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Westmeath County Council

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5th July 2002.

Planning File Ref. No. 98/1241
Lagan Cement Ltd.
Access Road and associated development works to provide vehicular access from the N.6 N.P. road at Kinnegad Td., Kinnegad, Co. Westmeath, to the proposed Landsdown Cement plant and assoc. quarry developments at Killiskillen and Cappoboggan, Co. Meath.

A Chara

I enclose herewith copy of EIS received by Westmeath County Council as part of the above planning application.

Mise, le meas,

Administrative Officer,
Planning.

LANSDOWN CEMENT WORKS
ENVIRONMENTAL IMPACT STATEMENT

To Accompany a Planning Application by LAGAN CEMENT LIMITED

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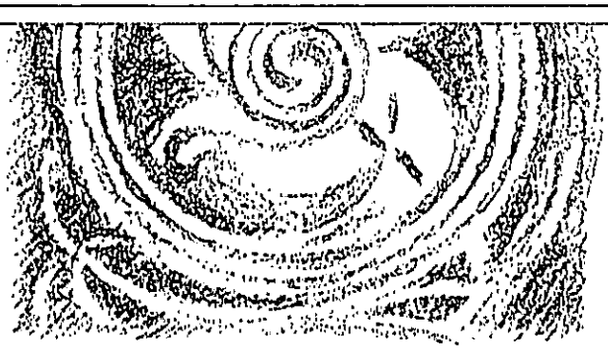
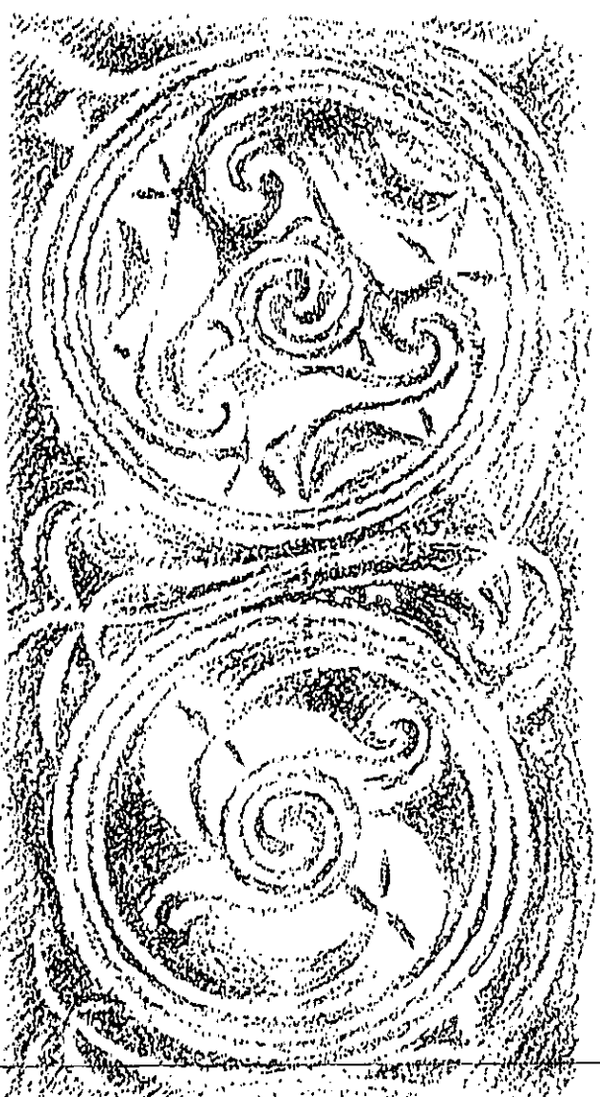
SECTION 1:
INTRODUCTION





1.1 PREAMBLE

Lagan Cement Limited is applying to Meath County Council for planning permission to erect and operate a new state-of-the-art cement works, and to quarry limestone and shale, on an overall site of approximately 161.8 hectares (400 acres), in the townlands of Killaskillen and Capaboggan in County Meath. The proposal will involve the manufacture of both white and grey cement from the deposit of limestone within the site.

It is estimated that the construction phase of the project will take up to 2 years and that the operational phase of the development will last for approximately 50 years.

The EIS has been prepared in accordance with the requirements of:

1. Sections 2 (d) and (i) of Part II of the First Schedule of the *European Communities (Environmental Impact Assessment) Regulations, 1989* (S.I. No. 349 of 1989)
2. The proposed changes in SI No 349/89 which will be necessary to implement Directive 97/11/EC.
3. The provisions of Article 24 (1) of the *Local Government (Planning and Development) Regulations, 1994* (S.I. No. 86 of 1994).

Part II of the First Schedule of S.I. No. 349 of 1989 requires that an EIS is prepared in respect of:

'2. *(d) Extraction of stone, gravel, sand or clay, where the area involved would be greater than 5 hectares.*

2. (i) All installations for the manufacture of cement.'

Article 24 (1) of S.I. No. 86 of 1994 states that:

'24(1) subject to sub-article (2), a planning application in respect of -

(a) development which is of a class for the time being specified under Article 24 of the Environmental Impact Assessment Regulations, or under any provision amending or replacing the said Article 24, or

(b) development which would be of a class referred to in paragraph (a) but for not exceeding a quantity, area or other limit for the time being specified in relation to that class and which comprises or is for the purposes of an activity in relation to which a license under Part IV of the Environmental Protection Agency Act, 1992 is required,

shall, in addition to the other requirements of this Part, be accompanied by an environmental impact statement.'

The production of cement is listed in the First Schedule of the *Environmental Protection Agency Act, 1992*. Accordingly, an Integrated Pollution Control License is required for the proposed development. An application for an IPC licence is to be made to the Environmental Protection Agency, and this EIS and related material will form part of that application.

1.1.1 List Of Contributors And Experts

The EIS was produced by Michael Cooke & Associates, David Jarvis Associates Limited, Geoffrey Walton Practice and Frank L. Benson and Partners. Specialist Inputs have been provided by:

Frank L. Benson and Partners Hainault House 69-71 St Stephen's Green Dublin 2	*Planning and Development Consultants*
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David Jarvis Associates Limited Landscape Architects and Planners 1 Tennyson Street, Swindon, Wiltshire, England	*Landscape and Visual*
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Roger Goodwillie and Associates Lavistown House, Kilkenny.	*Flora and Fauna*
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Mark Fermor Environmental Solutions Limited. 20 High Street, Shrewsbury, England.	*Hydrogeology*
Michael Cooke and Associates 7 Stockton Park. Castleknock, Dublin 15.	*Introduction, Human Beings, Interactions, Material Assets, Roads and Transportation*
BMA Unit 6, Woodbine Park, Blackrock, County Dublin.	*Geophysical Investigations and Well Survey*
Eddie McQuinn Consultancy Services Ltd Oakview Brewery Road Tralee, Co Kerry	*Agriculture*

Dr Yvonne Scannell — *Environmental Law*
Arthur Cox & Co, Dublin

In addition, a number of contractors were employed in specialist data collection, analysis etc. These included Peter Roe, S. Regan and Co., Drilling 2000, Ceram Research and PCA Mapping Limited.

1.1.2 Difficulties In Compiling Information

No great difficulties were encountered in compiling information for this Environmental Impact Statement.

1.1.3 Non-Technical Summary

A copy of the Non-Technical Summary of the Environmental Impact Statement is provided as a separate and self-contained document, and is available to the public at the offices of the Planning Department, Meath County Council.

1.2 EIS SCOPING AND CONTENT

The Lagan Group has always taken a responsible attitude to environmental considerations in all of its operations, and as part of the scoping exercise, all topics specified in the Environmental Impact Assessment Regulations have been assessed.

1.2.1 The Purpose And Scope Of The Environmental Impact Statement

Environmental Impact Assessment (EIA) may be defined as a systematic integrated evaluation of both the positive and negative impacts of a project on the natural environment, on beneficial uses of the environment, including man-made structures, amenities and facilities, and the socio-cultural environment. The aim of the approach is to identify and predict, for a given proposed development, any impacts of consequence; to describe the means and extent by which they can be reduced or ameliorated; to interpret and communicate information about the impacts; and to provide an input into the decision-making and planning processes.

An Environmental Impact Statement (EIS) is a key component of the impact assessment procedure. In preparing this EIS, full consideration was afforded to the information specified in paragraph 2 of the Second Schedule of the *European Communities (Environmental Impact Assessment) Regulations, 1989* (S.I. No. 349 of 1989), as amended by Article 3 of Directive 97/11/EC. Accordingly, the document is structured as follows:

Section 1. Preamble and Introduction.

Section 2. A description of the development proposed, comprising information about the site, design, nature and scale of the development.

Section 3. The data necessary to identify and assess the direct and indirect effects of the project on the following factors:

- human beings, flora and fauna;
- soil, water, air, climate and the landscape;
- material assets and the cultural heritage;
- the interactions between the factors mentioned in the first, second and third indents;

and, the measures envisaged in order to avoid, reduce or remedy any significant adverse effects which are identified with respect to any of the foregoing.

On the basis of the foregoing, a detailed Scoping exercise was conducted to establish the range and aspects of the environment to be considered. This exercise was conducted following consultations between The Lagan Group and its subsidiary, Lagan Cement Ltd., its professional advisors, and with Meath County Council, the Planning Authority for the area, and the Environmental Protection Agency. The scoping exercise involved a number of site visits, the collection of readily available initial data (i.e. published data), and initial conversations with interested parties. In this regard, a formal Scoping exercise was carried out by the Planning Authority and the applicant and its advisors.

In summary, the Scoping exercise afforded due regard to the following:

- The requirements of the EU Directive, the *European Communities (Environmental Impact Assessment) Regulations, 1989*, and the *Local Government (Planning and Development) Regulations, 1994.*
- Guidelines on the recommended information to be contained in Environmental Impact Statements, published by the Environmental Protection Agency.
- The requirements of Meath County Council, as elaborated in the current County Development Plan and as advised by the Planning and Engineering Officers, to facilitate evaluation of the proposed development.
- The advice and recommendations of the Environmental Protection Agency.
- The likely concerns of local residents and other third parties.
- The nature, location and scale of the proposal.
- Site visits to assess the existing environment, as well as any vulnerable or sensitive features and current uses.
- The likely and significant impacts of the proposed development on the environment.
- Available methods of reducing or eliminating undesirable impacts.
- The need for the eventual rehabilitation of the site.

From the scoping exercise, it was decided that any potential significant impacts on the environment were most likely to arise in respect of the following aspects of the environment, which have been afforded detailed and comprehensive assessment in the preparation of the EIS:

- Ecology (Flora and Fauna)
- Hydrogeology and Hydrology
- Noise
- Dust
- Vibration and Air Over-pressure
- Landscape
- Cultural Heritage (Archaeology)
- Roads and Transportation

To this end, specialist consultants were commissioned to prepare professional reports to address, in particular, these key issues.

1.2.2 Format Of The Environmental Impact Statement

Environmental Impact Statements require the assimilation, co-ordination and presentation of a wide range of relevant information in order to allow for the overall assessment of a proposed development. To allow for ease of presentation, and consistency when considering the various elements of the environment and the proposed development, a systematic structure based on the guidelines contained in the EPA's *Advice Notes on Current Practice* has been utilised.

Using this format, the EIS comprises 4 principal sections:

Section 1	The Introduction
Section 2	The Description of the Development
Section 3	The description of the Environment, Impacts and Mitigation Measures
Section 4	The Appendices pertaining to Sections 2 and 3

Section 3 is made up of a number of sub-sections, each of which addresses a particular topic or aspect of the environment. The existing environment, the likely impacts on this environment and mitigation measures proposed to ameliorate or avoid any identified impacts are all described, for the topic in question, within each sub-section. The sub-sections have been compiled by a number of the specialist consultants listed above.

1.3 THE PROPOSAL

Lagan Cement Limited is applying to Meath County Council for planning permission to erect and operate a new state-of-the-art cement works and to quarry limestone and shale at Killaskillen in County Meath. The proposal will involve the manufacture of both white and grey cement from the deposit of limestone. A detailed description of the proposed development and all site activities is contained in Section 2, below.

1.4 THE SITE

The application site occupies 161.8 hectares, at least 64 hectares of which will remain in agricultural use. It lies between 2.5 and 4.5 km southwest of Kinnegad and 1.2 to 3.5 km north of Ballinabrackey in County Meath (see Drawing 1.1). It is approximately 60 km by road from Dublin and Athlone, and Mullingar is located approximately 17 km to the northwest. The site conditions, in terms of landscape and geology, are described in detail in section 3.7 and 2.2 respectively.

The site borders the Kinnegad River to the north and straddles a County Road under which a connecting underpass is proposed. The proposed shale quarry and sand and gravel workings lie to the north of this road, with the limestone quarry and the works lying to the south. Cement is produced from kilning carefully controlled mixes of shale and limestone. The sand and gravel available on site will be used for construction works.

The lowest part of the site lies along the Kinnegad River at approximately 70 mOD. The ground surface rises to 90-92m OD west and southeast of Lansdown Lodge. The major part of the site is a landholding attached to Lansdown Lodge, a much altered building dating from the last century. The northern side of the site on land north of Lansdown Lodge drains to the Kinnegad River, whilst the remainder of the site drains to the west and ultimately to the same river.

The works will be located on the western side of the site, towards the southern boundary, where it is well screened by higher land to the north. Neither the works nor the limestone quarry will encroach into an area of raised peat bog in the southernmost part of the site. The plant area will be sunk approximately 3-5m below existing ground level. This combined with landscaped banks up to 20m high, and containing more than 1.5Mm3, of overburden will assist in screening the lower part of the works.

Details of works and the quarries, their processes, development and eventual site restoration are fully considered in Sections 2 and 3. It should be noted that this is a long term development with a lifespan of at least 40 to 50 years, and probably much longer.

1.5 SITE SELECTION AND CONSIDERATION OF ALTERNATIVES

From the outset the company identified a number of key constraints in site selection which are as follows:-

- Suitable location with respect to the market.
- Adequate raw materials and availability of land.
- Suitability of access.
- Limited environmental impacts.

The search area for the works was drawn widely and covered most of the central and northern part of the country. Following detailed desk study searches involving more than a dozen sites, actual site investigations were only possible on four locations where the company managed to acquire ownership or to agree purchase arrangements. The principal difficulties were identifying mineral deposits in sufficiently remote areas with large land holdings to provide an adequate resource. In many places, land ownership was fragmented and it was not possible to acquire a reasonably sized land holding for both works and the quarry.

With regard to the necessary natural resource, namely limestone, economically workable reserves must be worked where they are found. In this regard, the co-incidence of quality limestone and shale in economically workable reserves in sufficient volumes on the subject site is a significant natural resource of national importance. The limestone is high quality and particularly suited to the manufacture of white cement. In this regard, Jan Boie, an eminent international consultant in the manufacture of cement, describes the reserve as follows:-

'Your limestone is naturally so pure, that with the finest additives like kaolin, a whiteness of 96% would be achievable. That would manufacture the finest white cement in the world!'

1.6 THE COMPANY

1.6.1 Background

Lagan Cement Ltd. is part of the Lagan Group. Headquartered in Belfast, the Lagan name has been synonymous with the quarrying and construction industries for over 30 years in Northern Ireland. The Group is engaged in construction, surfacing, civil and marine engineering and the manufacture and supply of building materials, including aggregates, sand, cement and clay products.

In the Republic, the Lagan Group has an integrated quarrying, asphalt and bitumen emulsion plant at Ballycoolin, Blanchardstown, Co. Dublin, which is fully licensed by the Environmental Protection Agency. It also owns Kingscourt Brick in Co. Cavan and

Flemings Fireclays in Athy, Co. Kildare.

The Group employs over 500 people, including 150 in the Republic.

The Lagan Group's skills in surfacing have also won them contracts for airport runways in Britain and at the new airport in Hong Kong. In 1997 Group turnover was over £72 million sterling; pre-tax profits totalled £8.6 million sterling, and net assets were £33 million.

All the relevant companies in the Lagan Group have obtained ISO 9002 Quality Standard Accreditation and progress is well advanced towards the achievement of ISO 14001 Environmental Management Systems.

1.6.2 Lagan Cement Limited

In consequence of the group's activities, the Lagan Group is a major importer of cement into Ireland using the group's silo facilities located at Belfast port. This cement (amounting to circa 200,000 tonnes per annum) is used not only by the group's companies, but by other concrete manufacturers in Ireland.

For some time the Lagan Group has been seeking to establish its own cement manufacturing facilities, including the production of specialist white cement for use in international construction projects. The proposed site at Killaskillen (now to be known as the Lansdown site) represents the culmination of prolonged investigations and geological research.

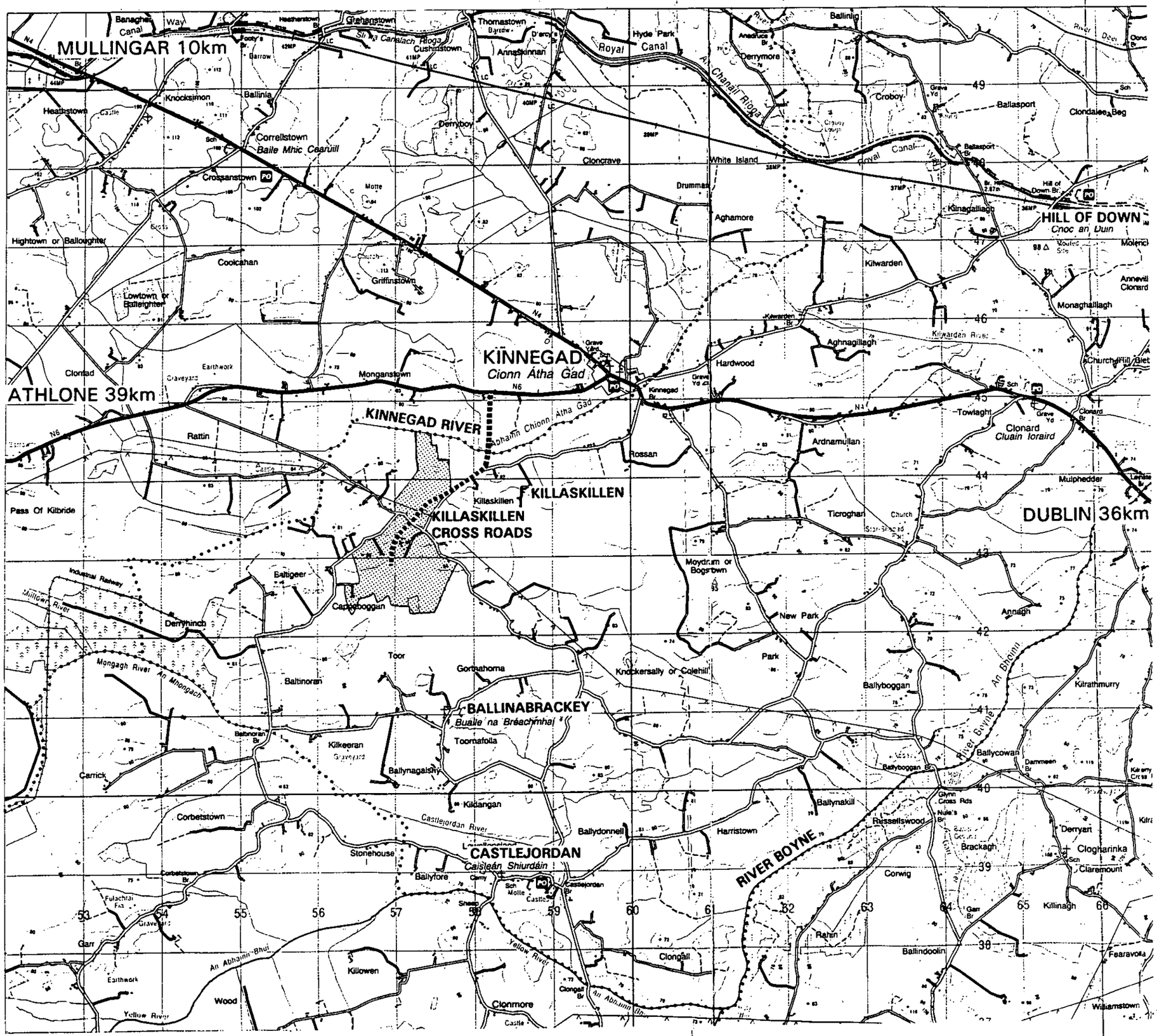
In relation to the site and its geological deposits, Professor G. Walton of the Geoffrey Walton Practice has stated the following:

'In the Lansdown site there exists a deposit of such very high quality limestone with such excellent lightness characteristics that it has been proven to be uniquely suited to the production of white cement. In addition to this, about two thirds of the required shale additive for the production of Ordinary Portland Cement (OPC) is also available on the same landholding.'

The cement works, which will comprise state-of-the-art facilities, has been designed by an international authority on cement works equipment and will accommodate all the necessary environmental protection measures. It will be the only cement works in Ireland or Great Britain to produce white cement.

It is the intention of the company to produce approximately 150,000t of white cement and approximately 300,000t of Ordinary Portland Cement (OPC) per annum. This will reduce the firm's dependence on a major imported component for many of its own activities, as well as contributing to the nation's exports by selling white cement into Europe and the east coast of North America. Some of the OPC will be sold into the Irish market as at present.

It is intended that over 200 permanent jobs will be created in the project directly as a result of this £40 million development by the Lagan Group. Further employment opportunities will be created for local service industries.


MULLINGAR 10km
ATHLONE 39km
DUBLIN 36km
KINNEGAD
Cionn Átha Gad
KINNEGAD RIVER
KILLASKILLEN
KILLASKILLEN CROSS ROADS
BALLINABRACKEY
Buaile na Bréachmhaí
CASTLEJORDAN
Caisleán Shiurdáin
HILL OF DOWN
Cnoc an Duin
RIVER BOYNE
Royal Canal
Hyde Park Canal
Banagher Canal
Slí na Canálach Ríoga
An Chanáil Ríoga
Grand Canal
Mongagh River An Mhongach
Milltown River
Yellow River
An Abhainn Bhuí
Abhainn Chionn Átha Gad
Kilwarden River
River Deel
River Boyne
An Bhroinn
Industrial Railway
Heathstown Castle
Knocksimon
Ballinla
Correlstown
Baile Mhic Cearúill
Crossanstown
Hightown or Ballooghter
Cookahan
Griffinstown
Lowtown or Balleighter
Clontad
Graveyard
Earthwork
Monganstown
Rattin
Pass Of Kilbride
Baltigeer
Cappaboggan
Derryninch
Baltinoran
Toor
Gortnahorna
Kilkeeran
Carrick
Corbetstown
Stonehouse
Ballyfore
Fulachtai Fia
Garr
Killowen
Wood
Clonmore
Castle
Ballydonnell
Ballynagalshy
Kildangan
Toornafolla
Knockersally or Colehill
Moydrum or Bogstown
Ticroghan
Church
Rossan
Ardnamullan
Clonard
Cluain Ioraird
Towlaght
Aghnagillagh
Hardwood
Kilwarden
Aghamore
Drumman
White Island
Cloncrave
Derryboy
Annaskinnan
Thomastown
Cushinstown
Barrow
Derrymore
Croboy
Ballasport
Clondalee Beg
Kinagallagh
Monaghallagh
Annevill
Clonard
Molenc
Mulphedder
Lenaste
Harristown
Ballynakill
Russellswood
Brackagh
Derryan
Clogharinka
Claremount
Corwig
Killinagh
Rahin
Ballindoolin
Fearavoka
Williamstown
New Park
Park
Annagh
Kilrathmurry
Ballycowan
Ballyboggan
Glynn Cross Rds
Nule's Br
Dammeen Br
Hill of Down Br
Clonard Br
Kinnegad Br
Castlejordan Br
Clongall Br
Garr Br
Yellow River Br
Batinoran Br
Graveyard
Church
Motte
Castle
Sch
Graveyard
Earthwork
Quarry
Works
Disused Sand Pit
Graveyard
Graveyard
Graveyard

SECTION 2:

DESCRIPTION OF THE DEVELOPMENT

THE CEMENT WORKS PROCESS 2.1
THE QUARRYING PROCESS 2.2

2. DESCRIPTION OF THE DEVELOPMENT

This section includes two principal elements, the cement works (2.1) and the limestone and shale quarries (2.2). The general requirements of project description for an Environmental Impact Statement (EIS) have been followed. Reference has been made to other sections of this EIS where it is considered appropriate to avoid undue repetition.

As noted in Section 1 this site lies approximately 3.5km southwest of Kinnegad and 2.5km north of Ballinabrackey. It is located south of the Kinnegad River in the central lowlands of Ireland in County Meath.

The local landscape and site features are covered in Section 3.7. Drawing No. 2.1.1A shows the boundary of the subject site and 1.0m interval contours based on a recent topographical survey. The site occupies 160.0 hectares of which the proposed development including stand-offs and screening banks will occupy all but 64 hectares.

A layout of the proposed site including both the plant and quarries is shown in Drawing No. 2.1.1B. As may be seen the proposed works are located on the western side of the site adjacent to the limestone quarry to the east. The northern part of the site contains a shale quarry, two areas for the recovery of sand and gravel and the main water handling structures for the proposed operations.

An existing 220 kv overhead electricity line crosses the northern (shale quarry) site. Any development in the vicinity of this line will comply with any safety clearances or other restrictions imposed by ESB.

2.1 THE CEMENT WORKS PROCESS

2.1.1 Introduction

The construction, operation and decommissioning/site restoration represent three distinct phases of the project. The development of the works and the quarries are of necessity interlinked. The whole project life will extend to at least 40 to 50 years during which time changes in the cement works (and the quarries) may be expected to comply with best practice and technical developments.

The construction phase is considered in more detail in Section 2.1.3. It will last for up to 2 years and comprise both the erection of the plant, following site preparation and foundation construction, and the formation of large screening banks up to 20m high. These screening banks will accommodate material excavated during the plant site preparation. Parts of the plant site will be lowered by 3 to 5m to provide adequate foundations and to lower the works in the landscape. The screening banks will also take overburden material from the quarry areas in the manner indicated in Section 2.2. Commissioning of the plant will take place during the last 6 months of this phase when the principal elements of the plant have been installed and the screening banks to the north, west and south of the works are in place.

The operational phase will last at least 40 years; there is more than sufficient limestone on site for this period, but alternative sources of shale will be investigated in about 30 years time. The development of the quarries over this period is covered in Section 2.2.

In the event of decommissioning (and many cement works last much longer than 50 years) all works, buildings and structures will be removed to ground level. Roads, foundations and hard standings *etc.* will be removed to a level to permit adequate drainage and returned to agricultural use within the proposed restoration arrangements detailed in Section 3.7.

The following parts of this section cover process description, works construction, hours of operation and activities, effects of plant operation and monitoring environmental and waste handling arrangements. Fuller accounts of environmental impacts are covered in Section 3.

Details of the proposed works are given in a set of Appendix Drawings which indicate the height and dimensions in plan of each of the component parts. These are described in Section 2.1.2 below.

2.1.2 Process description

It is proposed to manufacture both grey Portland cement (OPC) and white cement using the same overall process. Cement is produced in a kiln at very high temperatures from a mix of calcium, silica, alumina and iron. For the OPC the calcium will come from the proposed limestone quarry described in Section 2.2 below and the silica, alumina and iron, together with minor amounts of calcium, will come from the shale quarry (and from some imported shale). The limestone will also be used for making white cement, but the other components will come from imported kaolin. In addition, minor quantities of sand, iron ore and bauxite or PFA will be needed to provide an overall balance of elements in the final kiln feed.

① Kaolin ② Bauxite

These different materials need to be finely ground and mixed in precise proportions according to their chemical composition before entering the kilning process in a dry state. The mix of raw materials, known as raw meal, is pre-heated and calcined at 500-900°C when carbon dioxide is driven off; the meal is then sintered at temperatures of about 1400 to 1500°C when a calcium silicate clinker is formed of granules measuring 3-25mm. Gypsum is then mixed with the clinker and ground to produce cement; gypsum is added to control the setting time of the cement. Coal and fuel oil will be the kiln fuel in the OPC and white cement production respectively. At established full production, some 300,000t of OPC will be produced each year together with 150,000t of white cement.

The process involves the following steps:-

i. Initial reception, storage and treatment of raw materials.
ii. Raw material analysis and blending.
iii. Milling to form raw meal and re-mixing.
iv. Addition of fuel.
v. Kilning of raw meal.

vi. Clinker cooling and handling.
vii. Grinding clinker and addition of gypsum and fillers.
viii. Storage and handling of cement.

The general arrangement drawing (Drawing No. 2.1.1B) shows the position of each structure noted below.

2.1.2.1 *Raw material reception*

This is described in Section 2.2 below, but includes the crushing and/or stockpiling of excavated limestone and shale rich materials from the two on-site quarry excavations and some imported shale. The layout of the reception area is shown in Appendix Drawing No. 2.1.1. Two jaw crushers are required (see Appendix Drawing No. 2.1.2), one for the main Reef Limestone (*c* 75% of mix) and one for the -40mm product from the Shaley Limestone or Calp which comprises *c* 8% of the mix and is one of the three 'shale' components. The -40mm crushed material is stored under cover in a shed 12m high and 30 x 75m in plan (see Appendix Drawing No. 2.1.3), the shale stockpiles will be sheeted, the crushers are to be housed and the conveyors and transfer points covered (see Drawing No 2.1.1B for layout of the raw material reception area). The crushers and discharge conveyors *etc.* are set down 5.0m below ground level onto bedrock to reduce visual impact and provide adequate footings. The housing will be 15m above existing ground level and will be 6 x 12m in plan.

Imported kaolin will be delivered from off-site and stored in a separate covered stockpile adjacent to the blending house. This store will hold 5,000t of kaolin; it will be 9m high and 55 x 20m in plan (see Appendix Drawing No. 2.1.4). Separate stockpiles of adjustment materials *viz* sand, iron ore and bauxite or PFA will be held within the covered blending house.

The crushed -100mm Reef Limestone will be conveyed under cover direct to the blending house. The three shale components will be loaded into 3 x 100m³ bins from the stockpiles for conveying to the blending house. These bins will be about 8m high and will be loaded daily by a front end loader.

The crushing and conveying to the blending house and general materials handling in the raw material reception area will take place during normal quarry operating hours (see Section 2.2).

2.1.2.2 *Raw material analysis and blending*

The conveyor between the raw material reception area and the blending house will be fitted with neutron-type analysers for continuous measurement of calcium, silica, iron and alumina in the raw feed. A software system capable of handling up to six different raw material chemistries will be used to regulate the flow of each raw material to the blending house so as to ensure an adequate feed chemistry. If necessary, sand, iron ore or PFA/bauxite will be added to adjust the final mix.

A chevron type blending stockpile is formed in the 250 x 50m surface area blending house. This building is 25m high to the ridge (see Appendix Drawing No. 2.1.5).

About 30-40 layers are required for initial blending, but the stockpile may comprise more than 100 such layers. Reclaiming for dispatch to the mill takes place inside the blending house using a bridge type rake and chain scraper system loading onto a conveyor belt (shown in Appendix Drawing No. 2.1.6) rising to the mill. Storage bins holding adjusting materials (such as sand, oxides *etc.*) are located within the blending house for dosing the blended mix on this conveyor belt as required.

Bag filters will be installed at all locations such as conveyor transfer points where dust may be generated.

2.1.2.3 *Milling and re-mixing*

The raw mill (see Appendix Drawing No. 2.1.7) crushes the -100mm blended raw material to a fine powder and dries it at the same time. The mill is therefore operated as an air swept mill using hot waste gases (280-340°C) from the kiln preheater. The mill is housed in a building which is 26m high and 26 x 24m in plan. It is proposed that a roller type mill will be used. The waste gases draw the milled material (raw meal) out of the mill. Two large cyclones and finally an electrostatic precipitator clean the gases; the raw meal is then conveyed into the homogenising raw meal silo. Collected dust is fed back into the mill and then conveyed to the raw meal silo. This silo is 20m in diameter and 62m high including headworks (see Appendix Drawing No. 2.1.6).

Further check analyses are made on the raw meal at regular intervals on transfer to the homogenising silo. If necessary, correcting materials are added in the feed to the mill. In the homogenising silo the raw meal is further mixed by compressed air 'boiling' before transfer to one of two feed silos. Two silos are required to accommodate mixes of the alternate cement type. These feed silos (see Appendix Drawing No. 2.1.6) are 20m in diameter and 50m high; they can hold up to 30,000t of raw meal. The silo feeders and withdrawal hoppers are kept dust free by the use of bag filters.

2.1.2.4 *Addition of fuel*

The kiln may be fired by either coal, heavy fuel oil or gas, but coal will not be used when white cement is produced since the degree of whiteness is affected. Coal will be stored under cover in a separate shed which is 11.5m high and 76 x 24m in plan (see Appendix Drawing No. 2.1.10). Coal is milled prior to being added to the raw meal and gases in the pre-calciner described below. Arrangements will allow for oil or gas to be used as alternative fuels.

The following fuel requirements arise during operation at full output:-

- Coal at 33,500t per year, 60% being fed direct into the kiln and 40% into the precalciner (assumes 300,000t of OPC per year). Milled coal is held in bins inside the cooler building.
- Heavy fuel oil at 25,000t per year (assumes 150,000t of white cement per year). This is held in two tanks 5.5m high and 12m in diameter located alongside the cooler building (see Appendix Drawing No. 2.1.11). If gas is used as an alternative it will be supplied by pipeline. A demand of 40,000,000 Nm^3 per year of gas will be made if the kiln *etc.* is fired in this way. If however

gas is only used in the production of white cement, the demand will be 22, 500,000 Nm^3 per year.

- In addition, the electrical demand for the works will be 120kWh/t for OPC and 135kWh/t for white cement.

2.1.2.5 *Kilning of raw meal*

Material is drawn from the raw meal feed silos through discharge hoppers, *via* air slides to a weighing bin and is then fed to the upper stage of the kiln preheater. It subsequently travels downwards *via* a system of cyclones from the top of the preheater or heat exchange tower into the kiln. The preheater tower is 63.5m high including external ducting and cyclones and is 26 x 20m in plan. It has at its centre the main flue which is 125m high and 3m in diameter. It is founded 3m below current ground-level on appropriate mass footings (see Appendix Drawing No. 2.1.7). Heat exchange occurs whilst the meal components fall through the rising hot gases. The temperature of the solid material continues to rise by the addition of further hot gas streams reaching *c* 700°C. At this time milled coal or oil is added to the hot meal and the temperature reaches 900°C, carbon dioxide being driven off (a process known as calcining). From the last cyclone in the preheater tower the material is spun into the inclined rotary kiln at very high temperatures (up to 1500°C). The kiln is 54m long and 3.8m in diameter and located between 8 and 10m above ground level (see Appendix Drawing No. 2.1.8).

The kiln and cyclones have refractory linings which require periodic replacement. Stocks of refractory bricks are held in a separate storage building (see Appendix Drawing No. 2.1.9).

The hot gases described above are produced by firing some of the fuel at the lower end of the kiln; these gases pass up over the meal as it spins and rolls downwards on a 4% gradient sintering the meal into clinker. The gases then travel through the heat exchange tower, dry material in the raw meal mill (as noted in Section 2.1.2.3 above) and finally pass through the electrostatic precipitator before discharge from the flue. The fuel input is controlled to balance the heat requirements for kilning and the minimum emissions of NO_x.

The electrostatic precipitators (ESPs) clean the waste gases to the required degree. The system operates when dust laden gas is drawn through the precipitator unit at speeds not exceeding 1.0m per second. The unit comprises metal plate walls from which wires hang at *c* 0.3m intervals. These wires carry a very high voltage (*c* 110MV) which produces an electric field and a corona around each wire. This electric field charges the dust particles which travel from the wire to the earthed metal walls. Dust particles settle on the walls and are then tapped-off by vibrating the plates. The dust is collected in hoppers below the electric field and fed back into the raw mill and then to the homogenising silo.

Bag or fabric filters have been used for many years throughout industry. ESPs are a more recent development, but are now widely used in the cement and other industries to remove fine dust from gas emissions. The proper operation of ESPs and their control can be carefully monitored as noted in more detail in Section 3.5.5.3 which covers arrangements for ESP shutdown.

2.1.2.6 *Clinker cooling and handling*

The calcined and sintered (kilned) material leaves the kiln as 3 - 25mm diameter abrasive grey spheres known as clinker. The clinker falls into an enclosed chamber (see Appendix Drawing No. 2.1.12) onto a moving grate. The cooling chamber is 22m high and 47 x 28m in plan. An electrostatic precipitator is located above roof level, the top of which is 30.5m above ground level. Ambient air is drawn in to assist in cooling the clinker from 1300°C to 100°C. As noted above, the heated air is subsequently used in the process to assist in the combustion of the fuel in the rotary kiln, in the precalciner and finally in the process for drying and preheating the raw meal in the mill. The transfer process effectively recovers 85% of the heat.

The cooled clinker is then crushed by a roller-breaker to remove large lumps and is conveyed to one of three storage silos until required for milling. The silos are required to contain the dusty clinker and to allow for fluctuations in production. Two silos 45m high and 30m in diameter each being capable of storing 45,000t of clinker (see Appendix Drawing No. 2.1.13) are required for the two types of cement produced. A third, smaller silo 20m in diameter and 50m high is needed for clinker produced during start-ups *etc.* which may require subsequent blending. The total structure including the air slide distributor is 66m high.

2.1.2.7 *Grinding clinker and addition of gypsum and fillers*

Some 22,500t per annum of raw gypsum is required for 450,000t of cement. Gypsum is added to reduce the setting time; other materials including ground limestone fillers may be added at this stage. Gypsum is imported to the site and stored in a shed sufficient to hold 3,000t. The building is 9m high and 40 x 30m in plan. Part of this building is used to store fillers (see Appendix Drawing No. 2.1.14). If necessary gypsum (and fillers) may be crushed (to -35mm) to allow for subsequent mixing with clinker (at *c* 5% by weight for gypsum) prior to grinding/milling the mix to produce marketable cement. Appendix Drawing No. 2.1.15 shows the conveyor arrangement to the cement mill for clinker, gypsum and fillers. This has a closed circuit dust suppression system and the mill feed is controlled by belt weighers.

The cement mill is 36m high and 34 x 22m in plan (see Appendix Drawing No. 2.1.16). This ball mill is air swept to separate cement of sufficient fineness from the mix requiring further milling. The cement is then transferred pneumatically to three storage/supply silos each being 20m in diameter and 50m high; the feed section above the silos raises this structure to 56m (see Appendix Drawing No. 2.1.17).

2.1.2.8 *Storage and handling of cement*

From the storage silos cement is drawn pneumatically and conveyed by air slides and bucket elevators for bagging and pallet loading in the packing plant or for direct loading into container trucks. This section of the plant is 30m high and 58 x 40m in plan,

including the vehicle loading bays. All transfer points at the silos and in the handling plant are covered and appropriate dust collection arrangements are installed (see Appendix Drawing No. 2.1.18).

2.1.2.9 *Other facilities*

The following additional facilities are proposed:-

i. An electricity sub-station with distribution facilities also an auxiliary diesel generator. This building is 16m high and 32 x 16m in plan (see Appendix Drawing No. 2.1.19). It is located near the cement mill since the mill has a large electricity demand.
ii. Cable and drainage ducts.
iii. Lighting and earthing arrangements. Site lighting will generally be installed on buildings (see Section 2.1.4 below).
iv. Workshops (mechanical and electrical) (see Appendix Drawing No. 2.1.20).
v. Two laboratories; one for chemical monitoring of raw meal and product (see Appendix Drawing No. 2.1.21), and another for R&D into alternative uses of raw material and product (see Appendix Drawing No. 2.1.22).
vi. Water supply for the works, fire-fighting and staff use.. The water supply for the works, offices and canteen *etc.* will be obtained from the potable water supply well at Lansdown Lodge which currently supplies the chicken farm to the west (this will be closed when the site works commence). This supply is capable of providing up to 100m³ per day, more than is required by the works *etc.* There will be an underground tank system 3 x 30m and 4m deep which will hold recirculated cooling water and receive a make-up supply of up to 20m³ per day. Cooling water will be circulated to the raw mill, cement mill, heat exchange tower *etc.* at a rate of *c* 100m³ per hour. A small pump house 3m high and 6 x 8m in plan will contain the pump and control the water supply system for the works; an evaporation tower 3m in diameter and 6m high will be used to cool the recirculated water (see Appendix Drawing No. 2.1.29).
vii. A fire-fighting pond 4.5m high and 8m in diameter will be located east of the coal mill. It will contain over 200m³ of water (see Appendix Drawing No. 2.1.28) and will be topped-up from the Lansdown Lodge supply.
viii. A works sump will be provided for all run-off from the plant. It will contain a submersible pump for pumping collected water to the holding pond.
ix. Administrative and sales building. This building includes the R&D laboratory.
x. Works offices, first aid post and mess facilities/canteen (see Appendix Drawing No. 2.1.24).
xi. Plant control unit; this incorporates the on-site laboratory (see Appendix Drawing No. 2.1.21).
xii. Vehicle parking areas are shown on Drawing No. 2.1.1B.
xiii. Weighbridge and office. This is located on the access road out of the site as shown in Drawing No. 2.1.1B (see also Appendix Drawing No. 2.1.25).
xiv. Wheel/vehicle wash (see Appendix Drawing No. 2.1.27).
xv. Security post (see Appendix Drawing No. 2.1.26).
xvi. Fencing. 3m high security fencing will enclose the works area well inside the site boundary which will also be fenced (see Section 2.2.4).

2.1.2.10 *Sewage Treatment Works*

Introduction

The sewage treatment plant will be located at low level near the works sump and is shown on App.Dwg.No. 2.1.23 It treats the effluent in three stages – primary settlement, biological treatment and final settlement, the first and last stages being physical.

Primary Settlement

The raw sewage enters the primary settlement tank where its velocity is reduced permitting much of the solid matter in suspension to settle to the bottom to form a sludge which is periodically removed for disposal. The tank also provides some balancing effect on the flow rate entering the Works to even out surges to the biological reactor.

Biological Treatment

The settled effluent flows from the primary tank through the baffled outlet, which prevents floating solids passing into the first chamber of the submerged aerated, fixed film biological reactor. In this chamber it is rapidly mixed with the aerated bulk liquid already present in the reactor, aeration being provided by air blown into the reactor through fine bubble diffusers. The diffusers are positioned below a structure high voidage plastic media upon which a microbiological film grows and oxidises the organic matter in the oxygen enriched effluent which comes into contact with it as it rises through the media. The media with its large surface area to volume ratio is arranged such that it provides optimum contact between the effluent and the biological culture, as well as allowing sloughed off biomass to be entrained into the flow. The organic load applied to the media within the first and subsequent chambers of the bioreactor is such as to ensure that the process is not oxygen limited and the air supplied to the diffusers from centrifugal blowers is therefore regulated by a valved manifold to ensure optimum oxygen levels are available within each chamber of the unit. Dissolved oxygen probes, positioned in each chamber monitor the process and automatically control the air supply.

Final Settlement

The effluent from the bioreactor flows over a notched weir into the final settlement tank where the velocity of flow is greatly reduced permitting floc which sloughed off the biomass to settle. The settled humus sludge is returned at frequent intervals back to the inlet to the primary tank for co-settlement with the incoming sewage. The treated effluent from the Works is discharged to the works sump before being pumped with other surface water to the holding pond and settlement lagoon.

2.1.3 Works construction

The impact of construction will be kept to a practicable minimum by careful planning and execution of the works. A Construction Code of Practice (CCP) will be prepared to cover all aspects of the project with appropriate attention to key areas: -

- Construction methods.
- Safety and environmental management.
- Programming.
- Standards and quality.
- Commissioning.

The CCP will provide a common understanding of the strategic planning and management of construction and will be developed in consultation with the relevant statutory bodies.

Good Neighbour Policy Lagan will require that all contractors and sub-contractors consider the environmental impacts of any activities in advance, as part of the ongoing management of construction and will implement measures to mitigate impacts. Areas recognised as requiring special attention with respect to construction activity include:

- Noise and vibration.
- Traffic.
- Pollution control.
- Nuisance and disruption.

Combination of environmental impact analyses, planning, liaison and close management will ensure effective control. As part of the 'good neighbour policy' a manager will be appointed to liaise with local residents and the local community as well as special interest groups. Initiatives to maintain good communications may include:-

- Project news sheets dealing with progress and forthcoming activities.
- Organise visits to the site for interest groups.
- Co-ordination with local community events.
-

Access and traffic Access will be established from the northeast of the site as shown on Drawing No.2.1.1BN.The underpass will be constructed at an early stage to limit impacts on the minor roads around the site and to accommodate all but the largest plant movements.

Routes to and from the site and arrangements for abnormal loads will be by prior agreement with the Gardai. Temporary road works and traffic management will be planned to minimise nuisance and disruption to the public. The roads will be kept clean by use of vehicle wheel washing and regular attendance of road sweeping equipment.

Site preparation Substantial earthworks are proposed as part of the site preparation; these include both foundation construction and the formation of screening banks from the materials generated by the preparatory excavations. The scheduling of earthworks noted in Section 2.2 below allows the use of materials won on-site wherever possible. The general plant area has a drainage gradient of 1 in 80 to the works sump. Appropriate batters and/or retaining walls are proposed around the limits of the preparatory excavations.

Site hours During construction normal site hours will be 07:00 until 19:00 seven days per week. Occasional working outside these hours will be required to suit particular activities such as large pours of concrete requiring extended working.

Site facilities Welfare facilities for the labour force including the provision of parking for temporary accommodation will be established within the northern part of the limestone quarry area to ensure the site is self contained. In order to ensure supply and quality it is planned to set up some prefabrication and production facilities on site including concrete batching, precasting and steel fabrication.

Security will be maintained by fencing the entire site including the quarry when its development is commenced. The entry point will be controlled and entry restricted to identified personnel. The fencing will be regularly inspected and any breaches repaired.

Programme Construction is anticipated to last up to two years including a commissioning period. Timing of the construction start is dependent on the approval of the proposed development by the planning and licensing authorities.

2.1.4 Hours of operational activities

The manufacturing process described above incorporates the milling of limestone and shale into a fine powder, the production of cement clinker through the kiln and the milling of clinker into cement. These three activities comprise a 24 hour a day/seven days a week operation. Efficient use of a cement kiln requires long running times and it is expected that the kiln will operate for about 90% of available hours in each year. The remaining 10% of the time covers maintenance and transfer periods between OPC and white cement production. Kiln realigning tend to be a regular activity but not at defined intervals at such times plant maintenance may proceed throughout the day. There is no general shutdown for holidays *etc.* for the works.

A shift system will be employed in the works subject to discussions between management and staff; normal shift hours of 06:00 to 14:00, 14:00 to 22:00 and 22:00 to 06:00 hours, common to some cement works may be used. However, owing to automation the manning levels of such shifts will be lower than those working during the daytime.

The quarry operating hours are more restricted as noted in Section 2.2 below.

Because 24 hour operation is involved the cement works will require to be lit at night. To avoid intrusion from lights, the following approach will be adopted: -

- Minimum external lighting consistent with safety.
- Lighting designed to avoid spillage of internal lighting outside buildings.
- External lighting to be low level, directional and downward pointing wherever possible.
- Lowest possible intensity to be used.
- Least intrusive light colours.
- Lights to be used only when required.

The principal site entrance will be to the east of the shale quarry on the road to Kinnegad. There will be a security post and barrier where vehicles will be directed to the works or offices *etc.* A further barrier is located across the main access road just south of the offices and the visitor/employee car park. This latter barrier will operate when the shale quarry is not working, the entrance to this quarry being sealed off to prevent fly-tipping and unauthorised access.

A large part of the surface area within the works will be indicated and marked for vehicle parking and for vehicles awaiting loading or unloading. No supply vehicles or vehicles for cement collection will be permitted to park or lay-up along the public road near the site entrance. This will be strictly enforced by the firm to avoid obstruction of local roads.

2.1.5 Effects of plant operation

2.1.5.1 *Dust and gas emissions*

As a result of the operation of the cement manufacturing plant, emissions to atmosphere of particulate and gaseous pollutants will occur.

Emissions to atmosphere are considered under two headings, fugitive and unscheduled emissions and specific process emissions.

Fugitive emissions are associated with:-

- Particulates from delivery of raw materials to site;
- Particulates from storage of raw materials, processed materials and product;
- Particulates from spillage, internal transfer of materials and building losses.

Process emissions are associated with:-

- Particulates from crushing of raw materials (shale and limestone);
- Particulates from milling limestone, shale and coal;
- Particulates from conveying and transport of materials;
- Particulates from clinker grinding and gypsum mixing;
- Particulates from bag-filling and bulk transport loading of cement;
- Particulates, NO_x (Nitrogen oxides), SO_2, CO, CO_2, water vapour, trace Volatile Organic Components (VOCs) and metals from cement kiln.

The dominant emissions to atmosphere associated with the operation of the cement manufacturing plant are PM (particulate matter), PM_{10} (particulate matter having an aerodynamic diameter less than 10μm), sulphur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), carbon dioxide (CO_2) and water vapour. Traces of Volatile Organic Compounds (VOCs) and heavy metals will also be emitted depending on the fuel used in the main plant processes and on the chemical composition of the raw materials in use at the plant.

Emission control All of the main process emission sources involving material storage, handling and transfer operations are enclosed except for the coarse raw materials as

discussed previously. Clinker and dusty material storage areas are enclosed and emissions will be vented to appropriate abatement plant, primarily bag filters. Local extraction systems will be employed adjacent to significant sources such as those related to bulk material handling, loading and filling operations and the emissions will also be vented to abatement plant.

Particulate emissions from all main process emission sources will be controlled by use of Bag Filters and Electrostatic Precipitators. Bag filters are the abatement method chosen for all sources other than the cement mill and the cement kiln where electrostatic precipitators are to be used.

Emissions to atmosphere from the main process emission source, the cement kiln, will be continuously monitored. In particular, direct-reading sensors for CO, NO, NO_2, SO_2 and particulates (measured as opacity) will be installed in the main stack. Continuous emission monitoring will be completed in order to demonstrate compliance with regulatory requirements and to ensure that no inadvertent releases of pollutants are permitted. The carbon monoxide monitoring will act as an early-warning system so that production characteristics may be altered to minimise the potential for temporary shut-down of the ESP due to elevated carbon monoxide concentrations. Continuous Emission Monitors (CEMs) will also be installed on the cement mill stack. Each of the Bag Filter abatement systems will be fitted with pressure-drop sensors to ensure early recognition of and response to filter failure. The Directional Dust Deposition Monitoring Programme discussed in Section 3.5 will also allow an assessment of the ongoing impact of particulate emissions from the entire plant.

2.1.5.2 *Noise and vibrations*

The cement plant will produce both noise and vibrations when in operation. These are considered in more detail in Section 3 where current and anticipated noise levels are set out. The design of the noisiest areas such as the mills has been accommodated by the use of either high mass concrete or double skinned sheeting to attenuate the noise from within. Particular attention will be given to the use of best available technologies for noise reduction during the construction period notwithstanding the fact that the distance between the plant area and the nearest residential property exceeds 450m and is separated by a substantial screening bank.

Vibrations result from the operation of large rotating or reciprocating equipment such as kilns, mills or crushers. Investigations elsewhere show that these vibrations are one or two orders of magnitude *lower* than those from quarry blasting. Although continuous these vibrations will not give rise to structural damage, and at the distances involved will be at or below the limit of human perception.

Vibrations from heavy goods vehicles (HGVs) occur with rough or worn road surfaces. A smooth well drained road surface will be constructed and carefully maintained. The main site access road has been carefully located more than 150m from the nearest residential property and is well screened including a section in cutting to accommodate the underpass. The company has agreed to upgrade the public road north of the site for the period and lengths required according to the construction of the proposed trunk road around Kinnegad.

Further details on noise *etc.* associated with all vehicle movements is given in Section 3.5 below.

2.1.5.3 *Traffic movements*

These are considered in more detail in Section 3. They will include the importation to the site of construction materials (excluding sand and gravel won on site - see Section 2.2), fuel and those raw materials obtained from other sources. This latter item includes 40,000t per annum of Westphalian Shale from County Laois and up to 60,000t per annum of kaolin. The fuel will include 165t per day of coal or the equivalent of heavy fuel oil. It is estimated that there will be 171 HGV movements per day on and off site. The site vehicle movements chiefly associated with quarrying include 35 loaded-unloaded full cycle movements per day in the limestone quarry, 22 full cycle movements per day for two months to recover the Silty Shale and 26 full cycle movements per day for six months to recover the Shaley Limestone. A similar level of vehicle movements to and from the gravel workings can be expected during the construction period. About 100 full cycle vehicle movements per day will be needed to remove the overburden from the plant and quarry areas during the construction period which will be used to build the screening banks and to reduce *inter alia* the subsequent impacts of traffic.

2.1.5.4 *Groundwater drawdown*

This is covered in Section 3.4 and will result from dewatering both the limestone and shale quarries. A significant level of groundwater drawdown in the bedrock (11.0m) will occur locally up to 600m from the site boundary. A limited number of properties not owned by the firm will be affected and the company is prepared to establish long-term water supplies in the event of adverse affects on these wells. Details are shown on drawings in Section 3.4. Some dewatering of lesser significance (1.0m) may occur, extending up to 900m beyond the site limits. The depth of working has only a limited effect on drawdown levels outside the site. The Reef Limestone is much less permeable than the Silty Shale and Shaley Limestone and the effects of drawdown extend for a shorter distance from the limestone quarry than from the shale quarry in the northeast/southwest direction. It should be noted that a drawdown of 1m is less than the annual change in groundwater levels. Little effect on drawdown in the superficial deposits is envisaged especially in the areas where boulder clay is present (inferred to be present beneath all residential property).

2.1.5.5 *Effluents*

Sewage from the works will be treated in a separate sewage plant with the treated water discharged *via* pipes to the works sump and holding pond before flowing into the settlement lagoon described in Section 2.2. Eventually the treated water will be discharged into the Kinnegad River. Run-off is dealt with in a similar manner, also being channelled or pumped as necessary to the main works sump north of the raw materials reception area before pumping to the holding pond.

All oils and liquid fuels will be bunded to retain 110% of the maximum storage capacity. Spillage will be recovered for disposal to appropriate landfill sites.

2.1.5.6 *Landtake*

The land used for the proposed development is apparent from the general arrangement plant, Drawing No. 2.1.1B (see also Appendix Table No. 2.2.1). The areas used for various elements in the site including the works are:-

	Hectares
Cement plant	9.0
Access roads	4.7
Screening banks	37.6
Limestone quarry	up to 24.8
Shale quarry	up to 13.9
Sand and gravel workings	5.4
Water holding structures	3.0

These areas are for requirements of maximum development. The total site area is 160.0 hectares and the area of land available for agricultural use, at the later stages of working when landtake is at its greatest, is 64 hectares. Land not listed above includes margins for stand-offs and safety *etc*. It should be noted that some of the larger screening banks are available for tree planting/grazing (see Section 3.7) and the majority of the sand and gravel landtake will be backfilled.

2.1.6 Monitoring, environmental protection and waste handling

Monitoring will include data collection of long and short-term duration. Long-term monitoring will include the routine collection of data on water levels and directional dust monitoring. Noise and the vibration monitoring will be on an as required basis, *i.e.* at each and every blast and when new equipment is bought onto site and into operation for the first time. Other aspects of monitoring are covered in Sections 3.5 and 3.6.

Protection Measures include the provision of stand-offs and screening bunds/banks around both the works and the quarry. These banks range in height from 3 to 20m; a short length of 3m high noise fencing is proposed on the eastern side of the shale quarry near the site entrance. Measures in the works include the use of construction materials to reduce noise levels outside buildings. Standard arrangements for handling effluents are noted above.

Dust and fines collection facilities are installed throughout the plant. Material collected is routinely reintroduced into the cement production circuit and removed as saleable product. There is no need to allow for the disposal on site of flue dust as in former works; the disposal of this highly alkaline material is not necessary in a new plant such as this. The availability of back-up dust collection arrangements does not indicate the need for plant shutdown as explained in Section 3.5.5.3

Waste materials from the site include spent kiln linings and out of specification materials and waste from maintenance, repairs *etc* Solid inert, non toxic, non flammable wastes will be disposed of into the permanent screening bank north of the plant area shown on Drawing No. 2.1.1B. Any toxic materials or liquid wastes, other than treated

water will be disposed of into off-site licensed facilities. Wherever possible materials will be recycled or accommodated by blending or mixing with other materials produced or used on site.

2.1.7 Alternative processes

It is considered that the proposed works will represent state of the art technology in terms of energy efficiency, safety and the control of emissions. Hence other less favourable plant options have not been considered.

The design of the works has been an iterative process. Criteria of particular importance included impacts on dust and gas emissions by structures adjacent to the flue. Reduction of conveying distances and access to and within the plant site for raw materials and for product disposal were also important as was mobility around individual units. The scheme presented in Drawing No. 2.1.1B is considered to represent the best accommodation of the several constraints on layout; it also preserves rows of trees to assist in low level screening.

LEGEND

- Site boundary
- Proposed quarry limit
- 81 — Ground surface contours (1m intervals)
- Stream showing direction of flow (Water courses observed February 1998)

0 50 100 150 200
Metres

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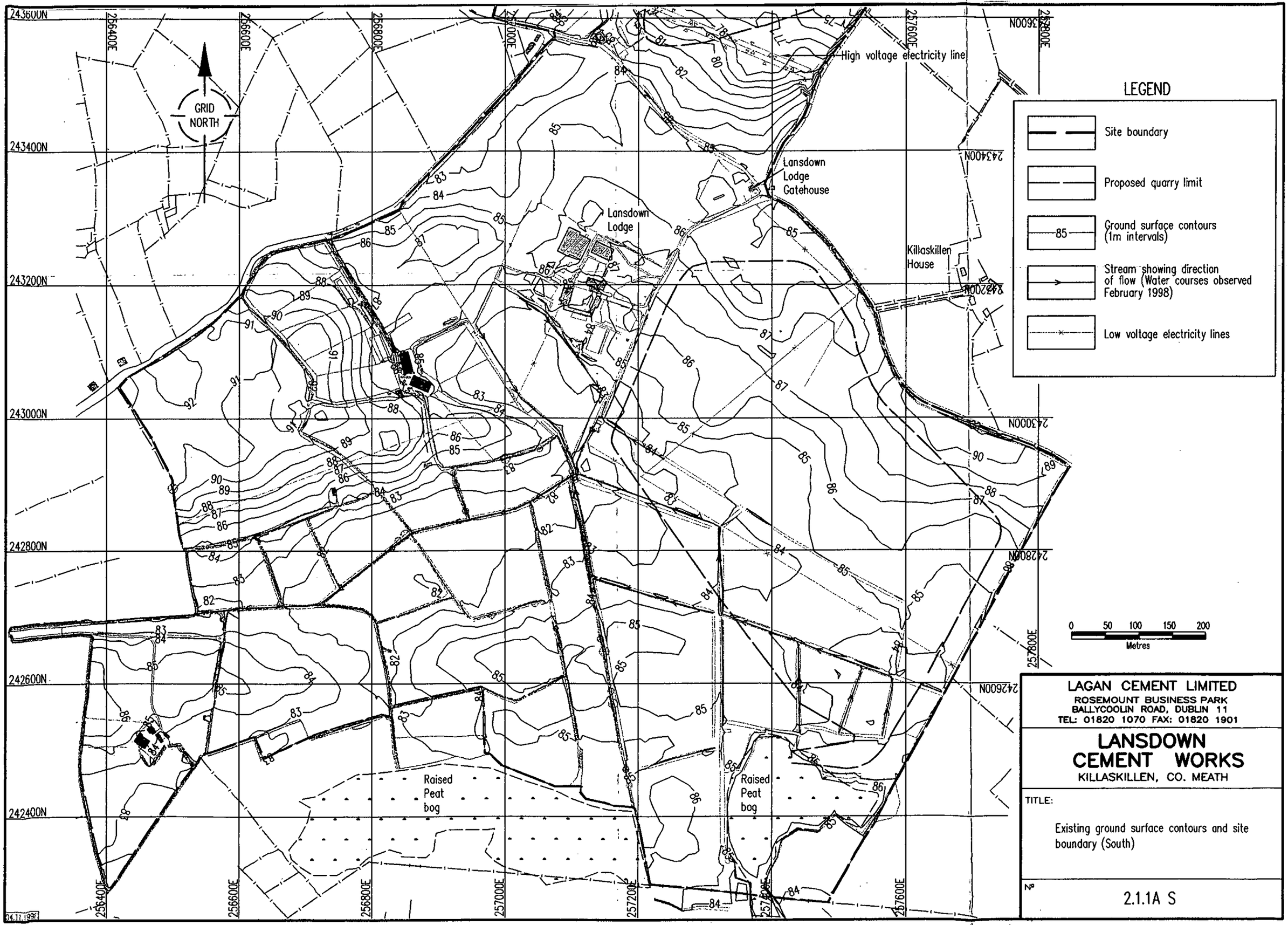
LANSDOWN CEMENT WORKS

KILLASKILLEN, CO. MEATH

TITLE:

Existing ground surface contours and site boundary (North)

№ 2.1.1A N



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LANSDOWN CEMENT WORKS

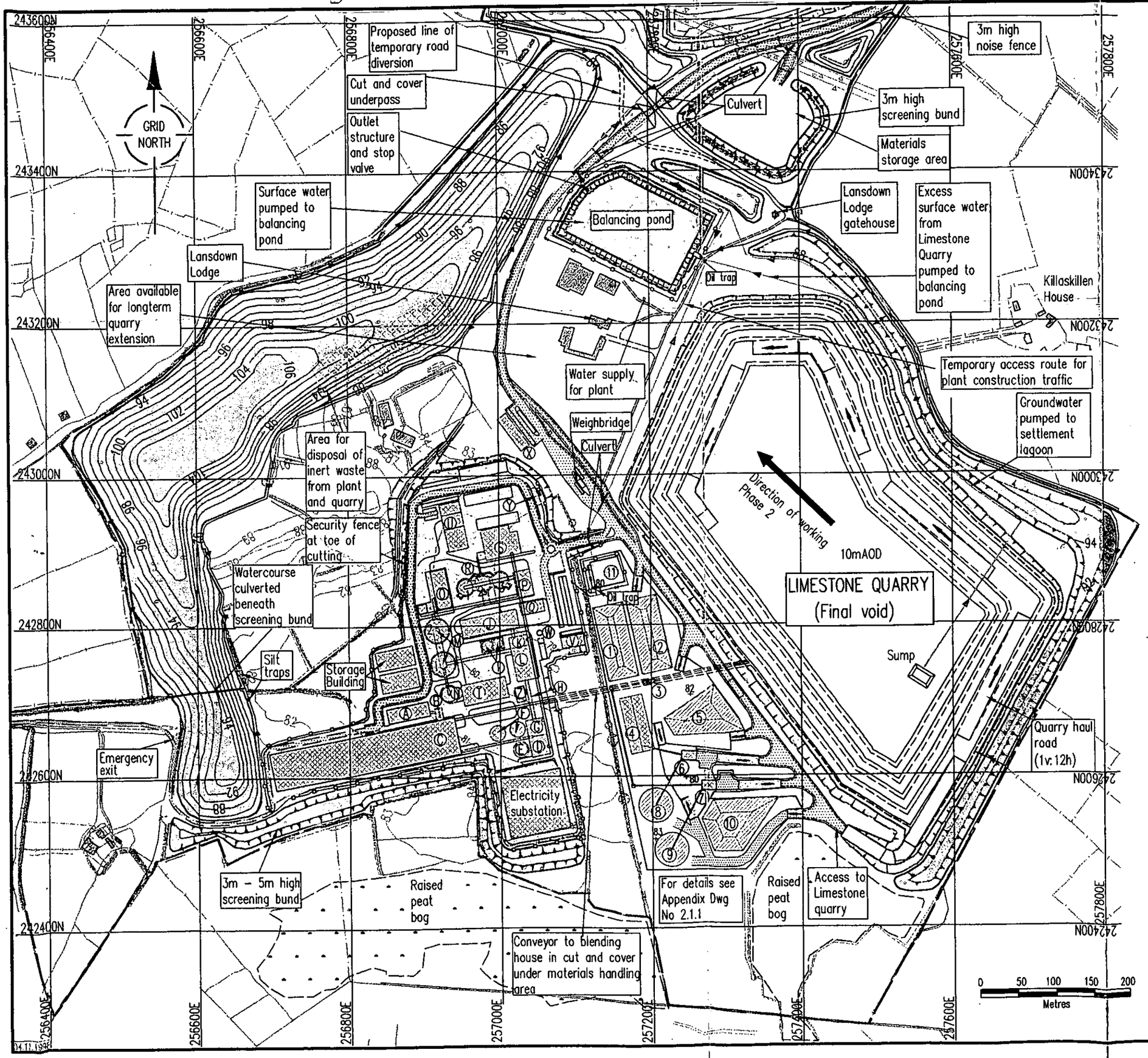
KILLASKILLEN, CO. MEATH

TITLE:

Existing ground surface contours and site boundary (South)

Nº

2.1.1A S



① Tober Colleen Shale RoQ stockpile
② Westphalian Shale RoQ stockpile
③ Shale feed hoppers
④ -40mm Calp covered stockpile
⑤ Calp RoQ stockpile
⑥ Calp crusher/feeder to conveyor
⑦ Reef Limestone crusher/feeder to conveyor
⑧ +40mm Calp stockpile
⑨ +40mm Reef Limestone stockpile
⑩ Reef Limestone RoQ stockpile
⑪ Works sump and sewage works

Ⓐ Kaolin store
Ⓑ Kaolin feeder
Ⓒ Blending house
Ⓓ Raw mill
Ⓔ Raw meal homogenising silo
Ⓕ Raw meal feed silos
Ⓖ Pre-heater tower
Ⓗ Kiln
Ⓘ Oil tanks
Ⓙ Coal store
Ⓚ Coal mill
Ⓛ Cooler building
Ⓜ Clinker silos
Ⓝ Off-spec silo
Ⓞ Gypsum and filler store
Ⓟ Cement mill
Ⓠ Electricity sub-station
Ⓡ Cement silos
Ⓢ Packing and bulk loading
Ⓣ Brick and heavy stores
Ⓤ Workshop and drivers facilities
Ⓥ Site facilities building
Ⓦ Water tanks/ control
Ⓧ Offices/ administration
Ⓨ Vehicle wash
Ⓩ Control room and laboratory

For legend refer to Drawing No 2.1.1B N

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LANSDOWN CEMENT WORKS

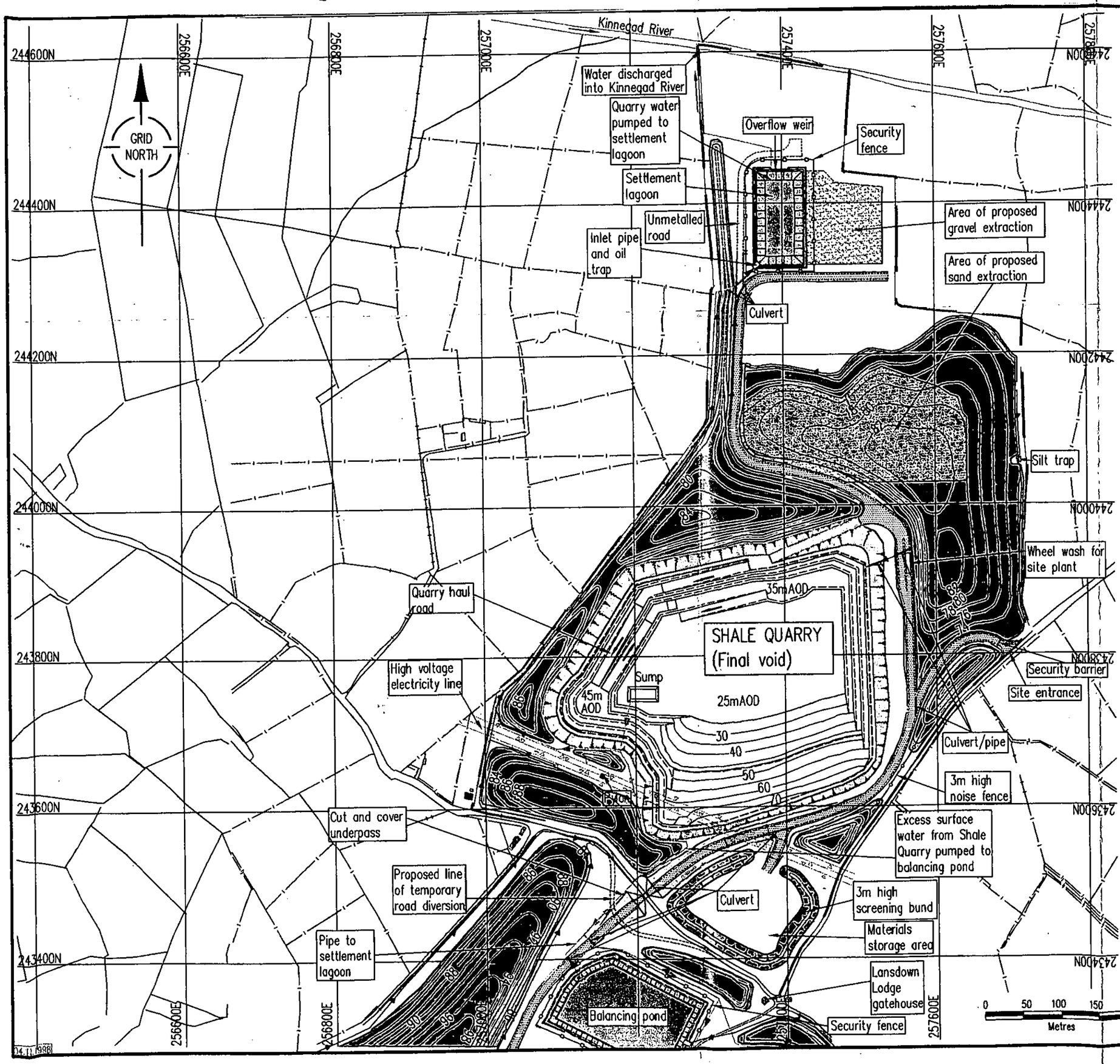
KILLASKILLEN, CO. MEATH

TITLE:

General site arrangement (South)

Nº 2.1.1B S

14.11.1994



LEGEND FOR 2.1.1B N and 2.1.1B S

- Site boundary
- Crest / Toe of overburden batters (1:2)
- Crest / Toe of rock batter
- Crest of rock excavation
- Metalled haul road with cutting
- Ponds/water treatment areas
- Screening bunds/overburden storage with 2m interval contours
- Pipe
- Drainage ditches showing direction of flow
- Retaining wall to 2mbgl
- Retaining wall to 5mbgl
- 1:10 ramp
- 2:1 reinforced earth slope
- Materials handling area Metalled surface @ 2mbgl
- Materials handling area Metalled surface @ 5mbgl
- Metalled surface plant area
- Conveyor

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LANSDOWN CEMENT WORKS

KILLASKILLEN, CO. MEATH

TITLE:

General site arrangement (North)

Nº 2.1.1B N

2.2 THE QUARRYING PROCESS

2.2.1 Introduction

Three areas with mineral resources have been identified within the site:-

- Very high quality Reef Limestone (Feltrim Limestone Formation) to the south of Lansdown Lodge.
- Silty Shale (Tober Colleen Formation) and Shaley Limestones (Lucan Formation) north of Lansdown Lodge.
- Sand and gravel in superficial deposits in the most northerly part of the site.

The location of the proposed bedrock quarries, and the general geological setting of the site is shown in Drawing No. 2.2.1. A general arrangement of the proposed quarries, sand and gravel workings, access roads and screening bunds *etc.* is given in Drawing No. 2.1.1 B. This also shows how the quarry areas are linked by a proposed underpass shown in Appendix Drawing Nos. 2.2.1 A, B and C.

2.2.2 Quarry design

It is proposed that 150,000t per year of white cement and 300,000t per year of grey cement will be produced. During the first year it is envisaged that the relevant production figures will be 50,000t and 250,000t and during the second year 100,000t and 300,000t respectively. At full production the approximate annual requirements for each of the raw materials will be:-

Reef Limestone	540,000t
Kaolin (imported)	60,000t
Westphalian Shale (imported)	45,000t
Silty Shale	40,000t
Shaley Limestone	40,000t

The Reef Limestone will come from the southern quarry and both the Silty Shale and the Shaley Limestone from the northern quarry.

In addition, it is estimated that approximately 190,000m^3 of sand and gravel will be required for the construction of haul roads and apron areas (sub-base and base course materials) and for foundation construction. Gravel will come from north of the site where the main settlement lagoon will be built; sand will come from an esker ridge 200m to the south. It may also be possible to recover some gravel from the overburden excavation since lenses of gravel are present in some locations.

2.2.2.1 *Limestone quarry*

Limits The excavation limits have been selected to permit reasonable stand-offs from roads and buildings and to ensure the provision of adequate screening banks:-

- On the north-eastern side a stand-off of at least 35m from the site boundary has been used to permit the construction of a 5m high screening bank with maintenance access.
- On the north-western side the working limits lie south of the access road to Lansdown Lodge and farm buildings, and are at least 100m from the gatehouse to Lansdown Lodge.
- On the south-western side workings are restricted to an overburden cover of less than 5 to 6m.
- On the south-east a stand-off of 30m is provided from the site boundary, sufficient for a 5m noise/screening bank between the southern end of the quarry and Ballinabrackey.

At depth the working limit of 10mAOD is based on the need to provide at least 40 years supply of the primary raw material.

Development proposals In general, overburden batters are proposed at slopes of 1 (vertical) in 2 (horizontal) with overall rock slopes at 1 in 1 (45°) and a 5m rockhead bench. The rock slopes will be benched at 15m intervals with 10m bench widths and bench faces inclined at 3 vertical to 1 horizontal. Benches are formed at 70, 55, 40, 25 and 10mAOD. The excavation is proposed to a depth in limestone of 75m. The proposed ultimate excavation is shown in Drawing No. 2.2.2. This drawing shows the proposed haul road located on the south-eastern and north-eastern sides of the quarry workings. The haul road will be 12m wide with sufficient additional space for a protective barrier and drainage; the maximum gradient will be 1 in 12 (8.3%) with horizontal bends.

Appendix Drawing No. 2.2.2 shows three intermediate stages in the development of the limestone quarry. Initial Phase 1 workings will take place in the south-eastern half of the area and deepen from the 70mAOD bench before advancing during Phase 2 to the north-west in each of the three benches. It is intended that working faces will be aligned north-east to south-west and that progress along each face will be from south-west to north-east. Subsequently, during Phase 2 the quarry will be deepened to the 10mAOD level with the haul road extending in an anti-clockwise spiral. Overburden removal will precede the limestone excavations in both Phases. Overburden removal will be to screening banks (see Section 2.2.3.4 below).

The initial overburden removal during the construction of plant *etc.* will last 1 year. Phase 1 will last 16 years; Phase 2 will last a further 30 years. The access ramp will be along the south-eastern and then the north-eastern sides of the quarry. The schedule of materials to be produced is given in Table 2.2.1.

Potential long-term extension areas lie to the north in the land around Lansdown Lodge and to the west within reasonable overburden cover. Extensions in depth may also be feasible.

2.2.2.2 *Shale quarry*

Limits The shale working limits have been largely defined by the location of the subcrop of the top of the Reef Limestone and the overlying Silty Shale. As with the limestone quarry, screening banks are proposed around the workings to the south, east and west; the remaining part of the esker and replacement spoil mounds will provide screening to the north. The extent of workings is influenced by the availability of the Silty Shale and the ratio of Silty Shales to Shaley Limestone (Lower Calp) of 1:1 required for the kiln feed for grey (OPC) clinker. The yield of clay rich material from the crushed Shaley Limestone suitable for the kiln field is 1:2.5, *i.e.* 1 tonne of clay rich Shaley Limestone is produced from 3.5 tonnes of raw Shaley Limestone. The working limits noted below have therefore been little constrained by site boundaries *etc*.

- On the northern side, the limit of required Shaley Limestone extraction.
- On the southern side, the inferred boundary between the Silty Shale and the Reef Limestone.
- On the eastern side, the inferred eastern extent of Silty Shale.
- On the western side, the inferred western extent of Silty Shale and a 30m stand-off from the electricity pylon.

At depth the working limit of 25mAOD is controlled by the reducing available volume of Silty Shale. On this basis the resource of Silty Shales and the Shaley Limestones are sufficient for 34 and 38 years respectively.

Development proposals In general the overburden batters will be 1 in 2 with a 5m rockhead bench. Overall rock slopes to the east, north and west will be 1 in 1, whilst on the southern footwall side the ultimate slopes will follow the pavement of the Reef Limestone (1 in 2 to 1 in 3). The uppermost slopes in the Silty Shale at the western and eastern ends may need to be excavated at 1 in 2 having regard to the soil like nature of the shale at sub-crop. The shale quarry will be worked to a bedrock depth (excluding overburden) of about 45m (see Drawing No. 2.2.3). Haul roads in the shale quarry will have gradients not exceeding 1 in 12 and horizontal bends. The main haul road enters from the north-east along the northern side of the quarry and then travels southwest to a level *c* 20m below rockhead before switching back to the northern side of the workings. This prevents undue traffic over the Silty Shales and avoids its sterilisation.

It is proposed that the Silty Shale and Shaley Limestone will be worked in a series of north-south cuts which are excavated in 5 or 10m lifts. Appendix Drawing No. 2.2.3 shows 10m benches excavated to levels of 65, 55, 45, 35 and 25mAOD. Benches will be advanced progressively to the east from the initial box cut on the western side of the workings. Each cut would be 50 to 60m wide to allow (with the face alignment) for sufficient mixing of Silty Shale and/or Shaley Limestone to ensure a consistent chemistry. Only two 10m benches will be present in the workings at any one time but 5m benches may be used where appropriate. It may be found appropriate to work the shale quarry to full depth over a more restricted area before extending the workings to the full lateral extent; if this is the case the workings will first take place in the more restricted area shown in Appendix Drawing No. 2.2.3a. Such an arrangement may assist in backfilling and the restoration of a larger area to agricultural and/or other beneficial

uses. Table 2.2.2 is a schedule of materials produced; as with the limestone quarry most of the overburden is excavated in the early years.

2.2.2.3 *Sand and gravel workings*

Limits. It is proposed that the ***gravels*** will be recovered from underwater to the north of the shale quarry and that part of the remaining void will be used as a settlement lagoon for suspended solids from the pumped water (see below). The working limits are defined by a hedgerow to the south, a stand-off of 125m from the Kinnegad River and at least 20m from other site boundaries. The gravels are up to 12m thick but the water level is high and it is proposed that gravel is only recoverable to a depth of 6 to 7m and that up to 1.0m of top and sub-soil will need to be removed. Approximately 90,000m³ of such gravel is available in the relevant area to a depth of *c* 6.0m allowing for overburden and waste material *etc.* ***Building sand*** which may be used separately or blended will be recovered from the esker. This sand is locally capped by glacial till (boulder clay) but may exceed 7 to 8m in thickness, most of which is above the water table. Approximately 125,000m³ of sand appears to be present from site investigations allowing for a 5m recovered thickness. The limits of both sand and gravel workings are shown in Drawing No. 2.1.1 B.

Development proposals These working areas will have excavated slopes of 1 in 1.5 to 1 in 2 above water and up to 1 in 1 below water. The gravel workings will commence at the settlement lagoon before extension to the east. The sand will be excavated on the southern side of the deposit preserving the outer northern and eastern slopes of the esker since this will screen both the sand workings and the shale quarry. The screening effect of the esker with respect to these workings will be enhanced by constructing an enlarged bank north and east of the existing features early in the operations.

In addition, it should be noted that *c* 45,000m³ of crushed limestone will be produced per annum from processing the Shaley Limestone. This will be used on site for the construction of temporary access roads although it is anticipated that some will be blended with the Reef Limestone in OPC production. It is estimated that a further 50,000m³ of construction materials will be obtained from overburden in various locations from lenses of clean gravel more than 1.0m thick during site preparation in the quarry areas.

2.2.3 Quarry operations

2.2.3.1 *Limestone quarry*

It is proposed that working of the limestone quarry will take place between 07:30 and 18:00 hours Monday to Friday and 07:30 to 13:00 hours on Saturday. Except in emergency, and then on advice to the Planning Authority, working will not take place on Sundays and Bank Holidays. Pumping may take place continuously. Some maintenance will occur at weekends.

The Reef Limestone will require ground preparation by drilling and blasting. Initially, the quarry will be worked using conventional hard-rock quarry equipment including hydraulic loading shovels and 50 to 70t dump trucks. It is proposed eventually to install

a system of in-pit crushing using a mobile sizer to reduce the limestone to a suitable size for conveying direct to plant. Conveyors will be covered.

Blast design will be based on careful monitoring of the initial blasts using low charge weights of explosive per delay. On the basis of experience, with similar geotechnical settings in similar limestones, blast vibrations can be kept below 12mm per second at a distance of 300m using a maximum charge per delay of 100kg. A maximum charge per delay of 50kg would maintain the same vibration limit at a distance of 140m from the point of blasting.

A detailed research programme carried out during the late 1970's by the US Bureau of Mines (USBM) found that in order to cause structural damage to masonry, brick or concrete buildings, vibration levels greater than 50mm per second were required. At very low vibration frequencies the threshold of cosmetic damage (hair line cracks in plaster) may be associated with lower vibration levels. A limit of 12.7mm per second was therefore recommended by the USBM for these relatively unusual vibration frequencies. More recent investigations by the British Standards Institute has found no evidence of damage to normal structures by blasting at vibration levels below those recommended by the USBM. Neither residential nor agricultural buildings in the vicinity should be adversely affected by the proposed blasting. Blasting is considered further in Sections 3.6 and 3.9.

Overburden will be removed by small articulated dump trucks loaded by hydraulic excavators or by scrapers. Additional vehicles will include graders/dozers for road preparation and maintenance. Mobile or transportable sprinkler systems will be used for dust suppression with sprays from water bowsers where necessary.

The recovered limestone will be delivered to the limestone crusher or the as-dug stocking ground west of the quarry (see Appendix Drawing No. 2.1.1). Limestone will be crushed by primary and secondary crushers with appropriate intermediate screening before being conveyed to the blending house. The crushers will be housed and the conveyers to the plant will be covered (see Appendix Drawing No. 2.1.2). A facility will be provided for discharging primary crusher-run material in the event of downstream breakdowns *etc*. A front end loader will be used to transport as-dug limestone from the stockpile to the crusher when required.

2.2.3.2 *Shale quarry*

Working hours and maintenance arrangements will generally conform to those of the limestone quarry.

The Silty Shale and Shaley Limestone will be worked by smaller earth moving equipment than that used in the limestone quarry. It is probable that the shale quarry will need to be worked for only part of each year from late spring onwards. The annual Silty Shale requirement could be excavated in one month. There is likely to be a need for ripping the Shaley Limestone especially at depth. It is possible that blasting of the minor area of Reef Limestone may be needed. Articulated, all-wheel-drive dump trucks of *c* 30t capacity are likely to be used in conjunction with a hydraulic backhoe excavator. Appropriate measures will be taken when working under the power lines. Superficial

materials may be removed by similar plant to that used for the same task in the limestone area. Graders, dozers and sprinkler systems/water bowsers will also be used to maintain road and access ramps in a safe and dust free state.

The Silty Shale and Shaley Limestone will be recovered separately and taken to the materials stocking area west of the limestone quarry near the plant (see Appendix Drawing No. 2.1.1). The Silty Shale will be placed in thin layers in a separate homogenising stockpile; another stockpiling area will be located nearby for the imported Westphalian Shale. These two shale stockpiles will be constructed using a dozer to assist in the grading and compaction of the outer surface. The stockpiles will be sheeted to reduce moisture uptake by the shales. A third stocking area will be provided for as-dug Shaley Limestone. This latter material will be taken either directly, or *via* the stocking area, to a separate shale crusher and the -40mm product transferred by covered conveyor to a 12m high covered homogenising shed with a high level reciprocating conveyor to facilitate blending. A separate uncovered stock pile of +40mm Shaley Limestone will be provided. The Silty Shale, Westphalian Shale and the -40mm Shaley Limestone will be rehandled in appropriate proportions into feeder bins for transfer to the blending house; a front end loader will be used for this activity and for direct loading of the crushers.

2.2.3.3 *Sand and gravel workings*

The sand and gravel will be excavated during the site development programme and will adopt the working hours and maintenance arrangements which conform to construction requirements.

Equipment to be used during the first two years will include long reach backhoes for the underwater gravel excavation and either hydraulic backhoes, shovels or front end loaders for the sand excavation. It is unlikely that dust suppression bowsers will be required for the gravel excavation, but haul road maintenance and spraying will be required in the sand pit area. Processing, which will primarily comprise screening, will be achieved using mobile plant at the sand excavation site where suitable bund screening will be available.

2.2.3.4 *Overburden disposal*

Overburden will be removed to permanent, landscaped locations which will act as screening bunds. Some 956,000m³ of overburden will require removal from the limestone quarry and 913,000m³ from the shale quarry. It is proposed to defer the removal of 495,000m³ of the spoil from the shale quarry for 5 years. Appendix Table 2.2.1 and Appendix Drawing No. 2.2.4 gives details of these overburden disposal/screening bund surface areas and volumes involved in the removal from the relevant excavation areas. As may be seen the company is committed to a very high level of screening bund construction from the outset.

Haulage of construction materials will be either by scraper or by articulated dump truck with the necessary temporary access road construction and maintenance by dozers, graders and bowsers. The overburden to be removed includes a significant proportion of free draining materials. The mounds will be constructed with long term stability a

major consideration. Detailed stability and construction reports will be prepared prior to bund construction to ensure the structures are quite secure. It has therefore been appropriate to design these bunds with realistically conservative slopes not steeper than 1 in 2 with outer slopes on the major structures often as flat as 1 in 4 to 1 in 5 and never steeper than 1 in 3. Soft clays, silts and peaty materials will be bunded *inside* containing cell walls and where appropriate drainage blankets will be placed following the removal to top and sub-soils *etc.* from the areas where bunds are to be built. Top and sub soils will be separately stored to assist in revegetation of completed screening banks and bunds. Since silt may be suspended in surface water run-off from the large screening bunds, silt traps will be employed before discharge into existing watercourses until surface plant growth has been established. These silt traps will be 3 x 6m long and 1.5m deep; they will be fenced.

2.2.3.5 *Surface water treatment and disposal*

The northern part of the site including the shale quarry area drains directly to the north, whilst much of the limestone quarry and the plant area currently drains to a watercourse running to the west and then to the north. Ultimately the surface drainage in both areas runs to the Kinnegad River. The proposed plant area currently drains into the river about 1.5km upstream of the main proposed discharge point. Since groundwater levels are high, being commonly at or near the base of the superficial deposits, groundwater pumping will be necessary to work both the limestone and the shales. Groundwater details are given in Section 3.4. A combined maximum pumping rate of 4,700m^3/day has been estimated allowing for surface water inflows from *above average* rainfall.

Dewatering of the quarry workings by sump pumping is proposed. A settlement lagoon with an oil trap will be required before discharge into a watercourse. The ***settlement lagoon*** is located about 750m south of the Kinnegad River. It is proposed that water from sumps in both quarries will be pumped *via* a 450mm pipe directly to the settlement lagoon. This lagoon will be constructed from the excavation remaining from the recovery of sand and gravel used in the building of roads, foundations *etc.* on site. The eastern side of the excavation will be backfilled prior to the settlement lagoon construction. Overburden from the shale quarry will be selected to form a protective margin around the excavation (to reduce wave erosion). The minimum lagoon dimension will be 120 x 60m with inlet, outlet and overflow arrangements as shown in Appendix Drawing 2.2.5. The lagoon has been sized to accommodate the maximum realistic rate of pumping on a steady state basis and to allow for storm water run-off to be directed through the lagoon from a separate balancing pond structure. It will also receive a small inflow from run-off ditches from sections of two screening banks in the northern area.

The ***balancing pond*** will be located north-west of Lansdown Lodge and will measure *c* 170 x 110m being excavated to a depth of *c* 4m below ground level. This will receive water pumped from the plant area which may contain some oils and may have an elevated pH. It will also receive storm water pumped in separate pipework from the two quarries and for a short period (1 week) be capable of storing all water pumped from the quarries, *e.g.* for pipe maintenance and lagoon desilting purposes. Details of the balancing pond are shown in Appendix Drawing No. 2.2.6.

The discharge from the balancing pond will be regulated by a throttle plate attached to the outflow pipe. Usual oil traps will be provided. The water will flow under the road north of the pond and drain to the settlement lagoon in the main 450mm pipe. In normal circumstances water will be pumped directly from the quarry sumps to the settlement lagoon. A bypass to the balancing pond will be provided. The limestone quarry sump will be approximately 30 x 20m, the shale quarry sump will be about 40 x 20m and sited on the western side away from the Silty Shale. Sumps will be *c* 10m deep.

The water retention structures (as well as the bunds) have been designed according to the *Handbook on the Design of Tips and Related Structures (Geoffrey Walton Practice for Dept. of Environment. HMSO pp150 (1991)).*

2.2.4 Quarry safety and security

The site will be fenced to discourage inadvertent access to the quarries and the water retention structures. In general the fences will be located and properly maintained around the perimeter of the site *inside* existing (and where necessary, strengthened) hedgerows. Since the site is away from a significant number of dwellings this fencing need not be obtrusive, but security fencing to deter deliberate trespass will be used around the holding pond and settlement lagoon. The main site entrance will have a barrier and may be operated remotely.

The safety and stability of the excavations have been given due consideration. The proposed excavated slopes in bedrock with overall batters of 1 in 1 will be quite secure in the strata to be excavated. It should be noted that although strata is generally inclined to the north and northwest the south eastern or footwall slope in the limestone quarry should be stable, notwithstanding an element of under cutting. No clay bands or silty intercalations were identified in the Reef Limestone in the relevant cored boreholes for which specific geotechnical logging was undertaken. However, the shale quarry is to be excavated to the top of the Reef Limestone on the footwall side giving a significantly flatter slope. This will avoid problems which might otherwise arise if 1 in 1 slopes were to be used in that location. Superficial materials will be excavated to slopes of 1 in 2 which are adequate for both short and long term stability where a sufficient sand and gravel content is present. Local support will be provided by excavation and backfilling with suitable spoil where patches of peaty soils are located.

The screening banks will be subject to separate investigation and reporting before construction as noted above. There is sufficient granular material to ensure adequate drainage in the structures, with weaker, softer soils being contained in internal cells.

2.2.5 Quarry restoration

The completion of quarrying operations is many tens of years ahead. Given the information obtained from the piezometers and the trial pit logging it is likely that the water table will eventually rebound in both quarries to a near rockhead level. The quarries would eventually therefore be flooded and suitable for a range of activities which avoid direct public access to the waterside. Section 3.7 considers this matter in more detail. All hard standings and plant will be removed at the end of quarrying

activities. Screening banks will be used to render the waterside banks safe in the event of accidental entry into water.

Overflow arrangements into existing minor watercourses would be feasible for both quarries. In the limestone quarry this could be at or about (257160E, 242960N) into a WNW flowing ditch system whilst in the shale quarry this could be at or about (257520E, 243650N) into a north east flowing ditch.

2.2.6 Alternative layouts

It is well recognised that mineral can only be worked were it occurs. There is only one area on the site where shale can be recovered. Limestone however extends to the west of the proposed quarry under the works site. Hence it would have been possible (theoretically) to switch the locations of the works and the limestone quarry. However, it is considered that better screening of the works is available in the selected location, taking advantage of natural screening to the north which will be increased by further placement of material.

Quarry layouts have been dominated by safety in terms of slope and haul road design as well as the need to maximise mineral recovery from minimum landtake. An at-surface road linking the shale quarry to the plant area was also considered, but rejected on grounds of impact on local traffic and the local population.

2.2.7 Summary

From the above it may be seen that the very high quality limestone deposit of singular consistency together with a contiguous shale deposit meeting much of the raw material requirement for works is a unique combination for Ireland. The layout of the cement works away from residential property and with the lower level structures visually screened by large bunds is well accommodated in the site. It is considered that the combination of prevention and protection measures is consistent with best industry practice and being a new plant is likely to exceed the standards of other works in the country.

Table 2.2.1 Schedule of materials produced from limestone quarry

Phase of working	70m level complete	End of Phase 1	End of Phase 2	Final
Drawing No.	A 2.2.2 (a)	A 2.2.2 (b)	A 2.2.2 (c)	2.2.3
***In situ* Volume (m^3)**				
Rockhead to 70m	1,351,800	1,351,800	2,456,100	2,456,100
70m to 55m		1,606,100	2,768,600	2,768,600
55m to 40m		769,800	2,315,400	2,315,400
40m to 25m				1,893,100
25m to 10m				1,499,100
TOTAL	1,351,800	3,727,700	7,540,100	10,932,300
Recoverable tonnage (t)				
Rockhead to 70m	3,082,100	3,082,100	5,599,900	5,599,900
70m to 55m		3,661,900	6,312,400	6,312,400
55m to 40m		1,755,100	5,279,200	5,279,200
40m to 25m				4,316,200
25m to 10m				3,417,900
TOTAL	3,082,100	8,499,100	17,191,500	24,925,600
Years of reserve	6.2	16.2	32.3	46.6
Volume of superficials excavated (m^3)	633,000	633,000	956,000	956,000

Notes:
Volumes and tonnages are cumulative.
In situ density of Reef Limestone 2.4t/m^3.
Losses, including those due to geological uncertainty, faulting, solution features *etc.*, of 5% are assumed in recoverable tonnage.
Reserve life does not take into account Reef Limestone from shale quarry (quality unproven).
Volume of superficials includes soils.

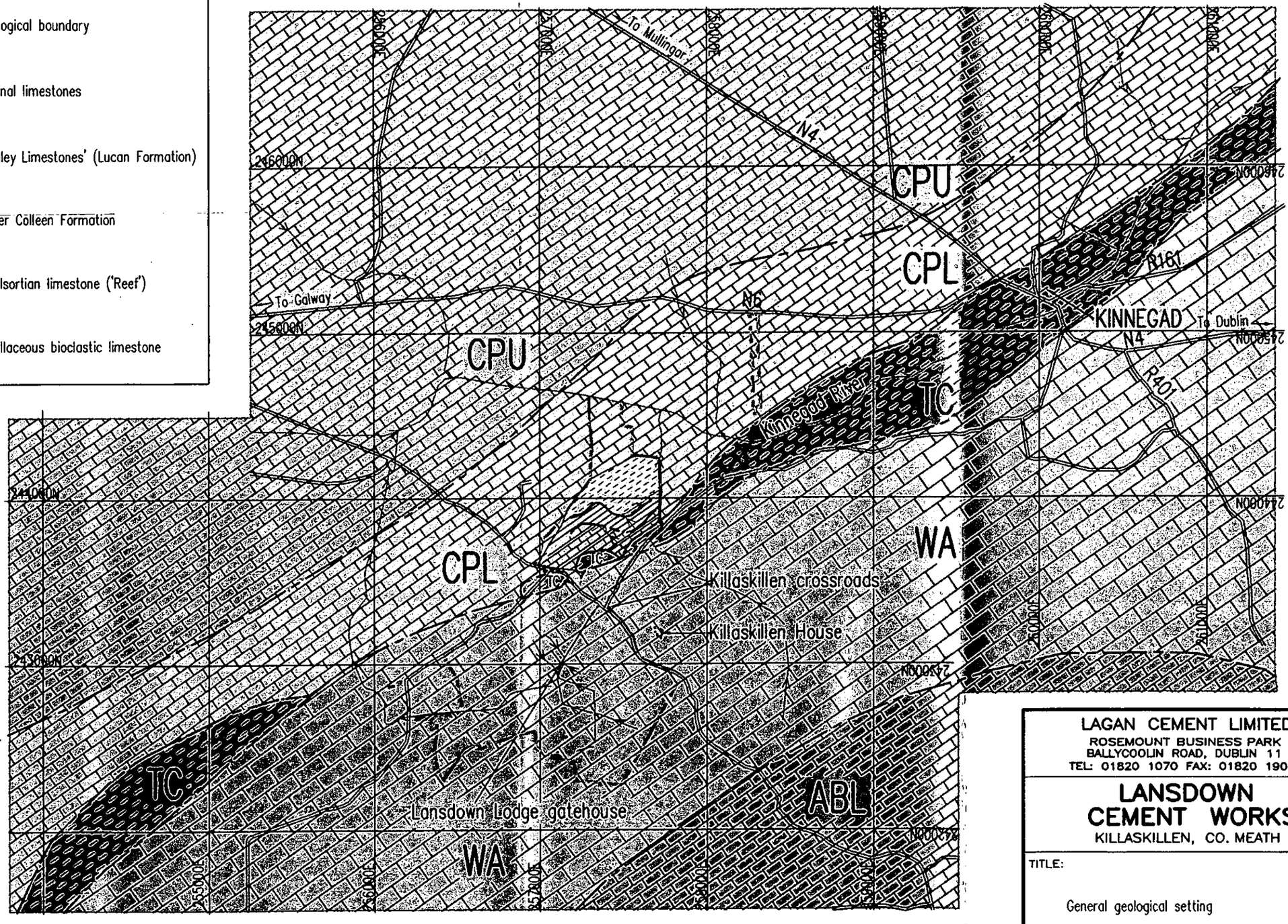
Table 2.2.2 Schedule of materials produced from shale quarry

Excavation Level	65mAOD	55mAOD	45mAOD	35mAOD	Final
Lucan Formation					
In situ volume (m^3)	239,100	1,004,700	1,619,300	2,053,600	2,333,000
Recoverable tonnage	545,100	2,290,700	3,692,000	4,682,200	5,319,200
Years of reserve	4.1	16.5	26.5	33.6	38.2
Tober Colleen					
In situ volume (m^3)	109,600	262,200	398,900	537,800	648,800
Recoverable tonnage	229,100	548,000	833,700	1,124,000	1,356,000
Years of reserve	5.9	13.9	21.0	28.3	34.1
Reef Limestone					
In situ volume (m^3)	0	13,200	46,900	87,200	136,400
Recoverable tonnage	0	30,100	106,900	198,800	311,000
Volume of superficials excavated (m^3)	418,000	913,200	913,200	913,200	913,200

Notes:
Volumes and tonnages are cumulative.
In situ density of Reef Limestone 2.4t/m^3, Tober Colleen Formation and Lucan Formation 2.2t/m^3.
An additional 67,000m^3 (140,00t or 3.5 years reserves) of Tober Colleen Formation may be recovered from the 15-25mAOD level.
Losses, including those due to geological uncertainty, faulting, solution features *etc.*, of 5% are assumed in recoverable tonnage.

LEGEND

- Site boundary
- Geological boundary
- CPU — Basinal limestones
- CPL — 'Shaley Limestones' (Lucan Formation)
- TC — Tober Colleen Formation
- WA — Waulsortian limestone ('Reef')
- ABL — Argillaceous bioclastic limestone



0 250 500 750 1000
Metres

04.11.1998

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BALLYCOOLIN ROAD, DUBLIN 11
TEL: 01820 1070 FAX: 01820 1901

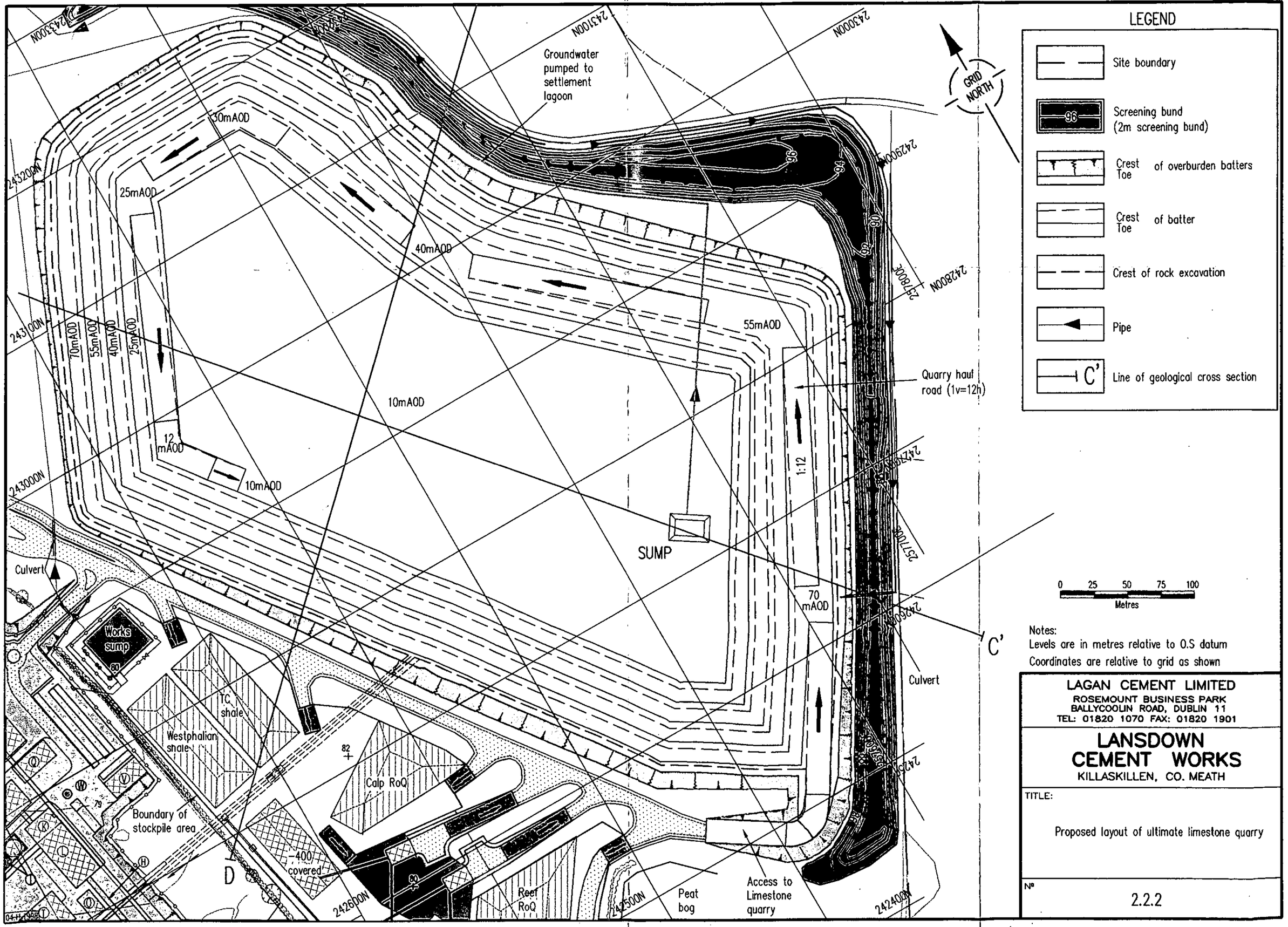
LANSDOWN CEMENT WORKS

KILLASKILLEN, CO. MEATH

TITLE:

General geological setting

Nº 2.2.1



Notes:
Levels are in metres relative to O.S datum
Coordinates are relative to grid as shown

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LANSDOWN CEMENT WORKS

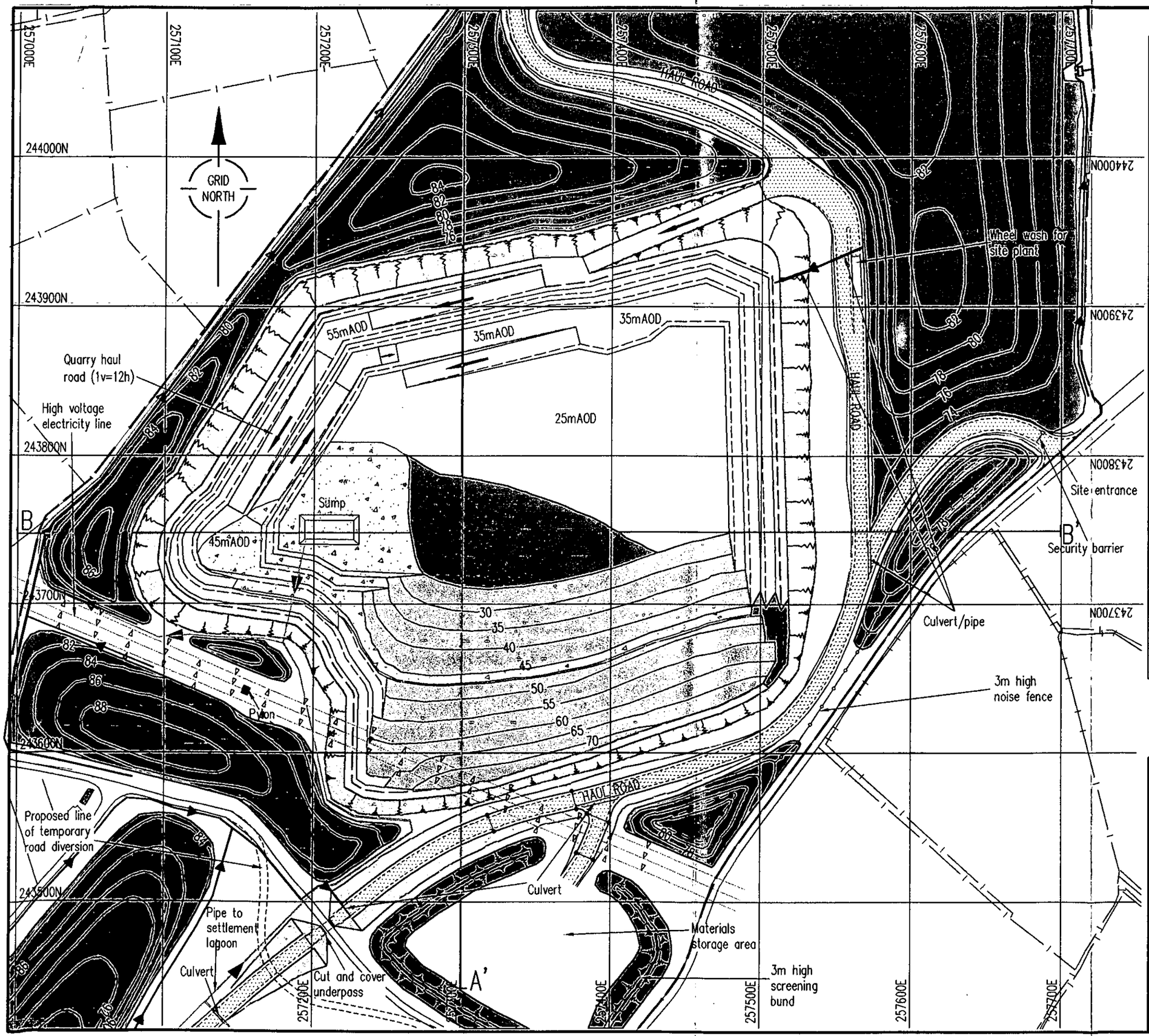
KILLASKILLEN, CO. MEATH

TITLE:

Proposed layout of ultimate limestone quarry

N°

2.2.2



LEGEND

- Site boundary
- Top of Waulsortian Limestone ('Reef' limestone) forming footwall of excavation
- Waulsortian limestone exposed in final quarry
- Tober Colleen Formation exposed in final quarry
- Crest / Toe of overburden batters
- Crest / Toe of rock batter
- Crest of rock excavation
- Pipe
- Screening bunds (2m contour intervals)
- Drainage ditch with direction of flow
- Line of geological cross section
- 'Goal posts'

0 25 50 75 100
Metres

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LANSDOWN CEMENT WORKS

KILLASKILLEN, CO. MEATH

TITLE:

Proposed layout of ultimate shale quarry

Nº 2.2.3

SECTION 3:

THE ENVIRONMENT, IMPACTS AND MITIGATION

SECTION 3:

THE ENVIRONMENT IMPACTS AND MITIGATION

HUMAN BEINGS	3.1
FLORA AND FAUNA	3.2
SOILS AND GEOLOGY	3.3
WATER AND HYDROGEOLOGY	3.4
AIR AND CLIMATE	3.5
NOISE AND VIBRATION	3.6
LANDSCAPE AND VISUAL	3.7
MATERIAL ASSETS	3.8
CULTURAL HERITAGE	3.9
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SECTION 3.1

HUMAN BEINGS

3.1 HUMAN BEINGS

3.1.1 Introduction

This section considers the existence, activities and well-being of people, not only as individuals but also as groups and populations, and the effects, positive or negative, of the proposed development on them.

3.1.2 Human Beings in the Existing Development

3.1.2.1 *Context*

The proposed site comprises an area of 160.0 hectares and is located in County Meath, 3km southwest of Kinnegad. The site extends southwards from the Kinnegad river to within 1.2 kilometers of the village of Ballinabrackey which lies to the south. The village of Castlejordan is located a further 2kms southeast of Ballinabrackey.

Landuse and Economic Activity:
As part of this report, a landuse survey was undertaken on the 29th and 30th of June 1998.

The landuse in the region, of which the proposed site forms part, is predominantly agricultural. However, there are areas of raised bog to the south, east and west of the site. The bogs to the east and west are being commercially harvested by Bord na Mona. The bog to the south is largely cutover and grassland has been pushed onto its margins, though there is also bare peat where fuel which is cut by individual local people is dried.

Agricultural practice in the area is quite homogeneous with over 90% of the fields used solely for pasture and/or the harvesting of hay or silage. This landuse is associated with low-intensity dairy and livestock (cattle and sheep) farming.

The soil is mostly heavy and naturally poorly drained and consequently non-intensive farming is a feature of the area and productivity is generally low. The area has been designated as a Disadvantaged Area (Less Severely Handicapped) by the Department of Agriculture, Food and Forestry.

The activity described above reflects the present landuse within the proposed site, the vast majority of which was used as pastureland up to now. A small area of the site in the south consists of an area of raised bog which is at present being worked privately. A small free range chicken farm is located at present near the western border of the site. This land has been purchased by the proposer and the use will be discontinued.

Apart from local agriculture and Bord na Mona there is little or no significant economic activity in the region surrounding the proposed site.

Kinnegad to the northeast is the largest service centre in the immediate area. Services in the town are confined to basic amenities such as public houses, restaurants and small retail outlets. Indeed, much of the limited service industry in Kinnegad is geared to passing trade. Situated at the intersection of the N4 and the N6, the two main western

routes to and from Dublin, a considerable amount of trade is generated in Kinnegad due to the large volumes of passing traffic. There are no production facilities located in the town and only one agricultural supply store serves the local community.

To the south, the villages of Ballinabrackey and Castlejordan function as very small rural centres offering only the most basic amenities. There is a public house and grocery shop in Castlejordan which also possesses a national school and a post office.

Population Distribution and Trends:
To study the settlement pattern in the immediate area, a household survey was carried out on the 25th and 26th of May 1998.

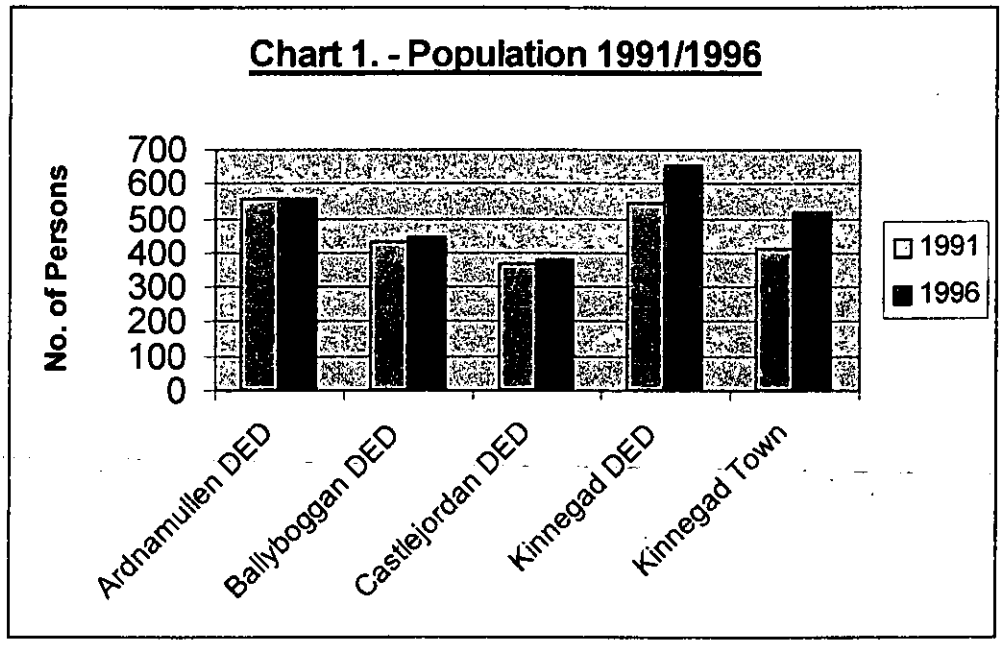
Small Area Population Statistics (SAPS) for the region around the proposed site were obtained from the Central Statistics Office.

In rural areas SAPS are generally available for District Electoral Divisions (DEDs) or for towns of over 1,000 population. As there are no such towns in the study area the SAPS obtained are quoted for DEDs only. In this respect 4 DEDs were considered relevant and together they encompass the region surrounding the site which could reasonably be seen to be potentially affected by the development. This area covers the southwest corner of County Meath, southwest of Clonard and an area of approximately 12 km^2 surrounding Kinnegad. The DEDs are listed below:-

- DED 069 Ardnamullan (Meath).
- DED 071 Ballyboggan (Meath).
- DED 073 Castlejordan (Meath).
- DED 083 Kinnegad (Westmeath).

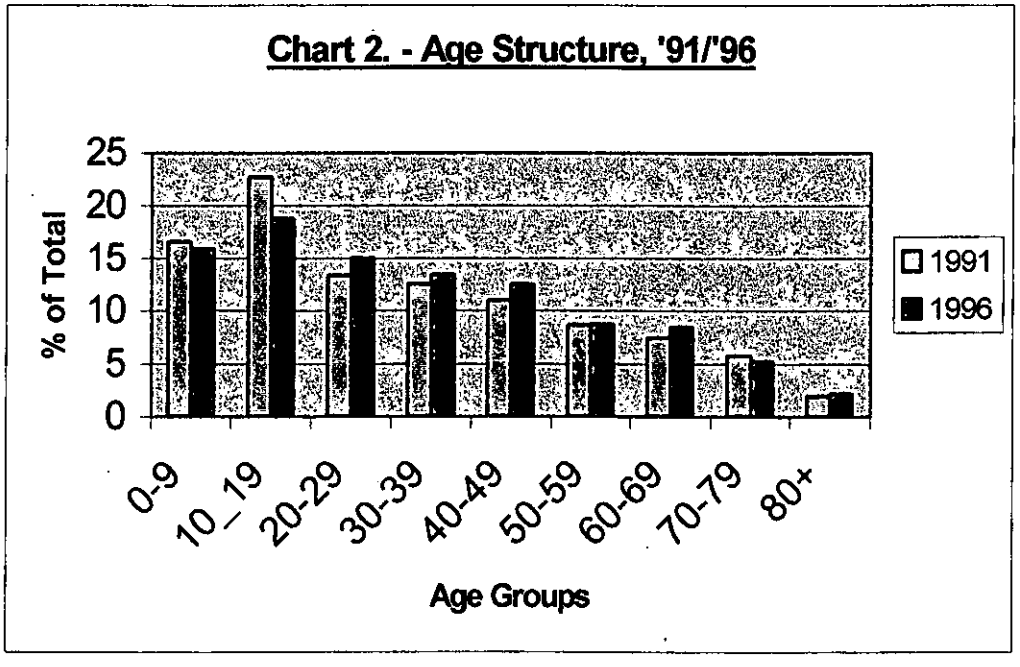
The SAPS in question were obtained from both the 1991 and 1996 Census of Population. The following charts condense and illustrate particular statistics which were considered relevant. To facilitate a comparison between the two censuses, the statistics for each year are shown side by side.

Unless stated otherwise, any statistics illustrated in the following charts and text are amalgamated for the four DEDs named above.



Total population of 4 DEDs:

1991 = **1894**
1996 = **2038**



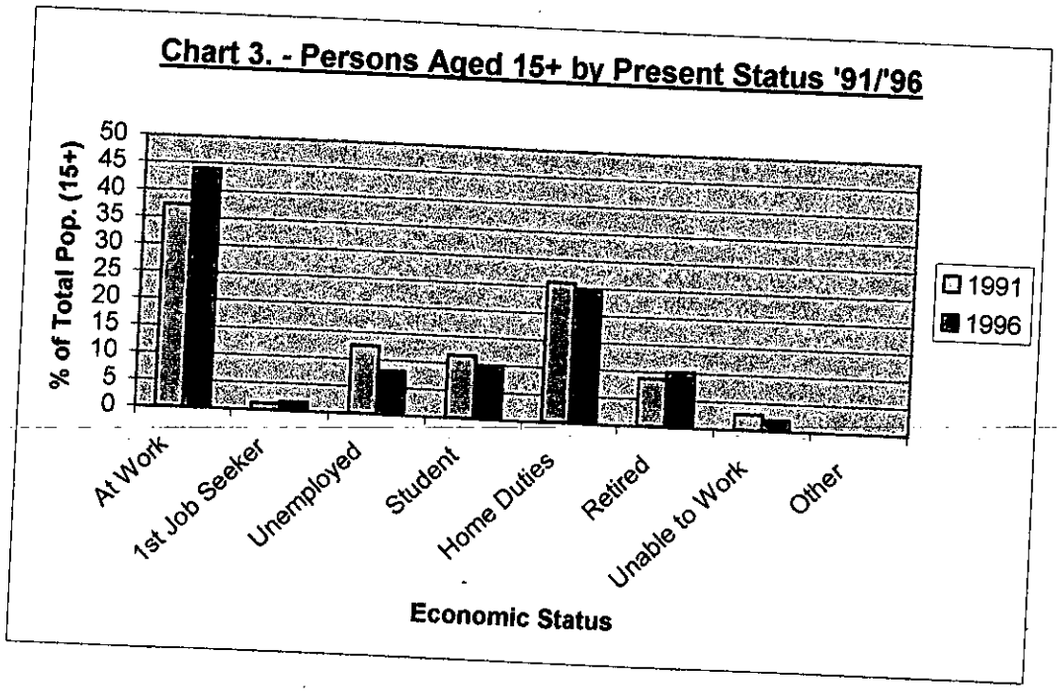


Chart 3. - Persons Aged 15+ by Present Status '91/'96
% of Total Pop. (15+)
50
45
40
35
30
25
20
15
10
5
0
1991
1996
At Work
1st Job Seeker
Unemployed
Student
Home Duties
Retired
Unable to Work
Other
Economic Status

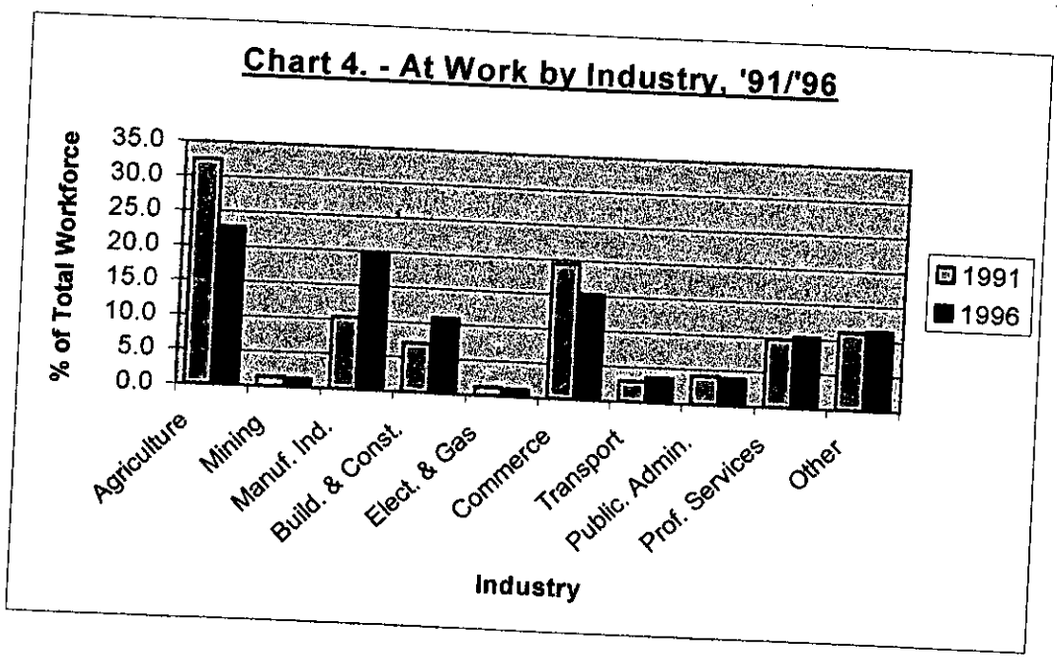


Chart 4. - At Work by Industry, '91/'96
% of Total Workforce
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1991
1996
Agriculture
Mining
Manuf. Ind.
Build. & Const.
Elect. & Gas
Commerce
Transport
Public. Admin.
Prof. Services
Other
Industry

The population statistics show that the region in question has a very small population. The total population of the 4 District Electoral Divisions was 1894 persons in 1991. The 1996 census returned a total population of 2038 persons, that is, a 7% increase. However, when the town of Kinnegad is omitted from these figures the growth was 2.8%. In this respect, it is also noted that in Table 1, Part 1 of the Meath County Development Plan, that the population in the Trim Development District fell by 0.1% between 1986 and 1991.

The statistics also support the finding that agriculture is the main economic activity and source of employment. As can be seen from chart no. 4, in 1991 over 30 % of the total workforce were involved in agriculture. This figure dropped to 23% by the 1996 census but nevertheless agriculture was still the main area of employment at that time.

Unemployment in the region is high. Taken as a percentage of the total workforce (that is, those at work, those seeking work for the first time and those unemployed) over 15 years of age, unemployment in 1991 was at 24.6%. In 1996 this figure was down to 15%. This drop in unemployment reflects the strong national economic growth that Ireland has experienced since the depression of the late 1980's and early 1990's. Nevertheless, when compared with the present national average rate of unemployment (9.6%) (CSO, per. com. 1998) it is clear that unemployment in this region is still disproportionately high. This suggests that growth in the local economy has been relatively slow and the area has failed, as yet, to reap fully the benefits of the present national economic growth.

The household survey shows the area immediately adjoining the site to be particularly sparsely populated. 14 dwellings are located within 500 metres of the site boundary.

Apart from the dwellings mentioned above there are no other 'sensitive neighbouring occupied premises', such as hospitals, schools or holiday accommodation in the immediate vicinity of the proposed development. Furthermore, information from Meath and Westmeath Tourists Boards indicate that tourism in this particular area is very low key or completely absent. In this respect, there is no evidence of transient populations which may be affected by the proposed development such as walkers, drivers or tourists generally.

3.1.2 Impacts on Human Beings

3.1.3 Impacts on Human Beings

3.1.3.1 *'Do Nothing' Impact*

In the absence of the proposed development the present trend of a small agriculture-dependant local economy is expected to continue. It is also expected that Bord na Mona will continue to work the bogs in the area, contributing to this economy.

However, due to the limitations imposed by the relatively poor quality of agricultural land, it is unlikely that any significant economic growth will occur in this region in the foreseeable future. There is nothing to suggest that the high level of unemployment in the region will be further alleviated in the short-term or long-term.

Furthermore, it is expected that, within 12 months, Galway traffic travelling at present through Kinnegad will bypass the town to the south. Within the next 10 years a complete bypass of Kinnegad is proposed for all traffic on the N4 and N6. Considering the present reliance of Kinnegad on passing trade it is clear that in the absence of any significant development in the area the local economy of Kinnegad will suffer even further.

It is possible that with the bypassing of Kinnegad by the N4 and N6, unemployment in the town may actually begin to increase again. This would have obvious repercussions in the area by way of increasing rural decline and altering the age distribution of the population as a consequence of emigration.

3.1.3.2 *Predicted Impact*

Having placed Human Beings in context, the EIS now progresses to examine the impacts, positive or negative, which the proposed development may have on them.

Ultimately, almost all the effects of a development impinge upon human beings in some way. These effects include those physical impacts which are primarily seen to affect particular aspects of the environment as opposed to people.

The accompanying drawing 3.1.1 shows the proximity of the local farm households to the proposed site. During site survey and consultations local farmers identifed the following issues which might have a potential impact on them and/or their farm enterprises, should the proposed development proceed:

- The amount of dust and gasses that will be emitted from the site and the effect that these may have on crops and on livestock when deposited on farm lands in the vicinity of the Lansdown site.
- The possible impact of any emissions on human health, especially in relation to people with respiratory problems.
- The effect of the quarry operations on the watertable with regard to its effect on wells and the possible effect on crops.
- That the streams in the locality, from which livestock drink, might run dry, be diverted or be contaminated. The capacity of the Kinnegad river to take the extra volume of water that will be discharged to this river.

- The potential of noise from quarrying, blasting, traffic and the cement plant to impact on this rural area.
- The possibility of damage to underground slurry storage tanks.
- The possibility of fly-rock being deposited on lands adjacent to the limestone quarry.
- The possibility of increased traffic causing problems for farmers in carrying out activities such as stock movement on fragmented holdings, silage cutting or slurry spreading.
- The visual impact of the proposed screening bunds and the cement plant structures.
- The possible effect of the proposed development on the raised bog.
- The effectiveness of any proposed mitigation measures.
- The possibility that adjacent lands might be devalued due to the proposed development of the Lansdown site.
- The de-commissioning plans for the site, especially the possibility that the quarries might be used as landfills, particularly in light of the planned improvement in the road infrastructure and the proximity to Dublin.
- The future use to be made of the lands referred to as Murphy's farm. The possibility that Lagan Group might buy more land in the area and perhaps expand their operation and consequently surround some of the farms in the area.
- The emergency road might be used as a full time entrance/exit.

The likely environmental impact of the above items, and the mitigation measures proposed to deal with them are described in the remaining sections of part 3 of this EIS. (3.2-3.11).

It is also considered that a manufacturing plant of this magnitude will have a major socio-economic effect on the surrounding district and for this reason it will be considered separately below.

Physical Environmental Impacts:
A number of environmental impacts which may impinge, directly or indirectly on human beings have been identified. These are listed below and are expanded on as appropriate:

- Air – Dust and other emissions from the process.
- Noise and Vibration.
- Water
- The Landscape.
- Traffic.
- Cultural Heritage.
- Material Assets.
- Flora and Fauna.

Air and Emissions:
The manufacture of cement involves the procurement of raw materials and the processing of these materials into the final product.
An unavoidable by-product of this process, and particularly the combustion of fuel, is the production of a number of emissions including particulate matter, carbon dioxide, carbon monoxide and sulphur and nitrogen dioxides.

