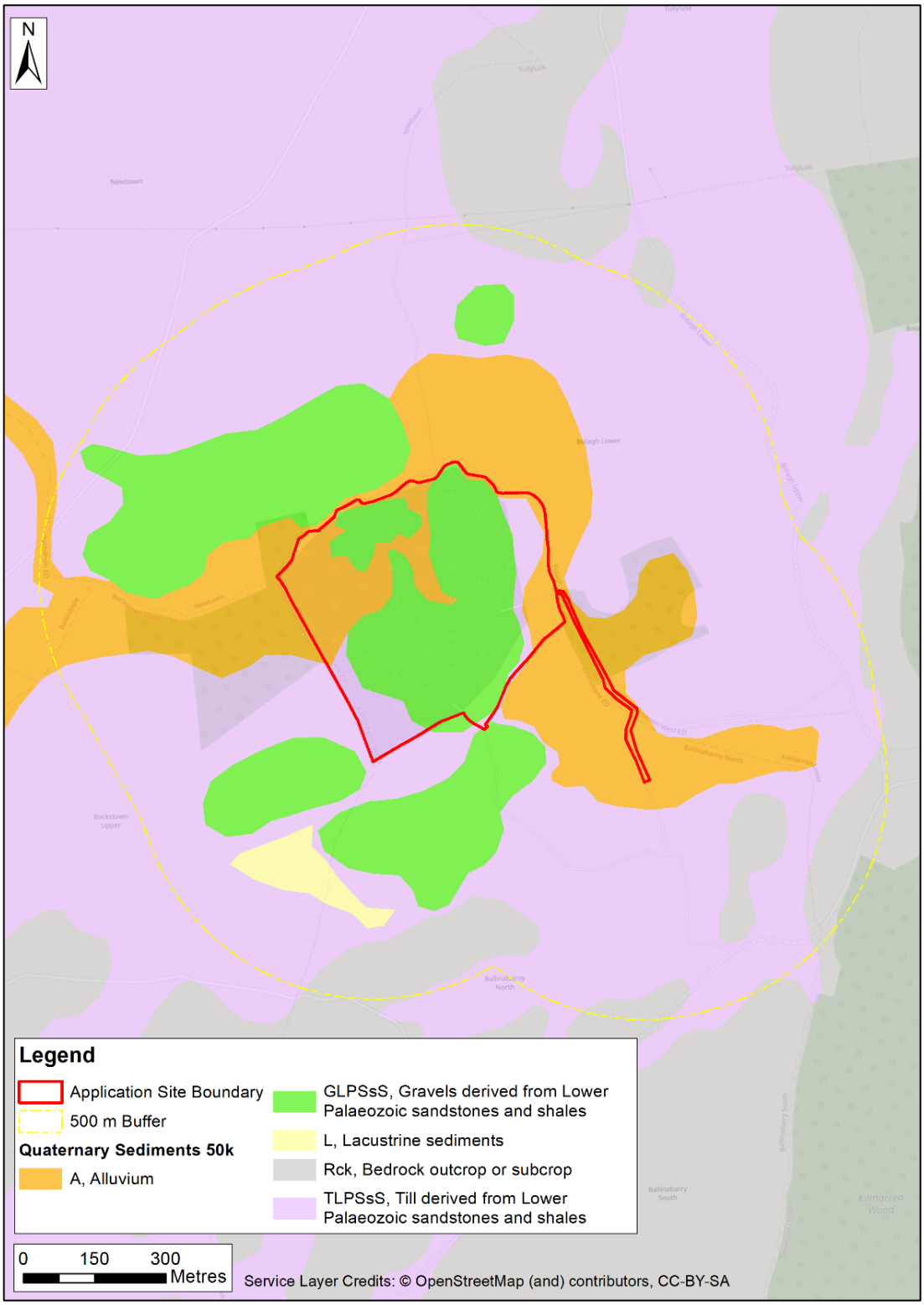


Figure 5.9: Quaternary Mapping (GSI, 2022)

5.4.4 Bedrock Geology

Based on the 1:100,000 scale geological mapping (GSI, 2022), the Site is underlain by the Ordovician Kilmacrea Formation, which is described as comprising buff-weathering grey and black slates and shales. Occasional pale grey sandstones and tuffs may occur within this formation (GSI, 2003). The Kilmacrea Formation is underlain unconfirmable by slates and siltstones of the Oaklands Formation (Minrex Geophysics Limited, 2008).

The area is heavily faulted with mainly north-south trending faults. No faults are mapped through the Site, but there are faults mapped within the wider Study Area.

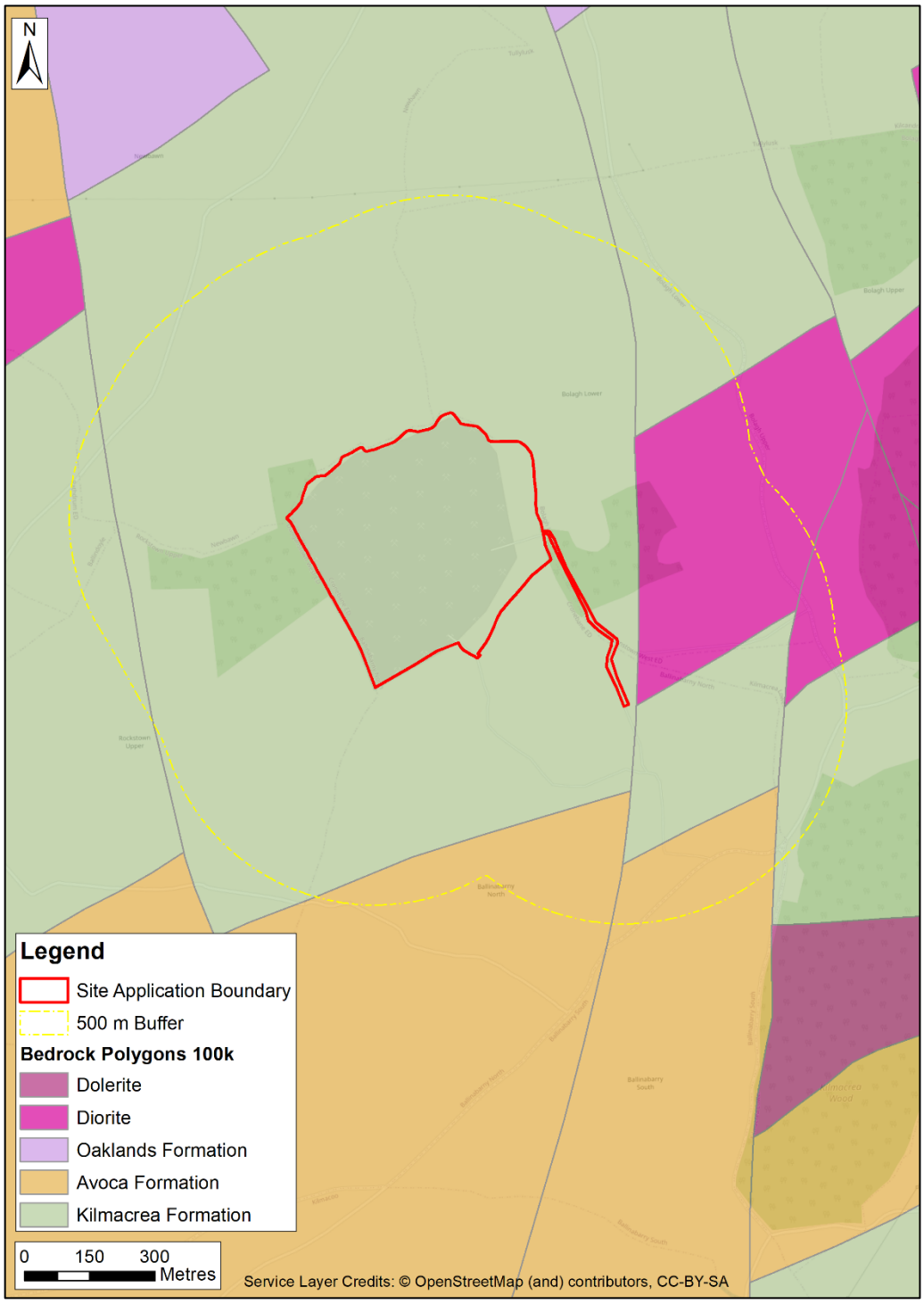


Figure 5.10: Bedrock Geology 1:100,000

5.4.5 Geological Assets and Aggregate Potential

Aerial photography indicates that, in addition to the Site, there have been some excavations to the south and southeast of the Site within the Study Area during the period 1990 to present. Bare ground is first shown in the 2000 imagery and is present in the 2004 and 2009 imagery. That ground was covered in vegetation by the time of the 2011 image.