With the enactment of recent European and National legislation and the establishment of the Environmental Protection Agency, emission standards have become ever more restricted and tightly controlled in recent years. At the same time, the technologies and measures required to achieve these strict standards have improved remarkably. Using this technology the measures proposed to reduce emissions to an absolute minimum are very extensive.

The emission standards and measures proposed to meet them are described in detail in Section 3.5. It has been established that a state-of-the-art cement works as proposed will not in any way pose a health hazard to human beings as a result of emissions to atmosphere.

Noise and Vibration:
A certain level of noise and vibration is another unavoidable consequence of a development of this kind. Noise will emanate from various aspects of the project such as the crushing and processing of the raw material and the operation of heavy machinery at and between the quarries. Vibration will occur as a result of blasting in the limestone quarry. The EPA Batneec guidelines will be strictly adhered to to ensure that no nuisance is caused by the process.

Water:
Water is another aspect of the physical environment which has the potential to also impact on Human Beings. The issue of most concern due to the proposed development involves the extraction of material from the quarries and the subsequent drawdown of the local water table. The vast majority of residences in the area source their domestic water supply from wells and it is expected that a number will be affected.
As is described in Section 3.4.5 Lagan Cement Limited proposes to provide an alternative water supply to these residences. The likely effect on agricultural production is considered in Appendix 3.9.2.

Landscape:
This issue has been taken very seriously by Lagan Cement Limited and a landscape architect was commissioned to advise on the project from an early stage. A detailed report by this landscape architect on the landscape and the implications of the proposed development is contained in Section 3.7. A number of specially designed landscaping measures have been draw up in order to integrate the development as much as possible into the existing landscape. These include the strategic placement of screening mounds and tree plantations and the use of the latest techniques of landforming.

Traffic:
Traffic generated by the development is another issue which has received careful consideration by the developer. A report on this matter is contained in Section 3.10. As is described in this section, the present access to the site, via the county road from Kinnegad to Killaskillen crossroads, was judged to be inadequate for the volumes and type of site traffic predicted and a new access route was sought and identified. This new route involves the construction of a new section of road which will link the site with the N6 national primary route to the north. This new access will serve to divert site traffic away from the eastern section of the county road, mentioned above, which is narrow and twisty and adjacent to which are situated a number of houses. For the new

proposed junction with the N6, a comprehensive traffic management scheme will be designed in co-operation with the relevant road authority.

Cultural Heritage, Material Assets and Flora and Fauna:
There are no archaeological sites located on the proposed site and hence the development is not expected to have a significant impact on the cultural heritage of the area. With the exception of the loss of some agricultural land and the use of a geological resource, the Material Assets of the region are unlikely to suffer significant adverse effects from the project. Impacts on agriculture are discussed in Section 3.9. There are no special designations which apply to the ecology of the site and the value of the Kinnegad river to the Boyne fishery is expected to increase due to the addition of excess treated groundwater from the quarries which will increase the flows in the river.

Socio-Economic Impact:
A development of this scale is bound to have serious implications for the socio-economic environment of the area.

It has been decided to address this issue in the context of the four District Electoral Divisions (DEDs) described in Section 3.1.2.1 above. The proposed development lies roughly in the middle of these DEDs and they cover the area which one could reasonably expect to be affected by the development.

The proposed development will consist of a construction and operational phase.
The construction phase will last up to two years and during this time over 100 people will be employed. During **the operational phase**, 200 personnel will be employed on a permanent basis. In the filling of these posts, priority will be given to people from the region. It is anticipated that the employment of those already possessing the necessary skills and those who will take advantage of training schemes initiated by the company help to will reduce local unemployment to much lower levels and to reverse the trend of out-migration.

As a result of the construction and operational phases of the development, a large demand for materials, supplies, maintenance and a wide range of other services will arise. The associated workforces will create another large demand for catering, accommodation and recreational services and facilities. On and off site construction traffic will create a demand for vehicle maintenance and services.

Although some of the more specialist requirements of the construction and operational phases of the development will be sourced from outside of the local region, a large proportion of the demand for general services, supplies and facilities, as described above, will nevertheless be placed on the local economy. In this respect, in order to meet the requirements of these new demands, a whole new service industry will, in effect, need to be developed in the local region.

A number of additional facilities associated with the project workforce and their families will also need to be made available locally. These include permanent accommodation, domestic services, retail outlets, recreational and educational facilities, as well as health and other facilities.

From a social perspective this development and the boost to the local economy is likely to have many positive effects on the local population. It is probable that the majority of people living in the area will be affected to a greater or lesser extent.

As a result of the increased economic prosperity in the region, unemployment would be expected to drop significantly and per capita income will increase generally. In the light of this and the additional amenities available in the area, living standards for most of the population should increase substantially. This will have further positive implications for social trends in the region, namely the stemming of emigration, halting rural decline and balancing the age distribution of the population.

The local towns and villages are likely to be the first places to show signs of the effect of the proposed development. New amenities, facilities and services associated with the development should appear and revitalise these areas, particularly Kinnegad town and the villages of Ballinabrackey and Castlejordan.

3.1.4 References

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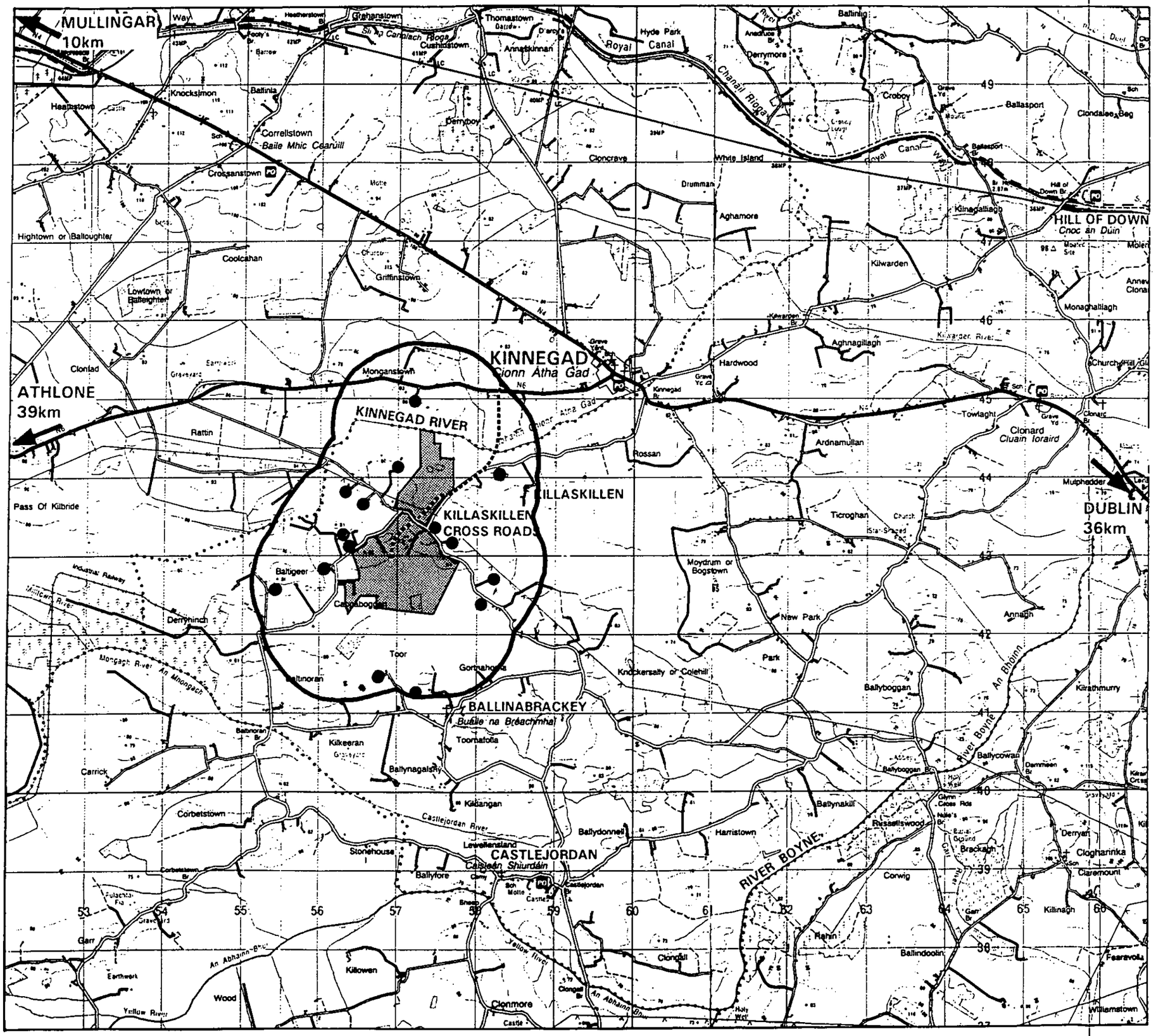
MULLINGAR
10km
ATHLONE
39km
DUBLIN
36km
KINNEGAD
Cionn Átha Gad
KINNEGAD RIVER
KILLASKILLEN
KILLASKILLEN CROSS ROADS
BALLINABRACKEY
Baile na Bréachmhaí
CASTLEJORDAN
Caisleán Shiurdáin
HILL OF DOWN
Cnoc an Dúin
RIVER BOYNE
Royal Canal
Grand Canal
Hyde Park Canal
Thomastown
Annaskinnan
Knocksimon
Heathstown
Correlstown
Baile Mhic Cearúill
Crossanstown
Derrynboy
Cloncrave
White Island
Drumman
Aghamore
Croboy
Ballasport
Clondalee Beg
Kilnagallagh
Hightown or Balloughter
Coolcahan
Griffinstown
Lowtown or Balleighter
Kilwarden
Monaghallagh
Clonlad
Monganstown
Hardwood
Aghnagillagh
Towlaght
Clonard
Cluain Ioraird
Ardnamullan
Rossan
Rattin
Pass Of Kilbride
Ticroghan
Moydrum or Bogstown
Baltigeer
Castleboggan
Derrynginch
New Park
Annagh
Toor
Gortnahown
Knockersally or Colehill
Ballyboggan
Kilrathmurry
Kiltinoran
Kilkeeran
Toornafolla
Ballynagalshy
Carrick
Corbetstown
Kildangan
Ballydonnell
Harristown
Ballynakill
Russellswood
Derryan
Clogharinka
Claremount
Brackagh
Stonehouse
Lewellenstand
Ballyfore
Corwig
Killinagh
Rahin
Ballindoolin
Clongall
Clonmore
Killowen
Wood
Garr
Earthwork
Yellow River
Mongagh River An Mhongach
An Abhainn Bhuí
An Bhóinn
River Boyne
Castlejordan River
Kinnegad River
Industrial Railway
Mullaghcrin River
Kilwarden River
Yellow River
Mulphedder
Fearavolla
Williamstown
Derrynmore
Ballinlig
Anadrue
Kevanagh
Grave Yd
Motte
Castle
Church
Holy Well
Sch
Bridge
Graveyard
Burial Ground
Glynn Cross Rds
Nolle's Br
Dunmeen Br
Ballycowan
Ballyboggan Br
Castlejordan Br
Kinnegad Br
Clonard Br
Hill of Down Br
Kevanagh Br
Batinoran Br
Gen Br
Jane
Ch
Sch
Grave Yd
Motte
Castle

SECTION 3:

THE ENVIRONMENT IMPACTS AND MITIGATION

HUMAN BEINGS	3.1
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SOILS AND GEOLOGY	3.3
WATER AND HYDROGEOLOGY	3.4
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MATERIAL ASSETS	3.8
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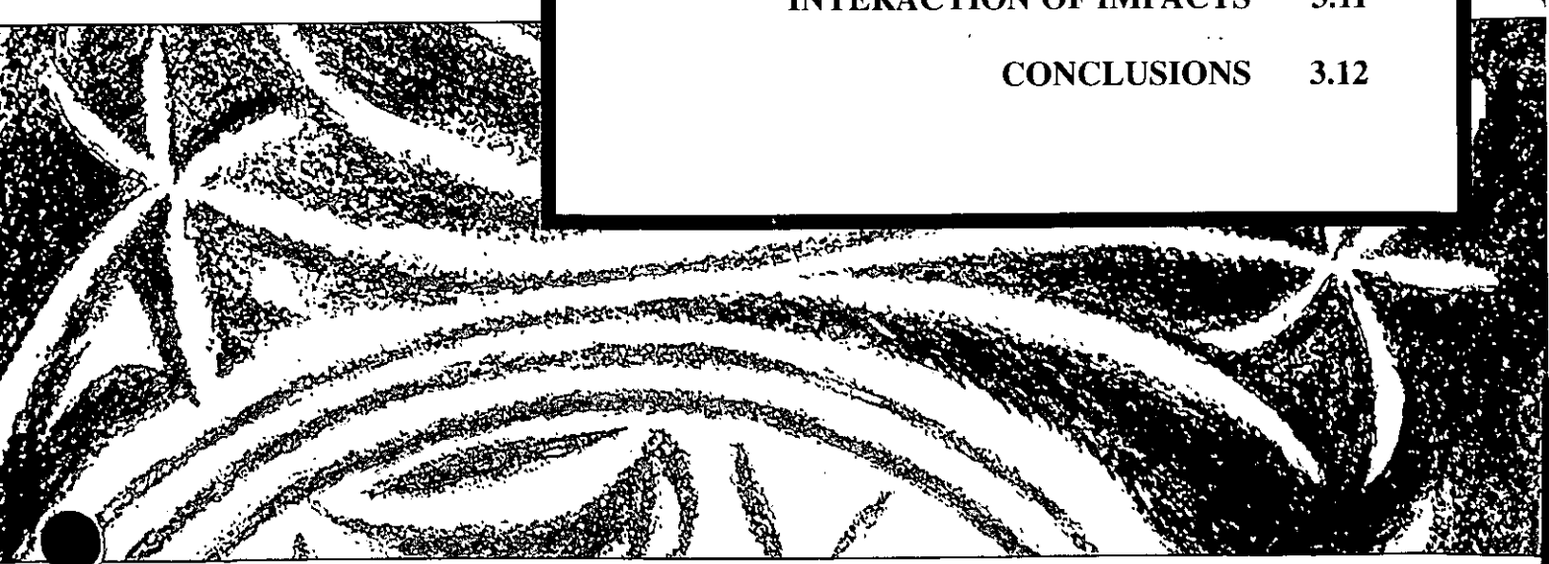
TRAFFIC	3.10
INTERACTION OF IMPACTS	3.11
CONCLUSIONS	3.12



SECTION 3.2

FLORA AND FAUNA

3.2 FLORA AND FAUNA

3.2.1 Introduction

The 'terrestrial' account is derived from three field visits in the period February/April 1998 during which the entire site was examined with the surrounding area, particularly the bogland to the south. Survey work on the river as far downstream as Kinnegad took place in June 1998 but has made use of monitoring data from the Environmental Protection Agency and also information provided by the Eastern Regional Fisheries Board. The full report of the aquatic survey of the Kinnegad River is contained in Appendix 3.2 of the EIS. The sampling sites and maps referred to in this section are illustrated in the aquatic report.

3.2.2 Site Description

The site consists of flat or gently sloping agricultural land which is highest on each side of the central area around Lansdown Lodge and falls gradually to a bog in the south and more steeply to the floodplain of the Kinnegad River in the north. The soil is mostly heavy and naturally poorly drained. In the lower parts the fields are surrounded by drains and peat forms easily in the soil. The bog itself is largely cutover and grassland has been pushed south onto its margins though there is also bare peat where fuel is dried. A bank of glacial, sandy soil overlooks the river valley and offers a notable contrast to the other fields.

The habitats that occur can be listed as grassland, arable fields, hedgerow, river and cutover bog and they will be described in this order. The vegetation is first described followed by notes on the vertebrate fauna. These animals and birds use several habitats on site and are seldom restricted to one. No attempt was made to assess the terrestrial invertebrate fauna as the habitats present are all very widespread and are most unlikely to harbour any species of interest. Invertebrates were examined in detail in the analysis of the river.

3.2.3 Habitats

3.2.3.1 *Grassland*

Pasture covers about 60% of the site with damp fields in the north and south and drier ones in the middle. All such grassland is species-poor and used as intensively as the ground conditions allow. The drier sites have ryegrass *Lolium perenne*, meadow grass *Poa* spp, creeping bent *Agrostis stolonifera*, creeping buttercup *Ranunculus repens* and dandelion *Taraxacum officinale* with nettle *Urtica dioica* and broad-leaved dock *Rumex obtusifolius* at intervals. Even the glacial deposit above the river valley has little to distinguish it apart from small amounts of cocksfoot *Dactylis glomerata*, mouse-ear *Cerastium fontanum*, yarrow *Achillea millefolium* and the moss *Brachythecium* cf *albicans*. *Lolium* declines in the damper parts and is replaced by yorkshire fog *Holcus lanatus*, timothy *Phleum pratense* and meadow foxtail *Alopecurus pratensis* with some red fescue *Festuca rubra* and curled dock *Rumex crispus*, sorrel *R.acetosa*, scutch *Elytrigia repens* and ragwort *Senecio jacobaea*. In wet places there is sweet grass *Glyceria fluitans* and sometimes rushes *Juncus effusus* and *J.inflexus* while a depression

in one of the southern fields has marsh foxtail *Alopecurus geniculatus* and lady's smock *Cardamine pratensis* centrally with a ring of creeping thistle *Cirsium arvense* and nettle *Urtica dioica* around the edge. Close to the bog edge on almost pure peat, crested dogstail *Cynosurus cristatus*, marsh thistle *Cirsium palustre* and field buttercup *Ranunculus acris* join the vegetation and there is also a poached field with abundant meadow grass *Poa trivialis*, *P.annua*, daisy *Bellis perennis*, ribwort plantain *Plantago lanceolata*, chickweed *Stellaria media* and bog chickweed *S.alsine*.

The fields SSE of Lansdown Lodge have reverted after tillage to grassland with tall herbs and have abundant scutch *Elytrigia repens* along with spear thistle *Cirsium vulgaris*, nettle *Urtica dioica*, dock *Rumex obtusifolius*, burdock *Arctium minus* and some rushes *Juncus* spp. A contrasting limestone outcrop close to the field edge has been trampled and enriched by wintering cattle but retains some of its original species including

Dactylis glomerata	cocksfoot
Poa pratensis	meadow grass
Achillea millefolium	yarrow
Potentilla reptans	cinquefoil
Bellis perennis	daisy
Medicago lupulina	black medick
Pilosella officinarum	mouse-eared hawkweed
Cardamine hirsuta.	bittercress

3.2.3.2 *Arable Fields*

Cereals have been grown recently in the fields east and south-east of Lansdown Lodge and there is a limited weed flora here because of the residual effect of herbicides. In early spring only annual meadow grass *Poa annua*, rough-stalked meadow grass *P.trivialis*, creeping bent *Agrostis stolonifera* and scutch *Elytrigia repens* were at all common. Additional species at that time included red deadnettle *Lamium purpureum*, speedwell *Veronica persica*, sow thistles *Sonchus oleraceus*, *S.asper*, ragwort *Senecio jacobaea*, shepherd's purse *Capsella bursa-pastoris* and corn poppy *Papaver rhoeas*.

3.2.3.3 *Hedgerow*

The hedges provide the most variable habitat on-site though they are all essentially linear wooded areas. Most have a ditch and bank and the ones in low-lying areas often have rather static water at the base. Above, there are hedgerow shrubs and trees with lines of larger trees in places. The most frequent woody plants (in approximate order of abundance) are hawthorn *Crataegus monogyna*, privet *Ligustrum vulgare*, bramble *Rubus fruticosus*, blackthorn *Prunus spinosa*, ivy *Hedera helix*, rose *Rosa canina*, holly *Ilex aquifolium*, honeysuckle *Lonicera periclymenum* and gorse *Ulex europaeus*. There is hazel *Corylus avellana* in the townland boundary of Cappaboggan south of the road with spindle tree *Euonymus europaeus* here and elsewhere in the western part. Grey willow *Salix cinerea* grows in wet places generally and there is a little eared willow *S.aurita* and wild damson *Prunus domestica* along the edge of the bog. Field rose *Rosa arvensis* is restricted to wet areas in the north. The dominant trees are beech *Fagus sylvatica* in the vicinity of Lansdown Lodge, ash *Fraxinus excelsior* generally, scot's

pine *Pinus sylvestris* on the flat land south of the river and leading down to the bog south of the House, sycamore *Acer pseudoplatanus*, elm *Ulmus procera* (now killed and re-sprouting as root suckers) and oak *Quercus* sp.

The common hedgerow plants are germander speedwell *Veronica chamaedrys*, cuckoo pint *Arum maculatum*, celandine *Ranunculus ficaria*, primrose *Primula vulgaris*, false brome *Brachypodium sylvaticum*, ground ivy *Glechoma hederacea*, shield fern *Polystichum setiferum* and violet *Viola riviniana* with cow parsley *Anthriscus sylvestris*, hogweed *Heracleum sphondylium* and goosegrass *Galium aparine* in the nutritionally enriched places. The townland hedge near Cappaboggan adds a significant number of additions which are only sporadically found elsewhere, if at all

Ajuga reptans	bugle
Fragaria vesca	wild strawberry
Oxalis acetosella	wood sorrel
Conopodium majus	pignut
Potentilla sterilis	barren strawberry
Carex flacca	grey sedge
C.sylvatica	wood sedge
Polypodium vulgare	polypody fern
Sanicula europaea	wood sanicle
Hyacinthoides non-scriptus	bluebell
Stellaria holostea	greater stitchwort
Ranunculus auricomus	goldilocks

Three-nerved sandwort *Moehringia trinervia* was seen on a single bank south-west of Lansdown Lodge.

As mentioned many of the hedges have water in them, at least during winter. Distant sedge *Carex remota*, meadowsweet *Filipendula ulmaria*, hard rush *Juncus inflexus*, soft rush *J.effusus* are characteristic of their edges with occasional tufted hairgrass *Deschampsia cespitosa* (in peaty places) and great willowherb *Epilobium hirsutum*, water mint *Mentha aquatica* and wild angelica *Angelica sylvestris*. The hedge along the edge of the bog is distinct with shining St John's wort *Hypericum pulchrum*, buckler fern *Dryopteris dilatata*, soft grass *Holcus mollis*, fraochan *Vaccinium myrtillus* and wild raspberry *Rubus idaeus*. The water plants in most places include fool's watercress *Apium nodiflorum*, watercress *Nasturtium officinale*, duckweed *Lemna minor*, water starwort *Callitriche* sp., sweet grass *Glyceria fluitans* and brooklime *Veronica beccabunga* while there is a single patch of pond sedge *Carex acutiformis* in a drain in the north-west corner, together with reed grass *Phalaris arundinacea*.

3.2.3.4 *Walls and Buildings*

Although many of the farmyard walls are built of limestone the upkeep of them has been sufficient to prevent much growth of vegetation. An exception is the wall south of the house 'lawn' where the plant species consist of:

Asplenium trichomanes	maidenhair spleenwort
A.ruta-muraria	wall rue

A.ceterach	rusty back
Pilosella officinarum	mouse-eared hawkweed
Leucanthemum vulgare	dog daisy
Sedum acre	stonecrop
Poa pratensis	meadow grass
Festuca rubra	red fescue
Cardamine hirsuta	bittercress
Verbascum thapsus	mullein

3.2.3.5 *Fauna*

The mammals that are known to occur in the farmland habitat on site are rabbit, hare, fox, badger, brown rat and field mouse. Either the animals themselves were seen or obvious signs of their presence. In addition it is very likely that house mouse occurs around the buildings and hedgehog in the denser hedges. Stoats are likely to hunt in the places that rabbits frequent while bats are known to feed around the house. No bat survey was done as changes to the house and outbuildings were not part of this application. Such a survey is advisable when renovation is planned.

The rabbit, fox and brown rat are widespread but there seems to be only one active badger sett - in the field boundary to the west of the glacial deposit south of the Kinnegad River. Another suitable hole in a hedge south-east of Lansdown Lodge one field away from the bog may have some temporary use.

The bird fauna of the farmland consists mainly of species that use both habitats for feeding and/or nesting. In winter good numbers of thrushes (redwing and fieldfare) were present while a roving flock of 4-5000 starlings was feeding in the fields around the river. Such a flock covers a wide area and would not depend on particular fields for food. Rook, jackdaw, magpie, hooded crow and wood pigeon were other obvious species.

In summer a few rooks (10 pairs) nest in pine trees in the north of the site as does a kestrel. Wood pigeon, hooded crow, magpie and mistle thrush are other species nesting in trees while the jackdaw breeds in buildings. Small birds associated with the hedges include such typical species as blue tit, great tit, coal tit, greenfinch, goldfinch, chaffinch, robin, dunnock and willow warbler. Chiffchaffs were present in the tall trees around the house where spotted flycatcher also occurs. Both these birds depend solely on trees while the skylark spends all its time in open fields. A single bird was singing adjacent to the river fields.

The farm buildings support a large population of swallows and although the visits were too early to assess the full size it is thought that 20-30 pairs are probably involved. A few house sparrows also nest though this is dependant on farming patterns. Two to three pairs of pied wagtail also seem to nest but no barn owls have been seen in recent years.

3.2.3.6 *River*

The river is a canalised structure rather similar to some of the adjacent drains though considerably wider (4m). The edging vegetation is substantially the same though forget-me-not *Myosotis scorpioides* in the water and reed fescue *Festuca arundinacea* on the bank above are additional species. Excavated material also supports wild carrot *Daucus carota*, hedge parsley *Torilis japonica* and coltsfoot *Tussilago farfara*. Distinct aquatic plants occur, including pondweed *Potamogeton natans* and the bur-reeds *Sparganium erectum* and *S.emersum*.

3.2.3.7 *Fauna*

The mammals associated with the river are mink and brown rat and evidence of both was seen. Otters are probably present at times but would only be passing through - there are no resting areas. The site is currently very open without bankside trees so there may be little nesting by moorhen though the species does occur. Heron, mallard, grey wagtail and black-headed gull were also present while a single green sandpiper was seen in February. Kingfisher is also likely to occur. None of these species find suitable nesting sites on this stretch of river.

For the invertebrate survey three different sampling sites were chosen. **Site 1** is located 100 metres upstream of the proposed development site, **Site 2** 100 metres downstream and **Site 3** approximately 4 km downstream at the lower bridge at Kinnegad. The latter site was included because it is the first semi-riffle habitat (with stony substrate) below the proposed development site. It is therefore suitable for the calculation of accurate quality ratings (Q-ratings) comparable to Environmental Protection Agency data.

The full invertebrate data are included in appendix 2 of the aquatic report (contained in EIS, Appendix 3.2) but may be summarised as follows. Above the development site (Site 1) the total number of taxa recorded was 32, indicating good species richness for a stream of this size. No rare or unusual species was recorded but single individuals of two highly pollution sensitive (Group A) mayfly species were present, *Heptagenia sulphurea* and *Rhithrogena semicolorata*. There were also five pollution sensitive (Group B) species present. These were mayflys *Ephemerella ignita* (abundant) and *Baetis muticus* (sparse), stonefly *Leuctra hippopus* (single specimen), and caddis flies *Sericostoma* (common) and *Lepidostoma hirtum* (single individual).

The substrate at this site consists of gravel and mud which are not suitable substrates for most Group A species. The invertebrate community therefore merits a Q-rating of 4, indicating unpolluted conditions.

Below the development site (Site 2) the total number of taxa recorded was similar at 34. One species found, the oligochaete *Potamothrix bavaricus* is described in the literature as rare and scarce (Brinkhurst 1971). Two pollution sensitive (Group B) species were recorded, the caddis fly *Sericostoma personatum* which was common and the mayfly *Ephemerella ignita* which was sparse. Moderately pollution tolerant group C and D species were dominant at this site. The EPA Q-rating method is not as accurate when applied to deep areas with muddy substrates such as this site. However, using

EPA methodology for depositing sites, this site would merit a Q-rating of 4 indicating unpolluted conditions.

At Kinnegad Bridge (Site 3) 37 taxa were recorded, the highest level of species richness. No rare or unusual species were recorded at this site but also no highly pollution sensitive ones. Four moderately pollution sensitive (Group B) species were recorded, the mayfly *Ephemerella ignita* which was common, the caddis fly *Goera pilosa* which was sparse and the mayfly *Paraleptophlebia submarginata* and the caddis fly *Athripsodes aterrimus*, both of which were present as single specimens. Moderately pollution tolerant group C and D species were dominant at this site. The invertebrate community here merits a Q-rating of 3-4, indicating slight pollution. It is likely that the slight deterioration in water quality between this site and the two sites sampled further upstream is due to pollution entering the river via tributaries downstream of the proposed development site.

There is a record of the freshwater crayfish *Austropotamobius pallipes* from this general area (10km grid square) though not from this site. If it is close, it is likely to occur upstream of the site where there are clean gravelly conditions.

3.2.3.8 *Fisheries Importance of the Kinnegad River*

The river is quite important for salmon and trout both of which spawn above the site and therefore regularly move through it. Some coarse fish also occur but there is little fishing for them.

The fisheries value has increased in recent years due to an improvement in water quality resulting from a reduction in agricultural pollution and from the upgrading of the Kinnegad Sewage Treatment Works. The river suffered a major fish kill in 1986. Noel McGloin of the Eastern Regional Fisheries Board states that upstream of Kinnegad (below Rattin Castle) there is good salmonid spawning ground. Recent redd counts revealed about 20 salmon redds and 40 trout redds. Downstream of Kinnegad the river is of somewhat lower value as salmonid nursery habitat. In the context of the Boyne system, the Kinnegad river constitutes a nursery river of moderate quality. It is notable that in habitat Sections 2 & 4 (Map 1, Aquatic Report) of the present survey, trout numbers observed (but not surveyed) seemed relatively large.

3.2.3.9 *Cutover Bog*

The raised bog at the southern end of the area has been substantially cut for fuel and continues to be used locally. A small part of the original dome is left, dry and firm above the level cutaway on the north side. The dome has been burnt quite recently and contains species such as

Calluna vulgaris	heather
Erica tetralix	cross-leaved heath
Narthecium ossifragum	bog asphodel
Trichophorium cespitosum	deer sedge
Eriophorum vaginatum	tufted bog cotton
Andromeda polifolia	bog rosemary

Campylopus introflexus	moss
Cladonia subcervicornis	lichen
C.crispata	,,
C.floerkeana	,,
C.pyxidata	fairy cup lichen

There is little *Sphagnum* moss on this part but regeneration on the cutaway involves *S.palustre*, *S.papillosum*, *S.cuspidatum*, *S.subnitens*, *S.capillifolium* and *S.tenellum* which locally can cover 60% of the surface. Through these grow bog cotton *Eriophorum angustifolium*, bog myrtle *Myrica gale*, common sedge *Carex nigra* and the moss *Polytrichum commune*. The drier peaty sites, some of which are used for drying turf have abundant moorgrass *Molinia caerulea*, common bent *Agrostis capillaris*, heath woodrush *Luzula multiflora*, sheep's sorrel *Rumex acetosella*, catsear *Hypochaeris radicata*, tormentil *Potentilla erecta*, milkwort *Polygala serpyllifolia*, bulbous rush *Juncus bulbosus*, soft rush *J.effusus* and carnation sedge *Carex panicea*. Unused parts of the cutover are densely overgrown by bracken *Pteridium aquilinum*, bramble *Rubus fruticosus*, moorgrass *Molinia caerulea*, rose-bay *Epilobium angustifolium*, downy birch *Betula pubescens* and common gorse *Ulex europaeus*.

3.2.3.10 *Bog Fauna*

There was some evidence of fox in this habitat while a small number of frogs were also seen. Suitable ground exists for pygmy shrew and stoat could also occur occasionally. Otherwise the vertebrate species are birds and include pheasant, curlew, snipe, meadow pipit and kestrel. The pheasant is likely to nest in the cutaway but to feed in the cereal and other fields. In contrast the kestrel only hunts over the bog but nests elsewhere. Both curlew and snipe were present in breeding habitat but whether they use the actual site is not known.

3.2.4 Evaluation

There are no features on site of significant ecological interest in a regional sense. The best things are the boundary hedge of Cappaboggan and the re-establishing bog communities on some of the cutover. The Kinnegad River is also important, not perhaps for its habitat quality at this point but because it is a link in the much larger Boyne system. This river has notable salmonid populations and is an important angling river.

3.2.4.1 *Designations*

No part of the site is included in a Natural Heritage Area (NHA) or Area of Scientific Interest (ASI). The nearest such area is Bogtown Bog which was included in the County Development Plan as an ASI. Now however this site has been drained for peat harvesting and it has no real ecological interest. Mount Hevey bog which straddles the Meath/ Westmeath border north-east of Kinnegad is the nearest intact bog.

There are no habitats or species which are subject to special protection in the Habitats (92/43/EEC) or Birds (79/409/EEC) Directives except for the salmon which is an Annex V species (a species of community interest subject to managed hunting). The freshwater crayfish is an Annex II species in the Habitats Directive but it does not apparently occur

on the site. The badger and bat species are protected mammals under Irish legislation, as are most birds.

3.2.5 Impact of Development

3.2.5.1 *Outline of structures*

The main features of the development are two deep quarries in the northern (shale) and south-eastern (limestone) sections of the site, extensive mounding along the western boundary and south of the Kinnegad River and the presence of a cement plant in the fields beside the peat bog. Quarrying will require dewatering of the local rock

3.2.5.2 *Ecological impacts*

Most of the site will be modified by this development and there will be major ecological changes. The fields and hedges will be replaced by landscaped mounding with grassland and woodland and there will be limited amounts of open rock (much of it vertical), as well as roadways and buildings. While the farmed pastures and their wildlife will mostly disappear the location of the more interesting species and habitats on the periphery of the site means that most if not all the plants and animal species that occur at present will continue to do so if the marginal hedges are retained.

In terms of animal life the badger sett in the north-western corner could continue in use as there are feeding grounds to the west. However human activity in the area may cause the animals to desert in due course and re-establish a sett elsewhere. Rabbits are more likely to stay in the area as they change burrows much more easily. The hare is likely to disappear during the construction period but could return as open woodland/grassland develops on the screening mounds. The loss of hedgerows will reduce the feeding areas of bats which require corridors for movement between groups of trees. Landscaping measures could help to maintain the local population but they are unlikely to stay in the long term on an industrial site. The use of the riverside fields by birds could well continue and will depend on future management there.

Airborne dust may have some local impact on surrounding vegetation but in a well-run operation can be largely contained on site. There is likely to be some impact on the remnant raised bog at the southern end as it will lie beside the cement works when constructed. The additional input will change the vegetation by reducing the amount of *Sphagnum* moss but could lead to increased plant growth and an increase in 'cutover' wildlife.

During construction and operation there will be an opportunity to create new habitat on the screening mounds and elsewhere. Rock and shallow limestone soils which are nutrient-poor develop a herb-rich vegetation that would add considerably to local diversity and allow some of the flora that is currently restricted to hedges to spread. A woodland/grassland mix would benefit the most species.

3.2.5.3 *Aquatic impacts*

Dewatering will draw down the watertable in a zone around the quarries. The projected zone contains no springs or marshes of ecological interest so that impact will be minimal. Dewatering is also unlikely to affect the bog as its watertable is perched on an impermeable marl layer. There is a possibility of some leakage from marginal drains if these are or were to be cut through the layer but in view of the quality of the bog this would not be a significant impact. The quarrying process will promote leakage from the Kinnegad river to groundwater of up to 970 cubic metres per day after 38 years. This will be more than offset by a total average site discharge of 3870 cubic metres per day resulting in a net increase of 2550 cubic metres per day.

This projected flow would increase flows at Kinnegad by the following proportions:

	Recorded Flows at Kinnegad (cubic metres per day)	**% increase which would be caused by the proposed discharge**
Mean Flow	60,000	4%
Maximum Flow	240,000	1%
Minimum Flow	5580	52%

The net gain in river flow (2900 cubic metres per day) will not be sufficient to cause significant additional scouring or other flood related habitat impacts downstream of the discharge point but will increase flow levels by up to 52%. While an increase in the minimum flow may have some effects on the flora and fauna, no specifically negative impacts can be predicted. Low water flows are usually associated with high temperatures and sometimes with unusually low oxygen conditions in rivers. A substantial increase in the minimum flow is likely to have a beneficial if any effect on salmonids.

3.2.5.4 *Water Temperatures*

Temperature of the Kinnegad River in the 1995-1997 period are tabulated in Appendix 3.2.3. The minimum temperature recorded in the period was 6.5 °C; the maximum was 20.5°C. In the period 1991-1994, the minimum was 3.1°C and the maximum was 14.3°C.

The water discharged from the proposed development will be on average 5-8°C higher than the Kinnegad River in winter and 5-8°C lower than the river in summertime. It can generally be expected that the lowest flows and therefore the most significant temperature effects will occur in the summer months when the water discharged will result in a lowering of river temperature. Given that temperatures as high as 20.5°C were recorded in the Kinnegad River in recent years, the effect of the proposed discharge is likely to be generally beneficial rather than damaging to salmonid fish. However it is possible that the temperature gradient in the immediate vicinity of the discharge may cause fish to avoid the area.

3.2.5.5 *Water quality*

The hydrochemistry of the discharged water is predicted to be of similar major ion composition to the water in the Kinnegad River and generally of better quality. It will thus have no detrimental impact on the flora and fauna of the river. The maximum suspended solids in the discharged waters from the proposed development will be 30mg/l. The EC salmonid directive sets a guideline maximum of 25mg/l of suspended solids but as discharged water will constitute a maximum of 52% the volume of the river flow, the suspended solids are unlikely to exceed the EC limit in the fully mixed area downstream. No significant salmonid spawning habitat was found in the 4 km downstream of the proposed development site and since this section of river is slow flowing with dense plant growth it should result in the rapid settlement of suspended solids. Since the downstream river substrate is naturally muddy, significant negative impacts on flora and invertebrate fauna are not likely. One rare species of aquatic worm (*Potamothrix bavaricus*) was recorded adjacent of the proposed site. The exact ecological preferences of this species are not documented; however as the genus *Potamothrix* is usually associated with muddy substrates, moderate levels of suspended solids are unlikely to have a deleterious effect.

3.2.6 Mitigation Measures

- Limestone debris could be incorporated into the surface layers of the screening mounds to allow for the development of herb-rich vegetation.

- Native species of trees and shrubs will be planted to create the maximum food resource for wildlife.

- All marginal hedges will be retained where possible and that along the boundary of Cappoboggan protected from damage by fencing during the construction period.

- A bat survey of Lansdown Lodge and its outbuildings will be carried out before development takes places so that measures can be incorporated to minimise impacts on these animals. The trees around this house will be retained.

- All reasonable measures will be taken to minimise the levels of suspended solids in the water released to the river during construction, operation and rehabilitation of the site. Fuels, lubricants and hydraulic fluids for equipment used on the site will be carefully handled to avoid spillage and provided with spillage containment according to codes of practice.

SECTION 3:

THE ENVIRONMENT IMPACTS AND MITIGATION

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3.3 SOIL (GEOLOGY)

3.3.1 Introduction

A generalised sequence of strata and overburden likely to be encountered during workings for limestone, shale, sand and gravel on this site is given in Drawing 3.3.1 which also shows the general geological setting of the site. Appendix Drawing No. 3.3.1.1 shows geological cross sections through the northern (shale) and southern (limestone) areas of the site.

The bedrock strata is generally inclined to the north and north-west at variable dips as noted below; it is covered by glacial and alluvial overburden. The three materials which will be encountered in the quarry excavations are considered below. Details of the boreholes and trial pits on which this description is based are given in Appendix 3.3.1. The location of boreholes and trial pits are given in Appendix Drawing 3.3.1.2. Appendix 3.3.2 refers to sampling and testing of materials. Appendix 3.3.3 gives a pedological description of soils in the area.

3.3.2 Superficial materials

These comprise all materials overlying recoverable limestone and shale including top and sub-soil. The agricultural soils appear to be about 500 to 750mm thick, but are thinner near the locations of limestone outcrops. They are generally silty, sandy loams with a variable stone content, being very peaty in lower lying areas.

A raised bog lies at the southern end of the site and is inferred to have extended over much of the southern sector of the site. It is not proposed to remove or disturb the remaining raised bog by any of the works connected with this planning application.

The superficial deposits above and adjacent to the proposed raw material quarries comprise the following broad sub-divisions:-

- Peaty sandy clay (agricultural soils generally 0.5 - 0.75m thick).
- Sands and gravels with some silty clay, well developed in the shale area, with local patches of boulder clay. A sand-rich esker capped with thin boulder clay crosses the northern part of the site.
- Boulder clay, *i.e.* stony silty clays sometimes stiff to hard, but usually soft to firm, in the limestone area and southern part of the shale area.

Superficials generally range between about 1.5 and 6.5m in thickness in the limestone area and between 5.0 and 10.6m in the shale area.

The base of overburden reflects both the undulations in the ground surface and the underlying geology; there are a number of localised hollows. Appendix Drawing No. 3.3.1.3 shows inferred contours on the base of the superficial deposits and Appendix Drawing No. 3.3.1.4 shows inferred isopachytes (contours of equal thickness) of the superficial deposits. This latter drawing also shows the limits of potential working for construction materials (see Section 2.2).

3.3.3 Limestone

The limestone which is of high to very high purity is described in the relevant Geological Survey of Ireland (GSI) publication (*"Bedrock Geological Map of the Carboniferous of Central Ireland - Meath - Sheet 13 GSI 1992")* as comprising Waulsortian mudbanks. It belongs to the Feltrim Limestone Formation of Middle Dinantian (Chadrain) age (Strogen P. *et. al. Geol. Jl. V25 pp 103-137* (1990)). The limestone is often loosely called the Reef Limestone. It is generally a pale to medium grey biomicrite with some sparite banding and *very little* non-calcareous (intra-mudbank) material. Data from the GSI suggests this limestone is many hundreds of metres thick. Banding indicates variable strata dips of up to 40°. In the direction of strata dip (to the north-west) the sub-crop width of limestone is at least 1,000m. The limestone is inferred to underlie the proposed location of the cement works having been proved in earlier KG series boreholes on the western side of the plant area.

There are no significant variations in observable characteristics of the limestone which is typically a moderately strong rock with widely spaced, tight discontinuities. Local solution features are present in near surface sections of the limestone (detected in only one borehole and inferred in places from geophysical logging). The RQD (Rock Quality Designation) is generally well over 95%. The limestone underlies the proposed plant area at shallow depth (4 - 6m) and will provide a satisfactory foundation for the principal structures.

The boundary with the overlying strata is inferred to extend ENE-WSW through a point approximately 300m north of Lansdown Lodge (see Drawing No. 3.3.1). Some minor faulting and solution features may be present at the northern margins, but in the absence of significant marker horizons, clay bands or material/chemical variations, the limestone has been regarded as homogeneous for the purposes of quarry design.

As noted above, the stratigraphical top of the limestone sequence lies north of Lansdown Lodge. Inferred levels of the limestone under the overlying Silty Shale and Shaley Limestones are given in Appendix Drawing No. 3.3.1.5 and the resulting sub-crop positions of the strata are shown in Appendix Drawing No. 3.3.1.6.

3.3.4 Shales and Shaley Limestone

The GSI bedrock geological map shows the strata in the northern part of the site to comprise dark grey shales (the Tober Colleen Formation) overlain by basinal limestones of Middle Dinantian (Chadian to Arundian) age. This strata has also been called the Lower Calp or Lucan Formation (Strogen P. *et. al. op.cit*). Four rock types have been identified:-

i) Silty Shale (Tober Colleen Formation). This lies below the Lucan Formation and directly overlies the Waulsortian Limestones. It comprises a dark grey, very silty shale with a marked pyritic content; it is locally oxidized to a brownish colour. This is described as the Silty Shale unit and is inferred to be the Tober Colleen Formation (Strogen P. *et. al. op.cit*). Very little limestone appears to be present in this unit; the

strata dip is up to 40°. The unit is very variable in thickness (0-45m) and is commonly absent (see below). It is often very weak to weak with abundant listric surfaces being fissile on bedding surfaces; the RQD is less than 10%. Appendix Drawing No. 3.3.5 shows the area in which the Silty Shale is inferred to lie over the Waulsortian Limestones. Appendix Drawing No. 3.3.1.1 shows the position of the Silty Shale in cross sections.

ii) Above the Silty Shale a range of argillaceous limestones occur belonging to the Lower Calp (or the **Lucan Formation**). These are chiefly shales and thicker interbedded thin shales and limestones; three units have been recognised from core logging and used for structural determination. These are:-

Shaley Limestone. This is an irregularly banded, dark and pale grey, shaley limestone with turbidite and slumping structures and occasional overturned beds. Some limestone beds greater than 0.5m thick are present. The strata dip varies from *c* 15° up to 50°. The full unit is inferred to be more than 70m thick; the full thickness has not been intersected in a single borehole. The strata is generally moderately weak with an RQD of 40 - 70%. Inferred contours on the base of the Shaley Limestone are shown in Appendix Drawing 3.3.1.7. A possible marker horizon comprising a dark grey bioclastic limestone/shale is present in a number of boreholes at, or near, the top of this unit. It should be noted that in places the Shaley Limestone directly overlies the Waulsortian Limestone; elsewhere it rests on the Silty Shale.

Striped Beds. These overlie the Shaley Limestone and are characterised by closely alternating pale grey and dark grey layers of argillaceous limestone/shale. The individual layers are often *c* 20 - 40mm thick. The thickness of this unit is variable ranging from 25 - 45m being subject to possible slumping and lateral and gradational variations. The strata is moderately weak with an RQD in the range of 20 to 50%. Strata dips are similar to those of the Shaley Limestone. Contours of the base of the Striped Beds are shown in on Appendix Drawing No. 3.3.1.8

Limestone with Shale Bands. This unit overlies the Striped Beds and is characterised by an argillaceous limestone beds 1.0 - 2.0m thick between shale bands of 100 - 150mm in thickness. The argillaceous limestone is moderately weak to moderately strong and the shale bands very weak to weak. The RQD of the limestone beds in this unit is greater than 60%. A breccia-conglomerate provides a localised marker horizon within this unit.

As may be seen from the cross sections and the geological plans, the geology of the shale area is not simple; thicknesses of the identified units are neither uniform, down dip nor along the strike. The three shale units will be worked together, and are described elsewhere as the *Shaley Limestones*.

3.3.5 Geological structure

The general direction of strata dip is inferred from correlation between drill cores to be in a northerly direction. Bedding dip measurements on drill cores show strata inclination to lie in the general range of 15 - 50° with occasional overturned strata. These

observations are broadly confirmed by measurements of strata orientation in the larger of the sample pits. The structural interpretation however is not straightforward; it appears that the upper surface of the Reef Limestone is quite uneven (see Appendix Drawing No. 3.3.1.5) and that the Silty Shale (Tober Colleen Formation) has been subject to washout or non-deposition. Minor faulting may be present, however possible faulting was only apparent in one borehole.

3.3.6 Chemical properties of the raw materials

Both grey and white cement will be produced in the new plant. The grey cement will comprise a mix of 75% Reef Limestone (Waulsortian Limestone), 8% Silty Shale (Tober Colleen Formation), 8% Shaley Limestone (Lucan Formation) and 9% Westphalian Shales (Coolbaun Formation). The latter shales will come from the current and former overburden materials to the brickshales in the parent company's quarries near Swan in County Laois. The white cement will comprise a mix of Reef Limestone (Waulsortian) and imported Kaolin in the approximate ratio of 1 to 0.3.

The chemistry of mean analyses of the materials for OPC are given in Table 3.3.1 which includes both principal components and trace elements of interest. Details of the sampling and testing of materials are given in Appendix 3.3.2.

The **Waulsortian (Reef) Limestone** is quite uniform in its chemistry with a mean CaO value of 54.2%. MgO levels are very low and some of the material is of very high purity with no trace elements of environmental concern detected in testing.

The chemistry of the **Silty Shales** and the combined **Shaley Limestones** have been considered separately. These materials have characteristic chemical properties. The Silty Shales have a high SiO_2 content and low CaO, Al_2O_3 and Fe_2O_3 contents which indicate a low proportion of clay minerals. The Shaley Limestones (Lower Calp or Lucan Formation) have a lower SiO_2 content, but a raised CaO content. For the purposes of optimising the clay content of the Shaley Limestones it is proposed that the component units of the Lower Calp will be crushed and screened and only the minus 40mm fraction will be used. A 60 tonne sample of Shaley Limestone was taken from one of the sample pits for crushing and testing. It has been compared with core samples from the Lower Calp across the shale area to determine the likely yield of acceptable material for kiln feed.

Westphalian Shales from the Coolbaun Formation have suitably high Al_2O_3 and iron contents and low percentages of CaO.

The **kaolin** will be imported from elsewhere in Europe for the production of white cement. It will be low in discolouring elements with less than 1.0% of Fe_2O_3.

The chemistry of mixes has been investigated in detail to maximise use of on-site materials. Only minor tonnages of raw material oxides (silica sand, iron ore and bauxite) will be required to meet occasional fluctuations in the quality of the materials noted above, *i.e.* less than 1,000 tonnes per annum for each oxide.

3.3.7 Other tests

Whiteness, Lightness and Reflectance testing has been undertaken on the Reef Limestones. Very high CIE L (Lightness) values were obtained confirming the suitable nature of this limestone for the production of white cement. This testing is consistent with the very high purity of the limestones.

Moisture contents and bulk densities have also been determined.

TABLE 3.3.1
Mean analyses of raw materials

Major element analysis

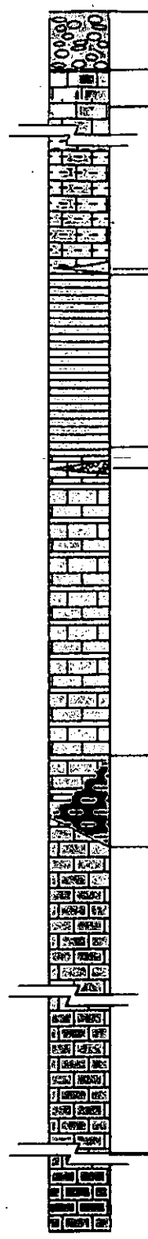
Component	Raw Material (wt %)			
	Waulsortian Reef Limestone (Feltrim Limestone Fm.)	Silty Shale (Tober Colleen Fm.)	Shaley Limestone (Lucan Fm.)	Westphalian Shale (Coolbaun Fm.)
SiO_2	0.74	71.43	35.49	55.36
Al_2O_3	0.26	10.92	5.49	22.51
Fe_2O_3	0.23	5.48	2.69	7.83
CaO	54.20	1.28	26.99	0.36
MgO	0.85	0.80	1.38	1.81
K_2O	0.06	1.94	0.96	3.99
Na_2O	0.00	0.23	0.26	0.87
L.O.I 1025°C	43.27	6.61	23.01	5.23
SO_3 in bead [1]	0.27	0.28	2.58	<0.05
Total	99.88	98.96	98.85	97.95
Moisture content [2]	0.25	6.12	1.82	*c*. 5.0

[1] SO_3 in bead refers to the SO_3 remaining in the bead after fusion

[2] Moisture content = weight of water / weight of dry sample

Trace element analyses

Element	Raw Material (ppm)			
	Waulsortian Reef Limestone (Feltrim Limestone Fm.)	Silty Shale (Tober Colleen Fm.)	Shaley Limestone (Lucan Fm.)	Westphalian Shale (Coolbaun Fm.)
Pb Lead	<10.0	15.0	10.0	15.0
Cd Cadmium	<5.0	60.0	10.0	<10.0
Zn Zinc	14.4	1000.0	85.0	110.0
Ni Nickel	<10.0	190.0	50.0	60.0
Cr Chromium	<10.0	145.0	85.0	90.0
Hg Mercury	<0.5	1.5	<0.5	<0.5
Se Selenium	<5.0	<5.0	<5.0	<5.0
As Arsenic	<1.0	40.0	10.0	3.2



GLACIAL TILL AND ALLUVIAL DEPOSITS
Sandy gravel, clayey gravel, silty clay. limestone cobbles and boulders 1-12m

'UPPER BASINAL LIMESTONES (not on site) Undifferentiated (CPU)

'LIMESTONE WITH SHALE BANDS'
Pale argillaceous micrites with thin shale bands
20+m

'Brecciated conglomerate'

'STRIPED BEDS'
Interlaminated shale and limestone
25-45m

'Bioclastic limestone horizon'

'SHALEY LIMESTONE'
Calc turbidites with slump structures and thin shale bands
40-80m

LUCAN FORMATION (CPL)

'SILTY SHALE'
Dark grey, occasionally oxidised, silty shale with thin limestone bands.
Subject to washout/non-deposition 0-45m

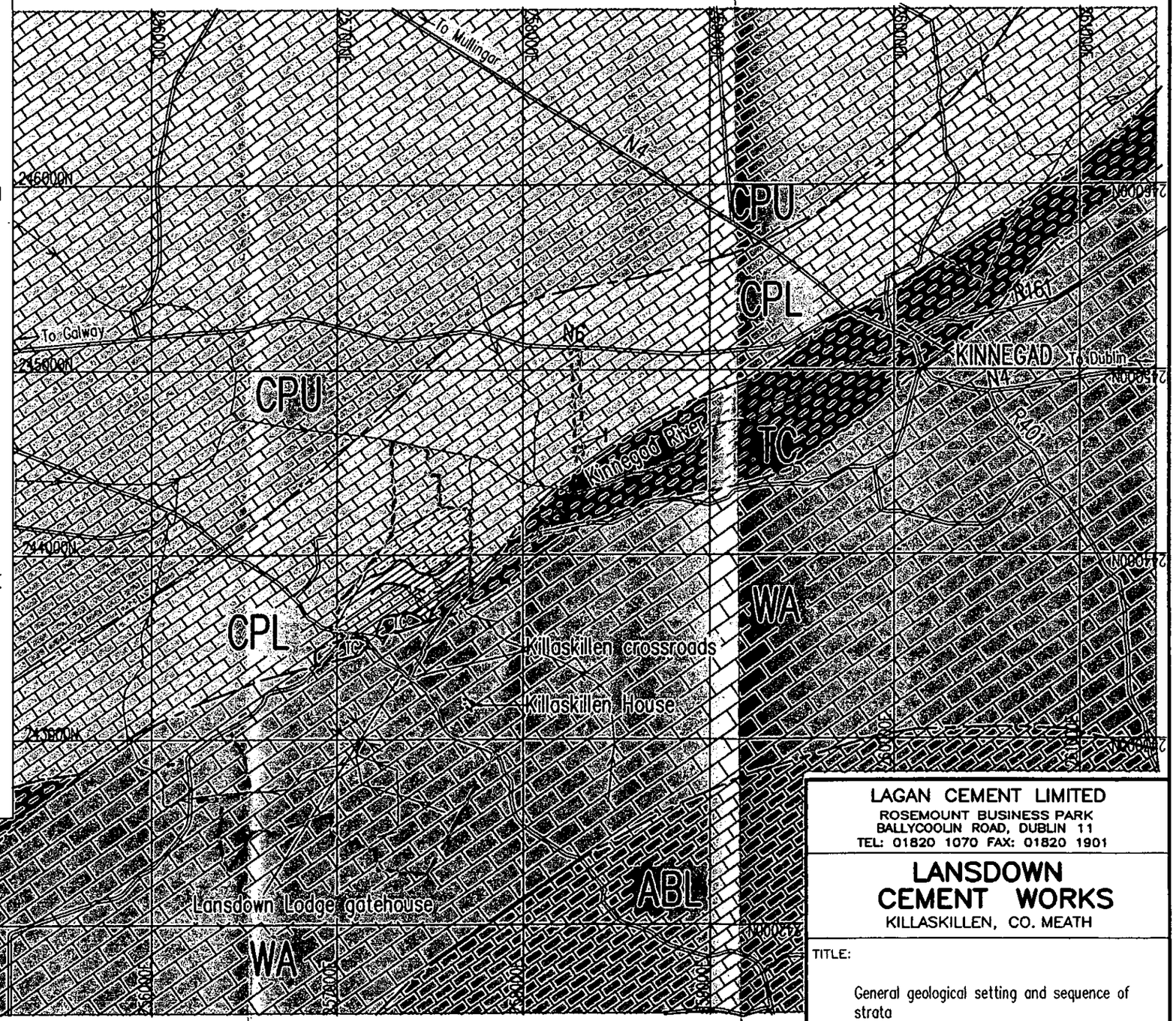
TOBER COLLEEN FORMATION (T.C.)

'REEF LIMESTONE'
Pale to medium grey, very high purity micrites
300-500m

FELTRIM LIMESTONE FORMATION (WAULSORTIAN) (WA)

'ARGILLACEOUS BIOCLASTIC LIMESTONE' (not on site) (ABL)

Aproximate scale 1/250



Note:
(WA) Unit coding shown on GSI plans. Thicknesses are inferred full thickness measurements not subcrop thicknesses

LEGEND

Site boundary

Note:
Geological boundaries outside area of site investigation from GSI Bedrock geology series, 1/100,000 Sheet 13. (Meath) (1992.)

04.11.1998

LAGAN CEMENT LIMITED
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LANSDOWN CEMENT WORKS
KILLASKILLEN, CO. MEATH

TITLE:

General geological setting and sequence of strata

N°

3.3.1

SECTION 3:

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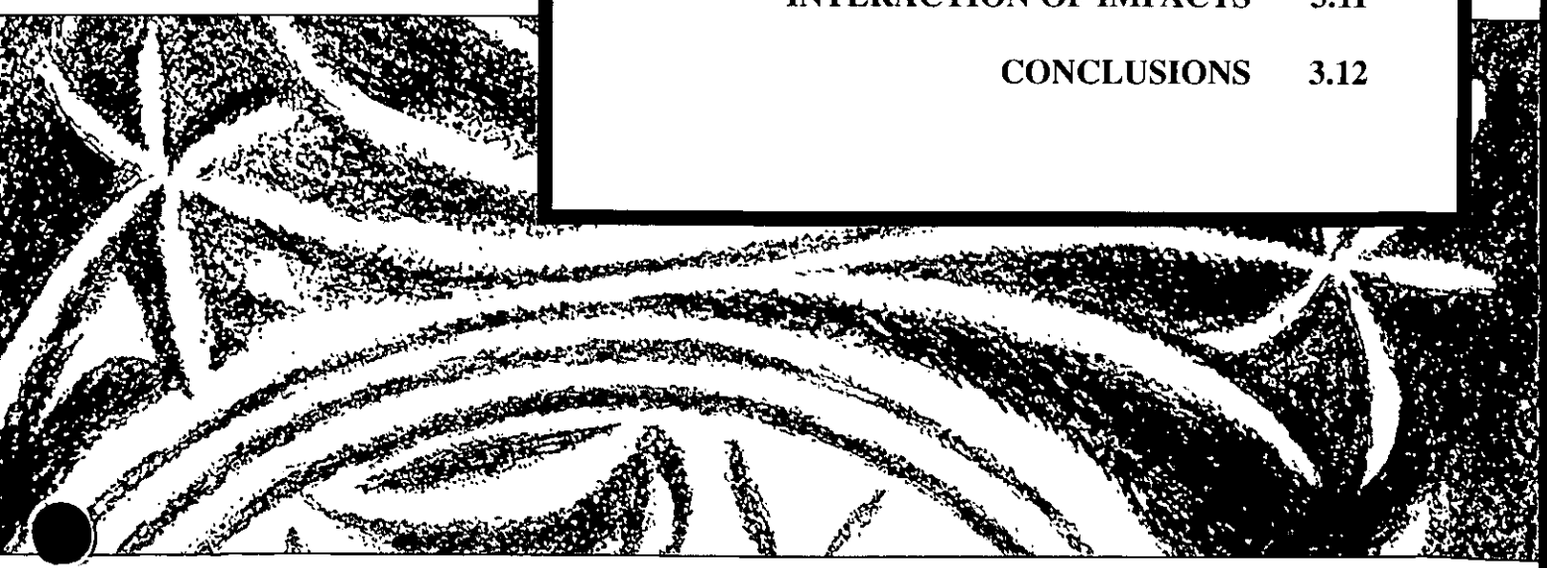


3.4 WATER AND HYDROGEOLOGY

3.4.1 Introduction

The water environment at the site and its surroundings is of significance to the scheme proposals in terms of both resources management and environmental impact. Groundwater conditions at the site have been characterised to assess dewatering requirements for the quarries, and to predict any dewatering impacts. Potential environmental impacts associated with the cement works and quarry development are described and mitigation measures proposed where necessary.

3.4.2 Water in the existing environment – Surface water

3.4.2.1 *Catchment description*

This section describes the surface water (or hydrological) conditions at the site and presents rainfall and general hydrological characteristics of the proposed site.

The site lies within the catchment of the Kinnegad River, which forms its northern boundary. The source of the Kinnegad River is west of the site and it has a total length of 17km to the stage board situated adjacent to the sewage works in Kinnegad. The catchment area of the Kinnegad River to this point is about 54km^2. Most of the flows in the Kinnegad River occur from the confluence of several tributaries approximately 6km west of Kinnegad town.

To the south of the site lies the catchment divide to the Castlejordan River. This river also flows to the east, creating a confluence with the Kinnegad River at the River Boyne.

3.4.2.2 *Rainfall and evapotranspiration*

A summary of available data for the Kinnegad area is given below. Average rainfall calculated from the long term data for the years 1961 to 1990 is approximately 868mm. A breakdown for each month and the breakdowns for actual and potential evapotranspiration (for the nearest available records at Lanesborough and Mullingar) are as follows:-

Mean monthly rainfall in mm for Kinnegad 1961-1990

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
89	61	65	56	61	61	55	78	82	87	84	91

Mean monthly Evapotranspiration in mm for Lanesborough 1964-1980

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
12	20	40	63	93	103	100	85	58	34	13	08

Mean monthly Potential Evapotranspiration in mm for Mullingar 1958-1982

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
01	13	31	54	74	84	77	63	39	16	02	01

3.4.2.3 *Surface water drainage features*

Drainage ditches in the area are fed by field drains installed for agricultural purposes. Drainage in the northern part of the site is generally towards the north, where ditches discharge runoff to the Kinnegad River. In the south, the drainage is to the west and then to the north into the Kinnegad River. Surface water features and drainage patterns are shown in Drawing No. 3.4.1. Surveys of local drainage ditches have confirmed that the site lies entirely within the surface water catchment to the Kinnegad River.

3.4.2.4 *Surface waterflow*

The flow rate of the Kinnegad River has been gauged by the Environmental Protection Agency at the Kinnegad gauging station, number 07032. Available data shows that a total of 85 spot gaugings have been undertaken between 7 September 1976 and 28 August 1997. Gauged flows have been estimated to range between about 0.065 and 2.778m^3/s (5580 and 240,000m^3/d), with an average of gauged flow of about 0.7m^3/s (60,000m^3/d). The accuracy and reliability of the gauging station is not known.

The gauged river flows at Kinnegad are shown on Drawing No. 3.4.2.

3.4.2.5 *Surface water quality and contamination*

Surface water quality is indicated by the following laboratory analyses based on samples obtained during April 1998. The representative locations listed below characterise baseline water quality in the area:-

- Water sample of standing surface water in a drainage ditch at NGR 2570824312.
- Water sample from the peat bog area south of the site at NGR 2571924248.
- Water sample from the Kinnegad River at NGR 2574824457.

A summary of selected determinands from laboratory analyses of these water samples is presented in Table 3.4.1. This table also includes results for a water sample from Borehole No. LANS22, which is representative of groundwater quality in the Waulsortian Limestone.

Table 3.4.1 Laboratory analysis of selected determinands

Sample ID	PH	Alkalinity (mg/l)	TDS (mg/l)	Cond (µS)	TOC (mg/l)	COD (mg/l)	Iron (mg/l)
LANS 22	8.5	305	450	455	2	<4	<0.01
Ditch sample	7.9	615	1100	1365	48.3	83	0.31
Peat bog sample	6.9	225	280	290	-	-	1.02
River sample	8.3	410	500	660	-	20	0.13

The full water quality analyses show the following features:-

- The groundwater sample is a calcium bicarbonate type water, typical of limestone acquifers. Ammonium indicates that some minor contamination exists in the groundwater system. This is likely to be the result of agricultural activity.
- The ditch sample shows that surface water in the area is contaminated. Raised ammonium, nitrite, nitrate, potassium, chloride, sodium, COD and TOC were found. Agricultural contamination is likely to have caused these raised levels.
- The peat bog sample shows lower total dissolved solids than the limestone groundwater, and lower pH. The chemistry is typical of peat bog water, and includes a significant iron content. Low level ammonium contamination was found.
- The Kinnegad River sample showed that the river water has slightly higher total dissolved solids than the groundwater sample. The water is of calcium bicarbonate type and shows some nitrate and COD indicative of surface runoff from agricultural land.

Analysis of metals in the samples show that only barium, manganese and iron are above the detection limit. There are no toxic metals at problematic levels in the aquifer or in surface waters.

Water quality observations for the Kinnegad River upstream of Kinnegad recorded by the Environmental Protection Agency (EPA) suggest that the water quality is at best slightly polluted/eutrophic (10.5km length) and at worst moderately polluted (6.5km length). This data covers the period 1990-1997 (see Appendix 3.2 to this report). The most affected areas of the river are just upstream of the town of Kinnegad where a low dissolved oxygen value has been recorded presumably due to the presence of biodegradable organic matter. The source of this pollution is thought to be from several different land uses, although the bulk is thought to be derived from agricultural sources (50%) and sewerage discharges (32%), (EPA, Water quality in Ireland 1990-1997).

3.4.2.6 *Surface water resources*

The main surface water resource in the area is the River Kinnegad. There are no significant perennial resources contained within any tributaries to the River Kinnegad or ditches at the site.

The superficial deposits at the site restrict infiltration of incident precipitation and encourage runoff. This runoff makes a small contribution to the available surface water resources in the area.

Evidence obtained during the field investigation programme indicated that minor flows exist in ditches within the site area, and that these flows discharge to the River Kinnegad which therefore contains the entire surface water resource in the area.

3.4.2.7 *Current surface water use*

There are no known surface water abstractions from the Kinnegad River in the vicinity of the site.

There is no comprehensive information available regarding current surface water use in the area. Evidence for water quality suggests that the river water is not suitable for potable use without water treatment, and uses in the vicinity of the site are likely to be restricted to agricultural applications principally for cattle since little of the land is in arable use.

3.4.3 Water in the existing environment - Groundwater

3.4.3.1 *Regional hydrogeological setting*

The general hydrogeological characteristics of the main hydrostratigraphic units in the Kinnegad area are outlined in Table 3.4.2. For details of the geology refer to Section 3.3.

Table 3.4.2 Summary of the main geological units underlying the site

Name	Thickness (metres)	Lithology	Likely hydrogeological properties
Peat	Up to 1 m	Peat	Aquitard
Glacial Till	1 to 12 m	Sandy gravel and soft clay. Limestone cobbles	Aquitard with minor perched aquifers in sand lenses
Alluvial Sand Gravel	>6.0 m	Gravel, med. to coarse Sand with occasional fine sand and silt lenses	Aquifer
Limestone/ Shale (Upper CPL)	20 m+	Pale micritic limestone with shale bands	Complex banded aquifer with dual porosity, yield predominantly low with high yield horizons
Striped Beds (Upper CPL)	12 m+	Interlaminated shale and limestone	Complex banded aquifer with dual porosity. Poor yields
Shaley Limestone (Lower CPL)	c.100 m	Basinal limestone with thin shale bands	Dual porosity fissured aquifer with reasonable yields
Silty Shales (T.C Formation)	Variable from 15 m to 25 m. Occas. Absent	Dark grey shale with thin limestone bands	Low storage complex fissured aquifer
Micritic Limestone (Waulsortian)	300 to 500m	Pale to med. grey high purity micritic Reef Limestone	Permeability variable with regional low yields varying from 0.1 to 1.0 l/s.

Numerous recorded wells and boreholes exist in the area. Most boreholes derive their yields from bedrock. Limited data is available on these wells. However, the available data show that in general borehole yields are low.
Boreholes are the principal source of supply of potable water to meet domestic and farm requirements in the area.

The most productive of the boreholes and dug wells recorded in GSI archives for south west County Meath show poor (< $40m^3/d$) to reasonable ($40\text{-}100m^3/d$) yields. It

appears that the highest yielding wells in the area are located within the Calp Formation (CPL).

3.4.3.2 *Local hydrogeological setting*

Detailed hydrogeological information for the Lansdown site was obtained from recent field investigations (see Appendix 3.4.1). The area is overlain by superficial deposits, predominantly Glacial Till (Boulder Clay) with the proportion of fluvial sand and gravel increasing towards the Kinnegad River. The piezometric head generally lies close to the boundary between the bedrock and superficial deposits, but is near to or above ground level in places.

Overlying peat deposits are either part of a larger raised bog along the southern site boundary or isolated pockets in low lying hollows elsewhere. Available evidence suggests that the peat areas are hydraulically isolated from the underlying bedrock groundwater system due to the presence of a low permeability glacial clay beneath the peat deposits. These areas are probably recharged exclusively by incident precipitation; only limited vertical seepage occurs into the underlying aquifer system.

3.4.3.3 *Aquifer characteristics*

The evidence for aquifer parameters in the area comes predominantly from the field investigation results (Appendix 3.4.1).

The estimated hydraulic conductivity and storage coefficients of the main groundwater units present at the site are summarised on Table 3.4.3

Table 3.4.3 Summary of estimated aquifer characteristics

Name of unit	Estimated hydraulic conductivity (m/d)	Estimated storage coefficient (dimensionless)	Comments
Boulder Clay	Variable	Variable	Properties will vary between low and high values according to lithology. Vertical hydraulic conductivity estimated from recent tests 0.003 m/d
Reef Limestone	0.07	0.0005	Test results suggest uniform characteristics
Shaley Limestones	0.9	0.001	Anisotropic permeability due to steeply dipping bedding and structural control

The Shaley Limestone (or Calp) is classified by the GSI under the Groundwater Protection Scheme of County Meath as generally moderately productive (Lm), the Reef (Waulsortian) Limestone is classified as moderately productive only in local zones (Li) and the Tober Colleen Formation is generally unproductive (Pu).

3.4.3.4 *Groundwater flow regime*

There are no records of previous readings of groundwater levels in the Reef Limestone or the Shaley Limestones at the site. Groundwater levels measured during the field investigation and following the completion of piezometers were used to determine groundwater levels beneath the site.

Within the site observed groundwater levels were a maximum of 85.65mAOD in the south, falling to 72.20mAOD in the north. The observations show that groundwater levels generally fall to the north east towards the Kinnegad River (Drawing No. 3.4.3).

The investigation has provided a sound basis for assessing the hydrogeological conditions in the area and developing a conceptual model of the groundwater flow system.

Essentially, the following groundwater flows occur at the site:-

i. Groundwater flows occur locally within the superficial deposits (Glacial Till where permeable, and fluvial sands and gravels). These deposits are quite variable, and overall flows are not likely to be of great significance although locally flows within the superficial deposits may be greater than in the bedrock.
ii. Groundwater flow in Waulsortion limestone occurs chiefly by fissure flow and is controlled by the overall low to moderate lateral permeability of the aquifer. This gives low groundwater flow rates.
iii. Groundwater flow in the Shaley Limestones (Calp), occurs in a multi-layered aquifer which has higher storage and permeability within fissured horizons than exists within the Reef Limestone. Low permeability layers in the Shaley Limestones are the likely cause of local confining conditions which has led to artesian overflow at low lying boreholes. Preferential orientation of fissuring follows the strike of bedding being oriented North 60 degrees East. This feature (known as anisotropy) provides the direction of maximum permeability in the Shaley Limestones. Consequently, the direction of minimum permeability lies at right angles to this, in a direction North 30 degrees West.

Recharge within the site area occurs from infiltrating rainfall; some lateral groundwater inflow to the site also probably occurs from the south and west. Natural aquifer discharge occurs to the Kinnegad River, and to seepages and evapotranspiration within the artesian areas.

3.4.3.5 *Groundwater quality and contamination*

The general groundwater quality in the area has been noted in Section 3.4.2.5 above.

As noted previously the results of the field and laboratory hydrochemical analysis of the sample from LANS 22 shows that the limestone groundwater is a calcium bicarbonate type water. The chemistry is typical of carbonate aquifers. The presence of ammonium indicates that some contamination exists in the groundwater system, probably from local agricultural activity. There are no toxic metals at problematic levels in the aquifer or in surface waters.

Overall the hydrochemical analyses demonstrate that there are no significant water quality problems associated with the aquifer. Some localised contamination exists as a result of agricultural activity in the area. The groundwater chemistry is similar to that of the river although it is of better quality. There are no mains sewer systems in the vicinity of the site. Localised groundwater contamination is therefore expected in places due to the disposal of sewage effluent to soakaways.

3.4.3.6 *Groundwater vulnerability*

The vulnerability of groundwater to contamination is assessed by reference to local soil properties and leachability, the permeability of overlying deposits, the potential for buffering of contaminants within the system, and the type of flow mechanism operating.

In the case of the Limestone and Shaley Limestones in the site, the superficial deposits provide some protection to the underlying bedrock aquifers, and the aquifer hydrochemistry provides significant attenuation and absorptive capacity within the aquifer. However, the likelihood of fissure flow increases the risk of contaminant migration. Hence the site has moderate vulnerability to contamination.

Vulnerability to contamination will be increased when superficial deposits are removed at the start of quarry development.

3.4.3.7 *Groundwater resources*

Groundwater resources in the area are limited. There are no major aquifers of regional significance.

The Calp (Lucan Formation) is recognised as providing the best potential for water supply development in the area, but yields are highly variable and generally low.

3.4.3.8 *Current groundwater use*

Groundwater is used widely in the area, albeit generally at low rates. The population is dispersed in rural dwellings, farms and small villages. Consequently installation of mains water supply *via* pipeline is costly, and individual dwellings are generally reliant on groundwater supplies.

Typical groundwater supplies provide sufficient for an individual household or farm, from a well or borehole located adjacent to the property. Records are incomplete, but the available information suggests that yields vary greatly. There is a significant risk of unsuccessful borehole development in the area.

Elsewhere in the region Meath County Council has developed several small to moderate yielding groundwater sources from the Calp.

A water features survey has been undertaken to identify the distribution of current groundwater users in the area.

3.4.4 Potential impacts on water

3.4.4.1 *Site dewatering proposals*

The proposed excavations will extend to a maximum depth of about 70m below groundwater level in the limestone area and approximately 50m in the shale area (equivalent to about 10mAOD and 25mAOD respectively). Consequently dewatering is required to facilitate quarrying operations. It is proposed to work both shale and limestone quarries by dewatering using sump pumping arrangements.

The design of the proposed dewatering works for the site is based on the following constraints:-

i. The limestone quarry is composed of competent rock behaving as a fissure flow aquifer with an average hydraulic conductivity of about 0.07m/d to the total depth of the proposed quarry. It is assumed that hydraulic conductivity will decrease significantly with depth due to reduced fissuring and increased overburden pressures. No geological features of hydrogeological significance have been identified in the limestone near the proposed quarry excavations.

ii. The groundwater in the limestone has a flow gradient of up to about 0.02 towards the north. The pre-excavation rest water level is in the range 79 to 83mAOD with approximately half the superficial deposits below the inferred groundwater levels.

iii. The average permeability of the overburden above the limestone and the percentage of rainfall contributing to recharge are considered to be low. The permeability of the overburden overlying the shale area is less well known, but it is thought to be higher than in the limestone quarry area with a greater proportion of high permeability sand and gravel horizons.

iv. Direct rainfall over the pit will contribute to the dewatering requirements. Runoff in the pit will give rapid flows towards the lowest part of the quarry. As a reasonable 'worst case' 90% of the total *average* rainfall is used as an estimate for average *effective rainfall* to the pit sump. The same rainfall estimates have been used for both the limestone and shale quarry areas. Higher than average rainfalls have also been considered.

v. The proposed shale quarry cuts through a complex layered aquifer of thin mudstones and argillaceous limestones with varying inflows expected depending on the permeability of the strata intersected in the quarry excavations and the lateral extent of these strata. The average hydraulic conductivity of the Shaley Limestones is estimated in the range 0.05 to 0.8m/d.

Dewatering sumps will be located within each quarry area, and pumps installed together with discharge pipelines to carry the discharge water to the settlement lagoon area (see Section 2.2.3.5).

3.4.4.2 *Likely dewatering abstraction rate*

The calculation of the likely quantities of water to be encountered during quarrying works has been determined using a computer program originally developed for similar purposes by the US Geological Survey. (The two dimensional MODFLOW finite difference program). The area extending 5km from the site has been modelled to determine the full effects of dewatering the quarries.

The field investigation (pump testing) has provided a firm basis for the prediction of dewatering requirements at each of the proposed quarry areas. Dewatering flows have been estimated for the main components of flow to the excavations *viz*:-

i. Groundwater inflow to each excavation area by lateral inflows of groundwater within the Shaley Limestones and Reef Limestone groundwater units.
ii. Water storage depletion in the aquifer present in the zones to be dewatered.
iii. Surface water runoff within each quarry area.

The estimates of quarry dewatering (abstraction) are based on a range of ground conditions and assumptions required in the MODFLOW program. These relate to the geometry of the excavation, the hydraulic conductivity of the strata, the position of major rivers and recharge and overflow of acquifers *etc.* Details are given in Appendix 3.4.2.

Dewatering and surface water inflows

The estimated long-term average flow rates due to dewatering abstraction using sump pumping are presented in Table 3.4.4. These are the best estimates of inflows calculated using the existing available data for the extent of dewatering proposed.

The predicted inflows are estimated for four periods about ten years apart in order to indicate how dewatering abstractions are likely to change with time.

Table 3.4.4 Predicted average dewatering and surface water inflows (m^3/d)

Quarry area	Average inflows				Surface water inflows
	10 years	20 years	30 years	38 years	
Limestone quarry groundwater inflows	1050	1290	1240	1540	250
Shale quarry groundwater inflows	1230	1520	1830	1980	100
Average total surface water inflows to quarries	350	350	350	350	350
Total average discharge	2630	3160	3420	3870	

3.4.4.3 *Likely quality of abstracted water*

The water quality of the dewatering discharge will reflect the origins of the water. Thus, the water quality will be largely that of a reasonably good quality calcium bicarbonate groundwater.

However, in addition to the quality attributes of the local groundwater, water abstracted from the sump will show the effects of runoff within the quarries. The main impact of this runoff within the working quarry areas will be to increase suspended solids content compared with the low suspended solids content groundwater.

3.4.4.4 *Dewatering discharge and treatment arrangements*

The arrangements for discharge of the dewatering abstraction and its prior treatment are described in Section 2.2.3.5. These include oil traps, a large balancing pond and a large settlement lagoon, and have been designed to ensure adequate treatment for suspended solids and any oil spillages. The ultimate point of discharge from the site will be to the River Kinnegad at the north western corner of the site; a discharge licence will be applied for in due course.

3.4.4.5 *Predicted quality of the dewatering discharge to the Kinnegad River*

The dewatering discharge hydrochemistry is expected to be similar to that of the source groundwater bodies (see Section 3.4.2). There are potential differences with the dewatering discharge water quality compared with natural groundwater quality due primarily to the increase in suspended solids in the sump pumping abstraction following contact between the inflowing water and surface materials.

The suspended solids content of the water will be maintained below relevant discharge consent limits by the settlement arrangements described in Section 2.2.3.5 in order to ensure compliance with regulations and prevent adverse impact on the Kinnegad River. The predicted suspended solids should be less than 30ppm based on the lagoon design proposed.

3.4.4.6 *Impact of the dewatering on groundwater*

The main effects of the dewatering at the quarries will be to cause a lowering of groundwater levels in the area around the quarries, change of the flows in the aquifers and an interaction with the River Kinnegad.

The groundwater model predicted the extent of the effect of future dewatering on the aquifers. The maximum predicted steady state drawdown due to dewatering the quarries, using the conservative assumptions given in Appendix 3.4.2, is shown on Drawing No. 3.4.4. This drawing shows the anticipated drawdown of groundwater within the bedrock aquifer in response to sump dewatering at the quarries.

The drawdown effects from each quarry interact, and as a consequence of the anisotropy of the shaley limestones, (see Section 3.4.3.4 above) dewatering drawdowns are predicted to extend further from the quarries in the ENE and WSW directions than elsewhere.

Groundwater users within the drawdown zone are at risk of derogation as a consequence of the development. The worst case impact which could occur is for

borehole supplies to dry up or require measures such as lowering of pumps or the deepening of wells in the event that a significant reduction in groundwater levels occurs.

The 1m contour of drawdown on Drawing No. 3.4.4 indicates the area within which properties using groundwater may be at risk of an adverse impact. Near this contour the effects will be limited since a 1m change in groundwater level is smaller than that which typically occurs naturally during the year. Further in from this 1m contour the effects are likely to be more marked especially at those properties near or within the 11m contour.

In consequence the company has arranged for an independent assessment of the wells within and near the area of drawdown to assess the likely impact at each installation. The findings of this well survey, which covered 42 properties within and up to 500m outside the 1m drawdown, are given in Appendix 3.4.4. Details of each well in respect of depth of well, depth to standing water and inferred maximum drawdown are given in Appendix Table 3.4.4A. This table shows that there are a number of properties within the 1m contour which do not belong to the company and which may be at risk of derogation. Drawing No. 3.4.5 shows how the drawdown develops over the various stages of quarry expansion and deepening. Drawing No. 3.4.4 shows the maximum inferred drawdown (after 38 years) and the drawdown is given for each well in Appendix Table 3.4.4A. Mitigation measures for the 22 wells, which are adversely affected, are outlined in Section 3.4.5.4 below and in Appendix 3.4.4. The effects of dewatering on soil moisture and agricultural soils is considered further in Appendix 3.4.5.

3.4.4.7 *Impact of the dewatering on surface water*

The dewatering zone is predicted to intersect the Kinnegad River for a short reach of the river, as shown on Drawing No. 3.4.4. Within this area some depletion of river base flows will occur. Reduction of flows in field drains and ditches may also occur in places. No significant reduction in river flows is predicted to occur upstream of the dewatering discharge point on the Kinnegad River.

There will be an overall net gain of river flows as a consequence of the development, through the discharge arrangements proposed (see Table 3.4.5). This is likely to be of significance at critical low flow periods in providing dilution of river-borne contamination. Hence the dewatering discharges will provide a net environmental gain for the river.

Table 3.4.5 Changes in flows in the Kinnegad River due to the dewatering system

Time in years	Predicted induced loss of baseflows (m^3/d)	Predicted discharge from dewatering system (m^3/d)	Predicted net gain to the River Kinnegad (m^3/d)
10	500	2630	2130
20	680	3160	2480
30	840	3420	2580
38	970	3870	2900

downstream. The predicted effect of the long-term increased flows in the river will be negligible during peak river flows, when the increase will be less than 1%.

As noted in Appendix 3.4.3, it is considered that there will be no adverse impacts on the water balance or ecology in the area of raised peat bog to the south of the plant area and limestone quarry.

3.4.4.8 ***Post-restoration impacts on groundwater and surface water***

Following completion of the quarrying and the end of dewatering, recovery of water levels will begin. Full recovery of groundwater levels will take several years to complete.

The quarries are to be restored to lakes. The lakes occupying the quarries will be predominantly groundwater fed, and groundwater levels will recover to elevations controlled by the balance of inflows and outflows.

Post-restoration groundwater levels in the area are predicted to be similar to those which occur currently in the locality. Once changes in aquifer storage have been accommodated no residual long term effect on surface water and groundwater in the area is expected, apart from minor reduction in surface runoff due to the presence of the lakes. The lake in the limestone quarry will be controlled at 82.5mAOD and at 72.5mAOD in the shale quarry.

3.4.4.9 ***Potential impacts during the construction phase***

Measures to protect the water environment during the construction phase of the project are akin to those described for the operating site in Section 2.2.3.5.

It is proposed that adequate measures to protect the water environment are taken at all times, and there is unlikely to be a significant impact due to the construction works at the site.

Some short term suspended solids load will occur in runoff from the site area during overburden stripping operations. This will be treated prior to discharge of runoff from the site through the diversion of runoff into temporary settlement lagoons and silt traps. Following construction of the permanent settlement lagoon all major surface drainage will be routed *via* this facility to ensure adequate settlement and avoid adverse river impacts due to suspended solids loading.

3.4.4.10 ***Site drainage proposals***

The site drainage proposals are described in Section 2.2.

The drainage arrangements proposed for the site will ensure that no uncontrolled discharge of drainage from the site occurs at any time. All water from drainage of the plant area will be directed to a plant sump where it can be monitored to ensure that water quality is adequate for mixing with other water in the balancing pond. It will then

be pumped to the balancing pond before discharge to the settlement lagoon with its oil interceptors.

3.4.4.11 ***Potential impacts of site drainage***

The cement works development will lead to some additional runoff as a consequence of the development of impermeable surfaces at the site. Runoff will be collected in the works sump before pumping to a balancing pond and eventual discharge *via* a large settlement lagoon. Calculations of flood runoff during design storm events have been used to allow for retention in the balancing pond ensuring that suitable capacity is available in case of extreme runoff events.

Some minor suspended solids loading to runoff will occur at times from the screening banks before vegetation is established. This will be treated in either the main settlement lagoon or in silt traps in order to ensure satisfactory limits are achieved prior to discharge from the site.

Details of the oil traps, balancing pond and settlement lagoon are given in Section 2.2.3.5.

3.4.4.12 ***Potential surface water contamination risks associated with the cement works development***

The main identified surface water risks associated with the cement works development are as follows:-

i. Contamination of runoff from the site with suspended solids from vehicles and quarrying and cement works operations.
ii. Contamination with chemicals used at the works for purposes such as weed control, engineering use *etc.* Such use of chemicals is expected to be very minor.
iii. Contamination with diesel or petroleum hydrocarbons caused by leakage or spillages during refuelling, storage or use in vehicles.
iv. Contamination with fuel hydrocarbons caused by leakage or spillages of the kiln fuels.

Strict storage controls and handling rules are proposed in order to prevent any significant risk of spillage.

3.4.4.13 ***Potential groundwater contamination risks associated with the cement works development***

The potential contamination sources of significance to groundwater are similar to those of concern with respect to surface water. Risks will be handled in a similar manner.

3.4.4.14 ***Cement works and ancillary water demand***

The works and quarries will have a demand for water supply. The main demands for water expected at the site are as follows:-

- Water for wheel washing.
- Water for dust suppression using sprinklers and water bowsers.
- Water for replenishment of the cooling system.
- Water for toilets, showers and washroom facilities.
- Water for the canteen and for potable use at the cement works.

The average demand for water at the site is estimated at about 100 m^3/d.

3.4.4.15 ***Proposed water supplies***

It is proposed that all or most of the predicted water demand be met from the existing groundwater supply at the site. The groundwater supply, currently used by the chicken farm, will be used to provide for all potable water requirements and for all supplies to the cement works and associated buildings.

In the event that total water demand at the site exceeds the available yield from the current site borehole, measures will be taken to reduce water demand where appropriate, and obtain additional supplies. Use of water from the settlement lagoons will be considered for dust suppression and wheel washing applications.

3.4.4.16 ***Likely site effluents***

The expected site effluents generated as a result of the scheme proposals are described in Section 2.1.5.5.

3.4.5 **Mitigation measures proposed**

3.4.5.1 ***Measures proposed to monitor the development of drawdown at the site***

The prediction of dewatering impacts are always subject to some uncertainty as a consequence of limited information on the groundwater system. In such circumstances it is proposed that the development of drawdown at the site is monitored within the framework of the general programme of environmental monitoring at the site.

A network of boreholes will be used in the vicinity of the works to monitor water levels through time. Most of this monitoring network will be based on current boreholes, where monitoring has commenced, and can continue throughout the site preparation. 20 no. boreholes are to be used for monitoring. The locations of these are shown on Appendix Drawing No. 3.4.4.1. Some are new borehole installations designed to check on effects near properties at risk of derogation. Some boreholes will be progressively destroyed as part of the development works, and replacement boreholes will be installed as required. All installations will be into bedrock and cased through superficial materials. Borehole depths will vary according to the proposed re-drill depths of new wells indicated in Appendix Drawing No.3.4.4.1 and Appendix Table 3.4.4B. Monitoring will take place at monthly intervals.

Discharges from the site dewatering system will be metered on a continuous basis to ensure that adequate records of dewatering are maintained.

The ongoing development of drawdown at the site will be modelled using changes in water levels to verify that drawdowns are in line with predictions. The model will be adapted and updated where required in the light of feedback from the field evidence. This will provide a framework for management of the aquifer and prediction of wells at risk of derogation.

3.4.5.2 *Measures proposed to monitor surface water flows*

A permanent stage board will be installed near the site discharge point on the River Kinnegad, and a scheme of regular river flow monitoring commenced. This is designed to provide additional information regarding the river flow regime, for which limited data is currently available.

3.4.5.3 *Measures proposed to monitor water quality*

Regular sampling and analysis of the site discharges are proposed in order to ensure full compliance with all legal and regulatory requirements.

3.4.5.4 *Measures proposed to mitigate potential impacts on existing groundwater users*

Wherever necessary, the company will provide replacement, deepened wells where current installations are at significant risk. The groundwater modelling shows such impacts should be restricted to specific properties, shown on Drawing No. 3.4.4, and noted in Section 3.4.4.6 above, and are most likely to include those properties within or near to the 11m contour.

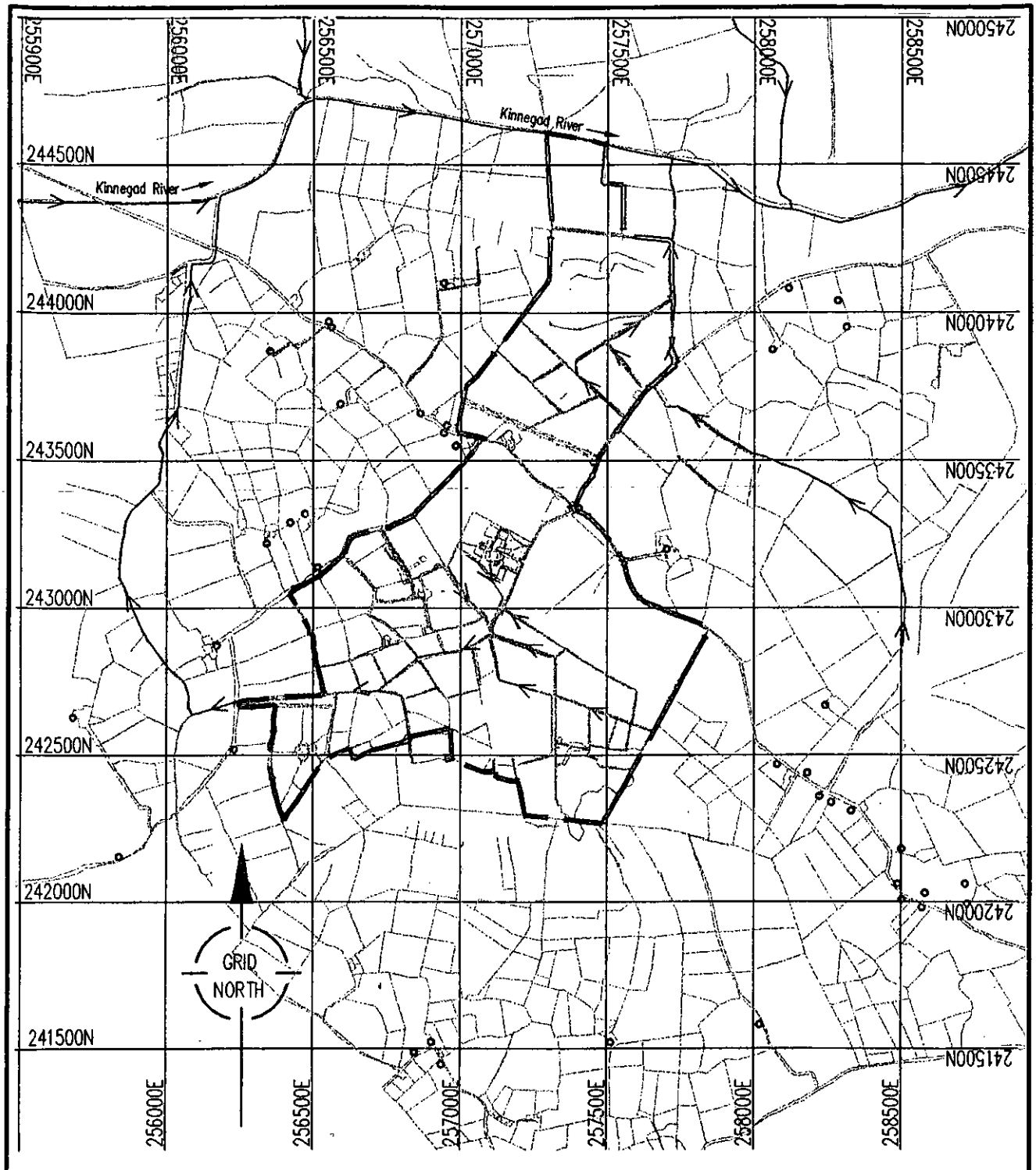
The wells which require replacement with deepened wells are identified in Appendix 3.4.4 and shown in plan on Appendix Drawing No. 3.4.4.1. Some 22 wells will require replacement (see Appendix Table 3.4.4B), 2 with 100m deep wells, 5 with 75m deep wells, 14 with 50m deep wells and 1 with a 25m deep well. Criteria used to assess the need for a replacement well are given in the Appendix.

The company will undertake to cover the full cost of each replacement facility including well testing, casing and pump, together with a reconnection to the existing domestic or other supply pipes and the necessary controls.

Feedback from groundwater monitoring will ensure that the wells at risk are kept under review and that replacement, deepened wells are provided in a timely manner well before a loss of water is obvious to the user.

3.4.5.5 *Measures proposed to minimise contamination risks from site activities*

Water treatment and pollution prevention measures to be incorporated within the scheme proposals are described in Sections 2.1.5.5 and 2.2.3.5 State of the art pollution prevention measures will be incorporated in the development to ensure that there is no significant risk of contamination caused by site activities.



LEGEND

Well

Site boundary

0 200 400 600 800

Metres

Note:
Location of wells from well survey September 1998.

04.11.1998

LAGAN CEMENT LIMITED
ROSEMOUNT BUSINESS PARK
BALLYCOOLIN ROAD, DUBLIN 11
TEL: 01820 1070 FAX: 01820 1901

LANSDOWN CEMENT WORKS

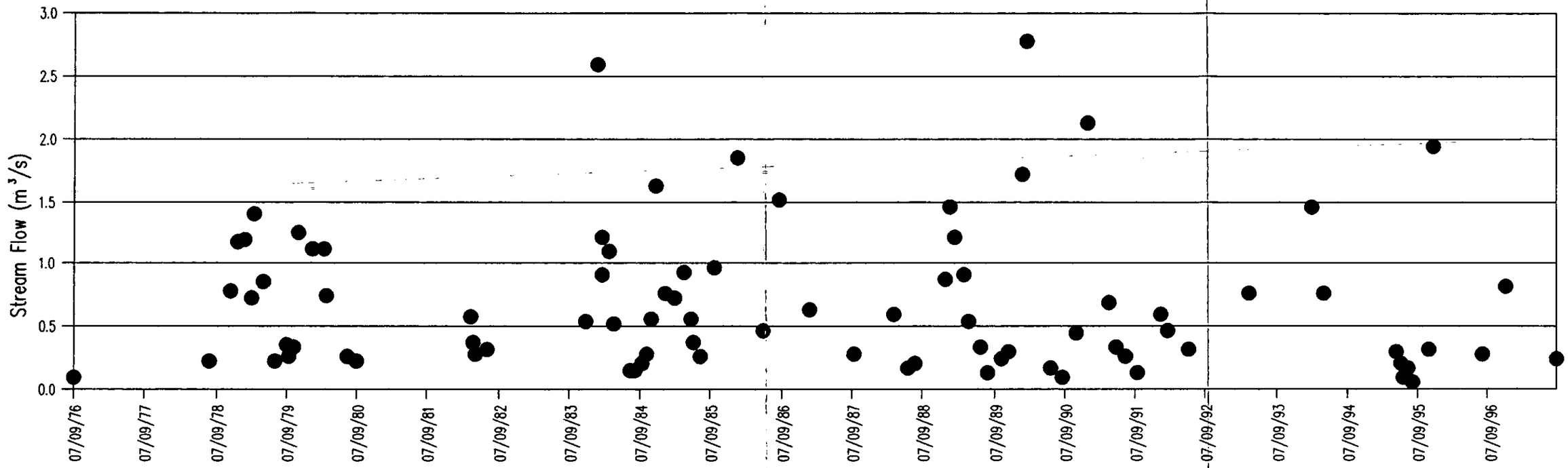
KILLASKILLEN, CO. MEATH

TITLE:

Surface water features and drainage pattern

Nº

3.4.1



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LANSDOWN CEMENT WORKS

KILLASKILLEN, CO. MEATH

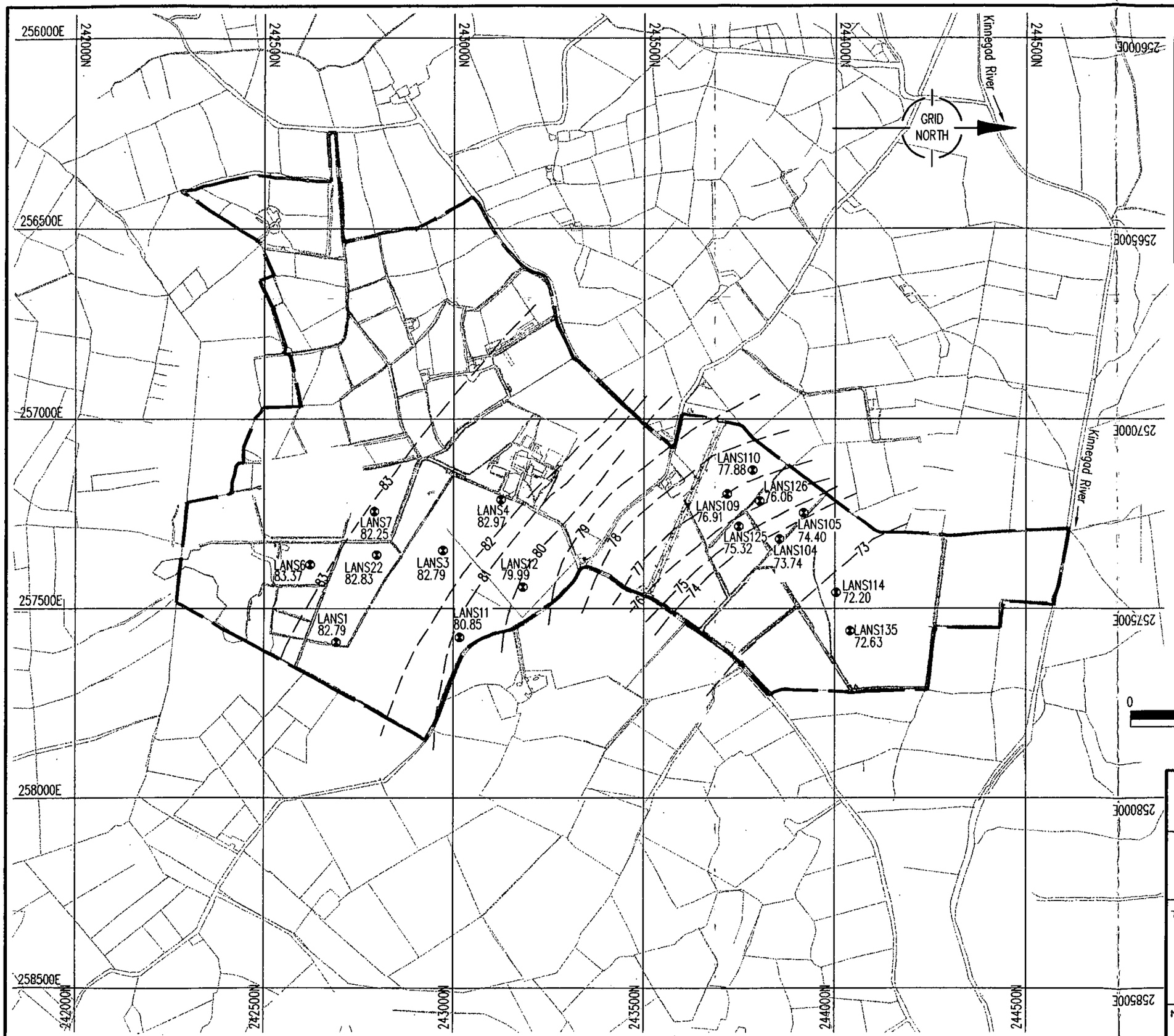
TITLE:

Recorded Kinnegad River flows at Kinnegad Gauging Station

Nº.

3.4.2

04.11.1998



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TEL: 01820 1070 FAX: 01820 1901

LANSDOWN CEMENT WORKS

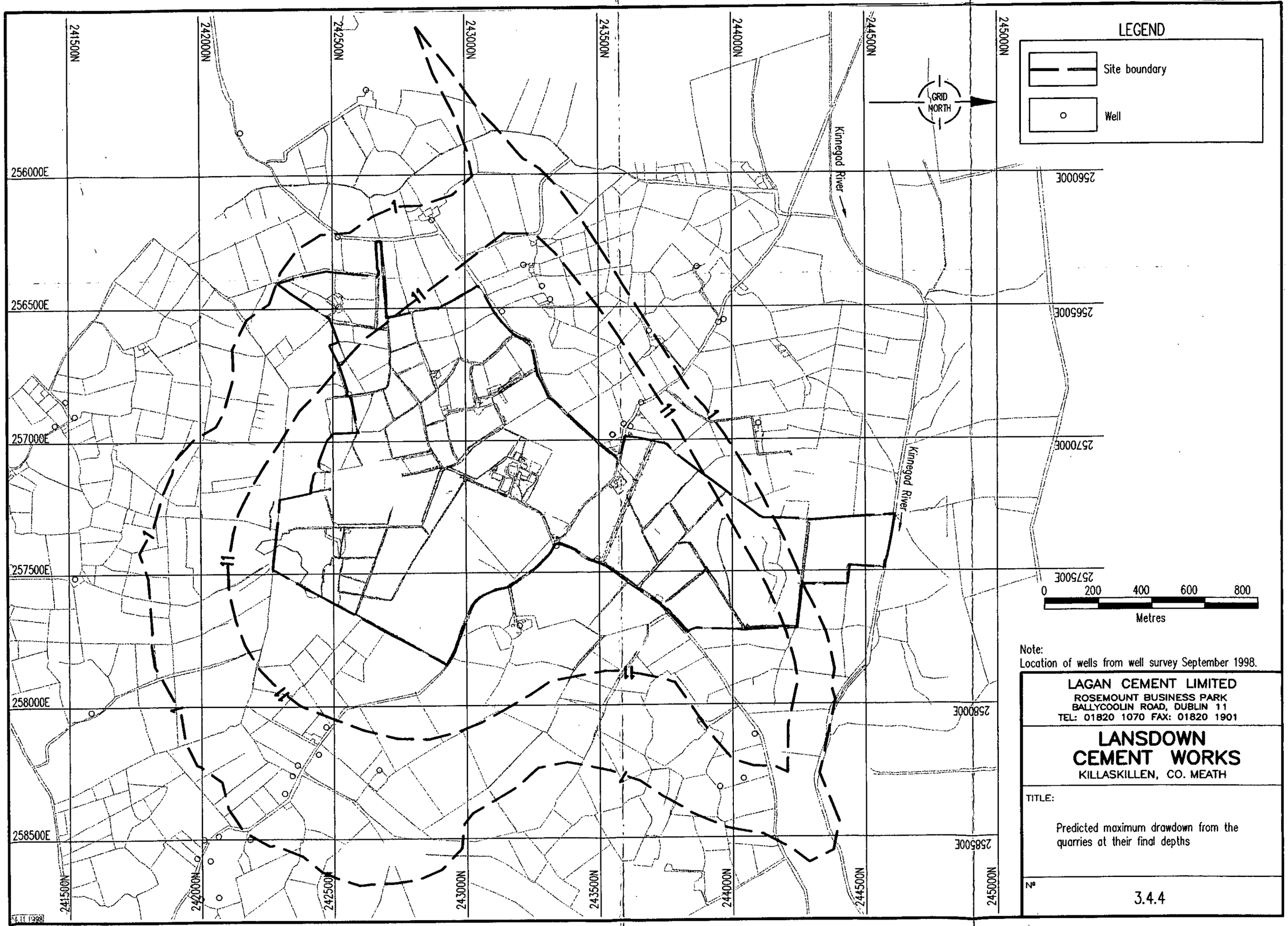
KILLASKILLEN, CO. MEATH

TITLE:

Groundwater head distribution measured on 1 June 1998

N°

3.4.3



Note:
Location of wells from well survey September 1998.

LAGAN CEMENT LIMITED
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BALLYCOOLIN ROAD, DUBLIN 11
TEL: 01820 1070 FAX: 01820 1901

LANSDOWN CEMENT WORKS
KILLASKILLEN, CO. MEATH

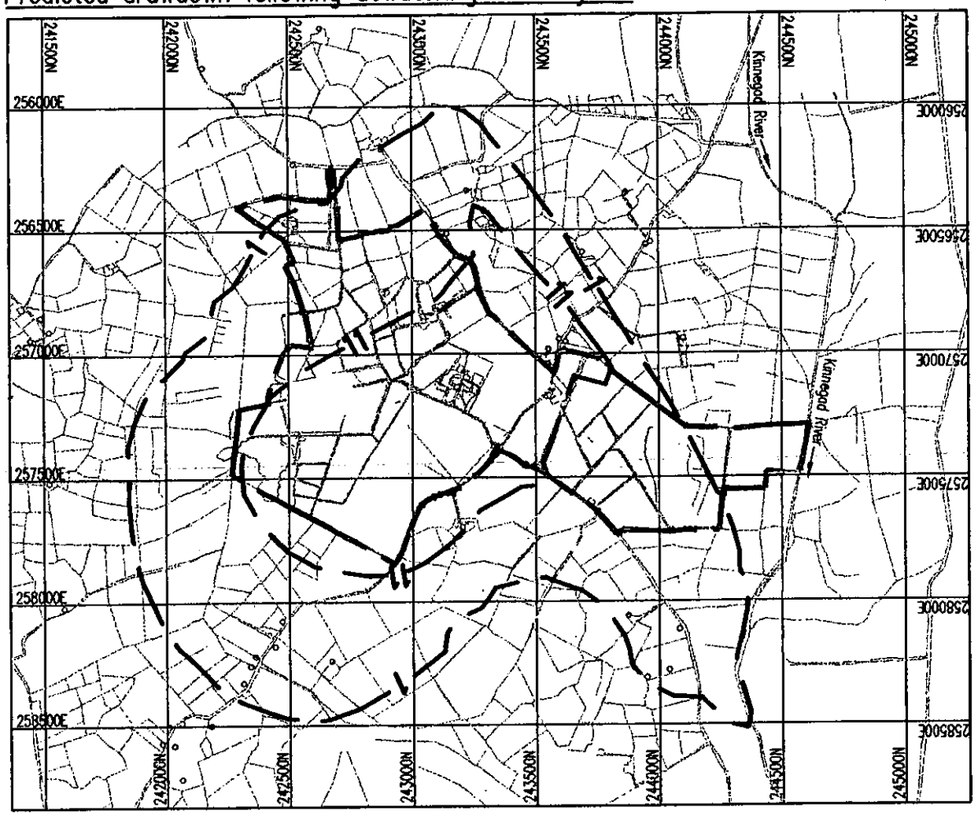
TITLE:

Predicted maximum drawdown from the quarries at their final depths

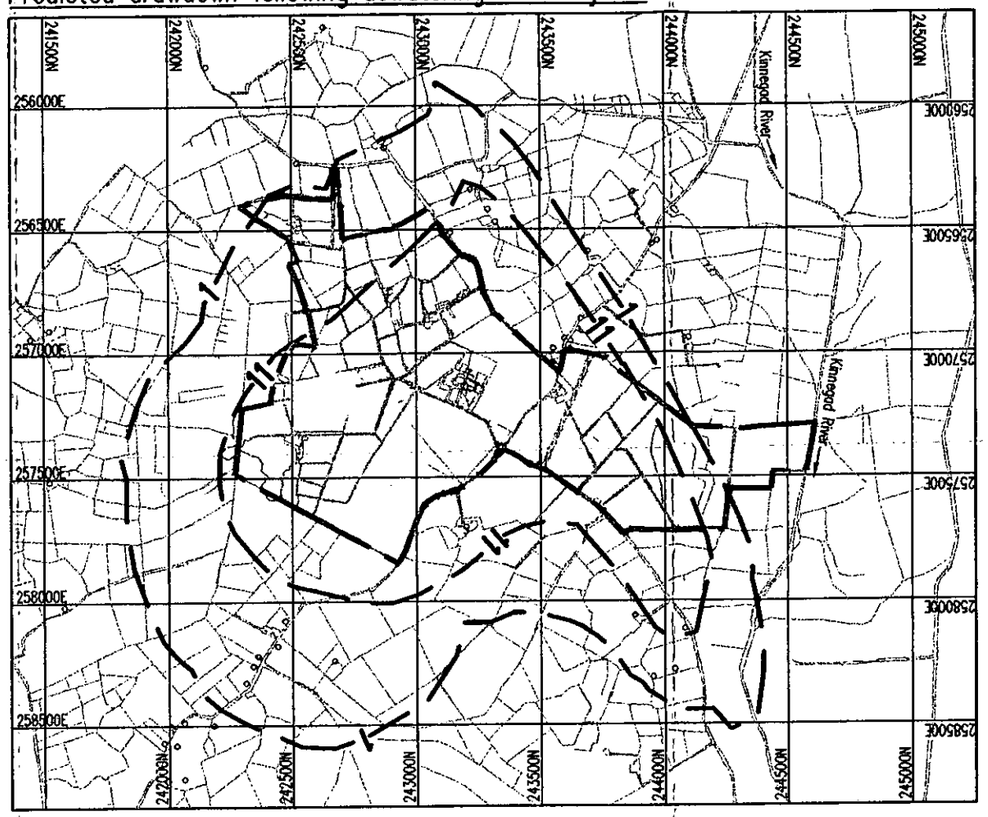
Nº

3.4.4

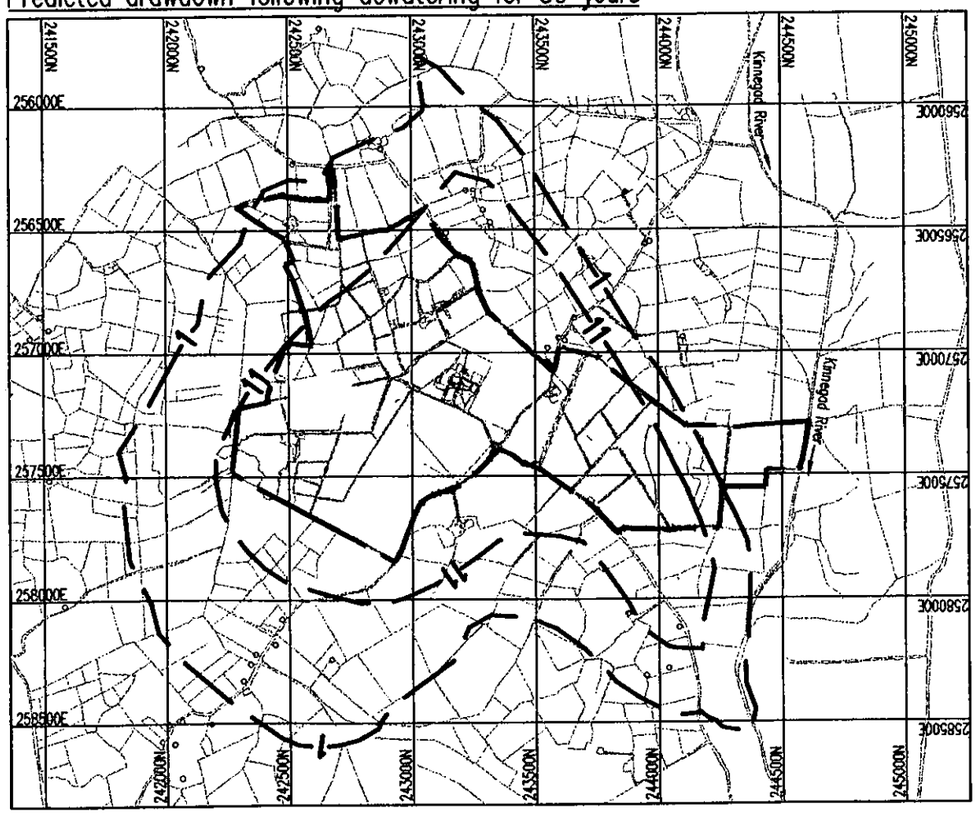
Predicted drawdown following dewatering for 10 years

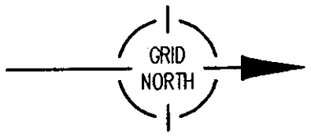


Predicted drawdown following dewatering for 20 years



Predicted drawdown following dewatering for 30 years





0 200 400 600 800
Metres

LEGEND

Site boundary

Well

Note:
Location of wells from well survey September 1998.

LAGAN CEMENT LIMITED
ROSEMOUNT BUSINESS PARK
BALLYCOOLIN ROAD, DUBLIN 11
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LANSDOWN CEMENT WORKS

KILLASKILLEN, CO. MEATH

TITLE:

Predicted drawdowns following dewatering for 10, 20 and 30 years

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APPENDIX 3.5.2 DISPERSION MODELLING STUDY OF THE IMPACT OF EMISSIONS TO ATMOSPHERE FROM THE PROPOSED DEVELOPMENT

3.5.1 Introduction

This section assesses the impacts of the proposed industrial development on the environment with respect to air quality. The site of the proposed development is located in the townland of Killaskillen near Kinnegad, Co Westmeath. The site incorporates land which was part of the Lansdown Property Holdings and includes Lansdown Lodge.

The site is located in a predominantly rural location, with the village of Ballinabrackey located approximately 1.5 km south of the nearest site boundary and Kinnegad lying approximately 3km to the north east of the nearest site boundary. The location of the site is well removed from substantial industrial developments although the Electricity Supply Board peat-fired power Station at Rhode, Co Offaly, is located just 13 km south-west of the site. The main Dublin – Galway road, the N6, passes the site approximately 0.5km north of the site boundary; an inner bypass of Kinnegad is scheduled for completion by mid 1999. There are plans to extend the M4 Motorway to Kinnegad in the medium term (10 years), and an outer bypass of the town will be completed on the same timescale; the new route passes closer to the nearest site boundary than the existing roadway. A substantial residential development is located at Kinnegad. Approximately 120 residences are located in scattered developments within a radius of 2km of the site boundaries.

3.5.2 The Existing Environment

3.5.2.1 *Climate*

The magnitude of potential impacts of emissions from the proposed industrial development will be substantially influenced by the local meteorological conditions and particularly by wind speed and direction and also by precipitation rates, so an evaluation of climatological conditions at the site is important when completing an assessment of the type being undertaken in this study.

Ireland's climate is subject to strong maritime influences with the effects decreasing as distance from the Atlantic coast increases. Since the island is very small with no part of the country being further than 120 km from the sea, the range of mean temperatures across the country is narrow. Data from Met Eireann, the Irish Meteorological Service, who maintain monitoring stations at a number of locations around the country indicates that January and February are generally the coldest months of the year, and most areas of the eastern half of the country have 750 – 1100mm/annum rainfall.

There is no continuous meteorological monitoring station located uniquely close to the site of the proposed development at Lansdown, but comprehensive monitoring data is available for Casement Aerodrome at Baldonnel which is located just 45km East of the site. The Meteorological Station in Mullingar does not record sufficient information to allow a comprehensive evaluation of meteorological conditions in the area and furthermore, since the data is incomplete, it is not suitable for use as input data in Dispersion Modelling Software. For the purpose of obtaining reliable information about the climatological conditions at the site of the proposed industrial development, meteorological data for the period 1992 – 1996 from the Met Eireann Station at Casement Aerodrome was analysed. In view of the close proximity of the two

locations, the flat terrain and the absence of direct marine influences, the data from Casement Aerodrome is expected to be a reliable indicator of conditions at the site of the proposed development.

Analysis of the monitoring data from the meteorological station at Casement Aerodrome show that the dominant wind direction is from the S-SW-W quadrant with an annual incidence of about 60% as shown in the Wind Rose for Casement Aerodrome, (Appendix 3.5.2. Figure 1). The average annual wind speed is in excess of 5 m/s, with wind speeds < 3 m/s occurring for just 19% of the year; high wind speeds at > 5 m/s occur for 65% of the year. A summary of wind speed occurrences for the period 1992 – 1996 is presented in Table 3.5.1.

An analysis of mean monthly temperatures and precipitation rates for Casement Aerodrome is presented in Table 3.5.2. Mean monthly temperatures for the area are in the range 5.4 to 15.3 °C, with mean monthly precipitation rates in the range 49.6 mm in June to 80.6mm in January. The mean annual precipitation rate for the area is 757mm.

The dispersion of pollutants from emission sources is also affected by atmospheric stability. The six categories of atmospheric stability normally used for this type of study range from very unstable (A) to stable (F). The percentage occurrence of the various atmospheric stability classes was determined for the five year period 1992 – 1996 and the results are summarised in Table 3.5.3. The most common type of stability category encountered in the area is neutral (D) stability at 76% which is representative of the conditions normally encountered in Ireland and is associated with cloudy, rainy or windy weather. Dispersion of pollutants is poorest under stable atmospheric conditions (categories E and F, normally experienced during the night) – this type of stability category is encountered for just 15% of the year.

The meteorological data for Casement Aerodrome in Baldonnel has been shown to be suitable for assessing the impact of emissions from the plant on the surrounding environment. In the absence of a locally-based meteorological station, a monitoring station will be permanently located on the site of the proposed development before construction activities begin in order to obtain reliable local information on key climatological conditions.

Table 3.5.1 Frequency of wind direction and wind speed for Casement Aerodrome (1992 – 1996)

DIRECTION	PERCENTAGE OCCURRENCE OF WIND SPEEDS (m/s)						
	< 1.54	1.54 – 3.09	3.09 – 5.14	5.14 – 8.23	8.23 – 10.8	> 10.80	TOTAL
0.0	0.944	0.822	0.736	0.171	0.005	< 0.001	2.678
22.5	0.604	0.518	0.428	0.260	0.042	0.012	1.864
45.0	0.631	0.583	0.641	0.469	0.122	< 0.001	2.446
67.5	0.936	1.157	1.417	0.784	0.110	0.005	4.409
90.0	1.799	2.654	3.186	1.923	0.495	0.066	10.123
112.5	0.789	1.070	0.871	0.615	0.155	0.103	3.603
135.0	0.682	0.686	0.653	0.538	0.146	0.075	2.780
157.5	0.619	0.622	0.643	0.519	0.162	0.134	2.699
180.0	0.901	1.170	1.496	1.475	0.801	0.965	6.808
202.5	0.762	1.197	1.747	2.895	2.052	1.662	10.315
225.0	0.881	1.859	2.984	4.792	3.050	1.963	15.529
247.5	1.315	2.403	3.526	4.869	2.608	1.463	16.184
270.0	1.840	2.461	3.013	3.219	1.460	0.927	12.920
292.5	0.863	0.819	0.801	0.608	0.120	0.021	3.232
315.0	0.631	0.698	0.693	0.260	0.052	< 0.001	2.334
337.5	0.650	0.566	0.554	0.272	0.026	0.024	2.092
TOTAL	14.847	19.285	23.389	23.669	11.406	7.420	100

Table 3.5.2 Mean monthly temperature and rainfall for Casement Aerodrome (1992 – 1996)

Month	Mean Temperature, °C	Mean rainfall, mm
January	5.5	80.6
February	5.4	62.1
March	6.3	59.1
April	8.2	57.9
May	10.0	68.2
June	13.6	49.6
July	15.3	56.2
August	14.7	54.0
September	12.1	54.5
October	9.6	61.0
November	7.3	76.1
December	5.0	77.6

Table 3.5.3 Percentage occurrence of atmospheric stability categories at Casement Aerodrome (1992 – 1996)

Stability Category	Percentage occurrence
A – very unstable	< 1
B – unstable	1
C – slightly unstable	6
D – neutral	76
E –slightly stable	9
F – stable	6
G – very stable	2

3.5.2.2 *Air Quality*

Ambient air quality monitoring in Ireland is generally undertaken to assess compliance with national air quality standards and to implement European Union Directives. The vast majority of sites used for monitoring are maintained by local authorities and most of these monitor smoke and sulphur dioxide only. The Environmental Protection Agency also operate and maintain a number of automated monitoring sites for ozone and nitrogen oxides in addition to monitoring smoke and sulphur dioxide. The air quality monitoring sites are generally located in urban areas or adjacent to large-scale industrial sources such as power stations so there is little information available about ambient air quality in rural areas. There is no monitoring station located close to the site of the proposed development or in a similar rural environment.

The site of the proposed development is located in a predominantly rural environment substantially free from significant industrial emission sources and significant residential developments. The ambient air quality in the region is expected to be influenced primarily by emissions from domestic heating sources and vehicle exhaust emissions with some small contributions from agricultural activities. There are approximately 120 residences located within a 2km radius of the site boundaries, and traffic on the main Dublin – Galway and Dublin – Sligo roads is expected to contribute to ambient air pollutant burdens in the local atmospheric environment.

In the absence of any monitoring data on ambient air quality at the site of the proposed development, a survey of ambient air quality was completed at the site to verify assumptions that air quality is representative of an unpolluted, rural environment. The scope of the survey included monitoring of dust deposition rates over a 28 day period and 24-hour average concentration of sulphur dioxide and nitrogen oxides over a period of seven consecutive days. The results of the surveys have been presented in a separate report which is attached in Appendix 3.5.1. and the key findings are summarised in Table 3.5.4.

The results of the ambient air quality surveys indicate that existing air quality in the vicinity of the site of the proposed development is good and representative of similar rural environments. Dust deposition rates were in the range 4.6 – 38.4 mg/m^2-day which is consistent with expectations for a rural environment. There are no national or EU air quality standards with which these levels can be compared. However, a figure of 150 mg/m^2-day is commonly applied to ensure than no nuisance effects will result from specified industrial activities and the existing dust deposition rate is substantially lower than this nuisance threshold.

Ambient concentrations of sulphur dioxide and nitrogen oxides recorded at the site are also representative of unpolluted rural environments. The concentrations of sulphur dioxide and nitrogen oxides are compared with the EU Air Quality Standards as shown in Table 3.5.4; clearly, the existing air quality is substantially better than that defined by the Limits and Guide Values for sulphur dioxide and nitrogen oxides. Since there are no major industrial facilities located close to the site, the dominant contributors to sulphur dioxide levels will be domestic heating sources and traffic will be the main source of nitrogen dioxide. The survey was limited in duration and spanned a single week during the summer season. It is likely that concentrations of the gaseous species monitored, sulphur dioxide and nitrogen oxides, will be higher during the winter when

domestic heating sources are expected to be in more frequent use. However, the ambient concentration of these substances will still be very low and air quality in the area is expected to be very good.

Table 3.5.4 Ambient air quality at the site of the proposed industrial development

Air quality parameter	Ambient air concentration	Air quality standard
Dust deposition rate, mg/m^2-day	4.6 to 38.4	150 [1]
Sulphur dioxide, $\mu g/m^3$	< 17.1 to 20.0	80 if smoke > 40; [2] 120 if smoke < 40
Nitrogen oxides, $\mu g/m^3$	< 0.5 to 13.04	200 [3]

NOTES

[1] There are no National Ambient Air Quality Standards, EU Standards or WHO guidelines for dust deposition rate; a level of 150 mg/m^2-day is a commonly applied nuisance threshold for this parameter.

[2] The EU Standard for sulphur dioxide varies depending on the smoke concentration; the Limits are expressed as an annual average of daily mean concentrations.

[3] The EU Limit for nitrogen dioxide is 200 $\mu g/m^3$ expressed as the 98-percentile of hourly mean concentrations.

3.5.3 Potential Impact of the Development

3.5.3.1 *Construction*

The construction of the cement manufacturing plant will involve activities which have the potential to release pollutants in to the atmosphere. The main emission sources are:

- Particulates from earthmoving operations;
- Particulates from piling and boring;
- Particulates from stockpiling of raw materials;
- Particulates from delivery and transfer of construction materials;
- Particulates from internal haul roads on site.

Emissions from construction vehicle movements are considered separately in Section 3.5.3.4.

Considerable amounts of sand, gravel and/or crushed aggregate will be required for the construction of access roads to the plant, plant and storage area surfacing and for the plant foundations and building construction. These materials will be recovered on site thus minimising the requirement for additional vehicle movements to bring materials on to the site.

Full details of the construction programme are not yet available, but it is planned to minimise environmental impacts associated with the construction phase by operating a comprehensive environmental management plan for the construction operations. Details of the mitigation measures to be employed are presented in Section 3.5.5, and the impact of emissions to atmosphere will be minimised by the selection of appropriate mitigation measures and also by sound environmental management practices during the construction phase.

3.5.3.2 *Quarrying*

The main quarrying activities are associated with the recovery of materials for use in the construction and operation of the cement manufacturing plant. The potential emissions from traffic and machinery associated with the quarrying activity are minor and are considered separately in Section 3.5.3.4. The most significant potential impacts arise from particulate emissions associated with the operation of the quarry, and the main potential emission sources are summarised as follows:

- Emissions from exposed surfaces such as material stockpiles, rock and soil surfaces;
- Emissions from road and yard surfaces;
- Emissions from blasting and excavation of raw materials;
- Emissions from material crushing and grinding operations;
- Emissions from material transfer operations.

The two main impacts of dust emissions from quarrying activities are incremental contributions to airborne particulate concentrations and to dust deposition rate on surfaces. The particulate emissions from the quarrying activity are expected to be in the 10 –75 μm size range, so the dominant impact of this activity will be the impact on dust deposition.

The particulate emissions from blasting will be insignificant since the blasts will be designed and managed in accordance with best international practice thus eliminating the potential for significant emissions as a result of this activity. Similarly, the management practices and mitigation measures planned for aspects of the operation such as grinding and crushing and material storage and transfer are presented in Section 3.5.5 and these will effectively control dust emissions from such sources. The most significant of the potential emission sources are associated with mechanical handling operations and material transfer operations; entrainment of particulates from windblow across exposed sources is also potentially significant.

The particulate emission rate from the quarrying operations will be greatly influenced by the weather, the amount of material handled per unit time and the management of site operations. The particulate emission rate from the operation of the quarry has been estimated using Air Pollution Emission Factors developed by the US Environmental Protection Agency. Using this methodology, the main sources of dust emissions from the quarrying operation are predicted to be raw material extraction, transport of raw material to the crusher and the crusher itself. Since the crushing and material conveying operations will all be enclosed (Section 3.5.5), the raw material extraction and storage operations will be the most significant sources of dust emissions at the site. The shale stockpiles will also be partially enclosed further minimising the potential for emissions from these sources.