The Geological Survey of Ireland produced mapping of active sand and gravel, crushed rock and dimension stone quarries (GSI, 2022). No active quarries are mapped in the Study Area.

The Geological Survey of Ireland compiles details on mineral localities and aggregate potential (GSI, 2022). Areas of moderate granular aggregate potential (relating to the sands and gravels) are mapped within much of the centre of the Site and to the south of the Site within the Study Area. Areas of low granular aggregate potential are mapped within the northwestern part of the Site and to the north and northwest of the Site within the Study Area. The Site and most of the Study Area are mapped as having moderate crushed rock aggregate potential, which relates to the Kilmacrea Formation.

The Geological Survey of Ireland also produces maps of mineral localities. There are no mineral localities (metallic, non-metallic or other) mapped within the Site or wider Study Area

5.4.6 Geohazards

The GSI's landslide susceptibility classification layer (GSI, 2022) indicates that the Site has a low (or low-inferred) classification. In the wider Study Area, the classification is low or moderately low. No previous landslides events are mapped.

5.4.7 Radon

The Radon Map for Ireland (EPA, 2022) indicates that the Site and Study Area are located in a High Radon Area where more than 20% of the homes are estimated to be above the reference level. A High Radon Area is classified by the EPA as any area where it is predicted that 10% or more of homes will exceed the Reference Level of 200 becquerel per cubic metre (Bq/m^3).

As radon is a naturally occurring gas derived from the decay of uranium in rocks and soils which is geologically controlled, the radon reference level during the period 1990 – 2022 is unlikely to have differed from the current reference level.

5.4.8 Geological Interest Sites

There are no sites designated for their geology or geological heritage sites located on Site or within the wider Study Area (GSI, 2021).

5.4.9 Selection of Sensitive Receptors

The changes in land use during the assessment period show that that as quarrying operations advanced, land use changed within the Site from agricultural use to extractive use and about 19.41 ha of agricultural land was lost during the assessment period. The baseline information suggests that the Site was, and the wider Study Area is, covered in either poorly draining soils of alluvial/river origin, or loamy drift. Loam is a mixture of clay, silt and sand. The loamy drift in the Study Area is described as well draining, but is largely used for grazing, or is covered in heath/scrub or trees, which suggests it may be less suitable for cultivating food crops. Typically, poorer quality agricultural land is used for permanent pasture or growing grasses, which indicates that the land in the Study Area might have, or have had, limitations on its agricultural use. This is supported by the Corine land cover mapping that classified the land as pasture and not used for arable farming or permanent crops.

The sands and gravels on Site have economic value as aggregate. This is the material that has been / is being extracted at the Site. There are other similar superficial deposits mapped in the Study Area, but their extent is limited and not all are mapped as having aggregate potential. There is mapped crushed rock potential that relates to the underlying bedrock. The bedrock has no special designation and is ubiquitous in the area.

No geological heritage sites have been identified as part of the baseline. Therefore, the impacts to, and effects on, geological sites have not been considered further in this assessment.

No likely contaminative land uses prior to quarrying have been identified; the Site was agricultural. It is unlikely that the quarry work would have mobilised existing contamination or that workers would have come into contact with contamination. Therefore, these land quality elements have not been considered further in this assessment.

Human receptors within the area (including workers onsite) had the potential to be impacted by the stability of material and faces at the Site and will be considered in the context of the human health receptor. However, it should be noted that this does not constitute a geotechnical/geohazard risk assessment.

Taking account of the above, and the receptor classification method described in Section 5.3, the receptors carried forward in this assessment and their assigned importance are presented in Table 5.5.

Table 5.5: Soil, Land and Geology Receptors

Receptor	Importance and Reasoning
Superficial deposits at the Site and within the study area	Low (no designation, locally limited extent, low-moderate resource potential/economic importance)
Bedrock Geology at the Site and within the study area	Low (no designation, no rarity, moderate crushed rock aggregate potential)
Land (agricultural land)	Negligible (no designation, no rarity, limited potential and value for agricultural uses other than grazing)
Human health at the Site and within the study area	High (human health receptor)

5.5 Characteristics of the Development

Historically, activities carried out onsite consisted of the stripping of overburden, mechanical excavation (i.e. excavator and loading shovel) of the underlying sands and gravels, and processing of the excavated material. During the assessment period (1990 – 2022) the extraction area expanded from an initial 0.75 ha with an lower basal elevation of 124 mAOD in 1990 to 20.16 ha in area and an lower basal elevation of 114 mAOD in the above the water table working areas. The extraction area expanded initially in a westerly and northerly direction up to 2000, then lateral expansion occurred in all directions between 2000 and 2009.