Although the quarrying operations will not be operated continuously, the windblown contributions to dust emissions will be continuous so continuous operation was assumed in calculating potential emission rates of particulates from the quarrying operations. The application of the US EPA Emission Factors to the operation results in a predicted emission rate of approximately 1.5 g/sec from the entire quarrying operation. When mitigation measures are taken into account, this estimate is further reduced to just 1.12 g/sec. This emission rate is insignificant in relation to the main process emissions which are summarised in the following section. The proposed mitigation measures (Section 3.5.5) have also been considered in computing this estimate.

3.5.3.3 *Cement Manufacturing Plant*

3.5.3.3.1 Emission sources

As a result of the operation of the cement manufacturing plant, emissions to atmosphere of particulate and gaseous pollutants will occur. The dominant emissions are PM (particulate matter), PM_{10} (particulate matter having an aerodynamic diameter less than 10μm), sulphur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), carbon dioxide (CO_2) and water vapour. Traces of Volatile Organic Compounds (VOCs) and heavy metals will also be emitted depending on the fuel used in the main plant processes and on the chemical composition of the raw materials in use at the plant.

Emissions to atmosphere are considered under two headings, fugitive and unscheduled emissions and specific process emissions. **Fugitive emissions** are associated with:

- Particulates from delivery of raw materials to site;
- Particulates from storage of raw materials, processed materials and product;
- Particulates from spillage, internal transfer of materials and building losses.

Process emissions are associated with:

- Particulates from crushing of raw materials (shale and limestone);
- Particulates from milling limestone, shale and coal;
- Particulates from conveying and transport of materials;
- Particulates from clinker grinding and gypsum mixing;
- Particulates from bag-filling and bulk transport loading of cement;

- Particulates, NO_x, SO_2, CO, CO_2, water vapour, trace VOCs and metals from cement kiln.

3.5.3.3.2 Emission characteristics

Process emissions: Cement Kiln

The principal source of emissions to atmosphere at the cement manufacturing plant will be the main exhaust stack from the cement kiln. The height of the exhaust stack will be 128m (125m above existing ground level) and the emission characteristics predicted for this emission source are summarised in Table 3.5.5.1.Information on emission characteristics was obtained from a consideration of the nature and scale of the processes which will be carried out at the plant, the chemical composition of the raw materials and fuels, and emission factors from this industry type developed by the United States Environmental Protection Agency (US EPA). The rationale used for developing this profile of the main process emission stream is outlined in the following sections.

Particulate emissions are the main emissions from this source originating from the processing of materials in the kiln. The maximum emission rate of particulates from this source will be substantially less than the BATNEEC Emission Limit Value (ELV) of 100 mg/Nm^3 permitted when production capacity is less than 500,000 tons of clinker per annum. For the purpose of this assessment, the maximum emission rate is assumed to be 50 mg/Nm^3 which is substantially greater than the average concentration expected during normal operation of the kiln.

Sulphur dioxide emissions originate from the sulphur in the fuel used in the processing operations and is also dependent on the chemical composition of the raw materials. The potential maximum emission rate of sulphur dioxide is readily calculated from the sulphur content in the fuels and raw materials to be used in the process. The fuel usage rate is dependent on the clinker production rate and this information, together with the maximum sulphur content in the fuel oil blends and coal to be used for various production cycles was used to calculate the potential maximum sulphur dioxide emission rate from this source. A significant portion (70 – 95%) of the sulphur dioxide generated in the combustion process is absorbed by chemical reaction in the alkaline clinker so the actual emission rate of sulphur dioxide is substantially lower than it would be from a combustion source where no absorption takes place. The emission rate of sulphur dioxide will be further reduced as the exhaust gases from the kiln are used to heat materials in the raw meal mill where further absorption in the materials occurs. The expected sulphur dioxide emission rate from this source was calculated from Plant Production capacity (450,000 ton per annum) and the sulphur content of the various fuels and raw materials to be used at the plant. In systems where pyrites are high in the raw materials fed in to the kiln, the absorption rate of sulphur dioxide could be as low as 70%. Although the sulphur content of the raw materials is particularly low in this development (Section 3.3), a conservative estimate of 70% absorption of sulphur dioxide was also considered in computing the expected mass emission rate of sulphur dioxide from this source.

Nitrogen oxides are present in the emission stream as a result of the combustion process. The concentration of nitrogen oxides is dependent on the type of fuel used and also on the characteristics of the combustion processes occurring in the precalciner

vessel and in the kiln. The incorporation of a precalciner kiln in to the design of the plant substantially reduces the potential for NO_x generation in the emission stream. Furthermore, the use of coal as a fuel for selected production cycles results in generation of much lower concentrations of NO_x in the emission stream than that associated with the use of either oil or gas. Much of the emissions will be in the form of nitric oxide (NO) which is expected to be substantially oxidised to nitrogen dioxide in the atmosphere. The expected concentration range is 300 – 800 mg/Nm^3 which is substantially lower than the 1300 - 1800 mg/Nm^3 BATNEEC ELV.

Carbon monoxide is emitted as a result of incomplete combustion and concentrations in the range 500 – 1500 mg/Nm^3 are predicted.

Carbon dioxide emissions are significant and originate from both fuel combustion and from the calcining process where it is liberated from the limestone raw material. Typical emission rates are in the range 700 – 1350 kg carbon dioxide per tonne of clinker produced. A detailed calculation of emissions potential from the raw material composition and the fuel consumption rate for each fuel type leads to an estimate of 764 - 917kg carbon dioxide emitted per tonne clinker produced. At an annual production rate of 450,000 tonnes of clinker, the potential CO_2 emissions total 345,000 – 420,000 tonnes per annum; this is probably an overestimate of emission potentials since coal, which results in higher carbon dioxide emissions than either oil or gas, would only be used for approximately 35% of the production output at peak plant production. The Environmental Protection Agency have estimated the national CO_2 emission rate at 33 million tonnes in 1993 so that the potential maximum contribution from this plant will be less than 1.3% of the national emissions total.

Water vapour will be emitted due to its formation during the combustion process and also as a result of the drying of materials in the kiln. Since the raw materials are particularly dry for this development project, the water vapour emissions are minimised relative to the potential emission rate from a source of this type.

Volatile Organic Compound (VOC) emissions are expected as a result of the combustion process but these are minor emissions and result in trace concentrations in the range of 1 - 2 mg/Nm^3 in the emission stream.

Heavy metals such as volatile metals (mercury, thallium), semivolatile metals (cadmium, lead, selenium, antimony, zinc, potassium, sodium) and refractory or non-volatile metals (barium, chromium, arsenic, nickel, vanadium, manganese, copper, silver) are expected as a result of their presence in the raw materials used. However, the raw materials to be utilised at this facility are extremely low in volatile and semi-volatile metals so this is not a significant issue for this development. Analysis of representative samples of the raw materials to be used at the plant indicates that typical concentrations of the environmentally significant volatile and semivolatile metals (lead, mercury, cadmium, selenium) are very low, resulting in emission concentrations of much less than 0.2 mg/Nm^3. Although some of the shale is relatively high in chromium and other metal concentrations, this material is present at a maximum of 16% of the raw material blend used in the kiln thus further minimising the potential for release into the atmosphere.

The exit gas from the cement kiln is used to heat raw materials in the raw mill for 90 – 95% of production time in the cement plant. Modern pre-heaters result in exit gas temperatures of approximately 300°C. When the gases exit from the raw mill, the temperature will have dropped to ca 90 to 105°C. Occasionally, the raw mill is by-passed and it is at this stage that the potential maximum emissions may be attained. In particular, absorption of sulphur dioxide is reduced and emissions of sulphur dioxide and nitrogen oxides can approach the maximum expected concentration for short time periods – generally 5 minute periods or less. The frequency of occurrence of such emissions is typically less than 5% of production time.

Process emissions: non-kiln

The main process emissions from sources other than the kiln are particulate emissions from the various processes discussed in Section 3.5.3.3.1. A summary of the emission characteristics from 22 process emission sources at the plant is presented in Table 3.5.6. Two emission scenarios are presented for each source. The average emission rate for each source is calculated from the design specification of 10 mg/Nm^3 for the Bag Filters which will be used to control emissions from these sources. The projected maximum emission rate from each source is calculated from the maximum expected concentration in the emission streams which will not exceed 20 mg/Nm^3. The total mass emission rate of particulates from all process sources other than the kiln will not exceed 8.352 kg/hr. The most significant individual emission source other than the cement kiln is the cement mill with a projected maximum emission rate of 1.128 kg/hour.

Many of these emission sources will not operate continuously so the projected emission rates are overestimates of the potential emission rates. Both the average and maximum allowable mass emission rates from each source are within the BATNEEC ELV of 50 mg/Nm^3 for particulates.

Fugitive emissions

Due to the nature of the processes being undertaken at the plant, there is potential for fugitive dust emissions associated with the operation of the cement manufacturing plant. The main areas with significant potential for fugitive losses are internal material transfers, building losses and the raw and final milling operations. Appropriate control technologies and management practices for minimising the potential for such losses are incorporated into the design of the plant as discussed in Section 3.5.5, so the magnitude of potential fugitive emissions is low. Similarly, management practices in relation to internal haul road and yard surfaces will minimise the potential for fugitive particulate emissions from these sources.

Table 3.5.5. Emission characteristics from cement kiln

Parameter	Design Specification			BATNEEC ELV [1]
Characteristics				
Stack height, m	125			NA
Stack diameter, m	3			NA
Exit flow rate, Am^3/hr	214,000			NA
Exit flow rate, Nm^3/hr	101,988 – 156,650			NA
Exit velocity, m/sec	8			NA
Exit temperature, K	373 – 573			NA
	Min	***Avg***	***Max***	
Gas composition				
SO_2 emission concentration, mg/Nm^3	150	350	500	400 – 750
SO_2 emission rate, g/sec	6.53	15.24	21.76	NA
NO_2 emission concentration, mg/Nm^3	300	550	800	1300 – 1800
NO_2 emission rate, g/sec	13.05	23.93	34.81	NA
Particulate emission concentration, mg/Nm^3	10	10	20 – 50	100 [3]
Particulate emission rate, g/sec	0.44	0.44	0.87 – 2.18	NA
CO_2 emission rate, kg/sec	9.47	11.37	13.64	NA
CO emission concentration, mg/Nm^3	500	1200	1500	NA
CO emission rate, g/sec	21.73	52.22	65.27	
TOC emission concentration, mg/Nm^3	-	-	2	150 [4]
TOC emission rate, g/sec [2]	-	-	0.087	NA
THM emission concentration, mg/Nm^3	-	-	< 0.2	[5]
THM emission rate, g/sec [2]	-	-	$< 1.65 \times 10^{-4}$	NA

NOTES

[1] Best Available Technology Not Entailing Excessive Cost; ELV = Emission Limit Value; Integrated Pollution Control Licensing Guidance Note for the Production of Cement

[2] TOC = Total Organic Carbon; THM = Total Heavy Metals

[3] Plant capacity < 500,000 ton per annum

[4] No values quoted in BATNEEC Guidance Note; typical value quoted from T A Luft

[5] No values quoted in BATNEEC Guidance Note; typical values 1 – 5 mg/Nm^3

Table 3.5.6 Emission characteristics from main particulate emission sources

Emission source	Design specification						
	Temp K	Velocity m/s	Flow Am^3/hr	Flow Nm^3/hr	Vent height m	Mass Emission rate, kg/hr	
						Avg [1]	Max [2]
Raw material to feeder bins	293	8	18000	16771	67	0.168	0.335
Raw meal conveyor #1	293	8	18000	16771	67	0.168	0.335
Raw meal silo #1	358	8	24000	18302	67	0.183	0.366
Raw meal silo #2	358	8	24000	18302	67	0.183	0.366
Homogenising silo	358	8	24000	18302	67	0.183	0.366
Kiln feed	348	8	24000	18828	67	0.188	0.377
Clinker silo #1	338	8	18000	14538	57	0.145	0.291
Clinker silo #2	338	8	18000	14538	57	0.145	0.291
Off-Spec Clinker Silo	338	8	18000	14538	57	0.145	0.291
Clinker transport #1	333	8	18000	14757	57	0.148	0.295
Clinker transport #2	333	8	18000	14757	57	0.148	0.295
Gypsum crusher	293	8	24000	22362	14.2	0.224	0.447
Cement mill	363	8	75000	56405	39	0.564	1.128
Cement silo #1	348	8	18000	14121	57	0.141	0.282
Cement silo #2	348	8	18000	14121	57	0.141	0.282
Cement silo #3	348	8	18000	14121	57	0.141	0.282
Cement transport conveyor #1	323	8	18000	15214	57	0.152	0.304
Cement transport conveyor #2	323	8	18000	15214	57	0.152	0.304
Packing plant	323	8	24000	20285	35	0.203	0.406
Bulk cement loading plant	318	8	24000	20604	35	0.206	0.412
Coal store	293	8	24000	22362	14.75	0.224	0.447
Coal Mill	293	8	24000	22362	24	0.224	0.447
Total						***4.176***	***8.352***

NOTE

[1] Average emission rate is calculated from the design specification of 10 mg/Nm^3

[2] Maximum emission rate is calculated from the design maximum of 20 mg/Nm^3

[3] BATNEEC ELV is 50 mg/Nm^3

[4] The cement mill will operate only at night, so the potential impact of the emissions from this source is less than would be observed if the mill was operating 24 hours per day

3.5.3.4 Traffic

The movement of Heavy Goods Vehicles (HGV), internal movements of construction vehicles and construction personnel vehicle movements will contribute to emissions of gaseous pollutants such as sulphur dioxide, nitrogen oxides, carbon monoxide and traces of VOCs. In addition, the HGVs will contribute to PM_{10} emissions from the diesel engines, the dominant source of this pollutant in urban atmospheres. The construction of the cement manufacturing plant is expected to take 2 years. During this time, the main raw materials to be used will be sourced on site, while the additional materials being transported to the site will result in minimal additional traffic movements. The overall contribution of construction traffic to pollutant emissions is expected to be insignificant, particularly in comparison to the predicted process emissions from the site and the traffic movements during the operation of the cement manufacturing plant.

The operation of the cement manufacturing plant will result in the creation of approximately 200 new jobs in the area. Operating on a three-shift 24-hour production cycle, this will result in additional traffic movements due to personnel travelling to and from work. The predicted additional traffic movements are relatively small and their contribution to emissions to atmosphere are insignificant.

The most significant potential contribution to atmospheric emissions from traffic sources is associated with the full-scale operation of the cement manufacturing plant. At full production capacity in Year 3 of operation, it is estimated that the maximum number of HGVs entering and leaving the cement manufacturing plant per day will result in 51 HGV movements with raw materials and fuels and a further 60 HGVs leaving the plant carrying product; this will result in a maximum rate of HGV movements of 171 per day. An additional normal maximum of 165 vehicle movements per day on site associated with the operation of the two quarries for differing periods is also considered. The potential emission rate of pollutants from these vehicle movements can be estimated using the US EPA Air Pollution Emission Factors. Since the number of vehicle movements is extremely low, there are no adverse impacts on ambient air quality predicted as a result of the traffic movements associated with the operation of the cement manufacturing plant.

3.5.4 Air Quality Impact Predictions

3.5.4.1 *Quarrying*

The main impact on ambient air quality will be that associated with deposition of dust generated by the quarrying operations; contributions to ambient PM_{10} concentrations are predicted to be negligible in view of the expected particle size of the dust generated by quarrying and related operations. The quarrying operations are expected to result in insignificant contributions to overall airborne particulate concentrations.

The contribution of particulate emissions to the overall dust deposition rate at the plant has been considered in the Dispersion Modelling study completed for the assessment of air quality impacts associated with the operation of the facility and discussed in detail in Section, 3.5.2.

The potential impact of quarrying operations on ambient air quality will be managed and controlled by the implementation of sound environmental management practices for all aspects of the operation and by judicious selection of appropriate control technologies. These initiatives are described in section 3.5.5. No adverse impact on ambient air quality in the vicinity of the proposed development is predicted as a result of the operation of the quarry and the associated activities.

3.5.4.2 Cement manufacturing plant

Introduction

The main pollutants which will be emitted as a result of the proposed development are PM (particulate matter), PM_{10} (particulate matter having an aerodynamic diameter less than 10μm), sulphur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO) and carbon dioxide (CO_2). Although trace amounts of Volatile Organic Compounds (VOCs) and heavy metals will also be emitted, the predicted emission rates of these substances is so low that a formal quantitative assessment of their impact on ambient air quality is not required. Evaluation of the predicted impact of the proposed development on the atmospheric environment is completed by quantitatively assessing the contribution of plant emissions to ambient air concentrations of the most significant pollutants emitted from the plant. In order to complete this assessment, it is necessary to define the criteria which will be used to assess the impact of plant emissions on ambient air quality in the vicinity of the proposed development.

National Air Quality Standards have been defined in Ireland for (SO_2), nitrogen oxides (NO_x) and particulate matter (smoke); these Air Quality Standards are based on the relevant EU standards, and form the basis of assessment of the impact of emissions from the plant on the surrounding environment. Assessment criteria are also considered from two other sources:

- The World Health Organisation (WHO);
- The UK Department of Energy, Transport and the Regions Expert Panel on Air Quality Standards (EPAQS).

The air quality criteria used for this assessment and their sources are presented in Table 3.5.7. In general terms, the assessment criteria are related to airborne concentrations of the pollutants of interest to which people are exposed. An additional impact of particulate emissions is the deposition of dust onto surfaces. Air Quality Standards for airborne dust are presented in Table 3.5.7, but there are no international standards or guidelines for dust deposition rates. The value most frequently used in Ireland for assessing the impact of dust deposition is 150 mg/m^2-day, while values in the range 200 – 250 mg/m^2-day are widely used in the UK; internationally, the guideline values used are in the range 150 – 650 mg/m^2-day.

Operational impacts of the cement plant

The main sources of emissions to atmosphere from the operation of the cement manufacturing plant are:

- The main cement kiln stack;
- 22 process emission sources;
- Fugitive emission sources.

The cement manufacturing plant will operate 24 hours per day for 48 – 50 weeks of the year. The characteristics of the emission streams from the main kiln stack and the other process emission sources have been presented in Section 3.5.3.3.2.

Emissions to atmosphere from the cement manufacturing plant will contribute to ambient ground level concentrations of pollutants, especially particulate matter, PM_{10}, NO_2, SO_2 and CO. To assess the impact of these emissions on ambient air quality, it is necessary to predict the incremental contribution to existing ground level pollutant concentrations from the plant emissions. This is achieved using a computer-based Dispersion Model. The Dispersion Model used in this assessment was the Industrial Source Complex Short Term Version 1.3 (ISCST3) Dispersion Model. This Model was developed for use by the US Environmental Protection Agency and is particularly suitable for use in complex terrain. The full details of the Dispersion Modelling Protocol are presented in Appendix 3.5.II.

The Dispersion Model was used to predict the ground level concentrations of the main pollutants emitted from the plant. In accordance with the requirements of the assessment criteria which are being used for the impact assessment, the predictions were chosen to allow direct comparison of predicted ground level concentrations with the relevant Air Quality Standard. In particular, the following predictions were made:

- Maximum hourly, maximum daily and the 98-percentile of daily mean concentrations of sulphur dioxide;
- Maximum hourly and 98-percentile of hourly mean concentrations of NO_2;
- Maximum daily dust deposition rate;
- Maximum hourly concentrations of particulate matter;
- Maximum hourly concentrations of carbon monoxide.

Table 3.5.7 Assessment criteria for air quality impact assessment

Parameter	Source	Air Quality Standard, $\mu g/m^3$	Statistical parameter
Particulates	***EU Directive*** Limit value	150	Annual mean
PM_{10}	***EPAQS***	50	99-percentile of 24-hour running mean
	EU Directive	50 30	24-hour mean Annual mean
NO_2	***EU Directive***		
	Limit value	200	98-percentile of hourly means
	Guide Value	135	98-perentile of hourly means
		50	50^{th}-percentile of hourly means; approximately equivalent to the annual mean
	WHO Guideline	40 – 50	Annual mean
		200	Maximum of one-hour means
SO_2	***EU Directive*** Limit value	350 if smoke = or < 150 250 if smoke > 150	98-percentile of daily means; no more than three consecutive days
		180 if smoke = or < 60 130 if smoke > 60	Winter median of daily mean values
		120 if smoke = or < 40 80 if smoke > 40	Annual median of daily mean values
	Guide Value	40 – 60	Annual mean
	WHO Guideline	50	Annual mean
		350	Maximum one-hour mean
		500	Maximum 10-minute mean
CO	***WHO Guideline***	10,000	8-hour mean
		30,000	One-hour mean
	EPAQS	11,600	Running 8-hour mean

The input data for the Dispersion Model is presented in Tables 3.5.5 and 3.5.6. The emission rates chosen for input into the Dispersion Model were the maximum levels which will be attained in accordance with BATNEEC requirements. Although such emission rates will not be routinely attained as a result of the operation of the plant, it is considered prudent to model the worst possible emission scenario in order to determine the maximum potential impact of plant emissions on ground level concentrations of pollutants in the vicinity of the plant. Average emission rates of pollutants were also modelled to assess the expected typical impact of plant emissions on ambient air quality. As discussed previously, climatological data from the meteorological monitoring station at Baldonnel were used as input data for the study.

Evaluation of impact of cement kiln emissions

The maximum potential impact of the plant emissions on ambient air quality is associated with the maximum potential emission rate of pollutants from the plant. The main source of emissions from the plant is the cement kiln and the potential maximum impact of emissions from this source on ambient air quality has been assessed, with particular attention focused on demonstrating that the proposed stack height is adequate for the proposed development. The results of the assessment are presented in Appendix 3.5.2. A summary of the results of the modelling study is presented in Table 3.5.8 together with the Air Quality Standards which are utilised to assess the significance of the impact on ambient air quality. A review of the significance of the impact of these emissions on ambient air quality is presented in the following sections.

Particulate matter and PM_{10}

There are two effects of particulate and/or PM_{10} emissions on ambient air quality which are considered in this study. Emissions of particulates from the main emission sources will contribute to both airborne particulate concentrations and to dust deposition on surfaces. The emissions from the cement manufacturing process emission sources will be in the sub 10μm size range ie PM_{10}. Consequently, the assessment of the significance of airborne particulate concentrations will be based on using the assessment criteria for this parameter.

The modelling results for airborne particulate concentrations are presented in Appendix 3.5.2 for maximum and average emission rates from the cement kiln, respectively. Even using the more stringent assessment criteria for PM10, the predicted ground level concentrations are substantially lower than the EU Air Quality Standards. At the maximum possible emission rate from the cement kiln, the predicted maximum 24-hour average ground level concentration is less than 1.9% of the Limit Value and under the average emission conditions which are considered to be more representative of the emissions from the cement kiln, the predicted maximum 24-hour ground level concentration is substantially less than 1% of the Limit Value.

The deposition of dust as a result of emissions from the cement kiln has also been considered in this assessment and the results are presented in Appendix 3.5.2. The dust deposition is assessed as an average of the daily dust deposition rates over the assessment period. The predictions clearly indicate that the average daily dust deposition rates are significantly lower than the Guideline of 150 mg/m^2-day which is the assessment criterion used to ensure that no adverse nuisance impacts result from such depositions. There are no adverse impacts predicted as a result of particulate emissions from the cement kiln.

Sulphur dioxide

The maximum predicted increments to ground level concentrations of sulphur dioxide in the vicinity of the plant are presented in Tables 8 and 15 in Appendix 3.5.2. and a summary of all of the impact predictions is presented in Table 3.5.8 together with the assessment criteria used to evaluate the significance of the modelling results. Two sets of modelling data were acquired to assess the impact of emissions of SO_2 from the cement kiln; both maximum and average emission rates from the source were modelled. The maximum impact of the emissions will arise when the emission rates are at a maximum and these potential worse case scenarios are used as the basis for predicting the worst possible impact of the emissions on ambient air quality.

The predicted maximum 98-percentile of 24-hour average concentrations is substantially lower than the Air Quality Standard defined in the EU Directive, while the predicted increments to the annual mean and maximum 1-hour average ground level concentrations are also substantially lower than the relevant EU and WHO Guideline values. As is clear from an evaluation of the results of the assessment, the average emissions from the kiln are significantly lower than the potential maximum emissions and hence the impact on ambient air quality is even less than that predicted from a consideration of the maximum emission rates from the kiln.

The predicted impacts of emissions of SO_2 from the cement kiln are well within the relevant Air Quality Standards and do not result in an adverse impact on ambient air quality in the vicinity of the plant. The emissions will not result in breaches of the EU Air Quality Standards.

Nitrogen dioxide

The maximum predicted increments to ground level concentrations of nitrogen dioxide in the vicinity of the plant are presented in Appendix 3.5.2. and a summary of all of the impact predictions is presented in Table 3.5.8 together with the assessment criteria used to evaluate the significance of the modelling results. Two sets of modelling data were acquired to assess the impact of emissions of NO_2 from the cement kiln; both maximum and average emission rates from the source were modelled. The maximum impact of the emissions will arise when the emission rates are at a maximum and these potential worse case scenarios are used as the basis for predicting the worst possible impact of the emissions on ambient air quality.

The main assessment criterion is the 98^{th} percentile of one-hour average concentration of nitrogen dioxide. The predicted maximum 98-percentile of 1-hour average concentrations is less than 3.6% of the Air Quality Standard defined in the EU Directive at maximum emission rate from the kiln and about 2.5% of the Limit Value under average emission conditions.

The predicted impacts of emissions of NO_2 from the cement kiln are well within the relevant Air Quality Standards and do not result in an adverse impact on ambient air quality in the vicinity of the plant. The emissions will not result in breaches of the EU Air Quality Standards.

Carbon Monoxide

The maximum predicted increments to ground level concentrations of carbon monoxide in the vicinity of the plant are presented in Appendix 3.5.2. As before, a summary of all of the impact predictions is presented in Table 3.5.8 together with the assessment criteria used to evaluate the significance of the modelling results. Two sets of modelling data were acquired to assess the impact of emissions of CO from the cement kiln; both maximum and average emission rates from the source were modelled. The maximum impact of the emissions will arise when the emission rates are at a maximum and these potential worse case scenarios are used as the basis for predicting the worst possible impact of the emissions on ambient air quality.

There are no EU Air Quality Standards for CO. In the absence of such limits, the WHO Guidleines are used as the key assessment criterion. The predicted maximum of 1-hour and 8-hour average concentrations are substantially less than 1% of the Guideline values under both maximum and average emission conditions.

The predicted impacts of emissions of CO from the cement kiln are insignificant and do not result in an adverse impact on ambient air quality in the vicinity of the plant. The emissions will not result in breaches of the WHO Guidelines.

Location of highest predicted values

The dispersion modelling study identified receptors inside and outside the site boundary where the highest predicted ground level concentrations occur. It was noted during the review of the dispersion modelling outputs that elevated ground level concentrations of pollutants occur on site on the 28m screening mound north of the cement plant works area. This is not an area where personnel will be working and so there are no exposure issues to be considered. The highest predicted ground level concentrations of all pollutants and for all statistical averaging periods in this area are still well within the relevant Air Quality Standards. Dispersion model outputs for PM10 distribution also show areas of elevated concentration in the region surrounding the 5m berm at the southern site boundary.

Evaluation of impact of particulate emissions from the entire plant

In addition to the cement kiln, particulate emissions may be released from 22 other main process emission sources. Fugitive losses from sources related to the quarrying and cement manufacturing operations are insignificant relative to the main process emissions. The impact of particulate emissions from all sources at the plant has been assessed and the results are presented in Appendix 3.5.2 for both the maximum and average potential emission rate from all sources.

As was the case when considering the impact of particulate emissions from the cement kiln, the impact of particulate emissions from the entire cement manufacturing plant is considered in terms of both airborne particulate concentrations and daily dust deposition rate. Since the particulate emissions from the cement manufacturing process emission sources will be in the sub-10μm size range ie PM_{10}, the assessment of the significance of airborne particulate concentrations will be based on using the assessment criteria for this parameter.

The modelling results for airborne particulate concentrations are presented in Appendix 3.5.2 for maximum and average emission rates from the cement plant, respectively.

Even using the more stringent assessment criteria for PM_{10}, the predicted ground level concentrations are substantially lower than the EU Air Quality Standards. At the maximum possible emission rate from all of the process emission sources, the predicted maximum 24-hour average ground level concentration is substantially lower than the Limit Value. Under the average emission conditions which are considered to be more representative of the emissions from the plant, the predicted maximum 24-hour ground level concentration is approximately 50% of the level predicted under maximum emission conditions and significantly lower than the Limit Value.

The deposition of dust as a result of emissions from process emission sources at the cement manufacturing plant has also been considered in this assessment and the results are presented in Appendix 3.5.2. The dust deposition is assessed as an average of the daily dust deposition rates over the assessment period. It is clear from the results of the study that the dust deposition rates are substantially lower than the 150 mg/m^2-day assessment criterion. There will be no adverse impact on ambient air quality in the vicinity of the plant as a result of the proposed development.

Table 3.5.8 Predicted increments to ground level concentrations (GLCs) of pollutants emitted from the cement kiln at receptors outside the site boundary

Air Quality Standard		Maximum predicted increment to ground level concentration, $\mu g/m^3$	Parameter and averaging period
Source	$\mu g/m^3$		
			Particulates
EU Directive Limit value	150	0.056	Annual mean
			PM_{10}
EPAQS	50	0.44	99-percentile of 24-hour running mean
EU Directive	50	1	24-hour mean
	30	0.056	Annual mean
			NO_2
EU Directive			
Limit value	200	7	98-percentile of hourly means
Guide Value	135	7	98-perentile of hourly means
	50	0	50^{th}-percentile of hourly means
WHO Guideline	40 – 50	-	Annual mean
	200	77	Maximum of one-hour means
			SO_2
EU Directive Limit value	350 if smoke = or < 150 250 if smoke > 150	3	98-percentile of daily means; no more than three consecutive days
	180 if smoke = or < 60 130 if smoke > 60	-	Winter median of daily mean values
	120 if smoke = or < 40 80 if smoke > 40	-	Annual median of daily mean values
Guide Value	40 – 60	0.35	Annual mean
WHO Guideline	50	0.56	Annual mean
	350	48	Maximum one-hour mean
	500	-	Maximum 10-minute mean
			CO
WHO Guideline	10,000	53	8-hour mean
	30,000	145	One-hour mean
Guideline	150 mg/m^2-day	1	**Particulate deposition rate**

The results of the Dispersion Modelling study shows the predicted ground level concentrations of sulphur dioxide, nitrogen dioxide, carbon monoxide and particulates, and the predicted daily dust deposition rate which will result from the plant emissions. The air quality impact predictions are summarised in Table 3.5.8 and isopleth or contour plots which graphically present the results are presented in Appendix 3.5.2., together with a more comprehensive discussion of the modelling predictions.

A detailed comparison of the predicted ground level concentrations of pollutants with the relevant Air Quality Standards and Guidelines shows that none of the Limits or Guide Values are approached or exceeded as a result of the proposed development. It is significant that even with the maximum potential emission rate from the cement kiln, estimated in Tables 3.5.5 and 3.5.6 and not expected to occur routinely or for extended periods, the resulting ground level concentrations of pollutants will not adversely affect ambient air quality or agriculture. The more representative average emission rates from the kiln result in even lower ground level concentrations of pollutants and exert even less of an influence on ambient air quality in the vicinity of the plant.

The impact of dust deposition as a result of the operation of the cement manufacturing plant has also been assessed using the dispersion modelling methodology outlined in Appendix 3.5.2. Once again, there is no adverse impact predicted as a result of the emissions from the plant. The maximum potential emission rate from each emission source was modelled to assess the potential significance of such emissions in respect of dust deposition in the vicinity of the site.

3.5.4.3 Traffic

The predicted impact of traffic movements on ambient air quality in the vicinity of the proposed development is insignificant due to the relatively small numbers of vehicle movements which are predicted to occur as a result of the operation of the cement manufacturing plant. Construction impacts are also insignificant since traffic movement predictions are again extremely low.

The maximum impacts on ambient air quality associated with traffic movements will be experienced within about 10m of the roadside where the vehicles are passing; the impacts at distances further removed from the roadside are insignificant since the pollutants will be rapidly and effectively dispersed as the distance from the roadside increases.

There are no adverse impacts on ambient air quality predicted as a result of traffic movements during construction and operation of the cement manufacturing plant and quarry at this site.

3.5.5 Mitigation measures

3.5.5.1 *Construction*

A comprehensive environmental management plan is being developed for the Construction phase of this development. Although full details of the construction programme are not yet available, the formulation of an Environmental Management Plan for the development is at an advanced stage. A central feature of the plan is the

identification at an early stage of all significant sources of particulate emissions and control of emissions from these sources by the use of appropriate control technologies and management practices.

The recovery of gravels on site which are required for construction will be from underwater in the northern area of the site, and this will minimise the potential for dust emissions associated with this activity. In wet weather, the wet ground will prevent dust emissions from construction activities. In dry weather, particulate emissions generated as a result of removal of the overburden, construction of screening berms and general construction activity will be controlled by mobile water sprays along the internal haul roads and adjacent to potentially significant emission sources such as loading areas. Stockpiles of raw materials will also be sprayed during dry weather to control dust emissions from these sources. A wheel wash will be located at the entrance to and exit from the shale quarry and a full vehicle spray and wheel wash will be located near the cement works entrance which also cater for limestone quarry traffic. Loose material loads entering or leaving the site will be covered during transit.

The screening and stand-off arrangements which are incorporated in to the design of the plant for controlling off-site noise (Section 3.6) and optimisation of the visual impact of the development will also be effective in eliminating off-site nuisance potential associated with dust emissions during the construction phase of this development.

3.5.5.2 *Quarrying*

Dust emissions from the quarrying operations will be minimised by implementing effective environmental management practices for the operation of the quarry. The main quarrying activities are associated with recovery of raw materials for use during construction and operation of the cement manufacturing plant. In the limestone quarry, ground preparation will be achieved using blasting techniques. Effective design and management of blasts will be employed to prevent the generation of fly-rock and significant particulate emissions in accordance with best management practice.

Fixed and mobile water sprays will be used to control dust emissions from internal haul roads, material stockpiles and storage and plant yard surfaces. Loose loads of materials entering the site will all be covered, and a dedicated wheel wash will be located at the entrance to the shale quarry. A full vehicle wash spray and wheel wash will be sited near the cement works entrance and will also cater for limestone quarry traffic. The mineral handling and crushing activities will take place to the west of the limestone quarry where all crushing, screening and conveying of materials will be covered in appropriate housing. The coarse raw material stockpiles will not be covered, but the –40mm crushed material is stored under cover and the shale stockpiles will be sheeted. Fixed and mobile water sprays will be used to dampen surface materials in dry weather and eliminate the potential for dust generation from these areas. The stockpiles of the finer crushed raw materials will be enclosed thus minimising the potential for emissions from these sources. A comprehensive Environmental Management Plan for the development is being formulated which will document all mitigation measures to be employed at the site of the development.

The screening and stand-off arrangements which are incorporated in to the design of the plant for controlling off-site noise (Section 3.6) and optimisation of the visual impact of the development will also be effective in eliminating off-site nuisance potential associated with dust emissions arising from the operation of the quarries.

The design and layout of the shale and limestone quarries have been specifically chosen to maximise the distance of the quarries from residential properties. The nearest occupied residences to the site of the limestone quarry are Lansdown Gate Lodge, which is owned by the Developer, the residence at Killaskillen crossroads, and Killaskillen House; these residences are located 100m, 110m and 175m from the nearest edge of the quarry. Other occupied residences are located more than 400m from the nearest boundary of the limestone quarry. The shale quarry is more than 150m from residential properties to the west of the site, more than 200m from properties to the south and in excess of 350m from the nearest residences in other directions. These distances, combined with the screening measures described in Section 3.6, will effectively eliminate the potential for significantly elevated dust deposition rates at sensitive receptors in the vicinity of the quarry.

The main potential impact on ambient air quality as a result of the operation of the quarry is the incremental contribution to dust deposition at sensitive receptors in the immediate vicinity of the site. A programme of Directional Dust Monitoring has been formulated for the site and, during the construction and operation of the facility, this programme will be implemented at strategic locations on the site boundaries to verify the effectiveness of the Environmental Management Plan for the facility

3.5.5.3 *Cement Manufacturing Plant*

The main characteristics of the emission streams released as a result of operation of the cement manufacturing plant have been discussed in Section 3.5.3.3.2 of this report. The raw materials to be used at the plant are low in concentrations of environmentally significant trace metals and sulphur thus greatly contributing to minimisation of emissions of these substances from the plant. Careful selection of low-sulphur fuels in the design and specification of the plant further contribute to minimising the emissions of sulphur dioxide and nitrogen dioxide from the facility. Furthermore, the plant is designed to allow for the use of natural gas fuel should it become possible to use this fuel at some date in the future.

A comprehensive Environmental Management Plan for the site has been formulated which will minimise the potential for emissions being released as a result of the site activities. Fugitive emissions from plant, yard and storage area surfaces will be minimised by the use of wet suppression techniques as discussed previously.

All of the main process emission sources involving material storage, handling and transfer operations are enclosed except for the coarse raw materials as discussed previously. Clinker and dusty material storage areas are enclosed and emissions will be vented to appropriate abatement plant, primarily bag filters. Local extraction systems will be employed adjacent to significant sources such as those related to bulk material handling, loading and filling operations and the emissions will also be vented to abatement plant.

Particulate emissions from all main process emission sources will be controlled by use of Bag Filters and Electrostatic Precipitators. Bag filters are the abatement method chosen for all sources other than the cement mill and the cement kiln where electrostatic precipitators are to be used. The emissions from the cement mill will be treated in a cyclone before passing in to the electrostatic precipitator. Although both abatement options offer similar abatement efficiencies, the bag filters are the preferred treatment option in areas where dust emissions can easily be collected and re-introduced into the production cycle to minimise the amount of waste generated for disposal. Electrostatic Precipitators offer advantages in respect of running costs and are chosen for treating emissions from the cement kiln and from the cement mill. Modern technology results in extremely low emission concentrations, typically less than 10 – 20 mg/Nm^3, which is substantially lower than the BATNEEC ELVs of 50 and 100 mg/Nm^3, respectively, for emissions from the cement mill and cement kiln.

The principal disadvantage of the use of the electrostatic precipitator as an abatement plant on the cement kiln is that the ESP is prone to occasional shut-downs when the carbon monoxide concentration reaches certain peak threshold values. For the purpose of this development, the plant will be automatically shut down if CO concentrations exceed a warning threshold level and production will not re-commence until the ESP is fully operational. Newly developed rapid-response CO sensors will be used to minimise the potential for CO concentrations to rise to levels which would cause the ESP to shut down.

Emissions to atmosphere from the main process emission source, the cement kiln, will be continuously monitored. In particular, direct-reading sensors for CO, NO, NO_2, SO_2 and particulates (measured as opacity) will be installed in the main stack. Continuous emission monitoring will be completed in order to demonstrate compliance with regulatory requirements and to ensure that no inadvertent releases of pollutants are permitted. The carbon monoxide monitoring will act as an early-warning system so that production characteristics may be altered to minimise the potential for temporary shut-down of the ESP due to elevated carbon monoxide concentrations. Continuous Emission Monitors (CEM's) will also be installed on the cement mill stack. Each of the Bag Filter abatement systems will be fitted with pressure-drop sensors and alarms to ensure early recognition of and response to filter failure. The Directional Dust Deposition Monitoring Programme discussed in Section 3.5.5.2 will also allow an assessment of the ongoing impact of particulate emissions from the entire plant.

The location of the plant with respect to sensitive receptors has been optimised from a consideration of off-site noise and visual impacts, and screening measures have been specified in the Design Layout for the same reason. The considerable distance between the main plant emission sources and the nearest occupied residences will also facilitate effective dispersion of pollutants before emission streams reach sensitive receptor locations. This buffer distance, and the screening measures planned at the site, are more significant for the minor process emission sources and the fugitive dust emissions from the site at large than for the main cement kiln emissions. The dominant factor influencing the potential ground level impact of emissions from the cement kiln is the stack height and this has been chosen to ensure effective dispersion of pollutants and minimisation of ground-level concentrations of pollutants resulting from emissions from this source.

3.5.5.4 *Traffic*

The recovery of raw materials from the quarries on the site of the proposed development serves to minimise the requirement for import of raw materials by road onto the site. Although the plant will be operating on a 24-hour cycle, it is not planned to have significant HGV movements between 10:00pm and 07:00am.

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THE ENVIRONMENT IMPACTS AND MITIGATION

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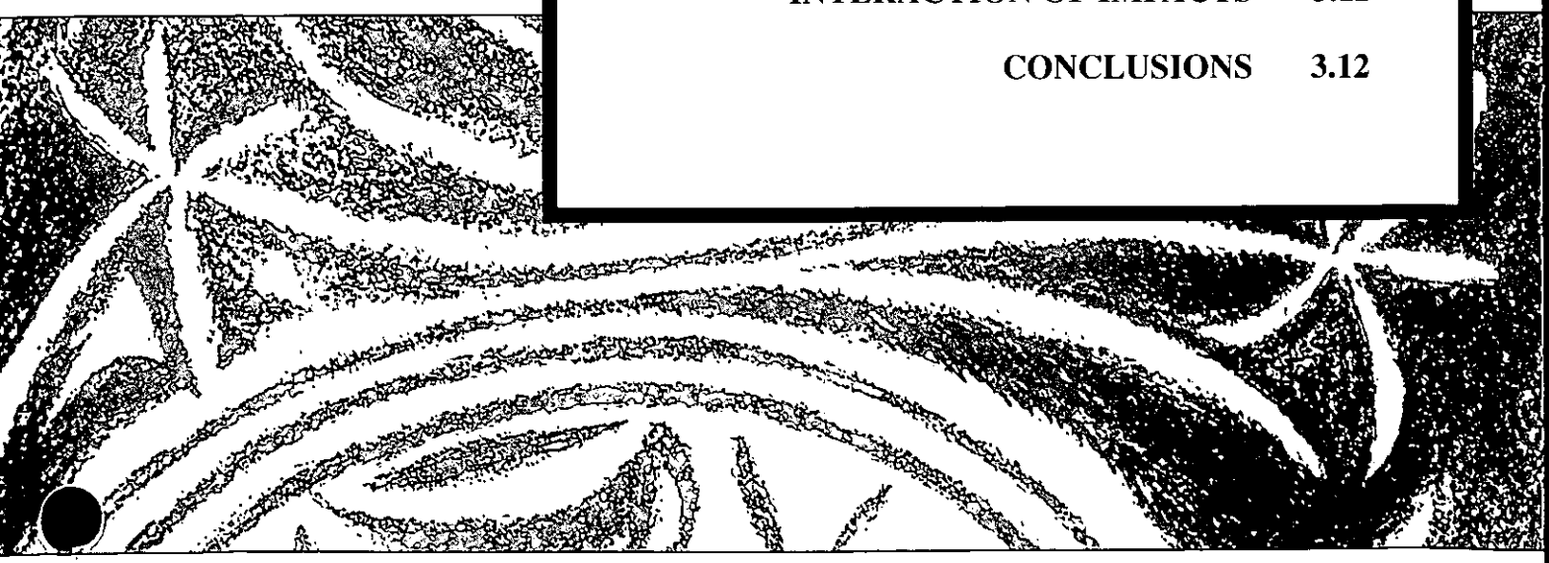

SECTION 3.6

NOISE AND VIBRATION

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3.6 NOISE AND VIBRATION

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APPENDIX I **Environmental noise survey at the site of the proposed development**

Introduction

TMS Environment Ltd have been commissioned to assess the impacts of a proposed industrial development on the environment with respect to noise and vibration. The location of the site of the proposed development has been described previously, so only those issues pertinent to the noise and vibration impacts are discussed here.

The site is located in a predominantly rural location, with the village of Ballinabrackey located approximately 1.5 km south of the nearest site boundary and Kinnegad lying approximately 3km to the north east of the nearest site boundary. The location of the site is well removed from substantial industrial developments. The main Dublin – Galway road, the N6, passes the site approximately 0.5km north of the site boundary; an inner bypass of Kinnegad is scheduled for completion by mid 1999. There are plans to extend the M4 Motorway to Kinnegad in the medium term (10 years), and an outer bypass of the town will be completed on the same timescale; the new route passes closer to the nearest site boundary than the existing roadway. A substantial residential development is located at Kinnegad. Approximately 120 residences are located in scattered developments within a radius of 2km of the site boundaries.

The nearest noise sensitive receptors are located at distances of 100m and 175m from the nearest edge of the limestone quarry. Other occupied residences are located more than 400m from the nearest boundary of the limestone quarry. The shale quarry is more than 150m from residential properties to the west of the site, more than 200m from properties to the south and in excess of 350m from the nearest residences in other directions. The distance from the nearest residence to any of the cement manufacturing plant buildings is more than 450m.

3.6.1 The Existing Environment

3.6.1.1 Noise

The site of the proposed development is predominantly rural and the existing noise environment is dominated by traffic noise associated with the roads around the area, agricultural noise sources and some contributions in some areas from traffic on the main Dublin-Galway road on the Galway side of Kinnegad. The existing noise environment was characterised by a series of measurements completed at the boundaries of the site of the development and at a number of noise sensitive locations in the vicinity of the plant. The measurements were completed in accordance with the requirements of ISO1996: Acoustics – description and measurement of environmental noise.

Measurements were completed at 15 community locations in the vicinity of the site. A description of the location of each monitoring point is presented in Table 3.6.1, and additional details are provided in Appendix I. The nearest residences to the quarry boundaries are located at distances of 100m from the limestone quarry boundary and 150m from the shale quarry boundary. The nearest residences to the plant buildings are located at least 450m away from the nearest plant building. The detailed measurement methodologies and survey results are presented in Appendix I, while the principal findings are summarised in Tables 3.6.2 and 3.6.3.

It was established during the course of completing the baseline ambient noise survey that the dominant contributors to noise in the area are traffic movements with some contributions from agricultural sources in some areas.

3.6.1.2 Vibration

There are no vibration sources located in the vicinity of the site at present, so no baseline evaluation of vibration levels was undertaken. However, the geology of the area was reviewed with respect to the potential impacts of vibration from blasting activity at the limestone quarry. In particular, the influence of the geology of the area on potential vibration impacts at sensitive receptors was reviewed.

A detailed investigation of the geology and geochemistry of the limestone and shale deposits at the site of the proposed development was completed by Geoffrey Walton Practice (Section 3.3 of this Environmental Impact Statement). They have also completed a review of the geology in the area with a view to assessing the potential impact of vibrations associated with blasting operations at the quarry on sensitive receptors in the vicinity of the plant. No faults were detected which would affect vibrations associated with blasting in the reef limestone area; a fault in the calp limestone would not affect vibration at the nearest residences. Possible solution features were detected on the site, but these do not extend laterally under adjacent residential properties and hence potential adverse impacts associated with such features do not arise.

Table 3.6.1 Monitoring locations for noise survey in the vicinity of the site of the proposed Development

Monitoring location	Description	Distance from nearest quarry boundary, m	Distance from nearest plant building, m
N1	ON SITE ADJACENT TO LANSDOWN LODGE	NA	NA
N2	SITE BOUNDARY ADJACENT TO ROADSIDE BESIDE KILLASKILLEN HOUSE	30	500
N3	SITE BOUNDARY AT KILLASKILLEN CROSSROADS	100	500
N4	SITE INTERNAL BOUNDARY BETWEEN SHALE QUARRY AND REMAINDER OF LAND HOLDING	700	800
N5	WESTERN SITE BOUNDARY ADJACENT TO RESIDENCES	1100	900
N6	WESTERN SITE BOUNDARY ADJACENT TO RESIDENCES	700	900
N7	NORTHERN SITE BOUNDARY BESIDE KINNEGAD RIVER	500	1750
N8	WESTERN SITE BOUNDARY ADJACENT TO RESIDENCES	200	1000
N9	AT SIDE OF COUNTY ROAD LEADING IN TO BORD NA MONA BOGLANDS, NEAR CLUSTER OF RESIDENCES	1900	3000
N10	AT THE JUNCTION OF THE DUBLIN ROAD AND THE ROAD LEADING UP TO THE SITE	2700	3500
N11	BALLINABRACKEY VILLAGE	1600	1750
N12	BALLINABRACKEY VILLAGE	1500	1350
N13	SOUTHERN SITE BOUNDARY	200	200
N14	BALTINORAN BRIDGE	2000	2500
N15	BESIDE A CLUSTER OF RESIDENCES SOUTH EAST OF SITE	900	1200

Table 3.6.2 Daytime noise levels in the vicinity of the site of the proposed development

Monitoring location	Existing noise climate		
	Average $L_{Aeq,1hr}$ dB(A)	Average $L_{A90,1hr}$ dB(A)	Average $L_{A10,1hr}$ dB(A)
N1	48.0	41.7	48.4
N2	47.2	39.3	49.0
N3	49.8	45.0	49.3
N4	47.9	35.0	46.8
N5	46.8	39.8	50.0
N6	42.6	35.7	44.5
N7	45.6	38.3	48.2
N8	45.8	39.3	46.4
N9	49.2	38.7	47.7
N10	56.5	41.3	59.3
N11	50.6	33.2	51.5
N12	49.4	42.9	52.2
N13	48.0	42.3	50.6
N14	54.5	39.8	47.9
N15	44.5	37.9	47.0

Table 3.6.3 Night-time noise levels in the vicinity of the site of the proposed development

Monitoring location	Existing noise climate		
	Average $L_{Aeq,15min}$, dB(A)	Average $L_{A90,15min}$, dB(A)	Average $L_{A10,15min}$, dB(A)
N1	38.5	27.4	34.0
N2	49.4	27.3	42.5
N3	49.7	28.2	49.3
N4	40.9	27.3	33.9
N5	41.3	30.4	36.2
N6	34.9	29.7	35.7
N7	38.3	32.2	39.4
N8	37.8	34.1	39.7
N9	38.8	31.7	41.3
N10	51.3	30.0	53.5
N11	38.7	29.3	41.8
N12	38.4	32.4	40.7
N13	36.6	32.3	37.9
N14	42.7	27.6	36.1
N15	31.9	27.4	32.4

3.6.2 Impact of the development

3.6.2.1 Construction

Noise

The construction of the proposed development will involve two main stages – initial site preparation for the limestone and shale quarries and construction of the cement manufacturing plant itself. The construction phase is expected to last for 2 years and construction activities will generally be restricted to day-light hours. Some works will require 24-hour operation.

The noise associated with development of the two quarries will be associated with the initial quarry development workings, including overburden removal and construction of the screening banks around the quarry workings, and works transport. Most of the overburden in the two quarries will be removed in the early stages of working and will be used to construct screening banks in the initial stages of development. Additional overburden removed during the life of the quarries will be added to the inside of the screening banks. The overburden will be removed by small articulated dump trucks loaded by hydraulic excavators or scrapers. The Sound Power Levels of the plant which will be used in the development of the quarries has been assessed and the maximum predicted plant Sound Power Levels (L_{WA}) associated with these workings is summarised as follows:

Table 3.6.4 Predicted noise levels associated with quarry development

Plant	**Predicted L_{WA}**
Tractor scraper (to be used in bund forming)	113
Dozer	112
Small articulated dump truck (to be used in bund forming)	105
Rigid body dump truck (limestone quarry)	119
Large articulated dump truck (shale quarry)	111
Hydraulic excavator	110

Construction noise impacts are assessed in terms of the requirements of BS 5228:1997 – Noise and vibration control on construction and open sites. This Standard does not specify noise limits associated with construction activities but does recognise that since the activities are temporary, noise limits higher than those associated with permanent installations are generally acceptable in the community. International practice dictates that noise limits in the range $L_{Aeq,1hr}$ = 65 to 75 dB(A) are generally acceptable in the community during daytime construction activities.

The site preparation activities are expected to be of relatively short duration and the bulk of the construction noise impacts will be associated with the construction of the cement manufacturing plant. Assuming a target community noise exposure level of 65 to 75 dB(A) as outlined above, the permissible Sound Pressure Level associated with site construction activities is calculated as follows. The nearest noise sensitive receptor to the plant buildings where the noisiest construction activities will occur is 450m away. Assuming a minimal ground-air attenuation of 3dB, the Sound Power Level allowed at the construction site to meet the requirement of a community noise exposure in the range $L_{Aeq,1hr}$ = 65 to 75 dB(A) is calculated as:

L_{WA} = (65 to 75) + 3 +(20log450 + 8) = 129.1 to 139.1 dB(A)

It is possible that if piling activities are used during construction that L_{Aeq} Levels at 1m up to 133 dB(A) may be experienced as a result of the various activities. Even these intermittent operations will result in noise levels which fall within the permissible level for the site. Furthermore, such activities would be severely limited in duration and frequency of occurrence.

The maximum noise levels associated with individual construction activities at the plant will not generally exceed Sound. Power Levels of 120 dB(A), resulting in a predicted community exposure level at the nearest noise sensitive receptor of 56dB(A). Since the screening bunds around the two quarries and in the vicinity of the plant buildings will be constructed at an early stage in the construction programme, a barrier attenuation of 15 dB(A) is also predicted. Furthermore, the depth to which the foundations will be sunk below ground (up to 6m for the plant foundations) will result in further shielding of the nearest communities from noise associated with the construction activities. Finally, the construction activities, and particularly the noisiest activities are not continuous, hence the $L_{Aeq.1hr}$ which will be experienced at noise sensitive receptors is even lower than this value. Consequently, it is clear that the noise levels experienced at the nearest community locations as a result of the construction activities will not result in adverse nuisance impacts.

Vibration

Several of the construction methods which may be employed during the construction of the plant can result in vibration impacts. These include all types of rock breaking activity and driven piling. The maximum vibration impact associated with the most significant of these impacts is levels of up to 2mm/sec peak particle velocity at 20m from a driven pile. The nearest noise sensitive receptor to the plant buildings is 450m away and, since vibration impacts will be attenuated with distance from the source, the vibrations which will be perceived at the community locations in the vicinity of the site will not result in adverse nuisance impacts.

3.6.2.2 Quarrying

Noise

The general layout and description of operation of the shale and limestone quarries is presented in Section 3.3 of this Environmental Impact Statement. The limestone quarry is located on the main land holding in the southern part of the site, while the shale

quarry is located to the north of the site in the direction of the Kinnegad river. The limestone quarry will be excavated to a depth of 75m in limestone and details of the proposed development of the quarry were presented in Section 3.3. Initial workings will take place in the south-eastern half of the quarry area and will develop to the north-west in a series of benches to the ultimate depth of 10m AOD. The 12m-wide haul road will be located on the south-eastern and then north-eastern edges of the quarry workings. The shale quarry will be worked to a bedrock depth (excluding overburden) of 45m. The main access road for this quarry will enter the site at the north-east along the northern edge of the quarry, turning south-west to a level ca 20m below rockhead and then switching back to the northern edge of the workings.

Working of the limestone and shale quarries will be restricted to 08:00 to 18:00 hours weekdays and 08:00 to 13:00 hours on Saturday. Some quarry pumping will take place at night-time and some maintenance work will be carried out at weekends but no main works are planned outside these times. The limestone quarry will operate for ca 50 weeks each year but sufficient materials from the shale quarry will be recovered during 2 – 3 months of operation during the summer months to ensure that year round operation is not required.

Noise from the quarry workings will be associated with the excavation, recovery, transport and crushing of raw materials. The limestone quarry will be worked using conventional hard-rock quarry equipment including hydraulic loading shovels and 50 to 70 ton dump trucks. There will be a requirement for ground preparation in the limestone quarry by blasting which will occur at a frequency of approximately once every two weeks; some drilling is also required. Smaller earth-moving equipment will be required in the shale quarry than that to be used in the limestone quarry. 30 ton all-wheel drive dump trucks will be used in the shale quarry in conjunction with a hydraulic backhoe excavator. Although there will be no need for regular blasting in the shale quarry, some Reef Limestone is present and a blast one to two times per year may be required. Some ripping of Shaley Limestone may be required at depth. The potential impacts of blasting are considered separately in the following section on vibration impacts.

The recovered limestone will be delivered to the as-dug stockpile using the 50 to 70t dump trucks; a front-end loader will transport the as-dug limestone from the stock piles to the primary and secondary limestone crushers located in the limestone quarry area. No crushing activity is planned on the site of the shale quarry as the recovered raw materials will be transported from there to the material stock piles west of the limestone quarry near the main plant and near to the crushers. A dedicated shale crusher will be used for crushing this raw material.

The noise associated with the crushing operations will occur for approximately 8 hours each day during day-light hours only, and will emanate primarily from the crushing operation and from the dedusting fan associated with the operation; predicted noise levels will not exceed an L_{Aeq} at 1m of 100dB(A). Using conventional methodology, the potential impact of the crushing activity on the noise climate at the nearest noise sensitive receptor to the point where the crushers will be located is calculated as follows. The crushers will be located to the west of the limestone quarry at a distance in excess of 500m from the nearest noise sensitive receptors. The crushers will be fully enclosed with a front opening for loading; the two crushers will not be operated

simultaneously so the potential noise impact is assessed for operation of a single crusher at a time. The predicted distance-adjusted noise level attributable to the crusher operation at 500m is calculated as 46.0dB(A). An attenuation of at least 15dB(A) will result from enclosure of the crushing equipment and air and ground absorption will contribute a further reduction of 11dB(A). Acoustic screening bunds are provided between the nearest noise sensitive receptors and the quarry and plant operations resulting in a barrier attenuation of at least 15 dB(A). Thus the predicted noise level at the nearest noise sensitive receptor associated with the crusher operation is 5 dB(A). Since the quarry and the crushers will not be operating at night, the impact of this activity on the noise climate at nearby residences is restricted to that experienced during normal daytime hours.

The predicted Sound Power Levels associated with the quarry working plant have been considered in Table 3.6.4. Once again, the potential impacts relate to day-time operation only. Although the quarry pumping will continue overnight, the impact of this operation on the noise climate at the nearest residences is expected to be insignificant. Noise levels associated with the excavation of raw materials could reach a maximum Sound Power Level of 113 dB(A); when the attenuation due to distance, air and ground vibration and the screening bunds is taken into account, the predicted noise levels at the nearest noise sensitive receptor located 100m from the nearest quarry boundary is 32 dB(A). Once again, this activity will only occur during the daytime hence the night time noise climate at noise sensitive receptors is unaffected by the quarrying activities.

Vibration

The most significant potential impact associated with the quarrying operations is the potential noise and vibration impacts associated with blasting for the purpose of recovery of raw materials in the limestone quarry. As mentioned previously, blasting will not generally be required for ground preparation in the shale quarry although one – two blasts per year may be required here to remove Reef Limestone. The blasts in the limestone quarry are expected to occur at a rate of once every 1 to 2 weeks. The blasting process results in ground vibrations and air overpressure impacts. Ground vibration at sensitive receptors is measured as peak particle velocity (PPV) in mm/sec while the air overpressure is measured in dB(Lin).

The level of ground vibration associated with a blast is dependent on the quantity of explosive detonated at any instant in time. Normal practice in the design of blasting sequences is to arrange the charges so that they are detonated in sequence with millisecond delays between the individual explosions, and the complete blast lasting 1 – 2 seconds. The ground vibration produced as a result of the blast is proportional to the **Maximum Instantaneous Charge (MIC)** which explodes within the sequence and also to the distance from the blast location to the measurement point. The relationship between the vibration levels and the distance from the blast site is empirically stated as follows:

$$PPV = a*(SD)^b$$

where a and b are site constants determined from experimental or trial blasts on the site and SD or **scaled distance** is the distance from the measurement point to the blast

location point divided by the square root of the MIC weight employed in the blast. Since soil and ground conditions vary considerably from site to site and exert a considerable effect on vibration, it is necessary to conduct trial blasts at a site in order to establish the optimum blasting conditions to ensure that pre-determined vibration levels are not exceeded at sensitive receptors in the vicinity of the blast site. By careful design of the blasts following trial blasts to establish the local site characteristics, it is possible to ensure that the vibration associated with the blast will not exceed the limits imposed at nearby sensitive receptors. This is further discussed in Section 2 of this EIS.

The acceptable vibration and air overpressure limits at sensitive receptors in Ireland is 12mm/sec (PPV) and 125 dB(Lin) (AOP) as defined in the Environmental Protection Agency BATNEEC Guidance Note for Noise in respect of Scheduled Activities. The proposed development will involve blasting at a frequency of approximately once every two weeks. In order to recover a two week supply of materials, 40 blast holes utilising charges of 60 – 100kg MIC will be required. On this scale, the limits of 12mm/sec for PPV and 125 dB(Lin) for air overpressure can readily be achieved, and no adverse impacts associated with blasting at the quarry are predicted. Potential impacts on agriculture are discussed in Section 3.9 of this EIS.

3.6.2.3 Cement manufacturing plant

Introduction

The likelihood of complaints arising from nearby residences associated with the operation of the cement manufacturing plant is assessed using the methodology adopted in BS4142: 1990 – Method for Rating Industrial Noise affecting mixed residential and industrial areas. This methodology requires that the background noise level at the site is established before the development proceeds. The contribution of tonal or impulsive characteristics of the noise is assessed in the rating of the noise levels as defined in BS4142, and this then allows the permissible noise level associated with development to be calculated. The British Standard states that complaints are likely if the difference between the background noise level before the development proceeded and the noise level which will be experienced after the development proceeds is greater than 10dB(A). Since background noise levels vary over a 24-hour period, permissible noise levels associated with day-time (07:00 – 22:00) and night-time (22:00 – 07:00) operation of the plant are determined.
Not withstanding the adoption of the BS4142 methodology for assessing the likelihood of complaints arising from the development, the noise limits which apply to industrial developments licenced under the Environmental Protection Agency Integrated Pollution Control Licensing system are defined in the EPA BATNEEC Guidance Note for noise as $L_{Aeq,1hr}$ = 55 dB(A) and $L_{Aeq,15min}$ = 45 dB(A) for daytime and night time operation, respectively. This criterion is also considered in assessing the impact of the proposed development on the noise climate in the vicinity of the plant.

The operation of the cement manufacturing plant is a 24-hour process with most of the main items of plant and machinery operating continuously. The main noise sources at the plant are also expected to have a tonal or impulsive character. Although these distinctive characteristics are expected to be undetectable at the nearest noise sensitive receptors due to the mitigation measures which are planned, as a conservative approach to rating the noise associated with the activity, a +5dB(A) noise penalty has been

applied due to the character of the noise associated with the operation of the plant. The BS 4142 criterion for ensuring that there is only a marginal possibility of complaint as a result of the operation of the plant states that the rating level must not exceed the background level by more than 5dB(A). Therefore the noise levels attributable to the operation of the cement manufacturing plant must not exceed the existing background noise levels at the various community locations.

The background noise levels at a number of strategic locations either on the site boundary or at noise sensitive receptors in community locations were measured and reported in Tables 3.6.2 and 3.6.3. The lowest background noise levels were measured at night time which is entirely consistent with expectations. Using the lowest measured hourly background noise level at each of the measurement locations, it is possible to calculate the maximum allowable plant L_{Aeq} level, or the specific noise level, at each location in order to ensure compliance with the requirements of BS4142. This information together with details of the measurement locations, is summarised in Table 3.6.5.

It is apparent from an evaluation of the assessment criteria, the relative proximity of the nearest noise sensitive receptors to the plant buildings and the existing background noise levels that the most difficult target to achieve will be that associated with the factory specific noise level allowable at N5 west of the site boundary. This receptor is located at a similar distance (approximately 450m) from the plant buildings as the next nearest residences west of the site boundary near N5 (500m), at Lansdown Lodge (500m), at Killaskillen Cross Roads (500m) and at Killaskillen House (650m). Consequently, it is proposed to use a distance of 450m as the distance from the plant buildings to the nearest noise sensitive receptors and the relevant assessment criteria as the basis for defining requirements in respect of noise control at the cement manufacturing plant.

Noise

The general site layout and a process description of the operation of the cement manufacturing plant have been presented in Section 2 of this EIS. The principal noise sources associated with the operation of the cement manufacturing plant are the material transfer operations, the cement kiln, the cement and coal mills, and various fans, blowers, compressors and other miscellaneous sources. A summary of the main noise sources and the expected noise levels associated with the main plant items is presented in Table 3.6.6 together with details of the expected operating times for each major noise source. The noise level data is presented in the form of predicted unattenuated noise levels at 1m from the noise source, and the predicted levels at 10m from the outside of the buildings.

The cement mill is clearly the dominant noise source associated with the operation of the cement manufacturing plant and, since this will operate only at night, the more stringent BS4142 noise assessment criteria must be complied with. This assessment criterion is more stringent than the BATNEEC approach and as discussed in the previous section, is considered more suitable because of the exceptionally quiet night time noise climate in the rural environment in which the proposed development is to be located. For daytime operation, the most appropriate assessment criterion is the BATNEEC limit of 55 dB(A).

Considering the data presented in Table 3.6.6 and applying standard acoustic assessment formulae, the maximum permitted noise outside the plant buildings which will allow achievement of a factory specific noise contribution of 27dB(A) at the nearest noise sensitive receptor 450m from the plant buildings can be calculated. The permissible total noise outside the plant buildings is determined to be 106dB(A) after allowing for 15dB reduction due to the screening bunds which will lie between all of the nearest residences and the cement manufacturing plant buildings. No allowance is made in this calculation for the screening of one building by any other, for ground or air attenuation or for ground screening, so this estimate clearly allows a significant safety margin in the assessment of potential off-site impacts. Many of the buildings will not even be visible from the community receptors in the vicinity of the plant resulting in further reductions in the factory specific contributions to noise levels at community locations. The plant buildings are designed to ensure that this level is achieved and that no adverse impacts on the surrounding community occur.

In view of the proposed attenuation and mitigation measures planned for the site, discussed separately in Section 3.6.4, no adverse nuisance impact is predicted at the nearest noise sensitive receptor as a result of the operation of the cement manufacturing plant. Even at night-time when existing background noise levels are at their lowest and using the most stringent BS4142 assessment criteria, no adverse impacts on local communities are predicted as a result of the proposed development. Using the less stringent day time BATNEEC assessment criteria, there is an even greater difference between the predicted factory specific contributions to noise levels at community locations and the 45dB(A) assessment criterion further supporting the conclusion that there will be no adverse noise impacts on surrounding communities as a result of the proposed development.

Vibration

The cement manufacturing process will require the use of large plant and machinery including the raw mill and cement mill which may have vibration impacts associated with their use. As mentioned previously, local site characteristics will be important in determining potential attenuation of vibrations with distance from the source. The maximum potential vibration levels predicted to arise at the nearest sensitive receptors which are located at least 450m away from the nearest plant buildings are less than the levels which would cause adverse comment from the community. The predicted vibration level at 100m from the mill is not expected to exceed 0.2 mm/sec and, since this value will be further attenuated by the distance to the nearest receptors, no adverse impact is expected as a result of vibration from plant and machinery associated with the operation of the cement manufacturing plant. The mitigation measures provided for in the design of the plant will ensure that no adverse impact from vibration associated with the development and operation of the cement manufacturing plant will occur at the nearest noise sensitive receptors.

Table 3.6.5 Noise assessment criteria in the vicinity of the development site

Monitoring location description	Permissible factory specific noise level, L_{Aeq} dB(A)	BATNEEC, dB(A)
N1: N SITE ADJACENT TO LANSDOWN LODGE; CLOSE TO NEAREST NOISE SENSITIVE RECEPTOR	27	55, day 45, night
N2: SITE BOUNDARY ADJACENT TO ROADSIDE BESIDE KILLASKILLEN HOUSE	27	55, day 45, night
N3: SITE BOUNDARY AT KILLASKILLEN CROSSROADS	28	55, day 45, night
N4: SITE INTERNAL BOUNDARY BETWEEN SHALE QUARRY AND REMAINDER OF LAND HOLDING	27	55, day 45, night
N5: WESTERN SITE BOUNDARY ADJACENT TO RESIDENCES	30	55, day 45, night
N6: WESTERN SITE BOUNDARY ADJACENT TO RESIDENCES	30	55, day 45, night
N7: NORTHERN SITE BOUNDARY BESIDE KINNEGAD RIVER	32	55, day 45, night
N8: WESTERN SITE BOUNDARY ADJACENT TO RESIDENCES	34	55, day 45, night
N9: AT SIDE OF COUNTY ROAD LEADING IN TO BORD NA MONA BOGLANDS, NEAR A CLUSTER OF RESIDENCES	32	55, day 45, night
N10: AT THE JUNCTION OF THE DUBLIN ROAD NEAR KINNEGAD AND THE ROAD LEADING UP TO THE SITE	30	55, day 45, night
N11: BALLINABRACKEY VILLAGE	29	55, day 45, night
N12: BALLINABRACKEY VILLAGE	32	55, day 45, night
N13: SOUTHERN SITE BOUNDARY	32	55, day 45, night
N14: BALTINORAN BRIDGE	28	55, day 45, night
N15: BESIDE A CLUSTER OF RESIDENCES SOUTH EAST OF SITE	27	55, day 45, night

Table 3.6.6 Noise sources associated with the operation of the cement manufacturing plant

Source	Duration of operation		Predicted noise level	
	Hours/day	Days/week	dB(A) at 1m	dB(A) at 10m
CEMENT MILL	8	5	132	78
COAL MILL	9	5	88	70
FANS/BLOWERS	9	7	96	74
ELECTROSTATIC PRECIPITATOR	24	7	70	70
SILO BLOWERS	24	7	130	73
PREHEATER FAN	24	7	118	92
KILN DRIVE	24	7	82	72
BAG-FILLING MACHINE	10	7	75	72
BAG FILTER FANS	24	7	88	74
COMPRESSORS	8	7	118	78
CONVEYORS	8	5	80	70
COOLER FANS	24	7	98	78
PROCESS FANS	24	7	92	76

NOTE

There are multiple fans, blowers and compressors associated with the operation of the cement manufacturing plant

3.6.2.4 Traffic

Much of the raw material required for the construction of the cement manufacturing plant will be sourced on site thus minimising the requirement for HGV traffic bringing materials on to the site. The maximum potential traffic impacts are predicted to occur 5 years after commencement of construction of the cement manufacturing plant when the plant is in full production. It is likely that by the time the plant is in full production that the Kinnegad bypass and will be complete, and access to the site for HGV will be directly onto the N6 west of Kinnegad. In view of this, the potential impact of the HGV movements has been assessed on the basis that the main access route to the plant will be directly on to the Galway road during both construction and operation of the cement manufacturing plant.

It is anticipated that at peak production 85 HGVs per day will enter and leave the plant as a result of the proposed development. This estimate of traffic movements will include transport of fuel, 40,000 t per annum Westphalian Shale from Co Laois, 60,000t per annum kaolin and transport of Product from the site. The HGVs will travel a short distance along the existing access road from Kinnegad and onto the new access road to the Galway road north of the site. It is expected that this will be the main access route to and from the plant when the plant reaches Peak production five years after commencement of the Construction Phase.

The proposed access road will be routed along the existing County Road from Killaskillen crossroads and will then swing north on a new access route to the proposed Motorway and Kinnegad bypass at a point west of Kinnegad on the main Galway road. This access route will pass the nearest residence to the roadway at the point where the new road swings north towards the new Motorway at a distance of approximately 50m from the roadside; another residence is situated on the roadside directly opposite the junction of the proposed new access road and the N6, at approximately 10m from this junction. The access road will be upgraded along the length of existing roadway which will be incorporated into the new access route to the north of the site in order to minimise the noise and vibration impacts associated with the development. Westmeath County Council are in the process of finalising their design for the re-alignment of the N6 from Kinnegad to Miltownpass and expect to commence work in the short term. This will result in the N6 being re-aligned to the extent that the residence currently situated on the N6 approximately 10m from the junction with the road leading to the site will be much further away from the main road than is currently the situation.

For the very low additional traffic flows which will result from the proposed development during the construction Phase, the calculation of the predicted change in noise levels expressed as $L_{A10,18hr}$ as a result of the traffic movement is determined to be less than 1dB(A) which is substantially less than the 3dB(A) increase which would be required to be a clearly perceptible change in the noise climate at a community location. The additional traffic movements may be noticeable to residents located along the existing access road but the noise impact of this increase in traffic is not significant and no adverse nuisance impacts are predicted as a result of the construction Phase of this development.

The movement of haulage vehicles on site associated with the operation of the quarries may also result in an impact at nearby residences. The potential impact of these activities is assessed using the methodology outlined in BS5228. The closest residence to any quarry boundary is 100m; although the shale quarry will only be operated for 2 – 3 months in the year and hence the associated traffic movements will only occur for this time frame, the potential maximum noise impact is assessed for continuous operation of both quarries. The maximum number of vehicle movements on site associated with the operation of the quarries is predicted as 17 per hour; due to the limited duration of operation of the shale quarry, this level of movements will occur for just 2 – 3 months of the year. Assuming a worst case scenario of 17 vehicle movements per hour at 20 kph and a maximum sound power level of 119dB for the largest trucks on site (Table 3.6.4), the predicted $L_{Aeq,1hr}$ at 100m after allowing for a screening of 15dB from the screening bund is 50dB(A). This is significantly lower than the internationally applied criterion of 65dB(A) for acceptability of traffic noise. Since the maximum traffic movements on site will occur for a very limited period of time, the potential impact at the nearest noise sensitive receptors is even less significant than the maximum impact predicted for continuous activity.

The increase in traffic flow associated with the proposed development will not have a significant adverse impact on the noise climate at most of the community locations in the vicinity of the site. The noise impact is likely to be significant at the single residence close to the access road leading north from the site. Noise impacts at the residence close to the junction of the access road with the N6 are also expected to be significant. The proposed re-alignment of the N6 discussed earlier in this section will significantly reduce the noise and vibration impacts at this residence due to the increased distance which will separate the residence from the main road.

3.6.3 Mitigation measures

3.6.3.1 Construction

The construction Phase of the Development will span approximately 24 months and will generally be restricted to daylight hours. As mentioned previously, some night time work is anticipated due to the nature of the construction works planned for the site. The most significant noise impacts associated with construction will occur during the initial site preparation works and during the construction of the cement manufacturing plant buildings. The site preparation work will be of short duration and will also involve construction of screening bunds which will minimise the noise impacts at the nearest noise sensitive receptors. Much of the raw materials required for construction will be sourced on the site thus minimising the requirements for import of raw materials and the associated traffic movements. Due to the relatively large distances between the nearest noise sensitive receptors and the locations where the plant buildings will be constructed, combined with the screening bunds which are being constructed at an early stage in the development, the assessment of potential impacts presented in Section 3.6.2.1 has shown that no adverse nuisance impacts are predicted as a result of the Construction Phase of the proposed development.

3.6.3.2 Quarrying

Noise

The design and layout of the shale and limestone quarries have been specifically chosen to maximise the distance of the quarries from residential properties and roads. The principal design features for this purpose are the provision of adequate stand-offs from site boundaries, roads and noise sensitive receptors to allow for construction of suitable screening banks.

The nearest occupied residences to the site of the limestone quarry are Lansdown Lodge, which is owned by the Developer, the residence at Killaskillen cross roads and Killaskillen House; these residences are located 100m, 110m and 175m from the nearest edge of the quarry. Other occupied residences are located more than 400m from the nearest boundary of the limestone quarry. The shale quarry is more than 150m from residential properties to the west of the site, more than 200m from properties to the south and in excess of 350m from the nearest residences in other directions.

On the north-eastern edge of the limestone quarry, a stand-off of at least 35m has been specified in the plant Design Layout to allow construction of a 5m high screening bank. On the south-eastern edge of the limestone quarry, a stand-off of 30m has been provided to allow for construction of a second 5m high screening bank between the quarry and Ballinabrackey village. As with the limestone quarry, screening banks are provided around the shale quarry workings to the south and west; the existing drumlins will provide screening protection to the north.

Construction materials are to be excavated from the site and the loss of the screening effect of the esker from which ca 60,000 tons of sand is to be recovered will be compensated for by constructing replacement screening banks north and east of the existing features at an early stage in the construction phase of the development.

The stand-off distances, combined with the screening measures, will effectively eliminate the potential for noise nuisance at sensitive receptors in the vicinity of the quarries. A comprehensive quantitative assessment of the potential noise impacts at nearby residences as a result of the operation of the quarries has shown that no adverse nuisance impacts will occur as a result of the development.

Vibration

The principal method of ground preparation in the limestone quarry will involve blasting. Mitigation measures to ensure that no adverse impacts from vibration are observed at sensitive receptors are primarily related to effective design and management of the blasting sequences and implementation of a monitoring programme at sensitive receptors. The company proposes to follow best international practice in the design and implementation of blasting sequences to minimise the impact of the blasts at sensitive receptors. Vibrographs for recording peak particle velocity and air verpressure associated with each blast will be located at sensitive receptors for automatic recording of these parameters for every blasting sequence.

There will be a requirement for blasting in the shale quarry at a rate of up to two blasts per year to remove reef limestone; the main material extraction and recovery operations from the shale quarry will not require blasting.

3.6.3.3 Cement manufacturing plant

A conservative approach to assessing the potential for noise nuisance as a result of the proposed development was adopted and the results of the assessment were presented in Section 3.6.2. The design of the plant has been formulated to meet the requirements of this rigorous assessment procedure. In particular, the design of the plant and the materials used for construction of the plant buildings, particularly those housing the noisiest plant machinery, have been chosen to ensure that noise levels outside the buildings are controlled to levels which will not result in a noise nuisance at nearby residences at any time. Suitable attenuation measures will be employed to meet the stringent criteria specified in section 3.6.2, and the construction of screening banks between the plant buildings and the nearest residences will further minimise the noise levels perceived at these locations as a result of the development. The layout of the facility has also been carefully designed to allow for screening of the more significant plant buildings in terms of noise by other buildings and, although this screening effect was not included in the quantitative assessment of potential noise impacts, this will further minimise the potential impacts associated with the development. As discussed previously, the proposed mitigation measures will ensure that there are no adverse noise impacts experienced at community receptors as a result of the operation of the cement manufacturing plant.

Potential vibration impacts associated with the operation of the cement manufacturing plant are generally associated with the mills and kiln and suitable mitigation measures will be incorporated in to the design of the buildings housing this machinery to ensure that the effects are minimised. In view of the proposed mitigation measures and the significant distance between the plant buildings and the nearest community receptors, the effects will be barely perceptible at community locations in the vicinity of the plant. No adverse impacts will occur as a result of the operation of the cement manufacturing plant at community receptors in the vicinity of the plant.

3.6.3.4 Traffic

The most significant potential noise impacts associated with traffic movements will occur when the plant is at peak production. As discussed previously, an additional 171 HGV movements on and off the site per day are predicted as a result of the development. The most significant impacts will be observed at the point where the existing county road will branch north in a new road development to join the N6 west of Kinnegad on the main Galway road, and at the junction of the new access road and the N6. Noise impacts are expected to be significant at the residence close to the junction of the access road and the N6. As discussed in Section 3.6.2.4, Westmeath County Council are in the process of finalising their design for the re-alignment of the N6 from Kinnegad to Milltownpass and expect to commence work in the short term. This re-alignment will result in an increase in the distance separating the residence and the main road, and the adverse impacts will thus be ameliorated relative to the current situation.

At the closest residence to the roadway near the entrance to the development, approximately 50m from the roadside, impacts from HGV movements will be minimised by the ameliorative measures which will be undertaken by the developer. In particular, the developer plans to upgrade the county road to minimise adverse impacts. Noise levels associated with traffic to and from the cement manufacturing plant at other residences in the vicinity of the plant will be substantially lower than the 3dB(A) increase which would be required to be a clearly perceptible change in the noise climate at a community location, so no adverse noise impacts associated with traffic are predicted in most community locations in the vicinity of the plant.

Vibration from traffic associated with the development and operation of the cement manufacturing plant could occur as a result of HGVs passing over rough or substandard road surfaces. The site roads will be constructed and maintained in a manner suitable for minimising potential vibration impacts associated with such traffic movements. The developer has also agreed to upgrade the county road north of the site towards the proposed motorway to further minimise the potential impacts of vibration from HGV traffic on nearby residences. Although the nearest residence is located ca 50m from the roadside, adverse vibration impacts are not expected to occur as a result of the proposed development.

SECTION 3:

THE ENVIRONMENT IMPACTS AND MITIGATION

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SECTION 3.7

THE LANDSCAPE

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3.7.2 **METHOD OF ASSESSMENT**

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DRAWINGS:

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APPENDICES:

A1 Photomontage Views 1 to 7
A2 Landscape and Visual Assessment Record Sheets 1 to 33

3.7.1 Introduction

This section considers the landscape context into which the new cement works would be built, and assesses the impacts on that landscape of the construction of the works. It also considers the visual effects of the buildings and new landforms, and describes measures to mitigate adverse impacts.

3.7.2 Method of Assessment

The assessment comprised five stages:

1. Desk Study.
2. Site visits.
3. Analysis of results.
4. Assessment of impacts and development of mitigation measures.
5. Conclusions.

Landscape and visual assessments were undertaken for the shale and limestone quarries and their associated earthworks, the access road and for the main plant area. As the project is currently under development, the results of this assessment will be reflected in the final detailed proposals.

This assessment identified both landscape impacts and visual impacts, which have been defined[1] as follows:

Landscape Impact "change in the fabric, character and quality of the landscape as a result of development. This can be positive or negative".

Visual Impact "change in the appearance of the landscape as a result of development. This can be positive (improvement) or negative (detraction)".[1]

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[1] *Guidelines for Landscape and Visual Impact Assessment,* The Landscape Institute and Institute of Environmental Assessment, E&FN Spon London 1995.

The document "Advice notes on Current Practice in the Preparation of Environmental Impact Statements", published in 1997 by the Environmental Protection Agency, Wexford, was consulted. The scope of the section related to the landscape (pp36-37) is reflected in this report.

3.7.2.1 *Desk Study*

Plans showing the quarry borehole layout, the topographical survey, and a preliminary quarry site layout, were provided. OS of Ireland maps at 6" to 1 mile (1:10,560) and 1:50,000 were also obtained, to establish likely study areas. The 6" mapping dates range between 1836 and 1910, and no more recent edition is available. 1:50,000 maps are currently being published, and areas to the west of the site are not yet available. To supplement this mapping, recent aerial photographs were obtained, and the stereoscopic overlap processed for 5m contours. Preliminary plant layouts and elevations were also used, to determine the scale and therefore likely visibility of main plant structures. Other background information on the area's cultural history was sought, to inform the assessment process. Results from the atmospheric dispersion modelling, which have influenced e.g. chimney heights, were also incorporated into the study.

A review of the Development Plans for the Counties of Meath, Westmeath and Offaly showed that there are no views towards the site which are listed for preservation or protection.

From all the above, areas for landscape and visual impact assessment were established, as follows:

For the landscape assessment, an area 10km x 10km, centred on the site. This extends 3km north of Kinnegad, south 1km beyond Castlejordan, and in an east-west direction to give a reasonable representation of landscape types.

For visual assessment, a circular area extending 12km from the centre of the site, extended to significant locations. This is to allow for the longer distance views of tall structures.

These areas are indicated on drawing 3.7.2.

3.7.2.2 *Site Visit*

Visits to the site were made in March/April 1998, when an inspection of the development site and a detailed review of the local area were undertaken. Weather conditions ranged from sunny with broken cloud to rain and mist : the site was not seen either in conditions of extreme clarity or of very low visibility, so the assessment therefore relates to average conditions.

The purpose of the site visits was:

a) to understand the detailed configuration and surface features of the site and its surroundings;

b) to identify significant viewpoint locations from which photomontage views would be prepared;

c) to record the local landscape character and the landscape context of the site, noting the principal sub-divisions, visual cut-offs and significant changes not shown on maps. At about 30 locations, objective and subjective data were

recorded, on standard sheets, to contribute to the analysis of impacts. These are included as Appendix A2 to this report.

During the visits, local roads up to about 20km from the site were travelled, with the photographic survey concentrated on the area within 5km. This represents the general limit of visibility in a lowland landscape.

As a result of the site visits, the following additional information was gathered:

1. Changes to local settlement patterns, for example new housing construction to the west and east of Kinnegad, and the location of unoccupied properties.

2. The detail of site topography and tree cover.

3. The broad characterisation of local landscape types.

4. The existence and significance of natural and man-made features in the study area, for example hills, peat bogs, plantations, power lines, power station, historic sites.

3.7.2.3 *Analysis of Results*

From the desk study, the landform context of the site was established, as shown in drawing 3.7.4. From the initial site survey and other data, plus the photographic and other information from site visits, the local landform and landscape character were established. The landscape study area was subdivided into five principal landscape types, as described in Section 3.7.3.2.

Due to the widely varying date of mapping and the incomplete overlap of information from the various sources, a degree of interpolation has been necessary, to complete the assessment.

Site visits and the Zone of Visual Influence (ZVI) study - by drawing numerous cross-sections radiating from the site - indicated the likely visibility, especially of the tallest structures.

This information was used to guide the layout of the plant area and the size and position of the new landforms, to minimise visual impacts.

In addition, photomontage views were prepared from seven viewpoints, to give an impression of the appearance of the developed site from a variety of locations, ranging from the site boundary to distant high ground. These are included in Appendix A1.

3.7.3 The Existing Landscape

3.7.3.1 *The Site*

The Lansdown site extends to 160.0ha, and is located 3km southwest of Kinnegad in Co Meath. The site is shown on drawings 3.7.1 and 3.7.2.

The land is currently farmed, although about 13ha at the southern end is a raised peat bog. It is divided into 46 fields, giving an average area of 3.60ha. Levels on site range from +70m AOD in the north, to +90m AOD in the southeast and +95m in the southwest. The site is subdivided by the road running northwest from Killaskillen crossroads, and contains 5 houses and farms, not all of which are currently occupied.

Field boundaries are frequently marked by tree belts containing Ash, Pine and Birch among other species. Birch and willow are more prominent in the south. Boundaries on the lower parts of the site often have a bank and wet ditch in addition to the tree line. General views of the site are shown on field assessment sheets Nº 25, 26 and 33 in Appendix A2.

None of the site area is subject to any landscape or conservation designation, and no such designations affect any adjoining land.

Rattin Castle, of Norman style lies 2km west of the site, at an elevation of about +80m AOD. Although on a slight ridge above the Kinnegad River valley to the north, this is up to 15m lower than the cement works site, 10m lower than the limestone quarry and at about the same level as the shale quarry.

3.7.3.2 *The Local Landscape*

The landscape study area of 100km² contains the following principal landscape types, as shown on drawing 3.7.5:

1. Peat Areas (worked and unworked) Over a large area in the west towards Rochfortbridge, and in a smaller area immediately south of the site lie open peat bogs. The large Bord na Mona works around Derrygreenagh is open and featureless, showing only the straight drainage channels and mechanical extraction lines. South of the site is the remaining unexcavated area of a raised peat bog, colonised by heather and grasses. Views are open, except where willows and other trees (e.g. birch) have begun to colonise or where large plantations have been established, as around Derryhinch, for example.

2. Heath and wood on higher ground To the north of the N6 around Griffinstown and Balloughter, lies an area of higher ground, supporting fields, plantations and heathy areas dominated by grass and gorse. Considerable local screening and undulating ground contribute to limit views within this area.

3. Lower lying farm and forest Northeast of the N4, and to the southeast, beyond Castlejordan are lower lying areas of wetter farmland, characterised by grazing fields with boundary ditches and extensive conifer plantations. Here again, the density of plantation and field boundary trees serves to limit local views.

4. Undulating fields and hedges In a broad band extending SW to NE across the study area lies an area of gently undulating farmland, both arable and pasture, with copses and larger blocks of woodland. Some longer views are possible from elevated locations within this area, but only the tallest structures are likely to be visible.

5. Open river valley Extending from Rattin to Kinnegad along the Kinnegad River is a tract of open landscape with few trees, and only low, intermittent hedges. Many field boundaries are post and wire fences. The river itself has been channelled and straightened in part, further simplifying its landscape context. White painted buildings are visible over distances of 1 to 2km within this open area.

Summary data is as follows:

1. Highest and lowest elevations are +118m AOD and +69m AOD respectively.

2. Proportions of the study area in 10m height bands are as follows:

	%
>110	0.23
100-110	1.69
90-100	8.55
80-90	41.63
70-80	44.15
<70	3.75
	100%

3. Steepest gradients are 1:6 (site survey) and 1:12 (OS data)

4. The site can be seen to lie across a low ridge at about +90m, with the two small hillocks at just over +80m to the north. The main plant area stands on the higher part of the site.

3.7.4 Landscape and Visual Impacts

3.7.4.1 *Existing Trends (The "Do Nothing" Impact)*

The quarries' and cement works' sites are set within an area of small grazing pastures and hay meadows bounded by mature tree belts. In the southern part of the site is a larger arable field. If the development does not proceed it is likely that this traditional agricultural regime will continue. The tree belts will ultimately become over mature and will become gappy by the loss of weaker trees. The pines in particular are likely to suffer losses and will not naturally regenerate. Replanting will be required within about a 50 year time frame to ensure tree belts are maintained.

In the wider area, demand for new houses and roads around Kinnegad will alter the rural aspect and may stimulate further development of the town. The local settlement pattern of scattered one and two storey houses within the rural landscape is also likely to lead to additional houses in the locality. These developments in turn are likely to result in an increase in traffic on local and national roads.

Towards the limits of the visual study area in the west, the large Bord na Mona workings around Derrygreenagh have already completely altered the pre-existing landscape; further change would only result from the re-colonisation or restoration of these workings.

Immediately to the south of the Lansdown site is a smaller area of peat bog. This could be changed if further extraction takes place. Alternatively, with no working or management, the existing trend from the existing heather covered peat towards willow/birch scrub will continue.

Much of the site and surrounding area is drained by open ditches in to the Kinnegad and other local rivers. If long term climate change results in warmer drier conditions prevailing, the local landscape may change by the drying of peat bogs and a general lowering of water tables. Tree species such as Ash would become more favoured than the willow etc on wetter ground.

3.7.4.2 *Landscape Impacts*

In order to operate the proposed cement plant, it would be necessary to open up both the limestone and shale quarries, to construct the main plant, and to provide the internal road network and new access road. As a result of these developments, the following changes in land cover would occur:

	Existing (ha)	During Operation (ha)
Buildings, hard surfaces, roads etc	2.8	23.1
Rock/unvegetated	0	27.4
Grass areas (inc peat bog)	159.8	111.8
Trees	5.4 [1]	3.1
Water bodies	0 [2]	2.6

[1] All as field boundary tree belts, measured at average width of 4m.
[2] Wet ditches not measured.

This represents a significant shift from vegetated to unvegetated surfaces during the operational phase. During the construction phase, there would be additional disturbance due to the need to strip areas prior to the construction of new landforms for screening and enclosure, which would then be restored to grass and planting. It is estimated that an additional 37ha (22% total site area) would be affected in this way.

On completion of site restoration, groundwater levels are expected to rebound close to existing levels, filling both the shale and limestone quarries. Where possible, margins would be re-graded to provide shallow bank gradients, with soiling, grassing and marginal and aquatic planting carried out.

The final proportions of land cover would be approximately as follows:

	ha
Buildings, hard surfaces, roads etc	5.1
Rock/unvegetated	0.7
Grass areas	125.0
Trees	3.2
Water bodies	34.0

Within the unvegetated category are rock faces and benches, which where above water level will in time become colonised by grasses, herbaceous and woody plants.

The construction of the settlement and attenuation ponds represents a considerable increase in water surface on site. Whilst these need to be steep sided regular reservoirs during the operational phase, there may be an opportunity to reduce bank angles and make other changes on completion, which would increase their value for wildlife.

With the lakes expected to form in the two quarries, there would be a significant increase in aquatic and wetland habitat on site at final restoration compared to the existing situation.

The proposed access road would involve upgrading the existing road for the first 450m running northeast from the site entrance, and constructing a further 1370m on a new alignment after that, as shown on drawing 3.10.5 The upgrading would require some widening and levelling of the existing surface, which might impact on verges and adjoining hedgerows. The new road section would cross parts of nine fields, in a few of which short sections of boundary hedge would be lost. An additional strip of land on the eastern side would be used to form a 3m high screen bund with planting. As part of the road scheme, an additional 1.35ha of tree and shrub planting would be undertaken, resulting in a significant nett increase in area over the existing situation.

3.7.4.3 *Predicted Visual Impacts*

The proposed development consists of two broad types of structures:

a) Quarries and associated earthworks, which tend to be extensive in area but limited in height (i.e. generally seen as horizontal elements).

b) Cement making plant, which in a modern works tends to be an arrangement of buildings and structures limited in area but of significant height (i.e. generally seen as vertical elements).

The character of the local landscape context, as described above, is generally one of small scale enclosures with significant tree belts, and subtle variations of relief. In this setting, the impact of horizontal elements is likely to be limited to the immediate environs on the site, while tall vertical elements are likely to be visible over longer distances.

A. Quarry Visibility

Locations from which the quarries development is likely to be seen are as follows, (Viewpoint numbers refer to Appendix A2):

1. On the Kinnegad to Killaskillen road, screening bunds on the eastern side of the shale quarry will run parallel to the road, and will be in the foreground for about 1km (VPs 2 and 26 and photomontage no 1).

   There will be visual intrusion by the loss of existing mature tree belts, the construction of raised landforms, and the opening of the new site entrance. Impacts will be moderate and initially negative, until new planting matures. In the

medium and long term, the impact would be neutral.

2. On the Killaskillen to Ballinabrackey road, next to the highest part of the site (+90m AOD), similar bunds enclosing the limestone quarry will run beside the road for 0.7km. (VPs 1, 2 and 33 and photomontage no 2).

   There will be long term visual obstruction from these bunds at road level, although the bund face will be mitigation of the view of the works and quarry from this point. About 35m of the works chimney would be visible above the bund, leading to a moderate additional long term negative impact.

3. Where the road west of Killaskillen crossroads passes through the centre of the site, screen bunds and materials stores will lie close to the road on both sides. (VP 25)

   There will be similar long-term visual obstruction to location 2 above, but without the additional intrusion of the works. In the medium term, the view will become dominated by developing woodland, a neutral change from the present fields, tree belts and power line.

4. Further west on the bog road, the crest of the major landform northwest of the main plant site is likely to be visible above existing trees. This will also be visible from the ridge east of Rattin Castle.

   These will be permanent changes, low to moderate in impact, but neutral in character.

5. Where farms and houses along the N6 north of the site have clear views to the south, this major screening landform is also likely to be seen (VP 28). Due to the greater elevation of some properties, e.g. Hill House at +93m AOD, screen bunds will also be used to block views of the southern face of the shale quarry (see VP 30).

   Dependent on the intervening screen from trees and hedgerows, the impacts would be low to moderate in magnitude, long-term or permanent, but neutral in effect, appearing as green landforms.

Due to tree cover and local relief it is unlikely that any of the quarry workings will be visible from the south, for instance around Toor or Gortnahorna (VP 4 and 5).

B. Cement Works Visibility

The cement plant will contain some tall structures up to 125m (chimney) and 62m (silos). The site layout and levels have been arranged in order to reduce the elevation of tall structures as far as possible. However, due to the need to achieve effective dispersal from the chimney this element is set above adjoining buildings and structures. In order to study the likely screening effect of local relief, a ZVI (zone of visual influence) study based on radial cross-sections was carried out. The works chimney would be visible over a greater area, but is of slender proportions, while in terms of visual massing, the tallest silos at 62m

will be more prominent. The ZVI therefore shows areas where either the silos alone or the silos and chimney would be screened by landform or major woodlands. The ZVI indicates that the silos and the chimney should be visible from most locations within the study area, but assessment in the field showed that there is considerable local screening from the density of vegetation cover, buildings and landform, and that actual viewpoints would be significantly fewer. In addition, distance and atmosphere effects combine to reduce visual impact progressively away from the site.

Taking account of these effects, locations within the visual study area from which tall structures are likely to be visually significant are as follows:

1. From houses close to the site boundary, such as at Cappaboggan. (VP 9 and photomontage no 3).

   Visual impact would be high and negative from the complex of buildings, silos and chimneys. Duration of impacts would be long-term, until the works finally closes. Following demolition, there would be moderate residual impact, neutral in character, from the by then well established screening landforms.

2. From the N4 bridge over the Kinnegad River, and from properties on the southwest side of Kinnegad. (VP 18 and 19, and photomontage no 4).

   At about 4km away, the works silhouette would constitute a moderate negative impact, although only the main chimney would rise significantly above intervening trees. Impacts would be long term, until demolition of the works, when there would be no residual impact.

3. From several locations and settlements along the N6 north of the site. For residents, views will be from rear windows and perhaps gardens, for road users views will be intermittent and not in the direction of travel. (VP 28 and 31, and photomontage no 5).

   Due to intervening high ground and the proposed screening landforms, the lower 20-25m of all buildings and structures would be obscured. The resulting negative visual impact would be moderate to high, depending on local screening and weather conditions. Impacts would be long term, for the life of the works.

4. From Rattin Castle and the east side of the ridge on which it stands, at about 2km from site. (VP 23)

   Views are at a similar distance to those in 3 above, and the magnitude and duration of adverse impacts would be about the same.

5. From hill tops to the south such as Clonin Barrow Hill, at Fahy, and at Edenderry Castle. Note, however that these locations are 10-12km from the site, so that the visual significance of objects and number of days when structures are seen will be greatly reduced.

When the chimney and tall structures are visible, impacts are likely to be low and negative, but will be long term, for the life of the works. There will be no residual visual impacts after demolition at these distances.

6. From the R400 crossing the peat area through Derrygreenagh and the east side of Knockdrin Hill nearby (8-9km from site). Visibility here is largely due to the absence of intervening surface features. (VP 15 and photomontage no 6).

   The silhouette of the main buildings, silos and chimneys is likely to constitute a moderate negative impact, especially from higher viewpoints where middle distance screening will be less.

7. From high points to the east such as Carbury Hill and Mylerstown, both of which have historic sites (castles, barrows) - distances here are 15km, at the limit of the study area; also from some higher ground closer to the site, e.g. around Clogharinka, about 10km away. The reduction in visual significance described in 5 above applies to these locations also.

   Negative impacts are likely to be slight to moderate, depending on weather effects, sun angle/time of day, and the detail of local screening effects.

8. To the north, as with southern views, low level screening will be effective for settlements such as Killucan and Raharney, whilst higher level views are limited to locations such as the hills north of the R156, about 10km from the site.

   From here, the bottom 20-25m of any building or structure would be screened, although when distance effects are taken into account, negative impacts would be moderate, but long-term.

3.7.4.4 *Traffic Visibility*

Figures for additional vehicles generated by the development are contained in Section 3.10 Due to the configuration of the site, and the existing and proposed tree cover, vehicle movements will not be visible from off-site other than on the access road.

Vehicles would be partially or fully screened by existing roadside hedges between the site entrance and the start of the new alignment. North of here, and due to the need to cross the open land beside the Kinnegad River, and then climb up to the new junction with the N6, vehicles would be visible for up to 2km to east and west for a distance of about 700m along the road. Where the new and existing alignments meet is the only house close to the road edge. Without mitigation measures, there would be a significant visual impact from moving traffic. This would be especially noticeable at night due to 24 hour operation of the works. Visual impact generally would be slight to moderate over about 3km² closest to the new road.

3.7.4.5 *Night Time Visibility*

The cement works will operate continuously except for maintenance outages, requiring the site and buildings to be adequately lit. Much of the manufacturing process takes place

in enclosed buildings, but areas where outdoor lighting will be needed are:

1. On main site access and circulation roads.

2. Around the principal vehicle loading, circulation and parking areas.

3. Areas on buildings and structures where man-access is required (e.g. in the pre-heater tower, on the raw mill and cooler buildings).

4. Lighting for staff car parks and footpath routes between buildings.

5. Aircraft warning lights on the main works chimney.

Road lighting will be designed to minimise light pollution by the use of lanterns fitted with anti-glare baffles.

Within the two quarries, some vehicle and task lighting will be required, especially during the winter months.

Light pollution may derive from two principal sources, first the direct visibility of bright illumination from individual fittings, and second the general "glow" which emanates from a large industrial installation. In order to mitigate the effects of the first, the type location and orientation of fittings will be considered, to reduce direct light spillage, e.g. by locating footway safety lighting behind or beneath handrails, and by orientating floodlights away from the site boundary.

Reducing the reflected glow is more difficult since it relates to the degree of activity on site and therefore to the general level of necessary illumination. It is also influenced by atmospheric conditions, especially low cloud and mist. The locality is at present largely unlit except for the main roads and some private driveway illumination, so the proposed works will have an impact. However it is intended, by the careful selection and location of lamp fittings, as well as by the choice of appropriate levels of illumination throughout the works, to reduce this effect to a minimum commensurate with safe and efficient operation.

Due to the existence of a number of small airfields in the vicinity of the development, the Aeronautical Information Service advise that warning lights will be required on the works chimney. The precise number and location of these will be determined during the planning consultation process. Whilst they will remain visible when the top of the chimney is out of sight in periods of darkness, it is not considered that the lights would significantly add to the general levels of illumination caused by the works.

3.7.5 Mitigation Measures

3.7.5.1 *Significant Impacts*

From the study of the landscape and visual effects of the proposed development, it is concluded that the potentially significant impacts are as follows:

1. The excavation of the two quarries, changing 38.7ha of existing pasture and arable land to rock-face and quarry base, lowering ground levels by up to 80m, followed by the formation of two lakes.

2. Construction of the cement works and screening landforms on 51.3ha of farmland.

3. The removal of 4720m length of mature tree belts within the site.

4. The likely visibility of the quarry screening bunds from houses and roads around the site, and from high ground to the north.

5. The visibility of tall structures, such as silos, the chimney and the pre-heater tower, on the main cement works site.

6. The visibility of traffic on the new access road.

Measures to avoid, reduce and ameliorate these impacts are described in the following sections.

3.7.5.2 *Landscape Impacts*

Landscape impacts related to the quarries and cement plant site cannot be avoided. The quarries would be stripped and worked in phases, so that the area of disturbance is kept to a minimum. On completion of limestone quarrying, a lake will form within it, and final restoration proposals would include the soiling of some sections of quarry bench to encourage colonisation, and some re-grading and planting of overburden slopes around the margins. (See Restoration Proposals, drawing 3.7.11)

In the shale quarry, groundwater will also collect to form a new lake, with lengths of rockface or bed exposed along the western and southern sides. The limestone footwall would be covered with overburden and soils, and then grassed.

Within the scheme of restoration are 16.8 ha of new woodland planting. Areas close to the site boundary, and some new tree belts associated with the new road layout would be planted at the start of development, and these would ultimately replace the existing tree belts which would be lost.

Although there is the opportunity to establish areas of new planting in phases from the commencement of development, and these will in some measure compensate for the loss of existing tree belts, it will be 10 to 20 years before new plantings begin to achieve the stature and wildlife value of those trees which are lost.

The pattern of tree cover throughout the life of the project is likely to be as follows:

	ha
Existing tree cover	5.4
Trees lost during construction	2.0
Trees planted within 5 years	7.5
Trees planted by completion of quarrying	11.6
Total trees (existing and planted) at final restoration	23.5

The layout of the cement works area is controlled by the necessary disposition of the various items of plant relative to each other, and the need to reduce haulage distances from the two quarries. Within these overriding operational constraints, the plant has been aligned and located to avoid major tree belts as far as possible.

As a consequence of the proposed development there would be a change in the balance and range of types of land cover present on site, as described in Section 3.7.4.2. This would lead to an increase in habitat variety, for instance by the creation of rock faces and ledges which may be attractive to birds of prey, and ultimately by an increase in aquatic and wetland habitat. Trees are present on site mostly as narrow linear belts : the restoration proposals include the establishment of more extensive woodlands which would provide habitats for different species. Finally, the creation of unimproved grasslands on widely varying slopes at different levels and aspects would allow the development of a more varied naturalising flora and fauna than exists at present. It is likely therefore that in compensation for the loss of areas of farmland and some planted tree belts, overall the site will experience increased biodiversity in the long term.

3.7.5.3 *Visual Impacts*

To mitigate views into the working quarries, it is proposed to form enclosing bunds and landforms around them, formed initially from soils and overburden. Where the limestone quarry is close to the site boundary, an off-set of 30 to 35m is allowed, sufficient for the construction and maintenance of a 5m high screen bund. A 5m bund is also proposed around the materials store just north of the Killaskillen crossroads.

On the north side of the shale quarry, enclosure will be by building on the natural landforms to create low mounds. On the west and south sides, the available land will be used to create other landforms of similar profile. To the east and northeast, quarrying would be limited by the need to allow sufficient support for the adjoining road, and here bunds 3-4m high would be formed together with a length of noise fencing.

Several measures have been adopted to reduce the visual impact of the cement works buildings, as follows:

1. The central area on which the tallest buildings stand would be reduced to circa 80m AOD.

2. The heights of the tallest silos have been kept as low as possible, and the plant layout has been kept compact, to reduce the visible profile of the works.

3. The plant location in the centre of the site and away from the site boundary reduces visibility from off-site.

4. Surplus material from forming the limestone quarry and from lowering the main plant area (amounting to about 1.3 million m^3) would be used to form a large screening landform on the west and northwest boundaries. The long crest runs from +90m to +106m AOD, reducing the apparent height of structures by 10 to 30m. (See plant elevations on drawing 3.7.7)

3.7.5.4 *Traffic Visibility*

The configuration of the site and the mitigation measures described above to reduce views of the quarries and works will also screen views of traffic movements on site. On the east side of the new access road, a new screen bund and planting are proposed to reduce or eliminate views of traffic from the north east (Kinnegad) direction. To the west, the combination of a planted belt on cut-off land, and an existing row of mature trees, will screen views over half of the new alignment. Other existing field boundary tree belts will contribute to screening within 1km of the road route.

3.7.6 Conclusions

From the Desk Study and site visits, it is concluded that the principal visual impacts of the proposal would be as follows:

1. Local impact on the nearest houses (about 20 in number), from the screening bunds and new landforms created from overburden and soils.

2. Local impact on the nearest houses, principally to the southwest, from the main plant structures.

3. Local impact on the area to the north from the new access road construction and moving traffic thereon.

4. A distant impact from the tallest structures, e.g. chimney, pre-heater tower, main silos. The cross-section ZVI study (Section 3.7.4.3) examines this in more detail.

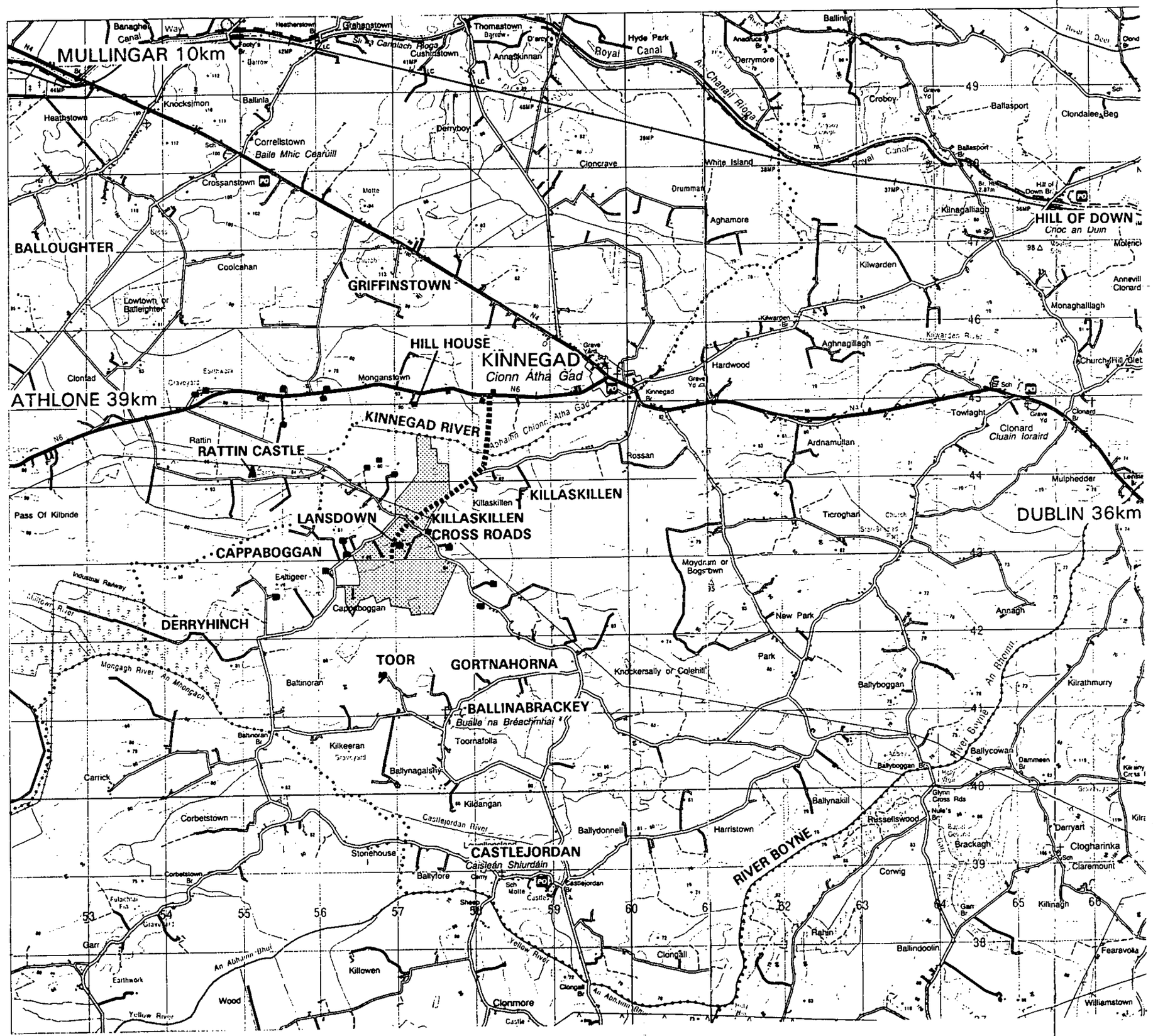
The principal landscape impacts on and around the site would be as follows:

1. The replacement of 90ha of farmland by the works site, quarry voids, faces and overburden slopes. On completion of quarrying, two new lakes will form.

2. The creation of new screening bunds and landforms, to enclose and mitigate the quarrying and manufacturing activities. These will represent significant changes to land levels and gradients over about 37ha of land. Most of this area could ultimately be returned to grazing.

3. The creation of new ponds and drainage ditches. These are required initially for water management within the site, but could ultimately provide an extension to the local wetland habitat.

4. Some belts of mature trees within the site will be lost, but new planting around and within the site will provide a new pattern of tree cover, leading to an overall increase in planted area.