A total extraction volume of over ca. 1.48 million tonnes of aggregate has occurred from the Site over 32 years from 1990 to 2021 (inclusive). The volume of extraction from the sand and gravel pit during the period of the Development was on average around 50,000 tonnes per year.

Once excavated aggregate left the quarry void, it was transported to the aggregate plant (via internal haul routes) by truck for processing: washing, and screening and temporary storage prior to being sold into the market.

Stockpiles of finished sand and gravel products varied in size over time and have generally been stored within the south-eastern part of the Site.

Along with haul roads and areas of stockpiling, the Site, over the period of this assessment, comprised the following main types of area:

- Administration areas – largely concentrated in southern part of the Site – comprising car parking, office buildings (with canteen and toilet), septic tank, workshop/machinery shed, tool shed, storage containers and bunded diesel tanks on concrete slabs, well and pumphouse.
- A central mineral processing area – comprising washing and screening plant with associated stockpiles, electrical control room, storage container, a diesel generator container and electrical substation.
- The excavation area(s) – comprising the working area(s) at any point in time.
- Water and overburden management areas – comprising temporary silt storage area and settlement ponds adjacent to the processing plant.

The following working methods are also considered to be of relevance to the assessment of impacts on land, soils and geology:

- Water supply for the washing/screening plant was recycled from the system of settling lagoons/ponds where water was circulated in a closed loop system within the central part of the quarry. These ponds were regularly cleaned out of sediment build-up.
- The silt from these settling lagoons/ponds was excavated periodically and stockpiled temporarily near the processing plant until it was in a condition that is suitable for handling and transport. The material is kept within the quarry for use in restoration.
- Wastewater from the welfare facilities was discharged via the on-site septic tank – the contents of which were periodically tankered of-Site as needed. The septic tank had sufficient capacity to cater for the PE equivalent of average 30 persons arising from full time site employees, contractors and additional visitors.
- The quarry has not had a permanent wheel-wash facility for trucks departing the Site for that majority of the rEIAR assessment period, and there has, therefore, been no need to dispose of settled sediments that would otherwise have been associated with this type of dust suppression and cleaning system. A concrete basin and grate wheel wash was installed in 2016 on the access road in use. This is part of the operators recycling facility development and is also used by the quarry vehicles.
- Diesel kept on Site was generally only used by on-site vehicles. The maintenance workshop/machinery shed and yard area was originally powered by a diesel generator, but the power supply was later converted to 3-phase. There are two 2,500 litre double-skinned diesel tanks; one empty tank used as a back-up and another with on average approximately 300 litres stored. There were also two 3,000 litre double-skinned gas oil storage tanks; one tank empty as a back-up and the other storing on average 300 litres of gas oil fuel; however, the gas oil fuel is no longer used.
- Lubricant engine oil was generally stored within the maintenance workshop/machinery shed area. The engine oil was typically kept in standard sized drums. Waste oil was stored within designated Intermediate Bulk Containers (IBCs) that were temporarily located to the east of the maintenance workshop prior to disposal off-site.
- It is understood that generally no other waste materials were stored with the study area.
- Although the quarried product may be used in concrete, concrete was not manufactured or sold at the site.

Restoration will use the stored soils and sub-soils to return the land to agricultural use.

5.5.1 Embedded Mitigation

The following elements of the Project Description (Chapter 2) and the operational processes that were followed at the Site are considered to provide some historical and current mitigation of the potential impacts on land, soils and/or geology:

- The material was and is excavated mechanically – no blasting has or is taking place.
- The removal of soils and other overburden took place gradually in phases and the material was stored on-Site for use in restoration. Restoration has commenced in the south-eastern corner of the Site.
- Topsoil stripped at the Site was not stored in mounds higher than 3 m and was not moved in wet conditions (Scott Wilson Report, included in D. W. Lane, 2009).
- Silt that was dredged from the bottom of the settlement ponds was stored at least 5 m away from any watercourses and on land that has slopes away from the watercourse (P.D Lane Associates, 2009). Run-off from silt storage was directed to a holding/settlement pond.
- Once dried, the silt from the settlement lagoons/ponds was stored on-Site for use in the restoration of the Site.
- The contents of the septic tank were periodically tankered of-Site as needed. There have been no known issues with the septic tank and the system was serviced regularly.
- Fuel storage was typically in double skinned tanks located on concrete aprons in the maintenance area. Refuelling occurred at these tanks over a concrete apron. Fuel for the Site was delivered regularly as bulk liquid by a dedicated mobile tanker.
- Oils, chemicals and admixtures were ordered and used as needed (avoiding large quantities being stored on Site).
- Used oil and chemical containers were stored within the maintenance area for disposal by a licensed contractor.
- Intermediate Bulk Containers, in which waste oil was stored, were sealed and it is understood that their integrity were monitored by on-site personnel.
- The waste arising on-site comprised municipal waste from staff welfare activities and was disposed of via domestic waste collection.
- Scrap metal arising on-site was stored within a designated area at the Site prior to collection by a licensed waste contractor.
- Sludge from the wheel wash (operated as part of the recycling facility rather than the quarry) was taken off-Site for disposal at an appropriate facility.
- Perimeter fencing was actively maintained to ensure that the risk of injury to civilians or animals was minimised. The entrance gate was locked and controlled by the Site management.
- Catch-berms have been placed along non-active faces, and warnings were used to limit access to non-active faces.

5.6 Potential Effects

The main potential impacts and associated effects that are considered in the assessment relate to the following:

- Activities or events that might have impacted land quality and associated human health (e.g. leaks and spills from machinery or stored substances, or discharges);
- Change of land use/land take (i.e. loss of agricultural lands);
- Loss of soils and superficial deposits;
- Sterilisation of the underlying geological resource; and
- Destabilisation and/or subsidence of unconsolidated material in stockpiles or on worked faces.

5.6.1 Land Quality

The following potential sources that could have impacted land quality at the Site have been identified:

- Leaks or spills from stored fuel/other substances;
- Leak or spills while transporting or offloading fuel/other substances;
- Leaks or spills from vehicles/machinery/equipment used or maintained during development; and
- Leaks from the on-Site septic tank.

Such sources could have affected the chemistry of the soil (where it was still in-situ) and migrated vertically and impacted the quality of the underlying geology. Where soils have been removed, this exposed the underlying superficial deposits. Where the superficial deposits have also been removed, or partially removed, this will have removed cover above the bedrock. The removal of covering materials makes the underlying material more vulnerable to pollution from contamination events and the superficial and/or bedrock geology has the potential to be directly impacted.

There is no land quality data available, so water quality during the assessment period (see Chapter 6) has been used as a proxy to determine if land is likely to have been contaminated. The water quality data indicates that groundwater and surface water quality has been generally good. Given the potential sources to ground mostly comprise fuel/oils and the septic tank discharge, some observations in relation to hydrocarbon and faecal coliform / nitrogen results in water are highlighted below:

- Groundwater
  - March 2008 sample Diesel Range Organics (DRO) and mineral oil concentrations were above drinking water regulation concentrations in BH2, which is located in the middle of the Site, but concentrations in a subsequent sample taken later in 2008 were not elevated.
  - 2016 samples showed elevated counts of faecal coliform in MW4 (>100 cfu/100ml) and BH2 (20 cfu/100ml). BH2 is located down-gradient of the on-Site septic tank. There were no exceedances of the water quality standards used for screening the concentrations of metals, DRO or mineral oil.
  - 2017 samples showed an elevated count of faecal coliform counts in MW5 (12 cfu/100ml), and an elevated concentration of mineral oil in MW5 (19 µg/l) that exceeded the water quality standard of 10 µg/l that was used for screening.
  - 2020/2021 samples showed that exceedances of European Communities Environmental Objectives (Groundwater) Regulations 2010 for ammoniacal nitrogen as NH_4 (threshold value 0.065 mg/l) were recorded on 17 August 2020 for samples taken from boreholes MW3 (0.11 mg/l) and MW5 (0.59 mg/l), and on 27 July 2021 for boreholes GWL (0.07 mg/l), BH2 (0.13 mg/l), MW5 (0.1 mg/l) and MW3 (0.42 mg/l).

- Surface Water
  - Groundwater flows northwest towards the surface watercourse located along the northern boundary, so groundwater may have an input to surface water at this location.
  - No hydrocarbons at concentrations above the selected screening criteria have been detected in any surface water samples.
  - Faecal coliforms were detected in a sample taken from SW4 in 2016. SW4 is located up-stream of the Site, so it is unlikely that on-Site activities are the source of this. No analysis of faecal coliforms has been undertaken since, but no concentrations of nitrate, nitrite or ammoniacal nitrogen above the selected screening criteria were found in the 2020/2021 sampling.

Overall, there does not seem to have been any repeat of the early 2008 elevated concentrations of hydrocarbons in the water environment. There is historical evidence of potential input to the water environment from the septic tank, which discharges to ground, so the discharge may also have led to a change in land quality around the discharge location.

There is likely to have been some measurable change to land quality (specifically soils and superficial deposits) as a result of the septic tank discharge, so potential impact on land quality is considered to have been **low (adverse).** There is less likely to have been an impact on the deeper bedrock quality, so the potential impact is considered to have been **negligible (adverse).**

The land around the septic tank discharge point is unlikely to be handled directly by workers, so the potential impact on human health is considered to have been **negligible (adverse).**

5.6.2 Change of Land Use/Land Take

There has been a loss of agricultural land as a result of the quarry expansion between 1990 and the present. The land use surrounding the quarry remains dominated by agriculture. Largely, the use is for tillage and pasture rather than commercial horticultural crops, which would be grown on higher quality soils. It has been assumed that the agricultural land lost to quarrying activities was of a similar nature and that there were also lower quality, poorly draining soils near the watercourses (as indicated by the marshy land on historical mapping). The loss of agricultural land as a result of the quarry expansion equates to 19.41 ha between the baseline and present. This is measurable, but unlikely to be perceptible within the surrounding rural area that is dominated by the same land use. Therefore, the potential impact on agricultural land is considered to have been **low (adverse).**

5.6.3 Loss of Soils and Superficial Deposits

The nature of the Development involves the removal of sands and gravels from the superficial deposits for processing and sale, which will result in permanent loss from the Site. It also involves the removal and storage of overburden that comprises stripped soils and superficial deposits unsuitable for processing. The impact on these can be considered temporary in nature, as they will be stored for reuse as a fundamental part of the Site's restoration. The potential magnitude of the impacts on superficial deposits is considered to be **low (adverse).**

5.6.4 Sterilisation of Geological Resources

Quarrying activities have been focussed on the superficial sands and gravels; therefore, that geological resource has been being exploited and is not sterilised. Operations that have been taking place above the bedrock have precluded extraction of the bedrock below and effectively temporarily sterilised the potential bedrock resource while sand and gravel quarrying is taking place. However, there was no known intention to excavate bedrock at the Site. The quarry is relatively small and the bedrock geology is ubiquitous in the area; therefore, there would have been other areas where the moderate crushed rock aggregate potential could have been

investigated and exploited, if required. Therefore, the potential impact of the sterilisation of bedrock geological resources is considered to have been **negligible (adverse).**

5.6.5 Stockpile and Slope Instability

Works at the Site took account of the nature of the materials being handled in order to make sure that slopes and stockpiles created were stable. There were no known collapse events within the quarry during the assessment period that could have impacted the surrounding lands or human receptors within the Site or beyond. Stockpiles dimensions and locations are managed, and berms were used to provide catch protection, where required. The stability of excavations and stockpiles is considered to have had a **negligible (adverse)** potential impact on humans.

5.6.6 Evaluation of Effects

The evaluation of effects takes into account the impact magnitude combined with receptor sensitivity using the method presented in Section 5.3. The evaluation of effect significance for each of the receptors discussed above (taking account of the embedded mitigation) is presented in Table 5.6.

All effects considered have a significance of ‘slight’ or less, which are not considered to be ‘significant’ for the purposes of this assessment. Therefore, no remedial mitigation measures to reduce the effect significance further are defined and no further assessment of residual effects has been undertaken.