MULLINGAR 10km
ATHLONE 39km
DUBLIN 36km
BALLOUGHTER
GRIFFINSTOWN
HILL OF DOWN
Cnoc an Duin
HILL HOUSE
KINNEGAD
Cionn Átha Gad
KINNEGAD RIVER
RATTIN CASTLE
KILLASKILLEN
KILLASKILLEN CROSS ROADS
LANSDOWN
CAPPABOGGAN
DERRYHINCH
TOOR
GORTNAHORNA
BALLINABRACKEY
Buaile na Bréachmhaí
CASTLEJORDAN
Caisleán Shiurdáin
RIVER BOYNE
Royal Canal
Hyde Park Canal
Grand Canal
Industrial Railway
Mongagh River An Mhongach
Castlejordan River
Yellow River
An Abhainn Bhuí
An Bhinnin
River Boyne
Knocknacarra
Heathstown
Knocksimon
Ballinla
Correllstown
Baile Mhic Cearúill
Crossanstown
Coolcahan
Lowtown or Ballaghter
Clontad
Monganstown
Rattin
Pass Of Kilbride
Killaskillen
Thomastown
Annaskinnan
Cushinstown
Derryboy
Clonerave
White Island
Drumman
Aghamore
Kilwarden
Hardwood
Aghnagillagh
Rossan
Ardnamullan
Towlaght
Clonard
Cluain Ioraird
Mulphedder
Ticroghan
Moydrum or Bogstown
New Park
Park
Knockersally or Colehill
Baltinoran
Kilkeeran
Ballynagalshy
Kildangan
Toornafolla
Corbetstown
Stonehouse
Ballydonnell
Harristown
Ballyfore
Garr
Killowen
Clonmore
Clongall
Ballindoolin
Rahin
Corwig
Brackagh
Russellswood
Ballynakill
Ballyboggan
Ballycowan
Kilrathmurry
Annagh
Croboy
Derrymore
Ballasport
Clondalee Beg
Kilnagalliagh
Monaghalliagh
Annevill
Clonard
Churchyard Hill
Derryan
Clogharinka
Claremount
Killinagh
Fearavolla
Williamstown
Earthwork
Wood
Castle
Motte
Graveyard
Grave Yd
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Ch
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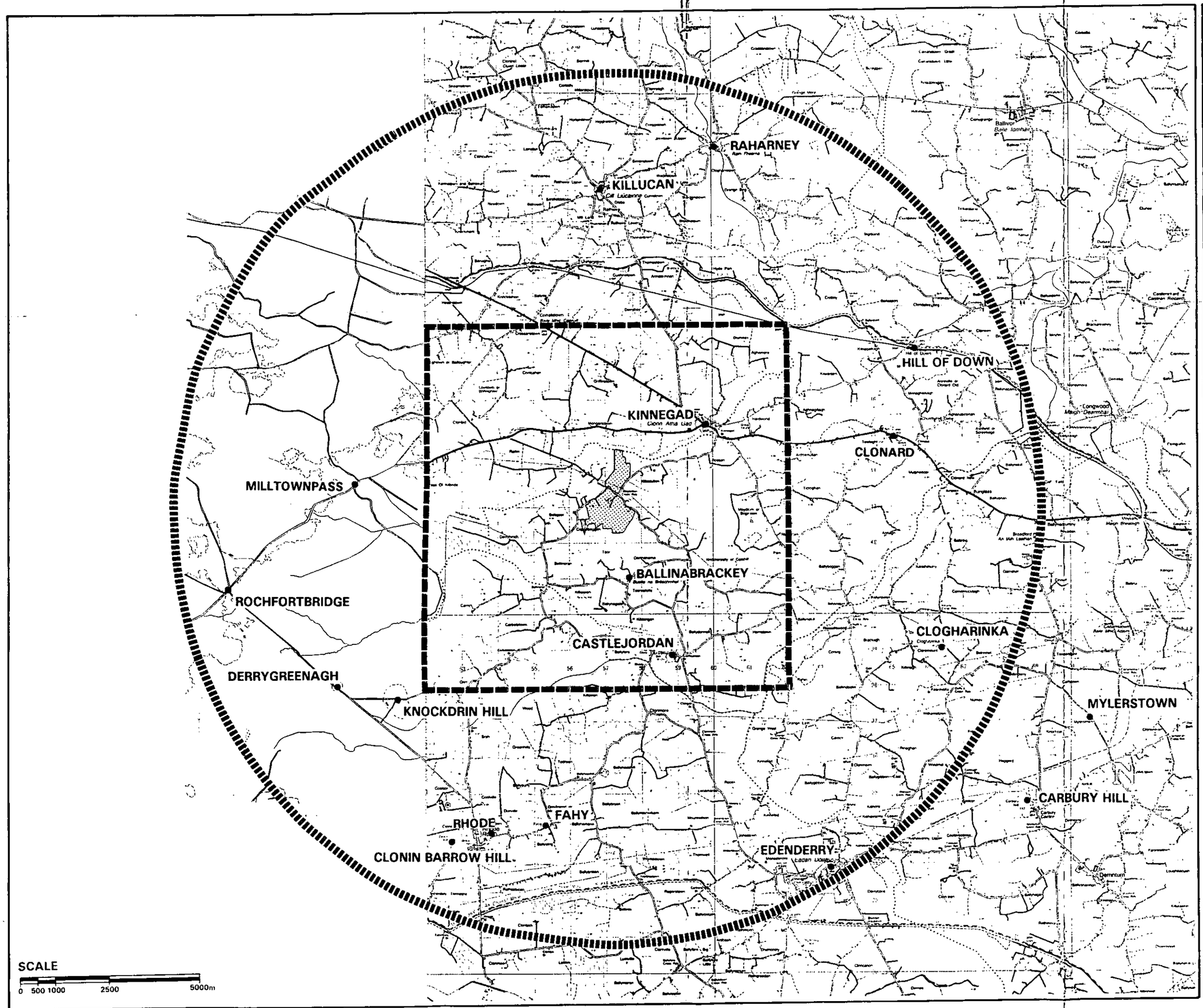

KEY

- SITE LOCATION
- LANDSCAPE IMPACT STUDY AREA
- VISUAL IMPACT STUDY AREA

N

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TITLE:

LANDSCAPE AND VISUAL STUDY AREAS

Nº 3.7.2

KEY

- SITE BOUNDARY
- SPOT HEIGHTS (81m)
- 10m CONTOURS (FROM ORDNANCE SURVEY) (90m)
- TREE BELTS AND HEDGEROWS
- BUILDINGS

SCALE

0 50 100 250

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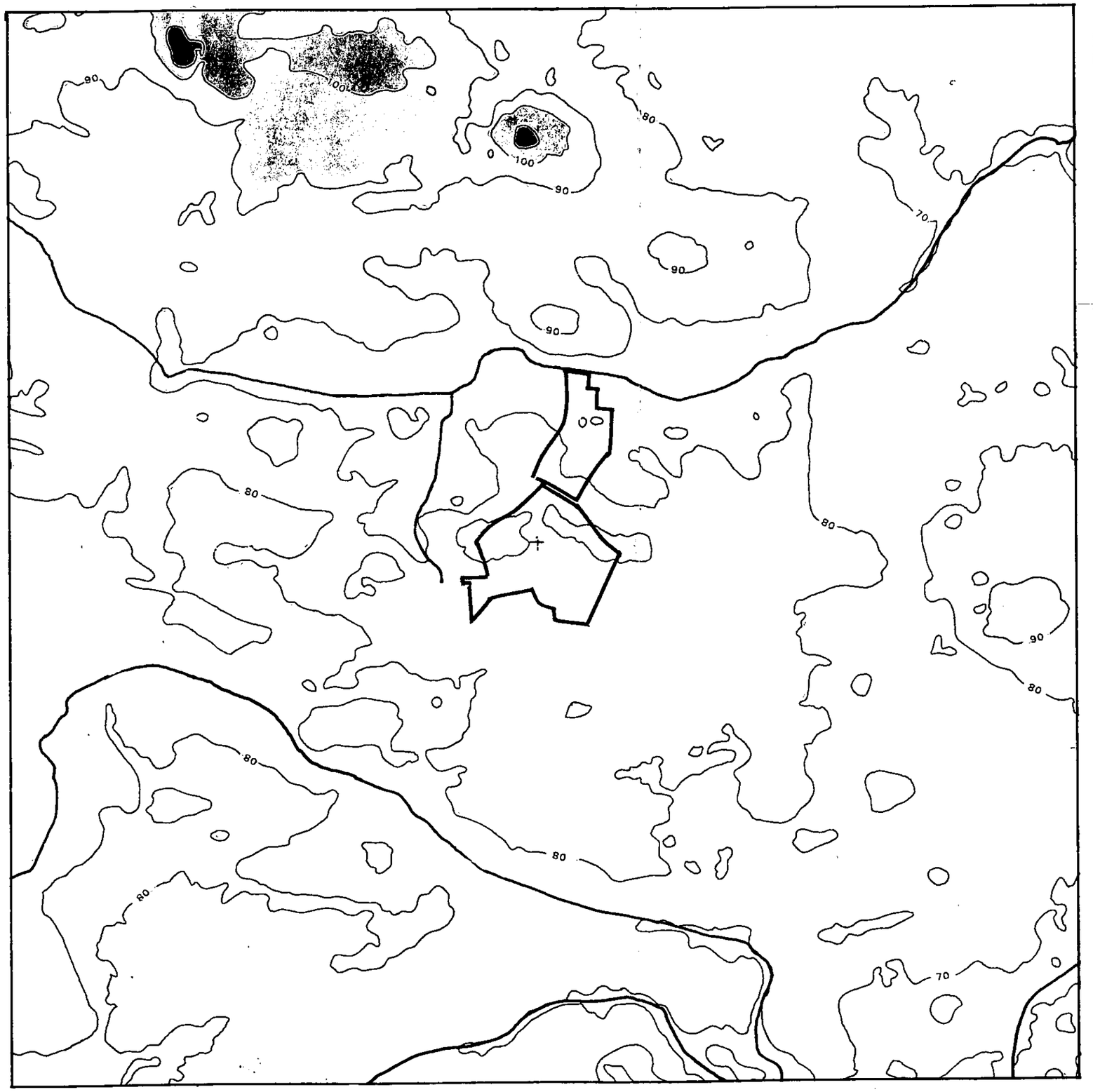
TITLE:

EXISTING
SITUATION

Nº 3.7.3



SCALE

0 250 500 1000 2000m

KEY

- SITE BOUNDARY
- 60-70m
- 70-80m
- 80-90m
- 90-100m
- 100-110m
- 110-120m
- RIVER

N

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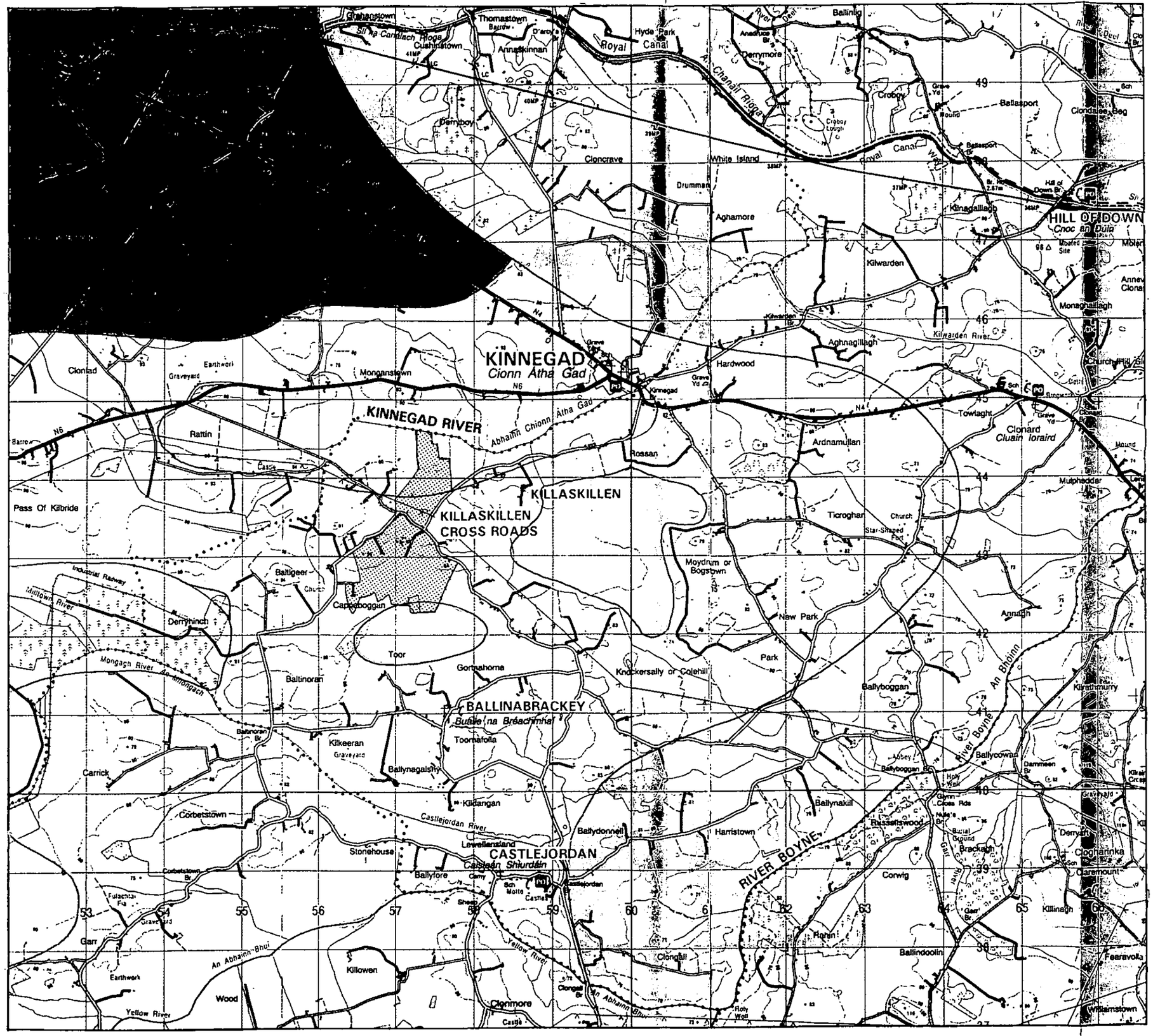
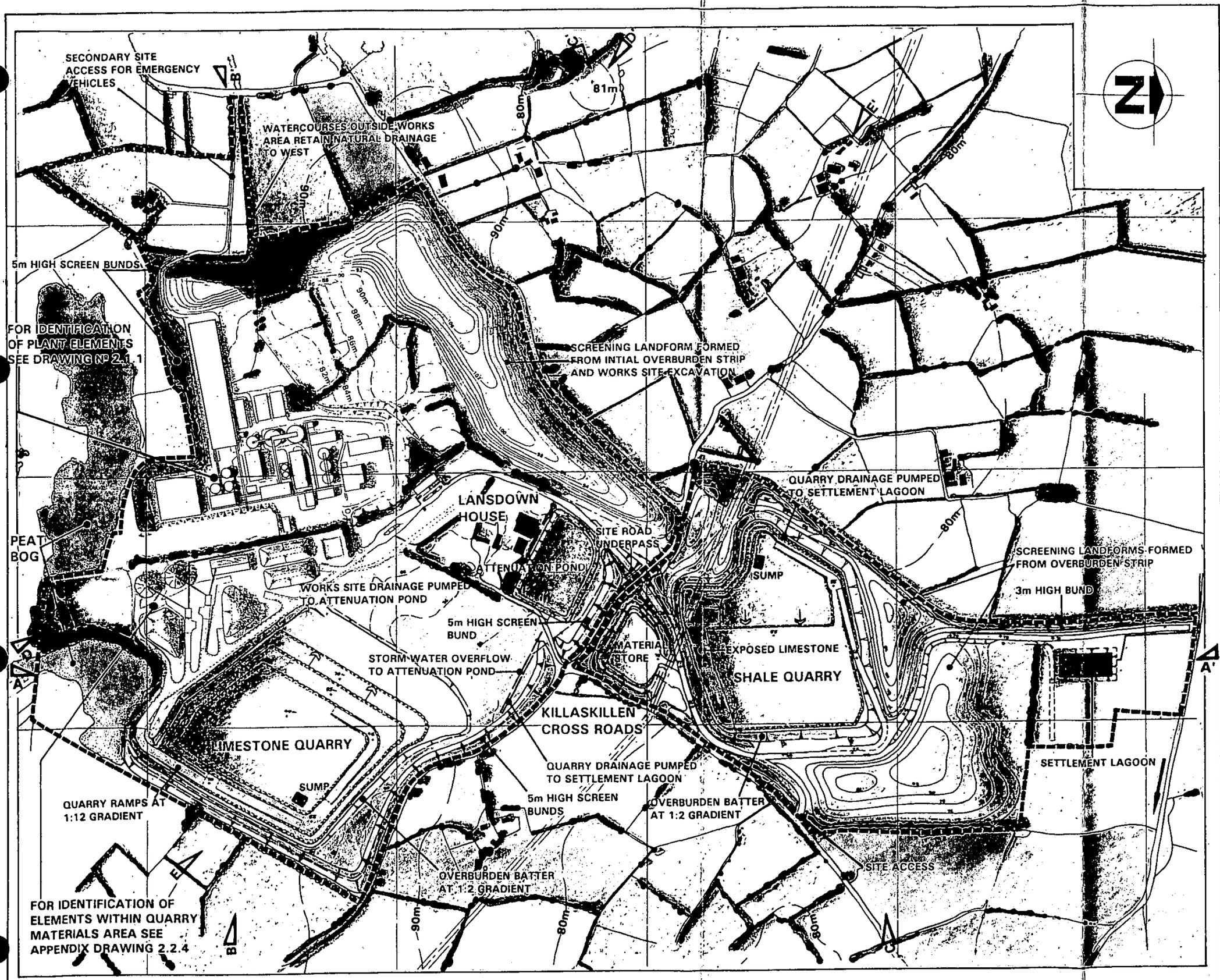
TITLE:

LANDFORM CONTEXT PLAN

Nº 3.7.4

CMS18


KINNEGAD
Cionn Átha Gad
KINNEGAD RIVER
Abhainn Chionn Átha Gad
KILLASKILLEN
KILLASKILLEN CROSS ROADS
BALLINABRACKEY
Buaile na Bréachnha
CASTLEJORDAN
Caisleán Shiurdáin
HILL OF DOWN
Cnoc an Dúin
RIVER BOYNE
An Bhóinn
Royal Canal
Hyde Park Canal
Kilwarden River
Mongagh River
Castlejordan River
Yellow River
An Abhainn Bhui
Clonard
Cluain Ioraird
Pass Of Kilbride
Graiguenstown
Thomastown
Cushinstown
Annaskinnan
Derryboy
Cloncrave
White Island
Drumman
Aghamore
Kilwarden
Aghnagillagh
Hardwood
Monganstown
Clontad
Earthwork
Graveyard
Rattin
Castle
Rossan
Ardnamullan
Towlaght
Ballsport
Croboy
Croboy Lough
Derrymore
Ballintig
Annaduce Br
River Deel
Kinnegad
Kinnegad Br
Grave Yd
Kilwarden Br
Hill of Down Br
Kinagallagh
Monaghallagh
Moated Site
Church Hill
Mulhaddar
Ticroghar
Church
Star-Shaped Fort
Moydrum or Bogstown
New Park
Annagh
Baltigeer
Church
Carnaboggan
Derryhinch
Millown River
Industrial Railway
Toor
Gortnahorna
Knockersally or Colehill
Baltinoran
Baltinoran Br
Kilkeeran
Graveyard
Ballynagalshy
Toornafolla
Kildangan
Carrick
Corbetstown
Corbetstown Br
Stonehouse
Lewellenstand
Ballydonnell
Harristown
Ballyfore
Carny
Sheep
Sch
Motte
Castle
Castlejordan
Fulachtan Fia
Garr
Earthwork
Killowen
Wood
Clonmore
Castle
Clongill
Clongill Br
Holy Well
Ballyboggan
Ballyboggan Br
Ballynakill
Russellswood
Burial Ground
Brackagh
Corwig
Rahin
Ballindoolin
Ballyconnan
Abbey
Dunmeen
Dunmeen Br
Glynn Cross Rds
Nuns Well
Derrynin
Clonfarinka
Claremount
Killinagh
Fearavolla
Williamstown
Kilrathmurry
Graveyard
Holy Well
Mound
Ballsport Br
Ballsport
Clondalee Bog
Sch
PO
Grave Yd
Mound
Bridge
Gate
Gate Br
Gen Br
Lane
Lane
Lane



KEY

- SITE BOUNDARY
- EXISTING CONTOURS: 10m V.I. (OFF-SITE) 2m V.I. (ON- SITE)
- PROPOSED CONTOURS
- ROCK FACE
- DIRECTION OF QUARRY WORKING
- GRADED SLOPES AT 1:2
- WATERCOURSES AND WATER BODIES
- PEAT BOG
- EXISTING TREES AND HEDGES
- PROPOSED TREE AND SHRUB PLANTING
- POWERLINES

NOTE

THIS DRAWING SHOWS THE EXPECTED SITE LAYOUT AT ABOUT 16 YEARS AFTER COMMENCEMENT

SCALE

0 50 100 250 m

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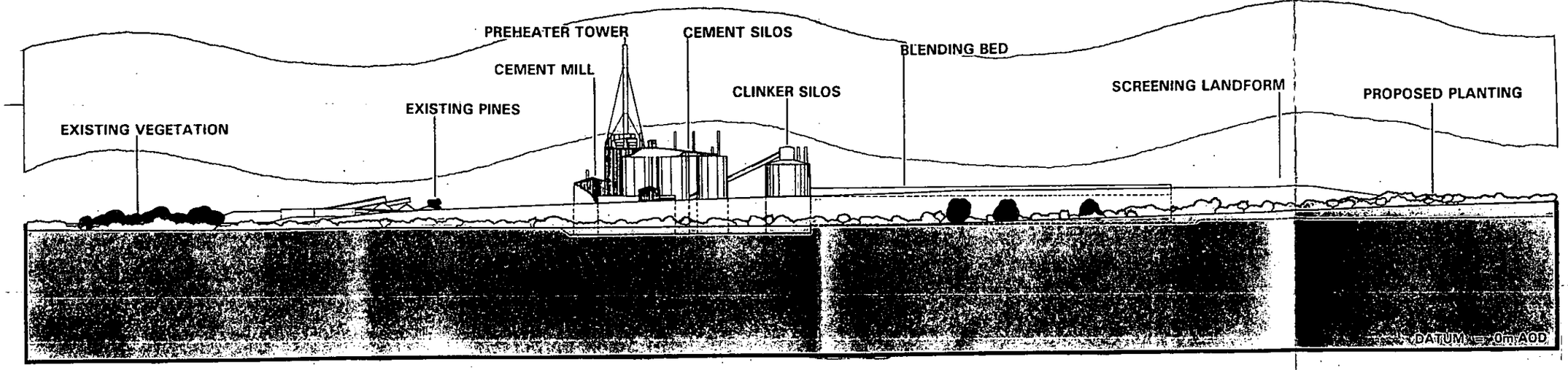
TITLE:

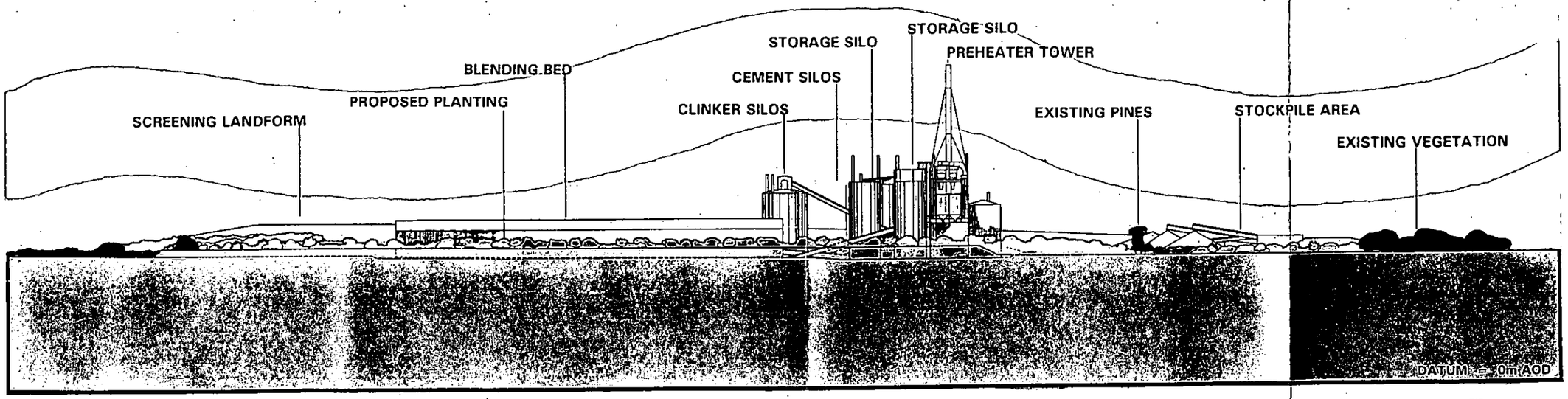
SITE LAYOUT AND LANDSCAPE PROPOSALS

3.7.6



GENERAL ELEVATION FROM NORTH

SCALE
0 25 50 100m



GENERAL ELEVATION FROM SOUTH

SCALE
0 25 50 100m

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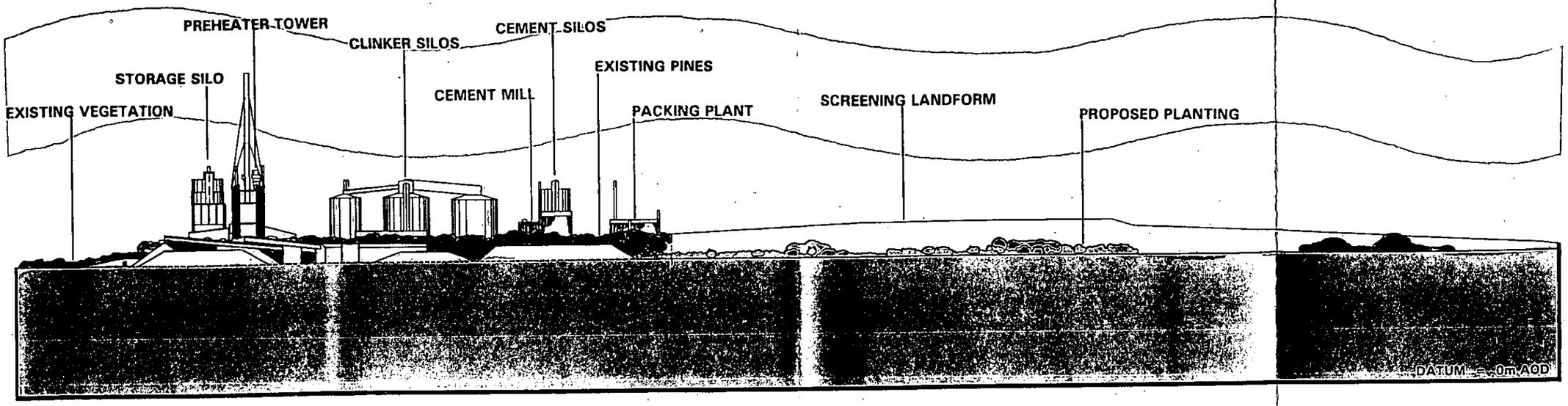
TITLE:

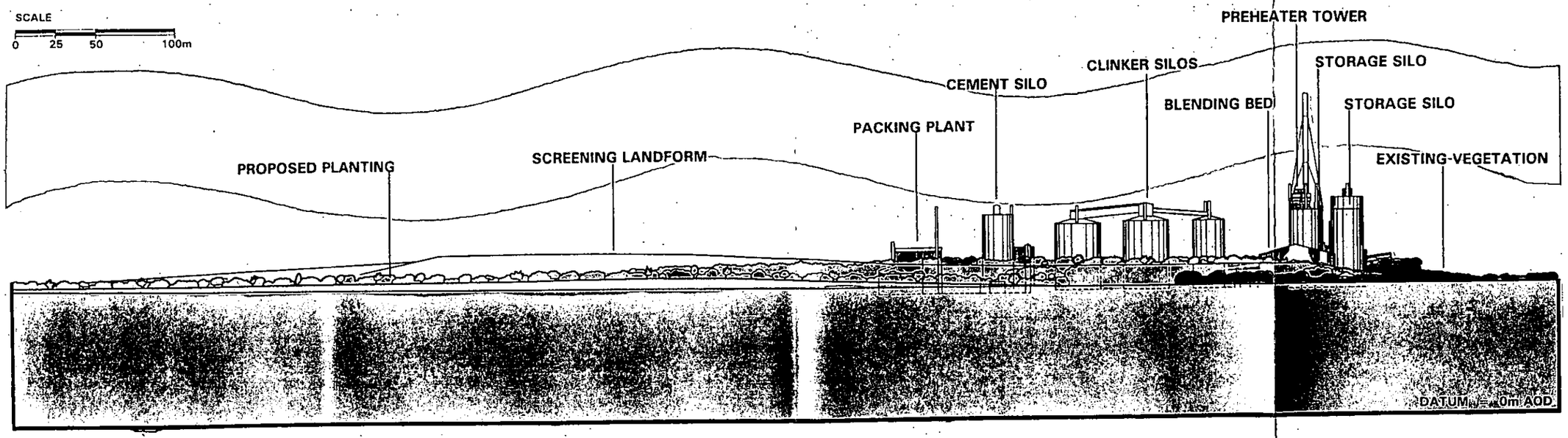
PLANT ELEVATIONS NORTH AND SOUTH

Nº 3.7.7 A



GENERAL ELEVATION FROM EAST

SCALE
0 25 50 100m



GENERAL ELEVATION FROM WEST

SCALE
0 25 50 100m

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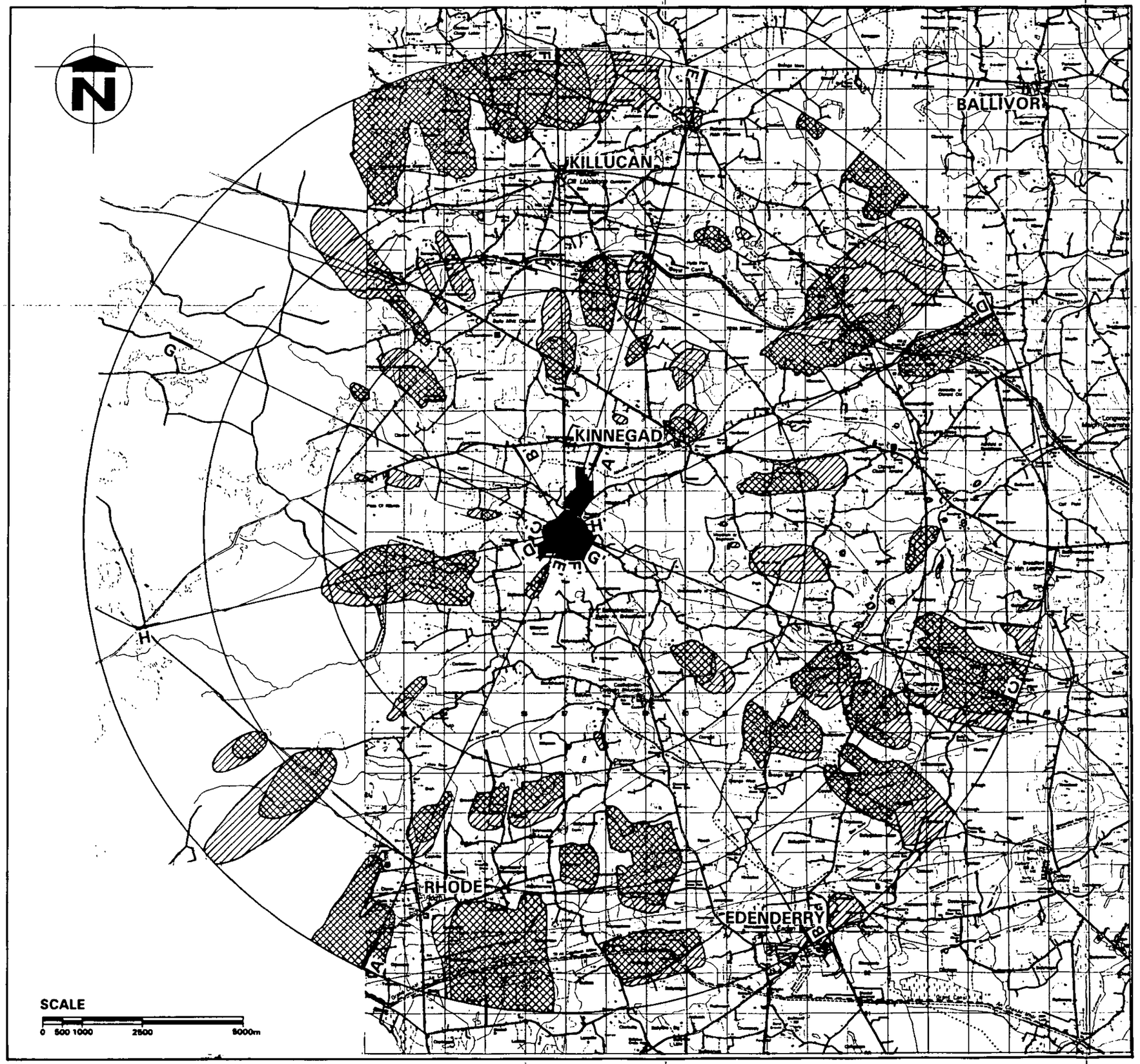
TITLE:

PLANT ELEVATIONS
EAST AND WEST

Nº 3.7.7 B



KEY

- SITE LOCATION
- ZONE FROM WHICH A 65m HIGH SILO WOULD NOT BE VISIBLE
- ZONE FROM WHICH A 125m HIGH CHIMNEY WOULD NOT BE VISIBLE
- SECTION LOCATION (G)

NOTE:
THIS ZVI IS BASED ON BALD OS LANDFORM DATA WITH MAJOR WOODLANDS.
THE SCREENING EFFECTS OF HEDGEROWS, BUILDINGS ETC ARE NOT INCLUDED

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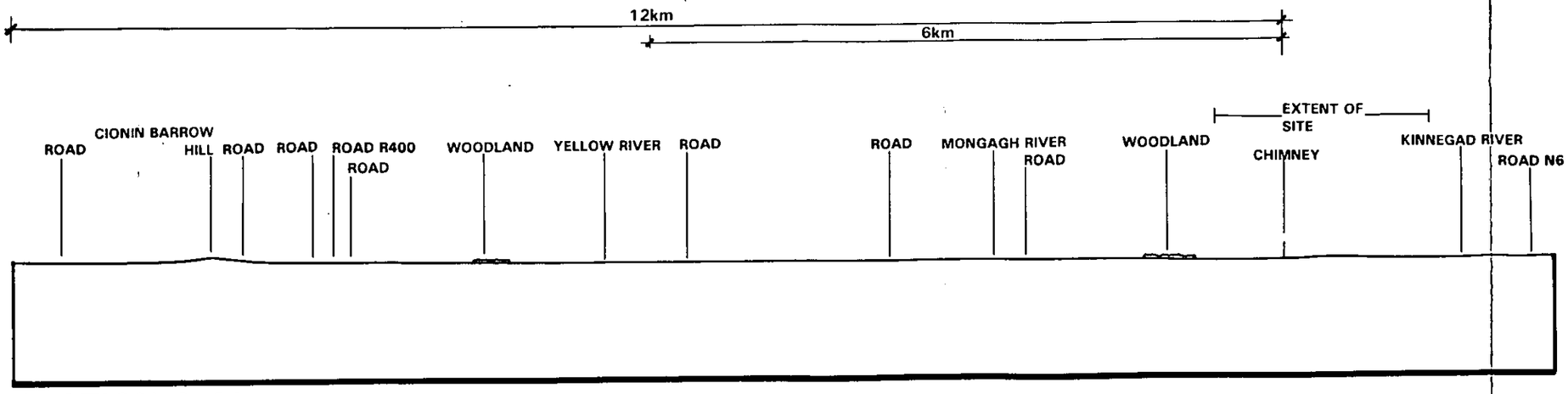
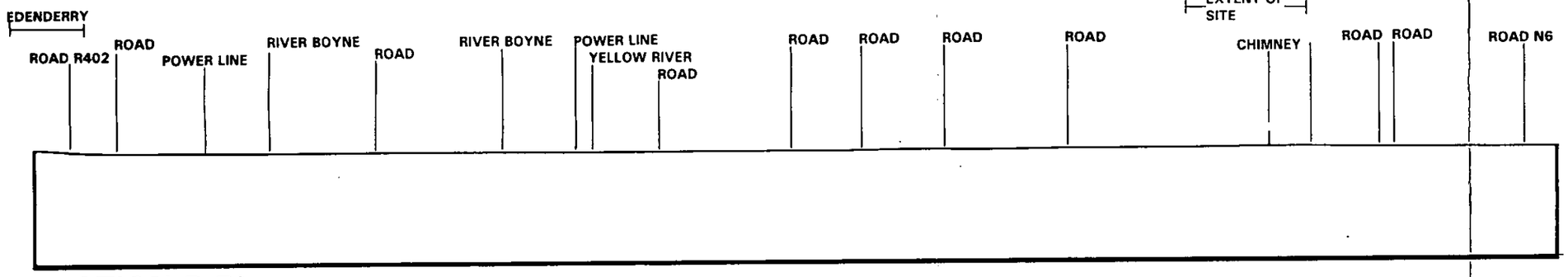
TITLE:

ZVI STUDY AND CROSS SECTION LOCATION

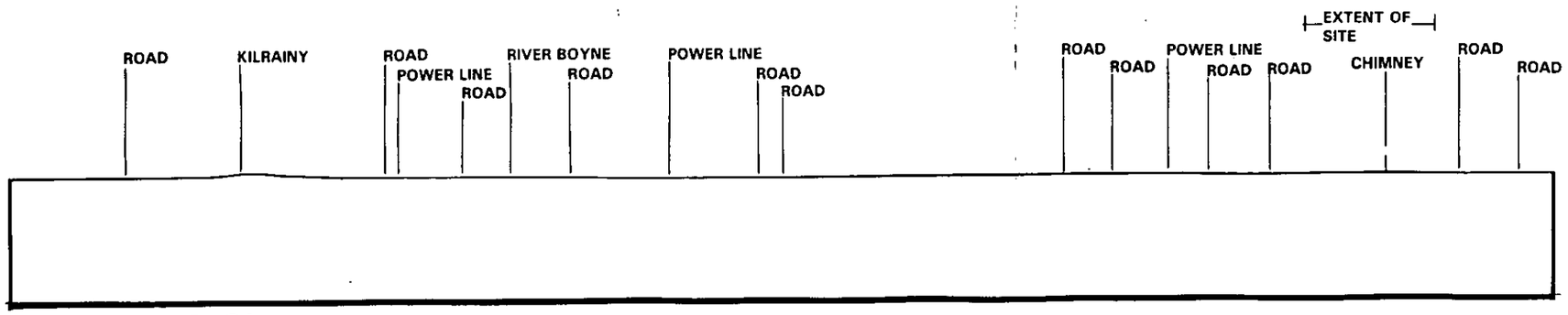
Nº 3.7.8



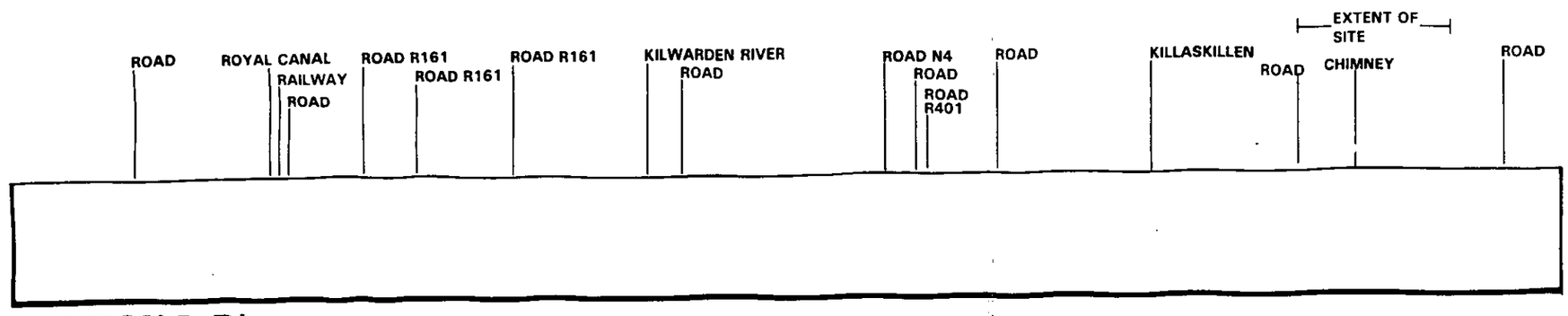
SECTION A A'



SECTION B B'



SECTION C C'



SECTION D D'

NOTE:
DATUM = 1000m BOD
FOR SECTION LOCATION
SEE FIGURE Nº 3.7.8

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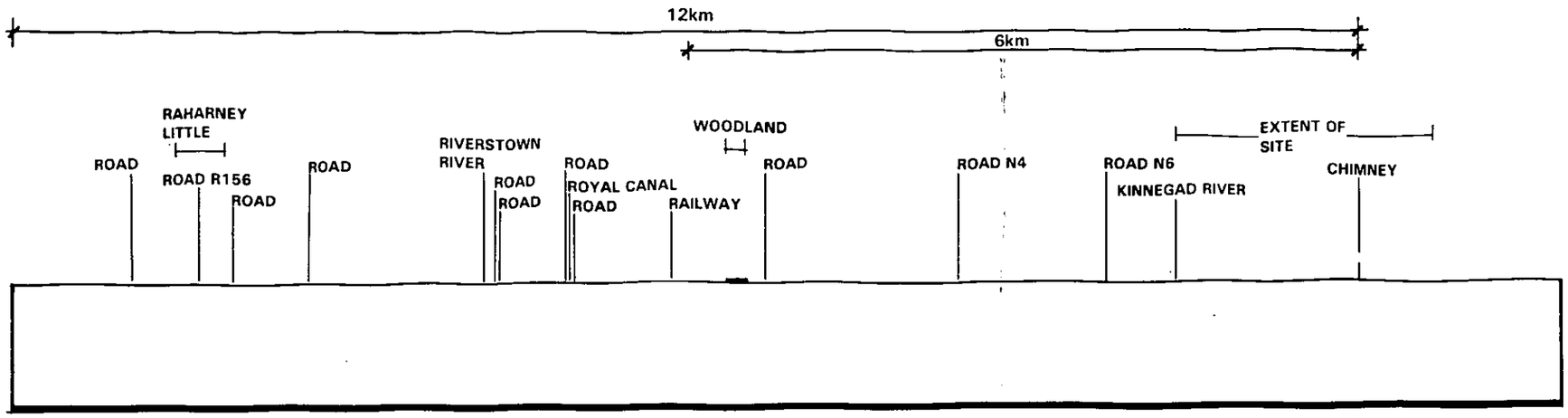
TITLE:

CROSS SECTIONS - LONG DISTANCE

(SHEET 1 of 2)

Nº **3.7.9 A**



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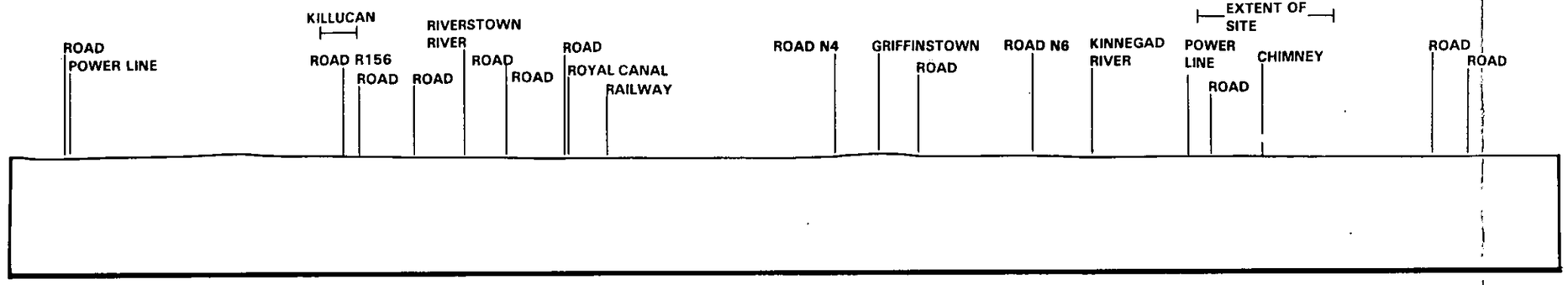
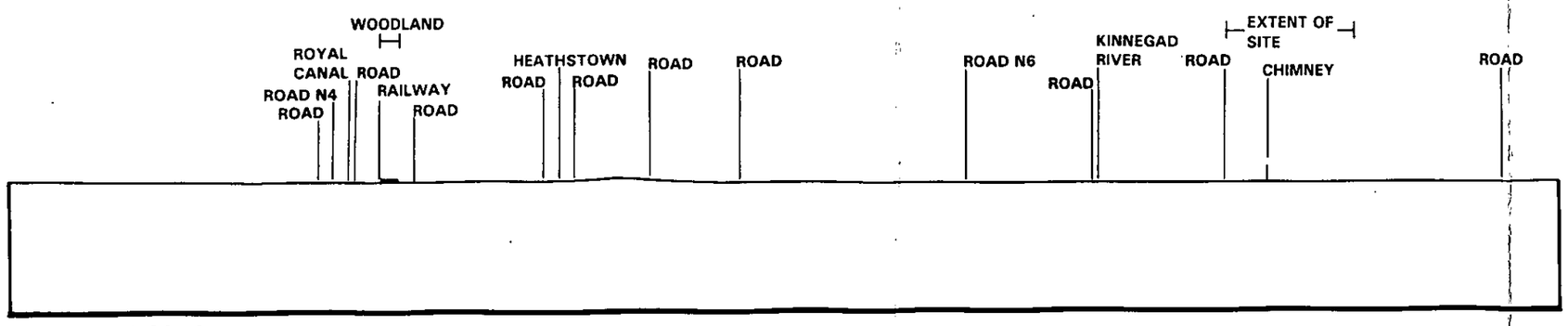


SECTION F F'



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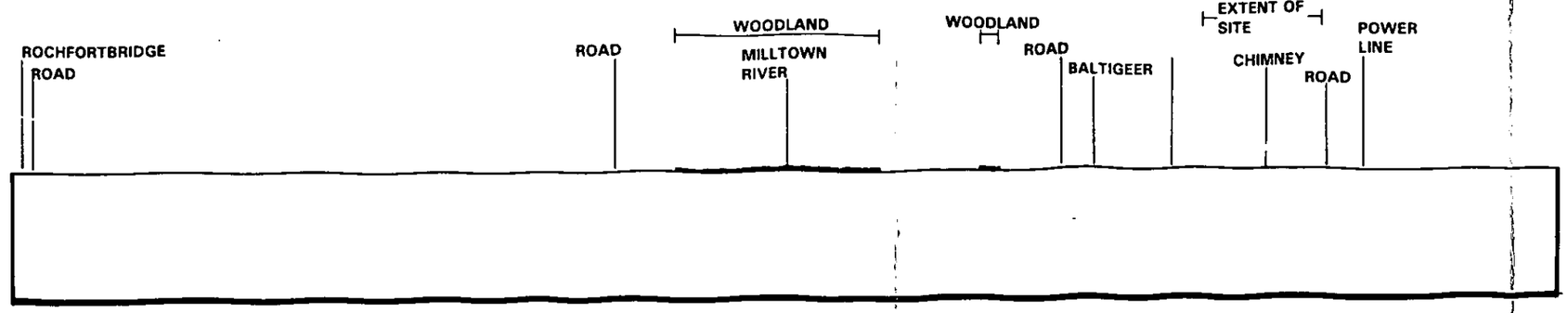

SECTION H H'

NOTE:
DATUM = 1000m BOD
FOR SECTION LOCATION
SEE FIGURE Nº 3.7.8

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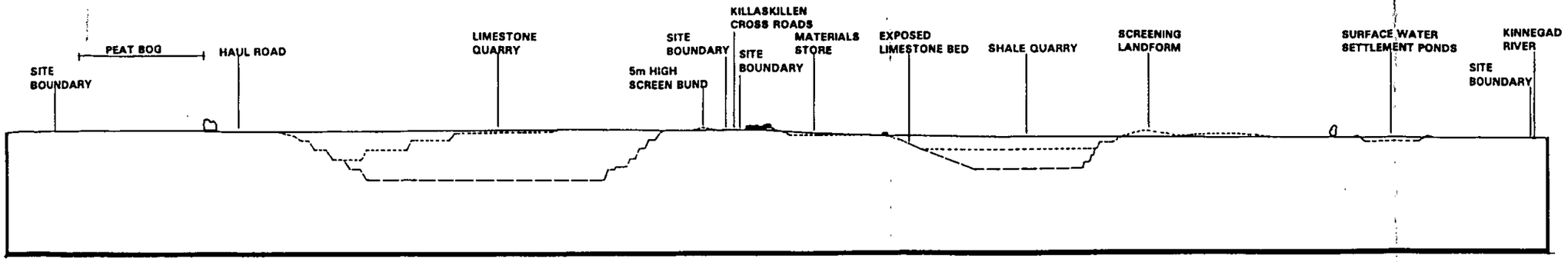
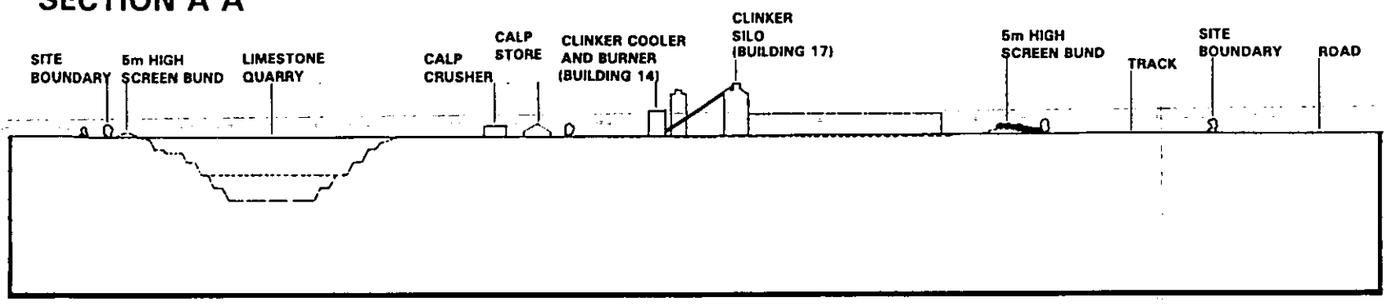
TITLE:

CROSS SECTIONS - LONG DISTANCE
(SHEET 2 of 2)

Nº **3.7.9 B**



SECTION A A'



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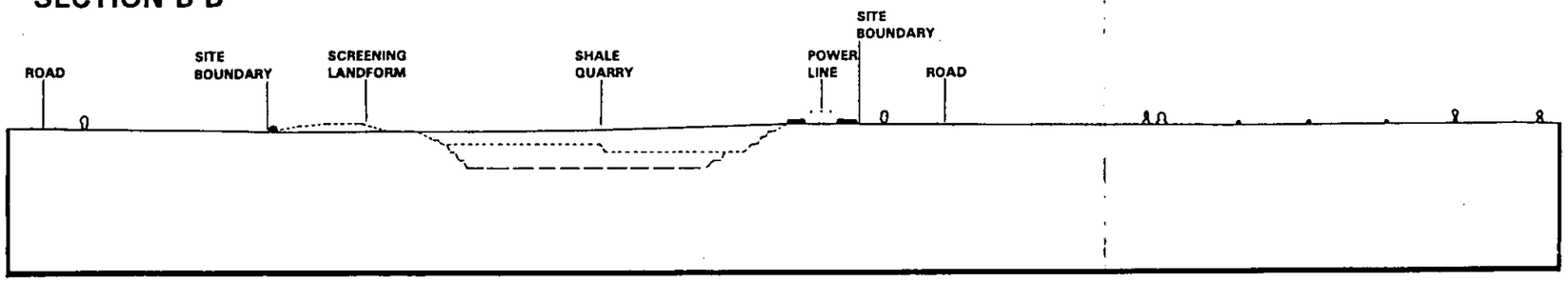

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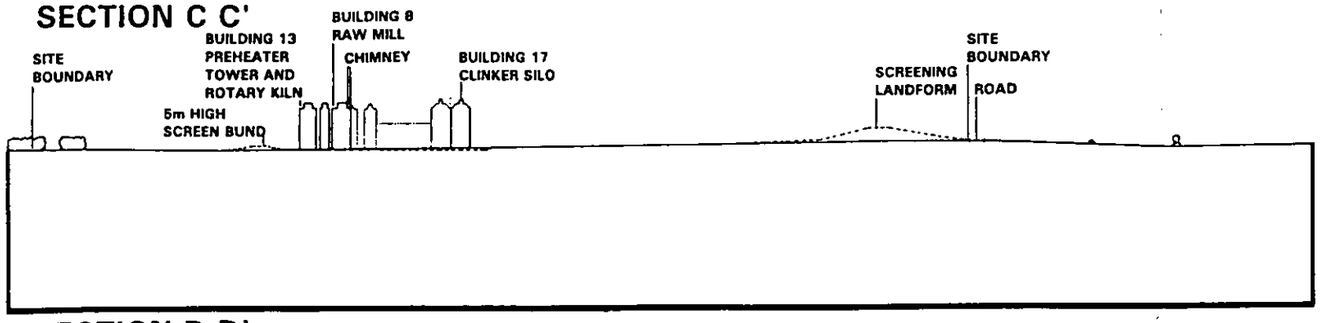

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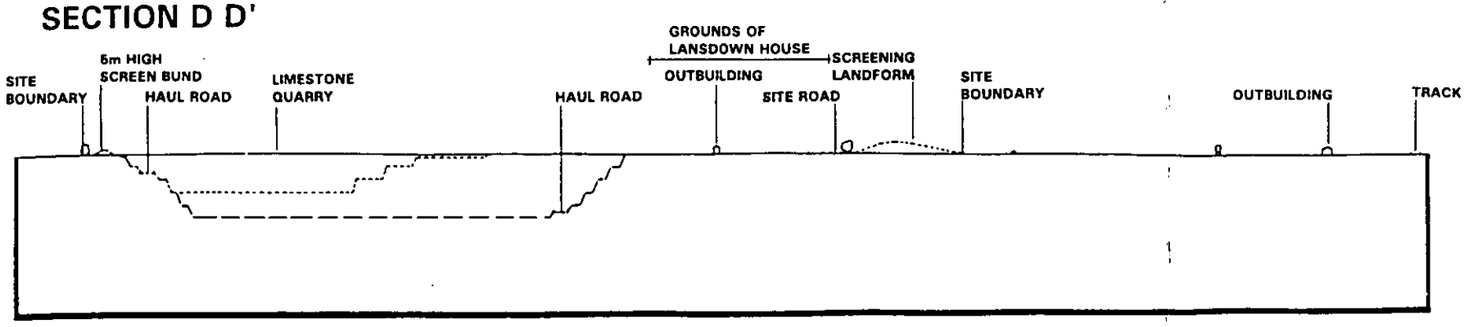


SECTION E E'

KEY

- EXISTING GROUND LEVEL
- PROPOSED GROUND LEVELS AT 16 YEARS
- PROPOSED FINAL QUARRY LEVELS
- EXISTING VEGETATION
- PROPOSED TREE AND SHRUB PLANTING

NOTE:
PLANT SITE DETAILS INDICATIVE ONLY

NOTE:
DATUM = 100 BOD
FOR SECTION LOCATION SEE FIG 3.7.6

SCALE

0 50 100 250m

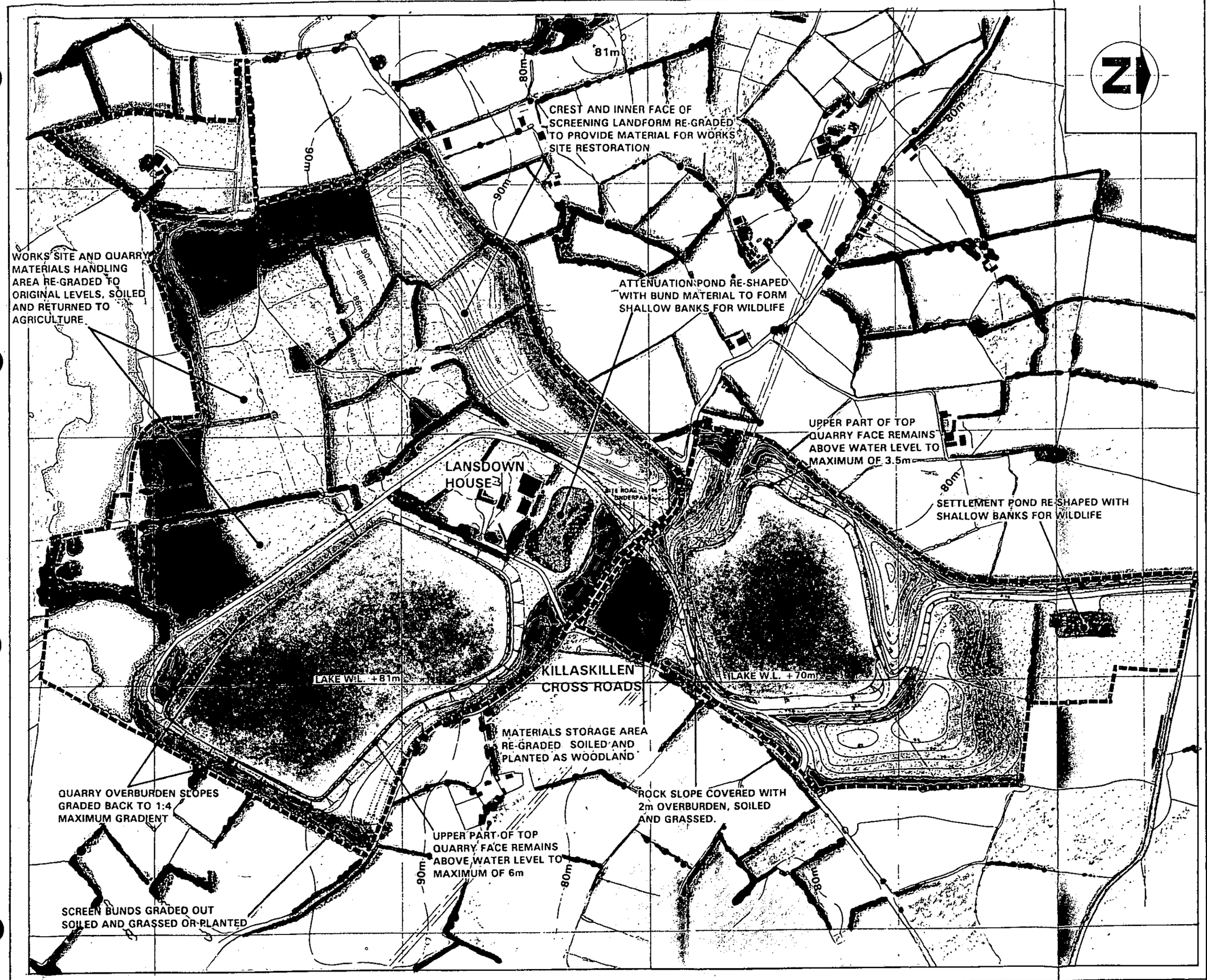
LAGAN CEMENT LIMITED
ROSEMOUNT BUSINESS PARK
BALLYCOOLIN ROAD, DUBLIN 11
TEL: 01820 1070 FAX: 01820 1901

LANSDOWN CEMENT WORKS
KILLASKILLEN, CO. MEATH

TITLE:

CROSS SECTIONS - LOCAL

Nº **3.7.10**



LAGAN CEMENT LIMITED
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TEL: 01820 1070 FAX: 01820 1901

LANSDOWN CEMENT WORKS
KILLASKILLEN, CO. MEATH

TITLE:

RESTORATION PROPOSALS

N° 3.7.11

SECTION 3:

THE ENVIRONMENT IMPACTS AND MITIGATION

HUMAN BEINGS	3.1
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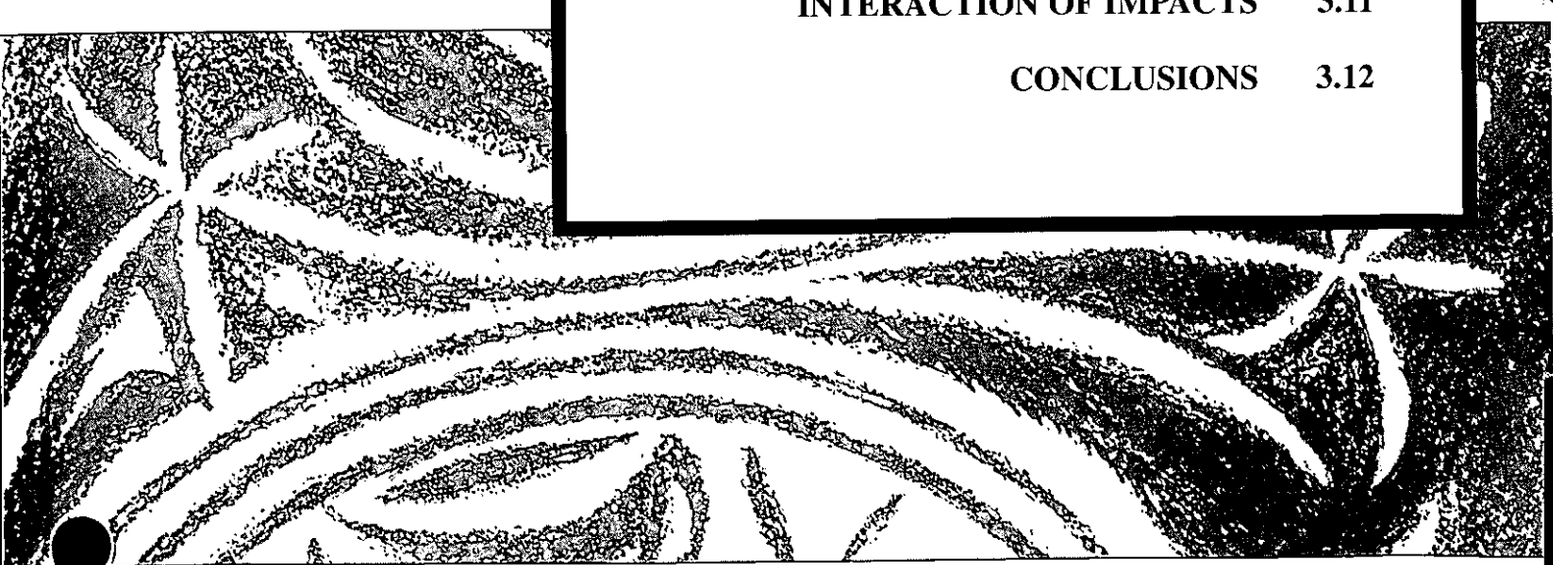
AIR AND CLIMATE	3.5
NOISE AND VIBRATION	3.6
LANDSCAPE AND VISUAL	3.7
MATERIAL ASSETS	3.8
CULTURAL HERITAGE	3.9
TRAFFIC	3.10
INTERACTION OF IMPACTS	3.11
CONCLUSIONS	3.12



SECTION 3.8

MATERIAL ASSETS

3.8.1 Introduction

This section considers the material assets in the region adjoining the proposed cement works. The term 'material assets' is used to describe the physical resources in the environment which may be of either human or natural origin. The objective of this assessment is therefore, to ensure that, in so far as possible, these assets are used in a sustainable manner such that they will be available for future generations.

3.8.2 Material Assets in the Existing Environment

The region adjoining the proposed site is very rural in character and sparsely populated. There is little or no manufacturing industry in existence and the service industry in the region is orientated solely towards agriculture, existing population and passing trade.

Within 3 kms from the site boundaries the following materials assets have been identified. All of these material assets are considered relevant in the context of the proposed development and are addressed in the following text:

Kinnegad Town.

- The village of Ballinabrackey.
- Various residences.
- Agricultural land on and surrounding the site.
- Commercially and privately worked peat bogs to the south, east and west of the site.
- Limestone and shale resources, on and off site.
- The local county road infrastructure and the N6 primary route.
- Areas of woodland, on site and to the south and west.

3.8.2.1 *Kinnegad Town:*

Kinnegad town serves as a local centre and at the time of the 1996 Census had a population of 517 people. This population is expanding and a new housing estate has recently been completed and another is under construction. Due to the town's strategic position at the intersection of the two main routes to the west of Ireland, the N4 and the N6, Kinnegad benefits from the demand for services generated from passing trade. Basic amenities available in the town include a number of small grocers, public houses, restaurants, take aways etc.

Surprisingly, there is little in the way of services for the surrounding agricultural industry. Apart from service stations, there is only one agricultural supply business in the town.

3.8.2.2 *Ballinabrackey:*

This village lies approximately 1.5km to the south of the southern end of the proposed site. It has a very small population (<100) and only very basic amenities such as a grocery store and a church.

3.8.2.3 *Agricultural land:*

According to information received from the Department of Agriculture, Food and Forestry, in County Meath there are 48,047 hectares of agricultural land classified as 'Disadvantaged' and all of this is regarded as 'LESS SEVERELY HANDICAPPED'. In May 1996 the following District Electoral Divisions which surround the area of the proposed site were designated as 'LESS SEVERELY HANDICAPPED':-

- Ardnamullen
- Ballyboggan
- Castlejordan.

A landuse survey undertaken for the Human Beings section of this EIS has revealed that over 90% of agricultural land in the vicinity of the site is used for pasture or the harvesting of hay or silage. Much of this land, particularly adjacent to areas of peat bog or streams and rivers, is of poor quality and would be classified as 'wet' and 'un-improved'. This is due to the high moisture content of the soils in question and also to the low pH of soils adjacent to areas of peat. As a consequence of this, the productivity of the agricultural land in the area is generally quite low and the associated farming is non-intensive.

Land Use:

Farms within an area of about 1 km radius of the proposed development site were surveyed and the following enterprises were found to be present:

Commercial dairy herds
Suckler cow herds
Beef enterprises
Sheep enterprises Poultry farm
Tillage
Turf cutting

Most farms support a mixture of the afore mentioned enterprises. The poultry farm within the site boundary is owned by Lagan Cement Limited and it will cease production if the development proceeds. The majority of the enterprises present are grass based with some turf cutting on the bogs to the south Lansdown site. Farm size in the area is variable with the majority being greater than 100 acres especially when rented and leased lands are taken into account.

Soil:

Farming in the area surveyed is influenced mainly by soil type. When classifying soils they can be divided into Great Soil Groups of which there are ten occurring in Ireland. The three Great Soil Groups and four Peat Soils occurring in the vicinity of the proposed site and the associated Soil Series are as follows: [1] [2]

Regosol Group

Milltownpass Series

Grey Brown Podzolic Group

Patrickswell Series

Gley Group

Howardstown Series

Mylerstown Series

Camogue Series

Peat Soils

Allen Series

Turbary Complex

Gortnamona Series

Banagher Series

Detailed descriptions of the above are given in Appendix 3.3.3.

Water:

The whole site lies within the catchment of the Kinnegad river while areas to the south of the site are within the area catchment of the Castlejordan river. Sampling the surface water at various locations showed varying levels of contamination (see Section 3.4: Water and Hydrology). The majority of farmers who have surface water resources on their farms allow their livestock to drink from this source.

---

1 An Foras Taluntais, Soils of County Meath

2 An Foras Taluntais, Soils of County Westmeath

The local population, including the farming community and their livestock, are generally reliant on groundwater supplies. Groundwater resources in the area are limited as there are no major aquifers of regional significance. The results of field and laboratory hydrochemical analysis show that some contamination exists in the groundwater system (see Section 3.4: Water and Hydrology).

Surface Vegetation:

The more productive pastures on the site and on the adjacent lands have a high proportion of perennial ryegrasses (Lolium perenne) while the less productive pastures are dominated by such species as meadow grasses (Poa trivialis and Poa annua), bent grasses (Agrostis capillaris and Agrostis stolonifera), cocksfoot (Dactylis glomerata), Yorkshire fog (Holcus lanatus) and timothy (Phleum pratense).

At present there is a field of linseed (Linum usitatissimum) on the area of the proposed limestone quarry. There is a small acreage of winter wheat (Triticum spp.) or winter barley (Hordeum spp.) in the immediate vicinity of the Lansdown site. For further detail on this subject refer to Section 3.2: Flora and Fauna.

3.8.2.4 *Peat Bogs*

Situated in the midlands of Ireland, areas of raised bog are a feature in the region surrounding the proposed development. Three adjacent areas of peat bog are relevant in this context. These lie to the south, east and west of the site. The area of bog to the east is more extensive and is located approximately 800 metres from the site boundary.; to the west it is 1500 metres. These bogs are worked both on a private basis and also commercially by Bord na Mona. The commercial operation includes the harvesting of turf and also the milling of peat for further processing. From a commercial and social perspective these peat bogs are a valuable asset. The bog to the south is smaller, covering an area of approximately 100 hectares. It stretches east to west along the southern boundary of the site with a small proportion (~5%) located just within the site. This bog is worked on a private basis and still represents an important source of fuel to individuals with turborary rights.

3.8.2.5 *Limestone and shale resources*

The proposed site overlies a unique deposit of limestone which is of high purity. This limestone is often call the Reef Limestone and its sub-crop width is at least 1,000 metres. Data from the Geological Survey of Ireland suggests that this limestone is many hundreds of metres thick and in light of this it represents a very significant, albeit non-renewable, resource.

An area of dark grey shales and shaley limestones (the Tober Colleen Formation and the Lucan Formation) exists beneath the northern part of the site. This comprises a number of different rock types and on its own would not normally be considered a valuable resource.

3.8.2.6 *Roads Infrastructure*

The roads infrastructure in the area consists of a network of county roads of generally poor quality, both in width and alignment. These roads connect local townlands, provide access to agricultural lands and link various villages with Kinnegad. To the north of the site, running east-west is the N6 national primary road. This section of the N6 is considered to be substandard and there are advanced proposals to upgrade it to dual carriageway or motorway standard.

3.8.2.7 *Woodlands*

There are four woodlands within 3km from the site. An area of broadleaf woodland, of approximately 10 hectares, lies just to the south of the site, while a considerably smaller area (~3Ha) lies over 1km to the west. A large area of coniferous plantation is located over 1.5 kms to the southwest. A small area (~2Ha) of broadleaf woodland exists within the site at the southern boundary.

3.8.3 Impacts and Mitigation Measures

3.8.3.1 *Do Nothing Impact*

In the absence of the proposed development the majority of the material assets described above are likely to remain unchanged for the foreseeable future. Due to the low productivity of the soils in the area, farming is unlikely to intensify and the present nature of agricultural practice will continue. Geological resources will remain unexploited and the areas of broadleaf woodland will also probably remain as they are. The future of the plantation of coniferous trees to the west of the site will probably be largely influenced by the policies of Coillte, and by market trends. Present trends regarding peatbogs in the area suggest that they will continue to be worked and, particularly in the case of the Bord na Mona commercial bogs, they will eventually become completely exploited. There are no plans, at present, to upgrade the county road infrastructure. However, serious proposals are under consideration to upgrade the N6 to dual carriageway or motorway standard. This road will then bypass Kinnegad to the south linking with the N4 east of Kinnegad.

3.8.3.2 *Predicted Impact and Mitigation Measures*

All potential impacts, both positive and negative, on material assets due to the construction of the proposed cement plant and the extraction of the necessary rock deposits have been addressed individually here or in other sub-sections of Section 3, and where negative impacts have been highlighted appropriate mitigation measures have been proposed.

Predicted Impacts On Agriculture

It is estimated from the dispersion modelling (see Appendix3.5.2) that the average deposition rate from the entire plant will be 48.8 mg/m^2/day (72 kg/acre/year) while the maximum predicted dust deposition rate will be 97.0 mg/m^2/day (143 kg/acre/year). Since the main raw materials used in cement manufacture are limestone (mainly calcium carbonate with calcium oxide being formed during calcining) and shale (silica, alumina and iron oxide) these materials will be represented in the dust emissions. With kaolin and gypsum (calcium sulphate) also added during the process, the dominant particulate emissions will be alkaline in reaction.

The practical effect of this should be to help counteract any potential acidic effect on soils from sulphur dioxide emissions (see Section 3.5: Air and Climate). The raw materials are especially low in heavy metals and therefore the heavy metal emissions will be very low (see Section 3.3 : Soils and Geology).

The other major change resulting from the development would be the excavation of the shale and limestone quarries and their dewatering. Whether this dewatering process and the resultant lowering of the water table will have an effect on crop growth is discussed in Appendix 3.4.5.

That discussion concludes that since plants are more or less independent of capillary adjustment for their immediate water supply from soils which are relatively high in moisture, and taking soil type into consideration, the proposed dewatering process associated with the Lansdown site will not adversely affect agricultural crops grown in the vicinity of the site.

The impacts of the proposed development of the Lansdown site on the quantity and quality of surface waters and ground waters are discussed in Section 3.4 : Water and Hydrology.

The Kinnegad river is more than capable of handling the extra volumes of water which will be discharged in its channel and the increased volume may have a beneficial effect. The peat bog to the south of the site is not considered to be at risk from the proposed dewatering scheme (see Appendix 3.4.3). Lagan Cement Limited propose to provide adequate deep wells or alternative supplies where current ground water supplies may be affected. Monitoring, water treatment and pollution prevention measures will be incorporated within the scheme proposals (see Section 2.1.5.5)

About 90ha of the agricultural lands on the site, mainly pasture and some tillage, will be required for the development, plus about 37ha for new landforms and screen bunds. The remaining area of about 30ha could remain in agricultural use. The removal of 127 hectares of land from agricultural production will not have a significant impact on agriculture in the area.

The possibility of blasting having an impact on either farm buildings and slatted tanks or on livestock has been considered, as follows:

Impact on structures:

The principal agricultural structures of possible concern are slatted cattle sheds and milking parlours. None of these is within 300m of the proposed quarries so the vibrations from blasting will be well below the normal maximum permitted vibration levels at structures in Ireland.

A detailed research programme carried out in the late 1970's by the US Bureau of Mines found that in order to cause structural damage in masonry, brick or concrete buildings, vibration levels of over 50mm per second were required. At very low vibration levels the threshold of cosmetic damage (hair line cracks in plaster) was found to be 12.7mm per second. Subsequent work elsewhere has confirmed this finding.

It is proposed that the maximum vibration levels at buildings near to the site will be 12mm per second. Those at some distance will experience much lower vibration levels; in consequence there is no likelihood of structural damage to properly built cattle sheds or milking parlours due to blasting. These structures are usually built of reinforced concrete or blockwork well able to withhold blast vibration several times greater than the proposed maximum.

Impact on cattle and sheep:

An extensive search of published literature has failed to disclose any report of adverse effects on cattle or sheep in terms of either behaviour, productivity or fertility. This is not surprising since blasts last for less than 1 second and rarely take place more than once a day. At Lansdown blasting is likely to be required at intervals of 10 to 15 days. The blasting will be far less disturbing for cattle than a thunderstorm. It is concluded therefore that there is no likelihood of structural damage to any slatted tanks or any adverse effect on livestock.

Impacts on traffic:

The projected increase in vehicle movements generated by various aspects of the development are detailed in Section 3.10. The impact of these increases will be addressed by the following:

- A new road to join the N6 and one of the county roads.
- The 700 metre section of county road between the site entrance and the new road will upgraded by widening and resurfacing.
- Linking the northern section of the site to the southern section by means of an underpass

Due to these proposals the roads in the area will not be adversely effected and movement of livestock and agricultural machinery should be able to continue as at present. The alternative access road will only be used in cases of emergency, and will otherwise be closed by a lockable gate.

3.8.4 Conclusions

1. The proposed dewatering process associated with the Lansdown site will not adversely affect agricultural crops grown in the vicinity of the site.

2. Lagan Cement Limited will provide adequate alternative supplies where current ground water supplies for agriculture may be significantly affected.

3. Monitoring, water treatment and pollution prevention measures will be incorporated within the scheme proposals.

4. The removal of 127 hectares of land from agricultural production will not have a significant impact on agriculture in the area.

5. The roads in the area will not be adversely effected and movement of livestock and agricultural machinery should be able to continue as at present.

6. While the proposed development of the Lansdown site will impact on agriculture in the vicinity of the site, these impacts have been provided for by Lagan Cement Limited by avoidance, reduction or remedy.

SECTION 3:

THE ENVIRONMENT IMPACTS AND MITIGATION

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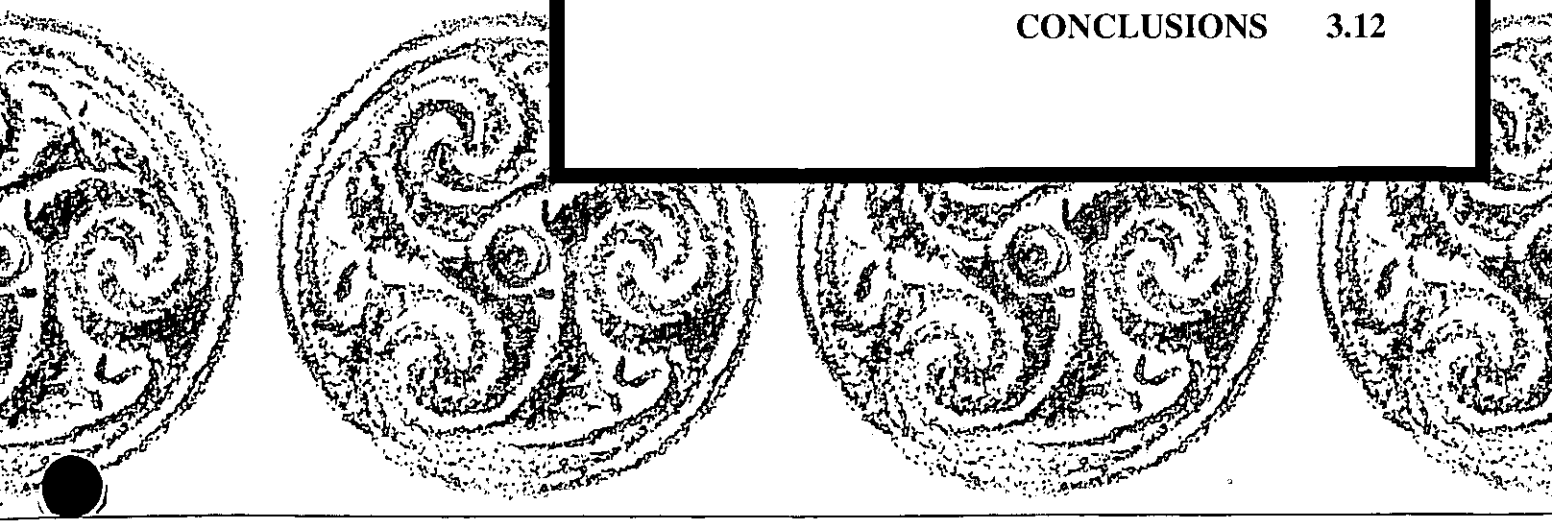


SECTION 3.9

CULTURAL HERITAGE

3.9.1 Introduction

This section gives an account of the archaeological significance of Killaskillen and surrounding townlands, Co. Meath (O.S. 6 inch Sheet 46 & 46a, Drawing No 1). The archaeological survey was carried out in response to a request by the client, Lagan Cement Limited, Rosemount, Ballycoolin Road, Dublin 1, for an Environmental Impact Statement prior to a Planning Application. As the proposed entrance to the quarry may be located in County Westmeath, O.S. 6 inch Sheets 27 and 34 for that county were also examined. **There are no archaeological sites identified in the Record of Monuments and Places for County Meath for Killaskillen townland (Office of Public Works, Drawing No 1).**

The surrounding townlands of Baltigeer, Kikeeran, Toor, Toornafolla, Knockersally and Rossan contain sites that are identified in the Sites and Monuments Record for County Meath. These sites are listed as a togher, a field system, a church, two enclosure sites, a church site, tomb fragments, an earthwork site and a bridge.

In County Westmeath (O.S. 6 inch Sheet 34) in the townland of Rattin two sites are listed as a castle (S.M.R. 34:8) and an earthwork site (S.M.R. 34:7). In the same townland (O.S. 6 inch Sheet 27) there is a graveyard (S.M.R. 27:66) with a cross and standing stone and ecclesiastical remains (S.M.R. 27:67) which include a rectangular enclosure and a possible church site. However, all these sites in Rattin townland are located some distance from the proposed quarry. The only two sites that require some consideration are two ringforts (S.M.R. 27:69 and 27:70) located near the possible entrance in the townland of Kinnegad. An archaeological inspection of the proposed development site in Killaskillen townland was carried out on Monday, 16th February, 1998. A further inspection of additional land that extends into the townland of Cappaboggan was carried out on Wednesday, 29th April, 1998.

3.9.2 Archaeology In The Existing Environment

3.9.2.1 *Archaeological and Historical Background*

The site of the proposed quarry is located in the townland of Killaskillen which is located south of the town of Kinnegad, Co. Westmeath. Kinnegad is a small market town at the junction of Dublin to Athlone and Dublin to Mullingar roads. Four miles east of Kinnegad is the town of Clonard. North-east of the main road on the east side of the Trim road a Protestant Church marks the site of the Early Christian Monastery which was founded here in 515. The founding Saint was St. Finnian who died in 549. He was Bishop and Abbot of Clonard. According to legend St. Finnian was "the tutor of the Saints of Ireland" and he was one of the foremost monastic founders of the 6th century. Clonard grew to become one of the three eminent monasteries of early Ireland, its school being among the first six. The Episcopal Monastery survived many burning and sackings during the 9th-12th centuries. Around the year 74A.D. Clonard became the see of the diocese of Meath, newly constituted by Bishop Echtighern MacMaoil-Chiarain from the ancient petty bishoprics of Clonard, Kells, Ardbraccan, Slane, Trim and Duleek. In 1201 the first Anglo-Norman Bishop transferred the see to Trim and the Abbey lost its Gaelic character. However St. Peter's Augustinian Priory survived until the Dissolution. The ruins were swept away centuries ago and the sole surviving relic of medieval Clonard is the 15th century octagonal sculptured font in the

Protestant church. Figure subjects include *The Flight into Egypt, The Baptism of Christ, St. Peter, St. Finnian and other saints.* In 1182 Hugh de Lacy built a castle near the monastery of which the conspicuous motte survives to the west of the Trim road.

Three miles south-west of Clonard on the left bank of the river Boyne are the remains of Ticroghan Castle, alias queen Mary's Castle and its 17th century enclosing star fort. After Cromwell's sack of Drogheda in 1649, the Royalist commander in Ireland Ormonde, retired to Ticroghan from Trim. The following year the castle was stubbornly defended by Lady Fitzgarret against the parliamentarian Colonels Reynolds and Hewson. According to legend, the attackers were about to withdraw when they noticed that the defenders, short of ammunition, were firing silver bullets. The assault was renewed and the castle captured. Three miles west of Kinnegad beside the old Galway road is the small churchyard of Clonfad (Cluain Fota-Baitan Aba). It marks the site of a monastery founded by St. Etchen, the Bishop who is said to have ordained St. Columcille. In the churchyard are the upper part and socket of an unfigured High Cross and a fragment of a smaller cross. A new cross 1958 was erected at the nearby Bishop's Grave to commemorate St. Etchen.

3.9.2.2 ***Sites and Monuments Record for County Meath (Drawing No 1)***

S.M.R. 46:1 Togher (O.S. 46:5:2/5) Baltigeer Townland (Drawing No 1)

This togher which was located in the Bog of Allen consisted of beams of oak laid down in a haphazard manner. There were five layers in total and gravel and sand was visible on the top most layer. Above this level a pavement of birch rods was evident, each measuring an inch in diameter. The birch rods formed a footway between 11-12ft in width. The beams of oak extended 5ft either side beyond this. The beams were flat planks and were hacked with axes and pegged down through holes. This togher was found buried at 8ft in the bog. A small socketed spearhead of Late Bronze Age origin around 400 B.C. was found in association with this. It is possible that this togher formed part of the Slighe Dala which was the road from Tara to Co. Tipperary, part of which was located further north.

S.M.R. 46:2/3 Field System and Church (O.S. 46:5:6) Baltigeer Townland (Drawing No 1)

The site consists of the ruins of a church within a ditch enclosure. The church is located in the north-west quadrant of the site slightly off centre. Gravestones of 19th century date are visible around the church and a millstone is located to the east of the church. All that remains of the church are portions of the north and south walls towards the west end. These ruins have a width of 5.3m and a length of 11.9m. The east wall is also visible and has a base batter. There is a small window and two internal recesses in this section of wall. The millstone located to the east of the church has a diameter of 0.93m north-south and 0.6m east-west. The ditch surrounding the site measures 7-8m in width and is flat bottomed. It measures 1.4m below the interior and 0.8m below the exterior. The east side of the ditch is destroyed by a field fence and at a distance of 150m west of the church is a bullaun stone.

S.M.R. 46:11 Enclosure Site (O.S. 46:11:1) Knockersally Townland (Drawing No 1)

This site is located in the townland of Knockersally but nothing is visible on the Ordnance Survey maps. However the site was picked up on an aerial photograph.

S.M.R. 46:12 Church Site (O.S. 46:13:3) Kilkeeran Townland (Drawing No 1)

This site is located in the townland of Kilkeeran. It is shown as a graveyard on the 1911 and on the 1837 Ordnance Survey maps. Kilkeeran graveyard is sub-rectangular in shape and has no evidence of a church. Burials in the graveyard date from 1776 to 1979. It is located on a slight local prominence and surrounded by a stone wall. It is listed as non archaeological.

S.M.R. 46:13 Tomb Fragments, Toor Townland (Drawing No 1)

Located in the townland of Toor these tomb fragments consist of two pieces of carved panels. They are now located in the new Catholic Church of Ballynabracky but are believed to have come from the Augustinian Holy Trinity Church of Ballyboggan. They are built in the sacristy wall of the church which is approximately 100 years old.

S.M.R. 46:14 Earthwork Site (O.S. 46:14:2) Toornafolla Townland (Drawing No 1)

Located in the townland of Toornafolla this site is marked "Fort" on the First Edition Ordnance Survey map. It is hachured on the 1913 O.S. edition. This earthwork has now been bulldozed but originally lay on a slight eminence. It was approximately 34m in diameter east-west.

3.9.2.3 ***Sites and Monuments Record for County Westmeath (Drawing 2)***

S.M.R. 27:69 Ringfort (O.S. 27:16:4) Kinnegad Townland (Drawing No 2)

This site appears to be a badly damaged ringfort. It is an oval enclosure and there is a clearly defined curve in the field fence to the south. There is a steep drop on the south side of this fence with indications of a possible external fosse. The outline of the remainder of the site can be traced in the field, though there are some gaps in the circumference. The outline is indicated by a low ridge, ill defined in places and traces of a shallow external fosse. The fosse is indicated by a shallow depression in the ground and a marked change in the vegetation. The outline is most clearly visible on the east side. The internal diameter from north-east to south-west measures circa 27m. This site is visible on the 1876 O.S. map.

S.M.R. 27:70 Ringfort (O.S. 27:16:6) Kinnegad Townland (Drawing No 2)

This site consists of an unusually small uneven enclosure bounded by a very low broad bank with slight remains of a fosse outside it. The site slopes from west north-west to east south-east. The bank rises slightly above the interior but is better defined on the outside. A fosse that has silted up surrounds the site and the entrance is not visible. The diameter of the ringfort measures 28m west south-west to east north-east and 23m

north north-west to south south-east. The bank measures 1.5m at the top and its internal height is circa 0.05m. The external height of the bank is 0.2m and the fosse measures 5.4m in width at the top.

3.9.2.4 *Conclusion*

The townland of Killaskillen and the site of the proposed development contains no archaeological sites listed in the Record of Monuments and Places for County Meath. The main concentration of Field Monuments is to the south of this townland. Archaeological sites are visible in surrounding townlands but these are located some distance from the site of the proposed development. An archaeological inspection of the site which was carried out on 16th February, 1998 and 29th April, 1998 revealed no evidence of surface features or field monuments.

3.9.3 Impact Of Proposed Quarry On S.M.R. Sites

The proposed quarry will not have an impact on the S.M.R. sites in the townland surrounding Killaskillen as they are all located some distance from the area where quarrying is intended to take place. The proposed entrance to the site is the only area that is anywhere near an S.M.R. site. S.M.R. 27:69 which is a destroyed ringfort is located west of the proposed entrance/laneway and separated from it by a dwelling house. It is a sufficient distance from the laneway and will not be impacted upon. Field walking of the site did not reveal the presence of any low visibility features. As much of the land is marshy and many of the fields are surrounded by drains there is a possibility that fulachta fiadh might exist in this area. However, there was no evidence for these on the surface.

3.9.4 Mitigation Measures Proposed

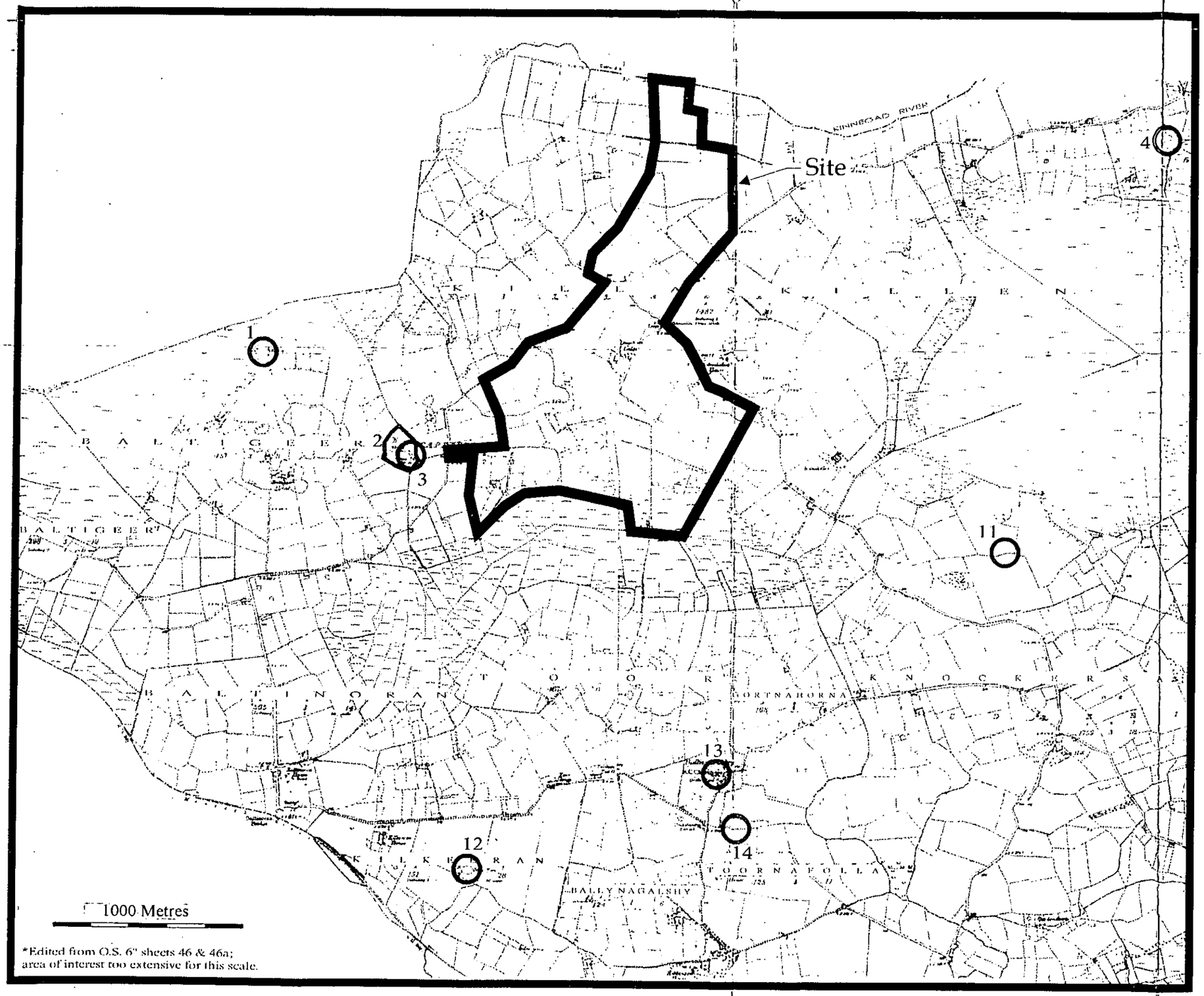
It is recommended that the stripping of topsoil for the proposed quarry and plant be carried out under periodic archaeological supervision. Should archaeological material be discovered during the course of archaeological monitoring it is recommended that the archaeologist fully records this and the developer shall comply with all requirements in the National Monuments legislation with regard to the appropriate course of action.

3.9.5 Bibliography

Killanin and Duignan, M.V., 1962, "The Shell Guide to Ireland", Dublin, 1962.

S.M.R. Files for County Meath, Office of Public Works, Stephens Green, Dublin.

S.M.R. Files for County Westmeath, Office of Public Works, Stephens Green, Dublin.



*Edited from O.S. 6" sheets 46 & 46a; area of interest too extensive for this scale.

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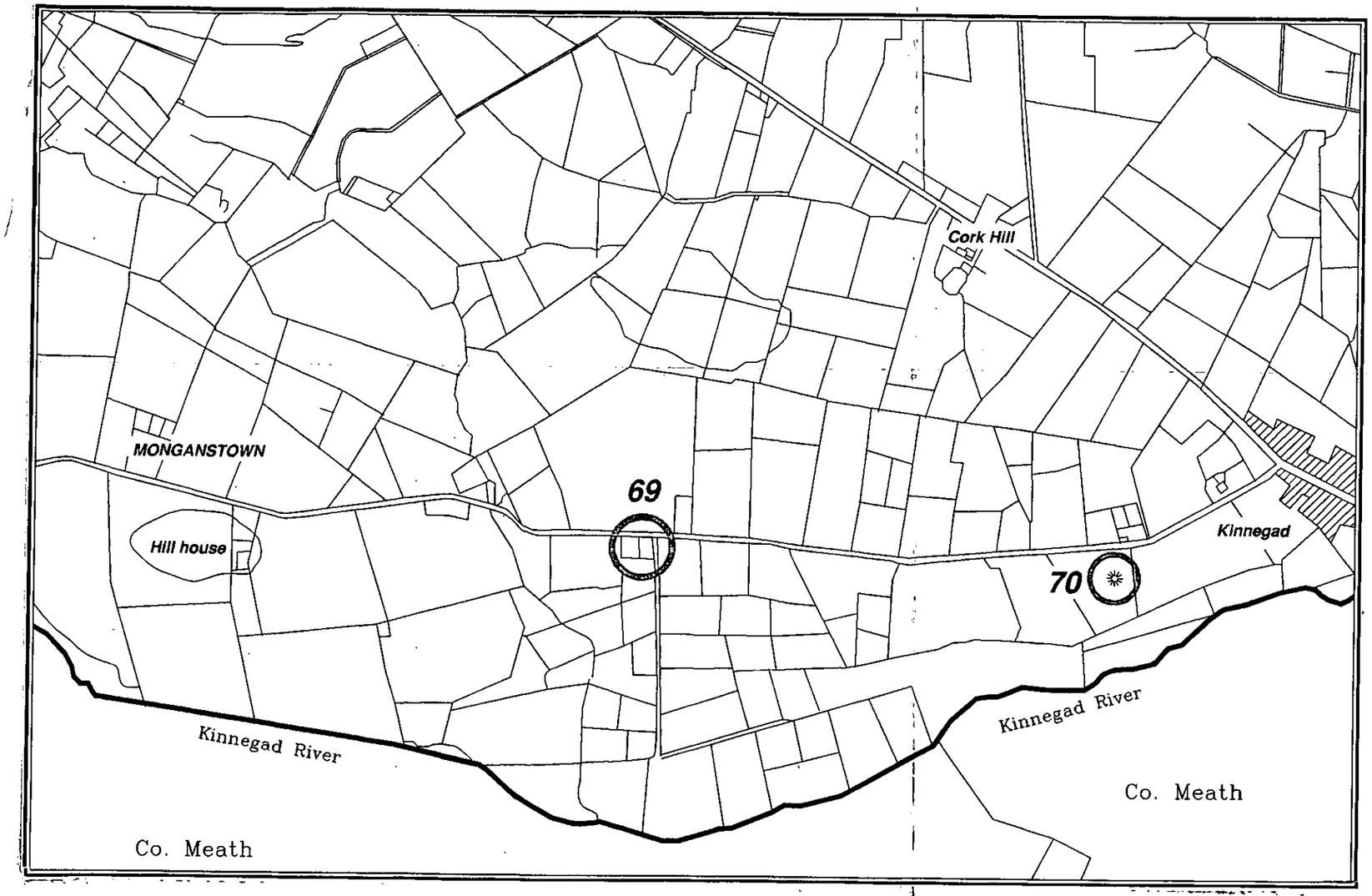
LANSDOWN
CEMENT WORKS
KILLASKILLEN, CO. MEATH

TITLE:

SITES AND MONUMENTS RECORD FOR CO. MEATH

Nº **3.9.1**



1000 Metres

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CEMENT WORKS
KILLASKILLEN, CO. MEATH

TITLE:

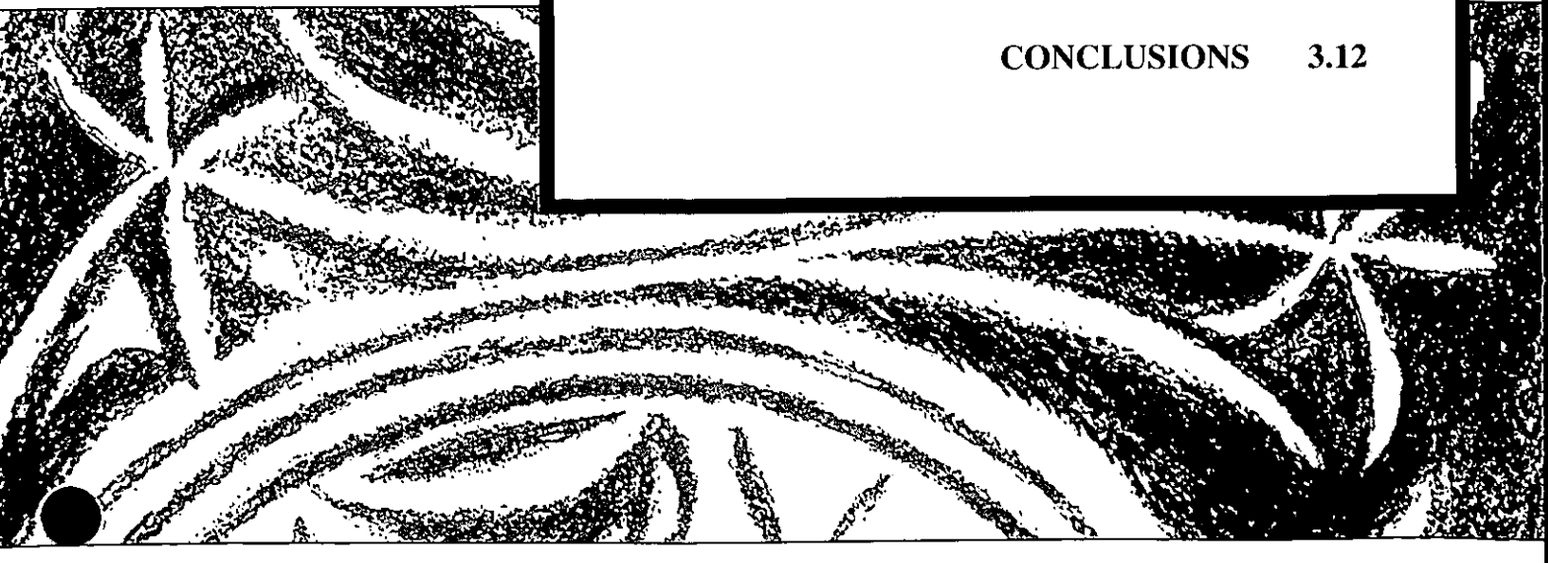
SITES AND MONUMENTS RECORD FOR CO. WESTMEATH

Nº **3.9.2**

SECTION 3:

THE ENVIRONMENT IMPACTS AND MITIGATION

HUMAN BEINGS	3.1
FLORA AND FAUNA	3.2
SOILS AND GEOLOGY	3.3
WATER AND HYDROGEOLOGY	3.4
AIR AND CLIMATE	3.5
NOISE AND VIBRATION	3.6
LANDSCAPE AND VISUAL	3.7
MATERIAL ASSETS	3.8
CULTURAL HERITAGE	3.9
TRAFFIC	3.10
INTERACTION OF IMPACTS	3.11
CONCLUSIONS	3.12



SECTION 3.10

TRAFFIC AND TRANSPORTATION

3.10.1 Existing Road Infrastructure.

The development site is located approximately 3 km to the southwest of Kinnegad. The proposed access to the site is from the N6 Galway Road approximately 1.5 kms west of the town.

Current access to this site is at Lansdown Lodge, from a county road which joins the N4 national primary road just east of Kinnegad. This county road forms part of a network of county roads in the area which provides access to agricultural lands and links various villages with Kinnegad and Milltownpass.

The primary road network in the area comprises the N6, Galway-Dublin road, and the N4, Sligo-Dublin road. The N4 approaches Kinnegad from the east, passes through the town and continues to the northwest towards Mullingar. The N6 branches off the N4 in the centre of Kinnegad and continues westwards, passing to the north of the proposed site. Both of these primary roads are generally of a high standard and they serve to connect the east and midlands of Ireland with the west of the country. Adjacent to Kilcock, the N4 becomes the M4 motorway. The M4 connects with the M50 which links with the M1 motorway north of Dublin and provides easy and high standard access to the northeast of the country.

Traffic counts have been obtained from the National Roads Authority (NRA) for the N6 and the N4. The following estimated Annual Average Daily Traffic (AADT) figures are given in the NRA publication *RT.550, National Roads And Traffic Flow 1996,* T.J. Holland. These are the most up to date figures available. However, the NRA estimate a present increase in AADT on these roads at 7% per annum. Thus, we can compound the 1996 figures, at 7% per annum, and arrive at an estimated figure for the year 2000.

1. N6 – Just west of Kinnegad:

1996	Estimated AADT	= **7,210**
	% HGV	= 16 %
2000	Estimated AADT	= **9,445**
	% HGV	= 16 %

2. N4 – Just east of Kinnegad:

1996	Estimated AADT	= **11,682**
	% HGV	= 16%
2000	Estimated AADT	= **15,305**
	% HGV	= 16%

3.10.2 Future Road Improvements

The following are the policy objectives of the relevant Statutory Authorities:-

- The NRA Operational Programme for Transport, 1994-1999, in its Indicative List of Projects in Planning which will be considered for construction in the period 1994 includes:
  - N4 Kilcock/Kinnegad.
- Westmeath County Development Plan 1994 contains the following objectives:-
  - The commencement and completion of a by-pass of Kinnegad for the N6. *This is scheduled to be completed by mid-1999.*
  - The establishment of a line and the design of a complete by-pass, of Kinnegad, for all N4 and N6 traffic.
  - N4 – Complete design and commence works on dual carraigeway improvements from The Downs to Kinnegad.
  - N6 – Complete design and continue improvements from Rochfortbridge to Kinnegad.
  - N6 – Complete design and implement works as appropriate on by-passes of Moate, Kilbeggan, Tyrellspass, Rochfortbridge and Milltownpass.
- Meath County Development Plan 1994 contains the following objective:-
  - Development Objectives, (i) Motorways – M4 : Western Motorway, (part of) Kilcock – Kinnegad

3.10.3 The Development – Traffic Generation

Construction Phase:
Traffic generated during this phase will include approximately 120 passenger vehicle movements associated with the construction workforce. About 200 on site vehicle movements per day will be required to remove the overburden from the plant and quarry areas. This traffic will be contained on site as the removed overburden will be used to build the screening banks and landforms. It is estimated that up to 40 HGV movements per day will be required to bring in construction material.

Operational Phase:
The operational phase will generate both internal and external traffic. Internal traffic is that which operates within the site only. External traffic consists of all vehicles which travel to and from the site. This traffic includes heavy goods vehicles required to import and export materials and fuels to and from the site. Passenger cars, used by employees to commute to and from work, and service vehicles are also included in this

category. In the context of an EIS, the external traffic requires most consideration as it is this traffic which must be accommodated by the surrounding road infrastructure.

The projected number of vehicle movements generated by the various aspects of the development are given below in Tables 1 and 2.

Note: A vehicle arriving and leaving the site corresponds to **2** vehicle movements.

Table 1. Internal Traffic	No. of vehicle movements per day
Transport of material from the limestone quarry.	70
Recovery of silty shale, from shale quarry.	44 For two months each year
Recovery of shaley limestone, from shale quarry	52 For six months each year

Table 2. External Traffic	No. of vehicle movements per day
Employee vehicles (PCUs).	280
Vehicles importing raw materials and fuel (HGVs).	50
Vehicles exporting product (HGVs).	120

The following factors relevant to the traffic projections for the operational phase should be noted:

- The works will operate a 3 x 8 hour shift system, 24 hours a day, 7 days a week.
- The importation of raw materials will occur between the hours of 7.30am and 6pm.
- It is estimated that 6 passengers cars per 10 employees will be generated.

3.10.4 Receiving Environment

At full production the proposed cement plant is expected to produce 150,000t per annum of white cement and 300,000t per annum of ordinary portland cement (OPC). All, or almost all, of the white cement will be destined for the export market, while it is expected that the OPC will destined for the Irish market.

From this and the figures given above it is estimated that 40 truck movements will be required daily to export the white cement. These HGVs will traverse a short section of the N6 to Kinnegad, will then travel the N4 and M4 after which they will either continue to Dublin Port or link with the M1, via the M50, and terminate at the port of Drogheda.

It is estimated further that 80 truck movements per day will be required to move the OPC and the majority of these truck movements will travel east on the route described above.

50 truck movements per day will be required for the importation of raw materials and fuel. It estimated that 30% of these will affect the N6 west of the plant, 60% will affect the N4 and M4 to the east while the remainder will involve shorter local trips which are difficult to predict at this stage.

3.10.5 Road Proposals

Access to Plant and Quarry:
The total number of daily vehicle movements generated by both the construction and operational phase represents a considerable traffic flow. This traffic must be managed carefully so as to ensure the safe passage of each vehicle and also to ensure that this additional traffic does not have a significant negative impact on either the residents or the road network in the area.

The issue of access to and from the site was considered carefully in the light of the existing roads infrastructure and existing traffic flows. Proposals by Westmeath County Council to improve the N6 and N4 and to by-pass Kinnegad were also taken into account.

The present access to the site, via the county road as described in Section 3.10.1 above, has been rejected on the grounds that certain sections of this road are badly aligned and unsuitable for the passage of heavy goods vehicles. Moreover, a number of houses are located adjacent to eastern section of this road near to Kinnegad. It was considered that the negative impacts on these residents from site traffic would have been unacceptable.

In light of this, the developer has gone to great lengths to identify and secure an alternative access route into the site. The proposed new access to and from the site is illustrated in Drawing 3.10.1 and is described below. Separate planning applications are being submitted to Meath County Council and to Westmeath County Council, for the sections of the proposed access road which fall within the respective counties.

Traffic will enter and exit the site, onto the existing county road, from the northeast section of the proposed site at a point approximately 400 metres northeast of the Killaskillen Cross Roads. The site traffic will then travel northeastwards for approximately 700 metres along the straightest and most improved stretch of this county road. At this point a new road will be constructed which will connect with the N6 national primary route, approximately 1km to the north. This new road will divert traffic associated with the development away from the poorer sections of the county road.

On Site:
The internal road layout is designed to connect all the major features of the development (see Drawings No. 2.1.1B, N & S in Section 2.1). The principal road within the site will run from the very north of the site, east of the shale quarry and south to the cement works. An underpass will be constructed under the county road which divides the northern and southern sections of the site. This underpass will ensure that internal site traffic does not conflict with existing traffic on the county road.

3.10.6 Traffic Impacts and Mitigations

Junction on to the N6:
The new access road will meet the N6 national primary route at a point approximately 1.5 kms west of Kinnegad. Sight distance at this point is greater than 300 metres in both directions. However, this road is extremely busy (Estimated AADT (1996) = 7,210) and vehicles tends to travel at high speeds on this straight but quite narrow stretch of the N6. For this reason, it is considered necessary to design a complete Traffic Management Scheme at this junction to ensure the safe interaction of site and existing traffic. The junction will be designed in full cooperation with the relevant Roads Authority.

County Roads:
To help assess the impact of site traffic on the adjoining county road network, a 7 hour traffic survey was carried out at the Killaskillen Crossroads between the hours of 8am and 3pm on the 22nd of July 1998. This survey has provided an idea of the volumes of traffic using the following county roads: Killaskillen to Kinnegad, Killaskillen to Ballinabrackey/Castlejordan and Killaskillen to Miltownpass.

The results of the survey confirms that existing traffic on these roads is very light[1]. The maximum number of vehicle movements recorded in any one hour was only 35. Mean hourly traffic figures for these roads, over the 7 hour period stated, were in the region of 20 vehicles per hour and minimum figures were as low as 10 vehicles per hour.

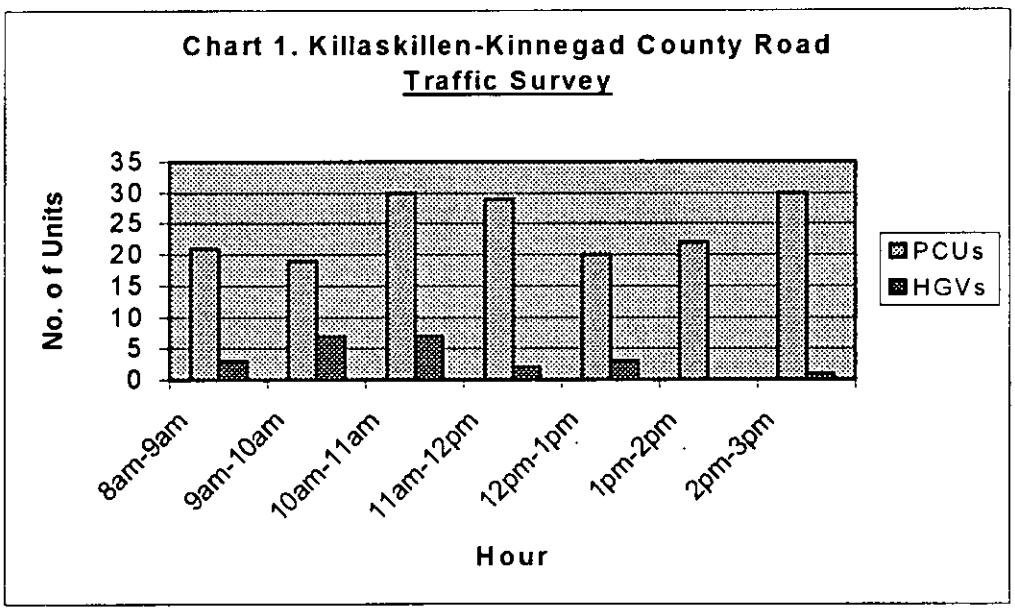
The county road which will be most affected by the development is that which runs between Killaskillen Cross Roads and Kinnegad. It is intended to use a 700 metre section of this road to provide a link between the site entrance and the new access road as described above. Nearly all commercial vehicles and the vast majority of other traffic entering and leaving the site will do so by this route.

[1] It was intended to calculate an estimated Annual Average Daily Traffic (AADT) figure for these roads using the NRAs '*Expansion Factors for Short Period Traffic Counts*'. However, due to the very small hourly traffic figures returned, it was deemed that the results would not be statistically true, even at a 68% confidence interval.

This particular section of the county road in question is of a higher standard than sections further east towards Kinnegad. The existing road surface is in good condition, with the exception of some potholes in the margins, and the alignment is straight. The present surfaced width is between 4 and 4.3 metres. At present, sight distance of 80 metres in either direction exists at the proposed entrance to the site.

Nevertheless, to accommodate the relatively large additional volumes of traffic, and in particular the HGVs, which will use this stretch of the road, it is proposed to upgrade this stretch to a suitable standard by widening and resurfacing it[2]. In addition, the junctions at the site entrance and the new access road will be designed to provide improved sight distance and the safe interaction between existing traffic and site traffic.

As mentioned above, existing traffic on this road is very light (the figures recorded during the traffic survey for this road are illustrated below in chart 1). In this regard and in the light of the above, it is not expected that traffic associated with the development will conflict to any significant degree with existing traffic on this section of the road.



PCUs = Passenger Car Units.
HGVs= Heavy Goods Vehicles.
Weather – Bright and sunny at first, overcast and wet from 11am onwards.

[2] These works will be undertaken by the local authority and will be confined within the available road boundaries. In this respect, it is not expected these road improvements will have any environmental implications.

It is also expected that a small percentage of site traffic, and particularly that associated with the work force, will use other routes to and from the site. Such traffic is likely to originate from the direction of Miltownpass, Ballinabrackey or Castlejordan and travel to and from the site via the Killaskillen Cross Roads. It is possible that some of the workforce may also use the Cappaboggan road.

The standard of the county roads which will be used by this traffic is generally quite poor. Road widths are generally less than 4 metres and as narrow as 3.3 metres in some parts. The surface condition and the alignment of the Ballinabrackey/Castlejordan road are particularly poor. Nevertheless, traffic associated with the development is not expected to have a negative effect on these roads for the following reasons.

- Only a very small proportion of the predicted volumes of traffic generated by the development will use these roads.
- No heavy goods vehicles associated with the development will use these roads.
- The existing traffic on these roads is extremely light. Traffic movements recorded on these roads (at the time of the traffic survey) did not exceed 25 vehicles per hour and mean figures were of the order of 18 vehicles per hour.

Two other very significant and fundamental mitigation measures are planned to minimise the effect of the project on the local roads infrastructure.

1. The construction of the underpass between the northern and southern sections of the site.
2. The optimisation in the use of the site in the design of the internal road layout.

These two measures will greatly reduce the effect of the development on adjoining roads by containing internal vehicle movements within the site and alleviating the need to use adjoining roads to transport materials around the site. In addition, the site entrance has been located as near as possible to the new proposed access route so as to minimise the length of county road which will be traveled by the bulk of the external site traffic.

The intended layout of internal roads and the location of the underpass are illustrated in Drawings No. 2.1.1B, N and S in Section 2.1. The design of the underpass is shown in Appendix Drawings No. 2.2.1 A and B in Appendix 2.2. During construction of the underpass it will be necessary to divert traffic around the area in question (see inset, Appendix Drawing No. 2.2.1 A, Appendix 2.2). This will cause a short-term negative impact on traffic using this county road. However, this is considered necessary in order to ensure that internal site traffic does not conflict with existing traffic on the county road in the long-term.

National Primary Routes:

The national primary routes, which site traffic is likely to use, are all generally of a high standard. Furthermore, as described in section 3.10.2 above, a number of serious proposals are already in place to upgrade any existing substandard sections of these roads. These include the proposal to provide a by-pass of Kinnegad for N6 traffic by the summer of 1999. The proposed horizontal alignment of this by-pass is illustrated in Drawing no. 3.10.6. Ultimately, it is intended to provide a complete, dual carraigeway

standard by-pass of Kinnegad for all N6 and N4 traffic. These measures mean that the vast majority of traffic generated by the development, and in particular HGVs, will not have to pass through Kinnegad at any stage of the construction or operational phase of the project.

In light of the above, it is clear that the additional traffic, including HGVs, using the national primary routes stated will be easily accommodated by these roads and will therefore have no significant adverse impact on them.

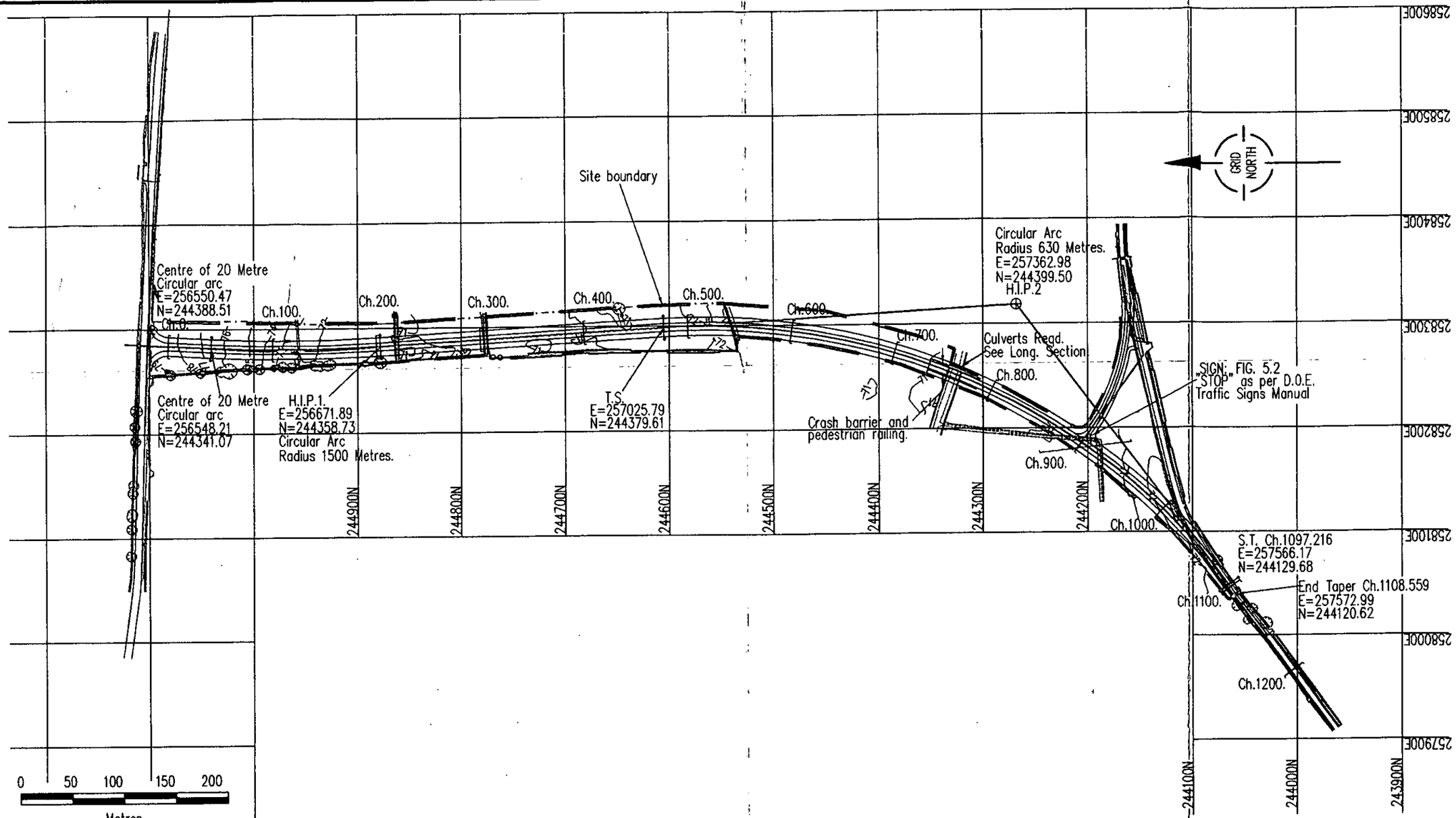
3.10.7 References

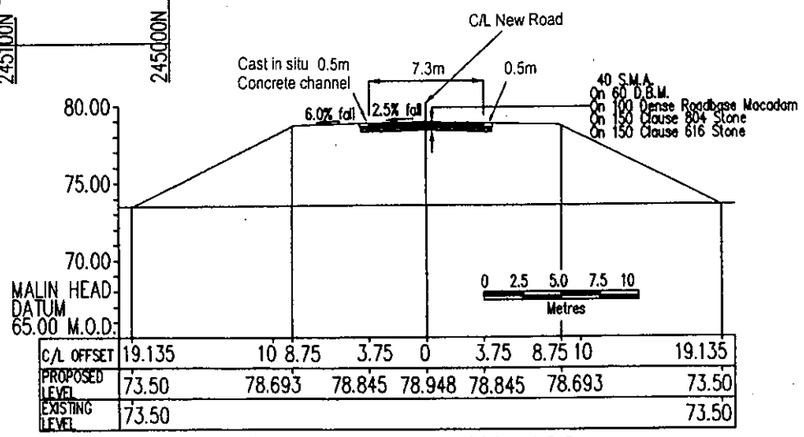
Devlin, J. (1978). National Roads Authority, *Expansion Factors For Short Period Traffic Counts, RT201.*

Meath County Council (1994). County Development Plan – 1994.

National Roads Authority (1994). The NRA Operational Programme for Transport, 1994 – 1999, *Indicative List of Projects in Planning.*

Westmeath County Council (1994). County Development Plan – 1994.





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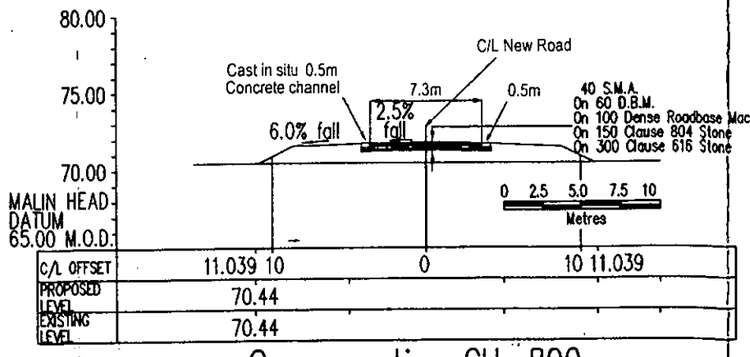
PROPOSED LEVEL	73.50	78.693		78.845	78.948	78.845	78.693		73.50
EXISTING LEVEL	73.50								73.50

Cross section CH. 100.



C/L OFFSET	11.039	10	0	10	11.039
PROPOSED LEVEL	70.44				
EXISTING LEVEL	70.44				

Cross section CH. 800.

03.11.1998

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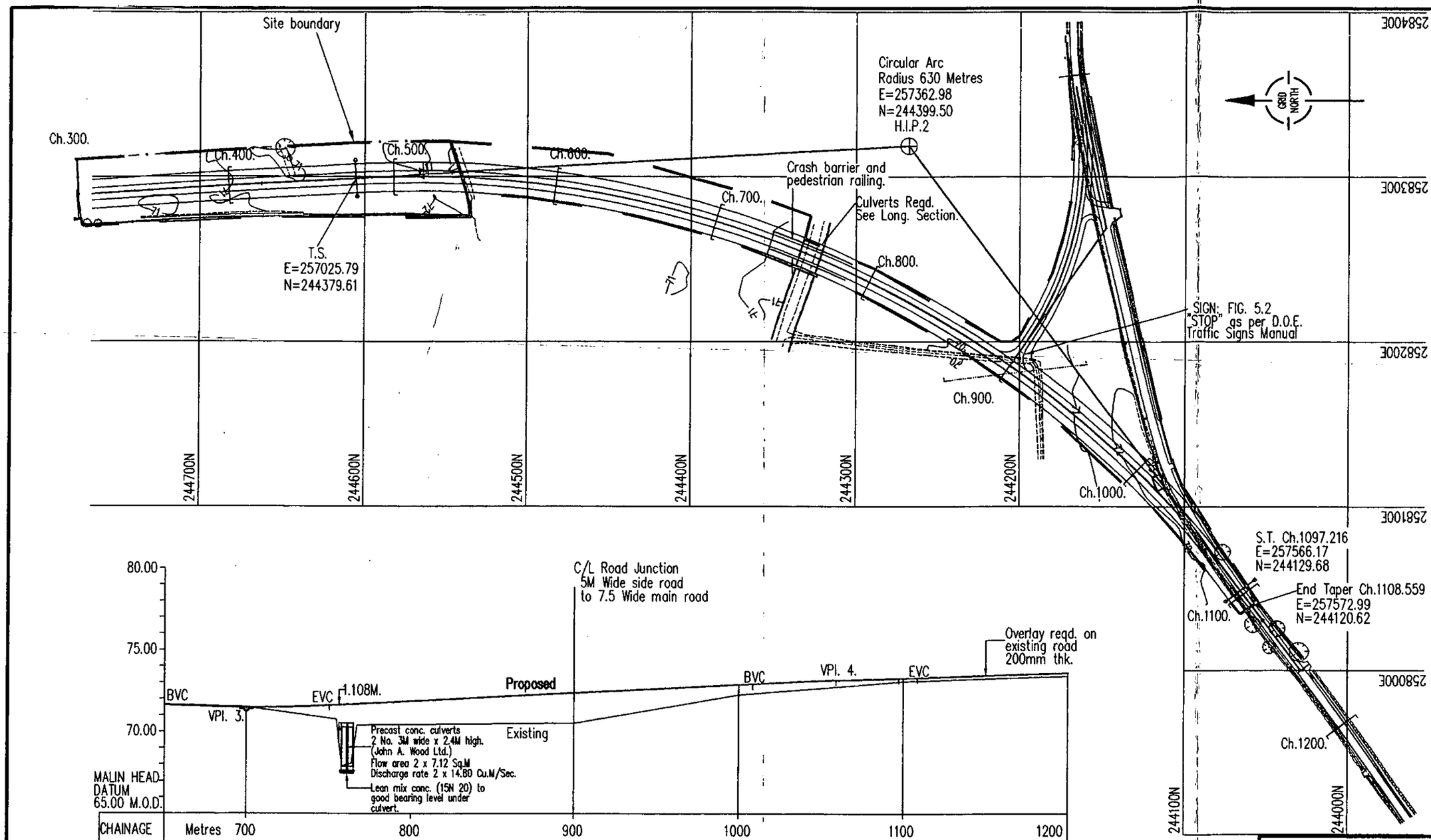
LANSDOWN CEMENT WORKS

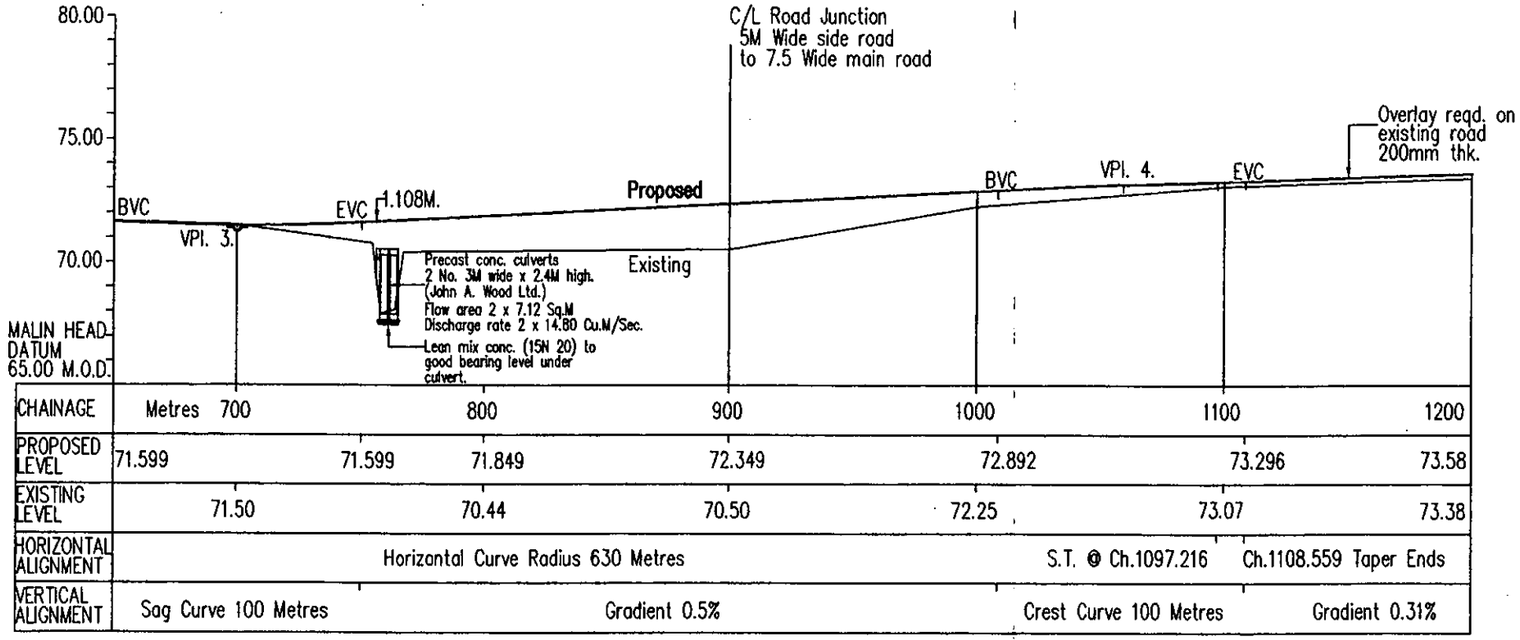
KILLASKILLEN, CO. MEATH

TITLE:

Proposed new access road to N6;
General arrangement plan and cross section

Nº 3.10.1





CHAINAGE	Metres 700	800	900	1000	1100	1200
PROPOSED LEVEL	71.599	71.599	71.849	72.349	72.892	73.296	73.58
EXISTING LEVEL	71.50	70.44	70.50	72.25	73.07	73.38
HORIZONTAL ALIGNMENT	Horizontal Curve Radius 630 Metres			S.T. @ Ch.1097.216	Ch.1108.559 Taper Ends	
VERTICAL ALIGNMENT	Sag Curve 100 Metres	Gradient 0.5%		Crest Curve 100 Metres	Gradient 0.31%	

Longitudinal section CH. 650 to CH. 1200

0 25 50 75 100
Metres

03.11.1998

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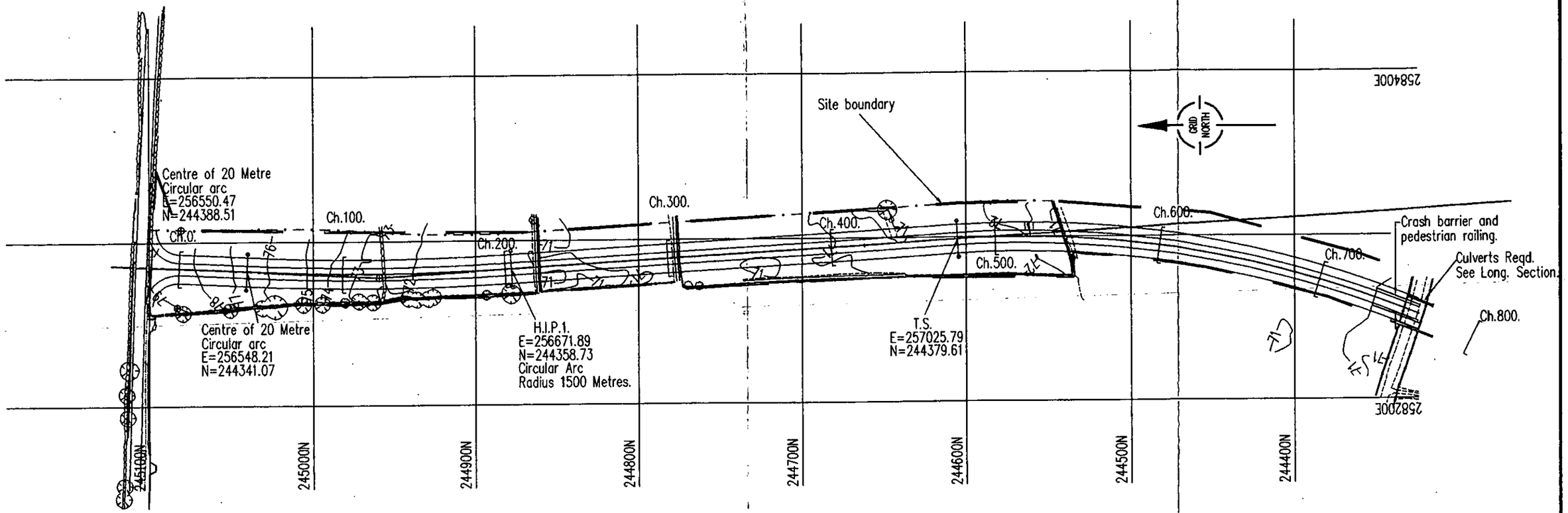
LANSDOWN CEMENT WORKS

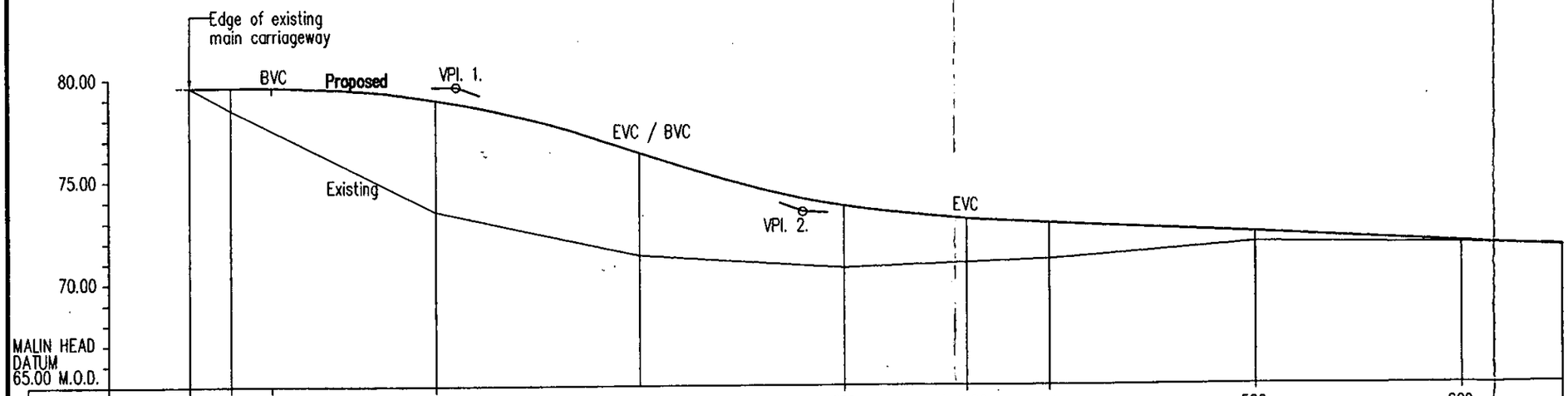
KILLASKILLEN, CO. MEATH

TITLE:

Proposed new access road to N6;
Plan and longitudinal section of southern end of new access road

Nº 3.10.2





CHAINAGE	Metres	-20	0	20	100	200	300	359.66	400	500	600
PROPOSED LEVEL		79.59	79.59		78.948	76.333	73.714	73.05	72.849	72.349	71.849
EXISTING LEVEL		79.59	78.5	77.5	73.5	71.35	70.71	70.943	71.10	71.87	71.79
HORIZONTAL ALIGNMENT											
VERTICAL ALIGNMENT		Gradient 0.0%			Crest Curve 180 Metres	Gradient 3.6187%	Sag Curve 159.66 Metres			Gradient 0.5%	

Longitudinal section CH. -20 to CH. 650

0 25 50 75 100
Metres

03.11.1998

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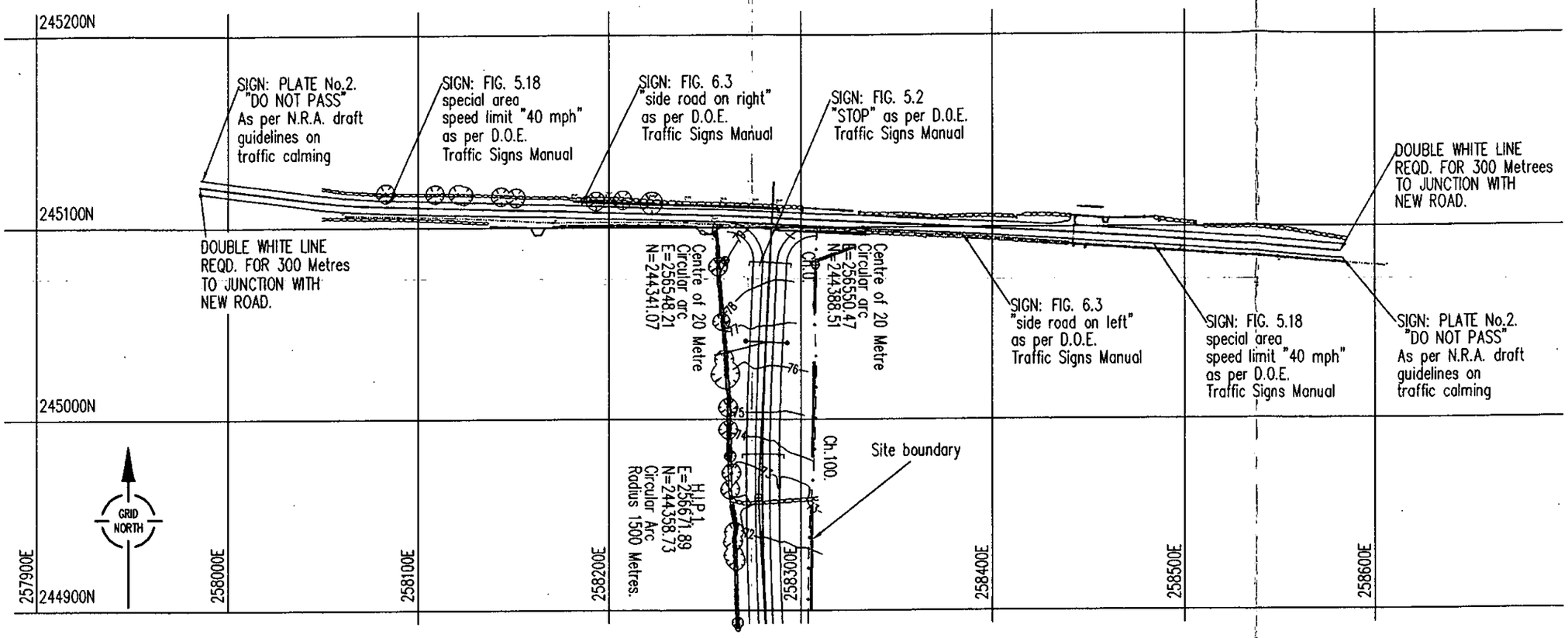
LANSDOWN CEMENT WORKS
KILLASKILLEN, CO. MEATH

TITLE:

Proposed new access road to N6;
plan and longitudinal section of northern end of new access road

Nº 3.10.3



0 25 50 75 100
Metres

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LANSDOWN CEMENT WORKS

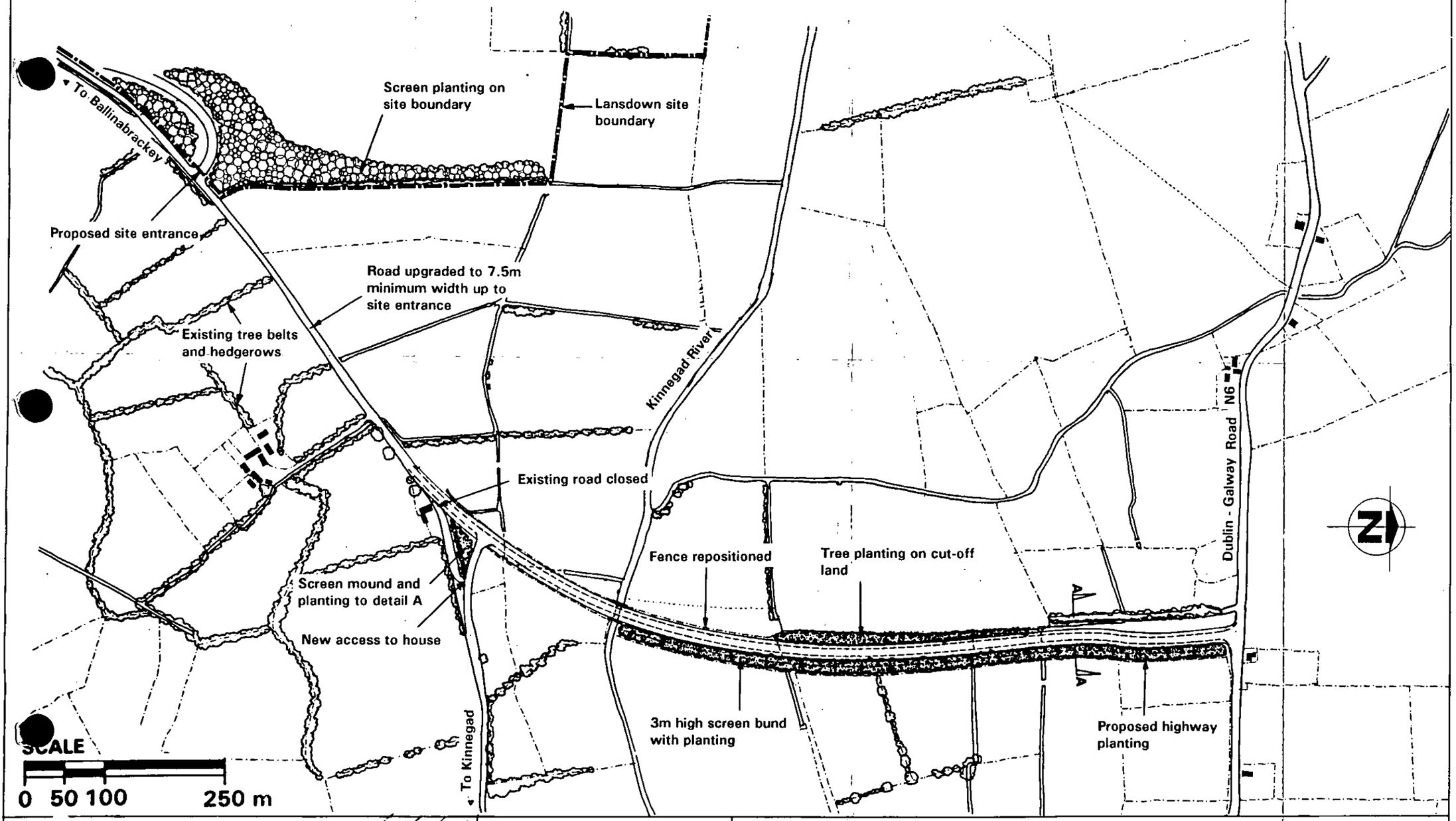
KILLASKILLEN, CO. MEATH

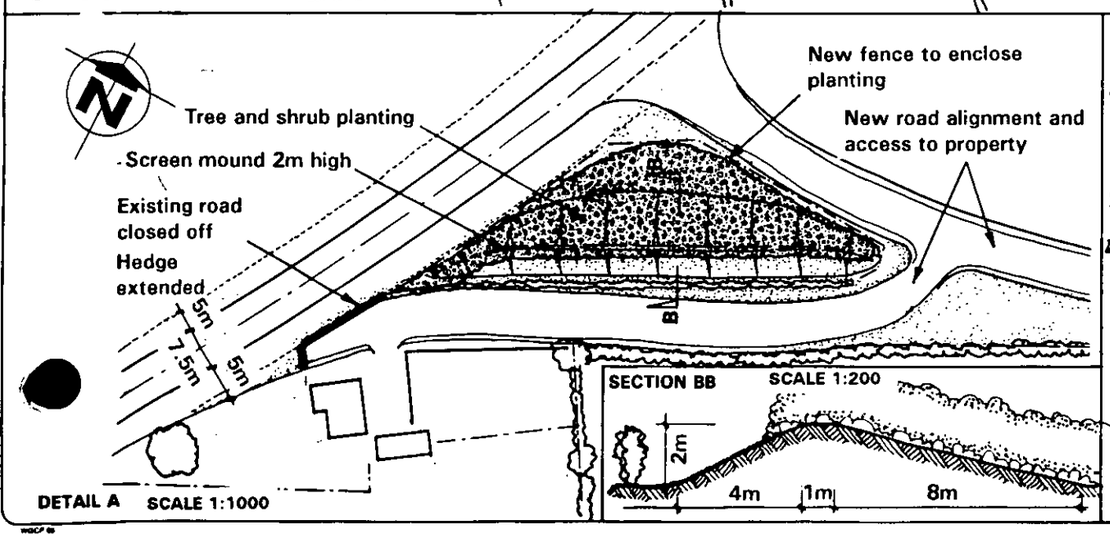
TITLE:

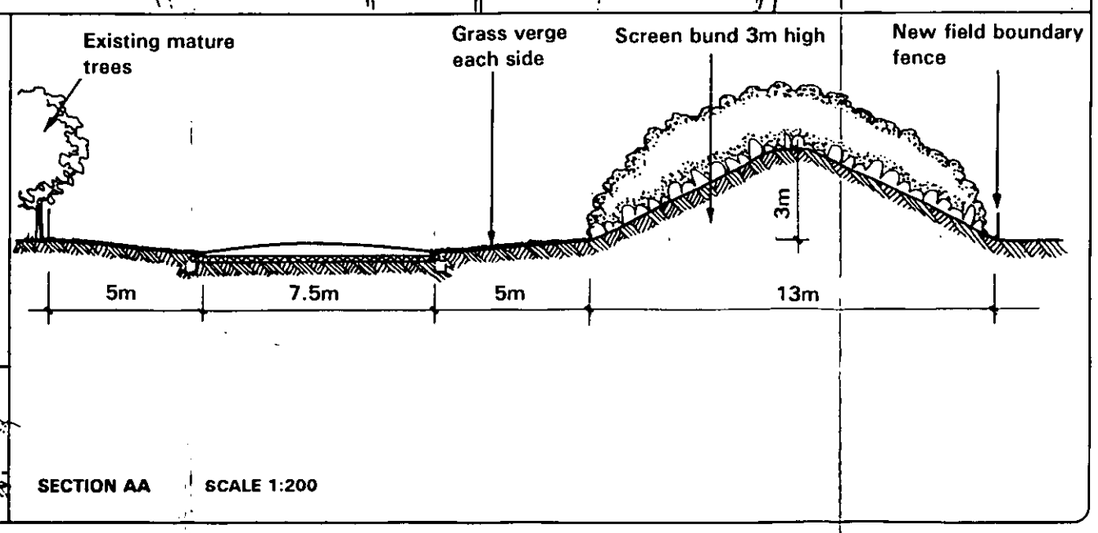
Proposed new access road to N6;
Details of junction onto N6

Nº 3.10.4

03.11.1998







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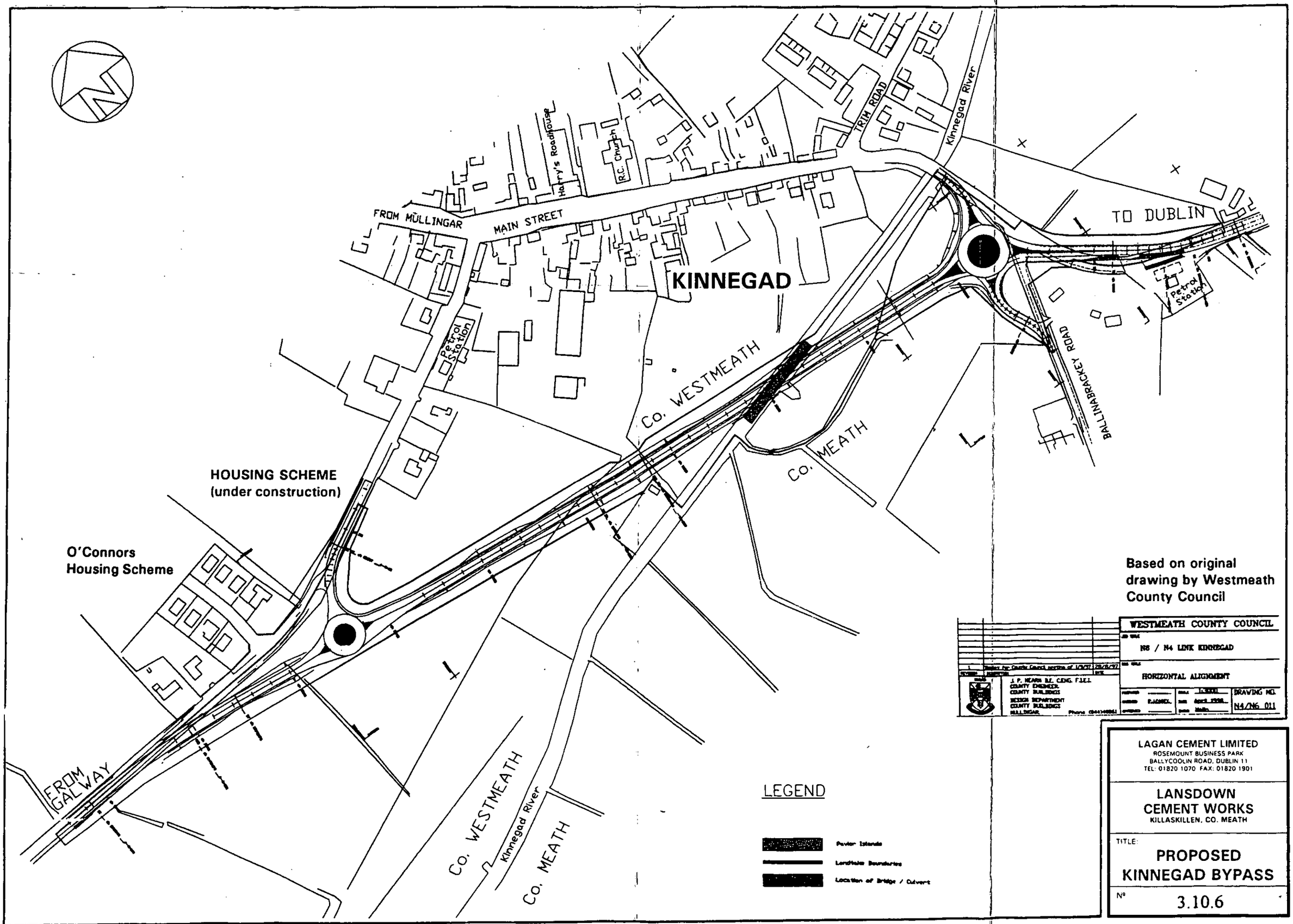
LANSDOWN CEMENT WORKS
KILLASKILLEN, CO. MEATH

TITLE:

PROPOSED ACCESS ROAD

Nº 3.10.5



Based on original drawing by Westmeath County Council

1	Issued for County Council meeting of 1/9/97	29/8/97
SYMBOL	AMENDMENT	DATE

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COUNTY BUILDINGS
MULLINGAR. Phone (044)48041

WESTMEATH COUNTY COUNCIL

N6 / N4 LINK KINNEGAD

HORIZONTAL ALIGNMENT

DRAWING NO. N4/N6 011

LAGAN CEMENT LIMITED
ROSEMOUNT BUSINESS PARK
BALLYCOOLIN ROAD, DUBLIN 11
TEL: 01820 1070 FAX: 01820 1901

LANSDOWN
CEMENT WORKS
KILLASKILLEN, CO. MEATH

TITLE:
PROPOSED
KINNEGAD BYPASS

Nº 3.10.6

SECTION 3:

THE ENVIRONMENT IMPACTS AND MITIGATION

HUMAN BEINGS	3.1
FLORA AND FAUNA	3.2
SOILS AND GEOLOGY	3.3
WATER AND HYDROGEOLOGY	3.4
AIR AND CLIMATE	3.5
NOISE AND VIBRATION	3.6
LANDSCAPE AND VISUAL	3.7
MATERIAL ASSETS	3.8
CULTURAL HERITAGE	3.9
TRAFFIC	3.10
INTERACTION OF IMPACTS	3.11
CONCLUSIONS	3.12

SECTION 3.11

INTERACTION OF IMPACTS

3.11.1 Introduction

In addition to the requirement to describe the likely significant effects of the proposed development on human beings, flora and fauna, water, landscape etc., there is also a requirement to consider the interaction of those effects.

3.11.2 Identification of Interactions

Various methods for this analysis exist, including the two dimensional matrix method used below. Here, each aspect of the environment considered in the preceding parts of the EIS is cross-referenced against the other aspects considered. Where an interaction is thought to be significant it is marked and the interactions are discussed below:

Table 1. Interaction of the Impacts

	Landscape & Visual	Human Beings	Flora & Fauna	Soils & Geology	Water & Hydrogeology	Air & Climate
Human Beings	x					
Flora & Fauna						
Soils & Geology						
Water & Hydrogeology		x	x	x		
Air & Climate		x				
Noise & Vibration		x				

3.11.3 Significant Interactions

Human Beings v Landscape and Visual:
Any negative impact on the landscape will principally interact with Human Beings. The landscape is considered an integral part of the aesthetic amenity of a region and therefore adverse negative impacts on the landscape may in a sense contribute to a reduction in quality of life for local residents.
It is felt that the Landscape and Visual Section (3.7) of this EIS has addressed this issue fully and that it proposes very serious and extensive measures designed to reduce impacts on the landscape as much as is physically possible.

Human Beings v Water and Hydrogeology:
The principal interaction of concern under this heading is the potential impact on the local water table and domestic water supplies in the area. This issue is addressed fully in the Water and Hydrogeology Section. Comprehensive modeling has been carried out by experts in order to ascertain the extent of drawdown of the water table as a result of

dewatering the excavations, and to identify households whose water supplies are likely to be affected. Where water supplies are affected the report outlines proposals to provide alternative water supplies.

Flora and Fauna v Water and Hydrogeology:
This interaction has been dealt with under Flora and Fauna in which there is also a specific aquatic ecology report. No significant negative impacts have been highlighted.

Human Beings v Air and Climate:
The perceived negative interactions under this heading would be likely to be caused by emissions from the plant, particularly Particulate Matter, Sulphur Dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), and water vapour. Section 3.5 (Air and Climate) states that there will be no adverse impacts on ambient air quality as a result of any of these emissions and all are within the relevant Air Quality Standards.

It further states that the EPA have estimated the national CO_2 emission rate at 33 million tonnes in 1993 so that the potential maximum contribution from this plant will be less than 1.3% of the national emissions total.

Human Beings v Noise and Vibration:
This is the principal issue of concern regarding the generation of noise and vibration by the development. In this respect, it is felt that all interactions have been addressed under the Noise and Vibration Section (3.6) and, where possible, mitigation measures have been proposed.

Soils and Geology v Water and Hydrogeology:
The only significant interaction under this heading concerns the drawdown of the water table during the quarry operation. This has been dealt with under Human Beings v Water and Hydrogeology above.

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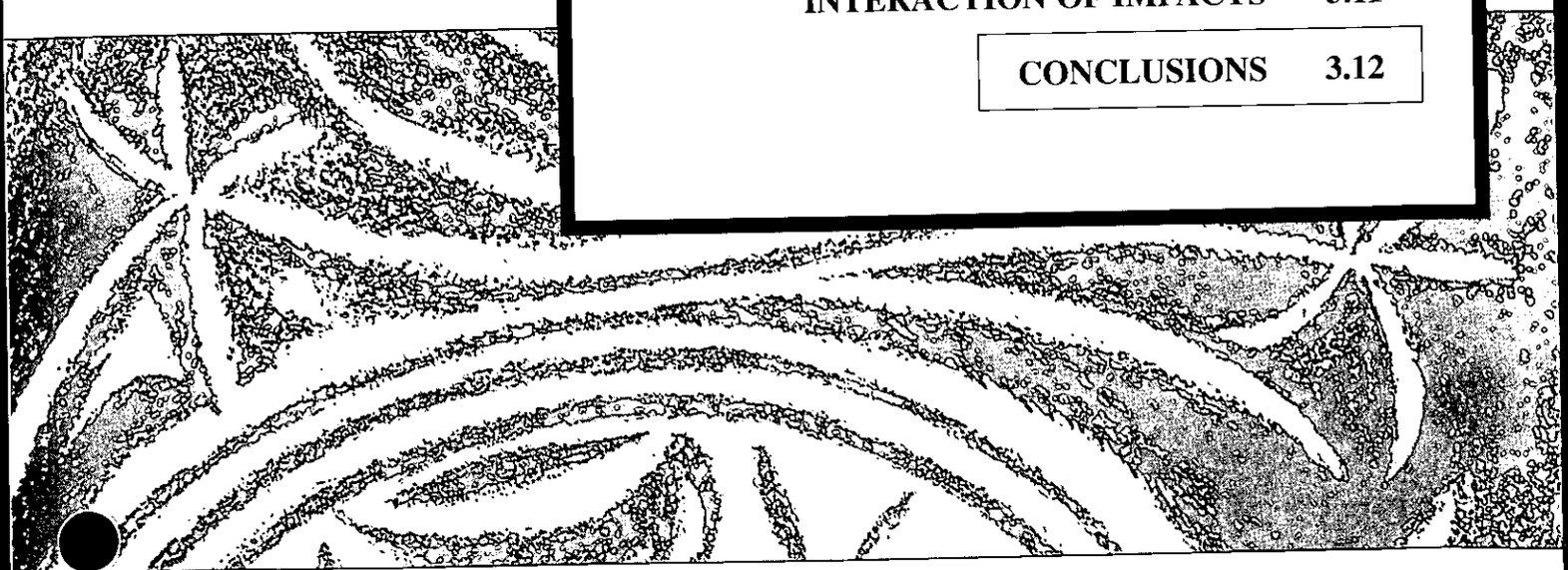


3.12 CONCLUSIONS

This proposal consists of a new cement manufacturing plant on a greenfield site. The location was determined primarily by the existence on the c160 hectare site of both limestone of a very high quality as well as shale and silty shale which are required as additives for the production of Ordinary Portland Cement (OPC). The limestone is of such a quality and whiteness that it will enable the production of a premium white cement for world markets.

Other important considerations in the selection of this site were, the possibility of acquiring a large site which would accommodate a large plant while providing adequate screening from residences in the area and the ability to create access to the national primary road system while bypassing local residences.

This project will involve an investment of £40 million. It will be designed and constructed to incorporate the latest and most efficient technologies. The plant will create 200 permanent jobs including technical and laboratory staff in an area of employment disadvantage. The project will be the largest industrial employer in the region and will have a significant impact on the local economy as it will generate demand for a wide range of goods and services leading in turn to further employment growth and business opportunities.

The quality of the limestone deposits at the site will enable the production of a world class white cement which will be exported to Britain, Continental Europe and the United States. The company Research and Development facility will seek to develop other uses and markets for this high purity limestone.

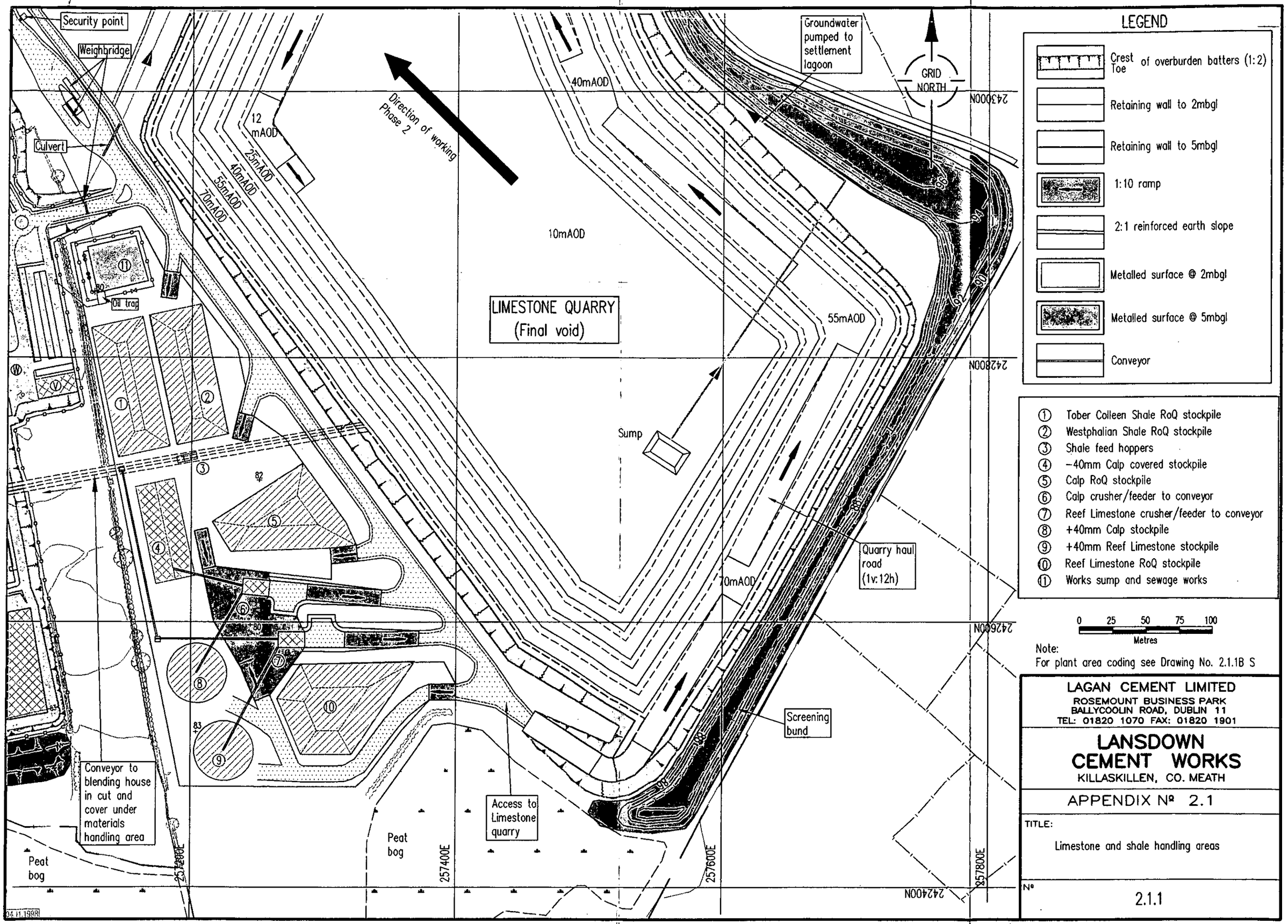
In view of the fact that this is a greenfield site, it has been possible to carry out baseline studies of all the elements of the physical environment. These studies have been carried out by experts and specialists in each area. Building on these baseline studies, identified impacts have been investigated. Where negative impacts have been identified, mitigation measures have been proposed to either negate or ameliorate these impacts in so far as possible.

A state-of-the-art facility can be developed on this site which should be acceptable to the local community, and which is likely to make a major contribution both to the local and national economy through employment and exports.

SECTION 4:

APPENDICES

APPENDIX
2.1
THE CEMENT WORKS PROCESS



Note:
For plant area coding see Drawing No. 2.1.1B S

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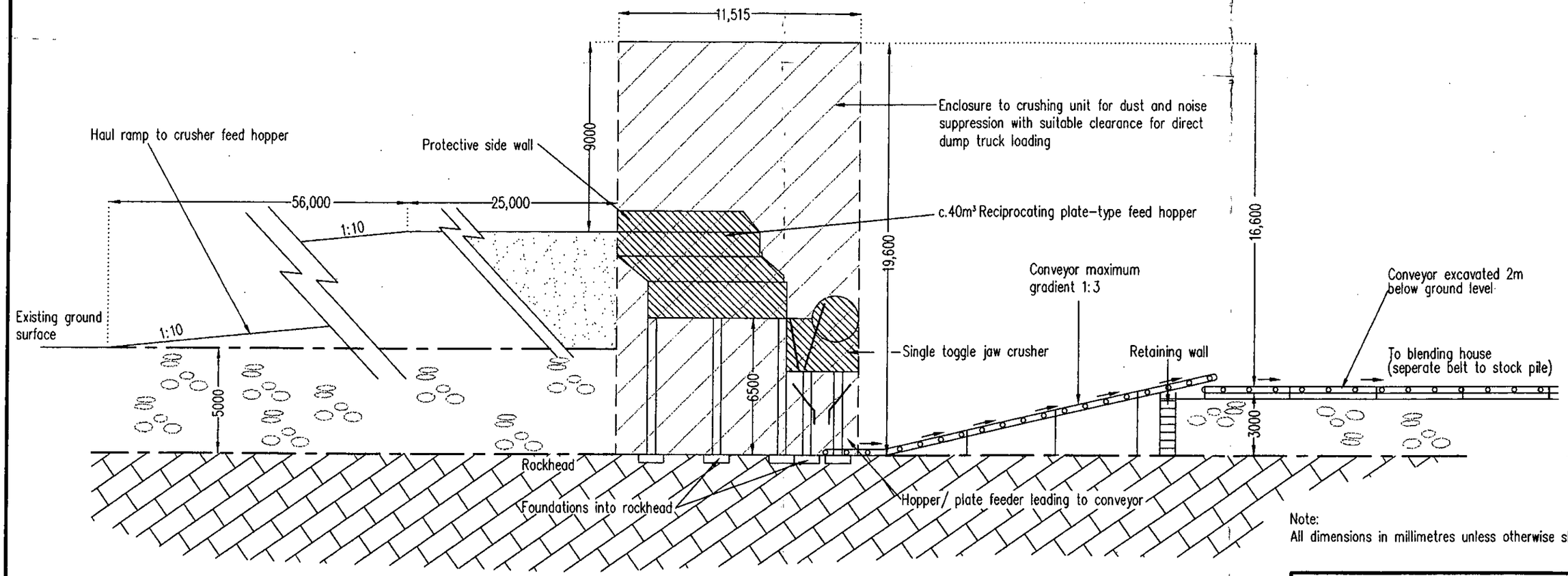
APPENDIX Nº 2.1

TITLE:

Limestone and shale handling areas

Nº

2.1.1



Note:
All dimensions in millimetres unless otherwise shown.

0 2.5 5.0 7.5 10.0
Metres

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LANSDOWN CEMENT WORKS

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APPENDIX Nº 2.1

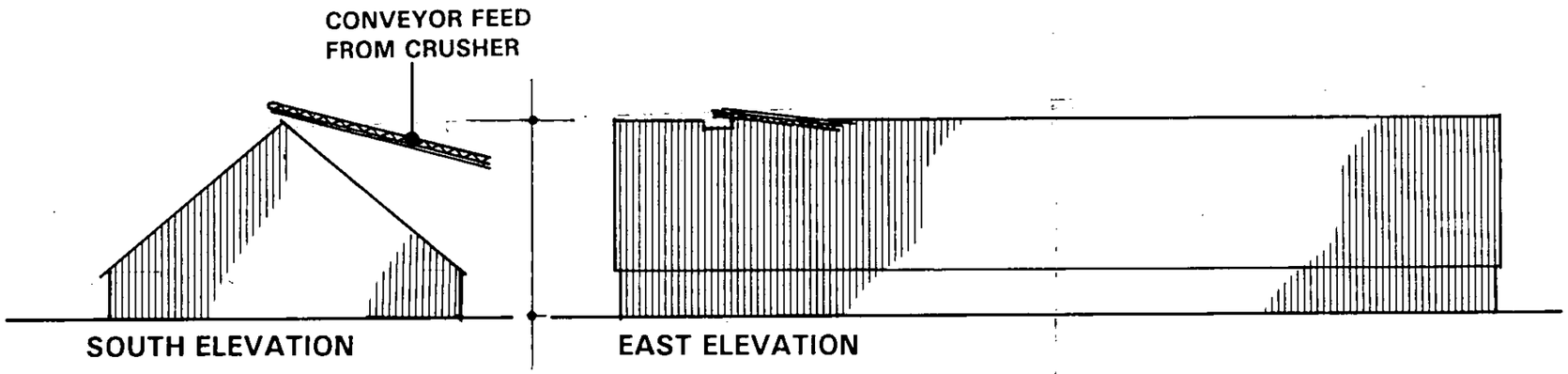
TITLE:

Limestone and shale crusher

Nº

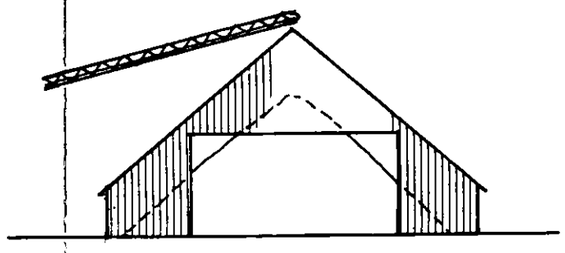
2.1.2

14.11.1998



SOUTH ELEVATION

EAST ELEVATION



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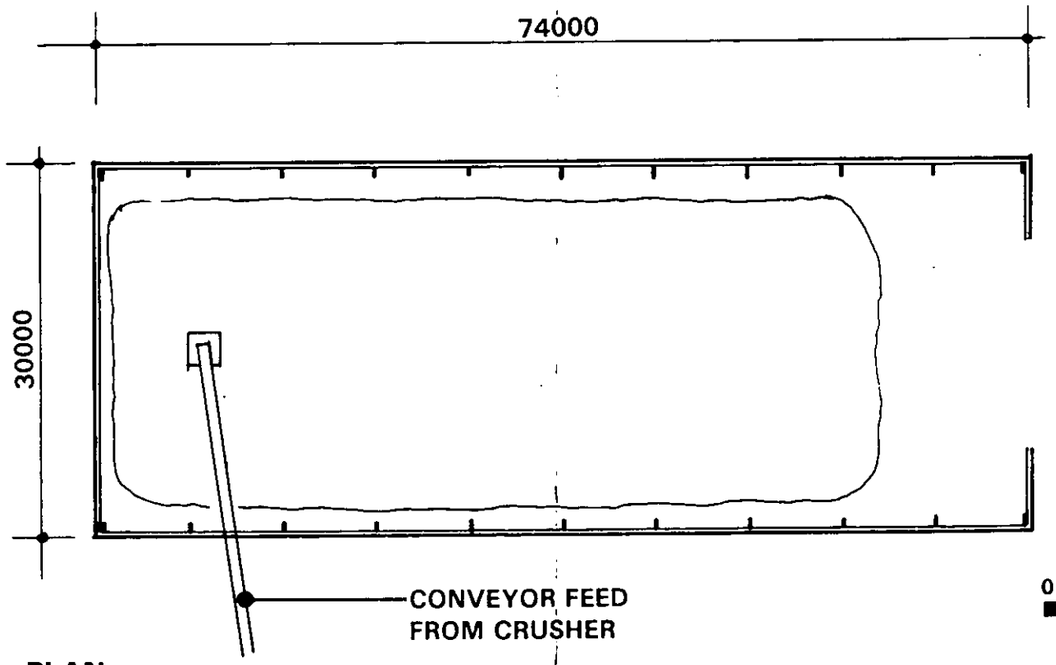

PLAN

0 10 20
5 15 25m

Scale 1:500

ALL STEELWORK TO BE GRADE 43 TO BS4360 OR EQUIVALENT IRISH STANDARD

ROOF CLADDING EUROPEAN PROFILES LTD PROFILE 900/26N PLASTISOL SHEETS COLOUR BS 10A05 GOOSEWING GREY

WALL CLADDING EUROPEAN PROFILES LTD PROFILE 900/40N PLASTISOL SHEETS COLOUR BS 10A05 GOOSEWING GREY

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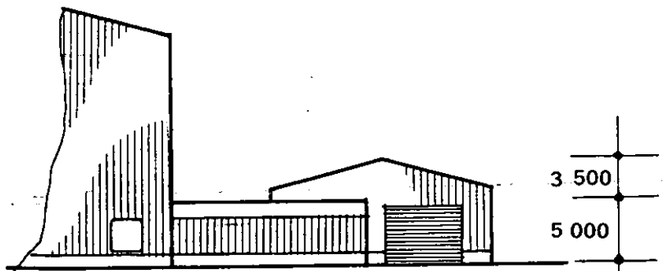
APPENDIX 2.1

TITLE:
COVERED
CALP STORE

Nº 2.1.3



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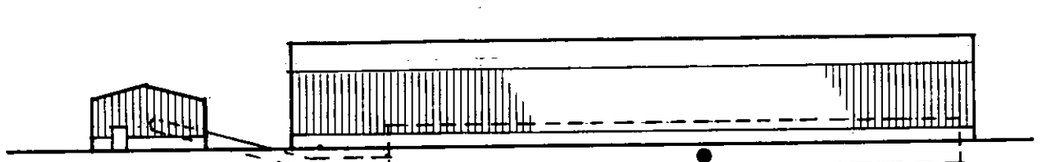
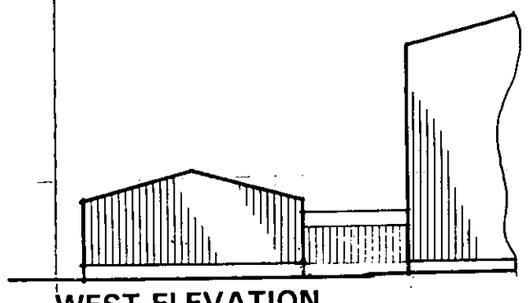


NORTH ELEVATION

KAOLIN IN RETAINED STRUCTURE



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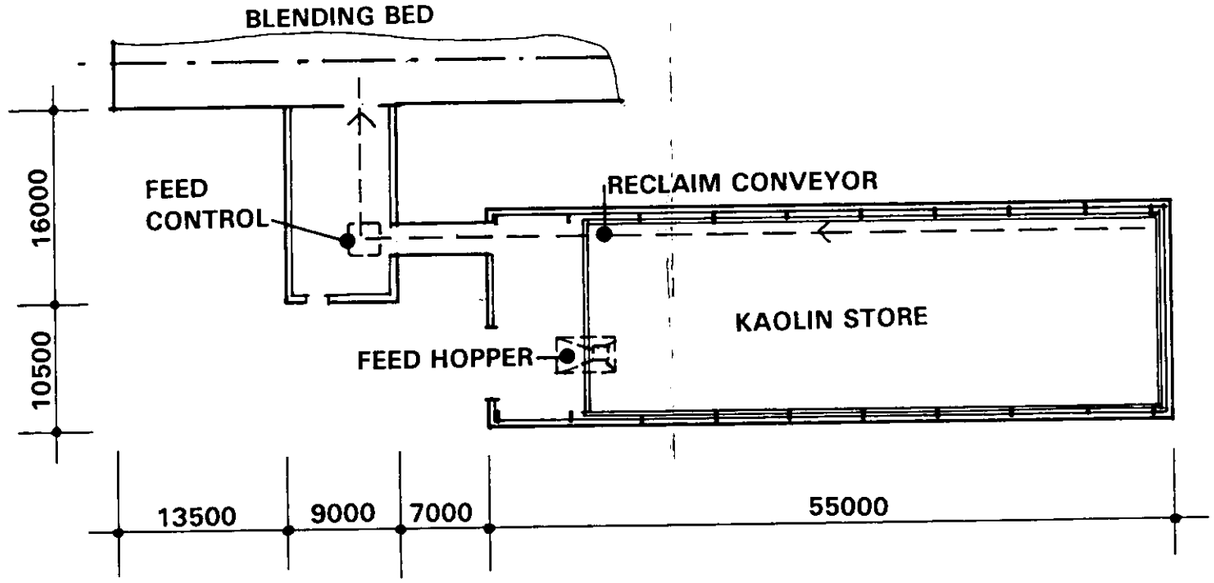

PLAN

0 10 20
5 15 25m

Scale 1:500

ALL STEELWORK TO BE GRADE 43 TO BS4360 OR EQUIVALENT IRISH STANDARD

ROOF CLADDING EUROPEAN PROFILES LTD PROFILE 900/26N PLASTISOL SHEETS COLOUR BS 10A05 GOOSEWING GREY

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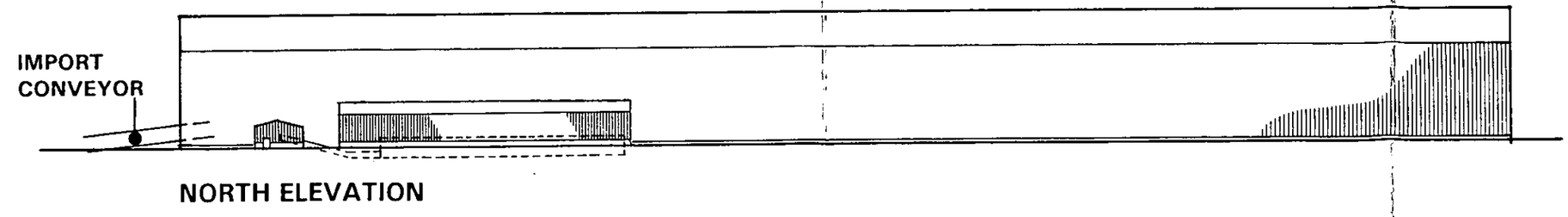
LANSDOWN CEMENT WORKS
KILLASKILLEN, CO. MEATH

APPENDIX 2.1

TITLE:
KAOLIN STORE AND CONVEYOR

Nº 2.1.4



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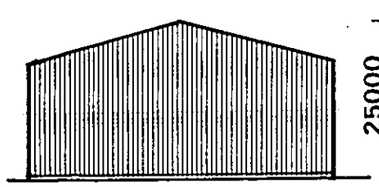

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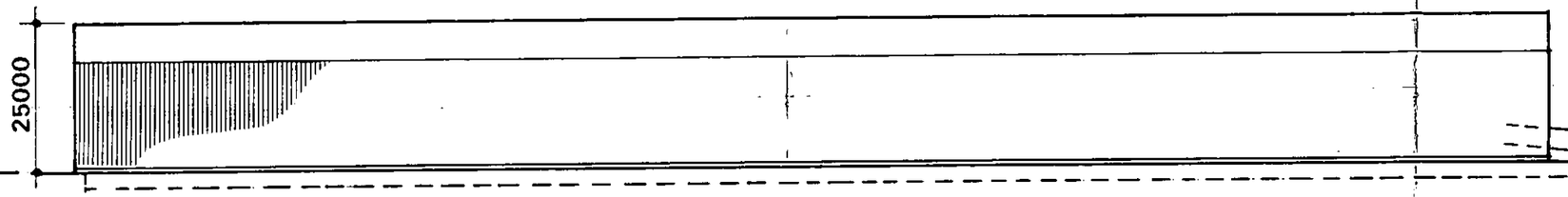
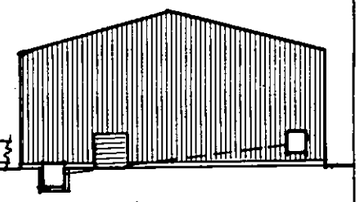
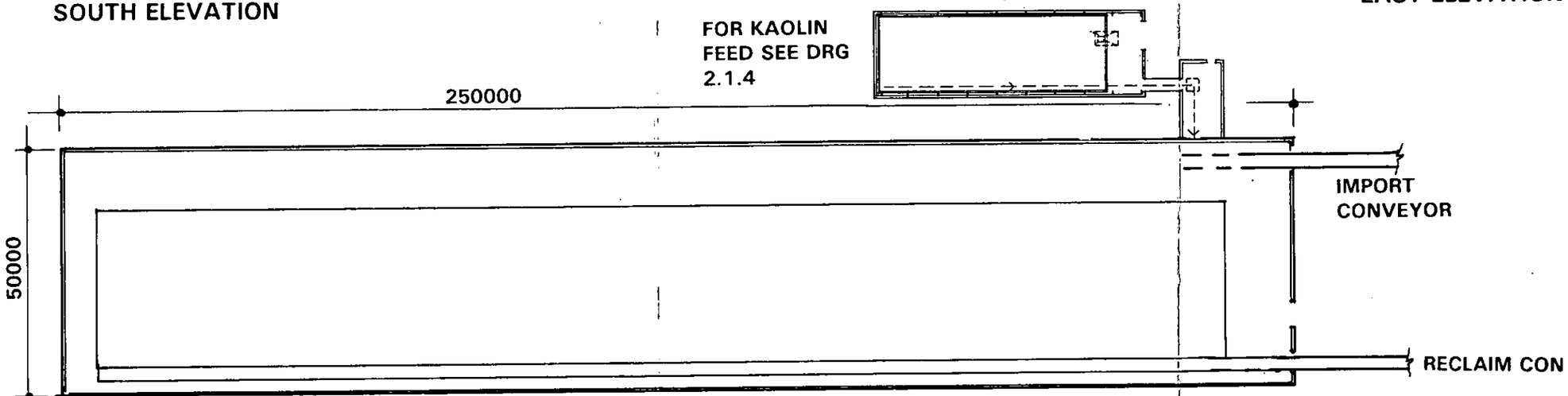


SOUTH ELEVATION



EAST ELEVATION



PLAN

Scale 1:1000

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5 15 25m

ALL STEELWORK TO BE GRADE 43 TO BS4360 OR EQUIVALENT IRISH STANDARD

ROOF CLADDING EUROPEAN PROFILES LTD PROFILE 900/26N PLASTISOL SHEETS COLOUR BS 10A05 GOOSEWING GREY

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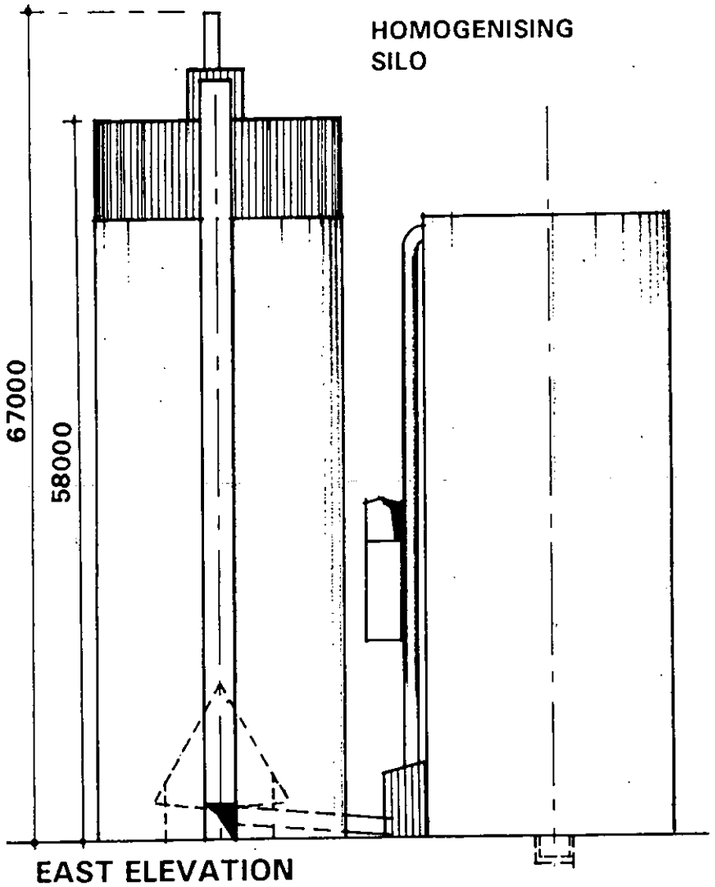
LANSDOWN
CEMENT WORKS
KILLASKILLEN, CO. MEATH

APPENDIX 2.1

TITLE:

BLENDING BED

Nº 2.1.5



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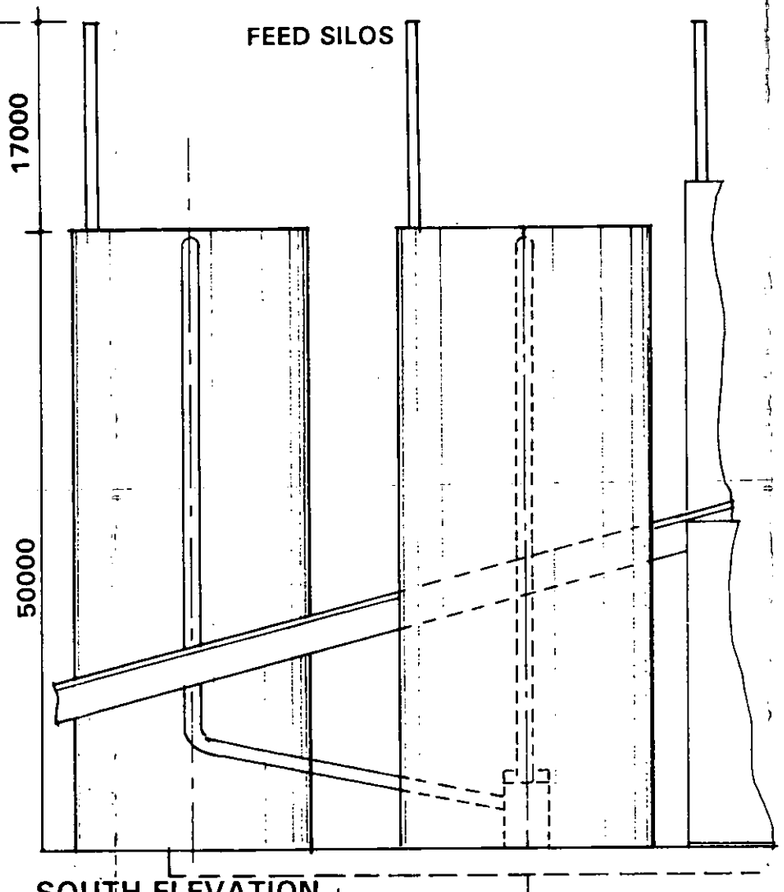
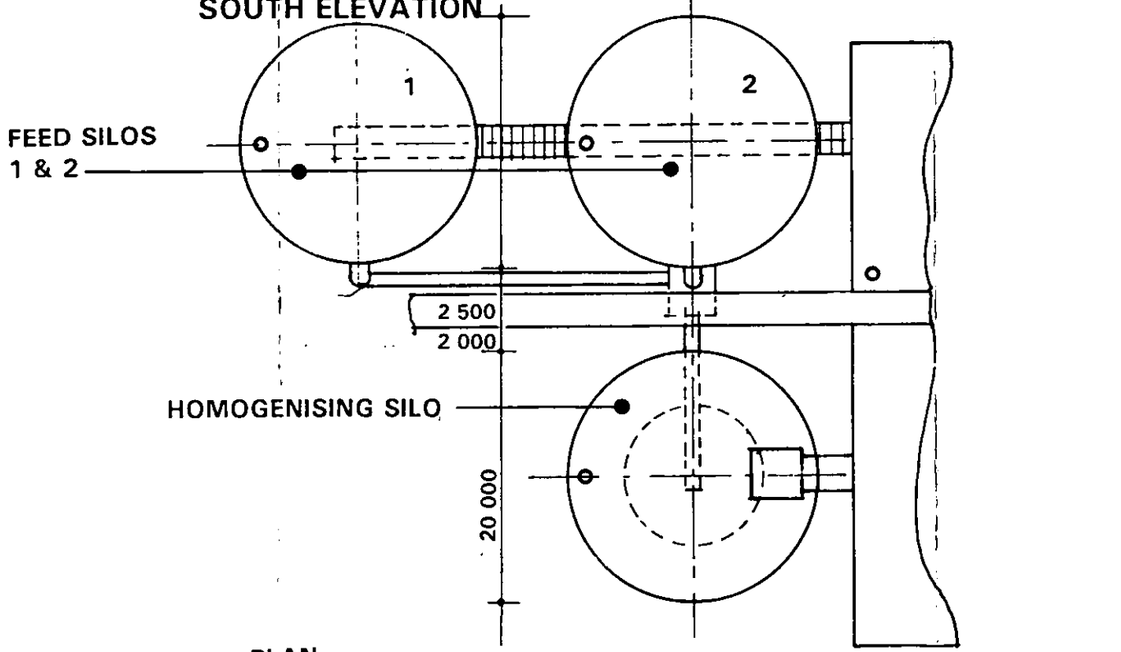


SOUTH ELEVATION



PLAN

Scale 1:500

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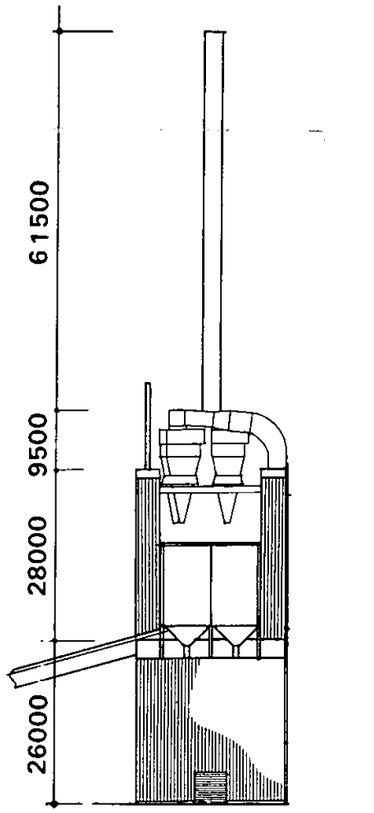
KILLASKILLEN, CO. MEATH

APPENDIX 2.1

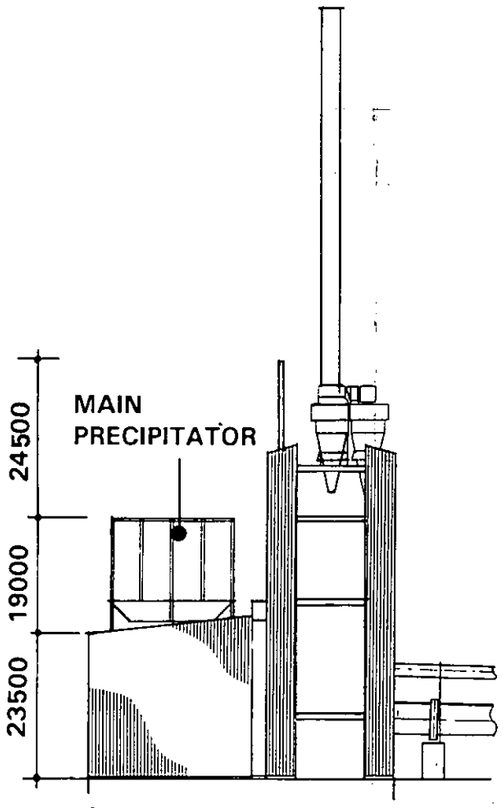
TITLE:

HOMOGENISING AND RAW MEAL SILOS

Nº 2.1.6



SOUTH ELEVATION



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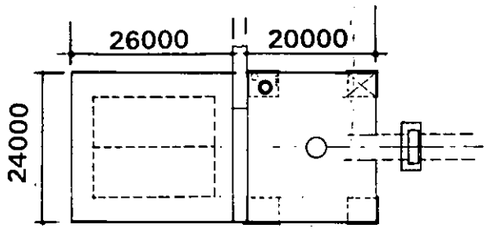
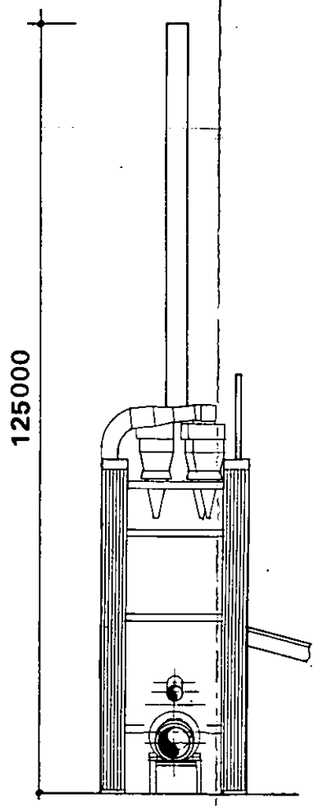


PLAN



NORTH ELEVATION

ALL STEELWORK TO BE GRADE 43 TO BS4360 OR EQUIVALENT IRISH STANDARD

ROOF CLADDING EUROPEAN PROFILES LTD PROFILE 900/26N PLASTISOL SHEETS COLOUR BS 10A05 GOOSEWING GREY

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0 10 20
5 15 25m

Scale 1:1000

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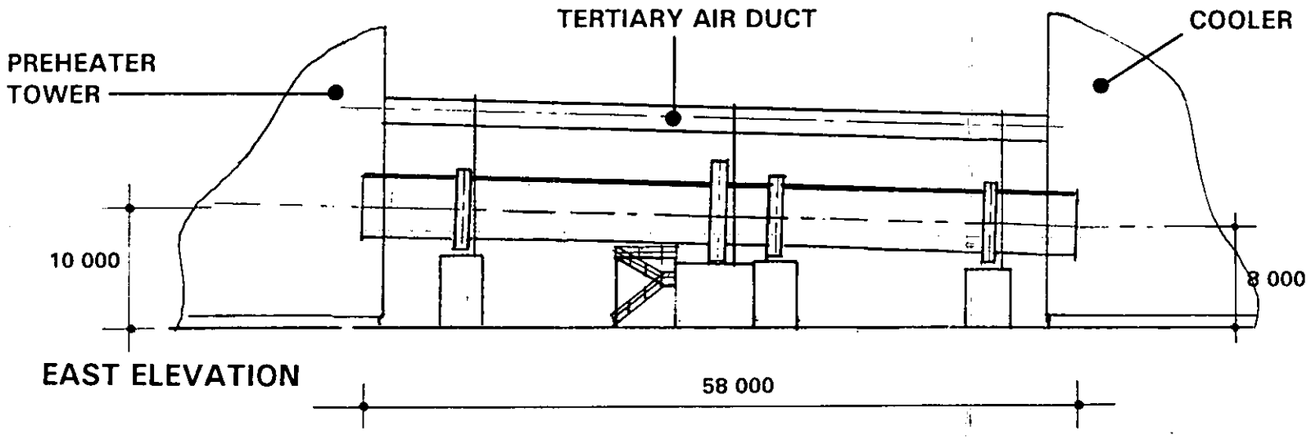
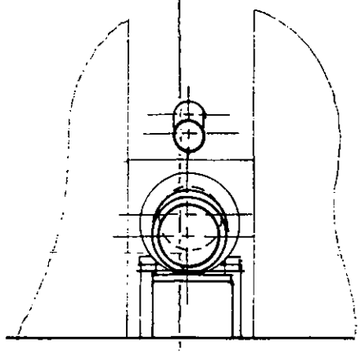
APPENDIX 2.1

TITLE:
RAW MILL & PRE-HEATER TOWER

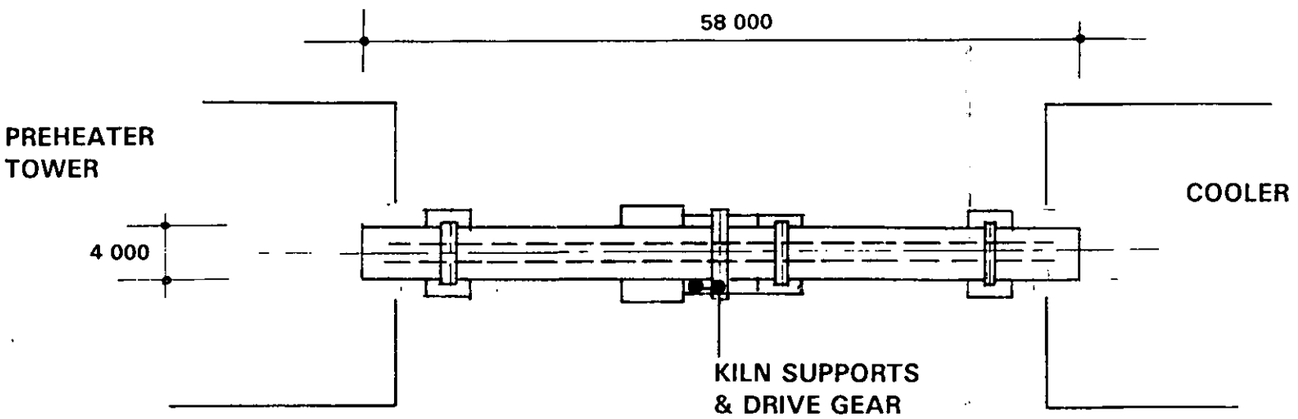
Nº **2.1.7**



EAST ELEVATION



NORTH SECTION/ELEVATION



PLAN

Scale 1:500

0 10 20

5 15 25m

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LANSDOWN CEMENT WORKS
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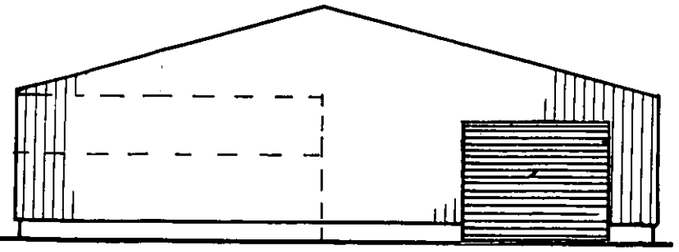
APPENDIX 2.1

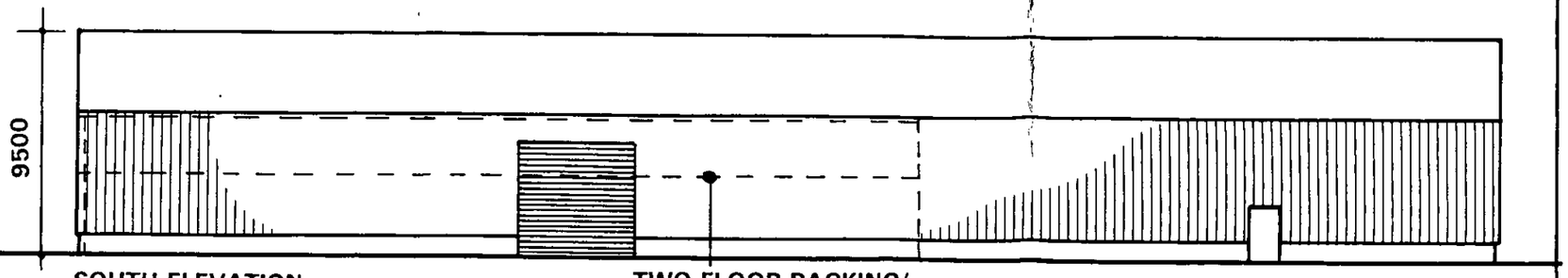
TITLE:

ROTARY KILN

Nº 2.1.8



WEST ELEVATION



SOUTH ELEVATION

TWO FLOOR RACKING/
LIGHT STORES

Scale 1:250

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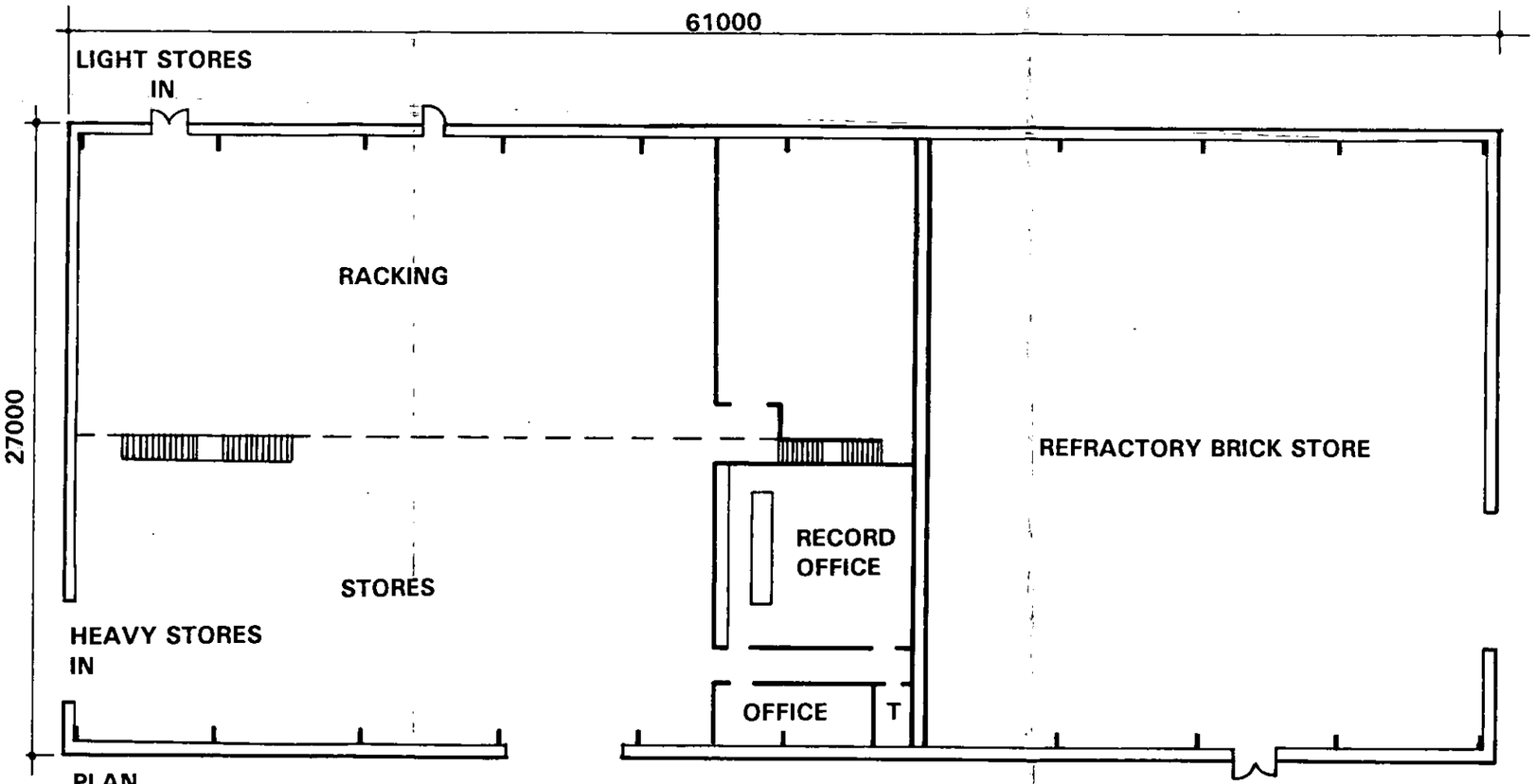
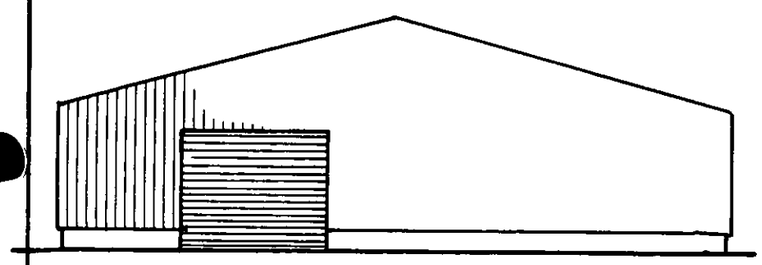
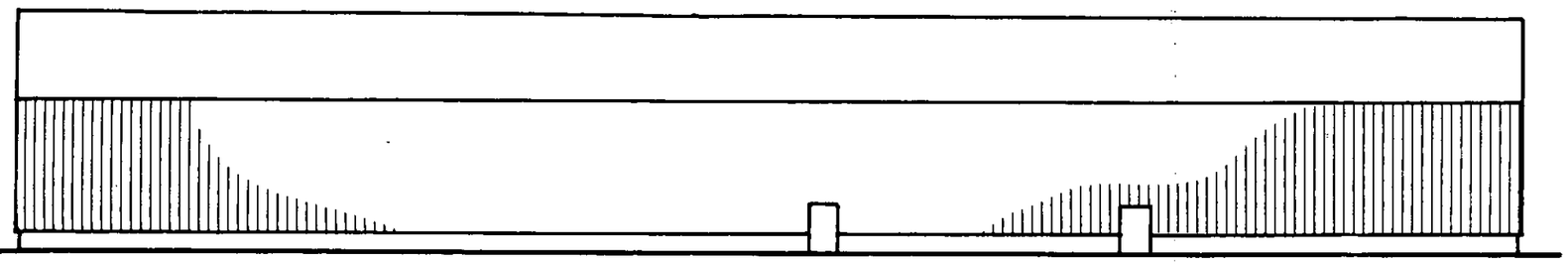
2 6 10m



PLAN



EAST ELEVATION



NORTH ELEVATION

ALL STEELWORK TO BE GRADE 43 TO BS4360 OR EQUIVALENT IRISH STANDARD

ROOF CLADDING EUROPEAN PROFILES LTD PROFILE 900/26N, PLASTISOL SHEETS COLOUR BS 10A05 GOOSEWING GREY

WALL CLADDING EUROPEAN PROFILES LTD PROFILE 900/40N PLASTISOL SHEETS COLOUR BS 10A05 GOOSEWING GREY

FASCIAS, RIDGE CAPPINGS AND APRONS TO MATCH CLADDING

FOUNDATIONS CAST IN SITU CONCRETE CONSTRUCTION TO CIVIL ENGINEER'S DETAILS

1000 HIGH DADO CAVITY WALLS BELOW CLADDING IN FAIR FACE CONCRETE BLOCKWORK

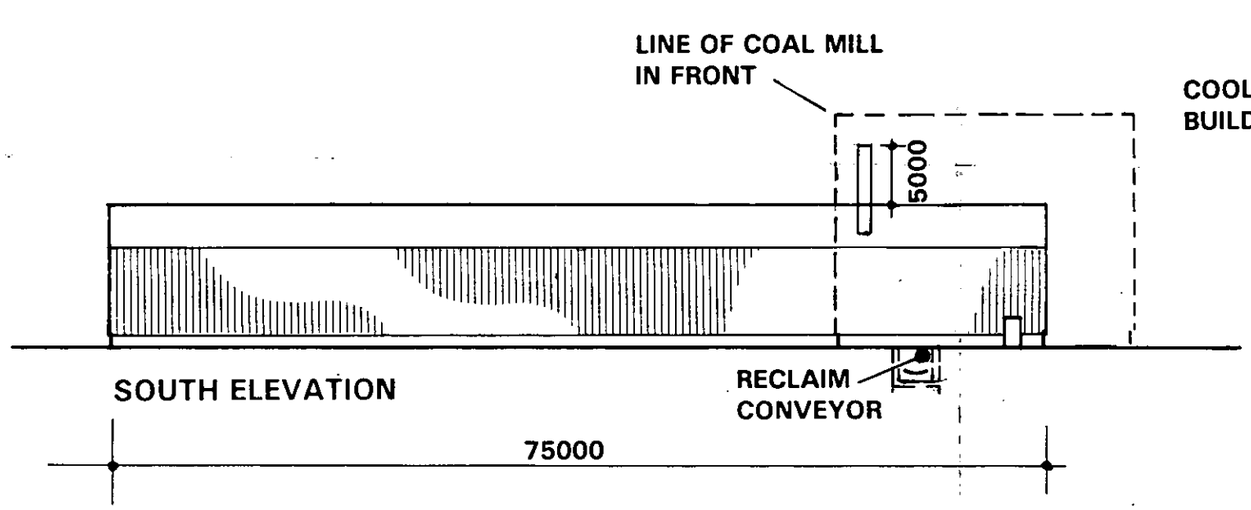
LAGAN CEMENT LIMITED
ROSEMOUNT BUSINESS PARK
BALLYCOOLIN ROAD, DUBLIN 11
TEL: 01820 1070 FAX: 01820 1901

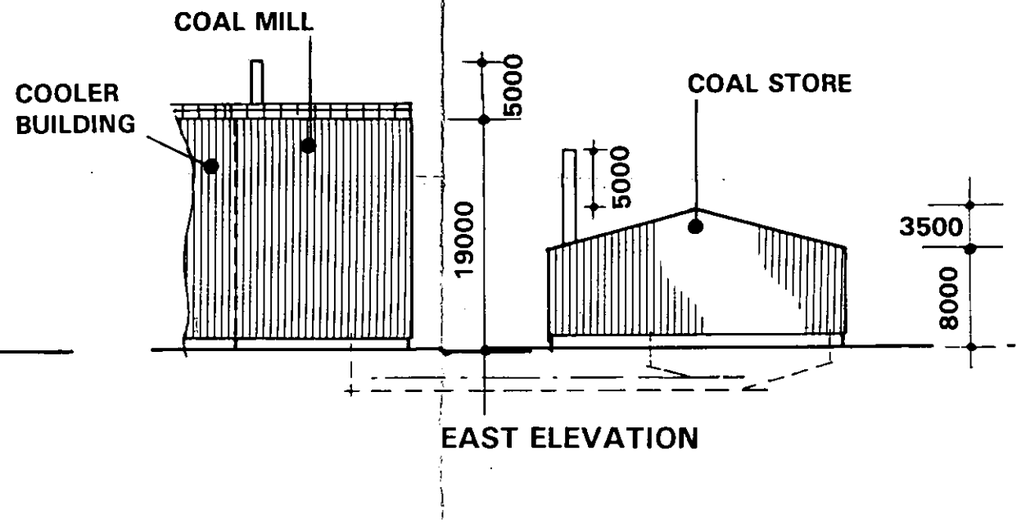
LANSDOWN
CEMENT WORKS
KILLASKILLEN, CO. MEATH

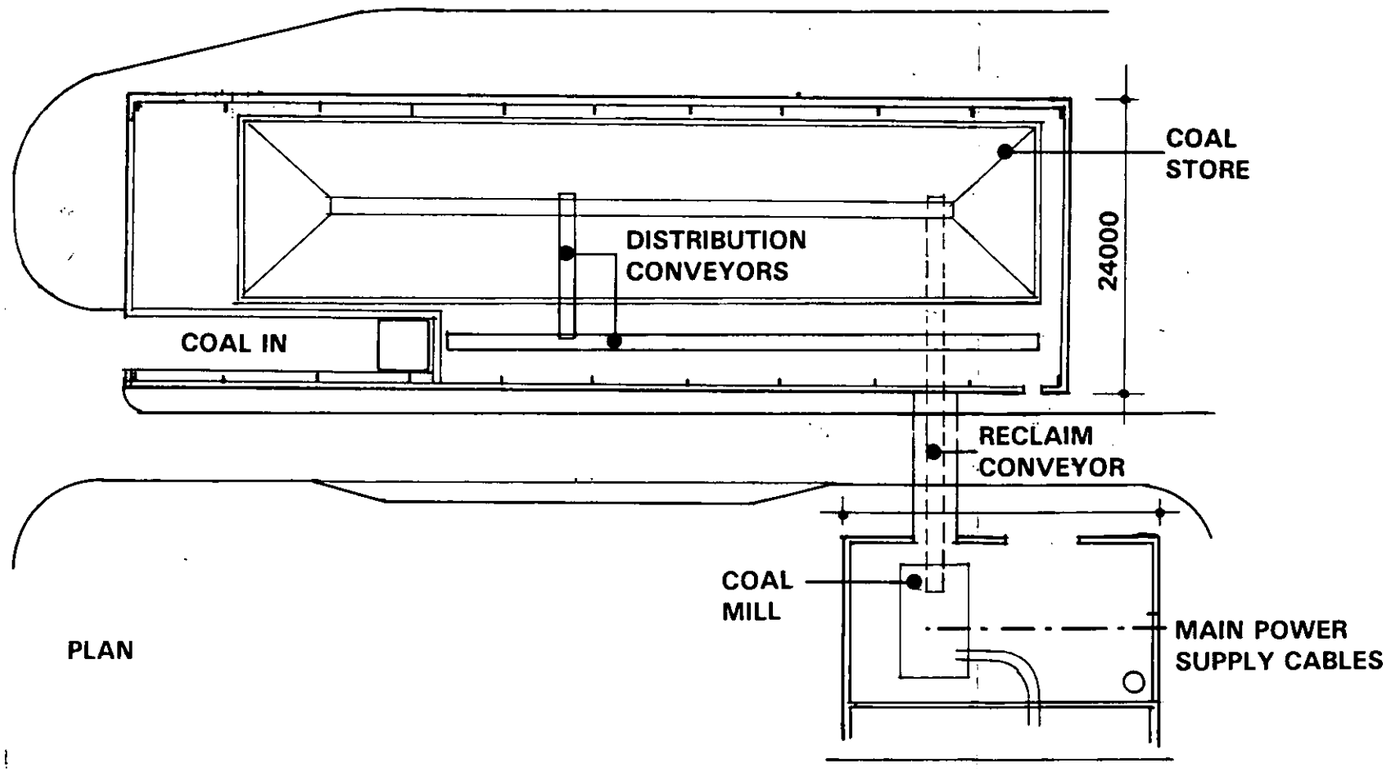
APPENDIX 2.1

TITLE:
BRICK LINING AND
HEAVY STORES

Nº 2.1.9







0 5 10 15 20 25m

Scale 1:500

ALL STEELWORK TO BE GRADE 43 TO BS4360 OR EQUIVALENT IRISH STANDARD

ROOF CLADDING EUROPEAN PROFILES LTD PROFILE 900/26N PLASTISOL SHEETS COLOUR BS 10A05 GOOSEWING GREY

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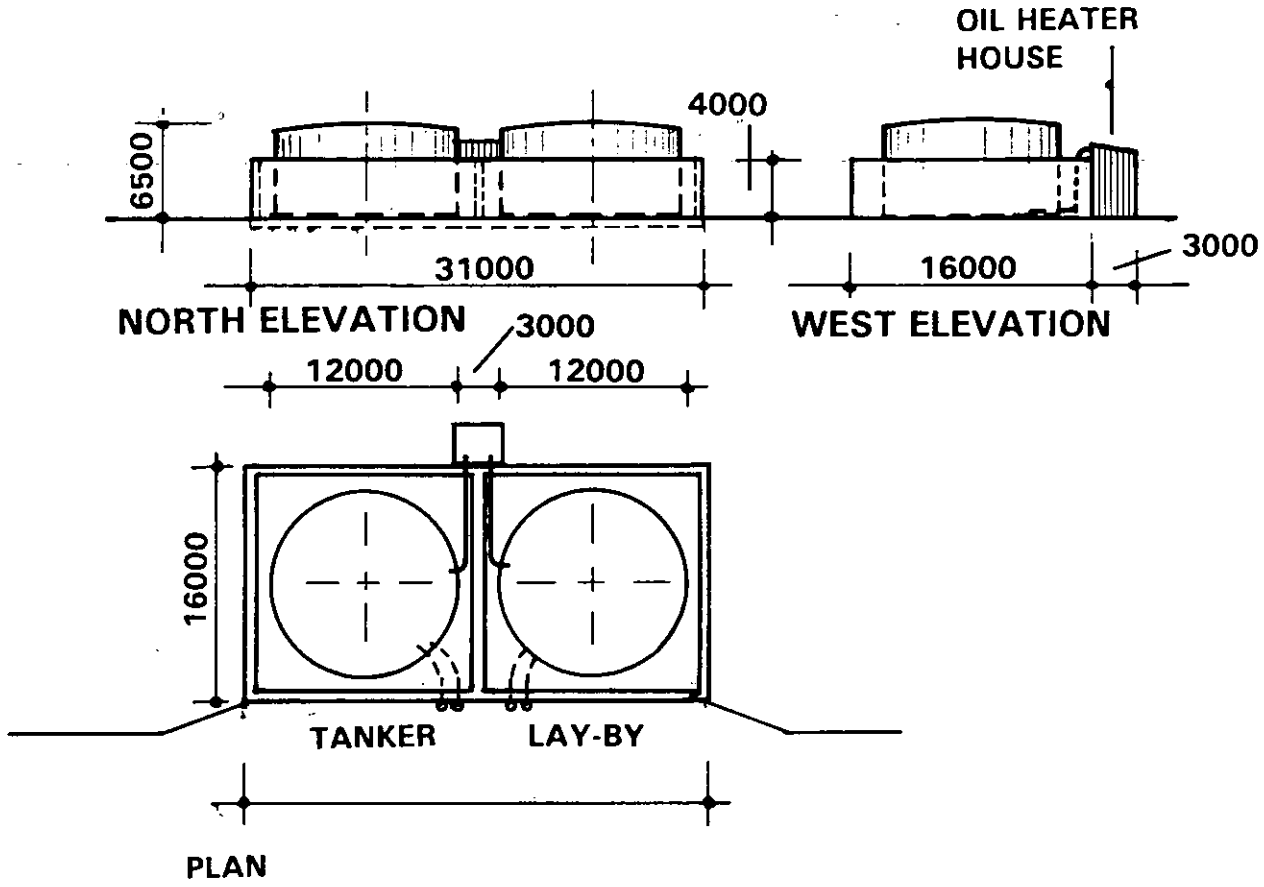
LANSDOWN CEMENT WORKS
KILLASKILLEN, CO. MEATH

APPENDIX 2.1

TITLE:

COAL STORE AND COAL MILL

Nº 2.1.10



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5 15 25m

Scale 1:500

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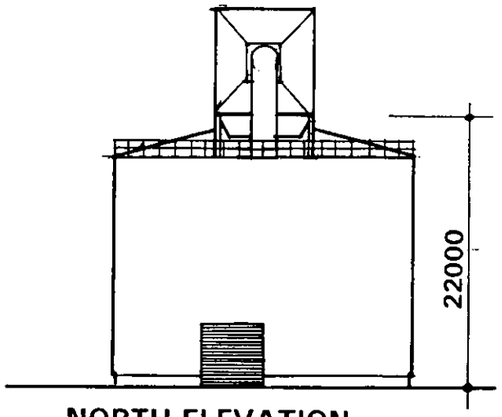
LANSDOWN CEMENT WORKS
KILLASKILLEN, CO. MEATH

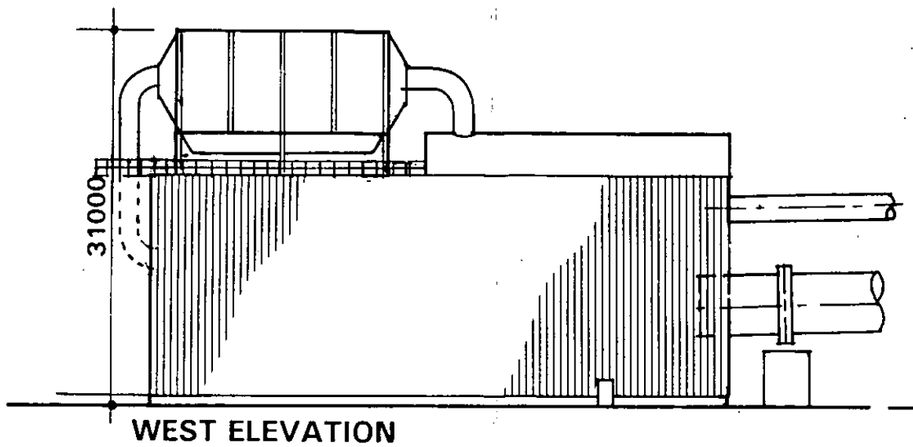
APPENDIX 2.1

TITLE:
OIL STORAGE TANKS

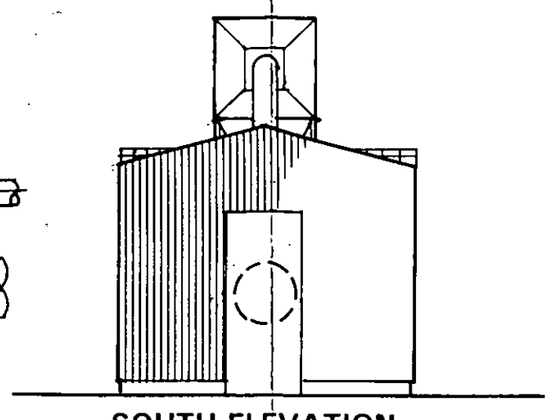
Nº **2.1.11**



NORTH ELEVATION



WEST ELEVATION



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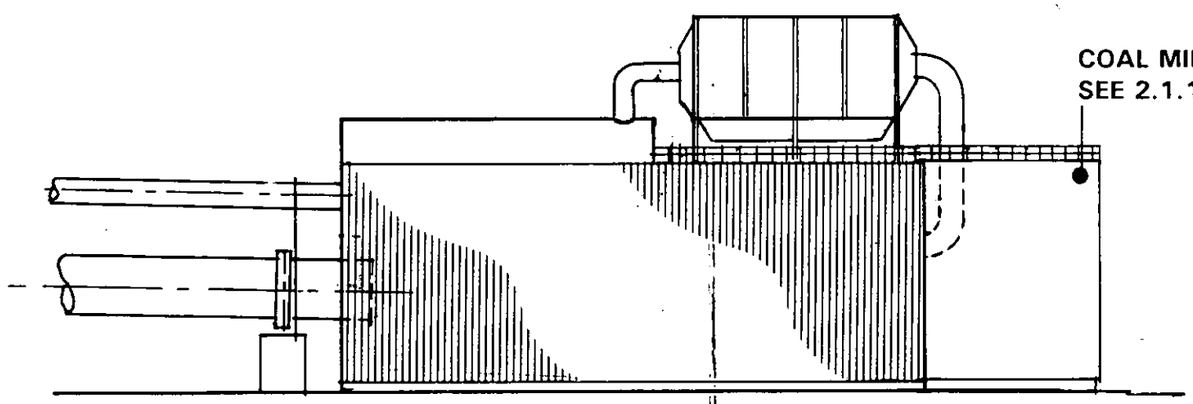
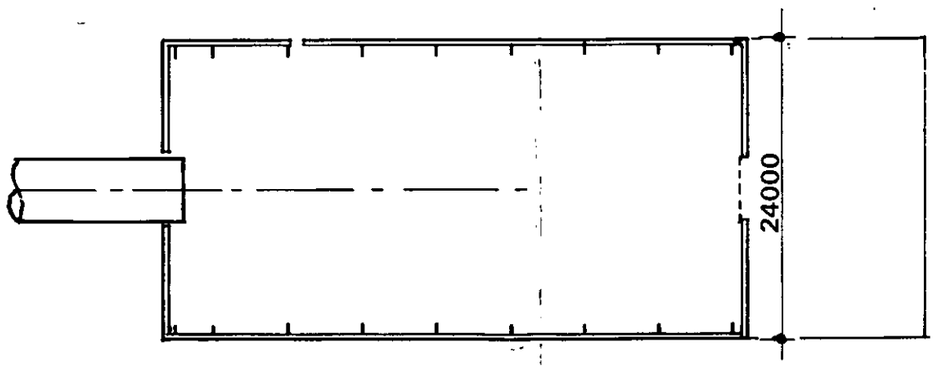


EAST ELEVATION



PLAN

Scale 1:500

0 10 20

5 15 25m

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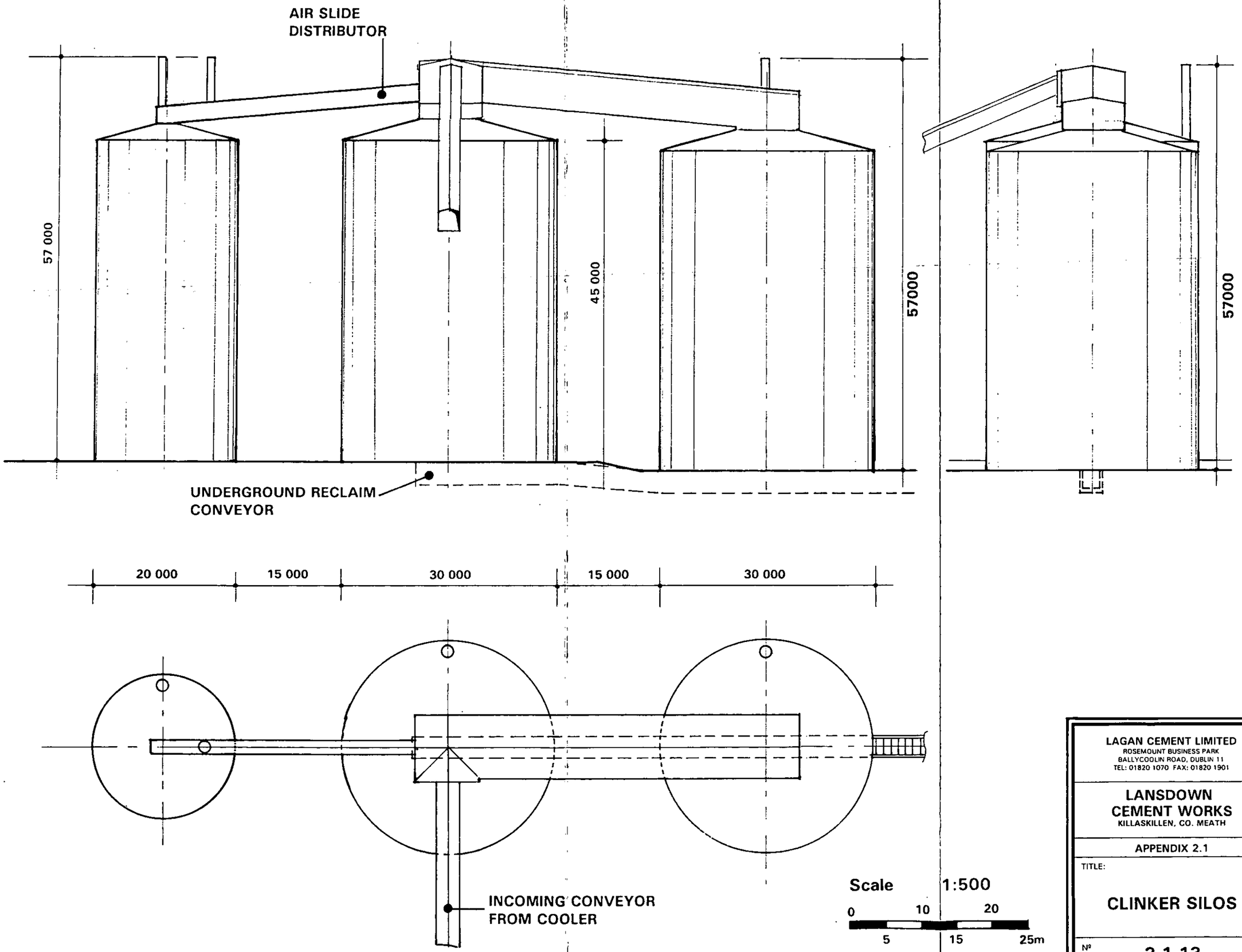
LANSDOWN CEMENT WORKS
KILLASKILLEN, CO. MEATH

APPENDIX 2.1

TITLE:

COOLER AND COOLER PRECIPITATOR

Nº 2.1.12



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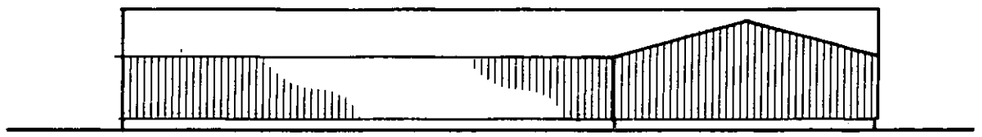
LANSDOWN CEMENT WORKS
KILLASKILLEN, CO. MEATH

APPENDIX 2.1

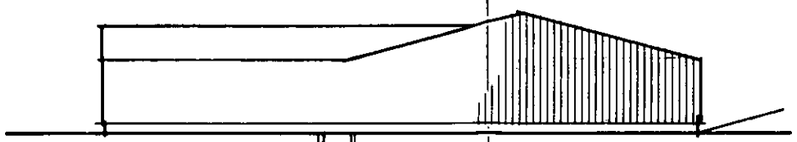
TITLE:

CLINKER SILOS

Nº **2.1.13**



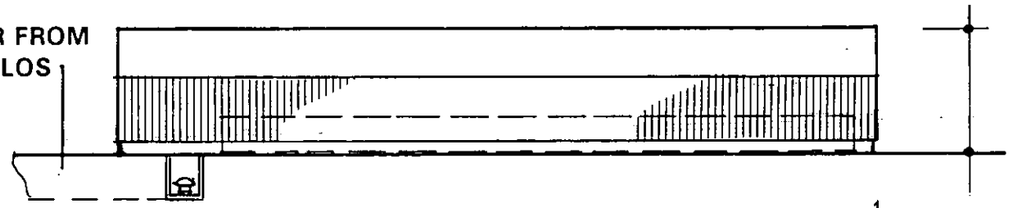
WEST ELEVATION



SOUTH ELEVATION

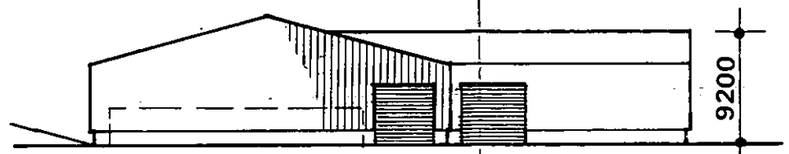
CONVEYOR TO CEMENT MILL

CONVEYOR FROM CLINKER SILOS



EAST ELEVATION

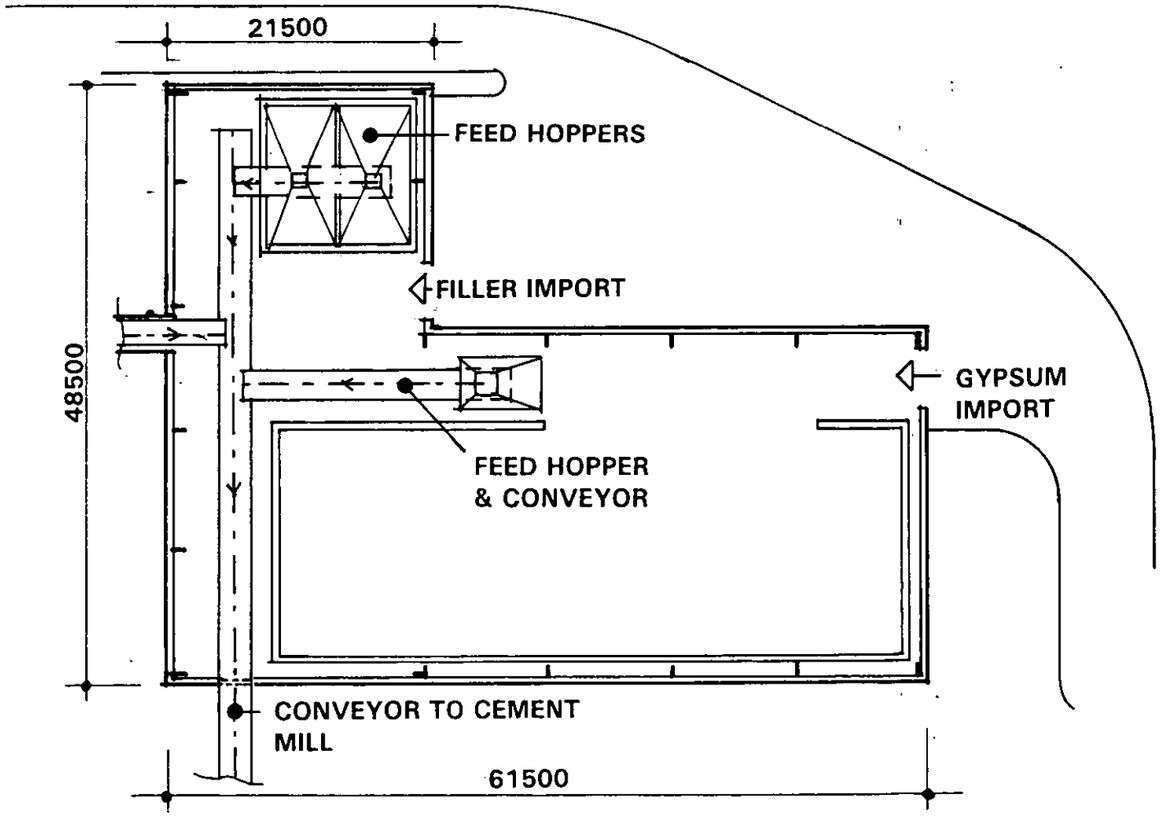
61500



9200

NORTH ELEVATION

49000



PLAN

0 10 20
5 15 25m

Scale 1:500

ALL STEELWORK TO BE GRADE 43 TO BS4360 OR EQUIVALENT IRISH STANDARD

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LANSDOWN CEMENT WORKS
KILLASKILLEN, CO. MEATH

APPENDIX 2.1

TITLE:
GYPSUM AND FILLER STORE

Nº **2.1.14**

ALL STEELWORK TO BE GRADE 43 TO BS4360 OR EQUIVALENT IRISH STANDARD

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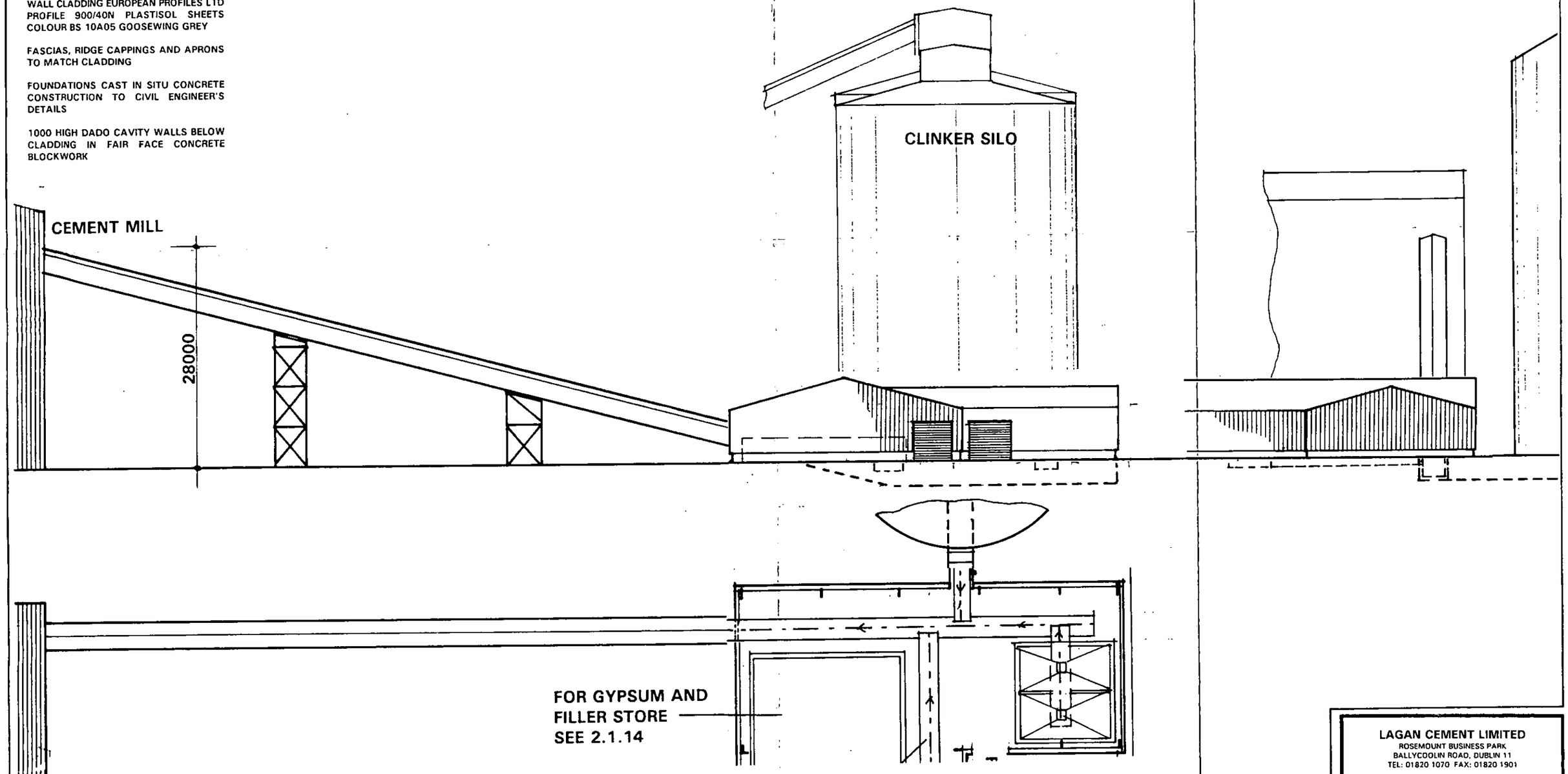

Scale 1:500

0 10 20

5 15 25m

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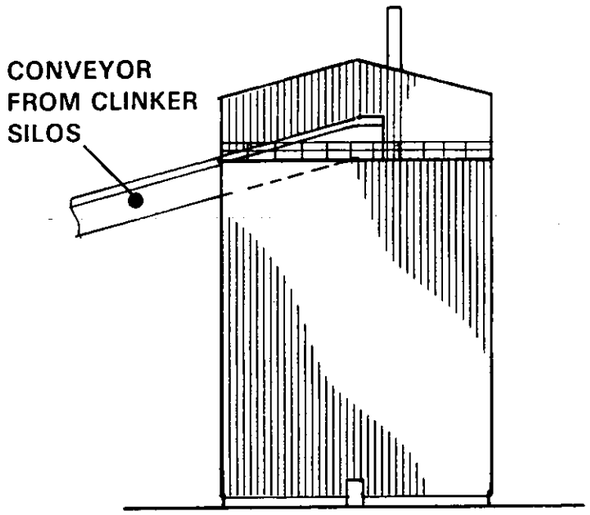
LANSDOWN
CEMENT WORKS
KILLASKILLEN, CO. MEATH

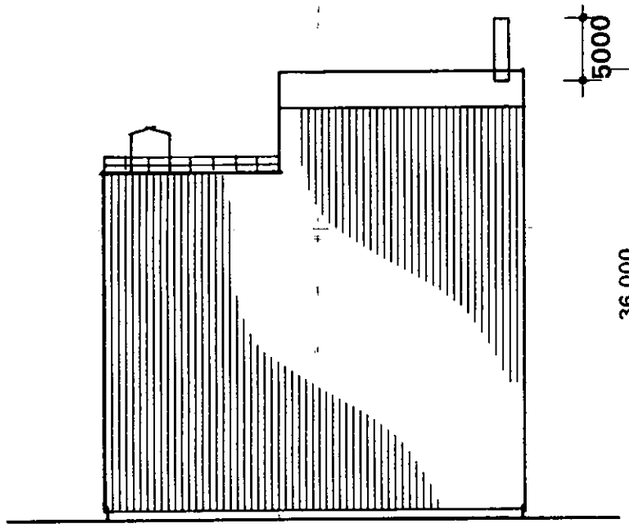
APPENDIX 2.1

TITLE:
CLINKER
CONVEYORS

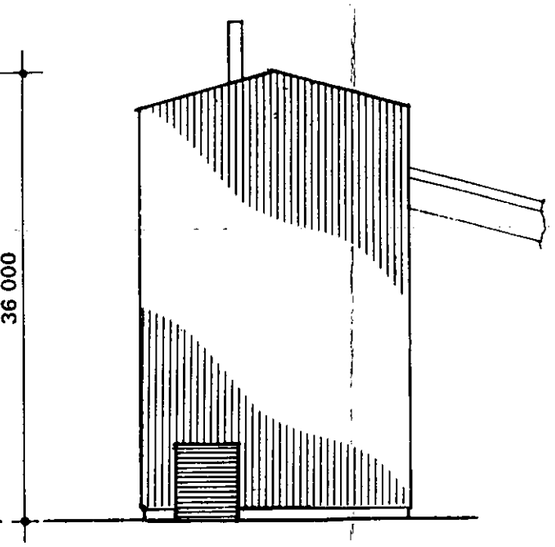
Nº 2.1.15



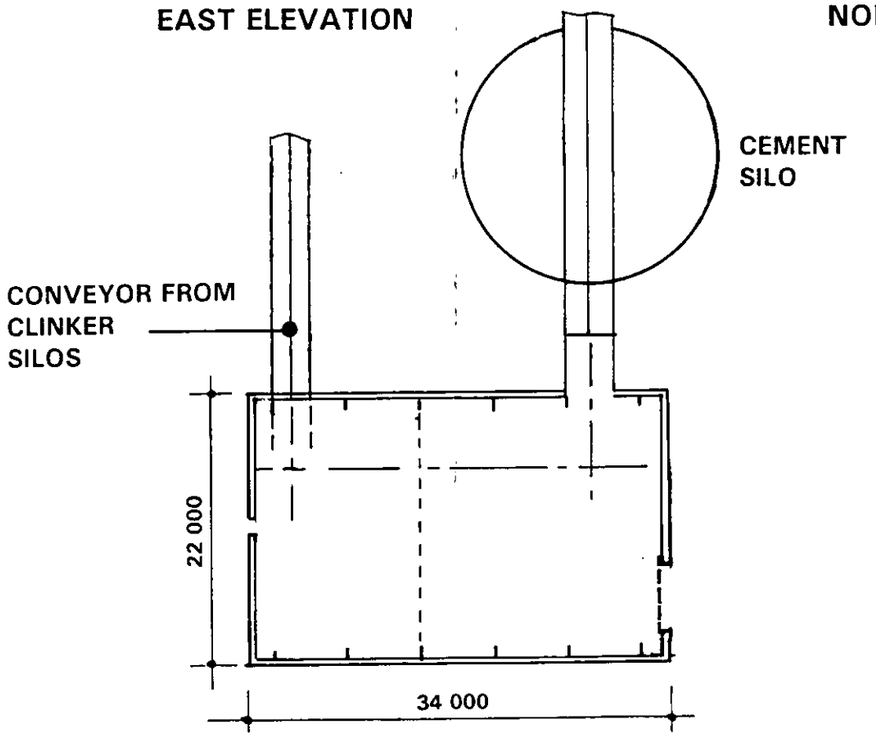
SOUTH ELEVATION



EAST ELEVATION



NORTH ELEVATION



Scale 1:500

0 10 20

5 15 25m

ALL STEELWORK TO BE GRADE 43 TO BS4360 OR EQUIVALENT IRISH STANDARD

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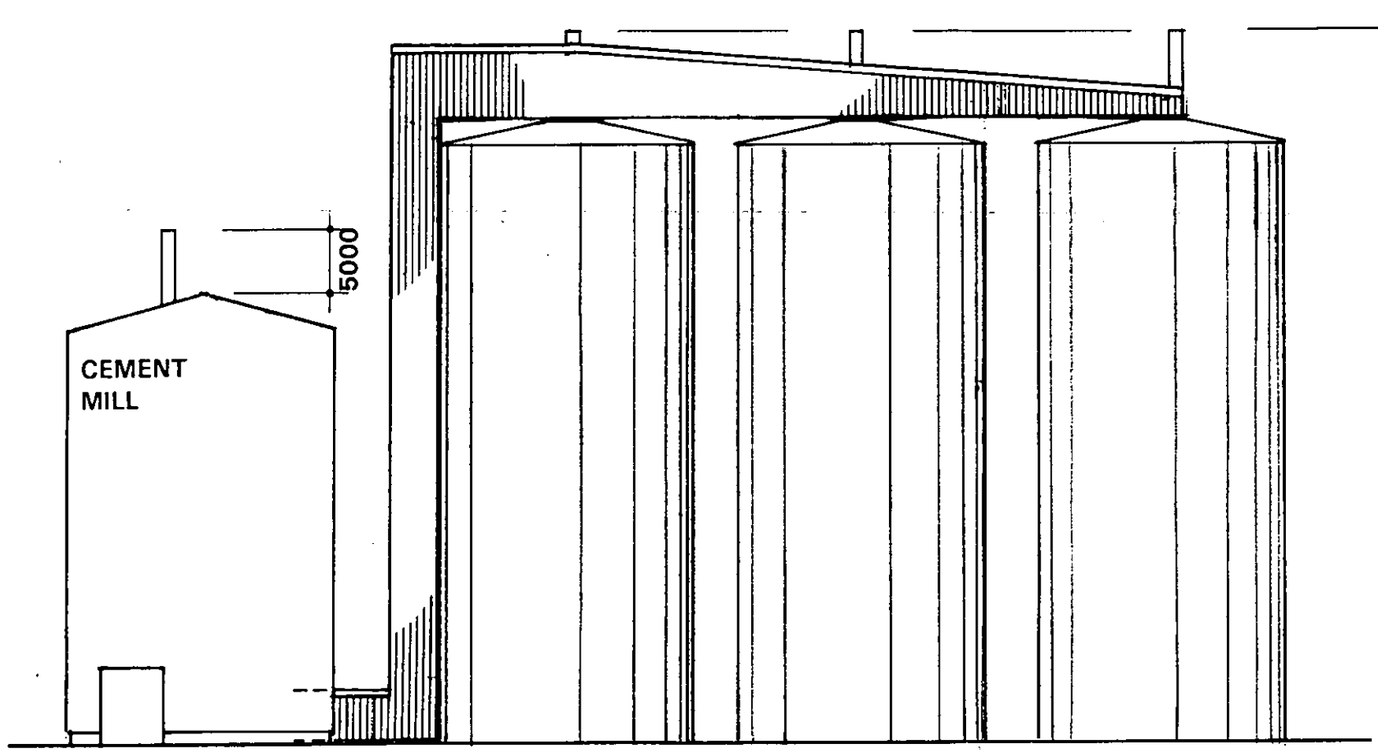
LANSDOWN
CEMENT WORKS
KILLASKILLEN, CO. MEATH

APPENDIX 2.1

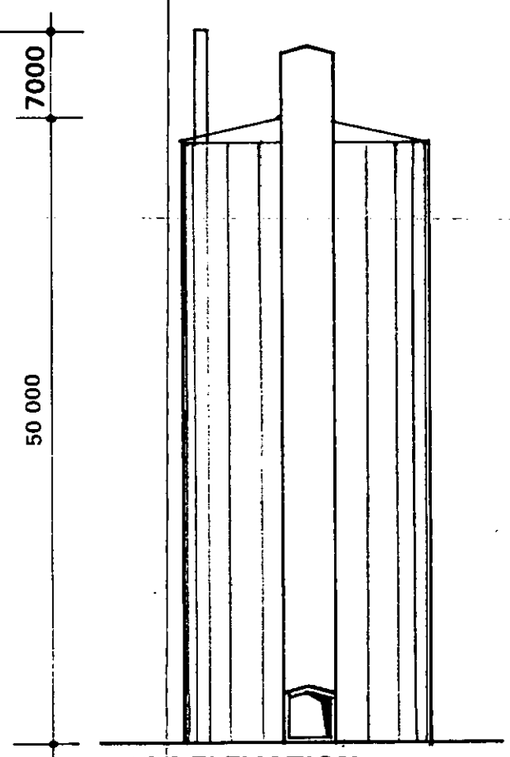
TITLE:

CEMENT MILL

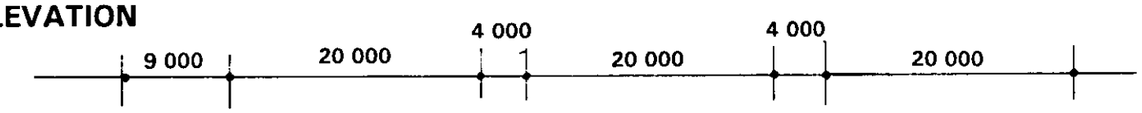
Nº 2.1.16

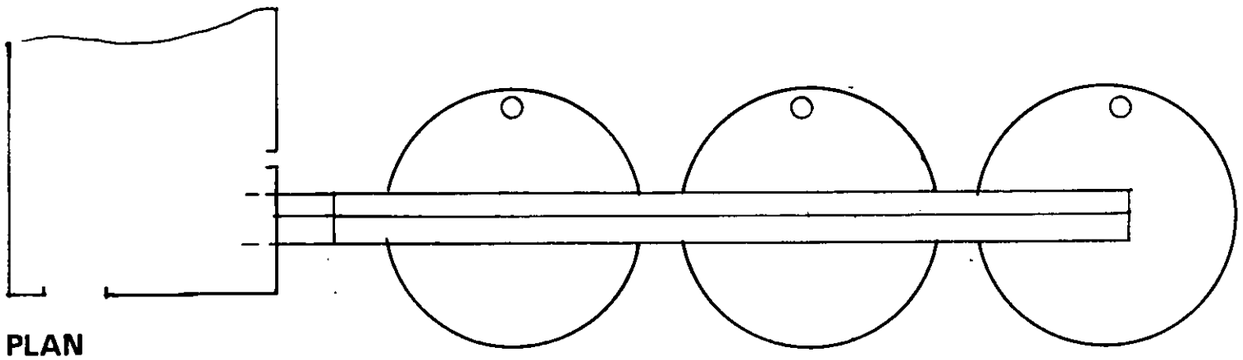


NORTH ELEVATION

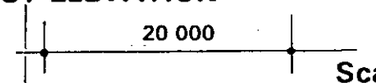


EAST ELEVATION





PLAN



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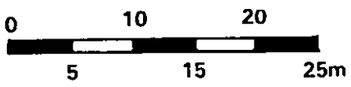

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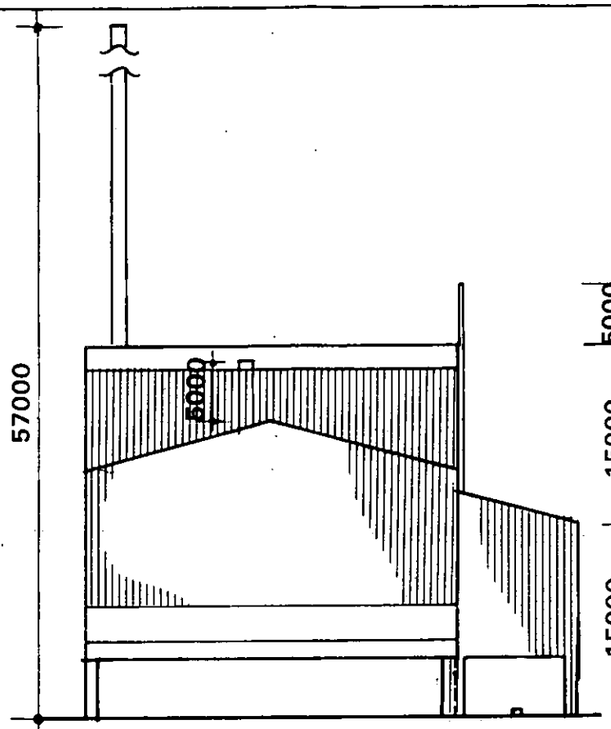
LANSDOWN CEMENT WORKS
KILLASKILLEN, CO. MEATH

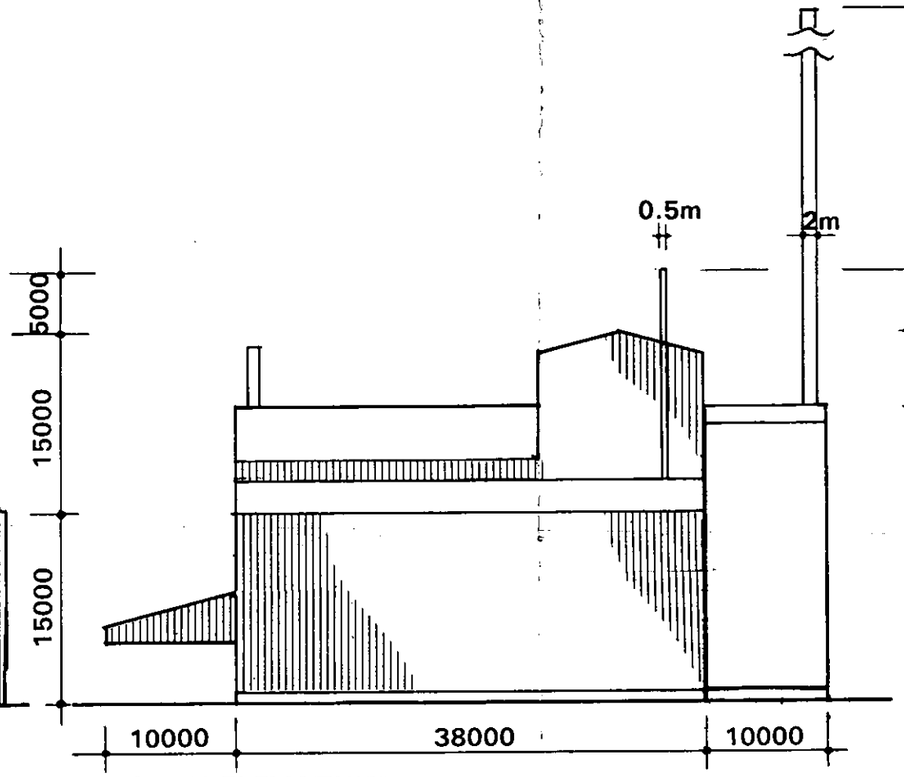
APPENDIX 2.1

TITLE:
CEMENT CONVEYOR AND SILOS

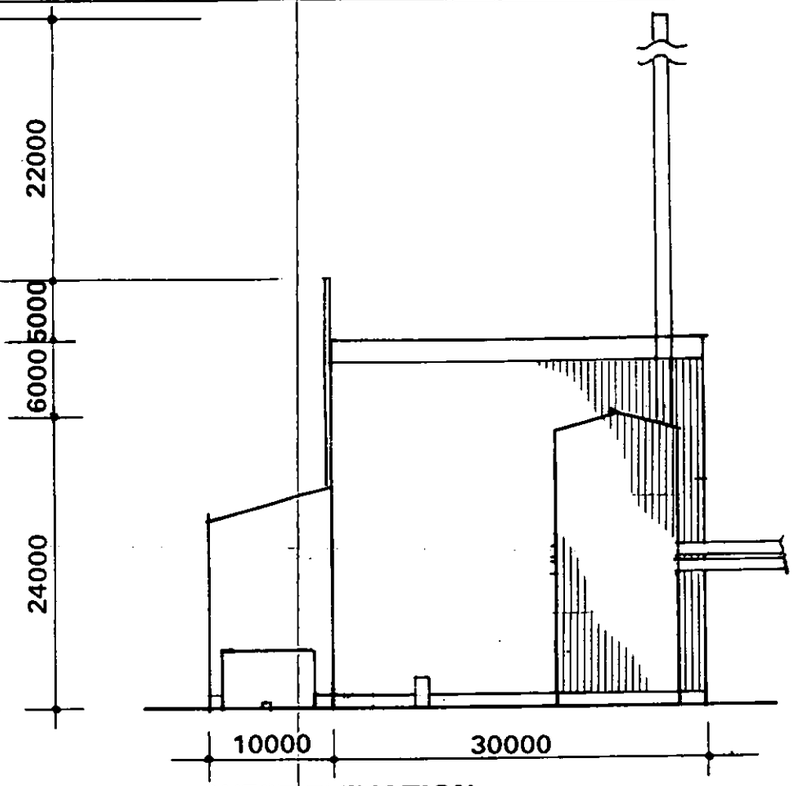
Nº 2.1.17



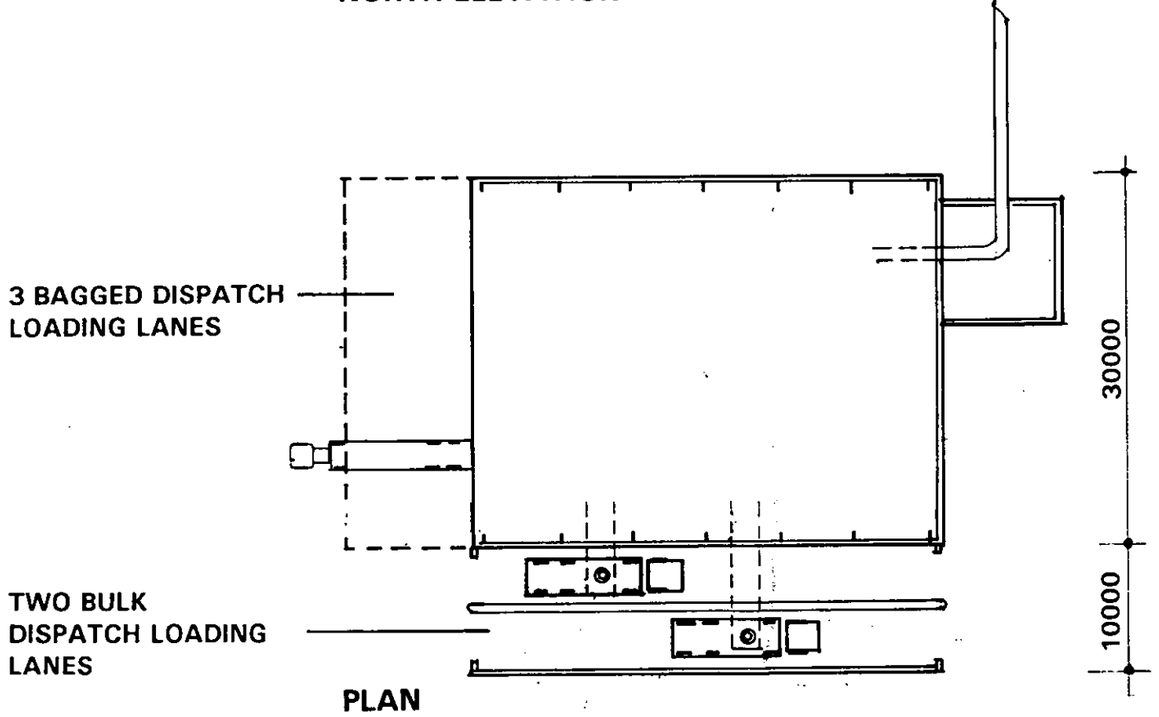
EAST ELEVATION



NORTH ELEVATION



WEST ELEVATION



PLAN

Scale 1:500

0 10 20

5 15 25m

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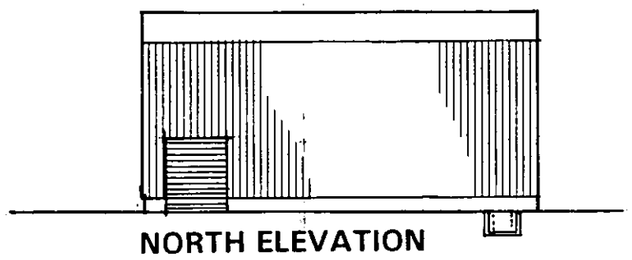
APPENDIX 2.1

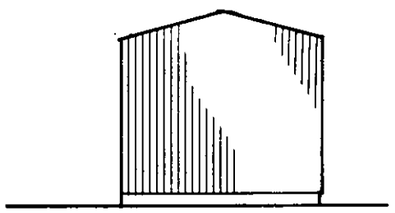
TITLE:

CEMENT PACKING AND BULK LOADING PLANT

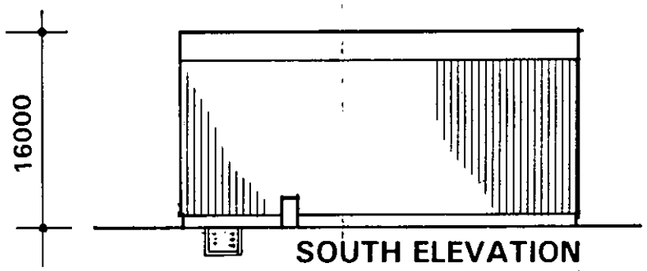
Nº 2.1.18



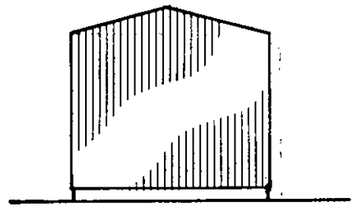
NORTH ELEVATION



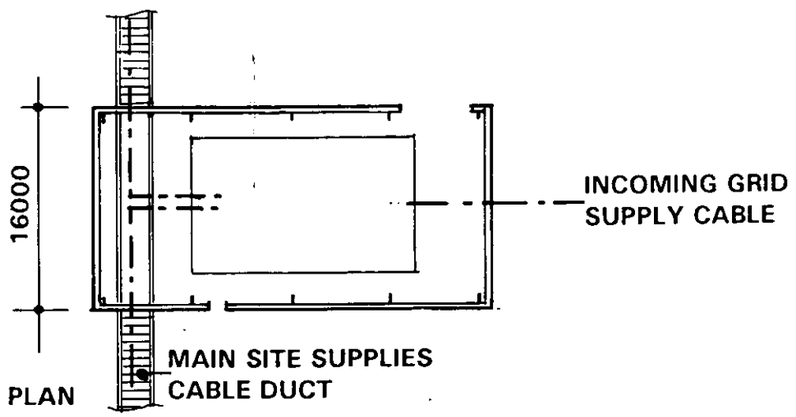
WEST ELEVATION



SOUTH ELEVATION



EAST ELEVATION



PLAN

Scale 1:500

0 10 20

5 15 25m

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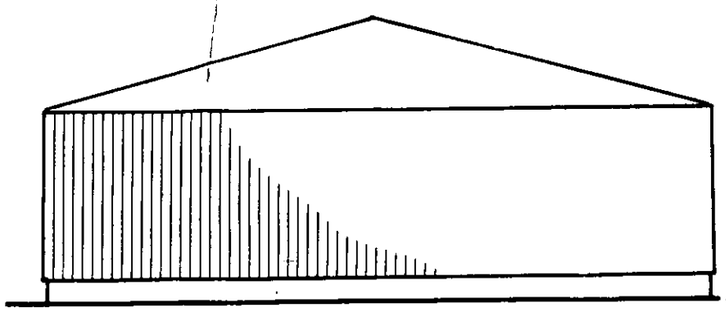
KILLASKILLEN, CO. MEATH

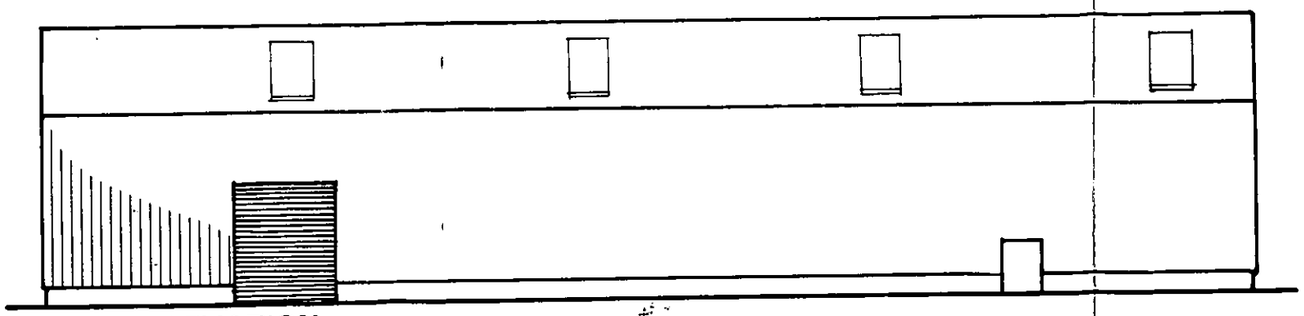
APPENDIX 2.1

TITLE:
INDOOR ELECTRICAL SUBSTATION

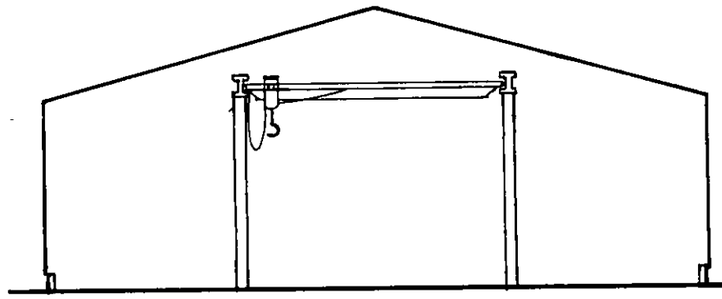
Nº 2.1.19



SOUTH ELEVATION



WEST ELEVATION



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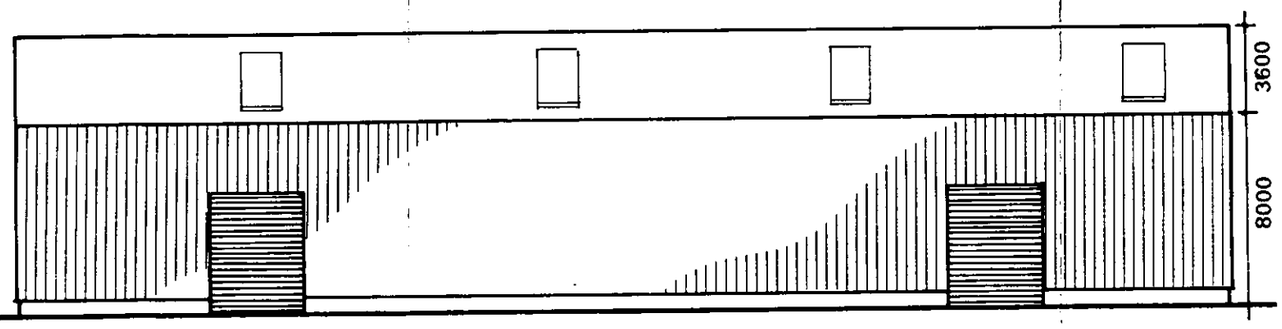

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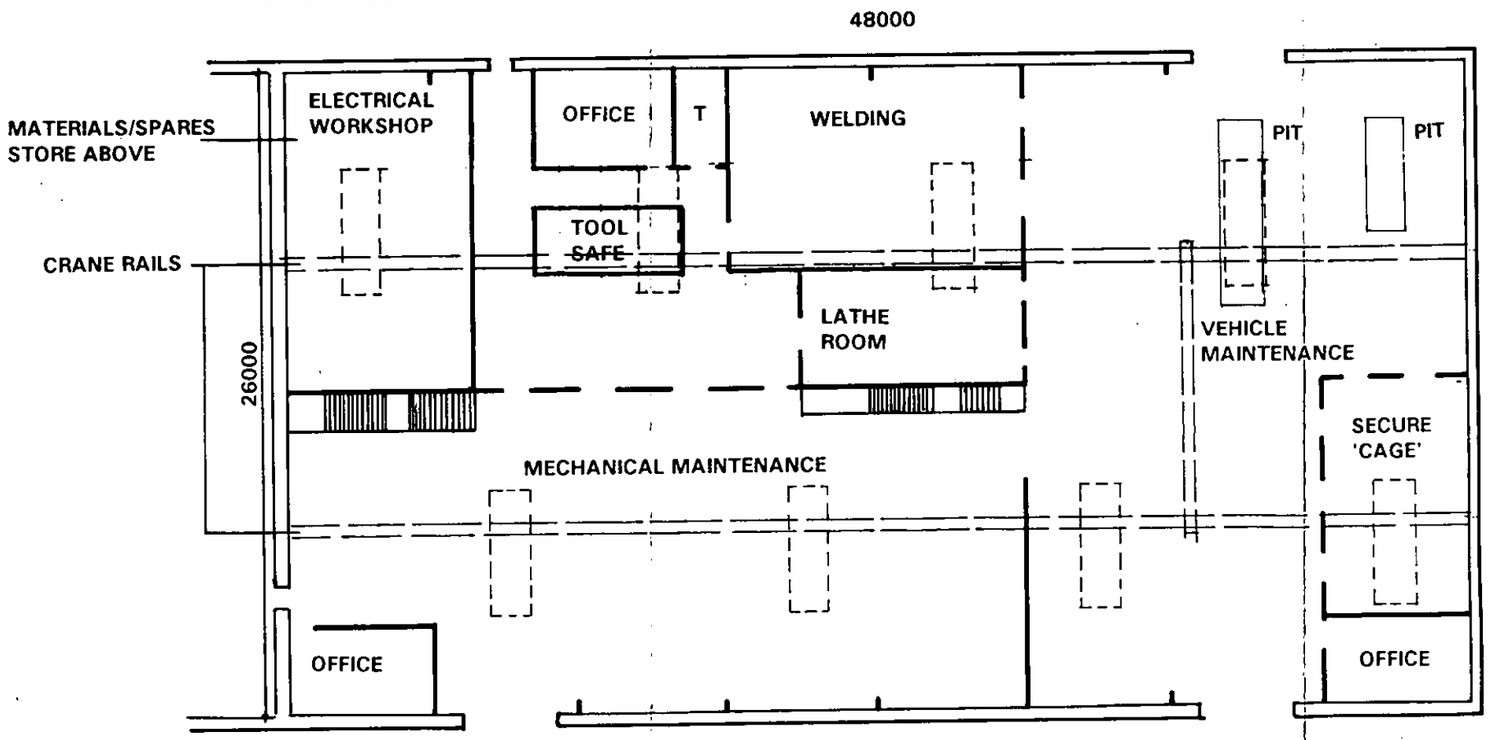

PLAN

0 2 4 6 8 10m

Scale 1:250

ALL STEELWORK TO BE GRADE 43 TO BS4360 OR EQUIVALENT IRISH STANDARD

ROOF CLADDING EUROPEAN PROFILES LTD PROFILE 900/26N PLASTISOL SHEETS COLOUR BS 10A05 GOOSEWING GREY

WALL CLADDING EUROPEAN PROFILES LTD PROFILE 900/40N PLASTISOL SHEETS COLOUR BS 10A05 GOOSEWING GREY

FASCIAS, RIDGE CAPPINGS AND APRONS TO MATCH CLADDING

FOUNDATIONS CAST IN SITU CONCRETE CONSTRUCTION TO CIVIL ENGINEER'S DETAILS

1000 HIGH DADO CAVITY WALLS BELOW CLADDING IN FAIR FACE CONCRETE BLOCKWORK

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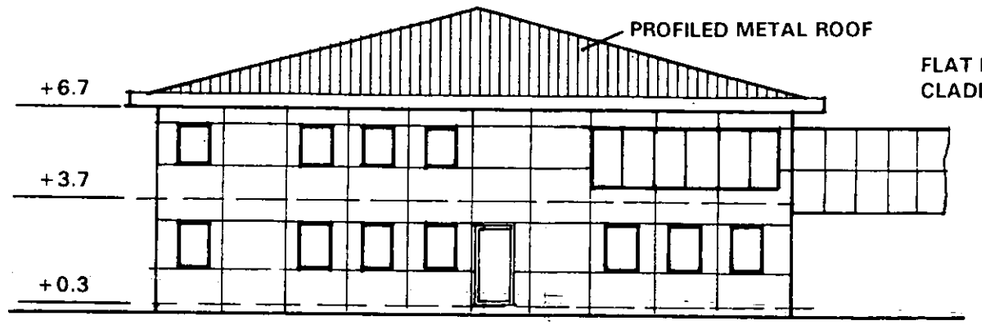
APPENDIX 2.1