Table 5.6: Evaluation of Initial Impacts and their Effect Significance

Receptor	Sensitivity	Source of Impact/Description of Change*	Impact Magnitude*	Level of Effect *	Duration and Nature*
Superficial deposits	Low	Loss/removal of superficial deposits at the Site.	Low (adverse)	Slight (adverse)	Resource – Permanent, direct, irreversible Overburden - Long term, direct, reversible
		Contamination by leaks and spills from machinery or stored substances, or discharges.	Low (adverse)	Slight (adverse)	Long term to permanent, reversible, direct
Bedrock Geology	Low	Sterilisation of bedrock economic resources.	Negligible (adverse)	Imperceptible (adverse)	Long term, direct, reversible
		Contamination by leaks and spills from machinery or stored substances, or discharges.	Negligible (adverse).	Imperceptible (adverse)	Long term to permanent, reversible, direct or indirect
Land (agricultural land)	Negligible	Change in land use - advancement of the extraction area through time and a loss of agricultural lands.	Low (adverse)	Imperceptible (adverse)	Long term, direct, reversible
Humans (site workers)	High	Geotechnical instability of stockpiles, quarry faces and slopes.	Negligible (adverse)	Slight (adverse)	Temporary to permanent and reversible to irreversible (depending on the resultant impact on the human), indirect
		Contact with contaminated soil/superficial deposits (e.g. ingestion, dermal contact, inhalation).	Negligible (adverse)	Slight (adverse)	Temporary to permanent and reversible to irreversible (depending on the resultant impact on the human), indirect

** Taking account of embedded mitigation*

5.7 Cumulative Impacts

For the purposes of this assessment, the activity of the nearest similar surface quarry in the local area has been considered. Other development, such as the construction of individual houses, is likely to have been on a much smaller scale and has not been considered.

Throughout the assessment period quarrying activities have taken place approximately 2.5 km to the north-west of the Site (centre of quarry to centre of quarry) at Balleese Wood Quarry. This quarry is on a similar scale to the Site and has carried out similar extractive and ancillary processes. Therefore, the operation of Balleese Wood Quarry will have had the potential to have similar sources of impact to land, soils and geology as the Site. The potential impacts would also have been largely localised to Balleese Wood Quarry, like they have been at the Site. Given the distances between the developments, and their relative size compared to the area of agricultural land available in the region, it is considered that there will have been no significant cumulative effects of their activities on the surrounding environment in terms of land, soils and geology.

5.8 Remedial Mitigation and Monitoring

All effects considered have a significance of ‘slight’ or less, so no additional remedial mitigation to reduce the significance of the effects is required.

The ongoing monitoring programme at the Site provided regular stability checks of the quarry faces. General Site inspections covered visual evidence of leaks and spills, and monitoring of groundwater quality (see Chapter 6) supported the understanding as to whether there have been events that could have resulted in land pollution.

5.9 Difficulties Encountered

Understanding, retrospectively, the activities and management methods that have taken place at the Site and when, has been a difficulty in this assessment due to the long period of working and limited records. However, it is considered that the information provided present a reasonable basis for this assessment.

5.10 References

1) Department of the Environment, Quarries and Ancillary Activities, Guidelines for Planning Authorities 2004.

2) Environmental Impact Assessments of Projects Guidance on the Preparation of the Environmental Impact Assessment Report (Directive 2011/92/EU as amended by 2014/52/EU). European Commission 2018.

3) Environmental Protection Agency (EPA), 2022: Online Mapping - https://gis.epa.ie/EPAMaps/ accessed 4 May 2022.

4) EU Environmental Impact Assessment Directive (Council Directive 2014/52/EU).

5) Geological Survey of Ireland (GSI), 2022: Spatial Resources Online Mapping - https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228 accessed 9 March 2022.

6) Geological Survey of Ireland (GSI), March 2003. Wicklow County Council Groundwater Protection Scheme.

7) Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment, Department of Environment, Community and Local Government, 2018.

8) Health and Safety Authority's, 2008, Guidelines to the Safety, Health and Welfare at Work (Quarries) Regulations.

9) Minrex Geophysics Limited, 2008. Sand & Gravel Resource Estimation Redcross, Co. Wicklow. Geophysical Survey. Report ref: 5285d-005, dated 21 October 2008.

10) Ordnance Survey of Ireland, 2022: Online mapping portal: https://webapps.geohive.ie/mapviewer/index.html, accessed 4 May 2022.

11) P.D Lane Associates, 2009: Planning Application Additional Information / Revised Plans Ref. 08/1153.

12) P.D Lane Associates, 2014: Remedial EIS for quarry at Ballinabarny North & Bolagh Lower, Redcross, Co. Wicklow