TITLE:
MECHANICAL AND ELECTRICAL WORKSHOPS

Nº 2.1.20



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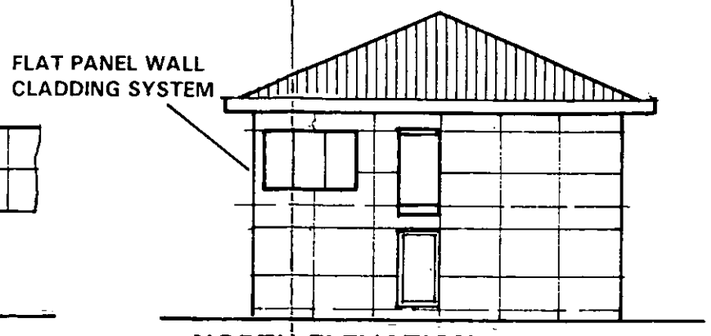
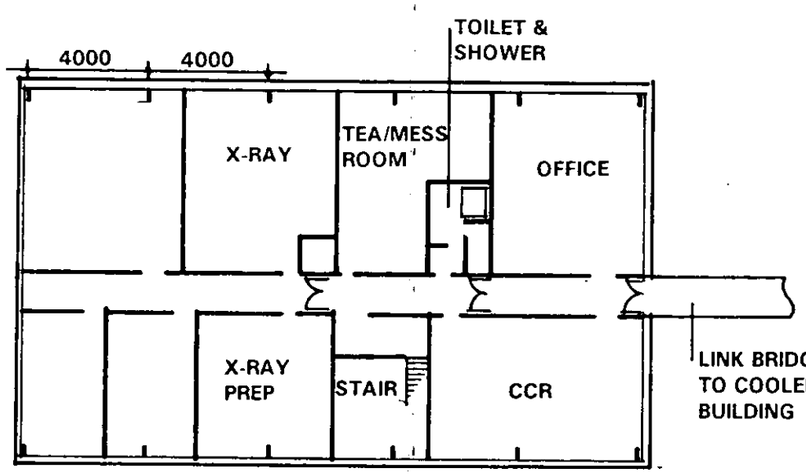
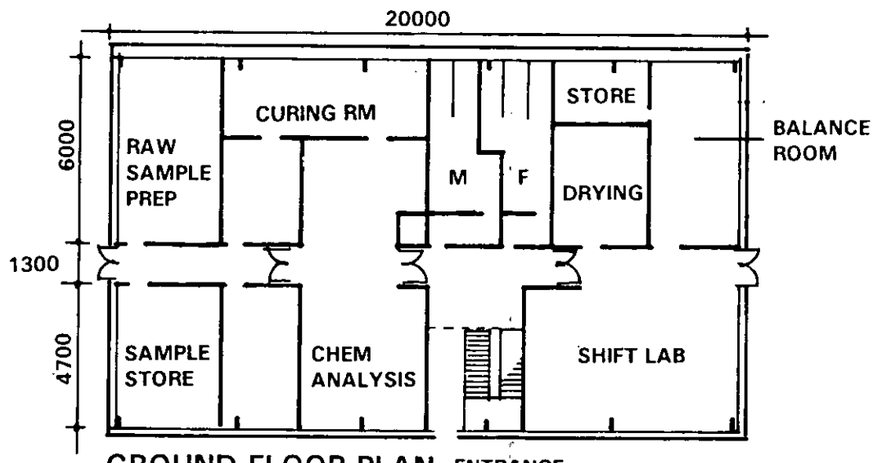


NORTH ELEVATION



FIRST FLOOR PLAN



GROUND FLOOR PLAN ENTRANCE

SCALE 1:200

0 2 4 6 8 10m

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LANSDOWN
CEMENT WORKS
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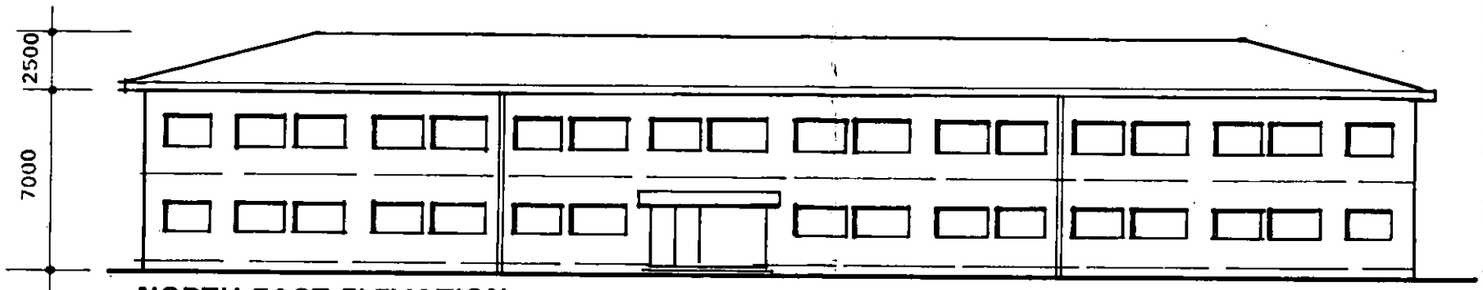
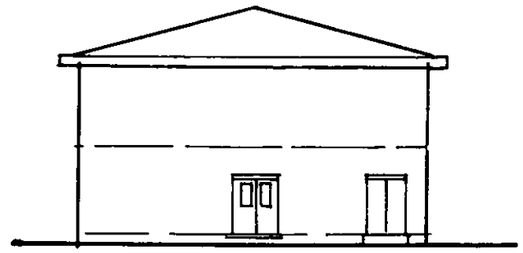
APPENDIX 2.1

TITLE:
SAMPLING LAB AND
WORKS CONTROL
BUILDING

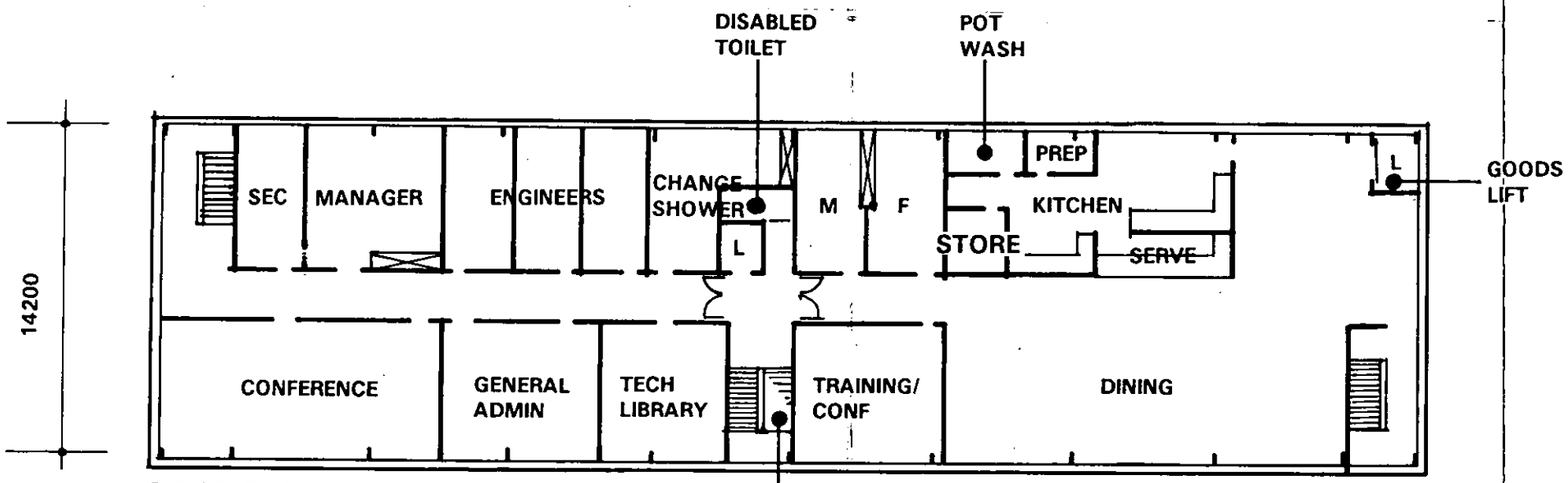
Nº 2.1.21



NORTH EAST ELEVATION

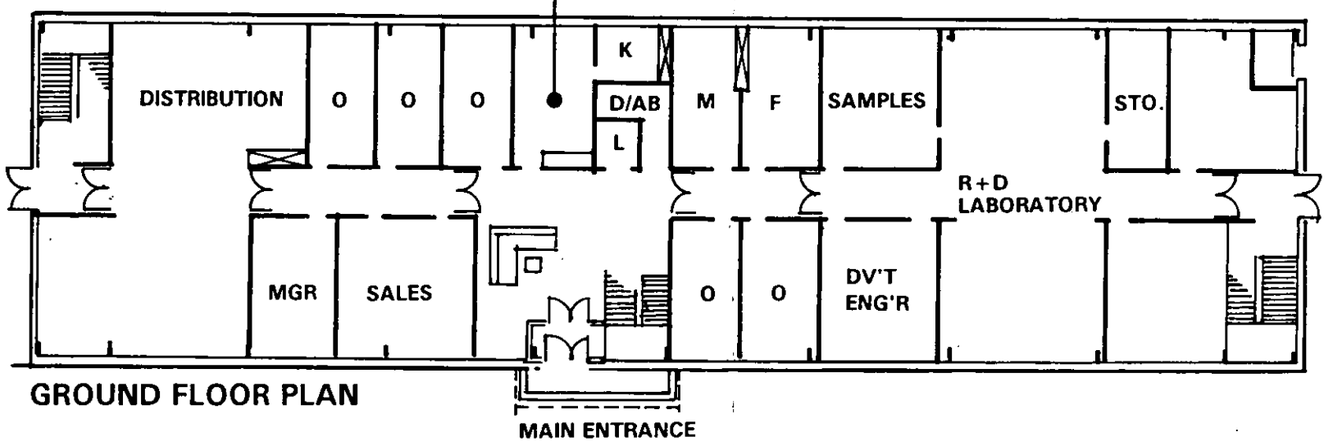


NORTH WEST ELEVATION



FIRST FLOOR PLAN

51400



GROUND FLOOR PLAN

Scale 1:250

0 4 8
2 6 10m

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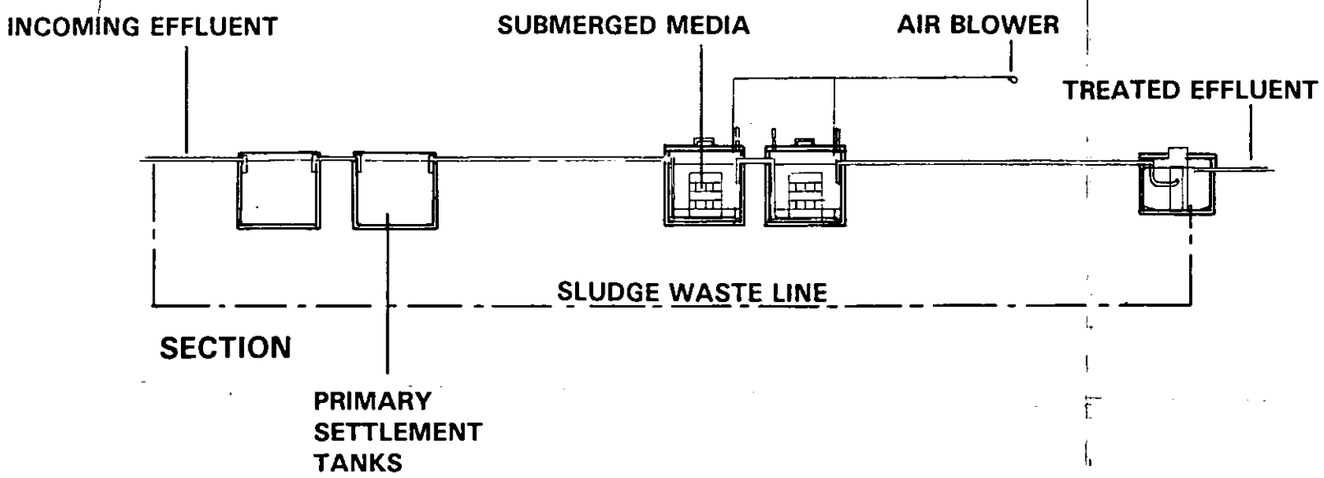
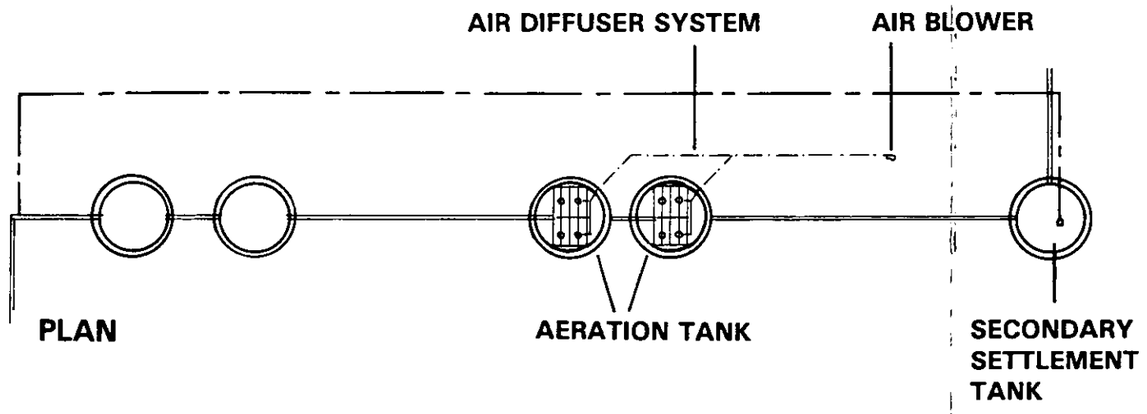
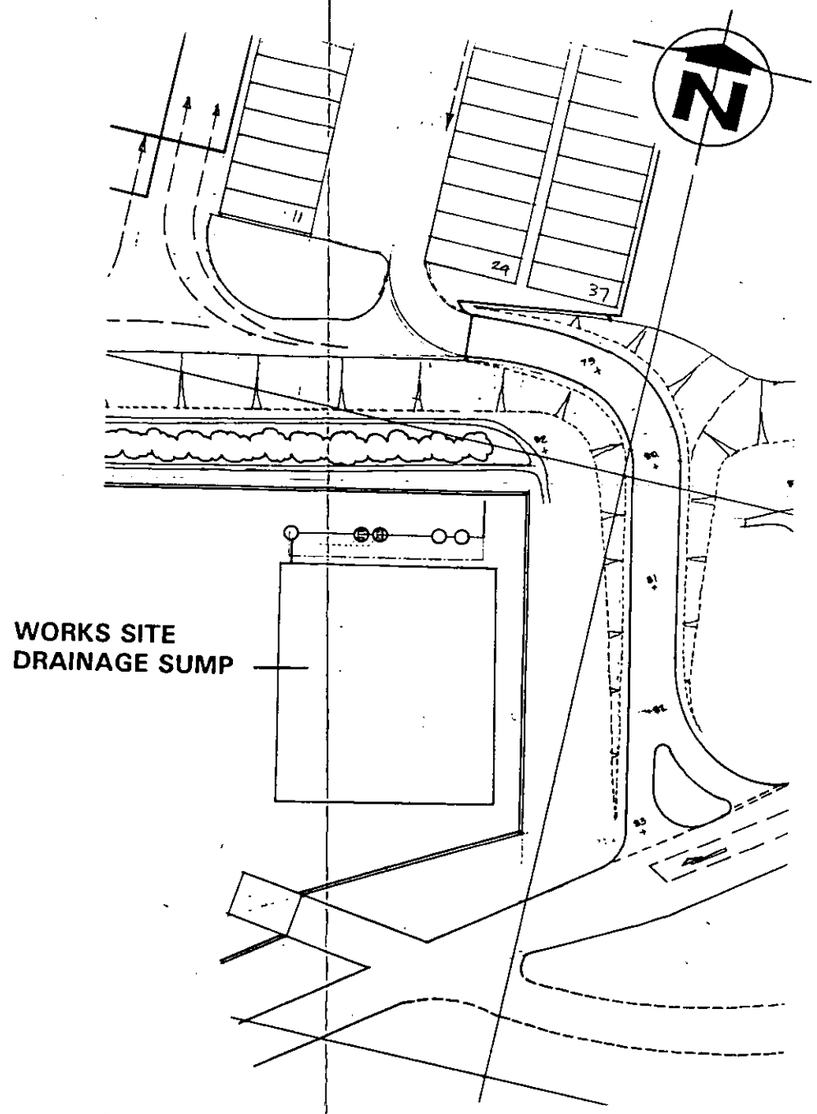
APPENDIX 2.1

TITLE:
ADMINISTRATION BUILDING

N°
2.1.22







SEWAGE TREATMENT LOCATION
NOT TO SCALE

SCALE 1:200

0 2 4 6 8 10m

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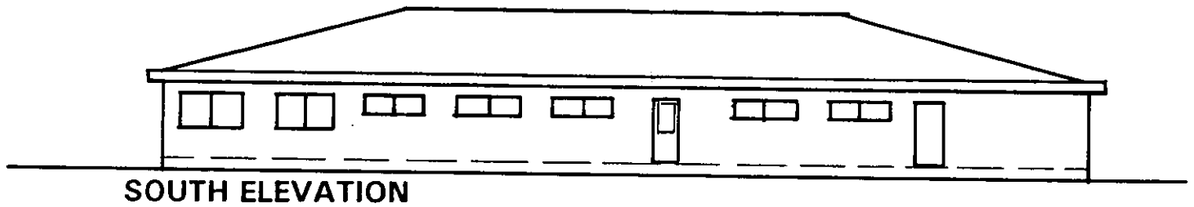
APPENDIX 2.1

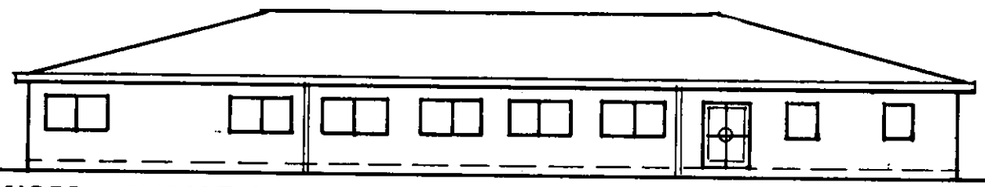
TITLE:
SEWAGE TREATMENT WORKS

N°
2.1.23

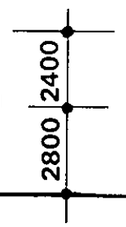


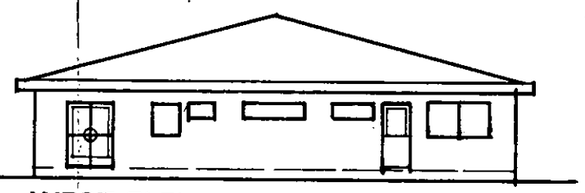
SOUTH ELEVATION

EAST ELEVATION



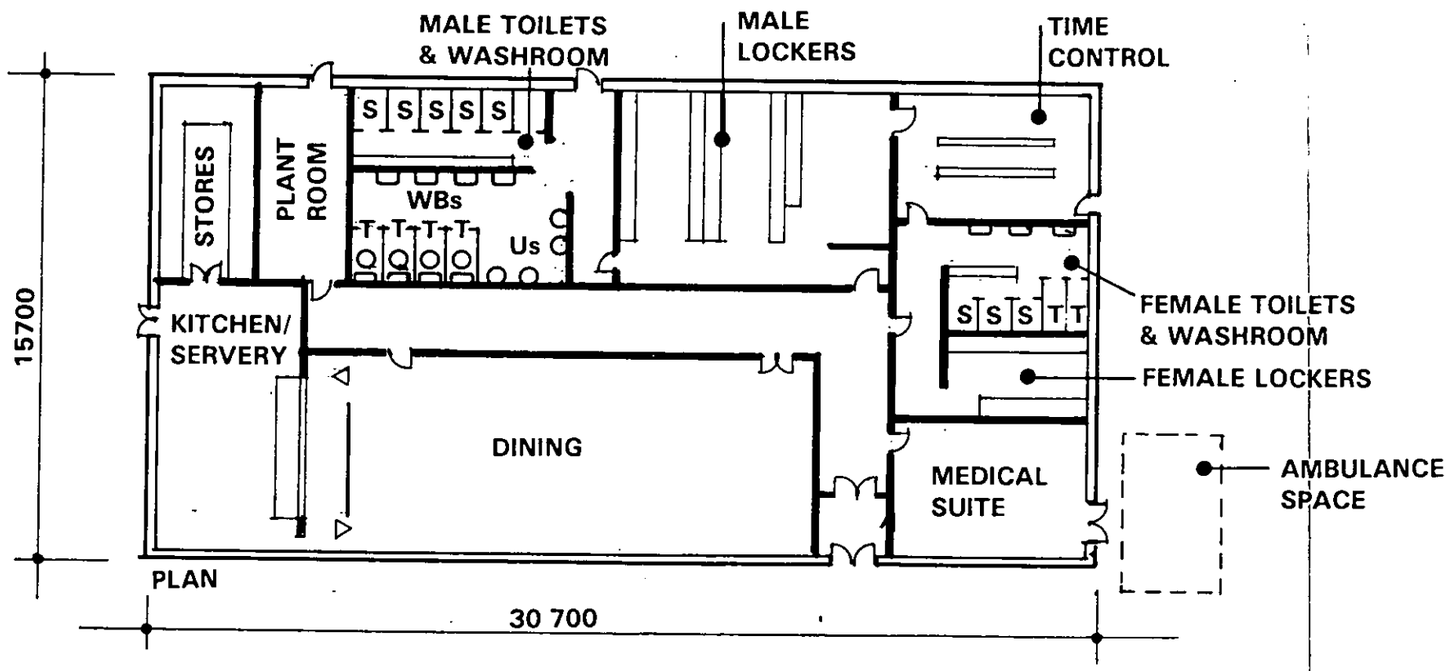
NORTH ELEVATION





WEST ELEVATION

S = Shower
T = Toilet
WB = Wash basin
U = Urinal



PLAN

Scale 1:200

0 2 4 6 8 10m

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LANSDOWN CEMENT WORKS
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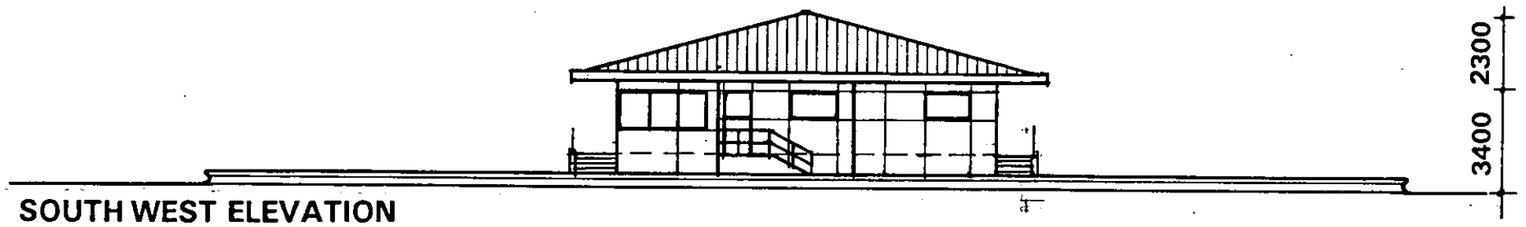
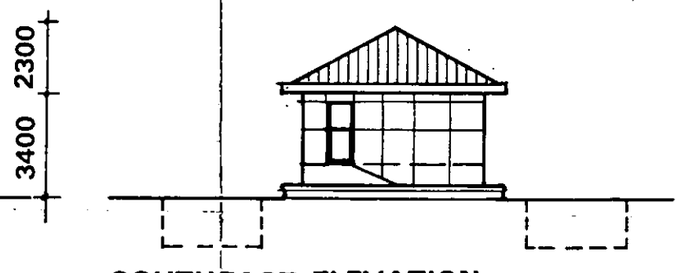
APPENDIX 2.1

TITLE:
SITE FACILITIES BUILDING

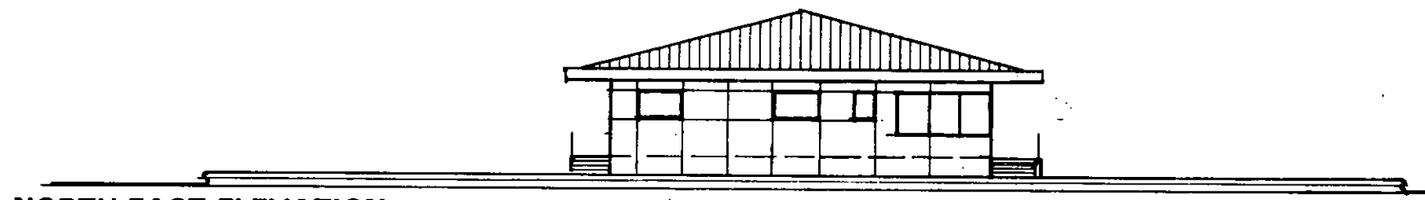
N°
2.1.24



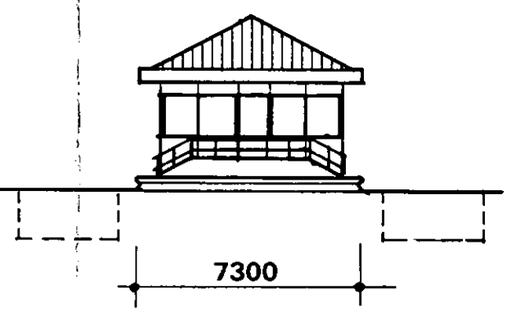
SOUTH WEST ELEVATION



SOUTHEAST ELEVATION



NORTH EAST ELEVATION



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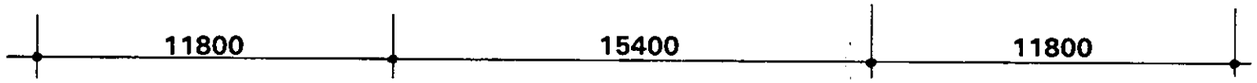

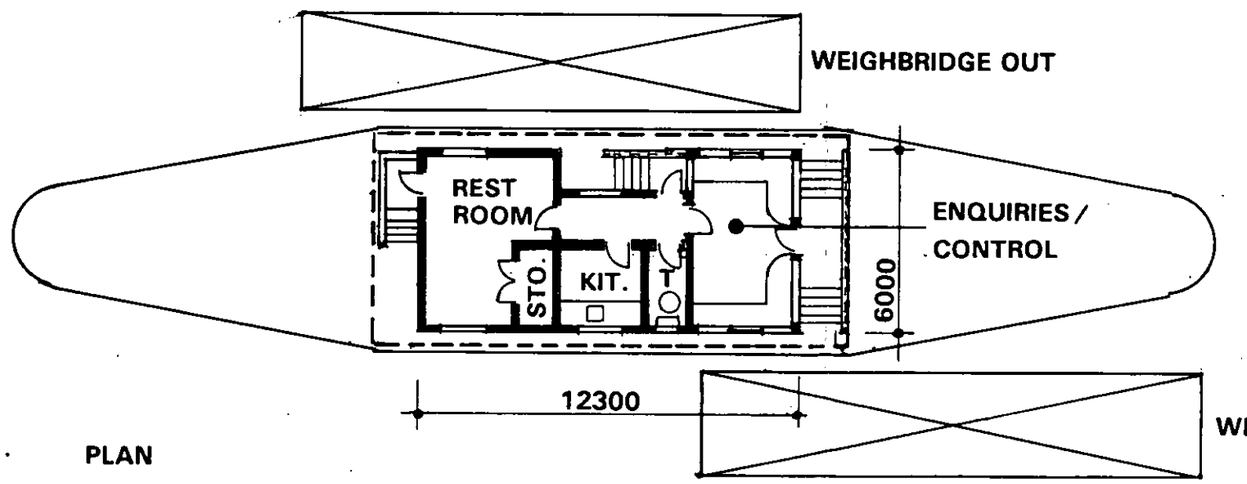

PLAN

SCALE 1:200

0 2 4 6 8 10m

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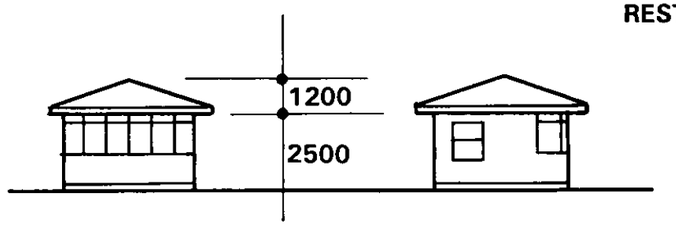
APPENDIX 2.1

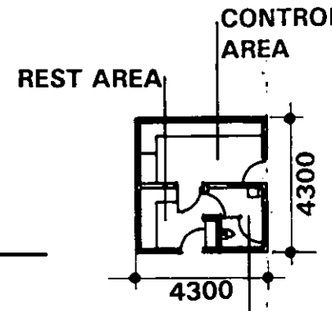
TITLE:
WEIGHBRIDGE AND OFFICE

Nº 2.1.25



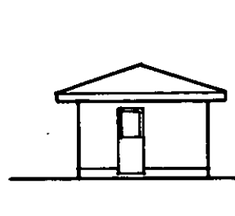
SOUTHWEST ELEVATION

SOUTHEAST ELEVATION

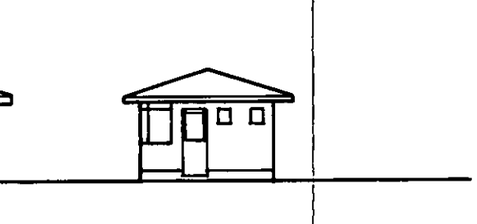


PLAN

WASHROOM



NORTHEAST ELEVATION



NORTHWEST ELEVATION

SCALE 1:200

0 4 8

2 6 10m

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BALLYCOOLIN ROAD, DUBLIN 11
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LANSDOWN CEMENT WORKS
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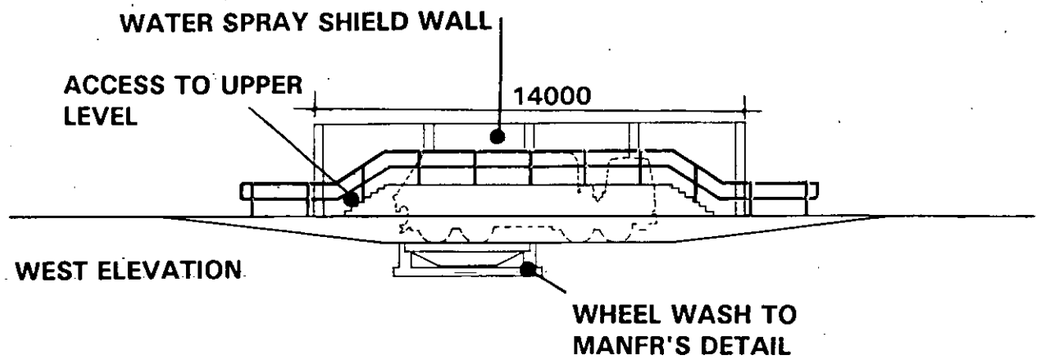
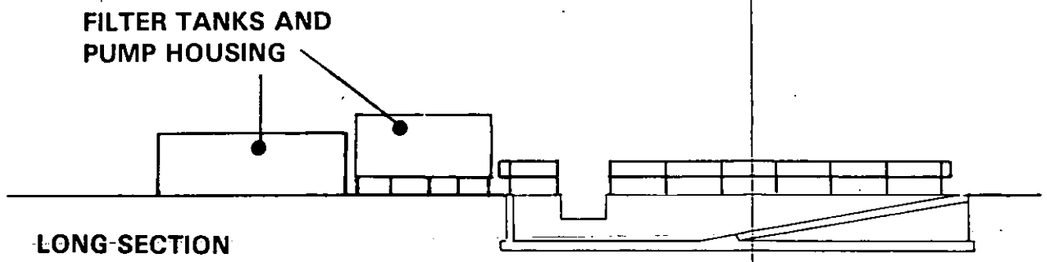
APPENDIX 2.1

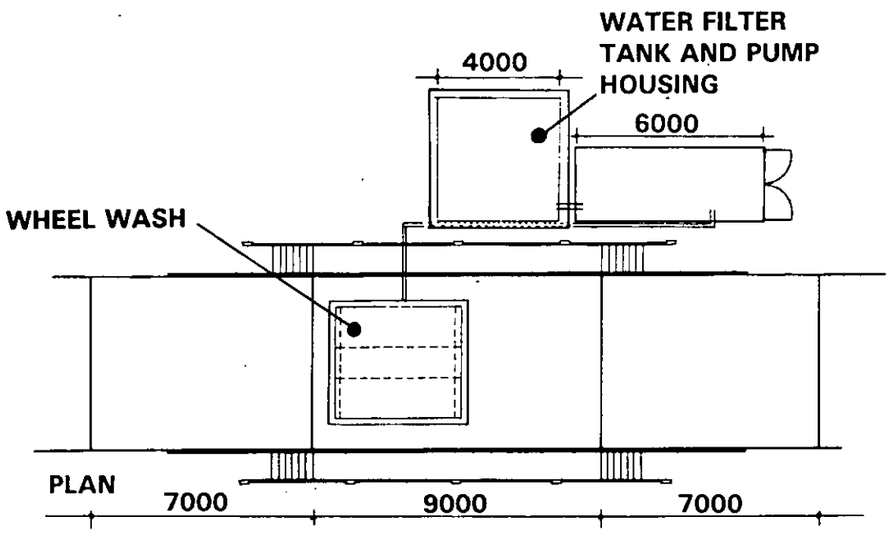
TITLE:

WORKS SITE SECURITY POST

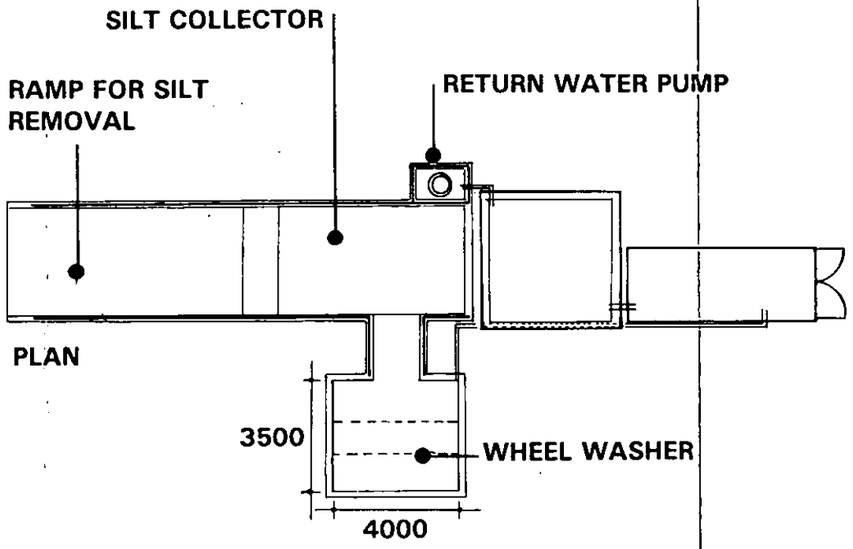
Nº 2.1.26

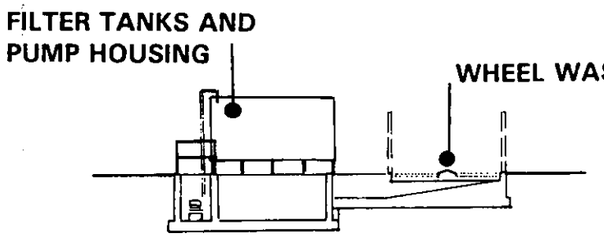






CEMENT WORKS VEHICLE WASH





QUARRY WHEEL WASHER

SCALE 1:200

0 2 4 6 8 10m

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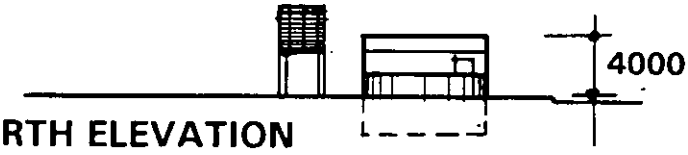
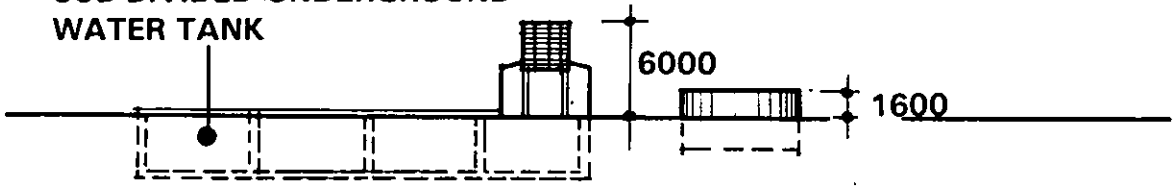
APPENDIX 2.1

TITLE:
WHEEL/BODY WASHERS

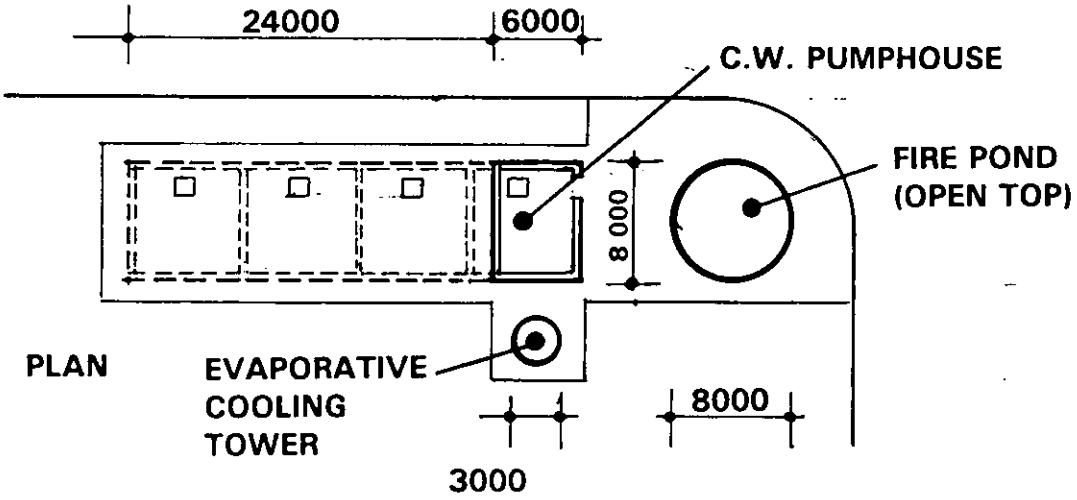
Nº 2.1.27



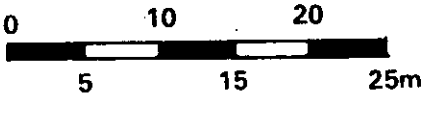
NORTH ELEVATION



EAST ELEVATION



PLAN



Scale 1:500

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APPENDIX 2.1

TITLE:
WATER RESERVOIR (FIRE POND) COOLING WATER PUMPHOUSE AND UNDERGROUND TANKS

Nº 2.1.28 / 2.1.29

APPENDIX
2.2
THE QUARRYING PROCESS

Appendix Table 2.2.1

Schedule of stripping and placement of soils and superficial materials

Total Site Area	1,600,100 m²
Northern Site Area	479,610 m²
Southern Site Area	1,120,490 m²

A: Overburden Excavation

	Initial Works				Final			
	Area	Topsoil [1]	Superficials	Total	Area	Topsoil	Superficials	Total
Northern Site	(m²)	(m³)	(m³)	(m³)	(m²)	(m³)	(m³)	(m³)
Roads	29,830	17,900	11,930	29,830	29,830	17,900	11,930	29,830
Shale Quarry	85,000	51,000	367,000	418,000	138,550	83,130	830,070	913,200
Sand excavation	34,810	20,890	13,920	34,810	34,810	20,890	13,920	34,810
Gravel excavation	19,160	11,500	7,660	19,160	19,160	11,500	7,660	19,160
Materials Handling Area	11,400	6,840	0	6,840	11,400	6,840	0	6,840
Total for Northern Area	180,200	108,120	400,510	508,640	233,750	140,260	863,580	1,003,840
Southern Site								
Plant	115,520	69,310	232,390	301,700	115,520	69,310	232,390	301,700
Stockpile area 2m strip	63,710	38,230	89,190	127,420	63,710	38,230	89,190	127,420
Stockpile area 5m strip	4,260	2,560	12,780	15,340	4,260	2,560	12,780	15,340
Limestone Quarry	248,030	148,820	807,180	956,000	248,030	148,820	807,180	956,000
Holding Pond	21,130	12,680	62,120	74,800	21,130	12,680	62,120	74,800
Roads	16,850	10,110	6,740	16,850	16,850	10,110	6,740	16,850
Inert fill [2]			60,000					60,000
Total for Southern Area	469,500	281,710	1,270,400	1,492,110	469,500	281,710	1,210,400	1,552,110
Site Total	649,700	389,830	1,670,910	2,000,750	703,250	421,970	2,073,980	2,555,950

B: Placement of superficials (including soils)

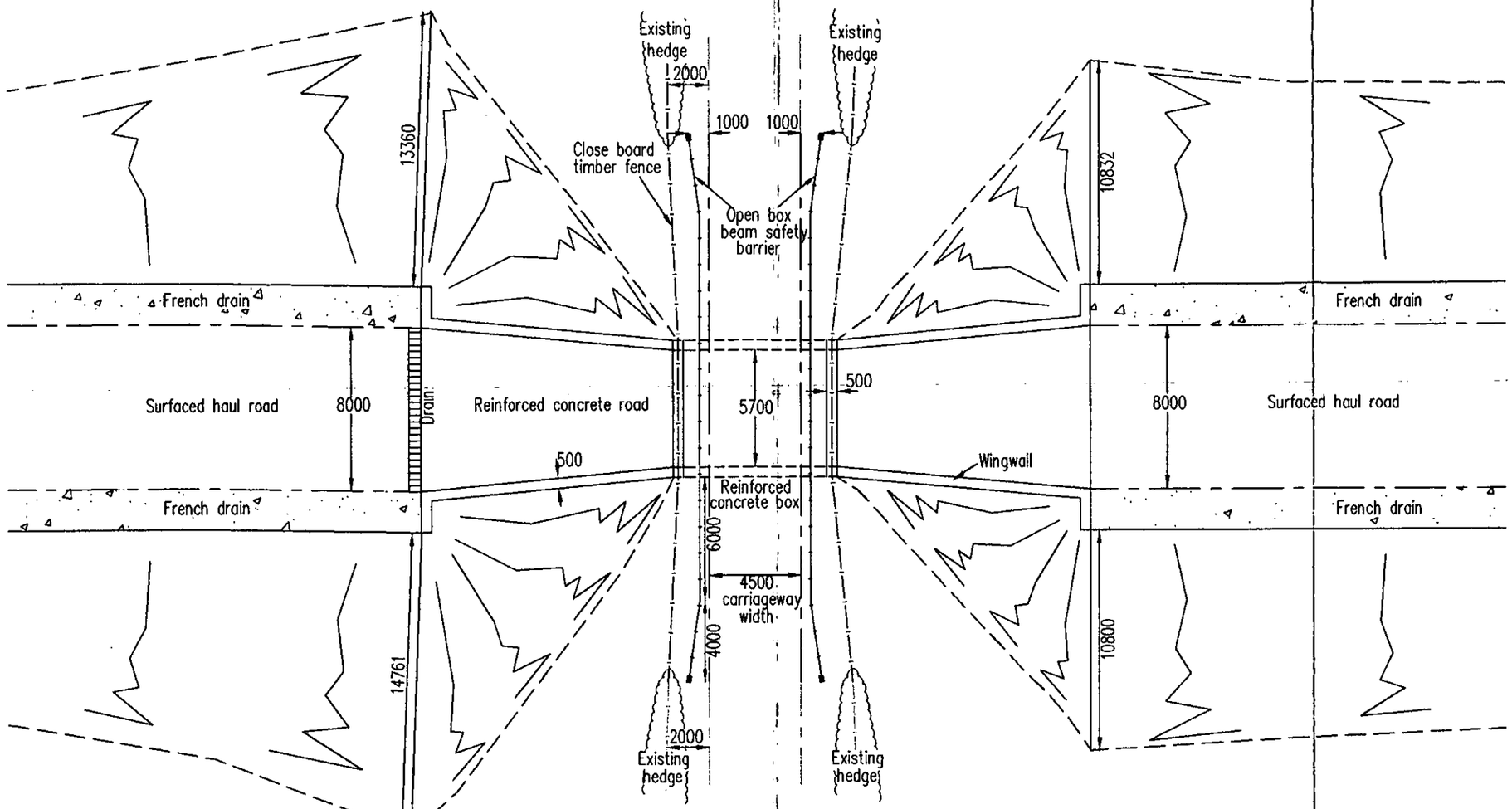
	Initial works		Final	
Bund Number (See Appendix Dwg No. 2.2.4	Area (m²)	Volume (m³)	Area (m²)	Volume (m³)
Northern Site				
Bund 1A	30,310	96,050	43,010	157,770
Bund 1B	1,060	1,130	1,060	1,130
Bund 2	86,940	236,850	86,940	291,130
Bund 3	16,620	38,770	16,620	38,770
Bund 4	5,230	13,030	5,230	13,030
Bund 5	3,860	10,220	3,860	10,220
Bund 6	8,720	16,630	8,720	16,630
Sand Excavation [3]		0	34,810	159,810
Gravel Excavation [4]	9,940	95,960	19,160	109,160
Total for Northern Area	162,680	508,640	219,410	797,650
Southern Site				
Bund 7	38,610	125,800	38,610	125,800
Bund 8	173,490	1,319,550	173,490	1,319,550
Bund 9	16,300	47,770	16,300	47,770
Bund 10	4,620	9,820	4,620	9,820
Total for Southern Area	233,020	1,502,940	233,020	1,502,940
Quarry backfill				255,360
Site Total	395,700	2,011,580	452,430	2,555,950

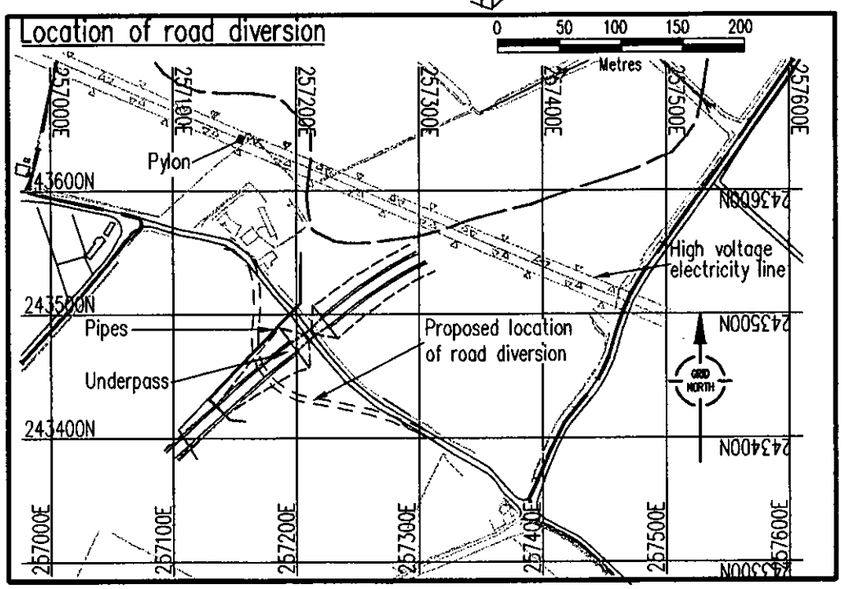
[1] 0.6m topsoil cover assumed.

[2] c 3,000m³ of inert fill assumed to be produced by plant per annum.

[3] Sand excavation left open during initial stages of working and bunding

[4] Gravel excavation partly backfilled.





0 2.5 5.0 7.5 10.0
Metres

Note:
All dimensions in millimetres unless otherwise stated

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APPENDIX Nº 2.2

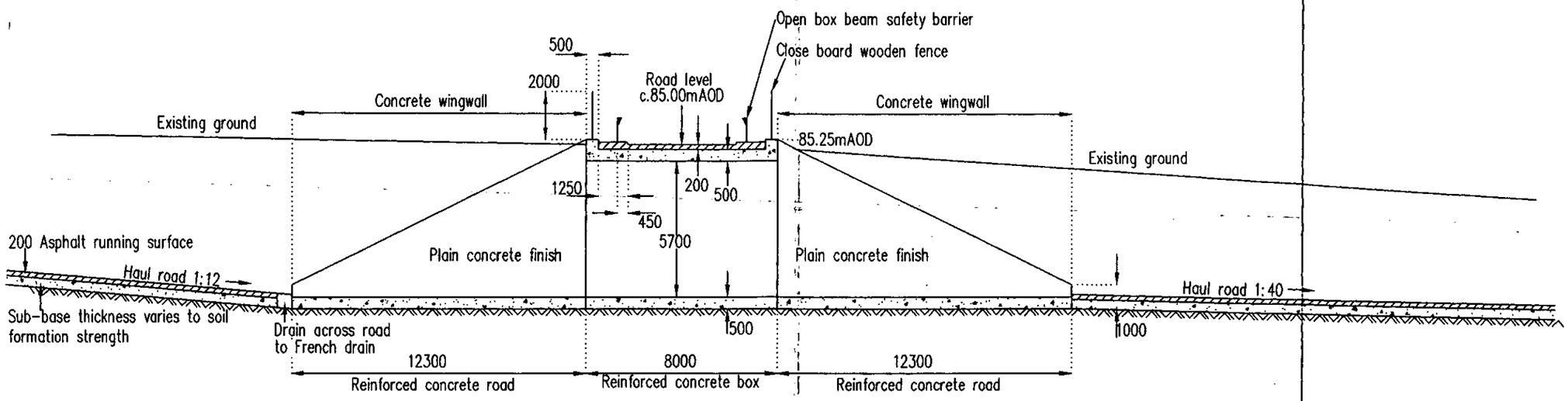
TITLE:

Underpass design – plan

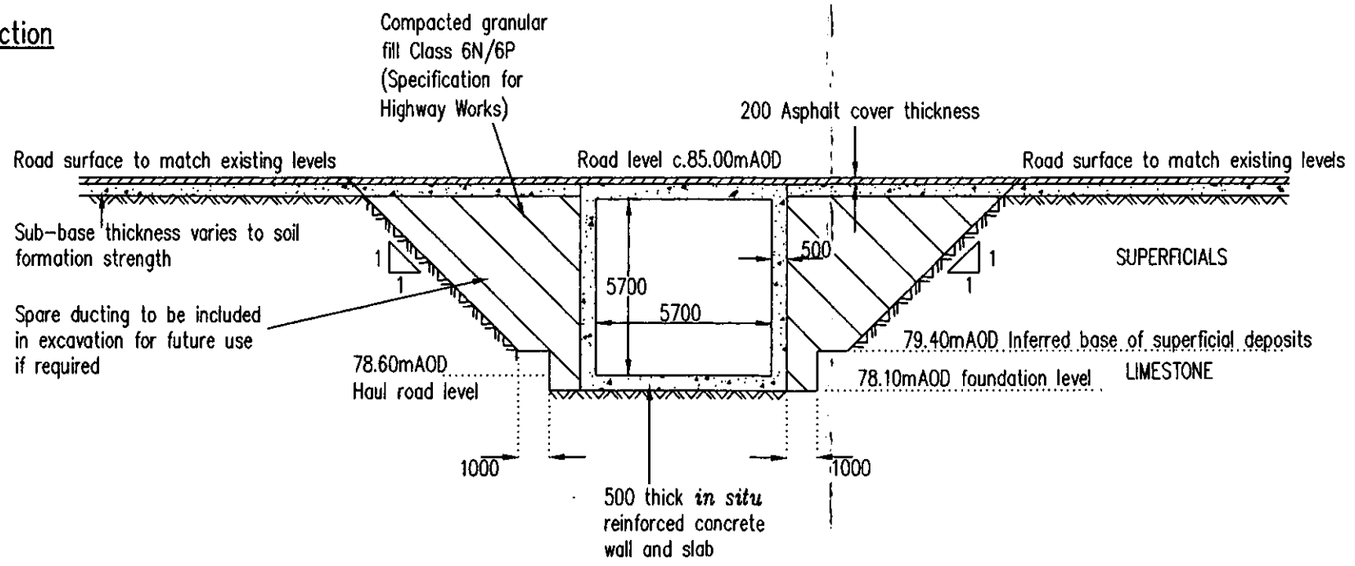
Nº

2.2.1 A

Typical long section



Typical cross section



0 2 4 6 8
Metres

Note:
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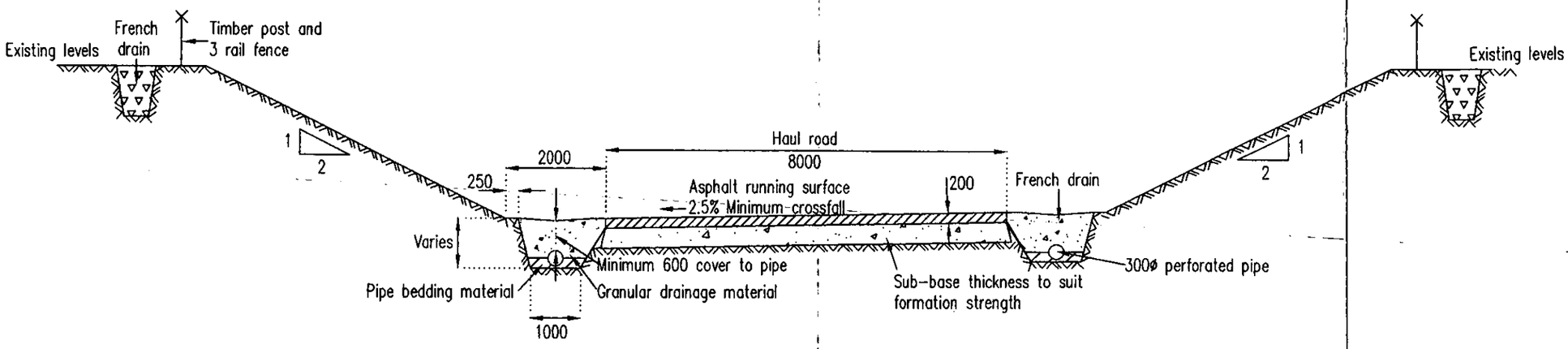
APPENDIX Nº 2.2

TITLE:
Underpass design – section

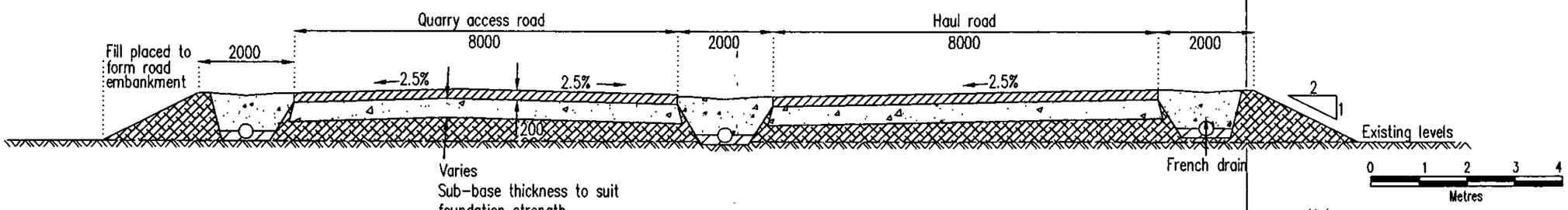
Nº
2.2.1 B

24.11.1998

Typical section through haul road in cutting



Typical section through haul road adjacent to shale quarry access road



Note:
All dimensions in millimetres unless otherwise stated

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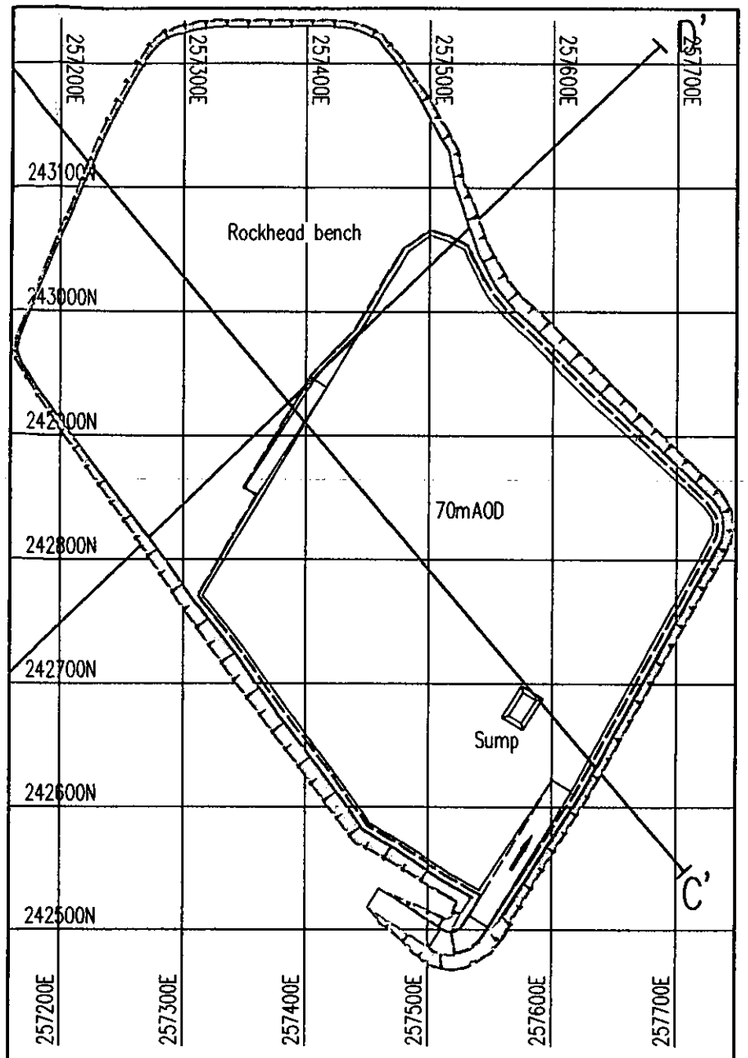
APPENDIX Nº 2.2

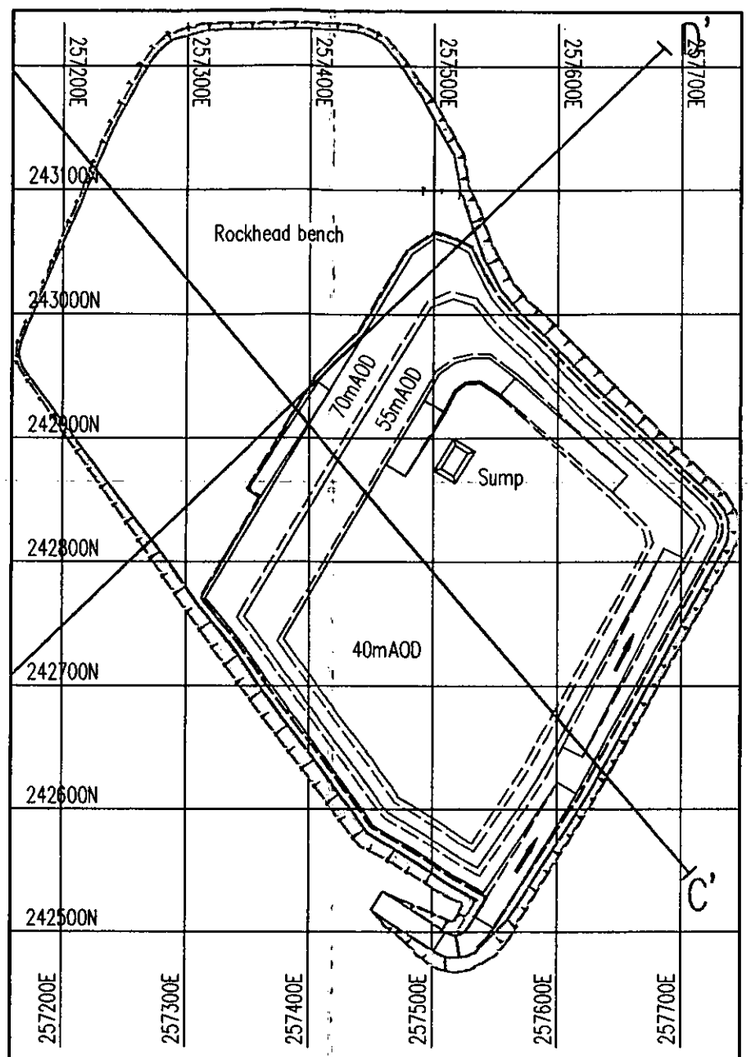
TITLE:
Detail of haul road construction

Nº
2.2.1 C



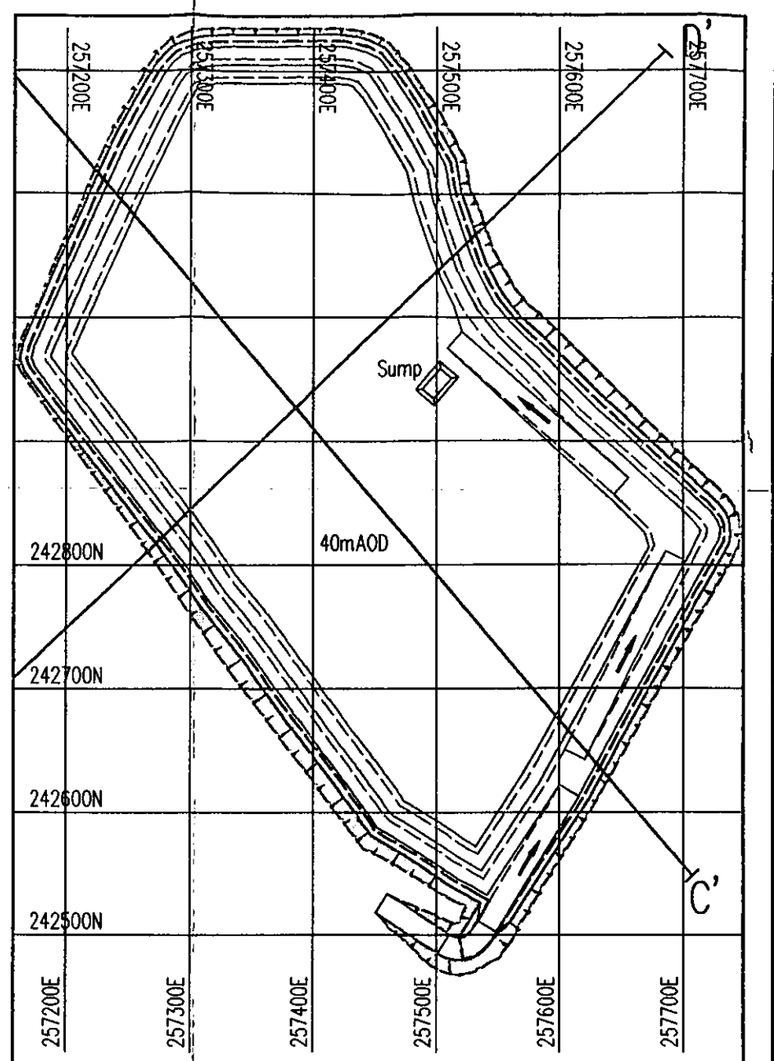
Phase 1 70m level

Year 6.2



End of Phase 1

Year 16.2



End of Phase 2

Year 32.3

LEGEND

- Crest Toe of overburden batters
- Crest Toe of rock batter
- Crest of rock excavation
- C' Line of geological cross section

0 50 100 150 200
Metres

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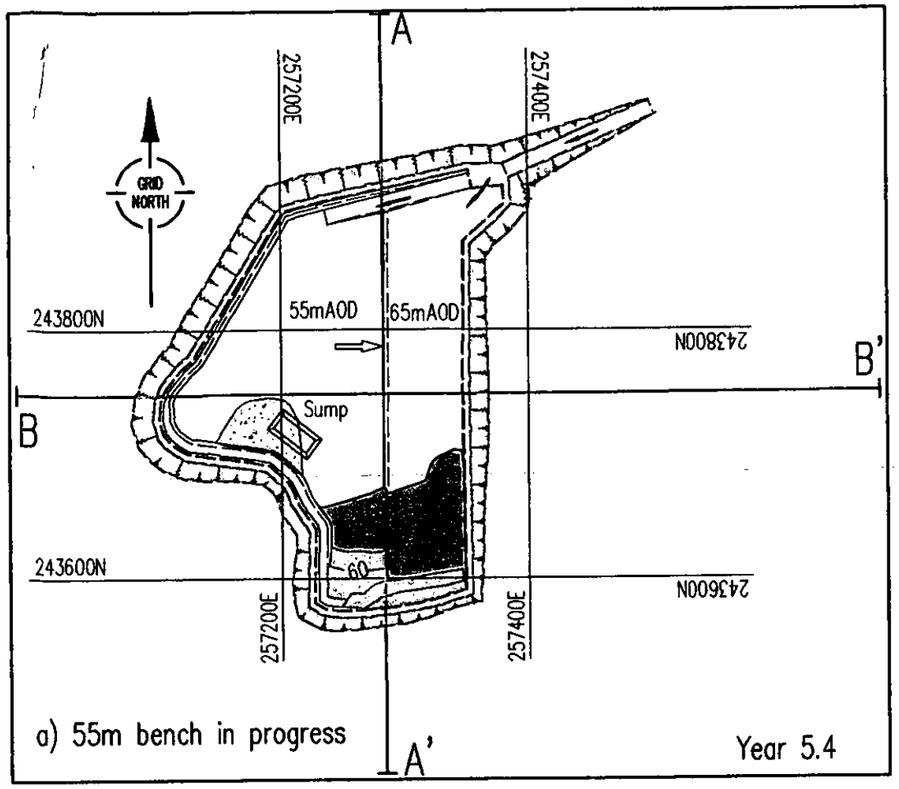
APPENDIX Nº 2.2

TITLE:

Phases in the development of the limestone quarry

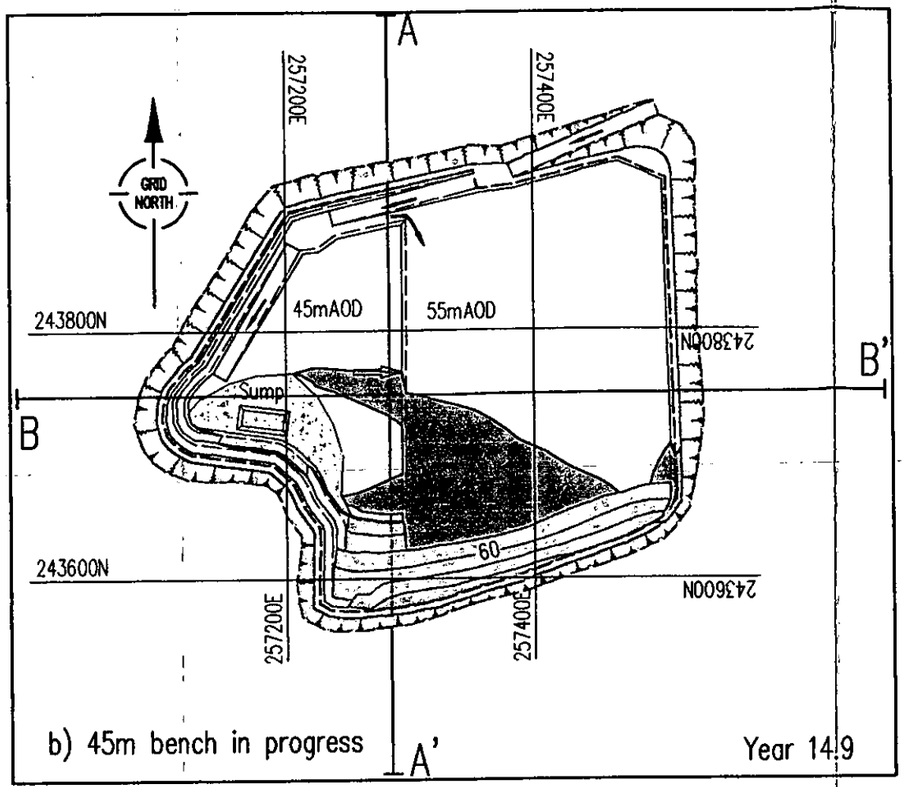
Nº

2.2.2



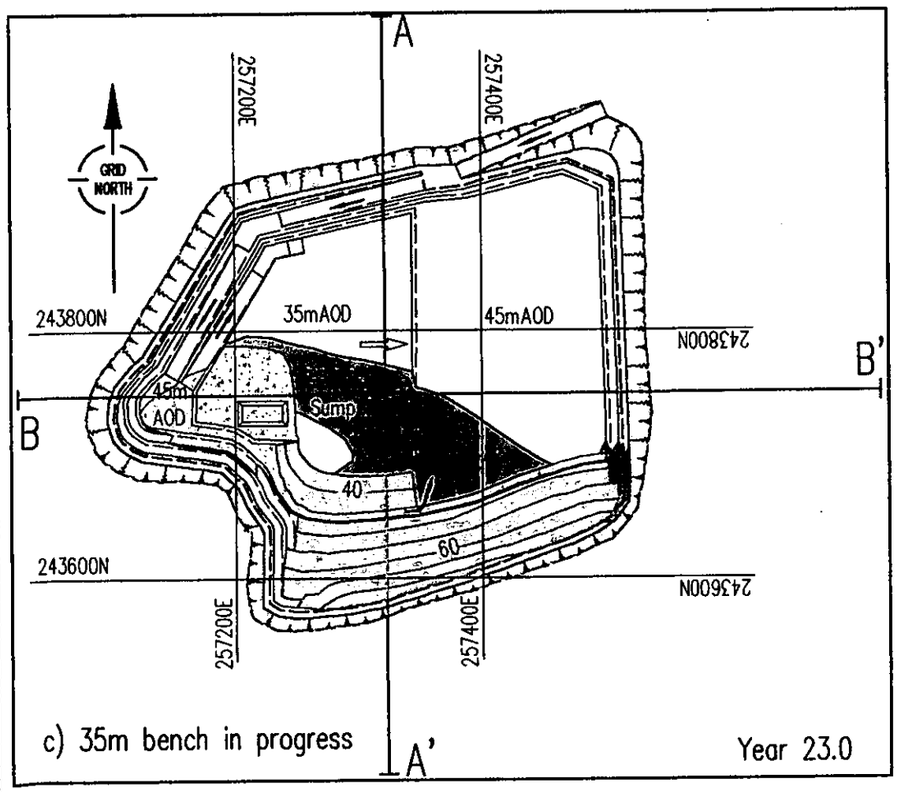
a) 55m bench in progress

Year 5.4



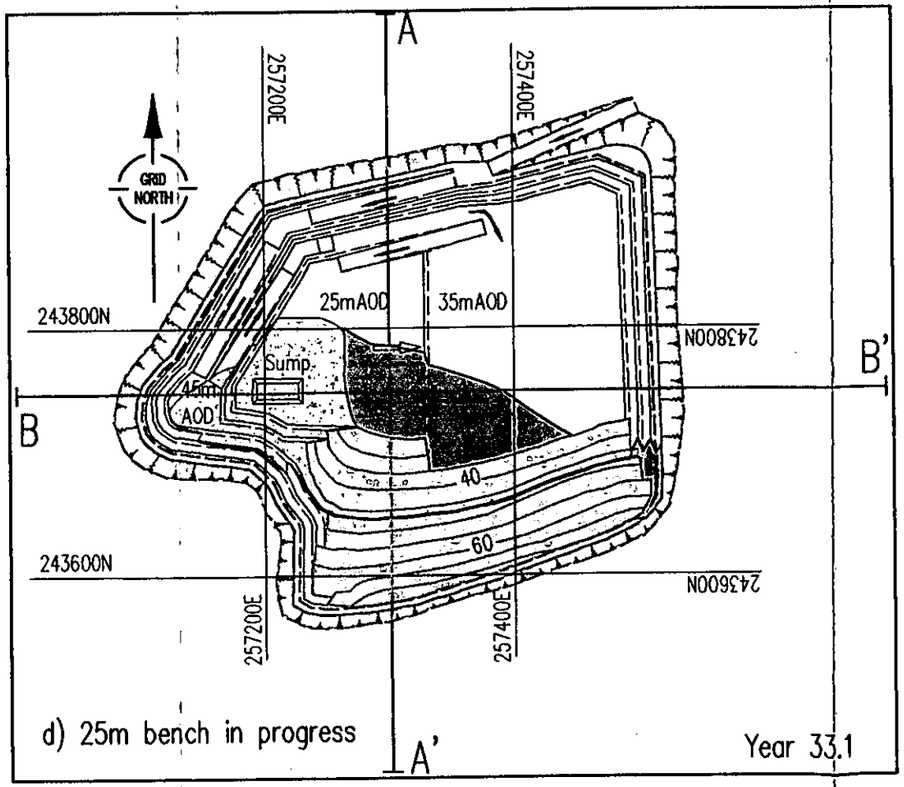
b) 45m bench in progress

Year 14.9



c) 35m bench in progress

Year 23.0



d) 25m bench in progress

Year 33.1

LEGEND

- Crest / Toe of overburden batters
- 45 — Top of Waulsortian limestone forming footwall of excavation
- Tober Colleen Formation exposed in quarry
- Area where Waulsortian limestone excavated
- Crest / Toe of rock batter
- Crest of rock excavation
- Direction of face advance
- B' — Line of geological cross section

0 50 100 150 200 Metres

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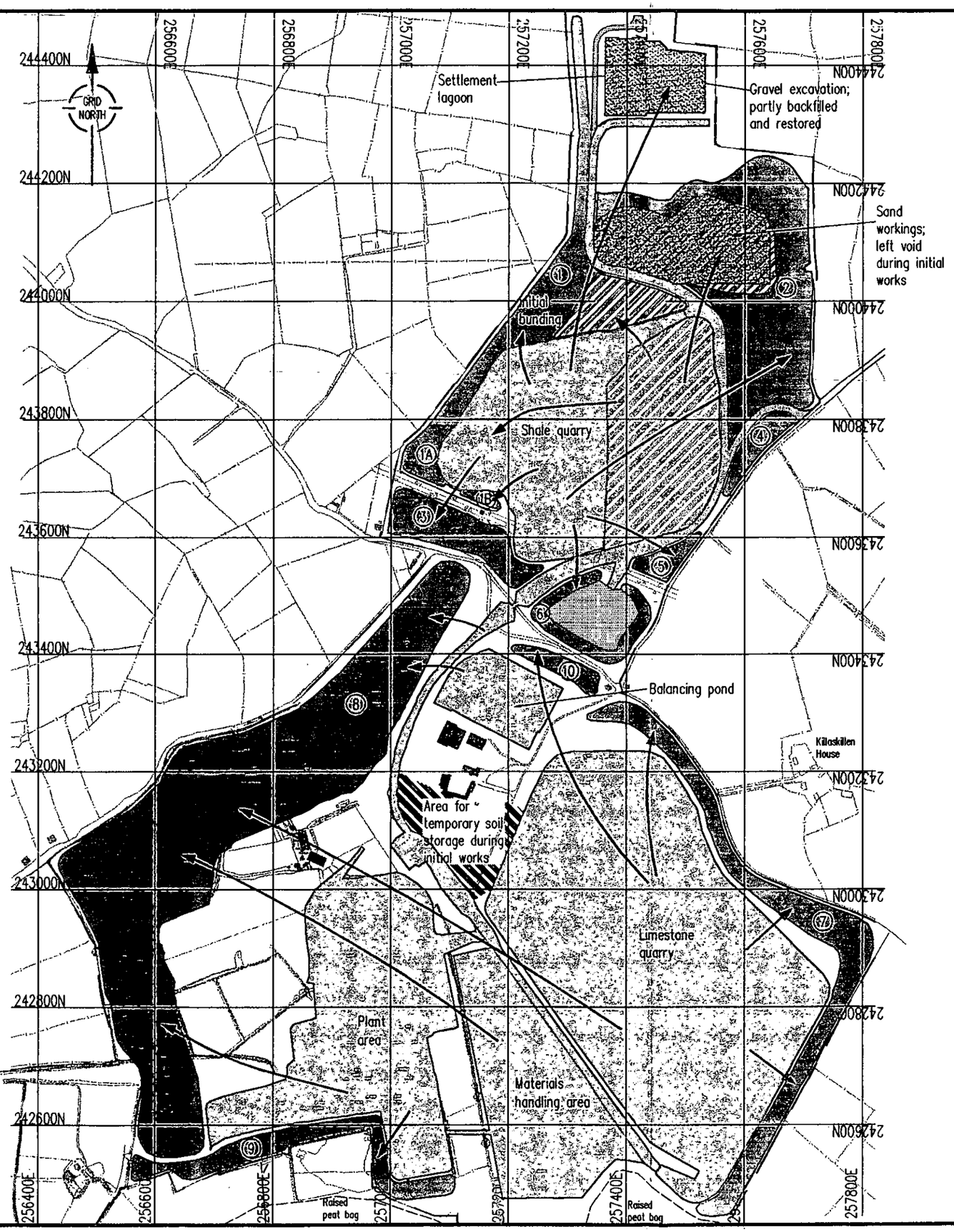
APPENDIX Nº 2.2

TITLE:

Phases in the development of the shale quarry

Nº 2.2.3

14.11.1998



LEGEND

- Site boundary
- Areas of superficial stripping during initial work
- Areas of superficial stripping after Year 5
- (8) Screening bunds placed during initial stripping of superficials Bund number as referred to in Table 2.2.1
- Area of bunding placed after Year 5
- Areas of proposed sand or sand and gravel excavation
- Soil stripping only
- Area unaffected by proposals (within site boundary)
- Direction of placement of superficials to screening bunds

0 100 200 300 400
Metres

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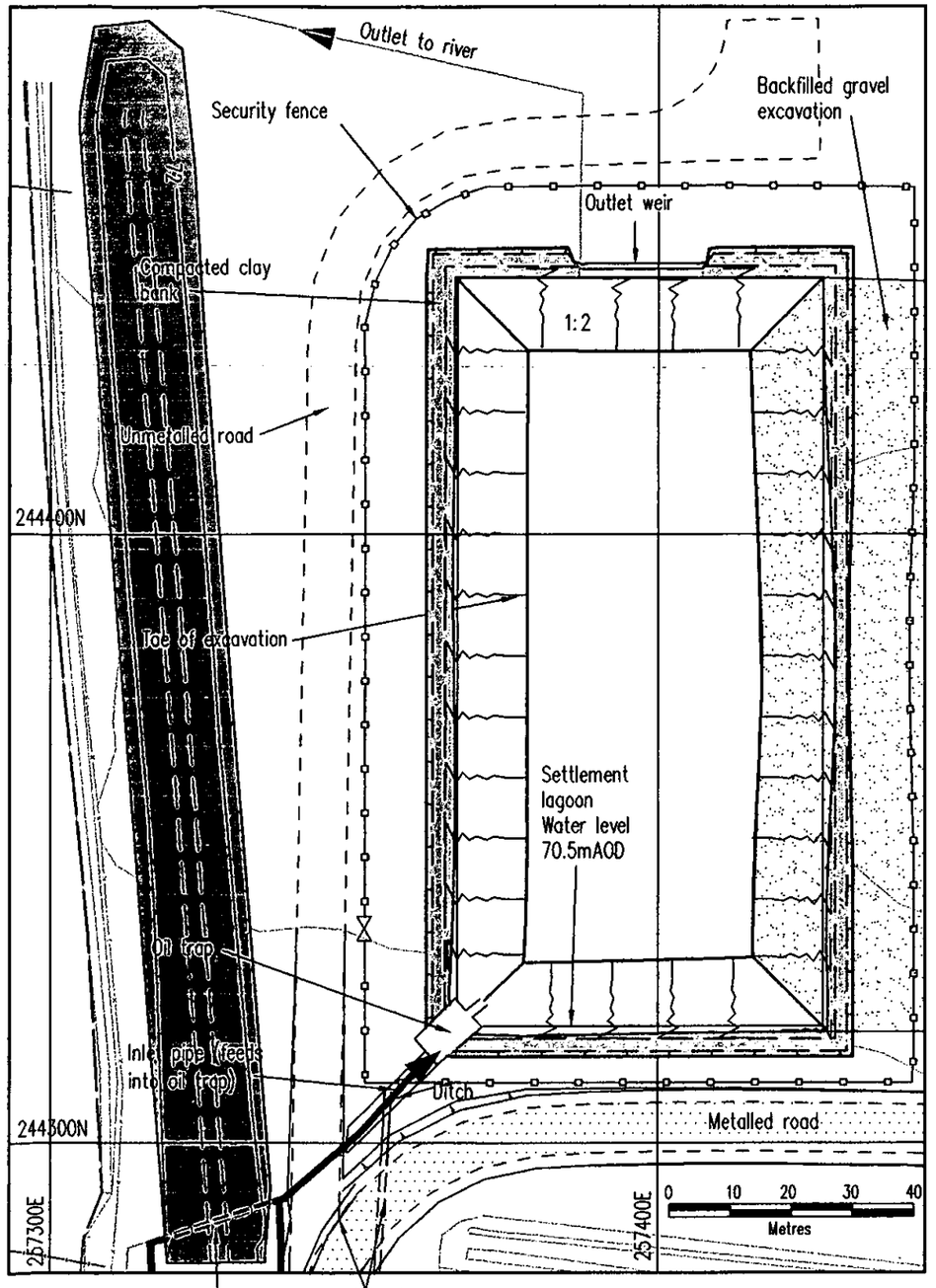
TITLE: APPENDIX Nº 2.2

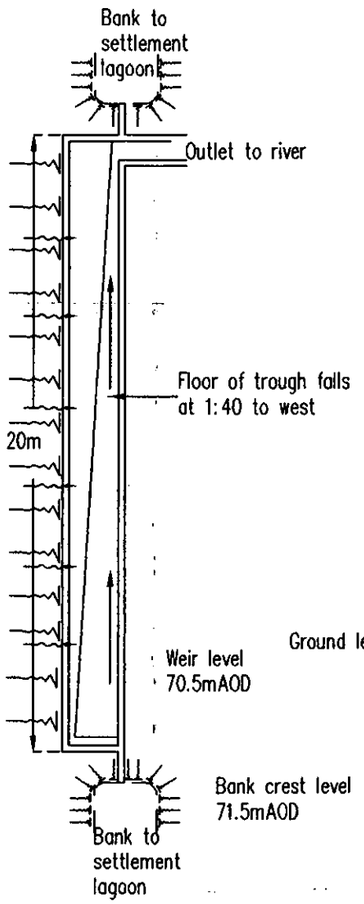
TITLE: Superficial disposal details

Nº 2.2.4

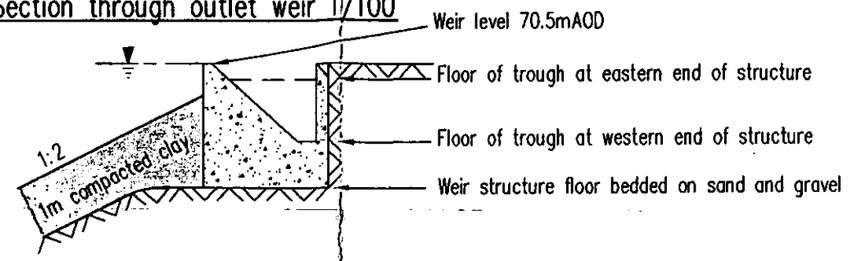
i) Plan of settlement lagoon 1/1000



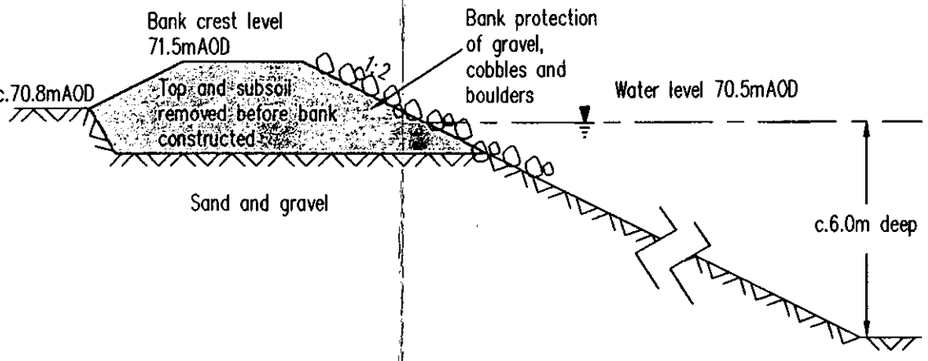
ii) Plan of outlet weir 1/200



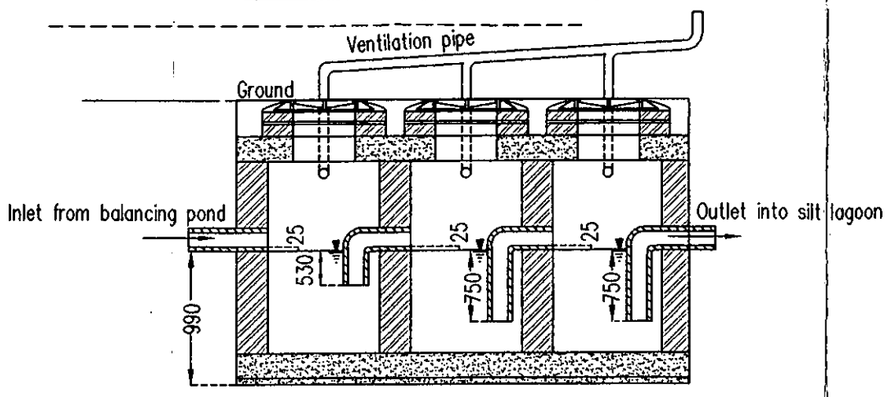
iii) Section through outlet weir 1/100



iv) Section through bank 1/100



v) Proposed oil/petrol interceptor



Note:
Unless stated otherwise, dimensions are in millimetres

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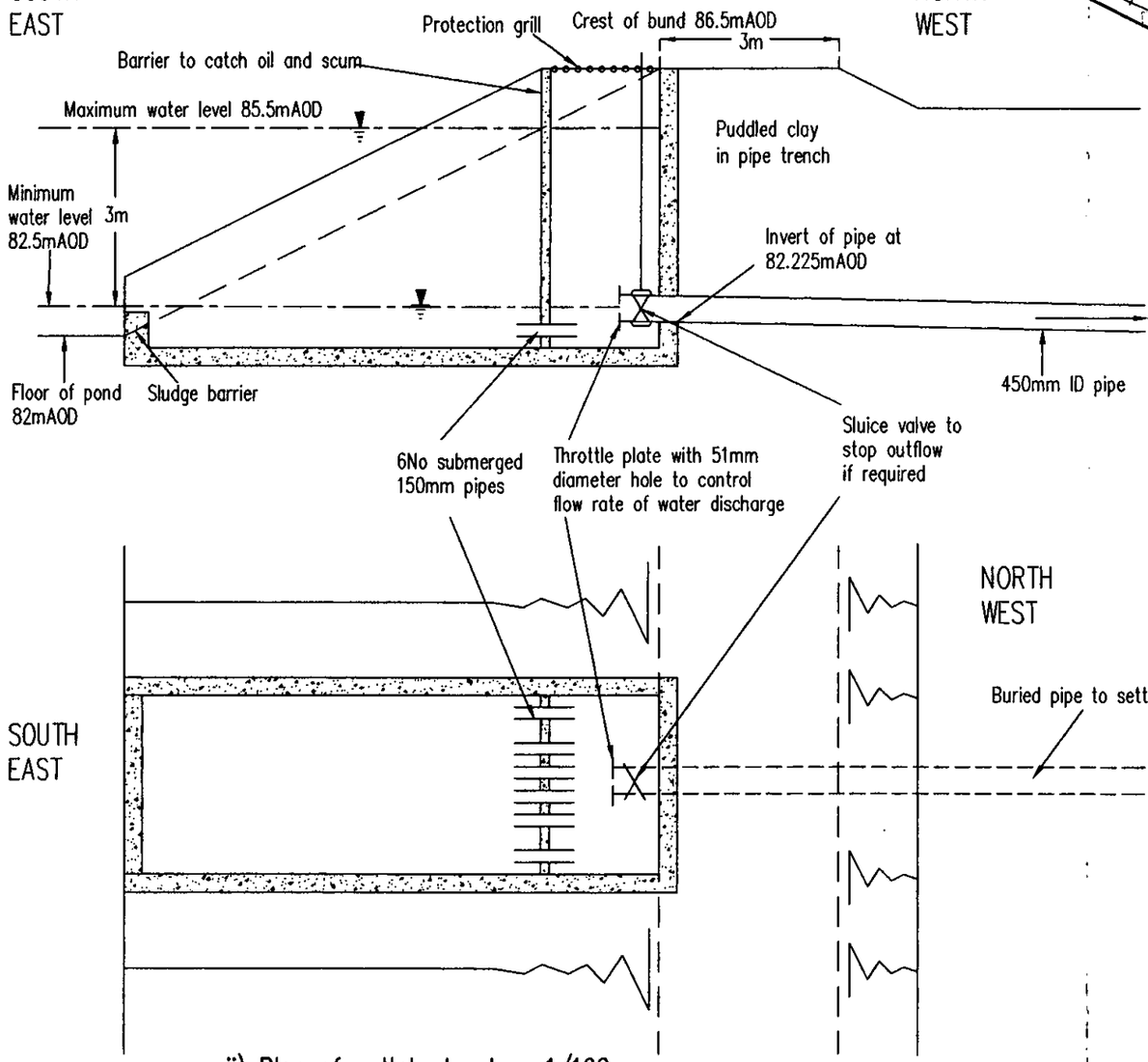
APPENDIX Nº 2.2

TITLE:
Settlement lagoon details

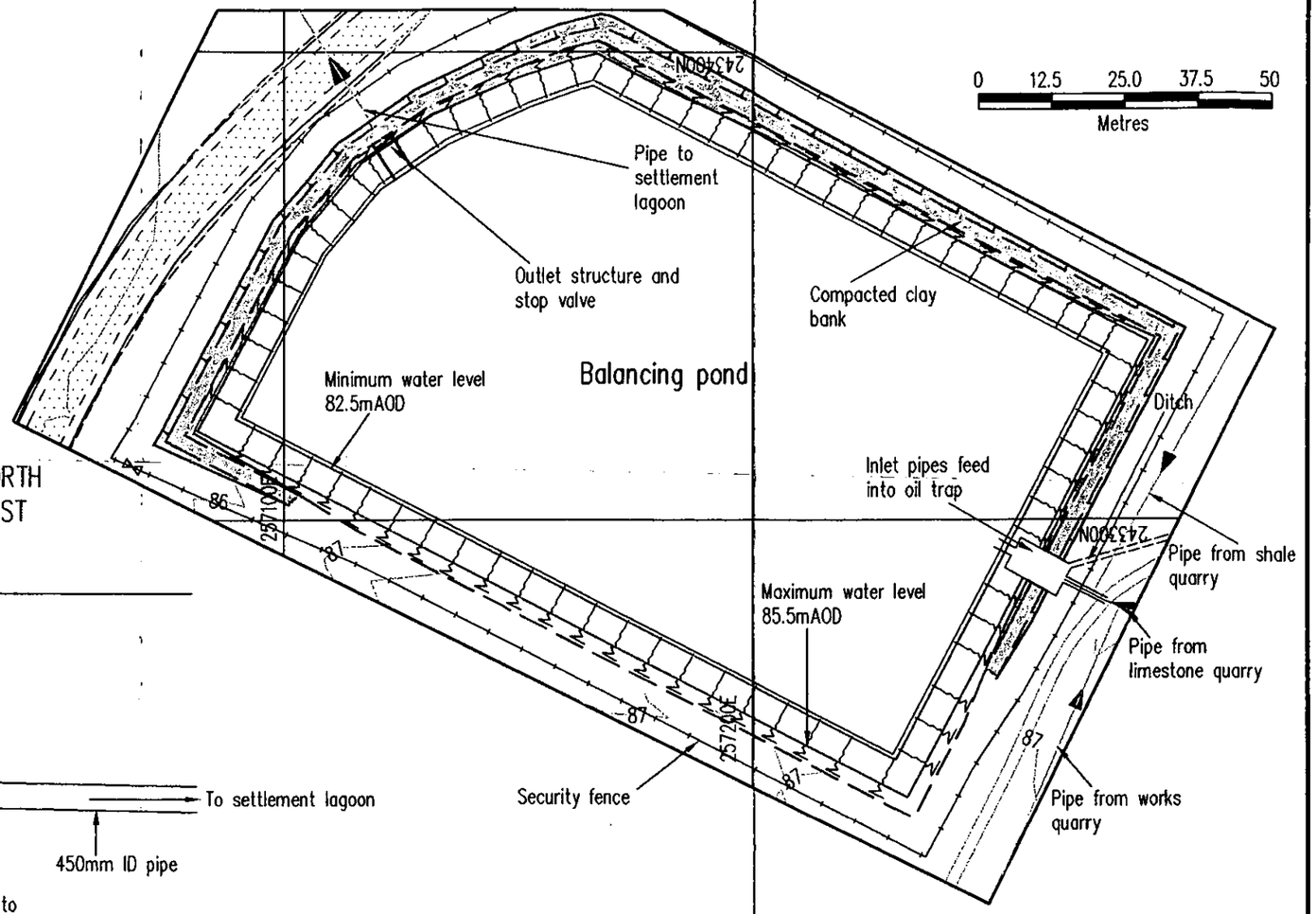
Nº
2.2.5

04.11.1998

i) Section through outlet structure 1/100



ii) Plan of outlet structure 1/100



iii) Plan of balancing pond 1/1250

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LANSDOWN CEMENT WORKS KILLASKILLEN, CO. MEATH	
APPENDIX Nº 2.2	
TITLE: Balancing pond details	
Nº 2.2.6	

04.11.1998

APPENDIX
3.2
FLORA AND FAUNA

APPENDIX 3.2

AQUATIC REPORT, KINNEGAD RIVER

A BASELINE AQUATIC ENVIRONMENTAL SURVEY OF THE KINNEGAD RIVER IN THE VICINITY OF A PROPOSED QUARRY DEVELOPMENT AT KILLASKILLEN, COUNTY MEATH, AND AN ASSESSMENT OF THE POTENTIAL IMPACT OF THE PROPOSED DEVELOPMENT ON THE AQUATIC ENVIRONMENT

CONTENTS

1.	INTRODUCTION	1
2.	METHODOLOGY	2
3.	EXISTING ENVIRONMENT	6
4.	ASSESSMENT OF IMPACTS	11
5.	MITIGATION MEASURES	15
6.	SUMMARY	16
7.	REFERENCES	18

ADDENDUM 1 HABITAT AT INVERTEBRATE SAMPLING SITES

ADDENDUM 2 INVERTEBRATE SPECIES LIST AND ABUNDANCE RATINGS WITH NOTES ON ECOLOGY AND DISTRIBUTION

ADDENDUM 3 CHEMICAL MONITORING DATA OF THE KINNEGAD RIVER UPSTREAM AND DOWNSTREAM OF KINNEGAD IN THE 1995-1997 PERIOD

1. INTRODUCTION

As part of the EIS for a proposed Cement Works and quarries at Lansdown, near Kinnegad, a study with the following objectives has been carried out:

- To assess the present water quality, fish habitat value and general ecological condition of the Kinnegad River in the vicinity and downstream of the proposed site.

- To assess the potential impact of the proposed development on the water quality and aquatic flora, fish and invertebrate fauna of the Kinnegad River, and to provide baseline data against which any future changes can be assessed.

- To recommend mitigation measures if appropriate.

To fulfil these objectives, a field survey has been carried out to assess the aquatic habitat quality and the condition of aquatic flora, invertebrate fauna and water quality in the immediate vicinity of the proposed development site and in the Kinnegad River as far downstream as Kinnegad. A general assessment of water quality and fishery value of the Kinnegad has been carried out, based on the monitoring data from the Environmental Protection Agency and information provided by the Eastern Regional Fisheries Board.

2. METHODOLOGY

2.1 HABITAT ASSESSMENT

Habitat assessment was carried out at each of the three sites selected for invertebrate/flora/water quality assessment. These sites were assessed in terms of:

- Stream width and depth
- Substrate type, listing substrate fractions in order of dominance, i.e. large rocks, cobble, gravel, sand, mud etc.
- Flow type, listing percentage of riffle, glide and pool in the sampling area
- Instream vegetation, listing plant species occurring and their percentage coverage of the stream bottom at the sampling site
- Dominant bankside vegetation, listing the main species overhanging the stream
- Estimated summer cover by bankside vegetation, giving percentage shade of the sampling site
- Rating of the site as habitat for trout adult, nursery and spawning on a scale of Poor/Fair/Good/Very Good/Excellent. This rating assesses the physical suitability of the habitat; the presence/absence/density of salmonids at the site will also depend on present and historical water quality and accessibility of the site to fish.

A general assessment of aquatic habitat quality was carried out in the area adjacent to the proposed development site and as far downstream as Kinnegad.

2.2 INVERTEBRATE SAMPLING AND ANALYSIS

Three sites were selected for invertebrate sampling, as shown on Drawing 3.2.1.

Site 1 is located approximately 100 metres upstream of the proposed development site and 20 metres downstream of the confluence with a stream from the north. This site was selected to represent the condition of the river upstream of any potential impact form the proposed development. (Photograph 4).

Site 2 is located approximately 100 metres downstream of the proposed development site. This site was selected to represent the condition of the river immediately downstream of the development site and before it receives water from any of the downstream tributaries. (Photograph 7)

Site 3 is located approximately 4 km downstream of the proposed development site at the lower bridge at Kinnegad. This site was selected because it is the first semi-riffle site with stony substrate downstream of the proposed development site.

It is therefore suitable for the calculation of accurate Q-ratings comparable to EPA data. This site represents the condition of the river 4 km downstream of the proposed development site. (Photograph 10)

A five-minute kick sample combined with a five minute stone wash sample was taken at sampling sites 1 and 3. At site 2 a sweep net sample of sediment and macrophytes was taken. Each sample was live sorted for 30 minutes, and macroinvertebrates were stored in 70% alcohol. Chironomids and oligochaetes were identified using a high-power microscope; other macroinvertebrates were identified using a low-power binocular microscope. A list of the taxonomic keys used for identification is given (see References). The relative abundance of each species recorded at each site was assessed (i.e. super-abundant/dominant, abundant, common, present in small numbers, or single specimen recorded).

2.3 WATER QUALITY ASSESSMENT

Several aspects of a river's macroinvertebrate community are likely to reflect environmental quality and therefore to serve as useful components for a baseline assessment or monitoring programme, i.e.

- Species composition and richness - What species are present? How many species are present?
- Presence/absence of indicator species
- Relative abundance of different species

Species composition, richness and relative abundance and presence/absence of indicator species are widely recognised as the most useful aspects of the macroinvertebrate community for river assessment and monitoring purposes (Bowman *et al* 1996). These are robust components, as they usually display a low level of natural short term or seasonal variation. Variation in these factors can therefore be taken as reflecting changes in water quality.

Based on the relative abundance of indicator species, a biotic index (Q-rating) was determined for each site in accordance with the biological assessment procedure used by the Environmental Protection Agency (Bowman *et al*, 1996).

2.4 LIMITATIONS ENCOUNTERED

The field survey was limited to an assessment of the aquatic flora, invertebrate fauna, habitat quality and water quality of the Kinnegad River close to the proposed development site and for 4 km downstream. Significant impacts (if any) are unlikely to extend beyond the section of river surveyed. General information on fish stocks and water quality of the Kinnegad river were provided by EPA and Eastern Regional Fisheries Board. Assessment of mammalian and bird fauna is not included in the present report.

3. EXISTING ENVIRONMENT

3.1 HABITAT ASSESSMENT

Habitat assessment for each of the biological sampling sites is tabulated in Addendum 1. General habitat assessment was carried out on approximately 5 km of the Kinnegad River, from 1 km upstream of the proposed development site to approx. 4 km downstream. On the basis of this assessment, four habitat sections were distinguished (as shown on Drawing 3.2.2).

Habitat Section 1

Course	Below the confluence of the two streams below the bridge
Length	40 metres
Description	Riffle area with muddy gravel
Salmonid Adult Habitat	Fair
Salmonid Nursery Habitat	Fair – Good
Salmonid Spawning Habitat	Poor – Fair
Photographs	1 & 2

Habitat Section 2

Course	As far as 10 metres downstream of confluence with tributary from the north
Length	300 metres
Description	Deeper section with muddy bottom and some gravel in the shallow water at the edges.
Salmonid Adult Habitat	Fair
Salmonid Nursery Habitat	Poor
Salmonid Spawning Habitat	None
Photographs	3

Habitat Section 3

Course	From 10 metres d/s of northern tributary
Length	50 metres
Description	Shallow riffle with substrate of gravel and mud. The water from the northern tributary appears not to fully mix immediately with the river water, because at this point there are practically two channels in the river separated by a shallow ridge in the centre, on which *Apium* is growing.
Salmonid Adult Habitat	Poor
Salmonid Nursery Habitat	Fair-Good
Salmonid Spawning Habitat	Poor-Fair
Photographs	4 & 5

Habitat Section 4

Course	From upstream of the proposed development site to Kinnegad.
Length	Approx. 4.5 km
Description	Downstream of section 3 the water gradually deepens. *Apium* is common here and clumps of *Callitriche* are also found. *Potamogeton natans* begins to appear as the water deepens. Total instream plant cover along this stretch is about 30%
Salmonid Adult Habitat	Fair
Salmonid Nursery Habitat	Poor
Salmonid Spawning Habitat	None
Photographs	6, 7, 8 & 9

3.2 WATER QUALITY ASSESSMENT

3.2.1 Water Quality in the Vicinity of the Proposed Development Site

Site 1 Invertebrate data from this site are tabulated in Addendum 2. The total number of taxa recorded was 32, indicating good species richness for a stream of this size. No rare or unusual species were recorded at this site. Single individuals of two highly pollution sensitive species (Group A), mayfly species *Heptagenia sulphurea* and *Rhithrogena semicolorata*, were recorded at this site. Five pollution sensitive (Group B) species were recorded. These were mayfly species *Ephemerella ignita* (abundant) and *Baetis muticus* (sparse), stonefly *Leuctra hippopus* (single specimen), and caddis flies *Sericostoma* (common) and *Lepidostoma hirtum* (single individual).

For a good riffle site with suitable substrates, a higher number of Group A invertebrates would be expected; however the substrate at this site consists of gravel and mud, which are not suitable substrates for most Group A species. The invertebrate community therefore merits a Q-rating of 4, indicating unpolluted conditions.

Site 2 Invertebrate data from this site are tabulated in Addendum 2. The total number of taxa recorded was 34, indicating good species richness for a stream of this size. One species, the oligochaete *Potamothrix bavaricus* is described as rare and scarce (Brinkhurst 1971). Two pollution sensitive (Group B) species were recorded, the Caddis fly *Sericostoma personatum* which was common and the mayfly *Ephemerella ignita* which was sparse. Moderately pollution tolerant group C and D species were dominant at this site. The EPA Q-rating method is not as accurate when applied to deep areas with muddy substrates such as this site. However, using EPA methodology for depositing sites, this site would merit a Q-rating of 4 indicating unpolluted conditions.

Site 3 Invertebrate data from this site are tabulated in Addendum 2. The total number of taxa recorded was 37, indicating very good species richness for a stream of this size. No rare or unusual species were recorded at this site. No highly pollution sensitive (Group A) species were recorded. Four moderately pollution sensitive (Group B) species were recorded, the *mayfly Ephemerella ignita* which was common, the caddis fly *Goera pilosa* which was sparse and the mayfly *Paraleptophlebia submarginata* and the caddis fly *Athripsodes aterrimus*, both of which were present as single specimens. Moderately pollution tolerant group C and D species were dominant at this site. The invertebrate community at this site merits a Q-rating of 3-4, indicating slight pollution. It is likely that the slight deterioration in water quality between this site and the two sites sampled further upstream is due to pollution entering the river via tributaries downstream of the proposed development site.

3.2.2 General Water Quality in the Kinnegad River

Water quality of the Kinnegad River has been monitored by EPA and its predecessors since 1976. Results of biological monitoring are tabulated in Table 1. During the late 1980s and early 1990s major problems were caused by pollution entering the river in the vicinity of Kinnegad. Chemical monitoring data of the Kinnegad River upstream and downstream of Kinnegad in the 1995-1997 period are tabulated (Addendum 3). Annual mean BOD and phosphate data are illustrated (Drawings 3.2.2 & 3.2.4). The results indicate that whereas treatment of sewage successfully prevents major increases in BOD, there is a substantial enrichment of the river with phosphorus.

Table 1 EPA Biological Monitoring Data

		EPA DATA – Q RATINGS								CS
		1976	1978	1981	1983	1985	1990	1994	1997	1998
0040	Bridge NE of Eskertown						4			
0060	Bridge SE of Cloonfad House						3-4	2-3	3	
0100	Ballivor Road Bridge Kinnegad	1-2	1	3	3	3	1	3-4	3-4	3-4
0200	Kilwarden Bridge			3	3-4	3	3			
0300	Clonard Bridge	2	1	4-5	3-4	3	3-4	3-4	3	

3.3 FISHERIES IMPORTANCE OF THE KINNEGAD RIVER

The fisheries value of the river has improved in recent years due to improvement in water quality resulting from reduction in pollution from agricultural sources and the upgrading of the Kinnegad Sewage Treatment Works. The river suffered a major fish kill in 1986. Noel McGloin of the Eastern Regional Fisheries Board states that upstream of Kinnegad there is good salmonid spawning, where recent redd counts revealed approximately 20 salmon redds and approximately 40 trout redds. Downstream of Kinnegad the river is of somewhat lower value as salmonid nursery habitat. In the context of the Boyne system, the Kinnegad river constitutes a nursery river of moderate quality. It was notable that in habitat sections 2 & 4 (Drawing 3.2.2) of the present survey, trout numbers observed (but not surveyed) seemed larger than the habitat quality would normally merit.

4. AN ASSESSMENT OF IMPACTS

4.1 CHANGES IN FLOW OF KINNEGAD RIVER

Dewatering will eventually promote maximum leakage from the river to groundwater amounting to 970 cubic metres per day. This will be more than offset by a maximum mean site discharge site discharge projected to be 3870 cubic metres per day resulting in a net increase of 2900 cubic metres per day.

This projected flow would increase flows at Kinnegad by the following proportions:

	Recorded Flows at Kinnegad (cubic metres per day)	% increase which would be caused by the proposed discharge
Mean Flow	60,000	4%
Maximum Flow	240,000	1%
Minimum Flow	5580	52%

The maximum net gain in river flow (2900 cubic metres per day) will not be sufficient to cause significant additional scouring or other flood related habitat impacts downstream of the discharge point because the discharge would constitute only approximately 1% of the peak flood flow at Kinnegad. The most significant impact on the flow of the Kinnegad River will be on low water levels which would be increased by as much as 52%. While an increase in the minimum flow may have some effects on the flora and fauna, no specifically negative impacts can be predicted. Low water flows are usually associated with high temperatures and sometimes with unusually low oxygen conditions in rivers. A substantial increase in the minimum flow is likely to have a beneficial if any effect on salmonids.

4.2 TEMPERATURE EFFECTS

Temperature of the Kinnegad River in the 1995-1997 period are tabulated in Addendum 3. The minimum temperature recorded in the period was 6.5 °C; the maximum was 20.5°C. In the period 1991-1994, the minimum was 3.1°C and the maximum was 14.3°C.

At high water temperatures, usually above 20°C, salmonid fish become less active and consume less food (Svobodova *et al* 1993). The Freshwater Fish Directive (78/659/EEC) specifies that thermal discharges must not cause the temperature downstream to exceed 21.5°C in salmonid waters and 10°C in salmonid waters during breeding period. An important aspect of temperatures in rivers is the inverse relationship between temperature and oxygen solubility. Where oxygen conditions are marginal, elevated temperatures may result in critical reductions in dissolved oxygen. Whereas elevation of water temperatures is generally of greater concern than reduction of temperatures, temperature shock occurs if salmonid fish are put into a new environment where the temperature is 8°C colder or warmer than the original water (Svobodova *et al* 1993).

The water discharged from the proposed development will be on average 5-8°C higher than the Kinnegad River in winter and 5-8°C lower than the river in summertime (Michael Cooke & Associates pers. comm.). It can generally be expected that the lowest flows and therefore the most significant temperature effects will occur in the summer months when the water discharged will result in a lowering of river temperature. Given that temperatures as high as 20.5°C were recorded in the Kinnegad River in recent years, the effect of the proposed discharge is likely to be generally beneficial rather than damaging to salmonid fish. However it is possible that the temperature gradient in the immediate vicinity of the discharge may cause fish to avoid the area.

4.3 ORGANIC AND INORGANIC POLLUTANTS

"The hydrochemistry of the discharged water is predicted to be of similar major ion composition to the water in the Kinnegad River. The quality of the dewatering water is generally expected to be better than that of the river." (Michael Cooke & Associates pers. comm.) Discharged water of similar major ion concentration to the river water will have no detrimental impact on the flora and fauna of the river.

4.4 SUSPENDED SOLIDS

Negative impacts of suspended solids include:

- Settlement on spawning areas, infilling the intragravel voids and smothering the eggs and alevins (newly hatched fish) in the gravel.
- Reduction in water clarity and visibility in a stream impairing the ability of fish to find food items.
- Smothering and displacement of aquatic organisms such as macroinvertebrates, reducing the amount of food items available to fish.
- Suspended solids can abrade or clog the gills of salmonid fish. It takes a high concentration of solid wastes to clog a fish gill and cause asphyxiation, but only a little to cause abrasion and thus permit the possibility of infections.

The maximum suspended solids in the discharged waters from the proposed development will be 30mg/l. The EC salmonid directive sets a guideline maximum of 25mg/l of suspended solids. As discharged water will constitute a maximum of 46% the volume of the river flow, the suspended solids are unlikely to exceed the EC limit in the fully mixed area downstream. No significant salmonid spawning habitat was found in the 4 km downstream of the proposed development site; this section of river is slow flowing with dense macrophyte growths, which should result in the rapid settlement of suspended solids. No significant negative effects on the salmonid populations of the Kinnegad River are likely as a result of suspended solids in the water discharged from the proposed development site, if suspended solids do not exceed the predicted maximum of 30 mg/l. As the river substrate downstream of the proposed development site is naturally muddy, significant negative impacts on flora and invertebrate fauna are not likely. One rare

species of aquatic worm (*Potamothrix bavaricus*) was recorded adjacent of the proposed site. The exact ecological preferences of this species are not documented; however as the genus *Potamothrix* is usually associated with muddy substrates, moderate levels of suspended solids are unlikely to have a deleterious effect.

4.5 OTHER POLLUTANTS

The potential exists for serious pollution of the river by fuels, lubricants and hydraulic fluids for equipment used on the proposed development site. Waste from onsite toilet and wash facilities are also a potential source of pollutants.

5. MITIGATION MEASURES

- The excavation of the site should be carried out in such a way as to ensure that an accidental inundation of the site by flood waters is impossible.

- Rehabilitation of the site after its active life is completed should be carried out in such a way as to ensure that suspended solids contamination of the river by erosion is not a possibility.

- All reasonable measures should be taken to minimise the levels of suspended solids in the water released to the river during the operation of the site.

- Fuels, lubricants and hydraulic fluids for equipment used on the site should be carefully handled to avoid spillage, properly secured against unauthorised access or vandalism, and provided with spillage containment according to codes of practice.

- Fuelling and lubrication of equipment should not be carried out close to the river.

- Any spillage of fuels, lubricants or hydraulic oils should be immediately contained and the contaminated soil removed from the site and properly disposed of.

- Waste oils and hydraulic fluids should be collected in leak-proof containers and removed from the site for disposal or re-cycling.

- Foul drainage from the site offices etc. should be removed to a suitable treatment facility or charged to a septic tank system constructed in accordance with SR6:1991 (Standard Recommendation for Septic tank systems – National Standards Authority of Ireland).

6. SUMMARY

- Assessment of habitat, invertebrate community and water quality was carried out on approximately 5 km of the Kinnegad River, from 1 km upstream of the proposed development site to approx. 4 km downstream.

- Some useful salmonid spawning and nursery habitat was recorded upstream of the proposed development site, but none in the area surveyed downstream.

- The area between the proposed development site and Kinnegad constitutes adult salmonid habitat of moderate but unexceptional quality.

- Invertebrate assessment upstream and downstream of the proposed development site reveals a good species richness and unpolluted conditions. One rare species of aquatic worm was recorded adjacent to the proposed development site; otherwise all species recorded are common.

- Invertebrate assessment at Kinnegad indicates good species richness and slightly polluted conditions.

- According to the Eastern Regional Fisheries Board, sections of the Kinnegad River upstream of Kinnegad have good salmonid spawning; downstream of Kinnegad, the river is of somewhat lower value as salmonid nursery habitat. In the context of the Boyne system, the Kinnegad river constitutes a nursery river of moderate quality.

- Changes of flow and temperature resulting from water discharges from the proposed development are unlikely to have negative effects on aquatic flora and fauna.

- The most significant potential pollutant from the proposed development is likely to be suspended solids. If suspended solids do not exceed the predicted maximum of 30 mg/l during the operational and post operational period of the proposed development, no significant adverse effects on aquatic flora and fauna are likely.

- Other significant sources of pollution are fuels, lubricants and hydraulic fluids for equipment used on the proposed development site; and waste from onsite toilet and wash facilities. Adequate measures should ensure no significant negative impact from these sources.

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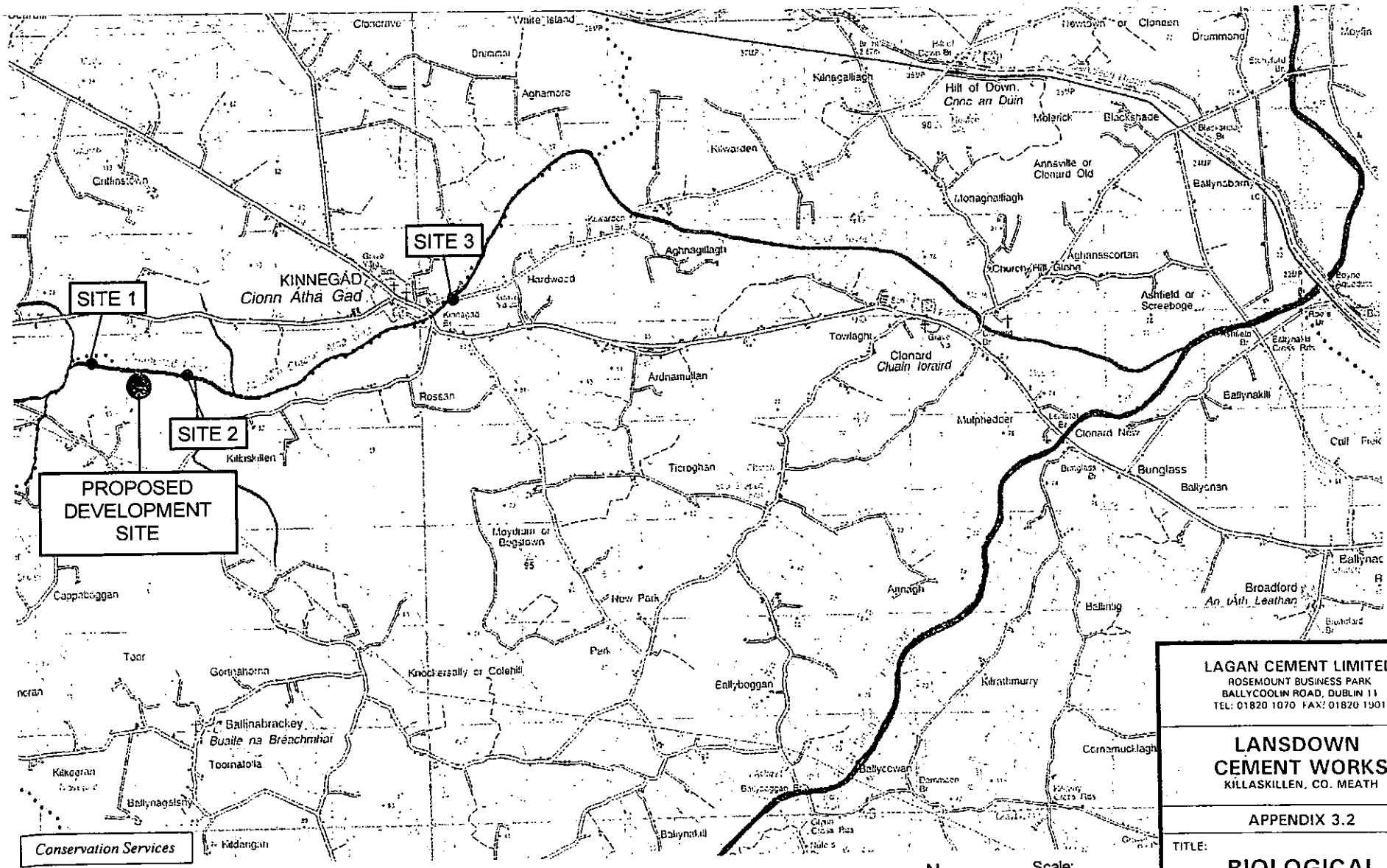

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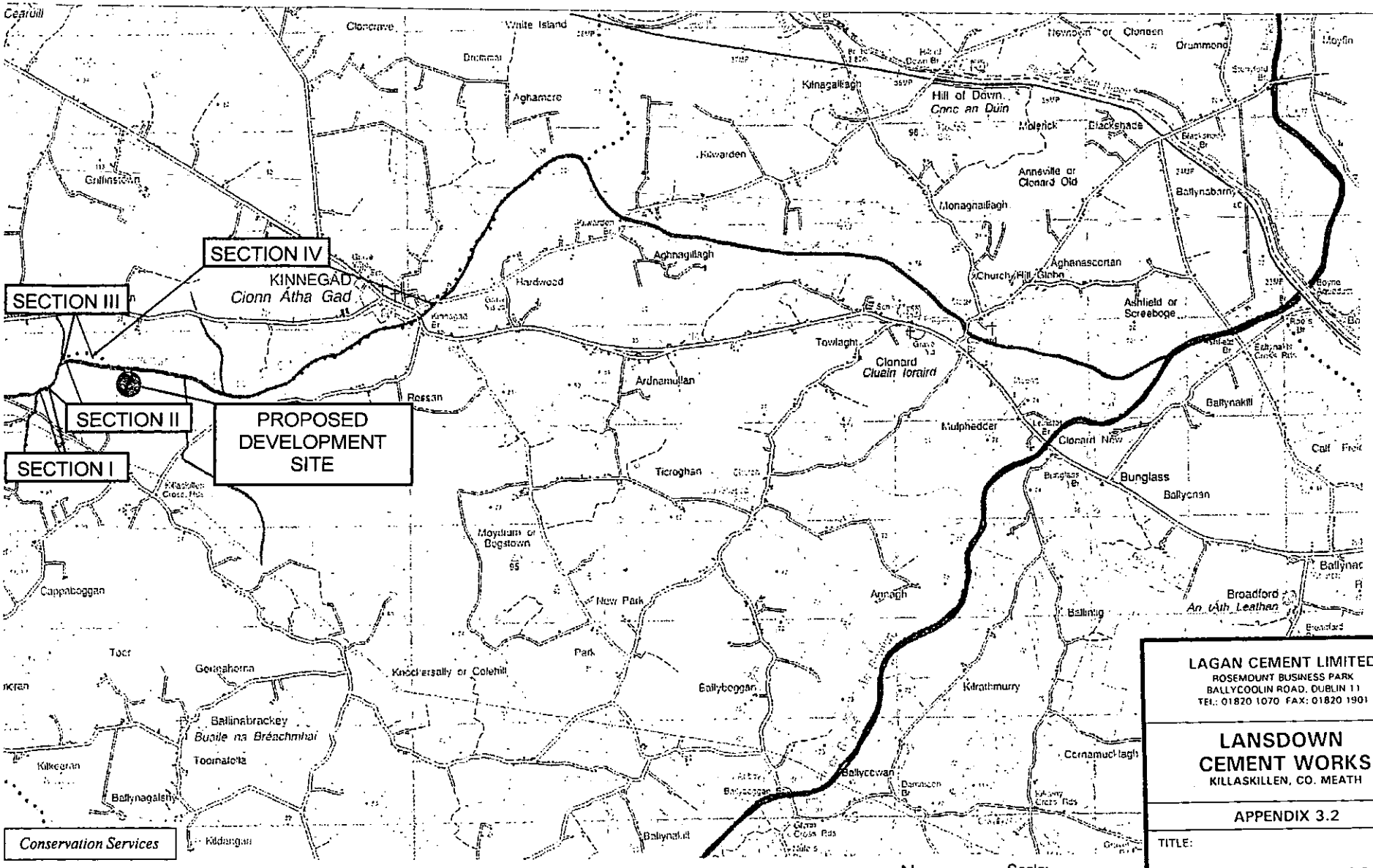
APPENDIX 3.2

TITLE:

BIOLOGICAL SAMPLING SITES

N° 3.2.1



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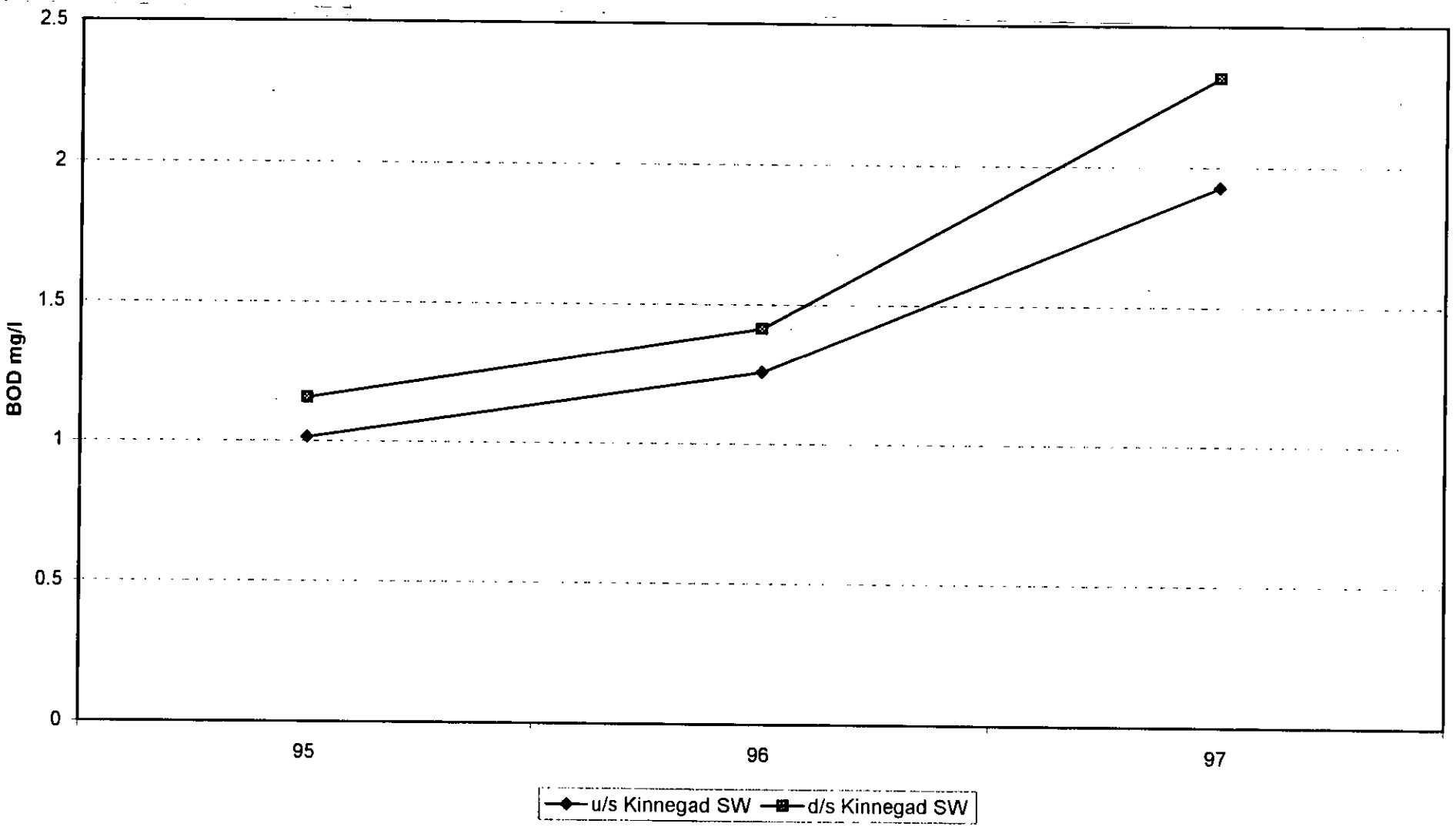
APPENDIX 3.2

TITLE:

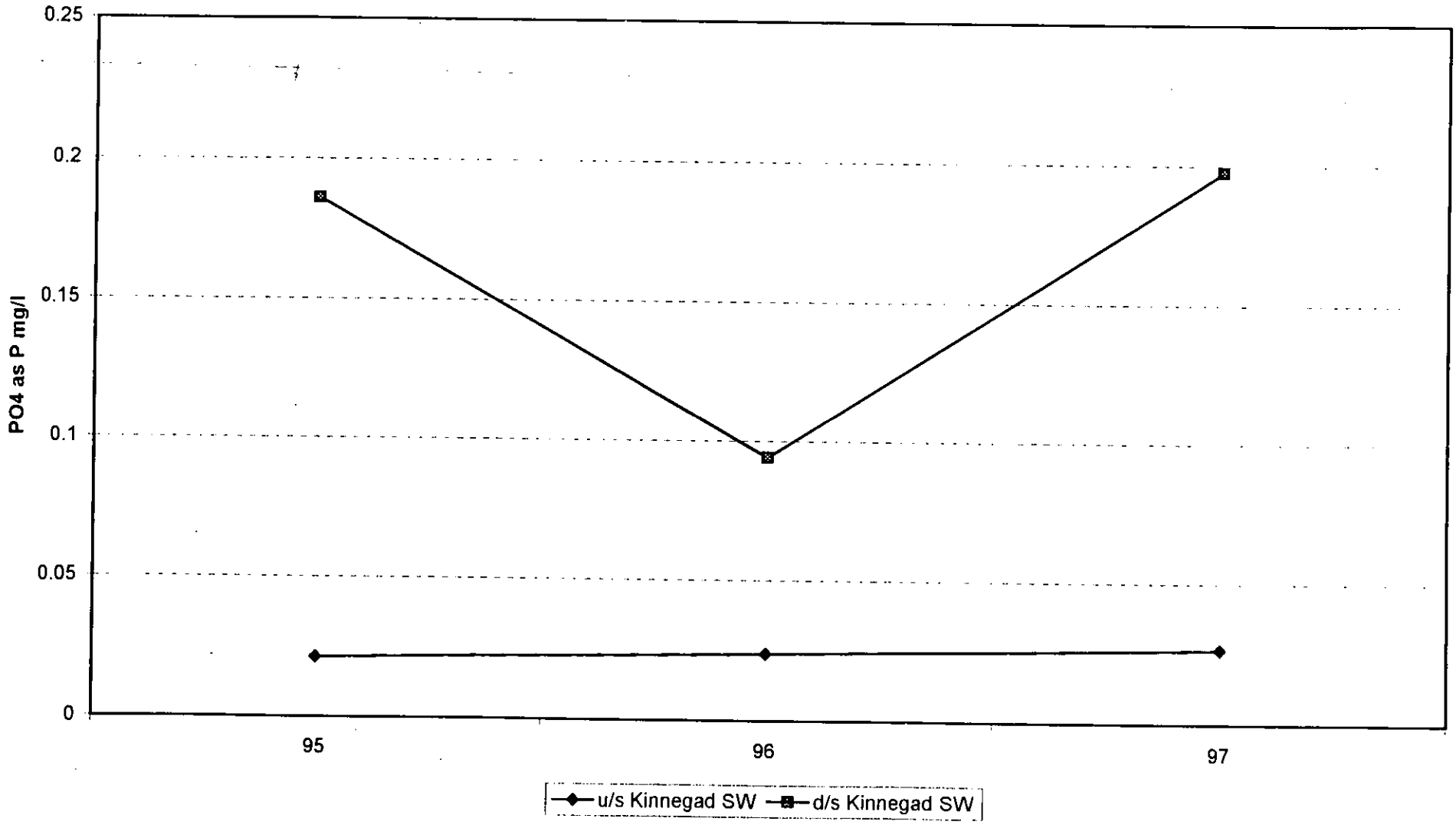
HABITAT SECTIONS

Nº 3.2.2

Appendix Drg 3.2.3 Annual mean BOD u/s & d/s Kinnegad SW 1995-1997 (data from EPA)

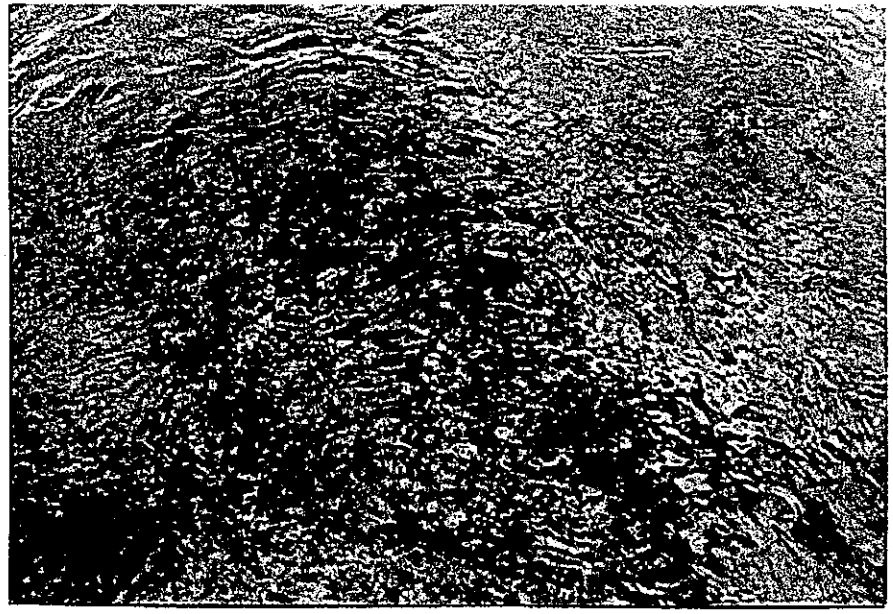


Appendix Drg 3.2.4 Annual mean Phosphorus u/s & d/s Kinnegad SW 1995-1997 (data from EPA)



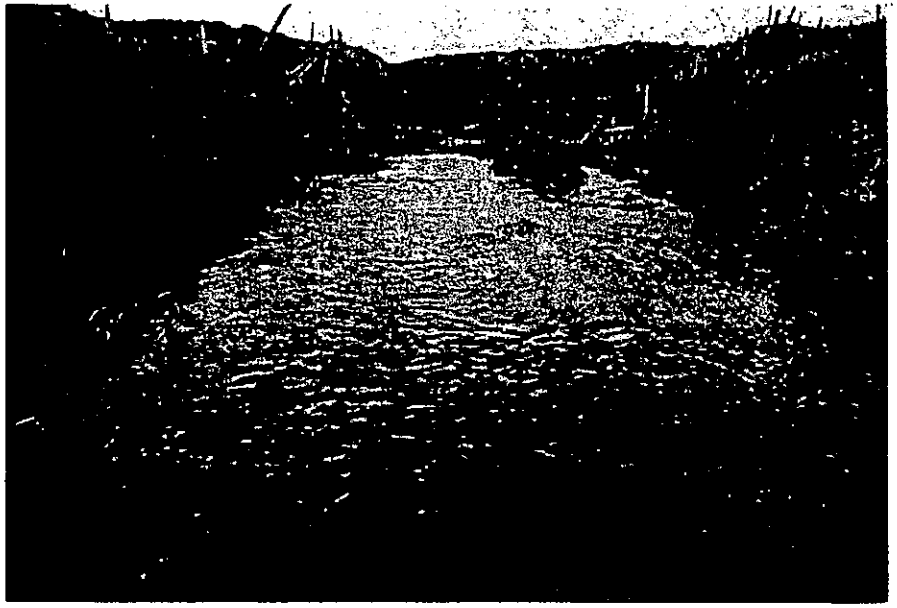
PHOTOGRAPH 1

PHOTOGRAPH 2



PHOTOGRAPH 3

PHOTOGRAPH 4



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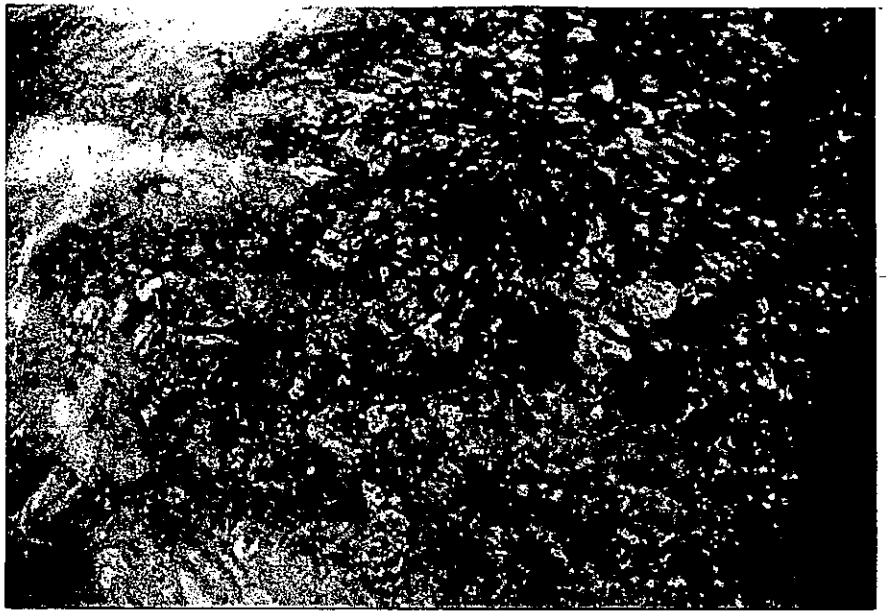
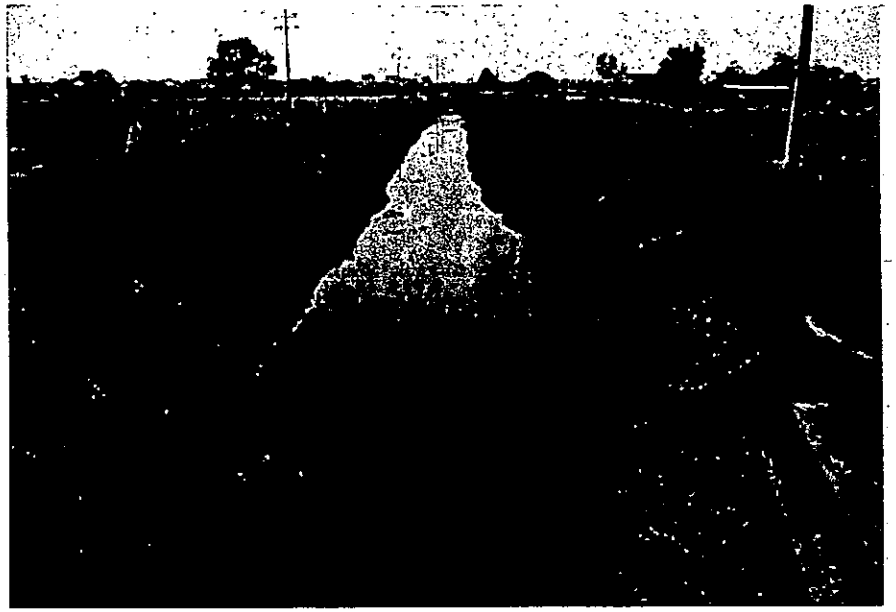


PHOTOGRAPH 6

PHOTOGRAPH 7

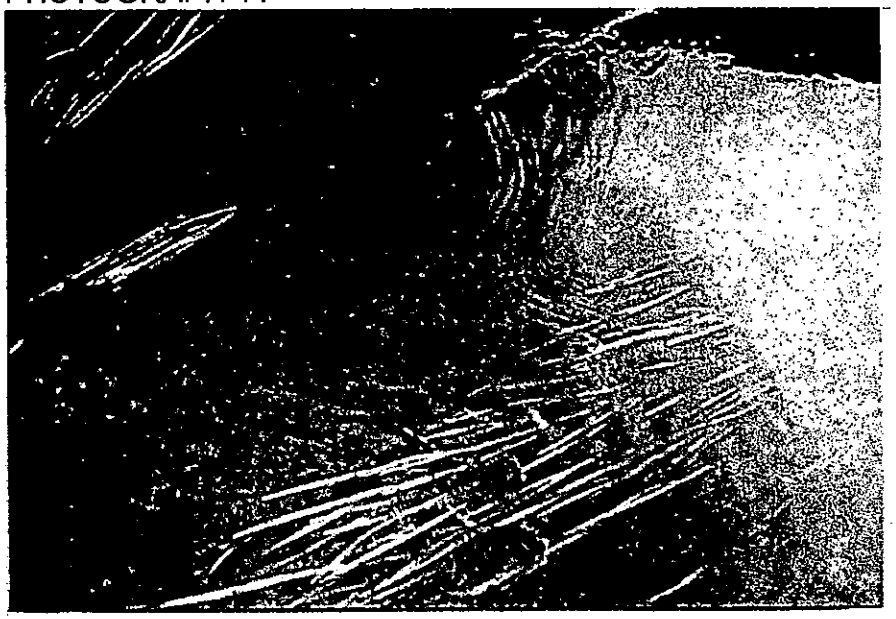
PHOTOGRAPH 8

PHOTOGRAPH 9



PHOTOGRAPH 10

PHOTOGRAPH 11



ADDENDUM 1

HABITAT AT INVERTEBRATE SAMPLING SITES

Site Code	1
Grid Reference	N 564 447
EPA Site Code	None
Location	20 metres downstream of confluence of stream from north
Width	5 metres
Average Depth	15 cm.
Substrate	Gravel, Mud
Flow Type	Riffle 80% Glide 20%
Instream Vegetation	*Apium nodiflorum* 5% Filamentous algae 5%
Dominant Bankside Vegetation	Grasses and rushes on steep slope
Estimated % Summer Shade of Stream by Bankside Vegetation	<5%
Salmonid Adult Habitat	Poor
Salmonid Nursery Habitat	Fair
Salmonid Spawning Habitat	Poor-Fair
Photographs	4 & 5

Site Code	2
Grid Reference	N 576 445
EPA Site Code	None
Location	100 metres downstream of proposed development
Width	5 m
Depth	75-100 cm.
Substrate	Mud
Flow Type	Glide 100%
Instream Vegetation % cover	*Potamogeton natans* 60% (*Sparganium erectum* also occurs along this stretch but not at the sampling site)
Dominant Bankside Vegetation	Grasses, Nettles and Willow herb on steep slope
Estimated % Summer Shade of Stream by Bankside Vegetation	<5%
Salmonid Adult Habitat	Fair-Good
Salmonid Nursery Habitat	Poor
Salmonid Spawning Habitat	None
Photographs	7

Site Code	3
Grid Reference	N 603 453
EPA Site Code	River 07/K/01 Site 0100
Location	Kinnegad Bridge on Ballivor Road
Width	6 m
Average Depth	25 cm.
Substrate	Gravel, Cobble, Rubble
Flow Type	Riffle 15% Glide 85%
Instream Vegetation	*Potamogeton crispus* 20% *Glyceria fluitans* 15% *Potamogeton natans* <5% *Callitriche* sp. <5% Filamentous algae 80% (cover over other plants and stones)
Dominant Bankside Vegetation	Snowberry, hawthorn, nettles , grass
Estimated % Summer Shade of Stream by Bankside Vegetation	20%
Salmonid Adult Habitat	Fair
Salmonid Nursery Habitat	Poor
Salmonid Spawning Habitat	Poor

ADDENDUM 2

INVERTEBRATE SPECIES LIST AND ABUNDANCE RATINGS WITH NOTES ON ECOLOGY AND DISTRIBUTION

Relative Abundance Ratings

+++++	Superabundant (i.e. hundreds in five-minute kick sample)
++++	Abundant
+++	Common
++	Present in small numbers
+	Single specimen recorded

ERU Indicator Groups (From Bowman *et al*, 1996)

Group A	Sensitive forms
Group B	Less sensitive forms
Group C	Relatively tolerant forms
Group D	Tolerant forms
Group E	Most tolerant forms
-	Not assigned to a group

	Site 1	Site 2	Site 3	Group	Ecology and Distribution in Freshwater
Oligochaeta (Segmented worms)					
Aulodrilus pluriseta		+++		E	Common in lakes, rivers, canals and ponds
Eiseniella tetraedra	++			-	Common in a variety of habitats; often in fast-flowing rivers
Limnodrilus sp.			+	E	Common and abundant in many habitats.
Nais simplex			++	-	Found in rivers
Potamothrix bavaricus		+		E	Rare and scarce
Stylodrilus heringianus	++			-	Widespread. Commonly found in sandy habitats.
Immature Tubificidae	+	+	+	E	
Hirudinea (Leeches)					
Erpobdella octoculata/testacea	+	++		D	Common in many habitats
Piscicola geometra	++	+	++	D	Fish parasite; common in many habitats
Gastropoda (Snails and limpets)					
Ancylus fluviatilis			++	C	Common in rivers and still waters, usually on hard substrates - stones etc.
Lymnaea peregra			++	D	Probably the commonest water snail in Europe, occurring in a wide variety of habitats
Physa fontinalis			+	D	Common in many habitats
Planorbis carinatus		+	++	D	Common
Planorbis contortus		++	+	D	Common in many habitats
Potamopyrgus jenkinsi	+++	++++	++++	D	Common, often very abundant in many habitats

	Site 1	Site 2	Site 3	Group	Ecology and Distribution in Freshwater
Valvata piscinalis		+++	++++	D	Commonly found in still or slow-flowing waters, typically amongst dense weed beds
Bivalvia (Freshwater Mussels)					
Pisidium sp.		+++	+++	D	Common in many habitats
Sphaerium sp.			++++	D	Common in many habitats
Hydracarina (Water mites)			++	C	Common in many habitats
Amphipoda (Freshwater shrimps)					
Gammarus duebeni	++++	++	+++	C	Common in Ireland in a wide range of habitats
Isopoda (Water slaters)					
Asellus aquaticus	++++	+++	+++	D	Common in still or slow-flowing waters amongst bottom debris
Ephemeroptera (Mayflies)					
Baetis rhodani	+++			C	Common and abundant in small streams; extending into rivers
Baetis muticus	++			B	Common, typical of small stony streams.
Caenis luctuosa			+	C	Common in rivers, lakes and ponds, especially amongst silt trapped between gravel and stones
Caenis rivulorum	+++		+	C	Found chiefly in stony streams and rivers

	Site 1	Site 2	Site 3	Group	Ecology and Distribution in Freshwater
Ephemerella ignita	++++	++	+++	B	Common, occurring mostly in running waters amongst vegetation
Heptagenia sulphurea	+			A	Widespread but commoner in rivers draining calcareous areas and in the lower reaches of rivers. Abundant in limestone lakes
Paraleptophlebia submarginata			+	B	Found chiefly in stony streams and rivers
Rhithrogena semicolorata	+			A	Common in stony rivers and streams
Plecoptera (Stoneflies)					
Leuctra hippopus	+			B	Common and abundant in rivers and streams with a stony substrate.
Megaloptera (Alder flies)					
Sialis lutaria		+++		C	Common in pondsa, lakes and sluggish parts of streams and rivers where there is an abundance of silt
Trichoptera (Caddis flies)					
Agapetus fuscipes	++			C	Widespread and abundant. Found on stony substrates of streams, rivers and lake shores
Athripsodes aterrimus			+	B	Widespread and common in ponds, lakes and slow flowing waters.
Goera pilosa			++	B	Common in fast-flowing streams and rivers.
Hydropsyche angustipennis	++		+	C	

	Site 1	Site 2	Site 3	Group	Ecology and Distribution in Freshwater
Hydropsyche pellucidula	++			C	Common, usually in fast-running waters.
Lepidostoma hirtum	+			B	Widespread and common in rivers, large streams and sometimes on lake shores
Orthotrichia sp.			+	C	
Polycentropus flavomaculatus		++		C	Common in slower-flowing or still waters
Potamophylax latipennis	+	+		C	Widespread and common. Found on stony substrates of streams rivers and lake shores
Sericostoma personatum	+++	+++		B	Common on stony substrates.
Lepidoptera (Butterflies and Moths)		++		-	Several genera have aquatic larvae which feed on water plants; they are locally common in shallow still or slow-flowing waters.
Tipulidae (Crane flies)	+++		+	C	Common in a variety of habitats.
Ceratopogonidae (Biting midges)		+		-	Common in a variety of habitats.
Simuliidae (Black-flies)	+++		++++	C	
Chironomidae (Non-biting midges)					
Chaetocladius sp.			+	D	Found in wet leaves, among plants and in mud in small water bodies.
Chironomus sp.		++		E	Common, preferring muddy substrata of standing or slow-flowing waters. Often abundant in organically polluted waters.

	Site 1	Site 2	Site 3	Group	Ecology and Distribution in Freshwater
Cricotopus/ Orthocladius sp.	+++	++++	++++	D	Common in all types of freshwater, frequently associated with aquatic plants. (*Orthocladius* larvae cannot be distinguished from some *Cricotopus* larvae with certainty.)
Diamesa sp.	+++			D	Mostly found in cool flowing water & springs; also shallow still water.
Eukiefferiella sp.			+++	D	Found in flowing water.
Endochironomus sp.		++		D	Found in almost all types of still water, sometimes mining in aquatic plants.
Heterotrissocladius sp.		+		D	Found in a wide variety of still and flowing water habitats
Micropsectra sp.		++++	+++	D	Found in a wide variety of still and flowing water habitats
Paratendipes sp.		+++		D	Found in soft sediments and sandy bottoms in standing and running water
Pentaneurini		+++	+	D	Common in a variety of habitats.
Polypedilum sp.	++	++	+	D	Common in a variety of habitats.
Potthastia longimana			++	D	Found in still or flowing water, usually associated with sandy substrates.
Potthastia gaedii		+		D	Found in flowing water, usually associated with sandy substrates.
Procladius sp.		+++		D	Common in muddy substrata of standing or slow-flowing waters.
Prodiamesa sp.		++		D	Common in a variety of habitats.
Thienemanniella sp.	++	+	+	D	Found in a variety of flowing water habitats
Tvetenia sp.	+++	+	++++	D	Common in flowing water.

	Site 1	Site 2	Site 3	Group	Ecology and Distribution in Freshwater
Coleoptera (Beetles)					
Brychius elevatus	++++		+	C	Common in running water and wave-washed lakeshores
Elmis aenea	+		+	C	Common in running water in riffles.
Gyrinus substriatus	++			C	Common in fresh or peaty, sometimes brackish, water
Gyrinus sp.		+		C	
Laccobius sp.			+	C	Several common genera occur, mostly in still or slow-flowing water
Orectochilus villosus			+	C	Common in running water and wave-washed lake edges.
Potamonectes depressus	++	++	+++	C	Common in lakes and rivers.
Number of Taxa	**32**	**34**	**37**		
Q-RATING	**4**		**3-4**		

ADDENDUM 3

EPA CHEMICAL MONITORING DATA OF THE KINNEGAD RIVER UPSTREAM AND DOWNSTREAM OF KINNEGAD, 1995-1997

EPA CODE *07K01*
St. No. *0100*

RIVER: KINNEGAD

SAMPLING STATION: **U.S KINNEGAD S.W**

Note: Annual means calculated by Conservation Services.

Date	BOD	DO	NO3 as N	NH3 as N	PO4 as P	PH	Temp	Cond
	mg/l	mg/l	mg/l	mg/l	mg/l		C	
20-Mar-95	0.8	11.2	1.0	0.36	0.037	7.70	8.0	
24-Apr-95	0.9	14.0	0.8	0.44	0.010	7.86	11.5	
31-May-95	0.8	10.0	0.5	0.20	0.013	7.75	13.0	
10-Jul-95	1.6	9.7	0.1	0.35	0.023	8.00	20.5	
29-Aug-95	1.1	7.3	0.1	0.09	0.023	8.05	18.0	
10-Sep-95	0.8	8.5	0.7	0.27	0.020	7.75	14.0	
21-Nov-95	1.1	9.0	1.4	0.63	0.023	7.65	8.0	
95 mean	**1.0**	**10.0**	**0.7**	**0.3**	**0.0**	**7.8**		
05/02/96	2.5	10.8	1.8	0.66	0.030	7.65	5.5	
03/04/96	0.4	11.5	2.5	0.24	0.020	7.85	10.0	
15/5/96	1.0	14.0	2.0	0.14	0.010	7.80	11.0	
20/6/96	0.8	9.0	0.5	0.26	0.027	7.80	18.0	
08/07/96	2.5	5.5	0.3	0.30	0.040	7.20	14.0	
13/11/96	0.8	10.3	2.5	0.47	0.020	7.50	6.5	
16/12/96	0.8	10.2	2.7	0.40	0.020	7.55	7.0	729
96 mean	**1.3**	**10.2**	**1.8**	**0.4**	**0.0**	**7.6**		
12/02/97	2.0	10.5	3.7	0.48	0.040	7.60	5.5	690
18/03/97	0.5	13.0	2.7	0.21	0.023	8.00	10.5	720
30/04/97	1.0	14.0	1.9	0.40	0.010	8.10	15.5	680
11/06/97	1.0	10.0	1.4	0.21	0.013	7.90	14.0	740
16/07/97	3.5	10.0	1.1	0.20	0.030	7.90	16.5	670
08/08/97	2.5	7.0	1.2	0.31	0.026	7.60		705
18/08/97	3.0	8.2	0.8	0.16	0.043	7.75	18.0	725
97 mean	**1.9**	**10.4**	**1.8**	**0.3**	**0.0**	**7.8**		

EPA CODE *07K01*
St. No. *0150*

RIVER:KINNEGAD

SAMPLING STATION: **D.S KINNEGAD S.W**

Note: Annual means calculated by Conservation Services.
In calculating annual means, sampling occasions on which samples were not taken at the upstream station have been excluded to allow direct comparisons to be made.

Date	BOD	DO	NO3 as N	NH3 as N	PO4 as P	PH	Temp	Cond
	mg/l	mg/l	mg/l	mg/l	mg/l		C	
01-Feb-95	1.6	10.0	1.6	0.60	0.063	7.20	8.0	
20-Mar-95	0.7	11.4	1.2	0.36	0.040	7.72	8.0	
24-Apr-95	1.0	13.0	1.4	0.43	0.100	7.88	11.5	
31-May-95	1.5	10.3	1.0	0.32	0.240	7.75	13.0	
10-Jul-95	1.5	9.7	0.1	0.27	0.263	8.05	20.5	
29-Aug-95	1.0	10.0	0.1	0.11	0.140	8.05	18.0	
10-Sep-95	1.1	8.5	1.7	0.32	0.410	7.80	14.0	
21-Nov-95	1.3	9.4	1.6	0.62	0.110	7.70	8.0	
95 mean (exc. Feb)	**1.2**	**10.3**	**1.0**	**0.3**	**0.2**	**7.9**		
05/02/96	1.7	10.8	1.8	0.63	0.033	7.6	5.5	
03/04/96	0.8	11.8	2.7	0.25	0.043	7.85	10.0	
15/5/96	1.0	13.4	2.0	0.17	0.090	7.80	12.0	
20/6/96	1.4	9.5	0.5	0.31	0.173	7.80	18.0	
08/07/96	2.5	6.8	1.5	0.35	0.150	7.30	14.0	
13/11/96	1.5	10.8	3.0	0.44	0.110	7.50	6.5	
16/12/96	1.0	10.6	2.8	0.38	0.060	7.50	7.0	733
96 mean	**1.4**	**10.5**	**2.0**	**0.4**	**0.1**	**7.6**		
18/03/97	1.0	13.0	2.8	0.52	0.113	8.00	10.5	720
30/04/97	1.0	14.0	1.9	0.40	0.010	8.10	15.5	683
09/06/97	1.4	10.0	1.6	0.34	0.180	7.90	14.5	740
16/07/97	4.5	9.7	1.2	0.26	0.183	7.95	16.5	720
08/08/97	2.7	7.3	1.4	0.29	0.200	7.64		686
18/08/97	3.3	8.6	1.4	0.19	0.500	7.79	18.0	715
97 mean (to end Aug)	**2.3**	**10.4**	**1.7**	**0.3**	**0.2**	**7.9**		
22/09/97	2.6	9.6	1.6	0.32	0.083	7.85	15.0	742
17/11/97	2.0	8.4	2.3	0.58		7.65	12.0	708

APPENDIX
3.3
SOILS AND GEOLOGY

APPENDIX 3.3.1

GEOLOGICAL INVESTIGATIONS

Investigations covering the limestone, shale and sand and gravel resource areas comprised the elements described below.

A1 Deep boreholes

13 No. deep boreholes were drilled in the high and very high quality limestone area and 25 No. deep boreholes in the shale area between January and May 1998. The positions of these boreholes numbered between LANS1 and LANS28 and LANS101 and LANS146 respectively are shown on Appendix Drawing 3.3.2.

The positions of boreholes not drilled are also shown on the several geological plans; the numbering of boreholes relates to positions proposed before later drilling showed some to be unnecessary. Boreholes were drilled using rotary coring with wireline equipment and reverse circulation methods. Continuous samples were taken from both sets of boreholes. The cored boreholes were logged according to the requirements of BS 5930 and generally followed the requirements of the International Society of Rock Mechanics before sampling for chemical analysis. The cuttings from the reverse circulation boreholes were logged before dispatch for chemical analysis.

Data on boreholes previously drilled in the vicinity was collected from the Geological Survey of Ireland (GSI) and the drill cores of three boreholes located on the site were examined (Borehole Nos. KG1, KG4 and KG5). A 100m deep water well had recently been drilled 50m east of Lansdown Lodge, but full details of the drilling are not available.

Borehole schedules for both areas are given in Appendix Tables 3.3 1A, 1B and 1C and positions are shown on Appendix Drawing No. 3.3.2.

Piezometer installations have been completed in 6 No. boreholes and one backfilled trial pit in the limestone area and in 7 No. boreholes in the northern shale area. In addition, all remaining boreholes in the limestone area and most boreholes in the shale area have plastic casing installed to allow for the monitoring of rest water levels in the bedrock, being temporarily plugged at the overburden/bedrock interface using bentonite pellets. Two test wells have been prepared, one has been installed in the limestone area and one in the shale area. Piezometer installation details, piezometer testing and well test data are referred to in Section 3.4.

Chemical and certain physical analyses were undertaken by CERAM Research at Stoke-on-Trent, England. Selected superficial material for grading and other physical testing were also sent to CERAM.

A2 Shallow and surface investigation

Drilling provided data on depths to bedrock, but more limited information on materials characteristics were derived from cuttings. To amplify details of the superficial materials and sub-crop locations, 70 No. trial pits and 2 No. large sample pits were excavated during March and April 1998 using a PC300 backhoe. Samples from the trial pits were taken throughout the sequence of superficial materials and described according to conventional soil mechanics practice. Most trial pits encountered bedrock in the limestone area, but in the shale area drilling returns have been used to determine the nature of the lower sections of the superficial deposits in locations with thicker superficial materials. Details are listed in Appendix Table 1D and trial pit positions are shown on Appendix Drawing No. 3.3.2

A number of surface geophysical traverses were run across the site following the borehole layout. The findings of this work were used to adjust drilling positions and depths and to investigate the presence of selected solution features and variations in bedrock level in the limestone area.

The borehole positions and the site features were surveyed by conventional terrestrial methods. Surface contours are given on Appendix Drawing No. 3.3.2.

Appendix Table 3.3.1A
Schedule of 1998 boreholes: Limestone area

BH No.	Easting	Northing	Ground Level mAOD	Base of Borehole		Base Overburden		Base Waulsortian Reef Limestone	
				Depth (m)	Level (mAOD)	Depth (m)	Level (mAOD)	Depth (m)	Level (mAOD)
LANS 1	257588.86	242688.63	84.88	80.90	3.98	3.50	81.38	> 80.90	< 3.98
LANS 2	257480.80	242814.15	85.37	82.40	2.97	4.60	80.77	> 82.34	< 3.03
LANS 3	257346.54	242972.46	84.97	79.33	5.64	3.00	81.97	> 79.33	< 5.64
LANS 4	257212.53	243124.48	85.88	79.40	6.48	1.71	84.17	> 79.39	< 6.49
LANS 5	257103.33	243301.42	86.64						
LANS 6	257384.13	242620.10	84.30	80.35	3.95	7.50	76.80	> 80.35	< 3.95
LANS 7	257243.19	242789.89	83.40	79.40	4.00	6.00	77.40	> 79.40	< 4.00
LANS 8	257135.25	242932.84	81.96						
LANS 9	257004.00	243100.03	82.39						
LANS 10	257698.33	242869.94	86.61	80.00	6.61	3.20	83.41	> 80.00	< 6.61
LANS 11	257576.22	243016.20	89.52	81.30	8.22	6.30	83.22	> 81.30	< 8.22
LANS 12	257443.98	243182.61	86.43	81.65	4.78	3.36	83.07	> 81.65	< 4.78
LANS 13	257286.97	243341.39	85.89						
LANS 14	257171.52	242581.13	84.88						
LANS 21	257484.05	242657.16	84.05	46.95	37.10	5.80	78.25	> 46.95	< 37.10
LANS 22	257358.49	242796.09	83.68	86.50	-2.82	6.20	77.48	> 86.50	< -2.82
LANS 23	257230.30	242963.91	84.14						
LANS 24	257277.83	243238.38	86.73						
LANS 25	257703.83	242692.16	84.32						
LANS 26	257588.51	242839.87	86.31	47.00	39.31	4.30	82.01	> 47.00	< 39.31
LANS 27	257462.76	242994.68	86.53	47.05	39.48	3.30	83.23	> 47.05	< 39.48
LANS 28	257327.40	243152.65	87.46						
LANS 29	257214.23	243322.03	85.96						
LANS 29	257655.71	242600.81	84.05						
WELL 1 [1]	257349.10	242807.70	83.68	87.00	-3.32	6.10	77.58	> 87.00	< -3.32

[1] Cavity identfied from 12.19m (71.49mAOD) to19.81m (63.87mAOD)

Appendix Table 3.3.1B
Schedule of 1998 Boreholes: Shale area

				Base of Borehole		Base Oberburden		Base Limestone with shale bands		Base 'Striped Beds'			Bioclastic marker bed in Shaley Limestone		Base Shaley Limestone (Lucan Fm.)		Base Silty Shale (Tober Colleen Fm.)			Base Waulsortian Reef Limestone (Feltrim Limestone Fm.)		
BH. No.	Easting	Northing	Ground Level mAOD	Depth (m)	Level (mAOD)	Depth (m)	Level (mAOD)	Depth (m)	Level (mAOD)	Depth (m)	Level (mAOD)	Thickness (m)	From (mAOD)	To (mAOD)	Depth (m)	Level (mAOD)	Depth (m)	Level (mAOD)	Thickness present in BH (m)	Depth (m)	Level (mAOD)	
LANS 101	257543.69	243644.61	73.05																			
LANS 102	257470.35	243710.04	73.10	61.17	11.93	9.70	63.40								33.63	39.47	NP	NP	0.00	NDE	NDE	
LANS 103	257394.36	243785.12	72.81	74.17	-1.36	8.27	64.54								69.01	3.80	NP	NP	0.00	NDE	NDE	
LANS 104	257316.80	243855.14	74.66	80.50	-5.84	6.80	67.86						56.83	51.62	NDE	NDE						[Note 1]
LANS 105	257246.85	243918.16	76.09	30.40	45.69	9.80	66.29	>30.40	<45.69													
LANS 106	257403.70	243495.21	80.24																			
LANS 107	257348.41	243588.70	77.18																			
LANS 108	257270.68	243640.84	77.49	25.00	52.49	3.60	73.89										NDE	NDE	21.40			[Note 2]
LANS 108A	257266.50	243648.70	77.49	24.50	52.99	4.00	73.49										NDE	NDE	20.50			[Note 3]
LANS 109	257197.01	243718.05	77.93	18.00	59.93	5.10	72.83								10.63	67.30	NP	NP	0.00	NDE	NDE	
LANS 110	257133.89	243784.15	78.43	27.11	51.32	6.80	71.63	12.13	66.30	NDE	NDE											
LANS 111	257669.74	243800.63	73.26	24.10	49.16	8.50	64.76										NDE	NDE	15.60			
LANS 111A	257659.40	243808.50	73.26	66.50	6.76	?19.00	54.26										NDE	NDE	47.50			[Note 4]
LANS 112	257601.20	243867.74	72.29	80.60	-8.31	10.29	62.00						50.21	44.85	NDE	NDE						
LANS 113	257529.58	243937.06	71.82	60.00	11.82	10.40	61.42	23.85	47.97	51.16	20.66	27.31	16.26	NDE	NDE	NDE						
LANS 114	257457.81	244003.50	74.06	30.18	43.88	11.20	62.86	NDE	NDE													
LANS 115	257386.06	244068.86	76.27																			
LANS 116	257372.58	243396.23	84.98																			
LANS 117	257296.44	243464.97	83.05																			
LANS 118	257220.04	243534.93	82.89																			
LANS 119	257160.69	243588.38	82.18																			
LANS 120	257078.54	243646.59	82.76																			
LANS 121	257015.44	243729.96	80.95																			
LANS 122	256992.14	243616.79	80.63																			
LANS 123	257438.94	243608.25	76.14																			
LANS 124	257365.02	243682.23	75.31	19.00	56.31	7.00	68.31										NDE	NDE	12.00			[Note 2]
LANS 124A	257358.70	243692.00	75.31	24.31	51.00	3.50	71.81										NDE	NDE	20.81			[Note 5]
LANS 125	257283.33	243748.14	75.79	60.00	15.79	8.60	67.19								18.70	57.09	57.00	18.79	38.30	NDE	NDE	
LANS 126	257215.28	243802.73	77.42	57.61	19.81	6.60	70.82								44.52	32.90	48.66	28.76	4.14	NDE	NDE	
LANS 127	257143.70	243874.53	78.80																			
LANS 128	257576.52	243758.24	74.44	37.00	37.44	14.00	60.44										35.85	38.59	23.00	NDE	NDE	[Note 2]
LANS 129	257502.17	243825.26	74.46	72.90	1.56	10.00	64.46			?	?		50.86	46.32	NDE	NDE						
LANS 130	257426.61	243896.08	72.54	60.35	12.19	7.80	64.74			30.47	42.07		37.17	34.09	NDE	NDE						
LANS 131	257352.14	243959.52	73.00	50.05	22.95	8.90	64.10			20.28	52.72				NDE	NDE						
LANS 132	257280.23	244026.71	73.99																			
LANS 133	257701.04	243911.09	71.95																			
LANS 134	257632.26	243978.30	71.87	79.20	-7.33	11.50	60.37	17.46	54.41	43.13	28.74	25.67	23.83	19.36	NDE	NDE						
LANS 135	257558.82	244040.30	75.15	75.95	-0.80	19.00	56.15	60.70	14.45	NDE	NDE											
LANS 136	257488.44	244103.80	77.11																			
LANS 137	257658.27	244076.62	73.65																			
LANS 138	257412.00	244372.00	71.20	11.38	59.82	9.60		NDE	NDE													
LANS 139	257276.10	243697.90	76.55	58.00	18.55	7.40									46.00	30.55	NP	NP	0.00	>58.00	<18.55	
WELL 2	257312.00	243717.00	76.33	52.00	24.33	6.50									16.50	59.83	NDE	NDE	35.50			

NDE Borehole not deep enough to intersect base of unit.
NP (Tobercolleen) Unit not present at in the stratigraphic sequence in borehole.

[1] Fault? at 32.96-29.66
[2] No core recovery
[3] Drilled using reverse circulation, with air and water flush from 0.0 to 9.5m, and with air flush from 9.5 to 25m
[4] Reverse circulation with air and water flush from 0.0 to 4.0m, openhole 4.0 to 19.2m, rotary coring 19.2 to 52.2m, openhole 52.2 to 66.5m
[5] Drilled using reverse circulation, with air flush from 0.0 to 19.3m, and with air and water flush from 19.3 to 24.3m

Appendix Table 3.3.1C
Schedule of 1983 Boreholes: KG Series

Information from GSI open files and other sources

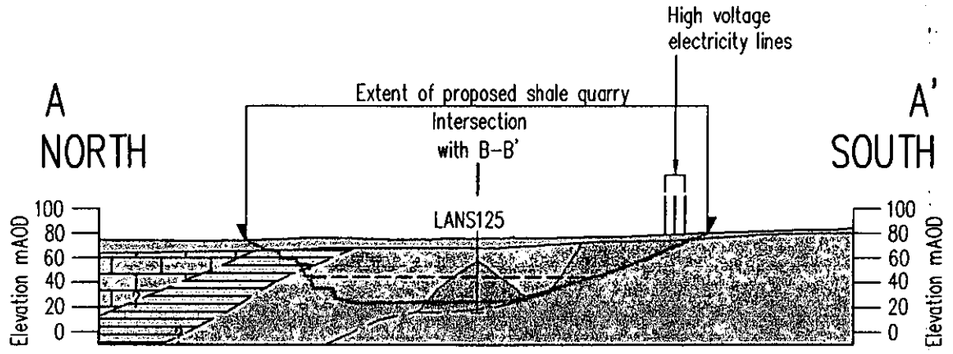
BH No.	E [1]	N [1]	Incl.	Azim.	Ground level mAOD [2]	Base of Borehole		Base Overburden		Base Shaley Limestone (Lucan Fm.)		Base Waulsortian Reef Limestone (Feltrim Limestone Fm.)		Notes
						Depth (m) [3]	Level (mAOD)	Depth (m) [3]	Level (mAOD)	Depth (m)	Level (mAOD)	Depth (m)	Level (mAOD)	
KG1	257070	243548	45 deg	150 deg	83.00	76.20	29.12	9.14	76.53	39.93	54.77	>76.20	<83.00	
KG2	256535	242690	45 deg	0 deg	85.00	62.48	40.82	15.24	74.22			62.48	40.82	Grey bioclastic limestone 59.7 to 62.48m. Fault or clay/pyrite filled cavity at 23.8-45m
KG3	256540	242845	Vertical		90.00	76.20	13.80	22.25	67.75			76.20	13.80	Grey bioclastic limestone to22.25-31.4m. Cavity at 33.8-39.6m
KG4	257530	243640	Vertical		73.00	13.70	59.30	6.20	66.80			13.70	59.30	
KG5	257265	243800	Vertical		76.00	67.70	8.30	6.00	70.00	52.50	23.50	67.70	8.30	'Reef' reported at 44.0m-48.4m

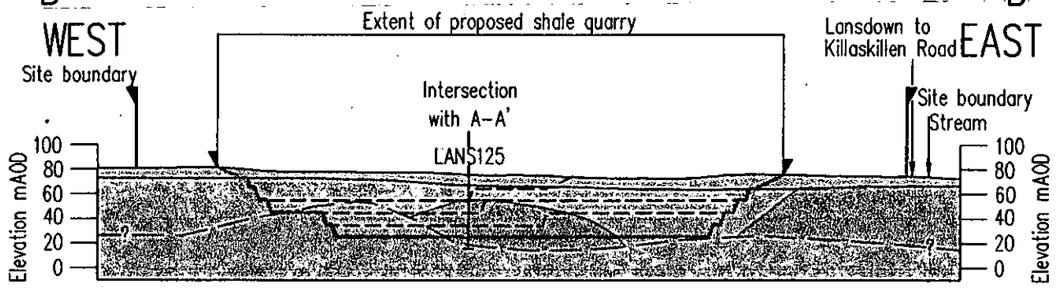
[1] Approximate position
[2] Approximate levels.
[3] For KG1 and KG2 length along borehole

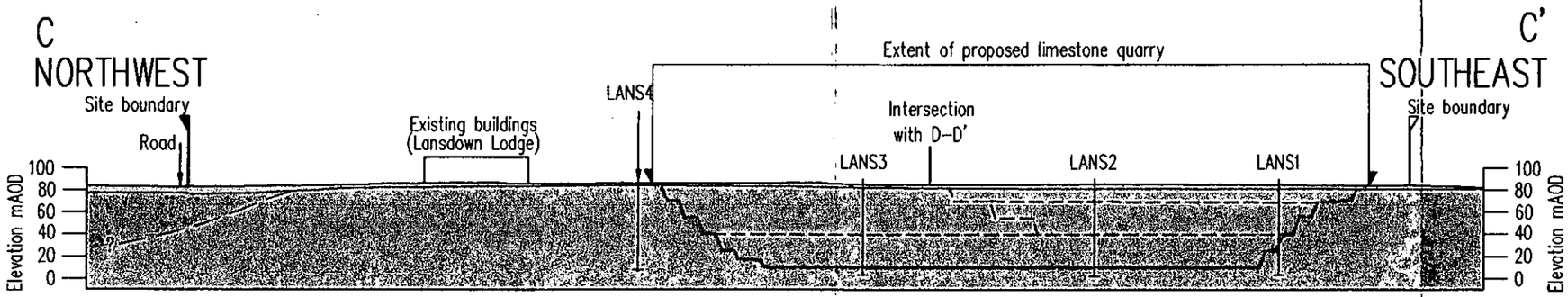
Appendix Table 3.3.1D
Schedule of 1998 Trial Pits

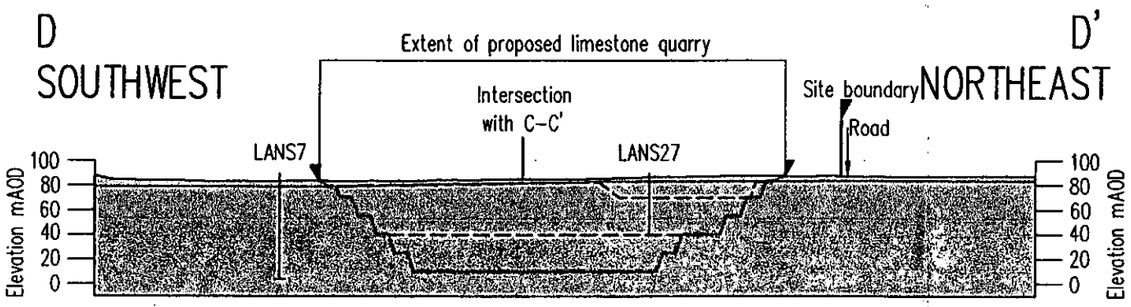
Trial Pit No.		Easting	Northing	Ground Level mAOD	Depth of trial pit		Topsoil / Subsoil/peat		Peat/ peaty	Base Superficials		Superficials: Cohesive: V. soft to firm				Superficials: Cohesive: Stiff to hard				Superficials: Granular				Bed Rock	Water Seepage		Water Inflow	
												Depth in Trial Pit		Level		Depth in Trial Pit		Level		Depth in Trial Pit		Level						
					Depth (m)	Level (mAOD)	Depth (m)	Level (mAOD)		Depth (m)	Level (mAOD)	from	to	from	to	from	to	from	to	from	to	from	to		Depth (m)	Level (mAOD)	Depth (m)	Level (mAOD)
TP	1	257542.00	242557.00	83.88	4.00	79.88	0.50	83.38	Y	4.00	79.88	0.50	2.10	83.38	81.78					2.10	4.00	81.78	79.88	'Reef' Limestone	0.50	83.38	2.70	81.18
TP	2	257256.00	242754.00	83.40	5.00	78.40	0.40	83.00	Y	5.00	78.40	0.50	3.50	82.90	79.90					3.50	5.00	79.90	78.40	'Reef' Limestone	0.40	83.00	2.50	80.90
TP	3	257454.00	242752.00	84.31	4.90	79.41	0.45	83.86	n	4.90	79.41	0.45	3.00	83.86	81.31	3.00	4.90	81.31	79.41					'Reef' Limestone	1.50	82.81	3.90	80.41
TP	4	257656.00	242764.00	84.82	3.15	81.67	0.26	84.56	n	3.15	81.67	0.26	3.15	84.56	81.67									'Reef' Limestone	1.70	83.12		
TP	5	257263.00	242950.00	83.69	1.50	82.19	0.50	83.19	n	1.50	82.19	0.50	1.50	83.19	82.19									'Reef' Limestone			1.40	82.29
TP	6	257455.00	242950.00	85.31	2.20	83.11	0.80	84.51	n	2.20	83.11	0.80	2.20	84.51	83.11									'Reef' Limestone			1.80	83.51
TP	7	257650.00	242951.00	90.06	2.45	87.61	0.30	89.76	n	2.45	87.61	0.30	2.45	89.76	87.61									'Reef' Limestone	none		none	
TP	8	257454.00	243153.00	87.13	2.80	84.33	0.50	86.63	n	2.80	84.33	0.50	2.80	86.63	84.33									'Reef' Limestone	none		none	
TP	9	257254.00	243155.00	86.94	1.30	85.64	0.40	86.54	n	1.30	85.64	0.70	1.30	86.24	85.64					0.40	0.70	86.54	86.24	'Reef' Limestone	none		none	
TP	10	257352.00	243262.00	85.06	2.20	82.86	0.70	84.36	n	2.20	82.86	0.70	2.20	84.36	82.86									'Reef' Limestone	none		none	
TP	11	257346.00	243059.00	86.59	2.85	83.74	0.60	85.99	n	2.85	83.74	0.60	2.85	85.99	83.74									'Reef' Limestone	none		none	
TP	12	257544.00	243063.00	87.94	5.00	82.94	0.80	87.14	n	5.00	82.94	0.80	5.00	87.14	82.94									'Reef' Limestone			4.90	83.04
TP	13	257550.00	242858.00	86.44	4.30	82.14	0.80	85.64	n	4.30	82.14	0.80	4.30	85.64	82.14									'Reef' Limestone			4.30	82.14
TP	14	257550.00	242662.00	83.71	3.80	79.91	0.40	83.31	Y	3.80	79.91	0.40	2.50	83.31	81.21	2.50	3.80	81.21	79.91					'Reef' Limestone			3.80	79.91
TP	15	257356.00	242654.00	84.44	3.70	80.74	0.70	83.74	Y	3.70	80.74	0.70	1.40	83.74	83.04	2.80	3.50	81.64	80.94	1.40 3.50	2.80 3.70	83.04 80.94	81.64 80.74	'Reef' Limestone	2.10	82.34	3.50	80.94
TP	16	257360.00	242866.00	84.55	3.70	80.85	0.85	83.70	n	3.70	80.85	1.45	2.50	83.10	82.05	2.50	3.70	82.05	80.85					'Reef' Limestone			3.70	80.85
TP	17	257220.00	243357.00	85.24	6.10	79.14	0.60	84.64	n	> 6.10	79.14	0.60	3.50	84.64	81.74	3.50	6.10	81.74	79.14					NDE	none	—	none	
TP	18	257160.00	243490.00	84.96	6.20	78.76	0.50	84.46	n	6.20	78.76	4.80	6.20	80.16	78.76					0.50	4.80	84.46	80.16	'Reef' Limestone	4.80	80.16		
TP	19	257126.00	242860.00	81.90	6.20	75.70	0.40	81.50	Y	3.40	78.50	0.40	3.40	81.50	78.50									'Reef' Limestone			3.40	78.50
TP	20	257156.00	242705.00	84.34	5.25	79.09	0.25	84.09		5.25	79.09	2.00	3.00	82.34	81.34	3.00	5.25	81.34	79.09	0.25	2.00	84.09	82.34	'Reef' Limestone			5.00	79.34
TP	21	257185.00	242532.00	85.30	6.10	79.20	0.25	85.05	Y	> 6.10	79.20	0.25	6.10	85.05	79.20									NDE	1.60	83.70		
TP	22	257595.00	243000.00	89.61	5.25	84.36	0.40	89.21		5.25	84.36	0.40	4.00	89.21	85.61	4.00	5.25	85.61	84.36					'Reef' Limestone	none			
TP	23a	257112.00	243062.00	83.27	0.80	82.47	0.30	82.97		0.80	82.47	0.40	0.80	82.87	82.47									'Reef' Limestone	none			
TP	23b	257112.00	243062.00	83.27	0.30	82.97	0.30	82.97																'Reef' Limestone	none			
TP	24	257347.70	242802.70	83.63	4.80	78.83	0.40	83.23		> 4.80	78.83	0.40	3.00	83.23	80.63	3.00	4.80	80.63	78.83					NDE	3.60	80.03		
TP	101	257400.00	244418.00	70.74	1.90	68.84	1.00	69.74	Y	> 1.90	68.84									0.60	1.90	70.14	68.84	NDE				
TP	101A	257455.00	244380.00	71.92	2.70	69.22	0.55	71.37	n	> 2.70	69.22									1.00	2.70	70.92	69.22	NDE			0.60	71.32
TP	102	257436.00	244218.00	71.24	2.40	68.84	0.40	70.84	Y	> 2.40	68.84									0.40	2.40	70.84	68.84	NDE			2.10	69.14
TP	103	257430.00	244080.00	78.02	6.00	72.02	0.60	77.42	n	> 6.00	72.02									0.60	6.00	77.42	72.02	NDE	none			
TP	104	257534.00	244084.00	76.93	5.80	71.13	0.60	76.33	n	> 5.80	71.13	0.60	2.70	76.33	74.23					2.70	5.80	74.23	71.13	NDE	none			
TP	104A	257517.00	244020.00	74.23	3.20	71.03	0.70	73.53	n	> 3.20	71.03	0.70	2.20	73.53	72.03					2.20	3.20	72.03	71.03	NDE			2.20	72.03
TP	105	257322.00	243995.00	73.41	4.00	69.41	0.50	72.91	n	> 4.00	69.41	0.50	2.30	72.91	71.11					2.30	4.00	71.11	69.41	NDE	0.50	72.91		
TP	106	257470.00	243930.00	72.18	3.00	69.18	0.35	71.83	Y	> 3.00	69.18	0.35	1.10	71.83	71.08					1.10	3.00	71.08	69.18	NDE	1.10	71.08		
TP	107	257680.00	243828.00	73.29	5.00	68.29	0.40	72.89	n	> 5.00	68.29	0.40	5.00	72.89	68.29									NDE	2.10	71.19		
TP	108	257566.00	243706.00	74.48	4.30	70.18	0.20	74.28	n	> 4.30	70.18	3.70	4.30	70.78	70.18					0.20	3.70	74.28	70.78	NDE	none			
TP	109	257475.00	243590.00	75.49	3.30	72.19	0.70	74.79	Y	3.30	72.19	0.70	3.30	74.79	72.19									NDE	0.70	74.79	2.00	73.49
TP	109A	257455.00	243580.00	76.29	2.65	73.64	0.50	75.79	n	2.65	73.64	0.50	2.00	75.79	74.29					2.00	2.65	74.29	73.64	'Reef' Limestone			2.30	73.99
TP	110	257380.00	243624.00	76.40	3.00	73.40	0.40	76.00	Y	> 3.00	73.40	0.40	2.50	76.00	73.90					2.50	3.00	73.90	73.40	NDE	0.70	75.70	2.30	74.10
TP	110A	257400.00	243598.00	77.37	4.20	73.17	0.25	77.12	n	? 4.20	73.17									0.25	4.20	77.12	73.17	?'Reef' Limestone			3.00	74.37
TP	111	257361.00	243758.00	73.94	4.70	69.24	0.30	73.64	Y	> 4.70	69.24	0.30	4.70	73.64	69.24									NDE			4.00	69.94
TP	111A	257316.00	243721.00	76.60	6.80	69.80	0.50	76.10	n	> 6.80	69.80	0.50 1.60	1.10 2.30	76.10 75.00	75.50 74.30	2.30	6.80	74.30	69.80	1.10	1.60	75.50	75.00	NDE			1.05	75.55
TP	112	257224.00	243866.00	77.11	5.00	72.11	0.65	76.46	n	> 5.00	72.11	0.65	4.00	76.46	73.11	4.00	5.00	73.11	72.11					NDE?			1.25	75.86
TP	113	257129.00	243750.00	78.26	4.60	73.66	0.70	77.56	Y	4.60	73.66									0.70	4.60	77.56	73.66	CPL			0.50	77.76
TP	113A	257307.00	243668.00	75.95	3.50	72.45	0.30	75.65	n			0.30	3.50	75.65	72.45									CPL	1.50	74.45		
TP	114	257018.00	243640.00	80.80	6.30	74.50	0.60	80.20	n	> 6.30	74.50	0.90 3.00	2.50 3.50	79.90 77.80	78.30 77.30	3.50	6.30	77.30	74.50	0.60 2.50	0.90 3.00	80.20 78.30	79.90 77.80	NDE	1.50	79.30		
TP	115	257222.00	243500.00	83.97	5.15	78.82	1.00	82.97	n	5.00	78.97	1.00	4.00	82.97	79.97	4.00	5.00	79.97	78.97					CPL			5.00	78.97
TP	116	257415.00	244340.00	70.69	2.00	68.69	0.35	70.34	Y	> 2.00	68.69									0.35	2.00	70.34	68.69	NDE			1.80	68.89
TP	117	257310.00	244580.00	71.08	2.20	68.88	0.70	70.38	Y	> 2.20	68.88									0.70	2.20	70.38	68.88	NDE	0.85	70.23	1.50	69.58
TP	118	257265.00	243462.00	83.09	2.10	80.99	0.45	82.64	n	2.10	80.99	0.45	2.10	82.64	80.99									'Reef' Limestone	none			
TP	119	257241.00	243482.00	83.48	4.20	79.28	0.50	82.98	n	3.65	79.83	0.50	4.20	82.98	79.28									'Reef' Limestone	3.00	80.48		
TP	120	257200.00	243526.00	83.33	5.60	77.73	0.30	83.03	n	5.60	77.73	0.30	5.60	83.03	77.73									CPL	2.80	80.53		
TP	121	257292.00	243508.00	81.55	2.00	79.55	0.50	81.05	n	1.90	79.65	0.50	1.80	81.05	79.75									'Reef' Limestone				
TP	122	257280.00	243558.00	80.36	3.30	77.06	0.60	79.76	n	> 3.30	77.06	0.60	1.65	79.76	78.71					1.65	3.30	78.71	77.06	NDE			2.40	77.96
TP	123	257350.00	243502.00	79.42	5.30	74.12	0.60	78.82	n	? 5.10	74.32	0.60	3.50	78.82	75.92					3.50	5.30	75.92	74.12	?'Reef' Limestone			4.00	75.42
TP	124	257361.00	243452.00	82.72	3.45	79.27	0.60	82.12	n	3.45	79.27	0.60	3.45	82.12	79.27									'Reef' Limestone	none			
TP	125	257312.00	243642.00	76.37	5.80	70.57	0.45	75.92	Y	4.20	72.17	1.10	3.30	75.27	73.07					0.45 3.30	1.10 5.80	75.92 73.07	75.27 70.57	Black shale (TC)			3.00	73.37
TP	126	257311.00	243615.00	77.09	4.70	72.39	0.30	76.79	Y	4.70	72.39	0.30	4.70	76.79	72.39									?			3.00	74.09
TP	127	257274.00	243622.00	77.74	4.00	73.74	0.60	77.14	n	> 4.00	73.74	0.60	3.30	77.14	74.44					3.30	4.00	74.44	73.74	NDE	1.20	76.54	3.30	
TP	128	257360.00	243642.00	75.66	5.50	70.16	0.70	74.96	Y	> 5.50	70.16					3.50	5.50	72.16	70.16	0.70	3.50	74.96	72.16	NDE	1.90	73.76		
TP	129	257359.00	243617.00	76.50	5.00	71.50	0.50	76.00	Y	> 5.00	71.50	0.50	3.90	76.00	72.60					3.90	5.00	72.60	71.50	NDE			3.90	72.60
TP	130	257390.00	243670.00	74.56	4.40	70.16	0.70	73.86	Y	> 4.40	70.16	0.70	4.40	73.86	70.16									NDE			3.30	71.26
TP	131	257310.00	243658.00	76.03	3.80	72.23	0.40	75.63	Y	3.80	72.23	0.40	3.80	75.63	72.23									TC/CPL*			3.70	72.33
TP	132	257284.00	243700.00	76.23	3.40	72.83	0.25	75.98	n	> 3.40	72.83	2.20	3.40	74.03	72.83	0.25	2.20	75.98	74.03					NDE			2.20	74.03
TP	133	257179.00	243827.00	77.82	5.10	72.72	1.00	76.82	Y/n	> 5.10	72.72	1.00	3.00	76.82	74.82	3.00	5.10	74.82	72.72					NDE	0.80	77.02		
TP	140	257150.00	243520.00	83.84	4.70	79.14	0.60	83.24	n	4.70	79.14	0.60	4.70	83.24	79.14									Black clay/thin lst			2.10	81.74
TP	141	257175.00	243447.00	85.19	6.20	78.99	0.80	84.39	n	> 6.20	78.99	0.80	6.20	84.39	78.99									NDE	none			
TP	142	257240.00	243426.00	85.96	3.80	82.16	0.40	85.56	n	3.80	82.16	0.40	3.80	85.56	82.16									'Reef' Limestone	none			
TP	143	257130.00	243368.00	85.87	1.85	84.02	0.50	85.37	n	1.85	84.02	0.50	1.85	85.37	84.02									'Reef' Limestone	none			
TP	144	257052.00	243500.00	82.46	6.20	76.26	0.40	82.06	n	> 6.20	76.26	3.00	6.20	79.46	76.26	0.40	1.50	82.06	80.96	1.50	3.00	80.96	79.46	NDE	4.00	78.46		
TP	145	256960.00	243406.00	82.84	5.70	77.14	0.40	82.44	n	> 5.70	77.14	0.40	3.80	82.44	79.04	3.80	5.50	79.04	77.34	5.50	5.70	77.34	77.14	NDE	1.50 -3.50	81.34 -79.34		
TP	146	256865.00	243312.00	84.58	5.50	79.08	0.50	84.08	n	> 5.50	79.08	0.50	4.00	84.08	80.58	4.00	5.50	80.58	79.08					NDE	3.50	81.08		

Trial pit locations not surveyed in detail.









LEGEND

- Superficial deposits
- 'Limestone with shale bands' (Lucan Formation)
- 'Striped Beds' (Lucan Formation)
- 'Shaley limestone' (Lucan Formation)
- Tober Colleen Formation
- Waulsortian limestone ('Reef limestone')
- Final profile of quarries

0 50 100 150 200
Metres
Vertical = horizontal

Note:
Screening banks not shown

LAGAN CEMENT LIMITED
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BALLYCOOLIN ROAD, DUBLIN 11
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LANSDOWN CEMENT WORKS

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APPENDIX Nº 3.3

TITLE:

Inferred geological cross sections

Nº 3.3.1.1

04.11.1998

LEGEND

- Site boundary
- Proposed quarry limit
- 81 — Ground surface contours (1m intervals)
- Stream showing direction of flow (Water courses observed February 1998)
- KG5 — KG series borehole (base of borehole where inclined)
- TP107 — Excavated trial pit (1998)

LANS SERIES BOREHOLES

- LANS3 — Drilled
- LANS8 — Not drilled
- LANS111A — Drilled using reverse circulation
- W2 — Well for pumping test
- B' — Line of geological cross section

0 50 100 150 200 Metres

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LANSDOWN CEMENT WORKS

KILLASKILLEN, CO. MEATH

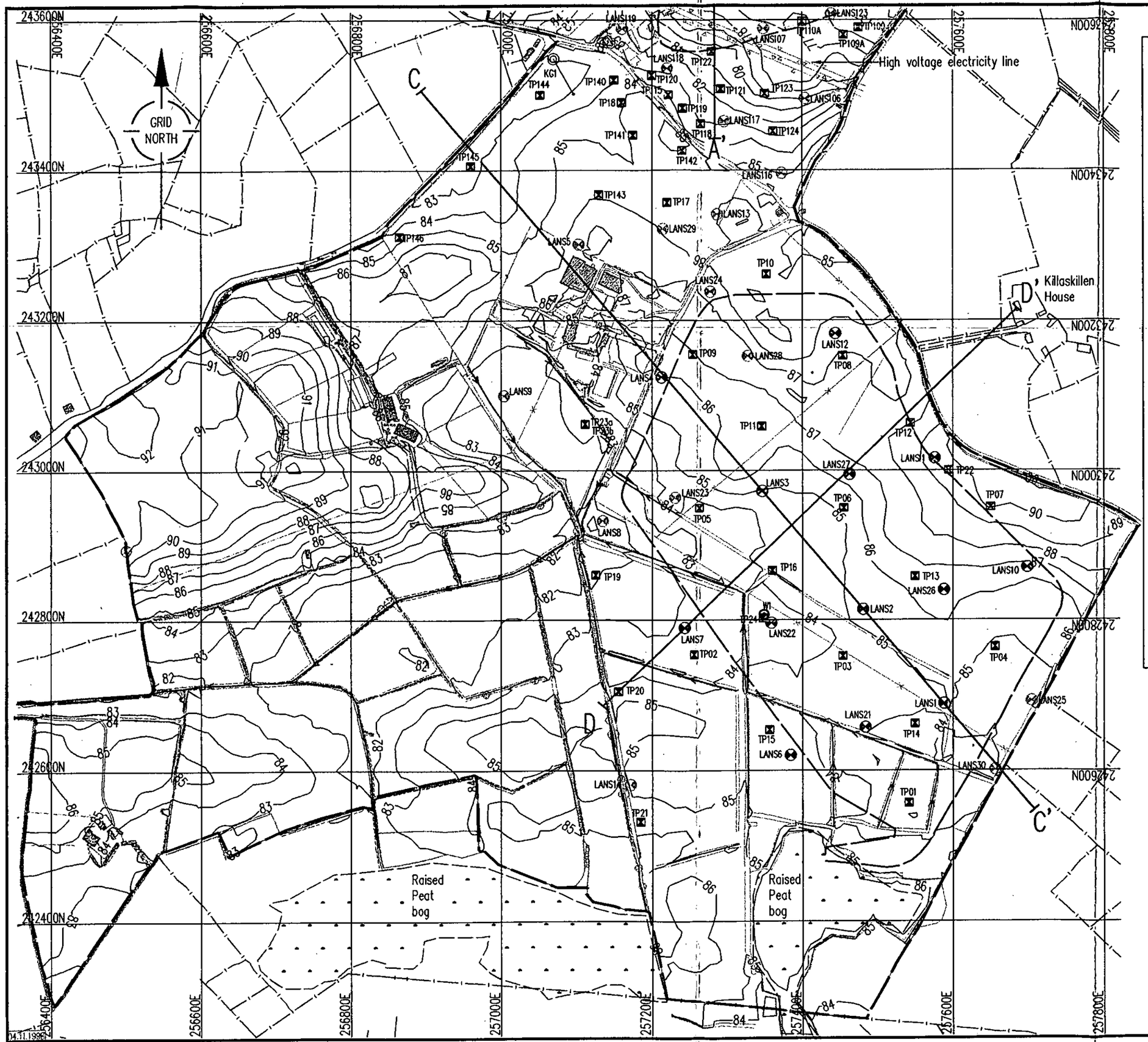
APPENDIX Nº 3.3

TITLE:

Borehole layout plan (North)

Nº

3.3.1.2 N



LEGEND

- Site boundary
- Proposed quarry limit
- 85 — Ground surface contours (1m intervals)
- Stream showing direction of flow (Water courses observed February 1998)
- KG5 — KG series borehole (base of borehole where inclined)
- TP107 — Excavated trial pit (1998)

LANS SERIES BOREHOLES

- LANS3 — Drilled
- LANS8 — Not drilled
- W1 — Well for pumping test
- Low voltage electricity lines
- C' — Line of geological cross section

0 50 100 150 200 Metres

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LANSDOWN CEMENT WORKS

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APPENDIX Nº 3.3

TITLE:

Borehole layout plan (South)

Nº

3.3.1.2 S

LEGEND

- Site boundary
- Proposed quarry limit
- 64.0 — Contours on the base of overburden
- Stream showing direction of flow (Water courses observed February 1998)
- KG5 — KG series borehole (base of borehole where inclined)
- TP107 — Excavated trial pit (1998)

LANS SERIES BOREHOLES

- LANS3 — Drilled
- LANS8 — Not drilled
- LANS111A — Drilled using reverse circulation
- W2 — Well for pumping test
- B' — Line of geological cross section

0 50 100 150 200 Metres

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LANSDOWN CEMENT WORKS

KILLASKILLEN, CO. MEATH

APPENDIX Nº 3.3

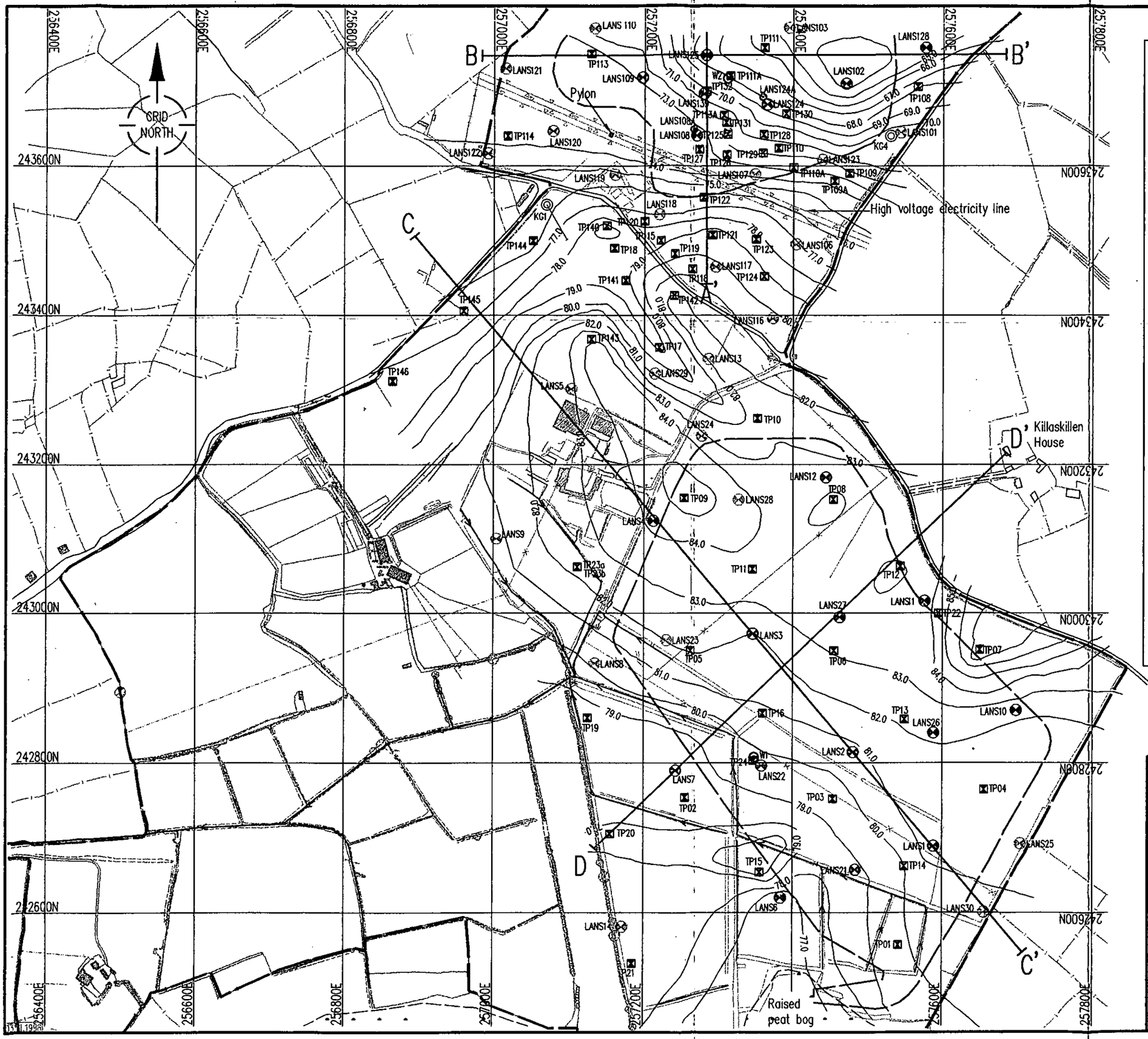
TITLE:

Inferred contours on the base of superficial deposits (North)

Nº

3.3.1.3 N

04.11.1998



LEGEND

- Site boundary
- Proposed quarry limit
- 84.0 — Contours on the base of overburden
- Stream showing direction of flow (Water courses observed February 1998)
- KG5 — KG series borehole (base of borehole where inclined)
- TP107 — Excavated trial pit (1998)

LANS SERIES BOREHOLES

- LANS3 — Drilled
- LANS8 — Not drilled
- LANS111A — Drilled using reverse circulation
- W1 — Well for pumping test
- Low voltage electricity lines
- B' — Line of geological cross section

0 50 100 150 200 Metres

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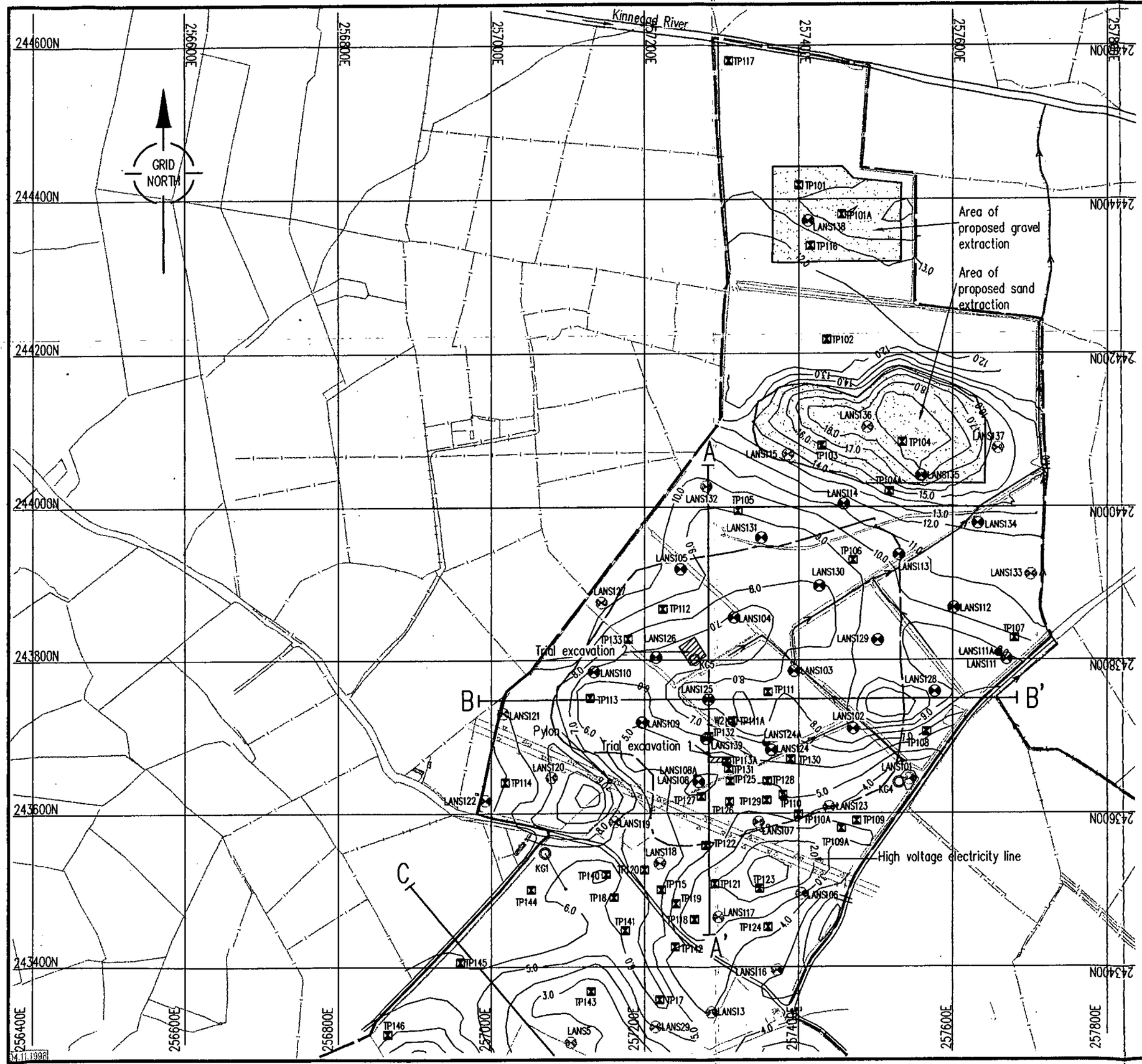
LANSDOWN CEMENT WORKS
KILLASKILLEN, CO. MEATH

APPENDIX Nº 3.3

TITLE:
Inferred contours on the base of superficial deposits (South)

Nº
3.3.1.3 S



LEGEND

- Site boundary
- Proposed quarry limit
- 15.0 — Overburden isopachytes
- Stream showing direction of flow (Water courses observed February 1998)
- KG5 — KG series borehole (base of borehole where inclined)
- TP107 — Excavated trial pit (1998)

LANS SERIES BOREHOLES

- LANS3 — Drilled
- LANS8 — Not drilled
- LANS111A — Drilled using reverse circulation
- W2 — Well for pumping test
- B' — Line of geological cross section

0 50 100 150 200
Metres

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LANSDOWN CEMENT WORKS

KILLASKILLEN, CO. MEATH

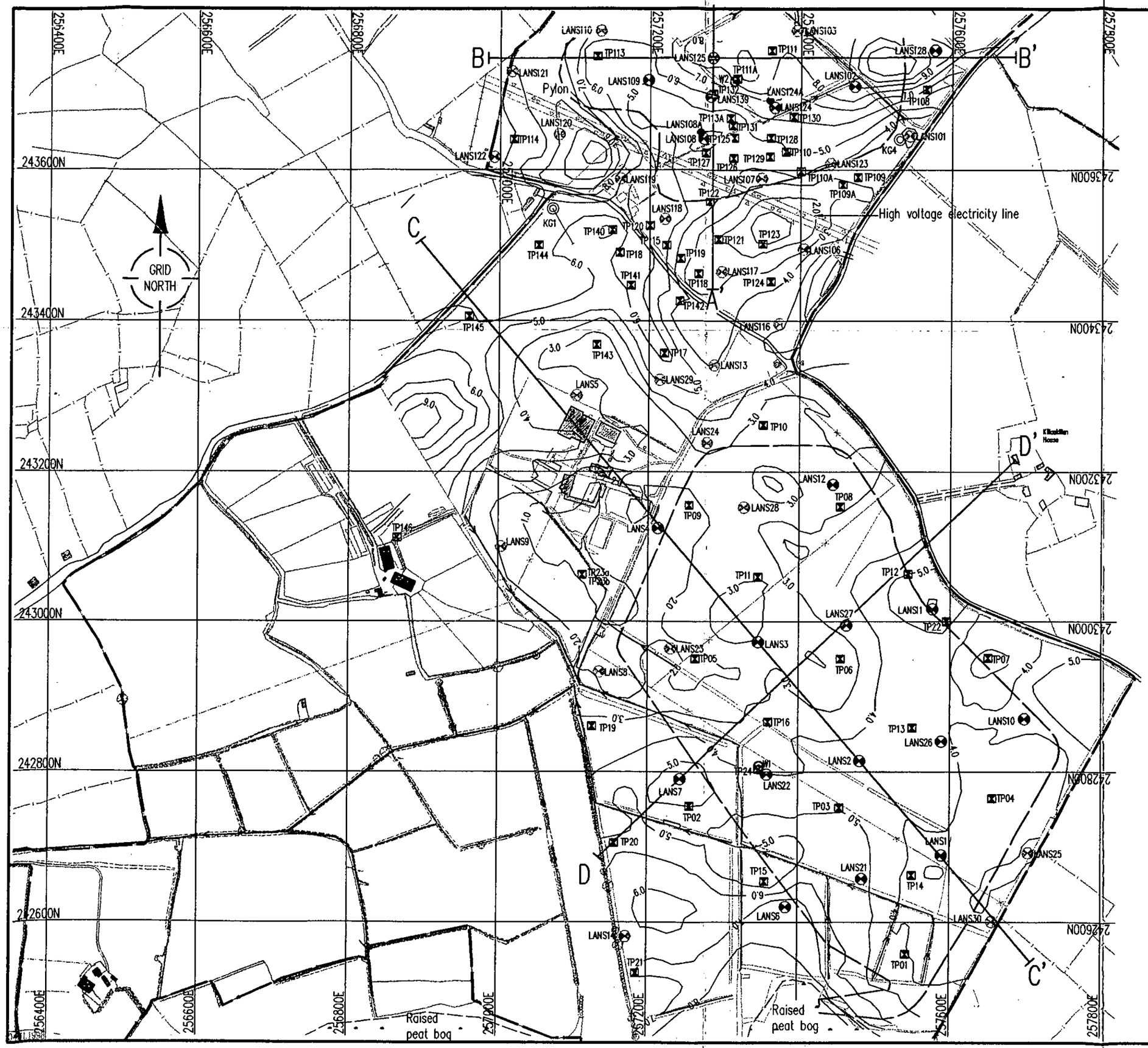
APPENDIX Nº 3.3

TITLE:

Inferred isopachytes of superficial materials (North)

Nº

3.3.1.4 N



LEGEND

- Site boundary
- Proposed quarry limit
- 5.0 — Overburden isopachytes
- Stream showing direction of flow (Water courses observed February 1998)
- KG5 — KG series borehole (base of borehole where inclined)
- TP107 — Excavated trial pit (1998)

LANS SERIES BOREHOLES

- LANS3 — Drilled
- LANS8 — Not drilled
- LANS111A — Drilled using reverse circulation
- W1 — Well for pumping test
- Low voltage electricity lines
- B' — Line of geological cross section

0 50 100 150 200 Metres

LAGAN CEMENT LIMITED
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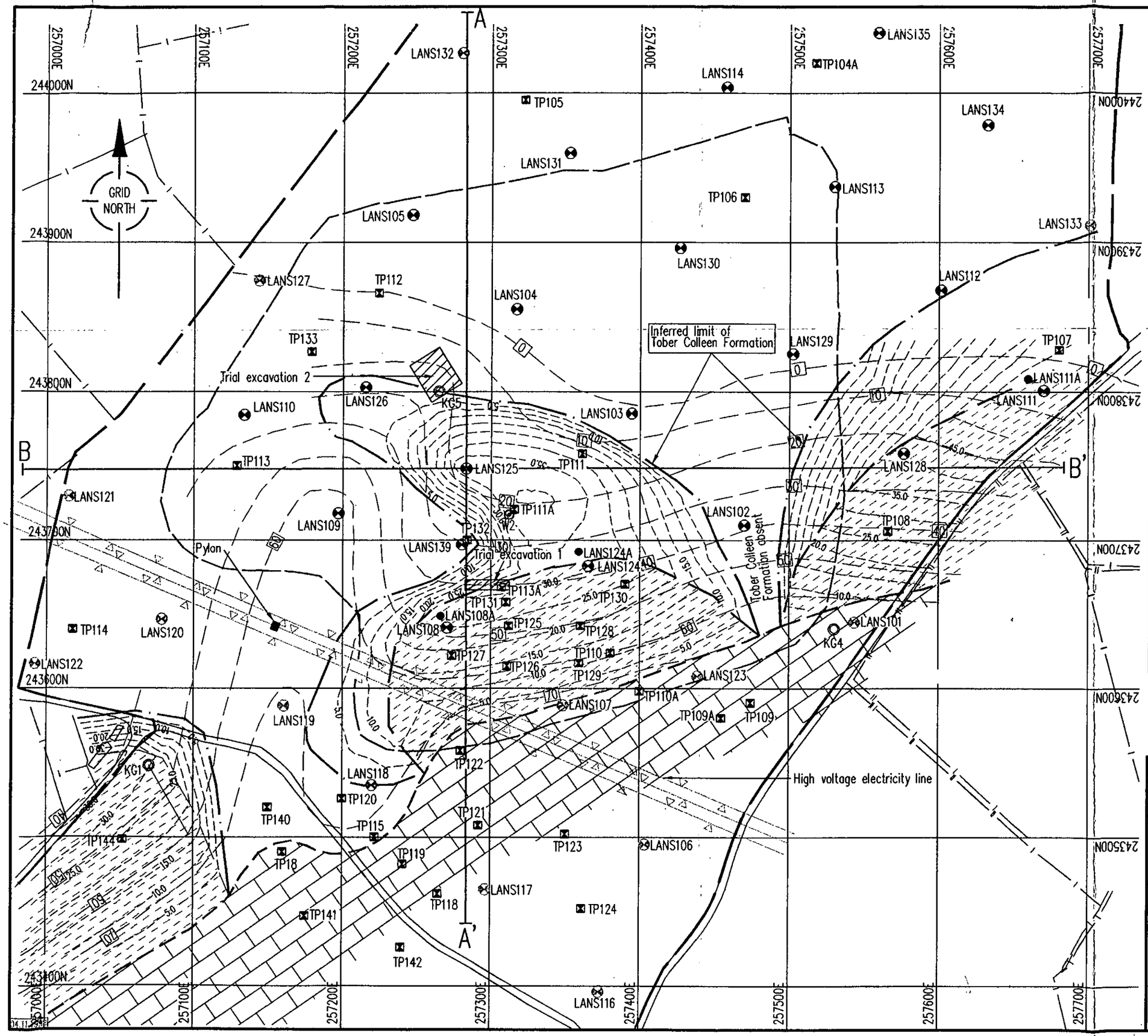
LANSDOWN CEMENT WORKS
KILLASKILLEN, CO. MEATH

APPENDIX Nº 3.3

TITLE:
Inferred isopachytes of superficial materials (South)

Nº
3.3.1.4 S



LEGEND

- Site boundary
- Proposed quarry limit
- Inferred contours on the top of Waulsortian limestone ('Reef limestone')
- Inferred isopachytes of Tober Colleen Formation
- Inferred subcrop of the Tober Colleen Formation
- Inferred subcrop of Waulsortian limestone ('Reef limestone')
- KG series borehole
- Excavated trial pit (1998)

LANS' SERIES BOREHOLES

- Drilled
- Not drilled
- Drilled using reverse circulation
- Well for pumping test
- Line of geological cross section

0 25 50 75 100 Metres

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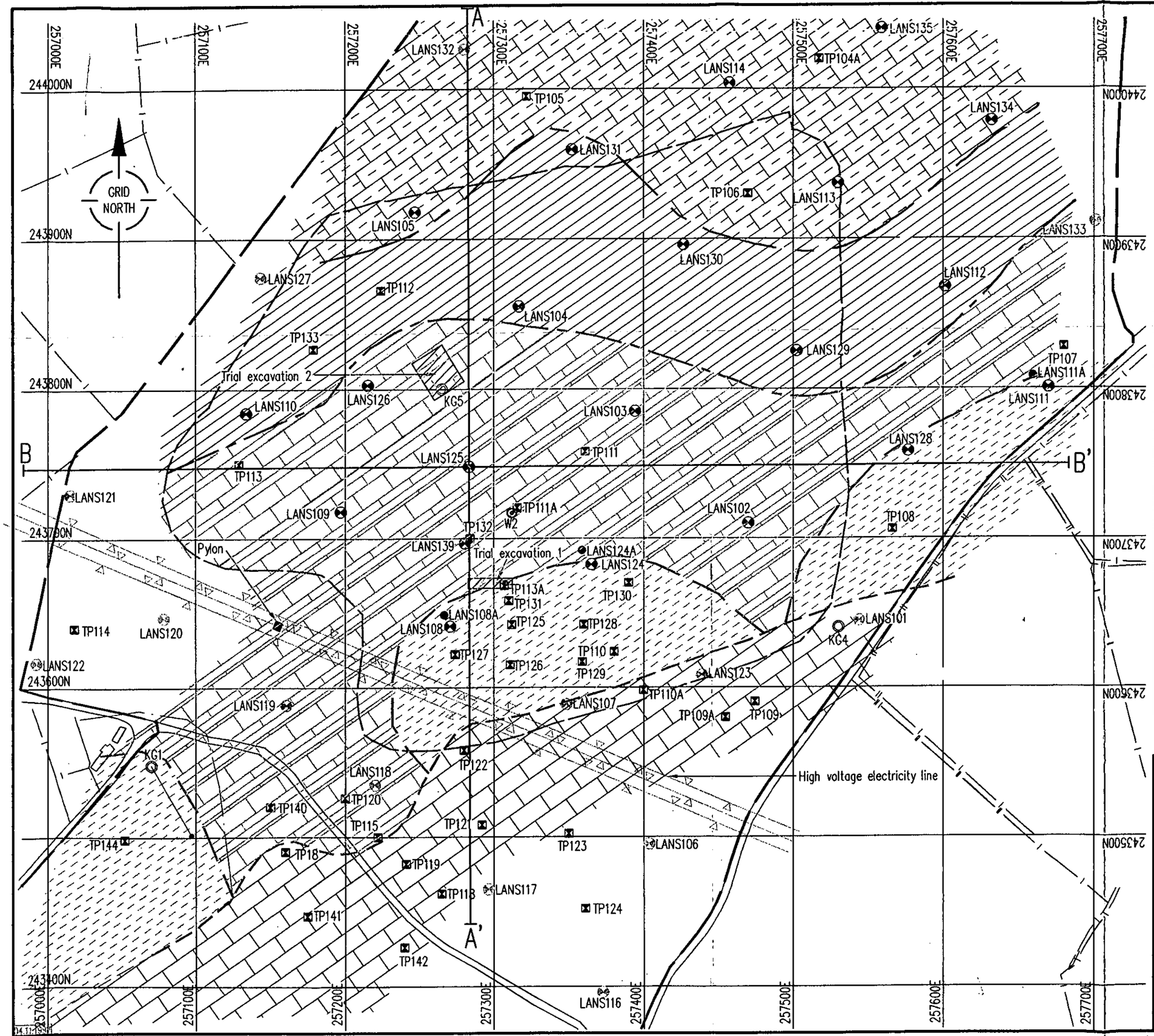
LANSDOWN CEMENT WORKS

KILLASKILLEN, CO. MEATH

APPENDIX Nº 3.3

TITLE:
Inferred contours on the top of the Waulsortian limestone and isopachytes of Tober Colleen Formation

Nº
3.3.1.5



LEGEND

- Site boundary
- Proposed quarry limit
- Lucan Formation
  - Inferred subcrop of Limestone and Shale
  - Inferred subcrop of the Striped Beds
  - Inferred subcrop of Shaley Limestone
- Inferred subcrop of the Tober Colleen Formation
- Inferred subcrop of Waulsortian limestone ('Reef limestone')
- KG5 — KG series borehole
- TP107 — Excavated trial pit (1998)

LANS SERIES BOREHOLES

- LANS3 — Drilled
- LANS8 — Not drilled
- LANS111A — Drilled using reverse circulation
- W2 — Well for pumping test
- B' — Line of geological cross section

0 25 50 75 100 Metres

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LANSDOWN CEMENT WORKS

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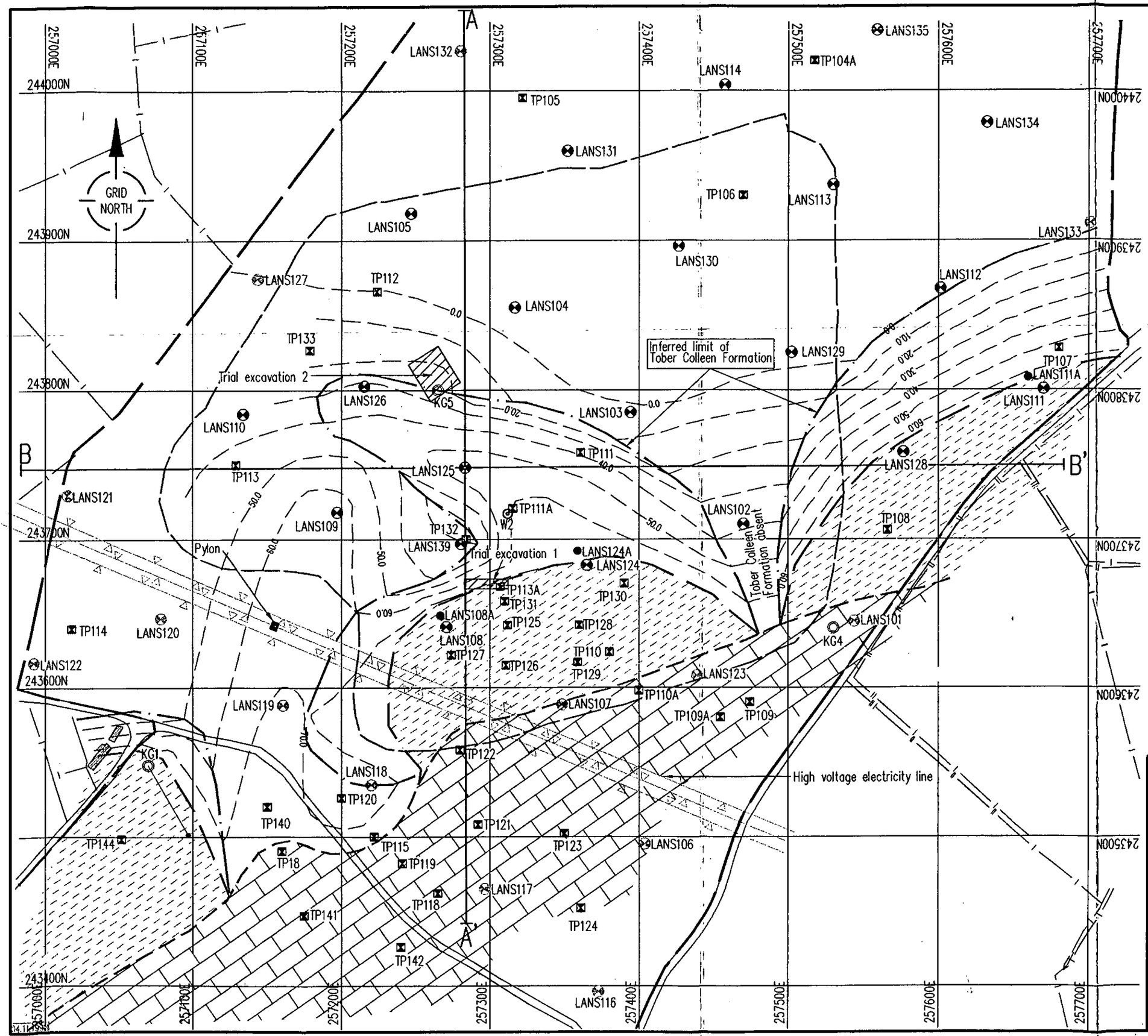
APPENDIX Nº 3.3

TITLE: Inferred subcrop of the Waulsortian limestone, Tober Coleen Formation and units in the Lucan Formation (Lower Calp)

Nº 3.3.1.6



LECEND

- Site boundary
- Proposed quarry limit
- 50.0 — Inferred contours on the base of the Lucan Formation
- Inferred subcrop of the Tober Colleen Formation
- Inferred subcrop of Waulsortian limestone ('Reef limestone')
- KG5 — KG series borehole
- TP107 — Excavated trial pit (1998)

LANS SERIES BOREHOLES

- LANS3 — Drilled
- LANS8 — Not drilled
- LANS111A — Drilled using reverse circulation
- W2 — Well for pumping test
- B' — Line of geological cross section

0 25 50 75 100
Metres

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LANSDOWN CEMENT WORKS

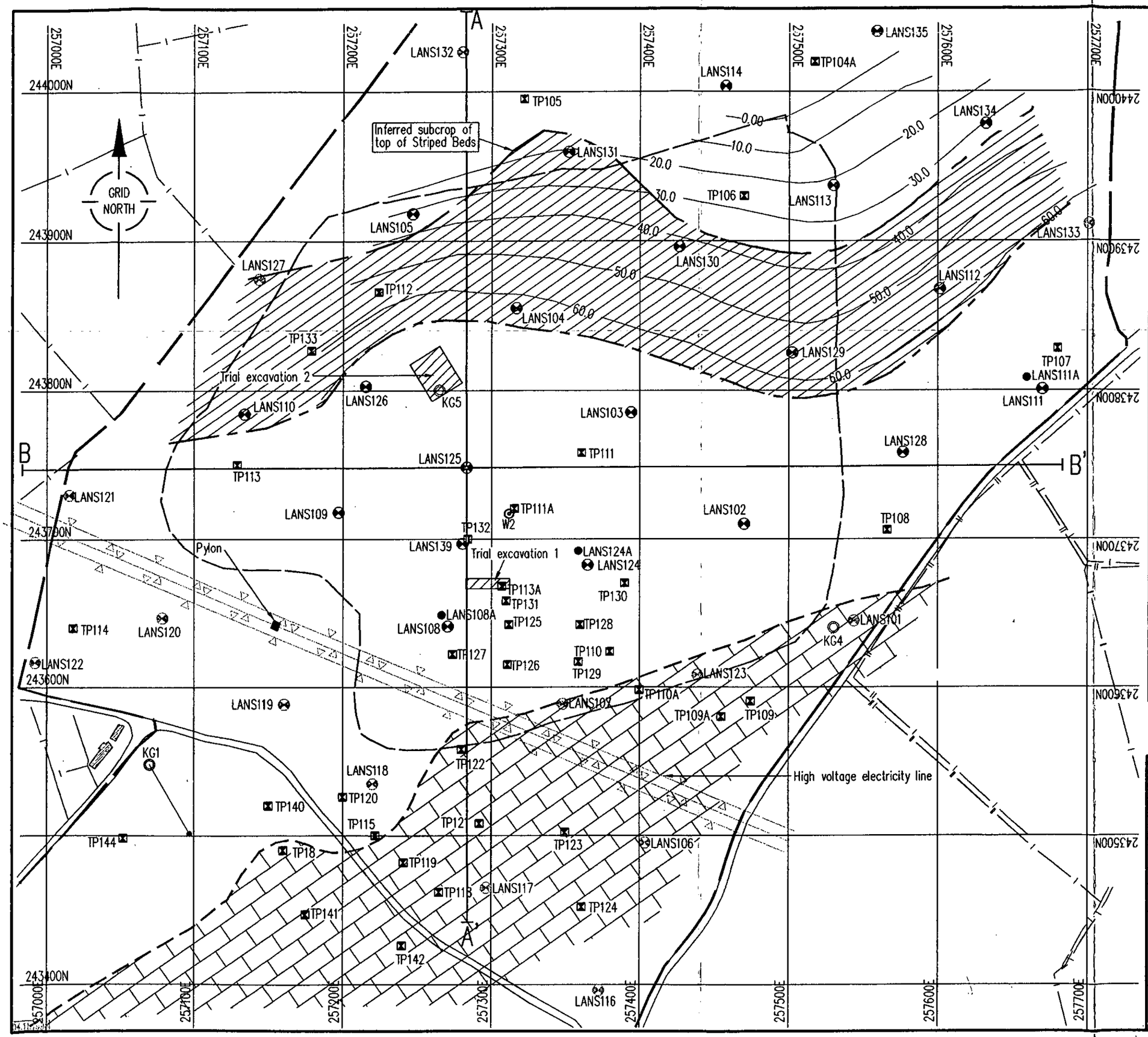
KILLASKILLEN, CO. MEATH

APPENDIX Nº 3.3

TITLE:

Inferred contours on the base of the Lucan Formation

Nº 3.3.1.7



LEGEND

- Site boundary
- Proposed quarry limit
- 20.0 — Inferred contours on the base of the Striped Beds
- Inferred subcrop of the Striped Beds
- Inferred subcrop of Waulsortian limestone ('Reef limestone')
- KG5 — KG series borehole
- TP107 — Excavated trial pit (1998)

LANS- SERIES BOREHOLES

- LANS3 — Drilled
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- W2 — Well for pumping test
- B' — Line of geological cross section

0 25 50 75 100
Metres

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LANSDOWN CEMENT WORKS

KILLASKILLEN, CO. MEATH

APPENDIX Nº 3.3

TITLE:

Inferred contours on the base of the Striped Beds

Nº

3.3.1.8

APPENDIX 3.3.2

SAMPLING AND TESTING MATERIALS

Both drill core and reverse circulation cuttings were originally sampled on site by reference to proposed bench levels in the final quarry. Following logging 15m intervals were used for sampling in the Reef Limestone and 5m intervals in Silty Shale and Shaley Limestone (Lucan Formation), but in the Shaley Limestones all limestone in sticks longer than 0.5m were excluded from the main samples and tested separately.

All crushing, sub-sampling and testing was carried out to usual industry standards by CERAM. Sub-sampling was in accordance with Gy's Law of Sampling. Analyses for major elements were carried out by the XRF method, total sulphur by the Meca method and chloride by ion chromatography. Moisture contents were also determined. Concentrations of trace elements of environmental interest (*viz* Pb, Cd, Hg, Se, Zn, As, Cr and Ni.) were determined using the ICP method.

SOILS OF COUNTIES MEATH & WESTMEATH OCCURRING IN THE VICINITY OF THE LANSDOWN SITE

1.0 SOILS OF CO. MEATH (see Drawing 1A & 1B)

There are two Great Soil Groups and a number of Peat soils occurring within the 1km radius of the Lansdown site.

1.1 GREY BROWN PODZOLIC GROUP

The development of these soils is associated primarily with a leaching process; the principal constituent accumulated in the B horizon is the finely divided clay fraction. To be classified as a Grey Brown Podzolic, a soil must have a B horizon significantly higher in clay content than the A or C horizons; this is then termed a textural B or Bt horizon.

The occurrence of clay skins on the structural ped surfaces within the Bt horizon is a further characteristic. These soils normally show a proportion of limestone in the parent material.

In general, the Grey Brown Podzolic soils possess a somewhat heavier texture than the Brown Earth or Brown Podzolic soils, they are well to moderately drained, possess a moderately well developed structure and are usually moderately acidic to neutral in reaction. The organic matter content in the soil is medium to high and the humus is of the desirable mull type.

Under Irish climatic conditions, the lighter-textured members of the Grey Brown Podzolic group are good all-purpose soils. When adequately manured and managed they are very productive under most agricultural enterprises. The heavier textured members are more suitable grassland soils, responding well to good manurial and management practices. In the northwest of the county the somewhat weak structure of these soils limits their use range to grassland, with tillage possible only under good management

The Grey Brown Podzolic soils are generally not available for forestry but should be highly productive for this purpose.

1.1.1 Patrickswell Series (Photograph 1)

This series occupies 7.12% (41,005 ac; 16,594 ha) of the county and is the predominant soil series in the vicinity of the Lansdown site. Apart from a large area east of Trim it is generally found in the southwest. It also occurs as a member of three soil complexes.

Where it occurs as a series the topography ranges from gently undulating to gently rolling. Elevation varies from 150 to 450 ft O.D. (46 to 137 m). Parent material consists of gravelly till of predominantly limestone composition with an admixture of shale and some sandstone. The soil is classified as a minimal Grey Brown Podzolic and differs from the Elton series in that it seldom exceeds 75 cm in solum depth. Within the Patrickswell series, small areas of the shallower Baggotstown Brown Earth Series (not shown on soil map due to scale of mapping used), occur on the crests of kames, hummocks and ridges, particularly in the Rathmolyon and Ballinabrackey areas.

The soils of this series are well drained, well structured, with a friable brown to dark brown surface horizon of gravelly loam texture, with some clay loams and sandy loams occurring also. Because of the influence of shale in the parent material they have a higher silt content than in Limerick and Clare. In the Bt horizon there is an increase of 4 - 6 % in clay content. There is a clear transition from the Bt horizon to the parent material. Roots are abundant to plentiful and well developed.

Soil suitability: The soils of this series have a wide use-range due to their depth, texture, structure friability and good moisture retention properties. They are highly productive grassland soils under good management. They are easily tilled and give high yields of wheat, feeding barley, oats, potatoes, swedes, mangels and vegetables. Like Elton series their texture, structure and good natural drainage leave them highly suitable for the growing of winter cereals, particularly winter wheat.

However, some limitations may be encountered on the associated soils (Baggotstown Series) which occur in places through the series, mainly on kames. Short sharp slopes, shallowness and susceptibility to drought in dry periods are the main limiting factors

1.2 GLEY GROUP

Gleys are soils in which the effects of drainage impedance dominate and which have developed under conditions of permanent or intermittent water-logging. The impeded condition may be caused by a high water-table or by a ''perched'' water-table due to the relatively impervious nature of the soils and their parent materials and, in many cases, by both of those factors, together with excess run-off from higher slopes. For this reason, gley soils can occur both in depressions and on elevated sites.

Where the gley condition results from a high water-table, the soils are referred to as ground-water Gleys. Where it is due to the impermeable nature of the soils or of their parent material, or to run-off from higher slopes, the soils are usually referred to as surface-water Gleys.

The mineral horizons of Gleys are usually grey (or bluish-grey, in more extreme cases), with distinct ochreous mottling much in evidence. Relative to the podzolic soil groups, depletion of bases and other constituents is not so pronounced. However, rotting area is limited, aeration poor, rate of decomposition of organic matter slow, and many other unfavourable features prevail.

Podzolised Gleys are soils in which there is evidence of a soil formation process similar to that described for Brown Podzolics or Podzols associated with the Gleys, whilst Podzolic Gleys refer to soils displaying evidence of Grey-Brown Podzolic characteristics associated with the Gley.

The majority of gley soils have weak structure, are not very friable and, in the wet state, tend to become very sticky. Due to their poor physical properties, these soils, except in very favourable seasons, present difficulties in cultivation, especially in the development of a desirable tilth. The poor drainage conditions retard growth in the spring. Even for pasture production, this is a decided disadvantage. Besides poor drainage, the characteristic weak structure renders these soils susceptible to poaching damage by grazing stock, a factor which curtails the length of grazing season and the proportion of fodder utilized. Despite their physical shortcomings, however, the potential of these soils for pasture production is high in many cases, provided management and manuring are satisfactory.

Gleys are generally considered to be relatively productive forest soils. However, wind-throw caused by poor root penetration is a common hazard.

1.2.1 Howardstown Series (Photograph 2)

This series is not extensive in Co. Meath, covering only 0.23% (1,342 ac; 543 ha) of the county. It is found mainly in the west and southwest. The parent material is derived from till of predominantly limestone composition with some shale and sandstone and some colluvium in depressions. The topography is generally flat to undulating with elevation between 200 and 300 feet (61 - 91 m) O.D. The soil has been classified as a poorly drained Podzolic Gley due to a clay increase of 50% in the B2tg horizon. This series is found frequently as the poorly drained member of the Patrickswell/

Howardstown complex:
The greyish-brown surface horizon is a silt loam though clay loams also occur within the series. Structure is weak fine crumb becoming massive to prismatic below 45 cm. Organic carbon levels are high, 6.8% in the A1 horizon, and decrease rapidly in the lower horizons. Roots are mostly confined to the surface horizon.

Soil suitability: This soil has a limited use range. Its main limitations are weak structure, slow permeability and poor drainage. It is suited mainly to pasture. Susceptibility to poaching is a problem and good management is necessary to sustain maximum production. If a suitable outfall is obtained it can be successfully drained.

1.2.2 Mylerstown Series (Photograph 3)

This series covers 0.18% (1,033 ac; 418 ha) of the county. It occurs chiefly on the edge of cut-over raised bogs where it was once covered with peat which has now been cut away. The parent material consists of stony, coarse textured limestone and some shale till.

This soil has silt loam texture in the surface horizon and is weak structured. Soil depth varies from 30 cm to 70cm. pH values are high, ranging from 6.2 in the A horizon to 6.9 in the C. Organic carbon level is high at 6.1%.

Soil suitability: This soil has a limited use range due mainly to its low lying position in the landscape and consequent poor drainage. It is suited mainly to grass production which requires good management for optimum utilization.

1.2.3 Camoge Series (Photograph 4)

This series covers 1.15% (6,637 acres; 2,686 ha) of the county. It consists of a poorly drained gley soil and is found in some river valleys mainly in the south and west of the county. The parent material consists of alluvium derived from dominantly limestone till with some shale influence. Topography is flat with elevations less than 300 feet (91 m). Because of the depositional pattern the texture varies but, in general, it is a silty clay loam over clay; in places it may have slightly peaty surface. The dark brown surface horizon has a weak structure. The parent material has a massive or weak prismatic structure with marked mottling throughout.

Soil suitability: These soils have a limited use-range. Drainage is poor, poaching is a serious problem and tillage is precluded because of the heavy texture and risk of flooding.

1.2.4 Alluvial Soils

The remaining gley soils are all formed from fresh-water alluvial deposits. The material laid down by rivers is usually found in the vicinity of existing stream and river courses whilst lacustrine deposits occur in landscape depressions, which were originally the sites of glacial or post-glacial lakes. The composition of river or lake alluvium is usually related to the geological formation in their vicinity.

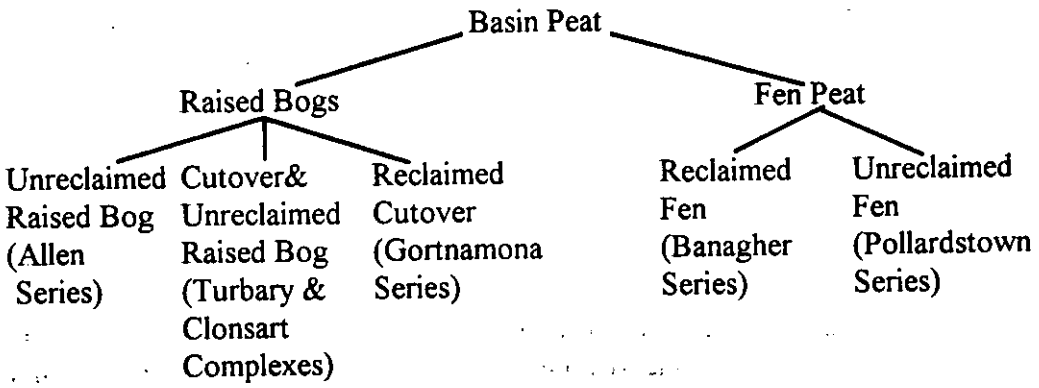
Most of these alluvial soils are very immature and show little or no profile development. They are differentiated on the basis of such factors as origin and composition of parent material, texture and drainage. The latter two frequently vary, even within individual series, giving rise to phases which are too small in extent to map.

The use-range of these soils is generally limited.

1.3 PEAT SOILS

Peats are characterised by a high content of organic carbon (over 30%) and by being at least 30 cm in depth. Two basically different types, basin and blanket peat, occur in the country but only basin peats are found in Co. Meath. Two types of basin peat occur namely Raised Bog Peat and Fen Peat.

Relationship of different peat soils in Co. Meath within overall classification scheme



1.3.1 Raised Bog Peat

Under suitable climatic conditions raised bog peat may be built up on top of fen peat. As the depth of fen peat increases, its living vegetation is less influenced by groundwater and more dependent on atmospheric precipitation as a source of moisture. This change in moisture supply results in the growth and development of a raised bog with its characteristic convex surface and acid plant remains.

The profile usually consists of a basal layer of fen or woody fen peat overlain by a layer of acid ombrogenous peat characterised mainly by its high content of Sphagnum mosses, variable quantities of bog cotton (Eriophorum spp.) and ericaceous remains (Calluna). In their natural state fen peats vary considerably in depth and are typically acid in reaction.

Extensive areas of raised bog in Co. Meath have been cut-over and large areas on the western border are under development by Bord na Mona for sod and milled peat.

The relationship of different peat soils in the county is shown above.

1.3.1.1 *Allen Series* (Photograph 5 - background)

This series occupies 0.81% (4,638 acres; 1,877 ha) of the county. In the unreclaimed state peat depth can reach 5.0 m. The basal peat layer, which is generally highly humified and locally termed "block peat," consists of remains of plants which grew under the influence of base-rich ground waters. This layer is overlain by a variable thickness of acid peat mostly composed of Sphagnum moss with cyperaceous and ericaceous plant remains.

The profile is comprised of alternating layers of variably humified Sphagnum mosses. Fibre contents vary over short distances from less than 35% for Sphagnum cuspidatum peat to over 75% for other poorly-humified Sphagnum species. Little profile development has taken place and the soil is typical of an initial raw peat soil.

The profile is wet throughout (85 to 91% water), and in the undrained stage, the water-table is very close to the surface. At the outer edges of the raised bog, where localised drainage has been carried-out to facilitate manual turf-cutting, the profile may be somewhat drier.

Soil suitability: In their natural state, no physical ''ripening'' i.e., loss of water and aeration of profile, has taken place and the soils are unsuited to any type of agricultural enterprise. However, with drainage, liming and fertilizing, grass production and forestry are feasible.

1.3.1.2 *Gortnamona Series* (Photograph 6)

Where some of the raised bogs have been drained, levelled and reclaimed they are mapped as the Gortnamona Series. This series occupies 1.64% (9,420 acres; 3,812 ha) of the county. The soil profile usually consists of a layer of acid strippings ("top sod") of variable thickness (100 to 150 cm) over basin peat (wood or fen plant remains). The drier surface is colonised by heathers (Calluna-Erica spp.) and bog cottons (Eriophorum spp.) with Eriophorum angustifolium and Sphagnum spp. in the wetter areas.

Soil suitability: These areas have a definite potential for afforestation, grassland, and, in some instance, a range of crops such as cereals, carrots and celery. Cropping potential depends on the proximity of a drainage outfall and is therefore, often restricted to the outer edges of bog areas, except in the case of large Bord na Mona developments. With suitable drainage and management the physical nature of such soils presents little or no difficulty and nutritional problems are also easily overcome with constant monitoring.

1.3.1.3 *Turbary Complex* (Photograph 5 - foreground)

When some raised bog areas are manually cut-over but not reclaimed because of a high watertable, the area is mapped as the Turbary Complex. These areas consist of both wet and dry peat, some having a few centimetres of soil developed, while others remain under water. The complex occupies 0.61% (3526 acres; 1427 ha) of the county.

Soil suitability: These areas are unsuitable to agricultural development.

1.3.2 Fen Peat

This peat type formed under the influence of base-rich groundwater and is composed mainly of the remains of reeds, sedges and other semi-aquatic or woody plants. Variations in concentration of the component plant remains depend on the topographic situation and nutrient content of the water supply. Peat soils of this type occur in river valleys and interdrumlin hollows. They have been mapped as one group but vary somewhat in botanical composition, nutrient status and soil reaction.

Two fen peats occur in Meath. One is unreclaimed fen peat (Pollardstown series), which does not occur within the 1km radius of the Lansdown site, and the other is reclaimed fen peat (Banagher series).

1.3.2.1 *Banagher Series* (Photograph 7)

This series consists of reclaimed fen peat and occupies 1.49% (8,577 acres; 3,471 ha) of the county. It occurs not only as large individual units but also within many of the soil complexes which predominate in the kame and kettle topography. Most of the small streams within these complexes are surrounded by Banagher Series. It is formed under base-rich ground-water conditions and the plant community is characteristically minerotrophic.

The profile has an organic surface horizon with well-developed structure and abundant roots. Mineral materials present in some places indicate that "marling" was carried out to improve fertility. Structure disimproves with depth and root content also decreases rapidly in the sub-surface horizon. The permanent watertable occurs at around 70 cm below the surface.

Soil suitability: These soils have a moderately wide use-range. Frost hazard and low base status are the main problems. The present land-use tends to be rough with rushes and sedges dominating the vegetation. Where the water courses are cleaned and the watertable lowered, production can be improved considerably.

Where major and minor elements are kept at an adequate level moderately high yields of grass can be obtained. Vegetable crops such as carrots, celery and brassicas can be produced successfully although an awareness of frost incidence is necessary.

The profile usually consists of a basal layer of fen or woody fen peat overlain by a layer of acid ombrogenous peat characterised mainly by its high content of Sphagnum mosses, variable quantities of bog cotton (Eriophorum spp.) and ericaceious remains (Calluna). In their natural state fen peats vary considerably in depth and are typically acid in reaction.

Extensive areas of raised bog in Co. Meath have been cut-over and large areas on the western border are under development by Bord na Mona for sod and milled peat.

2.0 SOILS OF CO WESTMEATH (see Drawing 2A & 2B)

The Great Soil Groups and Soil Series occurring in Co. Westmeath within the 1km radius of the Lansdown site have been described above with the exception of the Regosol Group.

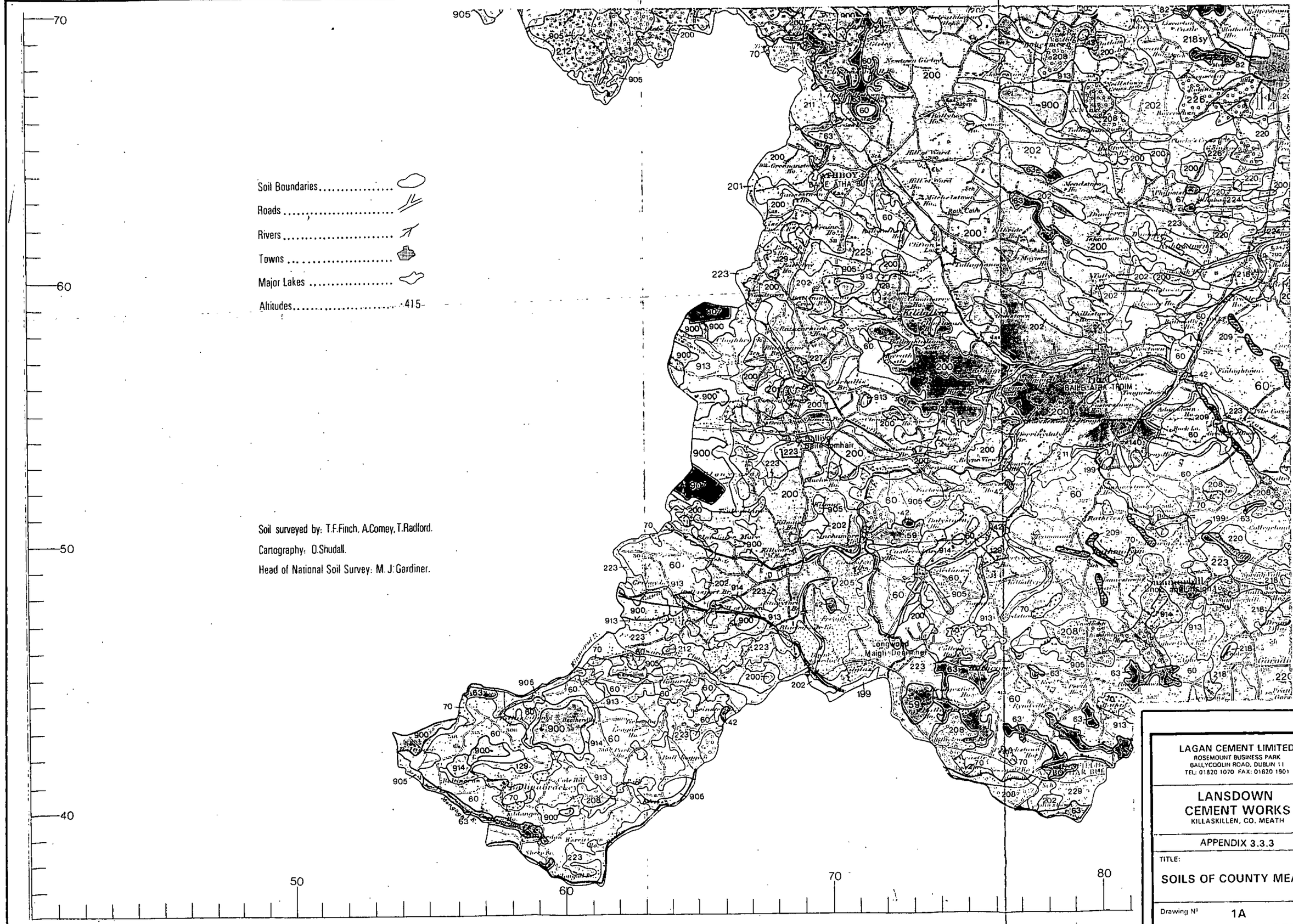
2.1 REGOSOL

This group comprises mineral soils which are immature and show no distinct horizon development. The soils occur mostly in low lying flat areas along river courses and at river estuaries, but they are also found on young deposits such as aeolian (windblown) sands. Depending on the source of the deposits such soils may very in nutrient status and also in physical and drainage characteristics.

2.1.1 Milltown Series

This soil covers 0.11% (194 ha 479 acres) of the county. Being formed from river alluvium it is confined to narrow strips along the river courses and to one extensive area south of Milltownpass along the small Milltown river. It is classified as a well-drained regosol. It consists of a well-drained very dark brown silty clay loam, with good structure, over a very dark grey sandy loam with single grain structure.

Soil suitability: Due to danger of flooding this soil has a limited use-range. It has good potential for grass production and its rapid permeability and good structure enables grazing to commence early in spring. Where the water-table has been lowered by arterial drainage the soil may be suitable for tillage.



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APPENDIX 3.3.3

TITLE:

SOILS OF COUNTY MEATH

Drawing N° 1A

Great Soil Group	Gley								
Soil Series	220 Ashbourne	220sy Ashbourne Shaley Phase	201 Ballyshear	63 Camoge	67 Drombanny	Dunsany	82 Feale	70 Howardstown	129 Mylerstown
Parent Material	Limestone and shale drift and Irish sea drift	Limestone and shale drift and Irish sea drift	Gravelly Limestone Till	River Alluvium	Peaty Lake Alluvium	Alluvium of Namurian shale and limestone origin	River Alluvium	Limestone Till	Gravelly Limestone Till
% Total Land Area	17·340	·122	·039	1·152	·140	·098	·641	·232	·179
Hectares	40,402	285	93	2,686	327	229	1,494	543	418

Grey Brown Podzolic					
218 Dunboyne	218gv Dunboyne Gravelly Phase	218sy Dunboyne Shaley Phase	59 Elton	90 Mortarstown	60 Patrickswell
Limestone and shale drift and Irish sea drift	Limestone and shale drift and Irish sea drift	Limestone and shale	Limestone Till	Limestone Till	Limestone Till
10·285	·111	3·347	·617	·151	7·124
23,959	259	7,803	1,438	352	16,594

Peats

	Raised Bog	Raised Bog (cutover–reclaimed)	Fen Peat	Fen Peat Improved
Soil Series	900 Allen	913 Gortnamona	908 Pollardstown	905 Banagher
% Total Land Area	·806	1·635	·025	1·488
Hectares	1,877	3,812	59	3,471

Peat Complexes

Industrial Sod Peat	Cutover Raised Bog
907 Clonsast	914 Turbary
·102	·612
238	1,427

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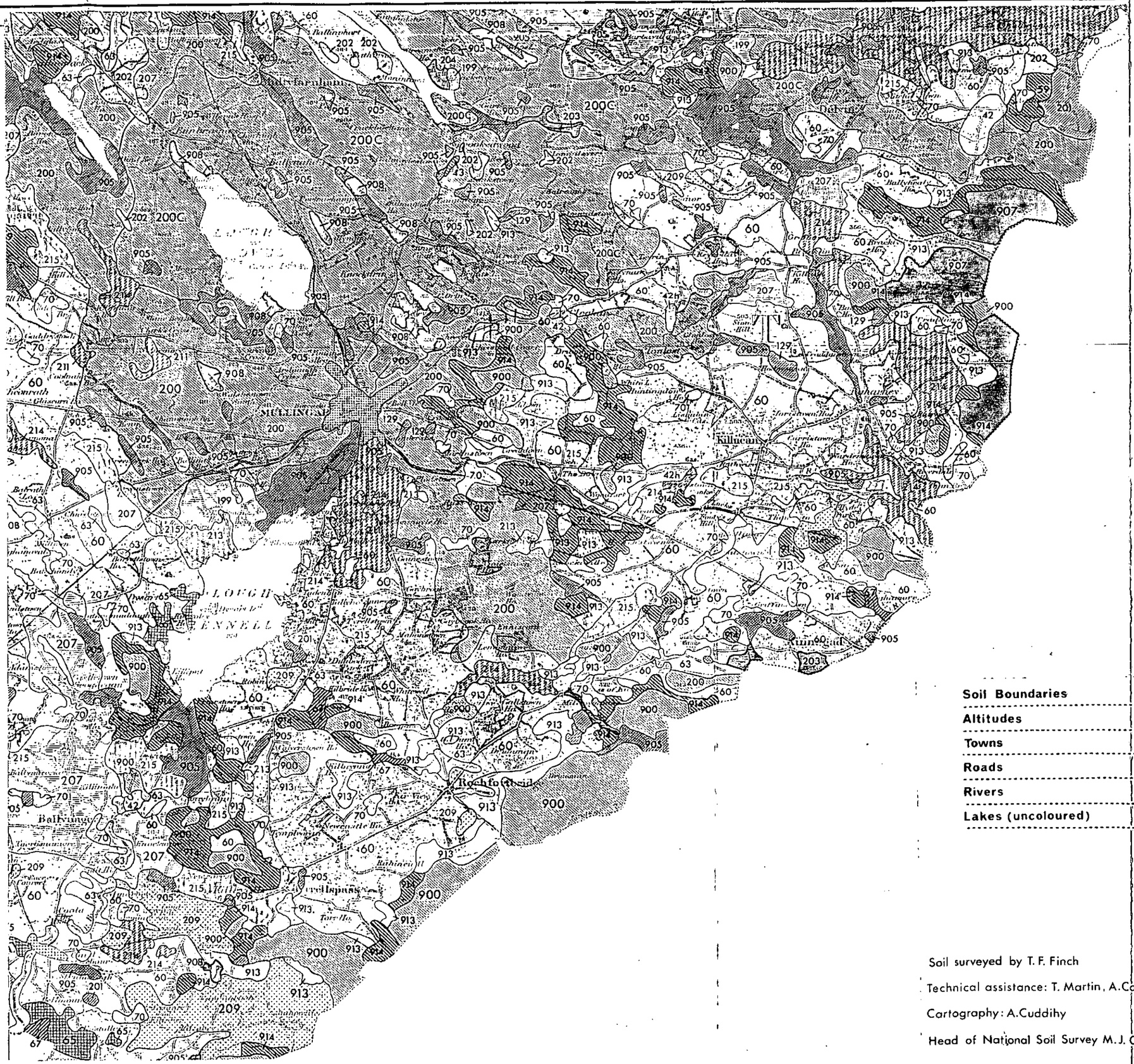
APPENDIX 3.3.3

TITLE:

KEY TO SOILS OF COUNTY MEATH

Drawing N° 1B



Soil Boundaries	○
Altitudes	·991
Towns	▒
Roads	⌇
Rivers	⋎
Lakes (uncoloured)	▽

Soil surveyed by T. F. Finch

Technical assistance: T. Martin, A. Comey and T. Radford.

Cartography: A. Cuddihy

Head of National Soil Survey M. J. Gardiner

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APPENDIX 3.3.3

TITLE:

SOILS OF COUNTY WESTMEATH

Drawing N° 2A

Great Soil Group	Rendzina	Brown Earth			Regosol	Lithosol
Soil Series	140	43	42	199	203	204
	Burren	Ballincurra	Baggotstown**	Ladestown	Milltownpass	Knockeyon
Parent Material	Limestone Bedrock	Limestone Till over Limestone Bedrock	Fluvioglacial Limestone	Fluvioglacial Limestone, Shale and Chert	River Alluvium	Chert Bedrock
%Total Land Area*	0·11	0·13	0·31	0·28	0·11	0·08
Hectares	186	219	546	494	194	144

	Raised Bog	Raised Bog–Cutover Reclaimed	Fen Peat	Fen Peat–Improved
Soil Series	900	913	908	905
	Allen	Gortnamona	Pollardstown	Banagher
%Total Land Area	3·64	4·31	0·36	5·98
Hectares	6,371	7,561	621	10,466

Peat Complexes	
Industrial Sod Peat	Cutover Raised Bog
907	914
Clonsast	Turbary
1·94	5·32
3,399	9,316

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KILLASKILLEN, CO. MEATH

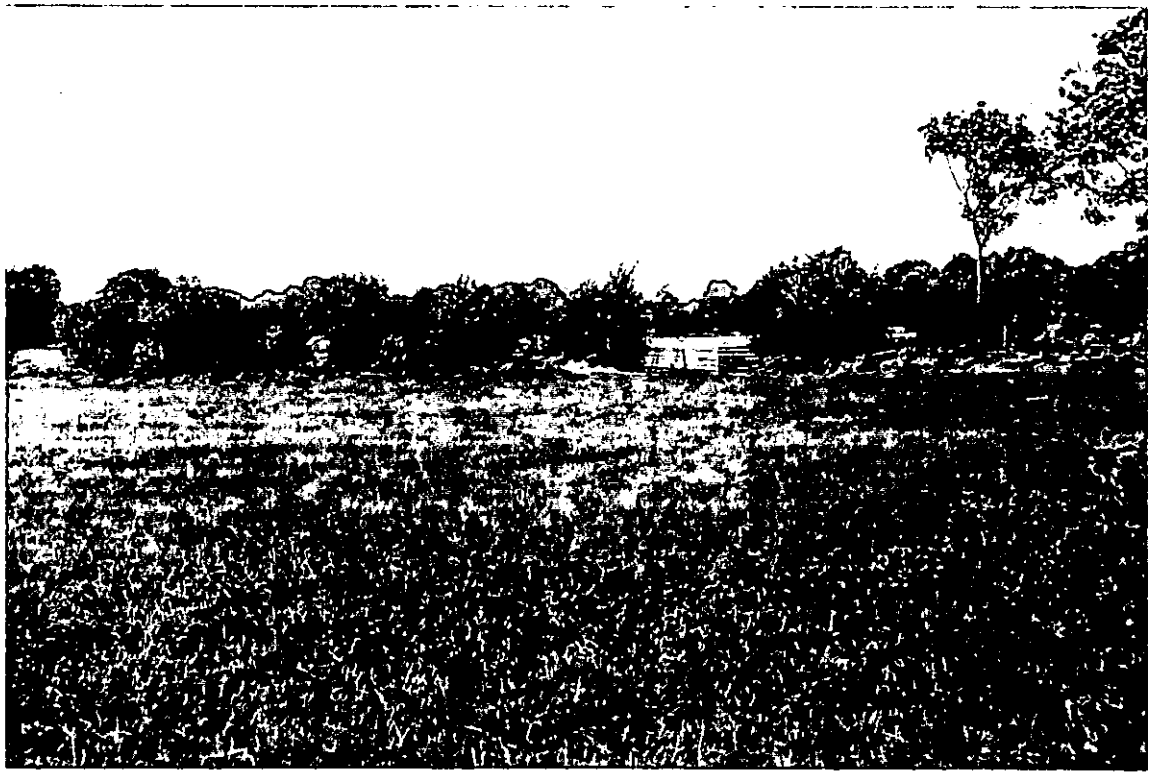
APPENDIX 3.3.3

TITLE:

KEY TO SOILS OF COUNTY WESTMEATH

Drawing N° 2B

Photograph 1 **Patrickswell Series**



Photograph 2 **Howardstown Series**

Photograph 3 **Mylerstown Series**

Photograph 4 **Camogue Series**

Photograph 5 **Allen Series (background)**
Turbary Complex (foreground)

Photograph 6 **Gortnamona Series**

Photograph 7 **Banagher Series**

APPENDIX
3.4
WATER AND HYDROGEOLOGY

APPENDIX 3.4.1

HYDROGEOLOGICAL INVESTIGATIONS

The primary objectives of the field investigation programme were to characterise the hydraulic properties of the groundwater units present beneath the site, to identify the groundwater head distribution in the area and to establish its relationship with nearby surface water bodies.

The field investigation programme consisted of a thorough scheme of drilling and testing at the site, including construction of boreholes and trial pits, installation of groundwater monitoring piezometers, hydraulic testing by means of constant and variable rate tests, hydrochemical sampling and analysis, surface water monitoring and inspection of selected trial pits and drill core.

Groundwater was encountered in many of the trial pit excavations. As noted in Section 3.3, the materials in the trial pits were highly variable, ranging from low permeability clays to high permeability sand and gravel horizons with cobbles and boulders in many places.

Groundwater inflows to the trial pits were observed in coarse sand and gravel horizons within the Glacial Till and immediately above the bedrock. The trial excavation to a depth of 9m below ground level (Trial Excavation No. 2) in the shale quarry area showed groundwater inflows of about $30m^3/d$.

Land drains were frequently encountered during trial pitting at depths of up to 1m. In places these contained water with inflows to the trial pits of *c* $8m^3/d$ to $130m^3/d$. In places land drains were at a similar level to groundwater levels and hence appear to control local groundwater pressures.

Groundwater inflows to boreholes were recorded during drilling. In most boreholes no significant water strikes were made suggesting that bedrock inflows were limited. The most significant water strikes recorded during drilling were in the Shaley Limestones. Artesian overflows to the surface were observed in several of the boreholes in the shale area with discharges ranging between about $7m^3/d$ and $430m^3/d$.

The evidence from the drilling suggests that there is little correlation between lithology and inflow rates in the Shaley Limestone area. It is likely that the distribution of fissuring in this material controls active groundwater flow. Groundwater flow is greater in the Shaley Limestones than in the Reef Limestone.

Analysis of the constant rate pumping test results was undertaken using analytical solutions for radial flow to a borehole. The method of Hantush and Jacob (1955) was found to provide the closest correspondence to the field data. This assumes that the aquifer has an overlying aquitard which is leaky. The solution also allows an estimation of the vertical hydraulic conductivity in the overlying aquitard. It is considered that the overburden in the test area is acting as a leaky overlying layer in response to the aquifer drawdown.

The interpretation of pumping test results indicated that the hydraulic response of the limestone system appeared to be fairly uniform across the test area, suggesting that on the scale of the pumping test the limestone aquifer system approximates reasonably well to the assumed conditions of uniform aquifer properties. This provides confidence that the predicted dewatering requirements for the limestone area can be reasonably well defined.

Slug tests were conducted in boreholes in the limestone and shale quarry areas. These tests were performed as falling head tests with a slug of water introduced rapidly into each borehole until water levels reached the top of casing. The purpose of the slug tests was to ascertain the local hydraulic conductivity of the limestones and shales and provide an indication of the performance characteristics of each piezometer. A mean value of hydraulic conductivity of 0.134m/d for the limestone area translates to a transmissivity (permeability) of about $10m^2/d$.

In the Shaley Limestones the arithmetic mean of the slug tests is much higher and suggests that the aquifer here has a significantly higher permeability. The mean value of hydraulic conductivity of 0.881m/d gives a transmissivity of about $65m^2/d$.

Daily readings of the water levels in all completed boreholes were undertaken throughout the field investigation period.

Results of water level measurements during the field programme show that a natural fluctuation of about 0.75m in the limestone area has been recorded during the field programme. The readings for the Shaley Limestones show a slightly lower range of water levels, with fluctuations of up to about 0.5m. The water level monitoring is ongoing; the frequency of measurement has been reduced.

Groundwater levels at the site vary between about 85.65mAOD at Borehole No. LANS 02 to about 72.30mAOD at Borehole No. LANS 114, giving an overall groundwater gradient of between 0.02 and 0.03 towards the north east and the Kinnegad River.

Groundwater gradients in the Shaley Limestones show a similar trend to those in the Reef Limestone. However, the presence of artesian conditions in the Shaley Limestones probably provides a significant control on groundwater levels in this area.

APPENDIX 3.4.2

ASSUMPTIONS IN MODELLING OF DEWATERING

The following assumptions of groundwater conditions were made in the MODFLOW computer model:-

i. The depth of dewatering for each quarry area is taken as the maximum depth of each quarry (at an elevation of about 25mAOD in the shale quarry and about 10mAOD in the limestone quarry). This is therefore consistent with the potential maximum dewatering requirements for each quarry following an estimated 30 to 40 years quarry life. Inflows predicted at intermediate times will be significantly less than this amount, and further simulations using the model have been undertaken to provide estimates of dewatering yield at intermediate times and depths.
ii. Drawdown due to natural drainage of the groundwater system into each quarry void resulting in the water table always being located in the floor of each excavation.
iii. The boundary with the nearby Kinnegad River is simulated using MODFLOW river cells. These cells represent the interaction between the aquifer and the river as a head dependent flux. This means that in the model current flows occur to the river from groundwater in proportion to the head gradients towards the river and hydraulic properties. Under the induced dewatering stress predicted to occur with drawdown of water levels, flows can also be induced to occur in the opposite direction, into the aquifer from the river.
iv. General head boundary condition cells are used at the perimeter of the model, set about 5km away from the site. These cells are set up so as to simulate the extension of the groundwater system to at least 1km beyond the model domain, with aquifer properties represented which are calculated to be similar to those within the model domain based on available data. This means that the model assumes an effectively continuous hydraulic unit within the area modelled which allows change of flows and heads within the modelled area in response to the dewatering abstraction from the sumps.
v. The inflow rates and aquifer impacts are considered in steady state. This means that a long term average condition is assumed for all inflows to the maximum dewatered quarry areas. No prediction is made of transient changes in groundwater head local to each quarry, although consideration of storage changes within the aquifer system has been made separately.
vi. Recharge is simulated in the model using calculated effective rainfall for the area. The shallow discharge of groundwater to ditches and drains in the area under current conditions is represented using MODFLOW drain cells. The drain cells are set to be effective at a depth of about 2m below ground level on average. When groundwater heads exceed this elevation, the drain cells remove water from the aquifer by simulating the effects of field drains, ditches or artesian seepages. When dewatering occurs water levels are reduced, leading to induced additional recharge within the dewatering zone of drawdown.
vii. The effective depth of the aquifer was assumed to be at about –20mAOD. This means that a limited aquifer thickness remains beneath the base of each quarry which will contribute to groundwater inflows to the base and sides of each quarry. This provides a reduced transmissivity close to each quarry which is considered consistent with likely reduced hydraulic conductivity with depth in the area.

Upward flow from underlying groundwater units beneath those proposed for excavation are assumed to be relatively small.

An estimate of inflows to each quarry has been computed using the steady state groundwater model. Sensitivity analysis has been undertaken to provide estimates of the likely range of predictions, and the rates presented are the most likely inflows in each case.

Modelling results indicate that the drawdown effects of the dewatering do not have any impact on the model boundaries at the margins of the model domain. This shows that the model boundaries have been established at a sufficient distance to avoid any artificial influence of the boundaries on the dewatering predictions.

The only boundary conditions affected by the dewatering are those of drain cells, which in practice simulate reduction in local groundwater discharge to the surface drainage system in the area, and of river cells, which simulate the changes which are predicted to occur to river-aquifer interaction as a result of the dewatering.

APPENDIX 3.4.3

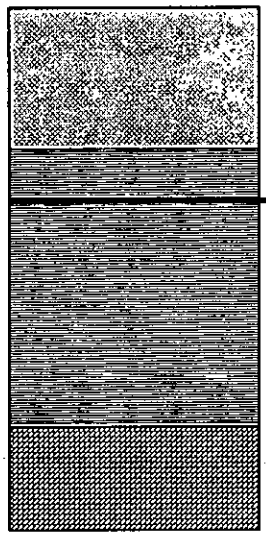
POTENTIAL IMPACTS OF DEWATERING ON THE RAISED PEAT BOG

There is a raised peat bog to the south of the proposed limestone quarrying area in the location shown on Drawing No. 2.1.1. The surface of the bog is approximately 4m above the level of the land to the north and within the site, from which it is inferred that peat has been removed in the past. The hydrogeological modelling indicates that groundwater levels in the limestone aquifer will be affected by quarry dewatering such that drawdowns of up to 11m could occur beneath the northern part of the bog. This appendix assesses whether such a drawdown will have any impact on the peat bog.

Whilst there has been no site investigation of the bog itself, geological and hydrogeological investigations have taken place within and near the proposed limestone quarry area. From these investigations, it is apparent that the overburden in this area is predominantly boulder clay with a total overburden thickness (excluding peat) in this region of the site of 4-7m. This is confirmed by dynamic probing across the area in the past and by recent boreholes and trial pits (see Section 3.3). Groundwater monitoring and observations in trial pits close to the edge of the peat bog demonstrate that the superficial deposits include boulder clay albeit with lenses of silty sandy gravel. This forms a confining layer above the limestone such that groundwater levels associated with the limestone in this area are generally observed to be above rockhead levels, within the superficial materials themselves. There is no likelihood of artesian water pressures from the limestone acting upwards into the peat since the surface level of the peat bog is elevated and groundwater levels in the limestone are generally adjusted to surface levels in the area, which are typically 4m below the surface of the peat bog.

Peat bogs are characteristically self supporting systems, reliant primarily on incident rainfall and/or recharge from surface streams for water supply. In the case of a raised bog such as this, the only source of water is from precipitation. The upper layer of the peat bog (the acrotelm) generally has a high permeability and an ability to store large amounts of water (water contents in excess of 100% are typical). It is the acrotelm that supports the peat bog ecosystem. The lower layers of the bog are known as the catotelm and comprise accumulated and compacted organic material. These layers have very much lower permeabilities than the acrotelm and tend to prevent or slow leakage of water from the peat bog through its base. It is extremely unlikely that the peat bog has ever depended upon water originating in the limestone since the chemistry of the limestone groundwater, with a raised pH would not support the development of the low pH conditions typical of bogs.

The inferred vertical profile beneath the peat bog is shown below, based on nearby trial pits.



The hydrogeological modelling indicates that groundwater levels within the limestone will fall so that they are well below rockhead level (*i.e* the level of the base of the boulder clay). The only mechanism by which this fall in groundwater levels could affect the peat bog would be drainage at the base of the peat bog. Clay underlain by highly permeable materials can, over a very long period, consolidate and drain. Boulder clay is characteristically not prone to such effects.

From the literature, (N. B. Hobbs (1986), Mires and Peats, *Qu. Jl. Eng. Geol. V. 19*), it is expected that the peat will have a permeability in its lower layers (catotelm) of between 10^{-7} and 10^{-6} m/s. This is a very low permeability, but is not as low as the likely permeability of clay rich sections of the boulder clay (typically 10^{-9} to 10^{-8} m/s).

From the information available, it is clear that the clay rich sections of the superficial materials act as perching layers above the limestone. Accordingly, the boulder clay separates the peat from the limestone such that they are not in hydraulic continuity with each other. Thus, downward leakage would not be increased by changes in the limestone groundwater head, and the hydraulic balancing of the raised peat bog would not be affected by any drawdown in the underlying limestone. Hence the peatbog is not considered to be at risk from the proposed dewatering scheme.

APPENDIX 3.4.4

IMPLICATION OF PREDICTED DRAWDOWNS AT LANSDOWN ON NEIGHBOURING WELLS

This appendix addresses groundwater drawdown due to the effect of the proposed Lansdown quarry workings at wells in the surrounding area and identifies those wells which require deepening to maintain supply.

A recent survey has identified 42 wells supplying domestic and/or agricultural water supplies in properties lying within, or close to, the area where groundwater drawdowns are predicted to be 1m or greater. Where information was available, the well survey reported well depth, standing water level, depth to bedrock, usage and details of well head structures and construction; locations are shown in Appendix Drawing No. 3.4.4.1.

A1 Water levels in well

Approximate grid co-ordinates were given to each well location. Ground surface contours from air photo interpretation, from the 1:25,000 topographic sheet and from the site survey were used to give each well location an approximate ground level. The accuracy of these values is probably +/- 1 to 3m. The accuracy is greater near the site boundary since this has been recently surveyed. The level of water standing in each well at the time of the survey has been calculated to Ordnance Datum (see Appendix Table 3.4.4A).

A2 Groundwater sources

Bedrock

Fourteen wells are known to be in bedrock aquifers (W01, W02, W03, W12, W15, W17, W24, W27, W36 and W39) or are inferred to intersect bedrock (W21, W25, W35 and W37). These are highlighted in Appendix Table 3.4.4A. The nature of the bedrock inferred from Geological Survey of Ireland (GSI) mapping, amended by recent drilling is included in the same table. All the major rock units as identified by the GSI in this area are represented, namely Reef Limestone (WA), Lower Calp (CPL), Tober Colleen Formation (TC) and Argillaceous Bioclastic Limestone (ABL).

W37 is recorded as 18m deep and intersecting rock at an unrecorded depth. The adjacent well W33 is reported as having more than 25m of superficial sands and it is probable that most of the active length of W37 is in superficials.

Superficials

Nineteen wells (W07, W08, W09, W11, W13, W14, W16, W18, W19, W26, W28, W29, W30, W31, W32, W33, W34, W38 and W40) are known to be in superficial deposits and a further five (W05, W06, W10, W22 and W23) are inferred to be in superficials. No data is available for the remaining four wells (W04, W20, W41 and W42).

The degree of hydraulic continuity between superficial water bearing sands and gravels and the underlying bedrock aquifers is known to vary across the site. From the recent site investigations the hydraulic continuity is likely to be greatest in the north where the sands and gravels are thickest; to the south the superficials are more clayey and the sand occur as thinner lenses. A 'worst case' has been assumed, *i.e.* dewatering of the bedrock will also dewater superficials even though this is not supported by trial pitting in the south of the site

A3 Groundwater levels outside the site

The groundwater levels inferred from hydrogeological investigations at Lansdown, and the inferred water levels in the wells are shown on Appendix Drawing No. 3.4.4.1. Groundwater levels within the site fall towards the north-east from a 'plateau' at 82-83mAOD in the south and south-western part of the site. The water level in the Kinnegad River on the northern boundary of the site is approximately 69mAOD. Water levels in wells to the south-west, south and south-east of the site generally reflect similar levels to those within the site. There is no marked difference between levels in bedrock wells and those in superficials. Wells in these areas overlie the Reef Limestone or ABL shown on GSI maps.

North-east of the site, water levels in W21, W27 and W29 are somewhat higher than would be expected by extrapolating the water level contours from within the site area. The higher groundwater levels may be due to local confinement by the less permeable Tober Colleen Formation.

North-west of the site, the groundwater levels in W33, W35, W36 and W37 do not fit a simple extrapolation from the site; this is a consequence of the character of the local strata and its inclination away from the site to the north/north-west. The strata from which these wells (W33, W35, W36 and W37) draw their water will not be excavated in either of the quarries. W36 appears to be anomolously low and may reflect recent pumping levels rather than a rest water level.

A4 Estimate of the drawdown at each well

An estimate of the drawdown at all wells within the 1m drawdown contour was made using the following assumptions:-

- Drawdown in the shale quarry of 50m assumes a pre-existing water level of 75mAOD and dry working to 25mAOD.
- Drawdown in the limestone quarry of 72m assumes a pre-existing water level of 82mAOD and dry working to 10mAOD.
- Linear drawdown between 1m and 11m drawdown contours as shown in Drawing No. 3.4.3 and between the 11m contour and the toe of the contiguous quarry face.

This latter assumption is conservative given the convex form of the drawdown surface.

On the basis of the inferred ground surface levels outside the site, this is considered to give a reasonable estimate of the expected drawdown. A maximum estimated drawdown for each well location is shown in Appendix Table 3.4.4A.

A5 Mitigation proposals

In order to protect the groundwater supply at each of the wells where the drawdown, due to the proposed quarrying, may have an adverse impact, it is proposed to drill 22 new boreholes at Lagan Cement's expense to provide replacement supplies. Not all the wells investigated will require replacement since the impact will be less in many places than that which occurs due to prolonged drought. Two of the 22 wells are currently disused.

The criteria for providing new wells is as follows:-

- Wells requiring deepening lie within the 1m contour of predicted drawdown.
- Wells in superficials within the 1m drawdown line will require deepening as if they were in bedrock.
- Wells in bedrock should have an effective depth during maximum drawdown of 20-25m.

New wells will be 25, 50, 75 or 100m deep depending on the extent of predicted drawdown at the deepest and most extensive phase of quarry workings. This is the time after about 38 years when the effects of dewatering will be most marked and for which this assessment has been made. The requirements for each well are given in Appendix Table 3.4.4B. It is possible that in spite of the recommendations to drill new wells at 22 properties, some of these wells will experience only limited effects owing to the depths of the existing wells; this will be most likely at the limits of noticeable drawdown in the 1m drawdown contour shown in Appendix Drawing No. 3.4.4.1. The company has therefore opted for a greater number of new wells than may strictly be required.

As may be see from Appendix Table 3.4.4B, and the above drawing, the wells are grouped in five 'neighbourhood' zones as follows:-

- One zone with 2 wells requiring deepening to 100m.
- One zone where 5 wells require deepening to 75m.
- Three zones where 14 wells require deepening to 50m.

In addition, one isolated well will require deepening to 25m.

The other wells should continue to operate without adverse impact from the future quarry workings; they will not need replacement.

Well details and estimate of drawdown at wells near the proposed quarries at Lansdown

Well Code [1]	E (approx) [2]	N (approx)	Approx. Ground level [3]	Inferred Bedrock [4]	Well Depth [1]	Standing Water level mbgl [1]	Standing Water level mAD approx	Depth to bedrock [1]	Usage [1]	Predicted dewatering (m) [5]	Other information
W01	257700	243200	86	Reef Limestone	>30	6.10	79.9	>1	D A	38	
W02	257400	243340	85	Reef Limestone	33.0	5.61	79.4	<1	D	64	
W03	258080	242470	87	Reef Limestone	73.0	4.01	83.0	4.30	D A	10	
W04	258180	242440	87	Reef Limestone	U	U		U	DISUSED	8	Property currently derelict
W05	258220	242360	87	Reef Limestone	U	3.71	83.3	U	D	7	
W06	258260	242340	87	Reef Limestone	U	3.99	83.0	U	D	6	
W07	258330	242310	87	ABL	9.8	2.63	84.4	>9.8	D	5	Gravel aquifer
W08	258490	242060	87	ABL	4.3	U		>4.3	D	<1	Sand and gravel aquifer
W09	258500	242010	87	ABL	5.5	2.27	84.7	>5.5	D	<1	Sand and gravel aquifer
W10	258725	241995	86	ABL	21.0	1.45	84.6	U	D A	<1	
W11	258715	242060	86	ABL	5.22	1.77	84.2	>5.22	D	<1	
W12	258500	242180	87	ABL	40.0	4.65	82.4	6	D	<1	
W13	258580	242030	86	ABL	14.0	1.44	84.6	>14	D A	<1	
W14	258240	242670	87	Reef Limestone	2.3	1.42	85.6	>2.33	D A	9	
W15	256170	242875	83	Reef Limestone	27.0	U		2	D A	5	
W16	256230	242520	85	Reef Limestone	2.0	1.06	83.9	>2	D	1	
W17	258570	241980	86	ABL	37	2.59	83.4	12	D	<1	
W18	256860	243660	83	CPL	4.85	1.06	81.9	>4.85	D	20	
W19	256590	243690	80	CPL	4.0	U		>4	D A	1	
W20	256940	243595	81	CPL	U	U		U	D	28	Well inaccessible
W21	258115	244080	80	TC	34.0	1.64	78.4	U	D	18	
W22	256980	243550	84	CPL (edge TC)	11.0	U		U	D	34	
W23	256980	243550	84	CPL (edge TC)	6.14	1.56	82.4	U	D	34	
W24	256515	243140	92	Reef Limestone	37.0	7.98	84.0	4.5	D	24	
W25	256420	243290	85	CPL(edge)	20.0	5.19	79.8	U	D A	15	
W26	256470	243320	84	CPL (edge)	1.6	0.80	83.2	>1.6	A	17	
W27	258280	244040	81	Reef Limestone	38-40	4.95	76.1	7-8	D	9	
W28	258310	243950	80	Reef Limestone	1.0-1.5	NM		>2	A	6	
W29	258060	243875	80	Reef Limestone	4.11	2.05	78.0	>4.11	DISUSED	11	
W30	256340	243220	85	Reef Limestone	1.84	0.85	84.2	>1.84	D A	14	Sand and gravel aquifer
W31	255680	242630	88	Reef Limestone	4.72	2.09	85.9	>4.72	A	<1	
W32	255830	242150	83	Reef Limestone	3.79	0.87	82.1	>3.79	A	<1	
W33	256550	243970	82	CPL	25	5.38	76.6	>25	D	<1	
W34	256950	243620	84	CPL	4.34	0.74	83.3	>4.34	D	28	
W35	256350	243870	78	CPL	18-20	6.72	71.3	>6.72	D A	<1	
W36	256940	244100	80	CPL	30.00	10.57	69.4	8-10	D A	<1	
W37	256560	243950	82	CPL	18.00	6.31	75.7	U	D	<1	
W38	256900	241520	85	Reef Limestone	3.96	1.00	84.0	>3.96	D	<1	
W39	256845	241490	85	Reef Limestone	37.00	1.35	83.7	15	A	<1	
W40	256935	241445	85	Reef Limestone	4.55	1.34	83.7	>4.55	D	<1	
W41	258020	241580	85	ABL	U	U		U	D	<1	
W42	257510	241520	90	ABL	U	U		U	D	<1	

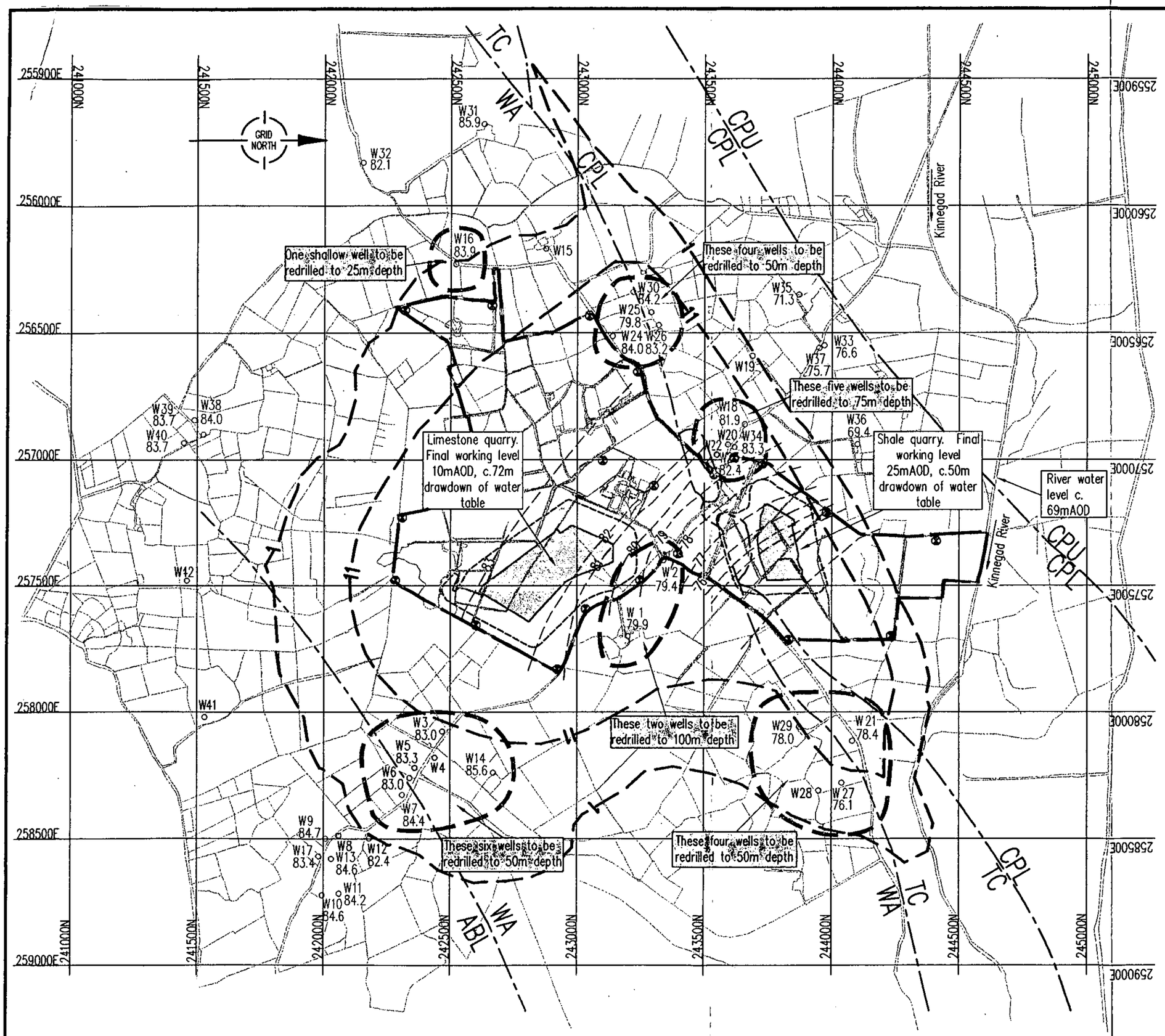
[1] From well survey, September 1998. Depth to bedrock based on owners advice.
[2] Approximate locations from 1:25,000 map
[3] Approximate level estimated from 1:25,000 map and air contours (error +/- c 1- 3m)
[4] From GSI mapping and recent site investigations
[5] From predicted drawdown contours and assuming excavations dry

Well in bedrock
U Unknown
D Domestic supply
A Agricultural supply
NM Not measured

APPENDIX TABLE 3.4.4B

Recommendations for wells in survey

Well Code	E (approx)	N (approx)	Recommended depth of replacement well
W01	257700	243200	100
W02	257400	243340	100
W03	258080	242470	50
W04	258180	242440	50
W05	258220	242360	50
W06	258260	242340	50
W07	258330	242310	50
W08	258490	242060	Not required
W09	258500	242010	Not required
W10	258725	241995	Not required
W11	258715	242060	Not required
W12	258500	242180	Not required
W13	258580	242030	Not required
W14	258240	242670	50
W15	256170	242875	Not required
W16	256230	242520	25
W17	258570	241980	Not required
W18	256860	243660	75
W19	256590	243690	Not required
W20	256940	243595	75
W21	258115	244080	50
W22	256980	243550	75
W23	256980	243550	75
W24	256515	243140	50
W25	256420	243290	50
W26	256470	243320	50
W27	258280	244040	50
W28	258310	243950	50
W29	258060	243875	50
W30	256340	243220	50
W31	255680	242630	Not required
W32	255830	242150	Not required
W33	256550	243970	Not required
W34	256950	243620	75
W35	256350	243870	Not required
W36	256940	244100	Not required
W37	256560	243950	Not required
W38	256900	241520	Not required
W39	256845	241490	Not required
W40	256935	241445	Not required
W41	258020	241580	Not required
W42	257510	241520	Not required



LEGEND

- W39 83.7 — Well in bedrock with approximate standing water level mAOD
- W38 84.0 — Well in superficial deposits with approximate standing water level mAOD
- W6 83.5 — Well with unknown depth and approximate standing water level mAOD
- —1— Inferred drawdown contours (see Drawing No. 3.4.3)
- —82— Inferred groundwater levels within site (06.06.1998)
- Site boundary
- Crest of quarry excavation
- Groups of wells with similar proposed well deepening
- Proposed final quarry floor
- Geological boundaries (see Drawing No. 3.3.1)
- Proposed groundwater monitoring wells

CPU = Basinal limestones
CPL = 'Shaley Limestones' (Lucan Formation)
TC = Tober Colleen Formation
WA = Waulsortian limestone ('Reef')
ABL = Argillaceous bioclastic limestone

0 200 400 600 800 Metres

Note:
Location of wells from well survey September 1998. Water levels based on inferred ground surface levels (air survey contours) and depths to standing water measured early September 1998. See Appendix 3.4.4.

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LANSDOWN CEMENT WORKS

KILLASKILLEN, CO. MEATH

TITLE: APPENDIX Nº 3.4

TITLE:

Position of wells and proposed well deepening

Nº 3.4.4.1

13.11.1998

APPENDIX 3.4.5

THE PREDICTED IMPACT OF QUARRY DEWATERING ON AGRICULTURAL SOILS

1.0 THE INFLUENCE OF WATER TABLES ON PLANT WATER SUPPLY [1]

At any one time only a small proportion of the soil water lies in the immediate neighbourhood of the adsorptive surfaces of the plant root systems. The two methods by which plants acquire sufficient water to offset transpiration are, capillary movement of the soil water to the plant roots and the growth of roots into moist soil.

The rate of moisture movement due to capillary action depends on the magnitude of the tension gradient developed and the conductivity of the soil pores. Plants must have large amounts of water delivered regularly and rapidly. However the influence of capillarity is only exerted through a few centimetres as far as the hour by hour needs of the plant are concerned.

Since the water supplying capacity of capillarity is limited, it is obvious that root extension plays a major role in the supply of water to plants. During favourable growth periods roots often elongate so rapidly that satisfactory moisture contacts are maintained even with a lessening water supply and without any great aid from capillarity. The mat of roots, rootlets and root hairs in a meadow or under a cereal crop is ample evidence of the enormous root system of plants. [2]

The rate of root extension is surprising even to those involved in plant production. The elongation of roots may be rapid enough to take care of practically all of the water needs of a plant growing in a soil at optimum moisture. Therefore the plant is more or less independent of capillary adjustment for its immediate water supply from soils which are relatively high in moisture.

When water moves upward from a watertable through the micropores of a soil the phenomenon is known as capillarity or unsaturated flow. The two forces which largely account for the retention of moisture by soil solids, namely adhesion and cohesion, are active when unsaturated flow takes place.

Usually the height of the rise resulting from capillarity is greater with fine textured soils, if sufficient time is allowed and the pores are not too small. This is readily explained on the basis of the capillary size and the continuity of the pores. With sandy soils the adjustment is rapid, but so many of the pores are either noncapillary or only weakly exhibit this capacity that the height of the rise cannot be great.

---

1 See also: Buckman and Brady, The Nature and Properties of Soils : Macmillan

2 H.J Dittemer, A Comparative Study of the Subterranean Members of Three Field Grasses

Contrary to popular opinion, the type of capillary adjustment just described is important in only those field soils where a water table exists. This water table may be temporary or more or less permanent. In most well drained mineral soils, there is no accumulation of free water for any period of time. If a water table does actually appear within the solum, it is temporary and usually is present at a time of year when it is of no practical consequence.

2.0 CONSEQUENCES OF THE DEWATERING PROCESS ON AGRICULTURAL LANDS ON A SOIL BY SOIL BASIS

2.1 PATRICKSWELL SERIES

(see Drawing 3.4.5.1 : Cross section A-A' & Drawing 3.4.5.2 : Cross section F-F')

The parent material is a limestone dominated till with an admixture of shale and some sandstone. The A horizon (0-45cm in depth) consists of a gravelly loam of moderate medium subangular blocky structure, moist friable and a well developed root mat. The B horizon (46-72cm in depth) consists of gravelly loam of moderate or weak fine subangular blocky structure, moist friable slightly plastic and with some roots. The C (+72cm in depth) horizon consists of gravelly loam of massive structure, moist friable to plastic and with very few roots. The average composition of all horizons is 17% coarse sand, 18% fine sand, 45% silt and 20% clay. Therefore, it is the opinion of the author that the dewatering and consequential lowering of the water table will not adversely affect agricultural crops grown on this soil type.

2.2 CAMOGUE SERIES

(see Drawing 3.4.5.2: Cross section B-B')

The parent material is alluvium derived from limestone till with some shale. The A horizon (0-16cm in depth) consists of a silty clay loam of weak, fine crumb in moderate subangular blocky structure, moist plastic and with many fine roots - almost a mat. The B horizon (17-47cm in depth) consists of silt loam, massive to prismatic, moist plastic and with very few roots. The C horizon (+57cm in depth) consists of silty loam of massive structure, wet plastic and has no roots. The average composition of all horizons is 6% coarse sand, 17% fine sand, 57% silt and 20% clay. Therefore, it is the opinion of the author that the dewatering and consequential lowering of the water table will not adversely affect agricultural crops grown on this soil type.

2.3 HOWARDSTOWN SERIES

(see Drawing 3.4.5.2: Cross section A-A')

The parent material is limestone till with some shale and sandstone. The A horizon (0-20cm in depth) consists of gravely silty loam of weak, fine crumb structure, wet plastic to slightly friable and with a developed root mat. The B horizon (21-82cm in depth) consists of gravely clay/silt loam, weak, coarse subangular blocky structure, moist plastic with few roots. The C horizon (83-104cm in depth) consists of gravelly loam of weak, fine subangular blocky structure, moist plastic with no roots. The average composition

of all horizons is 15% coarse sand, 15% fine sand, 46% silt and 24% clay. Therefore, it is the opinion of the author that the dewatering and consequential lowering of the water table will not adversely affect agricultural crops grown on this soil type.

2.4 MYLERSTOWN SERIES

(see Drawing 3.4.5.2: Cross section C-C')

The parent material is limestone - shale drift. The A horizon (0-15cm in depth) consists of gravely silt loam of weak, fine crumb in subangular blocky structure, moist friable and with a developed root mat. The B horizon (16-34cm in depth) consists of gravely clay loam, weak, fine subangular blocky structure, moist plastic with some roots. The C horizon (+35cm in depth) consists of gravelly loam of massive structure, moist plastic with very few roots. The average composition of all horizons is 21% coarse sand, 12% fine sand, 49% silt and 18% clay. Therefore, it is the opinion of the author that the dewatering and consequential lowering of the water table will not adversely affect agricultural crops grown on this soil type.

2.5 MILLTOWNPASS SERIES

(see Drawing 3.4.5.1: Cross section E-E')

The parent material is alluvium derived from limestone and shale. The A horizon (0-25cm in depth) consists of silty clay loam of moderate, fine crumb structure, moist slightly plastic and with plentiful roots - no mat developed. The C horizon (26-60cm in depth) consists of sandy loam of single grain structure, moist slightly friable with many roots. The average composition of all horizons is 31% coarse sand, 19% fine sand, 35% silt and 15% clay. Therefore, it is the opinion of the author that the dewatering and consequential lowering of the water table will not adversely affect agricultural crops grown on this soil type.

2.6 BANAGHER SERIES

(see Drawing 3.4.5.1 & : Cross sections B-B' & Drawing 3.4.5.2 : Cross section E-E')

The parent material is minerotrophic peat with alluvium. Roots are well distributed throughout the profile. The Oap horizon (0-22cm in depth) consists of well humified peat with little or no plant remains recognisable. The Oa1 horizon (23-59cm in depth) consists well humified peat with many large bits of wood. The Oa2 horizon (60-79cm in depth) consists of well humified peat with much turbid water and a water table at 79cm. Therefore, it is the opinion of the author that the dewatering and consequential lowering of the water table will not adversely affect agricultural crops grown on this soil type.

2.7 GORTNAMONA SERIES

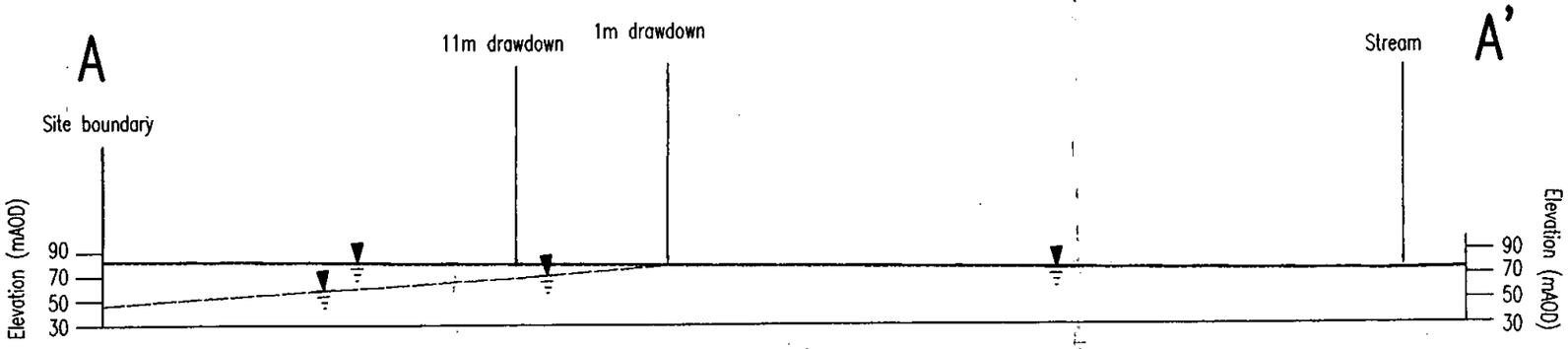
(see Drawing 3.4.5.2: Cross section C-C')

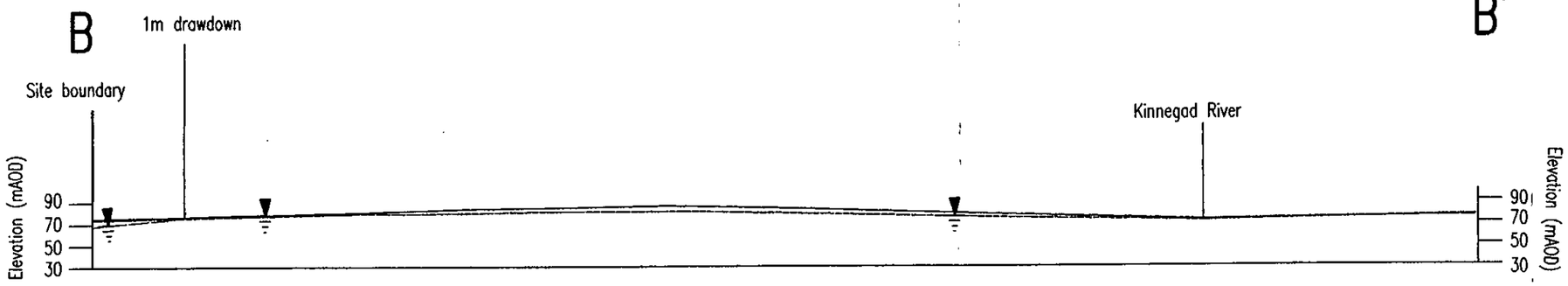
The parent material is ombrotrophic peat. Roots distribution is good in Oap and moderate in Oa1. The Oap horizon (0-33cm in depth) has no plant remains visible, is of strong, fine crumb structure and well humified. The Oa1 horizon (34-59cm in depth) consists well

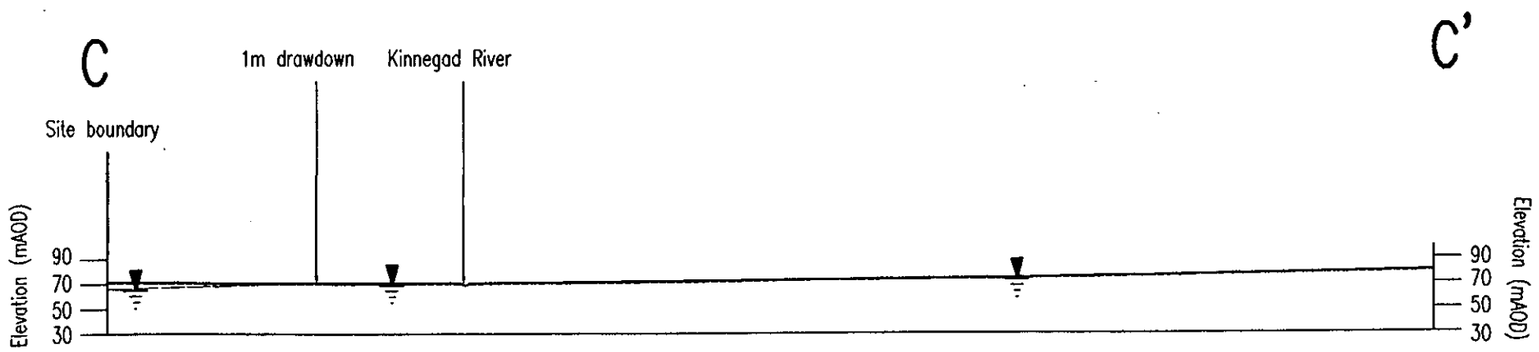
humified peat with very few plant remains and a strong, fine subangular structure. The Oa2 horizon (60-80cm in depth) is sapric and greasy cyperaceous. Therefore, it is the opinion of the author that the dewatering and consequential lowering of the water table will not adversely affect agricultural crops grown on this soil type.

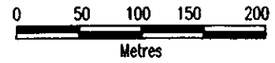
2.8 ALLEN SERIES AND TURBARY COMPLEX

The Allen Series and Turbary complex are raised bog and raised bog (cut-over) respectively. They are not important agriculturally and it has already been established in Appendix 3.4.3 that the peat bog is not considered to be at risk from the dewatering scheme.



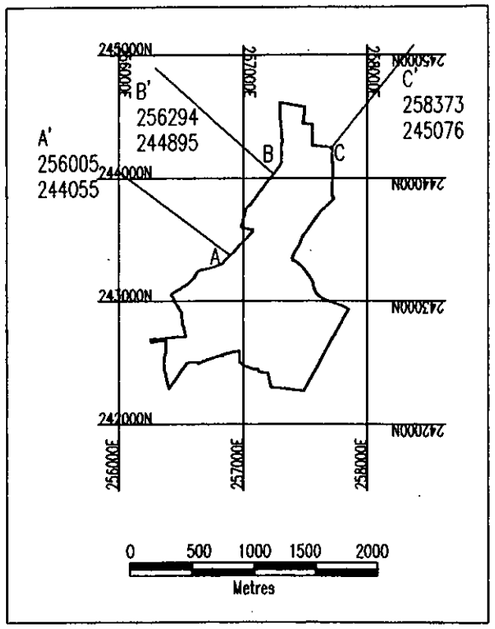






LEGEND

- Inferred water table during period of maximum drawdown
- Inferred existing water table
- Ground surface



LAGAN CEMENT LIMITED
ROSEMOUNT BUSINESS PARK
BALLYCOOLIN ROAD, DUBLIN 11
TEL: 01820 1070 FAX: 01820 1901

LANSDOWN CEMENT WORKS

KILLASKILLEN, CO. MEATH

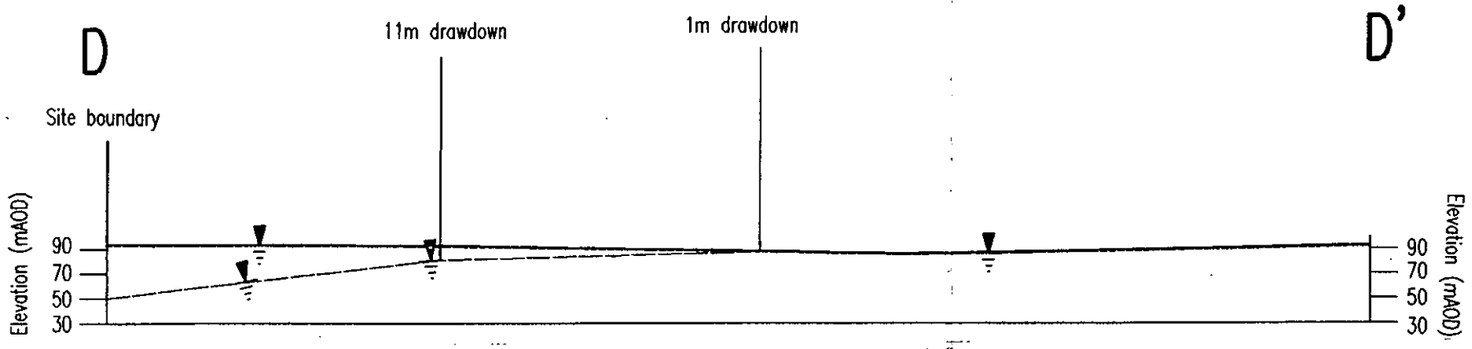
TITLE:

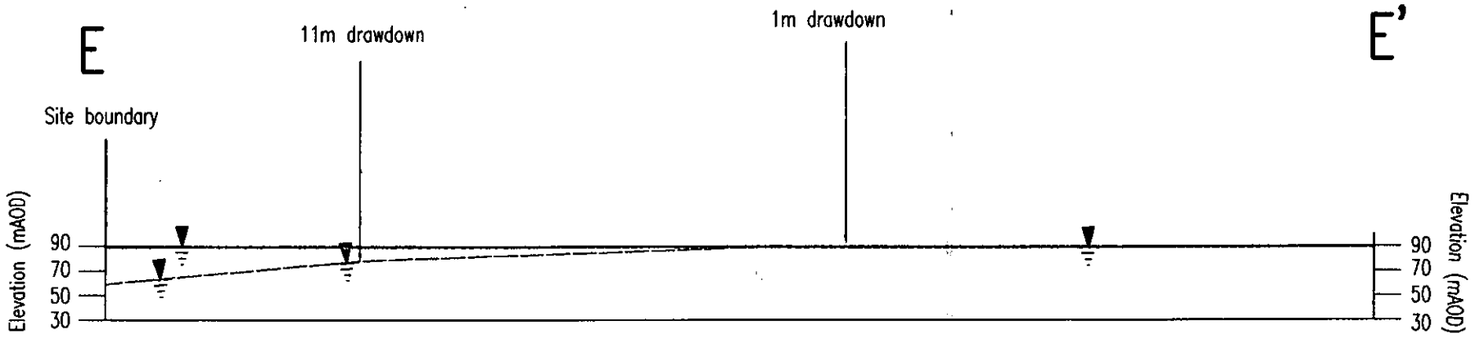
Cross sections showing inferred drawdown of conceptual ground water levels around the Lansdown Site

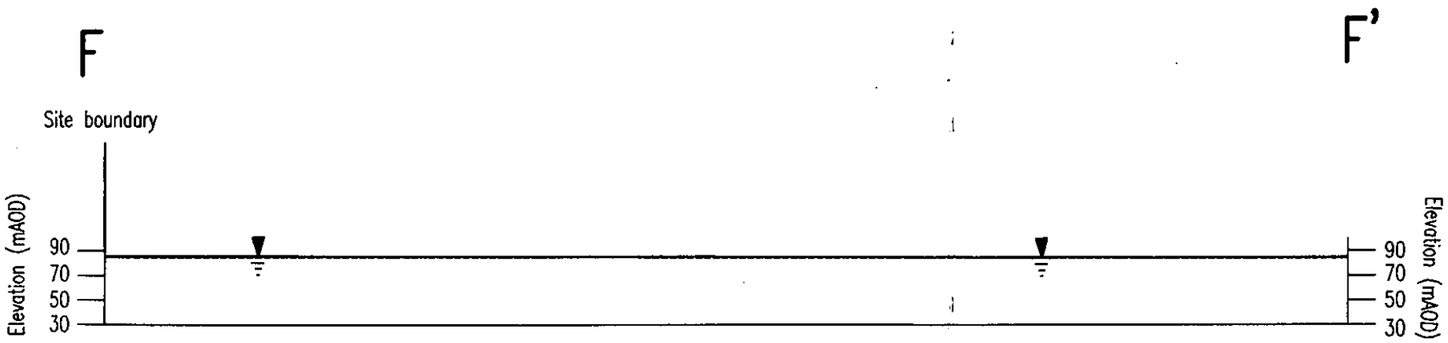
Nº

3.4.5.1

04.11.1998







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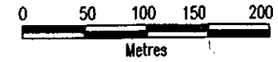
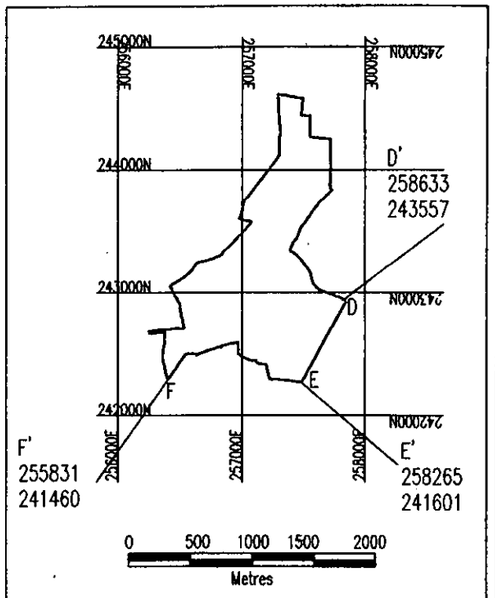


LEGEND

- Inferred water table during period of maximum drawdown
- Inferred existing water table
- Ground surface



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LANSDOWN CEMENT WORKS

KILLASKILLEN, CO. MEATH

TITLE:

Cross sections showing inferred drawdown of conceptual ground water levels around the Lansdown Site

Nº

3.4.5.2

APPENDIX
3.5
AIR AND CLIMATE

ENVIRONMENTAL IMPACT STATEMENT

SECTION 3.5: AIR AND CLIMATE

APPENDIX 3.5.I

AMBIENT AIR QUALITY SURVEY AT THE SITE OF THE PROPOSED DEVELOPMENT

1.0 Scope

This report presents the results of a survey of ambient air quality at the site of a proposed Industrial Development at Lansdown, Killaskillen, Co Meath.

2.0 Survey methodology

2.1 Dust deposition

The survey was conducted by TMS Environment Ltd personnel during the period 20th March to 17th April 1998. There are currently no EU Standards for dust deposition sampling, but British and International Standards do exist. The British Standard, BS1747, has not been updated in recent years, and technological developments have superseded the design of the Dust Deposit Gauge. The International Standard, ISO 4222, for ambient nuisance dust monitoring is extremely simple and is a viable choice for use in surveys of this type. Frisbee Dust Deposit Gauges were developed by the Warren Springs Laboratories in the UK and have been shown to have higher collection efficiencies and to generate more reliable sampling results than the alternative types of gauge. Furthermore, this type of Dust Deposit Gauge has gained widespread acceptance for this type of monitoring survey in Ireland. Consequently, this is the type of gauge selected for the dust deposition measurements at the site.

The dust deposition rate was measured by positioning four Frisbee Dust Deposit Gauges at strategic locations on the boundaries of the site for a period of 28 days. The selection of sampling point locations was completed after consideration of the requirements of BS1747 with respect to the location of the samplers relative to trees and other obstructions, height above ground and sample collection and analysis procedures. After the exposure period was complete, the Gauges were removed from the site; the dust deposits in each Gauge were determined gravimetrically and expressed as a dust deposition rate in mg/m^2-day in accordance with the relevant standards. The location of the Dust Deposit Gauges is marked as D1 – D4 on a map of the site presented separately.

2.2 Sulphur dioxide and nitrogen oxides

The monitoring survey was conducted by TMS Environment Ltd personnel during the period 15th to 22nd May 1998. Samples were collected over a period of seven consecutive 24-hour periods at a central location on the site of the

proposed Development area. The location of the sampling point is marked as A1 on a map of the site presented separately.

The sampling and analytical methodologies employed conformed with the following Standard Methods. Sulphur dioxide measurements were performed according to BS1747: Part 7: 1983, and nitrogen oxides were determined according to ASTM D1607: 1976. The samples were collected over 24-hour sampling periods. Samples were collected by absorption in hydrogen peroxide (sulphur dioxide) and Griess-Saltzmann reagent (nitrogen oxides). The samples were returned to the laboratory for spectrophotometric analysis according to the relevant Standard Methods. An automated 8-day sampler was employed for sample collection.

3.0 Measurement results

The measurement results are summarised in Tables 1 and 2.

4.0 Evaluation of results

4.1 Dust and particulates

There are many terms adopted to describe and quantify airborne particulate matter such as smoke, black smoke, Total Suspended Particulates, PM10 etc. A measurement frequently used in connection with air quality assessments where dust emissions may be significant is Dust Deposition Rate which is normally measured by gravimetrically determining the mass of particulates and dust deposited over a specified surface area over a period of one month (28 days). The results are expressed as dust deposition rate in mass per unit area per day.

For the purpose of this assessment, a survey of dust deposition rates over a 28 day period was completed. Typical dust deposition rates in a rural agricultural environment are in the extremely low mg/m^2-day range, typically 0 – 60, and the results of this survey are consistent with this expected concentration range. A Standard of 150 mg/m^2-day is normal for ensuring that no significant adverse nuisance effects such as soiling of buildings etc are encountered as a result of dust deposition from industrial activities. The existing air quality is good and dust deposition rates fall far short of the 150 mg/m^2-day threshold.

Table 1 Results of ambient air quality survey – dust deposition

SAMPLING POINT	DUST DEPOSITION, mg/m^2-day
D1	38.4
D2	15.3
D3	7.6
D4	4.6

Table 2 Results of ambient air quality surveys – sulphur dioxide and nitrogen oxides

SAMPLING DATE	24-HR AVERAGE CONCENTRATION	
	SO_2, $\mu g/m^3$	NO_X, $\mu g/m^3$
15/05/1998 TO 16/05/1998	20.0	13.04
16/05/1998 TO 17/05/1998	< 17.1	6.52
17/05/1998 TO 18/05/1998	< 17.1	1.09
18/05/1998 TO 19/05/1998	< 17.1	2.17
19/05/1998 TO 20/05/1998	< 17.1	< 0.50
20/05/1998 TO 21/05/1998	< 17.1	14.12
21/05/1998 TO 22/05/1998	< 17.1	2.17

4.2 Nitrogen oxides

The measurement results for nitrogen oxides are extremely low and are also consistent with the levels of nitrogen oxides which would be expected in a rural environment of this type. Annual mean concentrations of nitrogen oxides in rural atmospheres are expected to be in the range 0 - 30 $\mu g/m^3$, and 20 - 90 $\mu g/m^3$ in urban locations; the values recorded during this survey are within this expected concentration range. The air quality with respect to nitrogen oxide concentrations is described as very good.

Limit and Guide values for ambient concentrations of nitrogen oxides have been set by the European Community and also by the World Health Organisation. The EC Limit value which should not be exceeded is 200 $\mu g/m^3$ for NO_2, and this is expressed as the 98th percentile of hourly averages over a period of one year. This Limit is not even approached in the current location.

4.3 Sulphur dioxide

Annual mean concentrations of sulphur dioxide in rural atmospheres are expected to be in the range 3 - 6 $\mu g/m^3$, a concentration level substantially lower than the limit of detection attainable using the type of sampling and analysis methodologies normally employed for this type of survey. Concentrations of sulphur dioxide in the range 25 – 100 $\mu g/m^3$ are representative of typical urban environments. The values of sulphur dioxide measured during this survey were low and were consistent with the expected concentration range for this type of environment. The air quality with respect to sulphur dioxide concentrations at the site is good.

Limit and Guide values for ambient concentrations of sulphur dioxide have been set by the European Community and also by the World Health Organisation. The EC Limit value which should not be exceeded is 80 $\mu g/m^3$ for SO_2, and this is expressed as the annual average of daily mean concentrations over a period of one year; the associated Guide value is 40 $\mu g/m^3$. The existing air quality at the site does not exceed the Standards.

5.0 Conclusions

A survey of ambient air quality at the Lansdown site of the proposed industrial development has been completed during the period March – May 1998. The results of the survey are consistent with expectations for this type of environment and indicate that air quality in the area is extremely good and representative of similar rural, unpolluted environments.

ENVIRONMENTAL IMPACT STATEMENT

SECTION 3.5: AIR AND CLIMATE

APPENDIX 3.5.2

DISPERSION MODELLING STUDY OF THE IMPACT OF EMISSIONS TO ATMOSPHERE FROM THE PROPOSED DEVELOPMENT

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1.0 INTRODUCTION

TMS Environment Ltd have been commissioned to assess the impacts on air quality of a proposed industrial development. The site of the proposed development is located in the townland of Killaskillen near Kinnegad, Co Westmeath. The site incorporates land which was part of the Lansdown Property Holdings and includes Lansdown Lodge.

The site is located in a predominantly rural location, with the village of Ballinabrackey located approximately 1.5 km south of the nearest site boundary and Kinnegad lying approximately 3km to the north east of the nearest site boundary. The location of the site is well removed from substantial industrial developments although the Electricity Supply Board peat-fired power Station at Rhode, Co Offaly, is located just 13 km south-west of the site. The main Dublin – Galway road, the N6, passes the site approximately 0.5km north of the site boundary; there are plans to extend the M4 Motorway to incorporate a bypass of Kinnegad in the next 3 years, and the proposed route of the new Motorway passes closer to the nearest site boundary than the existing roadway. A substantial residential development is located at Kinnegad. Approximately 120 residences are located in scattered developments within a radius of 2km of the site boundaries.

2.0 PROJECT DESCRIPTION

The proposed development consists of a Cement Manufacturing Plant and two associated shale and limestone quarries from which the raw materials for use in the cement manufacturing plant will be extracted. The main impacts on air quality which will result from the proposed development are associated with the operation of the two quarries and the operation of the cement manufacturing plant. Emissions from the various sources associated with these activities were modelled to assess the impact of the emissions on ambient air quality in the vicinity of the proposed development.

3.0 DISPERSION MODELLING METHODOLOGY

3.1 Selection of dispersion model

A computerised mathematical dispersion model was used to predict the incremental additions to ground level concentrations of relevant criteria pollutants as a result of emissions from sources at the proposed development. The model chosen for this exercise was the Industrial Source Complex Short Term (Version 1.3) Dispersion Model (ISCST3). This model was developed for use in complex terrain by the US Environmental Protection Agency. The model is a gaussian plume dispersion model which computes average ground-

level concentrations of pollutants emitted from either elevated or ground-level emission sources. Separate Utilities associated with the Dispersion Modelling Software allow computation of ground-level concentrations of pollutants over defined statistical averaging periods, and additional features permit suitable consideration to be accorded to building downwash effects and the effects of elevated terrain in the vicinity of the plant.

3.2 Input data on emissions

3.2.1 Quarrying

The main quarrying activities are associated with the recovery of materials for use in the construction and operation of the cement manufacturing plant. The most significant potential impacts arise from particulate emissions associated with the operation of the quarry, and the main potential emission sources are summarised as follows:

- Emissions from exposed surfaces such as material stockpiles, rock and soil surfaces;
- Emissions from road and yard surfaces;
- Emissions from blasting and excavation of raw materials;
- Emissions from material crushing and grinding operations;
- Emissions from material transfer operations.

The two main impacts of dust emissions from quarrying activities are incremental contributions to airborne particulate concentrations and to dust deposition rate on surfaces. The particulate emissions from the quarrying activity are expected to be in the 10 –75 μm size range, so the dominant impact of this activity will be the impact on dust deposition.

The particulate emissions from blasting will be insignificant since the blasts will be managed in accordance with best international practice thus eliminating the potential for significant emissions as a result of this activity. Similarly, the management practices and mitigation measures planned for aspects of the operation such as grinding and crushing and material storage and transfer will effectively control dust emissions from such sources. The most significant of the potential emission sources are associated with mechanical handling operations and material transfer operations; entrainment of particulates from windblow across exposed sources is also potentially significant.

The particulate emission rate from the quarrying operations will be greatly influenced by the weather, the amount of material handled per unit time and

the management of site operations. The particulate emission rate from the operation of the quarry has been estimated using Air Pollution Emission Factors developed by the US Environmental Protection Agency. Using this methodology, the main sources of dust emissions from the quarrying operation are predicted to be raw material extraction, transport of raw material to the crusher and the crusher itself. Since the crushing and material conveying operations will all be enclosed, the raw material extraction and storage operations will be the most significant sources of dust emissions at the site. The shale stockpiles will also be partially enclosed further minimising the potential for emissions from these sources.

Although the quarrying operations will not be operated continuously, the windblown contributions to dust emissions will be continuous so continuous operation was assumed in calculating potential emission rates of particulates from the quarrying operations. The application of the US EPA Emission Factors to the operation results in a predicted emission rate of approximately 1.5 g/sec from the entire quarrying operation. When mitigation measures are taken into account, this estimate is further reduced to just 1.12 g/sec. This emission rate is insignificant in relation to the main process emissions which are summarised in the following section. The proposed mitigation measures have also been considered in computing this estimate.

3.2.2 Cement manufacturing plant

As a result of the operation of the cement manufacturing plant, emissions to atmosphere of particulate and gaseous pollutants will occur. The dominant emissions are PM (particulate matter), PM_{10} (particulate matter having an aerodynamic diameter less than 10μm), sulphur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), carbon dioxide (CO_2) and water vapour. Traces of Volatile Organic Compounds (VOCs) and heavy metals will also be emitted depending on the fuel used in the main plant processes and on the chemical composition of the raw materials in use at the plant.

Emissions to atmosphere are considered under two headings, fugitive and unscheduled emissions and specific process emissions. **Fugitive emissions** are associated with:

- Particulates from delivery of raw materials to site;
- Particulates from storage of raw materials, processed materials and product;
- Particulates from spillage, internal transfer of materials and building losses.

Process emissions are associated with:

- Particulates from crushing of raw materials (shale and limestone);
- Particulates from milling limestone, shale and coal;
- Particulates from conveying and transport of materials;
- Particulates from clinker grinding and gypsum mixing;
- Particulates from bag-filling and bulk transport loading of cement;
- Particulates, NO_x, SO_2, CO, CO_2, water vapour, trace VOCs and metals from cement kiln.

The principal source of emissions to atmosphere at the cement manufacturing plant will be the main exhaust stack from the cement kiln. The height of the exhaust stack will be 125m (which was determined from the results of various dispersion modelling runs to assess the optimum stack height for dispersion of pollutants) and the emission characteristics predicted for this emission source are summarised in Table 1. Information on emission characteristics was obtained from a consideration of the nature and scale of the processes which will be carried out at the plant, the chemical composition of the raw materials and fuels, and emission factors from this industry type developed by the United States Environmental Protection Agency (US EPA).

The main process emissions from sources other than the kiln are particulate emissions from the various processes which are involved in cement manufacture. A summary of the emission characteristics from 22 process emission sources at the plant is presented in Table 2. Two emission scenarios are presented for each source. The average emission rate for each source is calculated from the design specification of 10 mg/Nm^3 for the Bag Filters which will be used to control emissions from these sources. The projected maximum emission rate from each source is calculated from the maximum expected concentration in the emission streams which will not exceed 20 mg/Nm^3. The total mass emission rate of particulates from all process sources other than the kiln will not exceed 8.352 kg/hr. The most significant individual emission source other than the cement kiln is the cement mill with a projected maximum emission rate of 1.128 kg/hour.

Many of these emission sources will not operate continuously so the projected emission rates are over-estimates of the potential emission rates. Both the average and maximum allowable mass emission rates from each source are within the BATNEEC ELV of 50 mg/Nm^3 for particulates.

Due to the nature of the processes being undertaken at the plant, there is potential for fugitive dust emissions associated with the operation of the cement manufacturing plant. The main areas with significant potential for fugitive losses are internal material transfers, building losses and the raw and final milling operations. Appropriate control technologies and management practices for minimising the potential for such losses are incorporated into the design of the plant, so the magnitude of potential fugitive emissions is low. Similarly, management practices in relation to internal haul road and yard

surfaces will minimise the potential for fugitive particulate emissions from these sources.

3.3 Climatological data

The magnitude of potential impacts of emissions from the proposed industrial development will be substantially influenced by the local meteorological conditions and particularly by wind speed and direction and also by precipitation rates, so an evaluation of climatological conditions at the site is important when completing an assessment of the type being undertaken in this study.

There is no continuous meteorological monitoring station located uniquely close to the site of the proposed development at Lansdown, but comprehensive monitoring data is available for Casement Aerodrome at Baldonnel which is located just 45km East of the site. The Meteorological Station in Mullingar does not record sufficient information to allow a comprehensive evaluation of meteorological conditions in the area and furthermore, since the data is incomplete, it is not suitable for use as input data in Dispersion Modelling Software. For the purpose of obtaining reliable information about the climatological conditions at the site of the proposed industrial development, meteorological data for the period 1992 – 1996 from the Met Eireann Station at Casement Aerodrome was analysed. In view of the close proximity of the two locations, the flat terrain and the absence of direct marine influences, the data from Casement Aerodrome is expected to be a reliable indicator of conditions at the site of the proposed development.

Analysis of the monitoring data from the meteorological station at Casement Aerodrome shows that the dominant wind direction is from the S-SW-W quadrant with an annual incidence of about 60% as shown in the Wind Rose for Casement Aerodrome, Drawing 1. The average annual wind speed is in excess of 5 m/s, with wind speeds < 3 m/s occurring for just 19% of the year; high wind speeds at > 5 m/s occur for 65% of the year. A summary of wind speed occurrences for the period 1992 – 1996 is presented in Table 3.

Table 1 Emission characteristics from cement kiln

Parameter	Design Specification			BATNEEC ELV [1]
Characteristics				
Stack height, m	125			NA
Stack diameter, m	3			NA
Exit flow rate, Am^3/hr	214,000			NA
Exit flow rate, Nm^3/hr	101,988 – 156,650			NA
Exit velocity, m/sec	8			NA
Exit temperature, K	373 – 573			NA
	Min	***Avg***	***Max***	
Gas composition				
SO_2 emission concentration, mg/Nm^3	150	350	500	400 – 750
SO_2 emission rate, g/sec	6.53	15.24	21.76	NA
NO_2 emission concentration, mg/Nm^3	300	550	800	1300 – 1800
NO_2 emission rate, g/sec	13.05	23.93	34.81	NA
Particulate emission concentration, mg/Nm^3	10	10	20 – 50	100 [3]
Particulate emission rate, g/sec	0.44	0.44	0.87 – 2.18	NA
CO_2 emission rate, kg/sec	9.47	11.37	13.64	NA
CO emission concentration, mg/Nm^3	500	1200	1500	NA
CO emission rate, g/sec	21.73	52.22	65.27	
TOC emission concentration, mg/Nm^3	-	-	2	150 [4]
TOC emission rate, g/sec [2]	-	-	0.087	NA
THM emission concentration, mg/Nm^3	-	-	< 0.2	[5]
THM emission rate, g/sec [2]	-	-	$< 1.65 \times 10^{-4}$	NA

NOTES

[1] Best Available Technology Not Entailing Excessive Cost; ELV = Emission Limit Value; Integrated Pollution Control Licensing Guidance Note for the Production of Cement

[2] TOC = Total Organic Carbon; THM = Total Heavy Metals

[3] Plant capacity < 500,000 ton per annum

[4] No values quoted in BATNEEC Guidance Note; typical value quoted from T A Luft

[5] No values quoted in BATNEEC Guidance Note; typical values 1 – 5 mg/Nm^3

Table 2 Emission characteristics from main particulate emission sources

Emission source	Design specification						
	Temp K	Velocity m/s	Flow Am^3/hr	Flow Nm^3/hr	Vent height m	Mass Emission rate, kg/hr	
						Avg [1]	Max [2]
Raw material to feeder bins	293	8	18000	16771	67	0.168	0.335
Raw meal conveyor #1	293	8	18000	16771	67	0.168	0.335
Raw meal silo #1	358	8	24000	18302	67	0.183	0.366
Raw meal silo #2	358	8	24000	18302	67	0.183	0.366
Homogenising silo	358	8	24000	18302	67	0.183	0.366
Kiln feed	348	8	24000	18828	67	0.188	0.377
Clinker silo #1	338	8	18000	14538	57	0.145	0.291
Clinker silo #2	338	8	18000	14538	57	0.145	0.291
Off-Spec Clinker Silo	338	8	18000	14538	57	0.145	0.291
Clinker transport #1	333	8	18000	14757	57	0.148	0.295
Clinker transport #2	333	8	18000	14757	57	0.148	0.295
Gypsum crusher	293	8	24000	22362	14.2	0.224	0.447
Cement mill	363	8	75000	56405	39	0.564	1.128
Cement silo #1	348	8	18000	14121	57	0.141	0.282
Cement silo #2	348	8	18000	14121	57	0.141	0.282
Cement silo #3	348	8	18000	14121	57	0.141	0.282
Cement transport conveyor #1	323	8	18000	15214	57	0.152	0.304
Cement transport conveyor #2	323	8	18000	15214	57	0.152	0.304
Packing plant	323	8	24000	20285	35	0.203	0.406
Bulk cement loading plant	318	8	24000	20604	35	0.206	0.412
Coal store	293	8	24000	22362	14.75	0.224	0.447
Coal Mill	293	8	24000	22362	24	0.224	0.447
Total						***4.176***	***8.352***

NOTE

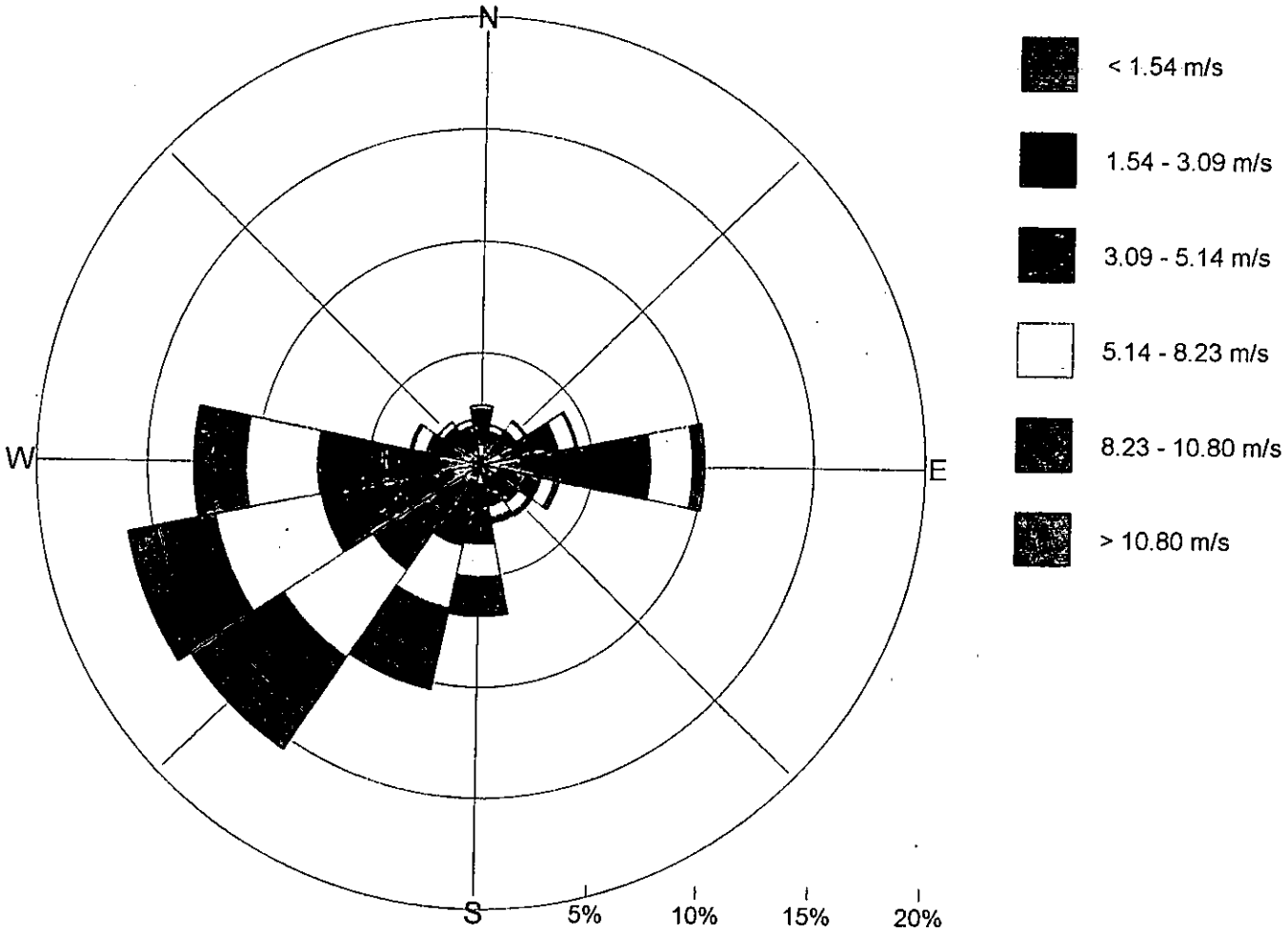
[1] Average emission rate is calculated from the design specification of 10 mg/Nm^3

[2] Maximum emission rate is calculated from the design maximum of 20 mg/Nm^3

[3] BATNEEC ELV is 50 mg/Nm^3

[4] The cement mill will operate only at night, so the potential impact of the emissions from this source is less than would be observed if the mill was operating 24 hours per day

Figure 1 Windrose for Casement Aerodrome, Baldonnel: 1992 - 1996



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LANSDOWN
CEMENT WORKS
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APPENDIX 3.5.2

TITLE:
WINDROSE FOR
CASEMENT AERODROME
BALDONNEL 1992-1996

Drawing N° 1

Table 3 Frequency of wind direction and wind speed for Casement Aerodrome (1992 – 1996)

DIRECTION	PERCENTAGE OCCURRENCE OF WIND SPEEDS (m/s)						
	< 1.54	1.54 – 3.09	3.09 – 5.14	5.14 – 8.23	8.23 – 10.8	> 10.80	TOTAL
0.0	0.944	0.822	0.736	0.171	0.005	< 0.001	2.678
22.5	0.604	0.518	0.428	0.260	0.042	0.012	1.864
45.0	0.631	0.583	0.641	0.469	0.122	< 0.001	2.446
67.5	0.936	1.157	1.417	0.784	0.110	0.005	4.409
90.0	1.799	2.654	3.186	1.923	0.495	0.066	10.123
112.5	0.789	1.070	0.871	0.615	0.155	0.103	3.603
135.0	0.682	0.686	0.653	0.538	0.146	0.075	2.780
157.5	0.619	0.622	0.643	0.519	0.162	0.134	2.699
180.0	0.901	1.170	1.496	1.475	0.801	0.965	6.808
202.5	0.762	1.197	1.747	2.895	2.052	1.662	10.315
225.0	0.881	1.859	2.984	4.792	3.050	1.963	15.529
247.5	1.315	2.403	3.526	4.869	2.608	1.463	16.184
270.0	1.840	2.461	3.013	3.219	1.460	0.927	12.920
292.5	0.863	0.819	0.801	0.608	0.120	0.021	3.232
315.0	0.631	0.698	0.693	0.260	0.052	< 0.001	2.334
337.5	0.650	0.566	0.554	0.272	0.026	0.024	2.092
TOTAL	14.847	19.285	23.389	23.669	11.406	7.420	100

Table 4 Mean monthly temperature and rainfall for Casement Aerodrome (1992 – 1996)

Month	Mean Temperature, °C	Mean rainfall, mm
January	5.5	80.6
February	5.4	62.1
March	6.3	59.1
April	8.2	57.9
May	10.0	68.2
June	13.6	49.6
July	15.3	56.2
August	14.7	54.0
September	12.1	54.5
October	9.6	61.0
November	7.3	76.1
December	5.0	77.6

An analysis of mean monthly temperatures and precipitation rates for Casement Aerodrome is presented in Table 4. Mean monthly temperatures for the area are in the range 5.4 to 15.3 °C, with mean monthly precipitation rates in the range 49.6 mm in June to 80.6mm in January. The mean annual precipitation rate for the area is 757mm.

The dispersion of pollutants from emission sources is also affected by atmospheric stability. The six categories of atmospheric stability normally used for this type of study range from very unstable (A) to stable (F). The percentage occurrence of the various atmospheric stability classes was determined for the five year period 1992 – 1996 and the results are summarised in Table 5. The most common type of stability category encountered in the area is neutral (D) stability at 76% which is representative of the conditions normally encountered in Ireland and is associated with cloudy, rainy or windy weather. Dispersion of pollutants is poorest under stable atmospheric conditions (categories E and F, normally experienced during the night) – this type of stability category is encountered for just 15% of the year.

The meteorological data for Casement Aerodrome in Baldonnel has been shown to be suitable for assessing the impact of emissions from the plant on the surrounding environment. In the absence of a locally-based meteorological station, a monitoring station will be permanently located on the site of the proposed development before construction activities begin in order to obtain reliable local information on key climatological conditions.

Table 5 Percentage occurrence of atmospheric stability categories at Casement Aerodrome (1992 – 1996)

Stability Category	Percentage occurrence
A – very unstable	< 1
B – unstable	1
C – slightly unstable	6
D – neutral	76
E –slightly stable	9
F – stable	6
G – very stable	2

3.4 Modelling protocol

Information on the site layout was obtained from the Project Development Team. The layout and area of the site and the dimensions of the various plant buildings were taken from the drawings and Layouts presented with the main EIS report. Information on dimensions and physical characteristics of the various emission sources was obtained from the plant designer. The data on emission characteristics from the various emission sources at the plant has been summarised in Tables 1 and 2 and is taken as the worst case emission scenario. Meteorological data used for the study has been discussed in Section 3.3. Topographical information was obtained from a site survey and from Ordnance Survey maps of the area.

The modelling study involved computation of predicted incremental contributions to ground level concentrations of pollutants over defined averaging intervals as a result of emissions from the plant. The scope of the modelling study encompasses prediction of the impact on ambient air quality of all main emissions from the proposed development.

The main impact of quarrying operations on ambient air quality will be that associated with deposition of dust generated by the quarrying operations; contributions to ambient PM_{10} concentrations are predicted to be negligible in view of the expected particle size of the dust generated by quarrying and related operations. The contribution of particulate emissions to the overall dust deposition rate at the plant has thus been considered in the Dispersion Modelling study.

The main pollutants which will be emitted as a result of the operation of the cement manufacturing plant are PM (particulate matter), PM_{10} (particulate matter having an aerodynamic diameter less than 10μm), sulphur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO) and carbon dioxide (CO_2). Although trace amounts of Volatile Organic Compounds (VOCs) and heavy metals will also be emitted, the predicted emission rates of these substances is so low that a formal quantitative assessment of their impact on ambient air quality is not required. The main emission source is the cement kiln as previously discussed, and other emission sources associated with the process release particulates (predominantly PM_{10}) as the dominant pollutant emitted. The cement Kiln will operate 24 hours per day for 48 – 50 weeks per year, while the cement mill will operate only at night; the other process emission sources will also operate continuously.

Evaluation of the predicted impact of the proposed development on the atmospheric environment is completed by quantitatively assessing the contribution of plant emissions to ambient air concentrations of the most significant pollutants emitted from the plant. In order to complete this

assessment, it is necessary to define the criteria which will be used to assess the impact of plant emissions on ambient air quality in the vicinity of the proposed development.

National Air Quality Standards have been define in Ireland for (SO_2), nitrogen oxides (NO_x) and particulate matter (smoke); these Air Quality Standards are based on the relevant EU standards, and form the basis of assessment of the impact of emissions from the plant on the surrounding environment. Assessment criteria are also considered from two other sources:

- The World Health Organisation (WHO);
- The UK Department of Energy, Transport and the Regions Expert Panel on Air Quality Standards (EPAQS).

The air quality criteria used for this assessment and their sources are presented in Table 6. In general terms, the assessment criteria are related to airborne concentrations of the pollutants of interest to which people are exposed. An additional impact of particulate emissions is the deposition of dust onto surfaces. Air Quality Standards for airborne dust are presented in Table 6, but there are no international standards or guidelines for dust deposition rates. The value most frequently used in Ireland for assessing the impact of dust deposition is 150 mg/m^2-day, while values in the range 200 – 250 mg/m^2-day are widely used in the UK; internationally, the guideline values used are in the range 150 – 650 mg/m^2-day.

Emissions to atmosphere from the cement manufacturing plant will contribute to ambient ground level concentrations of pollutants, especially particulate matter, PM_{10}, NO_2, SO_2 and CO. To assess the impact of these emissions on ambient air quality, it is necessary to predict the incremental contribution to existing ground level pollutant concentrations from the plant emissions.

The Dispersion Model was used to predict the ground level concentrations of the main pollutants emitted from the plant. In accordance with the requirements of the assessment criteria which are being used for the impact assessment, the predictions were chosen to allow direct comparison of predicted ground level concentrations over the relevant averaging interval with the relevant Air Quality Standard. 78 modelling runs were completed for the pollutants of interest in order to assess the impact of the development on ambient air quality.

Table 6 Assessment criteria for air quality impact assessment

Parameter	Source	Air Quality Standard, $\mu g/m^3$	Statistical parameter
Particulates	***EU Directive*** Limit value	150	Annual mean
PM_{10}	***EPAQS***	50	99-percentile of 24-hour running mean
	EU Directive	50 30	24-hour mean Annual mean
NO_2	***EU Directive***		
	Limit value	200	98-percentile of hourly means
	Guide Value	135	98-percentile of hourly means
		50	50^{th}-percentile of hourly means; approximately equivalent to the annual mean
	WHO Guideline	40 – 50	Annual mean
		200	Maximum of one-hour means
SO_2	***EU Directive*** Limit value	350 if smoke = or < 150 250 if smoke > 150	98-percentile of daily means; no more than three consecutive days
		180 if smoke = or < 60 130 if smoke > 60	Winter median of daily mean values
		120 if smoke = or < 40 80 if smoke > 40	Annual median of daily mean values
	Guide Value	40 – 60	Annual mean
	WHO Guideline	50	Annual mean
		350	Maximum one-hour mean
		500	Maximum 10-minute mean
CO	***WHO Guideline***	10,000	8-hour mean
		30,000	One-hour mean
	EPAQS	11,600	Running 8-hour mean

The input data for the Dispersion Model is presented in Tables 1 and 2. The emission rates chosen for input into the Dispersion Model were the average and maximum levels which will be emitted in the emission streams. Although the maximum potential emission rates will not be routinely attained as a result of the operation of the plant, the maximum potential emission rates were modelled as the worst possible emission scenario in order to determine the maximum potential impact of plant emissions on ground level concentrations of pollutants in the vicinity of the plant. The average emission rate of pollutants from the various emission sources was also modelled in order to assess the potential impact of the expected emission streams on ambient air quality in the vicinity of the plant.

Two different types of assessment were made during this study:

- assessment of the impact of various pollutant emissions from the cement kiln on ambient air quality;
- assessment of the impact of particulate emissions from the entire plant on ambient air quality.

Since the impact of the emissions can be observed at considerable distances from the emission sources, a Grid 6km x 6km centred on the main emission source, the cement kiln, was constructed with receptors located at 300m intervals. Within the site boundary, a radial grid was used with receptors located at 100m grid intervals and at sensitive receptors on site resulting in a total of 688 receptor points within a radius of 500m from the main stack.

The averaging intervals for the modelling study were chosen to allow comparison of the predicted air quality impacts with relevant Air Quality Standards and Guidelines. In particular, 1-hour, 8-hour , 24-hour and annual average ground level concentrations (GLCs) of various pollutants were calculated at various distances from the site; the 50^{th}- , 98^{th}- and 99^{th} percentile of these average GLC's were also computed. 24-hour average dust deposition rates were also computed to evaluate the impact of dust deposition from the plant on the surrounding environment.

Building downwash effects might be expected as a result of the proximity of the preheater tower, the cement mill and the various silos to the main cement kiln stack. These effects were modelled using the modelling routine, BPIP, which is part of the ISCST3 modelling Suite.

4.0 DISPERSION MODELLING PREDICTIONS

4.1 Maximum potential impact on ambient air quality

As previously discussed, the potential maximum impact on ambient air quality of emissions from the plant and quarries was assessed by modelling the potential maximum emission rates from the plant. Modelling runs were completed to assess the following impacts:

- Cement Kiln: emissions of particulates, PM_{10}, SO_2, NO_2, CO
- Cement Kiln + quarry + process emission sources: particulate emissions

The modelling runs predicted the incremental additions to ground level concentrations of the various pollutants over specified averaging intervals to allow comparison of the predictions with relevant Air Quality Standards and Guidelines. The results of the modelling runs are presented in graphical form in Addendum I where isopleths or contour plots showing the pollutant concentrations as a function of distance from the site in the area surrounding the plant are plotted and reproduced. The parameters of greatest interest are the predicted maximum GLC for each pollutant and averaging interval for which an Air Quality Standard is defined. The locations of the receptors at which these maxima occur have been abstracted from the modelling output data and are presented in summary form in Table 7 – 13 as follows.

Tables 7 – 11 Ambient air quality impact, Cement Kiln, max emission rate

Tables 12 - 13 Ambient air quality impact, all sources, max emission rate

4.2 Expected impact on ambient air quality

The expected impact on ambient air quality of emissions from the plant and quarries was assessed by modelling the expected average emission rates from the plant. Modelling runs were completed to assess the relevant impacts as described in the preceding section. Modelling predictions are presented in graphical form in Addendum I and again a summary of the key impact predictions is presented in Table 14 – 20 as follows.

Tables 14 – 18 Ambient air quality impact, Cement Kiln, avg emission rate

Tables 19 - 20 Ambient air quality impact, All sources, avg emission rate

Table 7 Air quality impact predictions – airborne pollutants; max emission rate

Emission sources Cement Kiln
Pollutant Total particulates and PM_{10}

STATISTICAL PARAMETER	LOCATION OF HIGHEST VALUE PREDICTED	HIGHEST PREDICTED VALUE, $\mu g/m^3$
1-HOUR AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY*** X(m): 256523;Y(m): 242991	10.5
	OUTSIDE SITE BOUNDARY X(m): 256375;Y(m): 242933	4.86
24-HOUR AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY*** X(m): 256523;Y(m):242991	1.94
	OUTSIDE SITE BOUNDARY X(m): 256336;Y(m):243135	0.97
99-PERCENTILE OF 1-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS	***INSIDE SITE BOUNDARY*** X(m): 256523;Y(m):242991	2.28
	OUTSIDE SITE BOUNDARY X(m): 256375;Y(m): 242933	1.23
99-PERCENTILE OF 24-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS	***INSIDE SITE BOUNDARY*** X(m): 256518;Y(m):242949	0.85
	OUTSIDE SITE BOUNDARY X(m): 256336;Y(m): 243134	0.44
ANNUAL AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY***	0.056
	OUTSIDE SITE BOUNDARY	0.035

Table 8 Air quality impact predictions – airborne pollutants; max emission rate

Emission sources Cement Kiln
Pollutant SO_2

STATISTICAL PARAMETER	LOCATION OF HIGHEST VALUE PREDICTED	HIGHEST PREDICTED VALUE, $\mu g/m^3$
1-HOUR AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY*** X(m): 256523;Y(m): 242991	104.5
	OUTSIDE SITE BOUNDARY X(m): 256375;Y(m): 242933	48.5
24-HOUR AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY*** X(m): 256523;Y(m):242991	19.4
	OUTSIDE SITE BOUNDARY X(m): 256336;Y(m):243135	9.65
98-PERCENTILE OF 24-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS	***INSIDE SITE BOUNDARY*** X(m): 256523;Y(m):242991	6.19
	OUTSIDE SITE BOUNDARY X(m): 256375;Y(m): 242933	3.28
ANNUAL AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY***	0.56
	OUTSIDE SITE BOUNDARY	0.35

Table 9 Air quality impact predictions – airborne pollutants; max emission rate

Emission sources Cement Kiln
Pollutant NO_2

STATISTICAL PARAMETER	LOCATION OF HIGHEST VALUE PREDICTED	HIGHEST PREDICTED VALUE, $\mu g/m^3$
1-HOUR AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY*** X(m): 256523;Y(m): 242991	167.2
	OUTSIDE SITE BOUNDARY X(m): 256375;Y(m): 242933	77.5
24-HOUR AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY*** X(m): 256523;Y(m):242991	31.1
	OUTSIDE SITE BOUNDARY X(m): 256336;Y(m):243135	15.4
98-PERCENTILE OF 1-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS	***INSIDE SITE BOUNDARY*** X(m): 256518;Y(m): 242949	8.08
	OUTSIDE SITE BOUNDARY X(m): 259514;Y(m): 242067	7.22
50-PERCENTILE OF 1-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS	***INSIDE SITE BOUNDARY***	0
	OUTSIDE SITE BOUNDARY	0

Table 10 Air quality impact predictions – airborne pollutants; max emission rate

Emission sources Cement Kiln
Pollutant CO

STATISTICAL PARAMETER	LOCATION OF HIGHEST VALUE PREDICTED	HIGHEST PREDICTED VALUE, $\mu g/m^3$
1-HOUR AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY*** X(m): 256523;Y(m):242991	313.4
	OUTSIDE SITE BOUNDARY X(m): 256375;Y(m):242933	145.4
8-HOUR AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY*** X(m): 256523;Y(m):242991	106.6
	OUTSIDE SITE BOUNDARY X(m): 255753;Y(m): 242088	52.6

Table 11 Air quality impact predictions – dust deposition; max emission rate

Emission sources Cement Kiln
Pollutant Dust deposition

STATISTICAL PARAMETER	LOCATION OF HIGHEST VALUE PREDICTED	HIGHEST PREDICTED VALUE, mg/m^2-day
DUST DEPOSITION RATE mg/m^2-day	***OUTSIDE SITE BOUNDARY***	1.43

Table 12 Air quality impact predictions – airborne pollutants; max emission rate

Emission sources All emission sources
Pollutant Total particulates and PM_{10}

STATISTICAL PARAMETER	LOCATION OF HIGHEST VALUE PREDICTED	HIGHEST PREDICTED VALUE, $\mu g/m^3$
1-HOUR AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY*** X(m): 256523;Y(m): 242991	142.5
	OUTSIDE SITE BOUNDARY X(m): 257003;Y(m): 242404	92.8
24-HOUR AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY*** X(m): 257061;Y(m): 242517	42.5
	OUTSIDE SITE BOUNDARY X(m): 257030;Y(m): 242251	27.9
99-PERCENTILE OF 1-HOUR AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY*** X(m): 256518;Y(m): 242949	47.6
	OUTSIDE SITE BOUNDARY X(m): 257105;Y(m): 242422	30.3
99-PERCENTILE OF 24-HOUR AVERAGE GROUND LEVEL CONCENTRATION 99	***INSIDE SITE BOUNDARY*** X(m): 256768;Y(m): 242704	22.0
	OUTSIDE SITE BOUNDARY X(m): 256487;Y(m): 242699	14.5
ANNUAL AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY***	5.07
	OUTSIDE SITE BOUNDARY	2.13

Table 13 Air quality impact predictions – dust deposition; max emission rate

Emission sources All emission sources
Pollutant Dust deposition

STATISTICAL PARAMETER	LOCATION OF PREDICTED VALUE	mg/m^2-day
DUST DEPOSITION RATE mg/m^2-day	***OUTSIDE SITE BOUNDARY***	97.0

Table 14 Air quality impact predictions – airborne pollutants; average emission rate

Emission sources Cement Kiln
Pollutant Total particulates and PM_{10}

STATISTICAL PARAMETER	LOCATION OF HIGHEST VALUE PREDICTED	HIGHEST PREDICTED VALUE. $\mu g/m^3$
1-HOUR AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY*** X(m): 256523;Y(m):242991	2.11
	OUTSIDE SITE BOUNDARY X(m): 256375;Y(m): 242933	0.98
24-HOUR AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY*** X(m): 256523;Y(m): 242991	0.39
	OUTSIDE SITE BOUNDARY X(m): 256336;Y(m): 243135	0.20
99-PERCENTILE OF 1-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS	***INSIDE SITE BOUNDARY*** X(m): 256523;Y(m):242991	0.46
	OUTSIDE SITE BOUNDARY X(m): 256375;Y(m): 242933	0.25
99-PERCENTILE OF 24-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS	***INSIDE SITE BOUNDARY*** X(m): 256518;Y(m): 242949	0.17
	OUTSIDE SITE BOUNDARY X(m): 256336;Y(m): 243135	0.09
ANNUAL AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY***	0.011
	OUTSIDE SITE BOUNDARY	0.007

Table 15 Air quality impact predictions – airborne pollutants; average emission rate

Emission sources Cement Kiln
Pollutant SO_2

STATISTICAL PARAMETER	LOCATION OF HIGHEST VALUE PREDICTED	HIGHEST PREDICTED VALUE, $\mu g/m^3$
1-HOUR AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY*** X(m): 256523;Y(m):242991	73.2
	OUTSIDE SITE BOUNDARY X(m): 256375;Y(m): 242933	34.0
24-HOUR AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY*** X(m): 256523;Y(m): 242991	13.6
	OUTSIDE SITE BOUNDARY X(m): 256336;Y(m): 243135	6.76
98-PERCENTILE OF 24-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS	***INSIDE SITE BOUNDARY*** X(m): 256523;Y(m):242991	4.33
	OUTSIDE SITE BOUNDARY X(m): 256375;Y(m): 242933	2.30
ANNUAL AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY***	0.40
	OUTSIDE SITE BOUNDARY	0.25

Table 16 Air quality impact predictions – airborne pollutants; average emission rate

Emission sources Cement Kiln
Pollutant NO_2

STATISTICAL PARAMETER	LOCATION OF HIGHEST VALUE PREDICTED	HIGHEST PREDICTED VALUE, $\mu g/m^3$
1-HOUR AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY*** X(m): 256523;Y(m):242991	114.9
	OUTSIDE SITE BOUNDARY X(m): 256375;Y(m): 242933	53.3
24-HOUR AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY*** X(m): 256523;Y(m): 242991	21.3
	OUTSIDE SITE BOUNDARY X(m): 256336;Y(m): 243135	10.6
98-PERCENTILE OF 1-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS	***INSIDE SITE BOUNDARY*** X(m): 256518;Y(m): 242949	5.55
	OUTSIDE SITE BOUNDARY X(m): 259514;Y(m): 242067	4.97
50-PERCENTILE OF 1-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS	***INSIDE SITE BOUNDARY***	0
	OUTSIDE SITE BOUNDARY	0

Table 17 Air quality impact predictions – airborne pollutants; average emission rate

Emission sources Cement Kiln
Pollutant CO

STATISTICAL PARAMETER	LOCATION OF HIGHEST VALUE PREDICTED	HIGHEST PREDICTED VALUE, $\mu g/m^3$
1-HOUR AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY*** X(m): 256523;Y(m): 242991	250.8
	OUTSIDE SITE BOUNDARY X(m): 256357;Y(m): 242933	116.3
8-HOUR AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY*** X(m): 256523;Y(m): 242991	85.3
	OUTSIDE SITE BOUNDARY X(m): 255753;Y(m): 242088	42.1

Table 18 Air quality impact predictions – dust deposition; average emission rate

Emission sources Cement Kiln
Pollutant Dust deposition

STATISTICAL PARAMETER	LOCATION OF PREDICTED VALUE	AVERAGE PREDICTED VALUE, mg/m^2-day
DUST DEPOSITION RATE mg/m^2-day	***OUTSIDE SITE BOUNDARY***	0.24

Table 19 Air quality impact predictions – airborne pollutants; average emission rate

Emission sources All emission sources
Pollutant Total particulates and PM_{10}

STATISTICAL PARAMETER	LOCATION OF HIGHEST VALUE PREDICTED	HIGHEST PREDICTED VALUE, $\mu g/m^3$
1-HOUR AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY*** X(m): 256523;Y(m): 242991	71.2
	OUTSIDE SITE BOUNDARY X(m): 257003;Y(m): 242404	46.4
24-HOUR AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY*** X(m): 257061;Y(m): 242517	21.3
	OUTSIDE SITE BOUNDARY X(m): 257030;Y(m): 242251	13.8
99-PERCENTILE OF 1-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS	***INSIDE SITE BOUNDARY*** X(m): 256518;Y(m): 242949	23.4
	OUTSIDE SITE BOUNDARY X(m): 257105;Y(m): 242422	15.1
99-PERCENTILE OF 24-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS	***INSIDE SITE BOUNDARY*** X(m): 256768;Y(m): 242704	11.0
	OUTSIDE SITE BOUNDARY X(m): 256487;Y(m): 242699	7.22
ANNUAL AVERAGE GROUND LEVEL CONCENTRATION	***INSIDE SITE BOUNDARY***	2.52
	OUTSIDE SITE BOUNDARY	1.05

Table 20 Air quality impact predictions – dust deposition; average emission rate

Emission sources All emission sources
Pollutant Dust deposition

STATISTICAL PARAMETER	LOCATION OF PREDICTED VALUE	mg/m^2-day
DUST DEPOSITION RATE mg/m^2-day	***OUTSIDE SITE BOUNDARY***	48.8

5.0 EVALUATION OF THE IMPACT OF THE DEVELOPMENT

5.1 Cement kiln emissions

The maximum potential impact of the plant emissions on ambient air quality is associated with the maximum potential emission rate of pollutants from the plant. The main source of emissions from the plant is the cement kiln and the potential maximum impact of emissions from this source on ambient air quality has been assessed, with particular attention focused on demonstrating that the proposed stack height is adequate for the proposed development. The results of the assessment are presented in Tables 7 – 11 and in Tables 14 - 18 and in Addendum I. A summary of the results of the modelling study is presented in Table 21 together with the Air Quality Standards which are utilised to assess the significance of the impact on ambient air quality. A review of the significance of the impact of these emissions on ambient air quality is presented in the following sections.

Particulate matter and PM_{10}

There are two effects of particulate and/or PM_{10} emissions on ambient air quality which are considered in this study. Emissions of particulates from the main emission sources will contribute to both airborne particulate concentrations and to dust deposition on surfaces. The emissions from the cement manufacturing process emission sources will be in the sub-10μm size range ie PM_{10}. Consequently, the assessment of the significance of airborne particulate concentrations will be based on using the assessment criteria for this parameter.

The modelling results for airborne particulate concentrations are presented in Tables 7 and 13 for maximum and average emission rates from the cement kiln, respectively. Even using the more stringent assessment criteria for PM10, the predicted ground level concentrations are substantially lower than the EU Air Quality Standards. At the maximum possible emission rate from the cement kiln, the predicted maximum 24-hour average ground level concentration is less than 1.9% of the Limit Value and under the average emission conditions which are considered to be more representative of the emissions from the cement kiln, the predicted maximum 24-hour ground level concentration is substantially less than 1% of the Limit Value.

The distribution of predicted 99-percentiles of 24-hour average ground level concentrations is shown in Drawing 9, Addendum I. The distribution is similar to the distribution of the 1-hour and 24-hour average GLCs shown in Drawings 1 and 5.

The deposition of dust as a result of emissions from the cement kiln has also been considered in this assessment and the results are presented in Table 11 (maximum potential emission rate) and Table 18 (average particulate emission rate). The dust deposition is assessed as an average of the daily dust deposition rates over the assessment period. As shown in Tables 11 and 18, the predictions clearly indicate that the average daily dust deposition rates are significantly lower than the Guideline of 150 mg/m^2-day which is the assessment criterion used to ensure that no adverse nuisance impacts result from such depositions. There are no adverse impacts predicted as a result of particulate emissions from the cement kiln.

Sulphur dioxide

The maximum predicted increments to ground level concentrations of sulphur dioxide in the vicinity of the plant are presented in Tables 8 and 15, and a summary of all of the impact predictions is presented in Table 21 together with the assessment criteria used to evaluate the significance of the modelling results. Two sets of modelling data were acquired to assess the impact of emissions of SO_2 from the cement kiln; both maximum (Table 8) and average (Table 15) emission rates from the source were modelled. The maximum impact of the emissions will arise when the emission rates are at a maximum and these potential worse case scenarios are used as the basis for predicting the worst possible impact of the emissions on ambient air quality.

The predicted maximum 98-percentile of 24-hour average concentrations is substantially lower than the Air Quality Standard defined in the EU Directive, while the predicted increments to the annual mean and maximum 1-hour average ground level concentrations are also substantially lower than the relevant EU and WHO Guideline values. As is clear from a comparison of the data presented in Tables 8 and 15, the average emissions from the kiln are significantly lower than the potential maximum emissions and hence the impact on ambient air quality is even less than that predicted from a consideration of the maximum emission rates from the kiln.

The distribution of predicted 98-percentiles of 24-hour average ground level concentrations is shown in Drawing 10, Addendum I. The distribution is similar to the distribution of the 1-hour and 24-hour average GLCs shown in Drawings 2 and 6.

The predicted impacts of emissions of SO_2 from the cement kiln are well within the relevant Air Quality Standards and do not result in an adverse impact on ambient air quality in the vicinity of the plant. The emissions will not result in breaches of the EU Air Quality Standards.

Nitrogen dioxide

The maximum predicted increments to ground level concentrations of nitrogen dioxide in the vicinity of the plant are presented in Tables 9 and 16. As before, a summary of all of the impact predictions is presented in Table 21 together with the assessment criteria used to evaluate the significance of the modelling results. Two sets of modelling data were acquired to assess the impact of emissions of NO_2 from the cement kiln; both maximum (Table 9) and average (Table 16) emission rates from the source were modelled. The maximum impact of the emissions will arise when the emission rates are at a maximum and these potential worse case scenarios are used as the basis for predicting the worst possible impact of the emissions on ambient air quality.

The main assessment criterion is the 98th percentile of one-hour average concentration of nitrogen dioxide. The predicted maximum 98-percentile of 1-hour average concentrations is less than 3.6% of the Air Quality Standard defined in the EU Directive at maximum emission rate from the kiln and about 2.5% of the Limit Value under average emission conditions.

The distribution of predicted 98-percentiles of 1-hour average ground level concentrations is shown in Drawing 11, Addendum I. The distribution is similar to the distribution of the 1-hour and 24-hour average GLCs shown in Drawings 3 and 7.

The predicted impacts of emissions of NO_2 from the cement kiln are well within the relevant Air Quality Standards and do not result in an adverse impact on ambient air quality in the vicinity of the plant. The emissions will not result in breaches of the EU Air Quality Standards.

Carbon Monoxide

The maximum predicted increments to ground level concentrations of carbon monoxide in the vicinity of the plant are presented in Tables 10 and 17. As before, a summary of all of the impact predictions is presented in Table 21 together with the assessment criteria used to evaluate the significance of the modelling results. Two sets of modelling data were acquired to assess the impact of emissions of CO from the cement kiln; both maximum (Table 10) and average (Table 17) emission rates from the source were modelled. The maximum impact of the emissions will arise when the emission rates are at a maximum and these potential worse case scenarios are used as the basis for predicting the worst possible impact of the emissions on ambient air quality.

There are no EU Air Quality Standards for CO. In the absence of such limits, the WHO Guidleines are used as the key assessment criterion. The predicted maximum of 1-hour and 8-hour average concentrations are substantially less than 1% of the Guideline values under both maximum and average emission conditions.

The distribution of predicted 1-hour and 8-hour average ground level concentrations is shown in Drawings 4 and 8, Addendum I.

The predicted impacts of emissions of CO from the cement kiln are insignificant and do not result in an adverse impact on ambient air quality in the vicinity of the plant. The emissions will not result in breaches of the WHO Guidelines.

Location of highest predicted values

The dispersion modelling study identified receptors inside and outside the site boundary where the highest predicted ground level concentrations occur. It was noted during the review of the dispersion modelling outputs that elevated ground level concentrations of pollutants occur on site on the 28m screening mound north of the cement plant works area. This is not an area where personnel will be working and so there are no exposure issues to be considered. The highest predicted ground level concentrations of all pollutants and for all statistical averaging periods in this area are still well within the relevant Air Quality Standards. Dispersion model outputs for PM10 distribution also show areas of elevated concentration in the region surrounding the 5m berm at the southern site boundary.

5.2 Particulate emissions from the entire plant

In addition to the cement kiln, particulate emissions may be released from 22 other main process emission sources. Fugitive losses from sources related to the quarrying and cement manufacturing operations are insignificant relative to the main process emissions. The impact of particulate emissions from all sources at the plant has been assessed and the results are presented in Tables 12 and 13 (maximum potential emission rate from all sources) and Tables 19 and 20 (average emission rate from all emission sources). A graphical representation of air quality impact is included in Drawings 12 and 13, Addendum I.

As was the case when considering the impact of particulate emissions from the cement kiln, the impact of particulate emissions from the entire cement manufacturing plant is considered in terms of both airborne particulate concentrations and daily dust deposition rate. Since the particulate emissions from the cement manufacturing process emission sources will be in the sub-10μm size range ie PM_{10}, the assessment of the significance of airborne particulate concentrations will be based on using the assessment criteria for this parameter.

The modelling results for airborne particulate concentrations are presented in Tables 12 and 19 for maximum and average emission rates from the cement plant, respectively. Even using the more stringent assessment criteria for PM_{10}, the predicted ground level concentrations are substantialiy lower than the EU Air Quality Standards. At the maximum possible emission rate from all of the process emission sources, the predicted maximum 24-hour average ground level concentration is substantially lower than the Limit Value. Under the average emission conditions which are considered to be more representative of the emissions from the plant, the predicted maximum 24-hour ground level concentration is approximately 50% of the level predicted under maximum emission conditions and significantly lower than the Limit Value.

The deposition of dust as a result of emissions from process emission sources at the cement manufacturing plant has also been considered in this assessment and the results are presented in Table 13 (maximum potential emission rate) and Table 20 (average particulate emission rate). The dust deposition is assessed as an average of the daily dust deposition rates over the assessment period. It is clear from the results of the study that the dust deposition rates are substantially lower than the 150 mg/m^2-day assessment criterion. There will be no adverse impact on ambient air quality in the vicinity of the plant as a result of the proposed development.

Table 21 Predicted increments to ground level concentrations (GLCs) of pollutants emitted from the cement kiln at receptors outside the site boundary

Air Quality Standard		Maximum predicted increment to ground level concentration, $\mu g/m^3$	Parameter and averaging period
Source	$\mu g/m^3$		
			Particulates
EU Directive Limit value	150	0.056	Annual mean
			PM_{10}
EPAQS	50	0.44	99-percentile of 24-hour running mean
EU Directive	50	1	24-hour mean
	30	0.056	Annual mean
			NO_2
EU Directive			
Limit value	200	7	98-percentile of hourly means
Guide Value	135	7	98-perentile of hourly means
	50	0	50^{th}-percentile of hourly means
WHO Guideline	40 – 50	-	Annual mean
	200	77	Maximum of one-hour means
			SO_2
EU Directive Limit value	350 if smoke = or < 150 250 if smoke > 150	3	98-percentile of daily means; no more than three consecutive days
	180 if smoke = or < 60 130 if smoke > 60	-	Winter median of daily mean values
	120 if smoke = or < 40 80 if smoke > 40	-	Annual median of daily mean values
Guide Value	40 – 60	0.35	Annual mean
WHO Guideline	50	0.56	Annual mean
	350	48	Maximum one-hour mean
	500	-	Maximum 10-minute mean
			CO
WHO Guideline	10,000	53	8-hour mean
	30,000	145	One-hour mean
Guideline	150 mg/m^2-day	1	**Particulate deposition rate**

6.0 CONCLUSIONS

A comprehensive evaluation of the potential impact of emissions from the proposed cement manufacturing plant and associated activities on ambient air quality has been completed. The results of the study demonstrate unambiguously that there will be no significant adverse impacts on ambient air quality in the vicinity of the plant.

The main assessment criteria used were the relevant European Union and World Health Organisation Air Quality Standard Limit and Guide values for criteria pollutants. In particular, the modelling exercise demonstrated that the proposed stack height for the cement kiln, which is the main process emission source at the plant, is sufficient to ensure effective dispersion of pollutants emitted from this source. The assessment was completed using the worst-possible estimated emission rates of pollutants in order to assess the potential impact on ambient air quality. A similar assessment was completed using the predicted average emission rates from the plant, and this assessment resulted in predictions of even less significant impacts on ambient air quality.

IMPACT ASSESSMENT OF ATMOSPHERIC EMISSIONS, LANSDOWN

ADDENDUM I

Graphical representations of pollutant distributions in the vicinity of the plant

LIST OF DRAWINGS

Drawing 1 Isopleth showing 1-hour average ground level concentrations of particulate matter and PM_{10} emitted from the cement kiln

Drawing 2 Isopleth showing 1-hour average ground level concentrations of SO_2 emitted from the cement kiln

Drawing 3 Isopleth showing 1-hour average ground level concentrations of NO_2 emitted from the cement kiln

Drawing 4 Isopleth showing 1-hour average ground level concentrations of CO emitted from the cement kiln

Drawing 5 Isopleth showing 24-hour average ground level concentrations of particulate matter and PM_{10} emitted from the cement kiln

Drawing 6 Isopleth showing 24-hour average ground level concentrations of SO_2 emitted from the cement kiln

Drawing 7 Isopleth showing 24-hour average ground level concentrations of NO_2 emitted from the cement kiln

Drawing 8 Isopleth showing 8-hour average ground level concentrations of CO emitted from the cement kiln

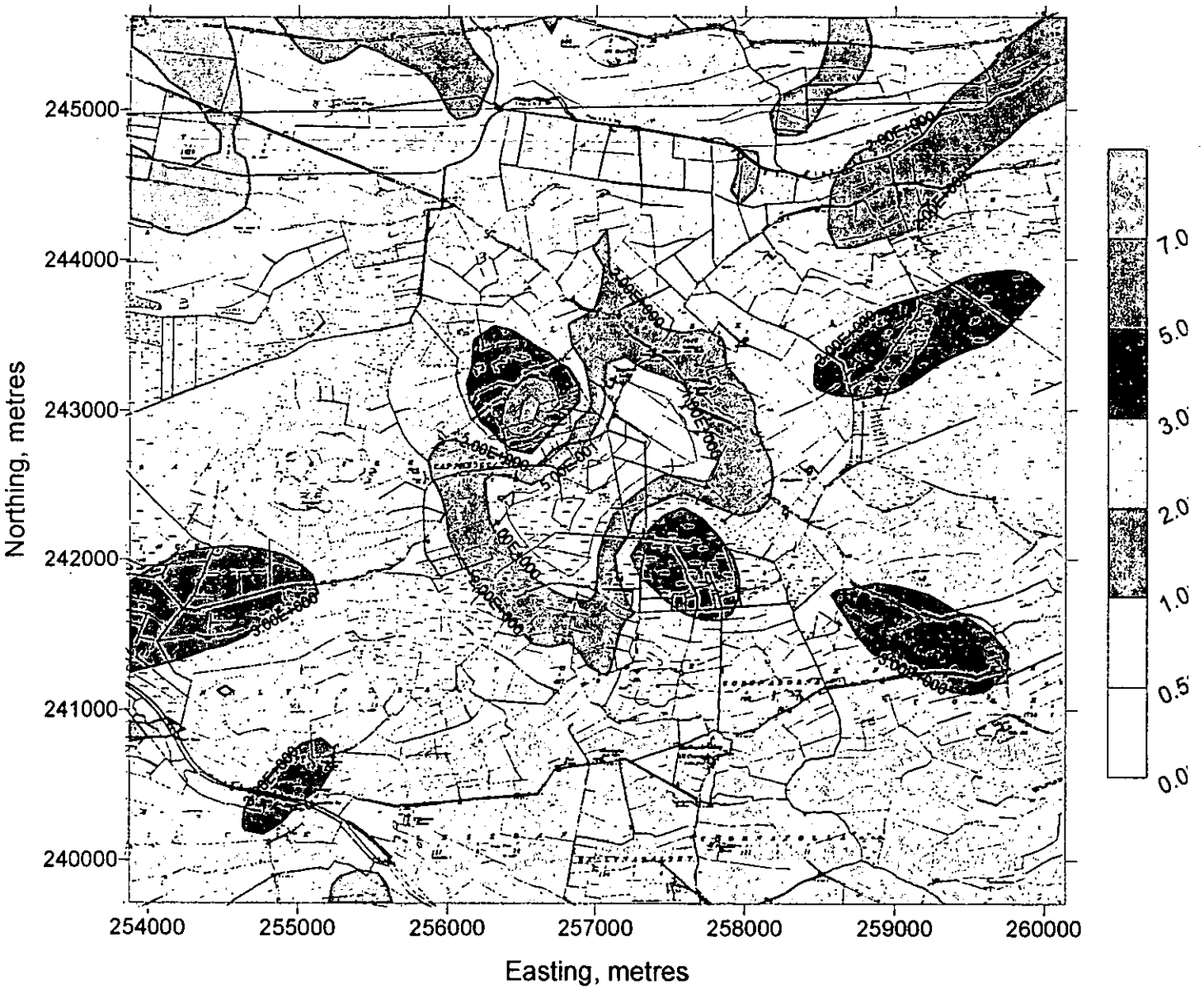
Drawing 9 Isopleth showing 99-percentile of 24-hour average ground level concentrations of particulate matter and PM_{10} emitted from the cement kiln

Drawing 10 Isopleth showing 98-percentile of 24-hour average ground level concentrations of SO_2 emitted from the cement kiln

Drawing 11 Isopleth showing 98-percentile of 24-hour average ground level concentrations of NO_2 emitted from the cement kiln

Drawing 12 Isopleth showing 24-hour average ground level concentrations of particulate matter and PM_{10} emitted from the entire cement plant at maximum potential emission rates

Drawing 13 Isopleth showing 99-percentile of 24-hour average ground level concentrations of particulate matter and PM_{10} emitted from the entire cement plant at maximum emission rates



Concentration units: $\mu g/m^3$

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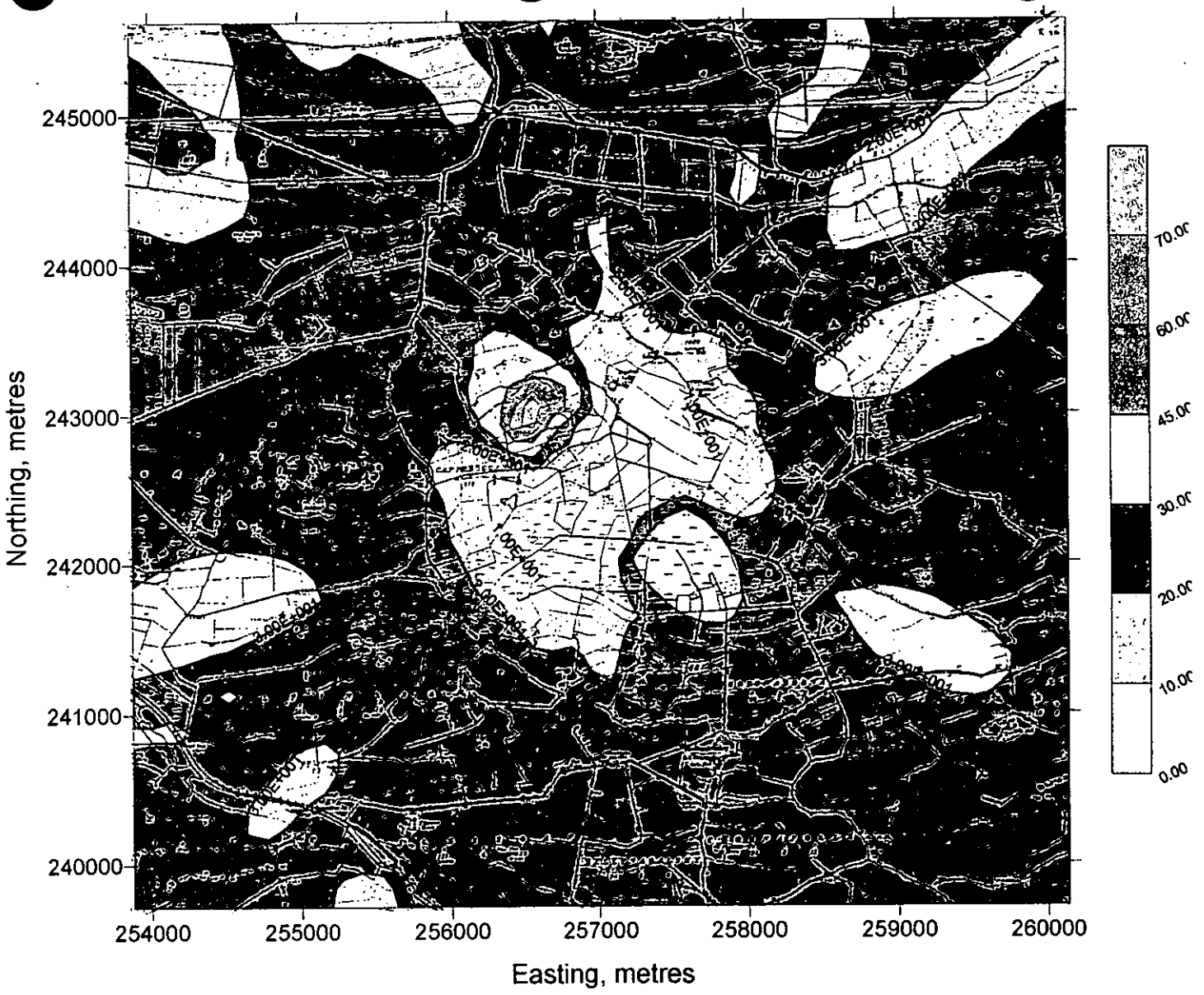
LANSDOWN CEMENT WORKS KILLASKILLEN, CO. MEATH
APPENDIX 3.5.2 : ADDENDUM 1
TITLE: **ISOPLETH SHOWING 1-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS OF PARTICULATE MATTER AND PM_{10} EMITTED FROM THE CEMENT KILN**
Drawing N° 1



Concentration units: $\mu g/m^3$

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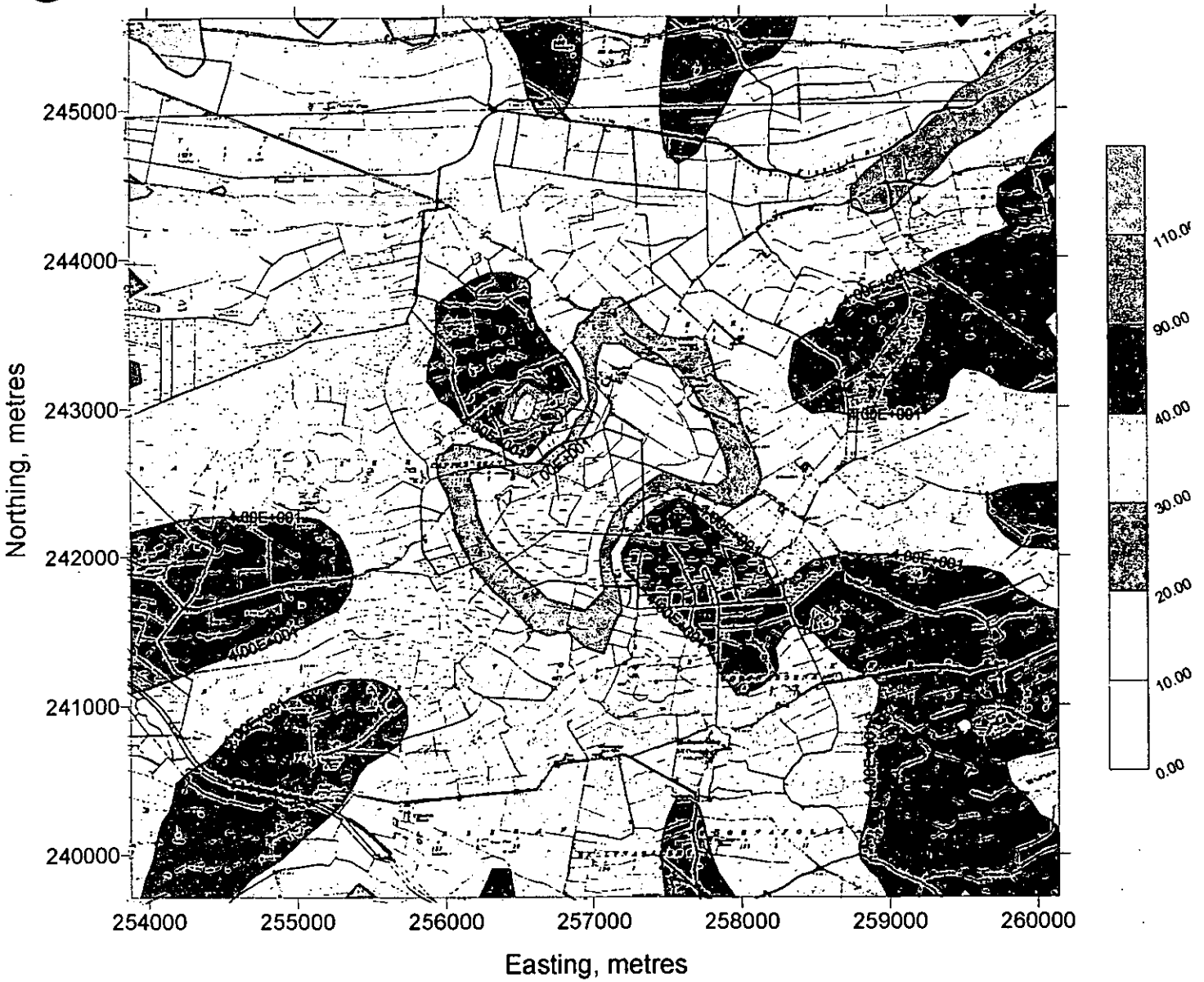
APPENDIX 3.5.2 : ADDENDUM 1

TITLE:
ISOPLETH SHOWING 1-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS OF SO_2 EMITTED FROM THE CEMENT KILN

Drawing Nº 2



Concentration units: $\mu g/m^3$

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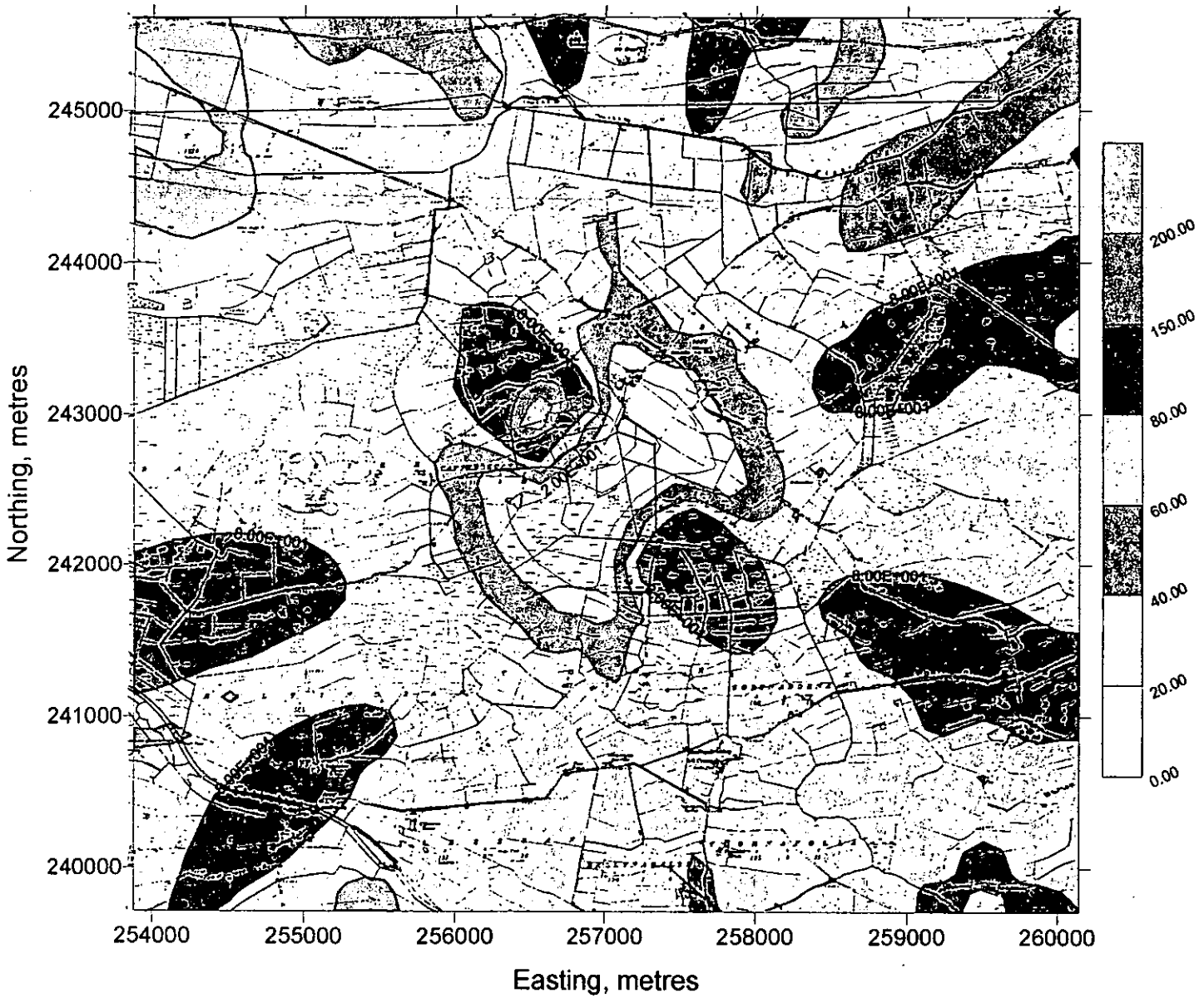
APPENDIX 3.5.2 : ADDENDUM 1

TITLE:
ISOPLETH SHOWING 1-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS OF NO_2 EMITTED FROM THE CEMENT KILN

Drawing Nº 3



Concentration units: $\mu g/m^3$

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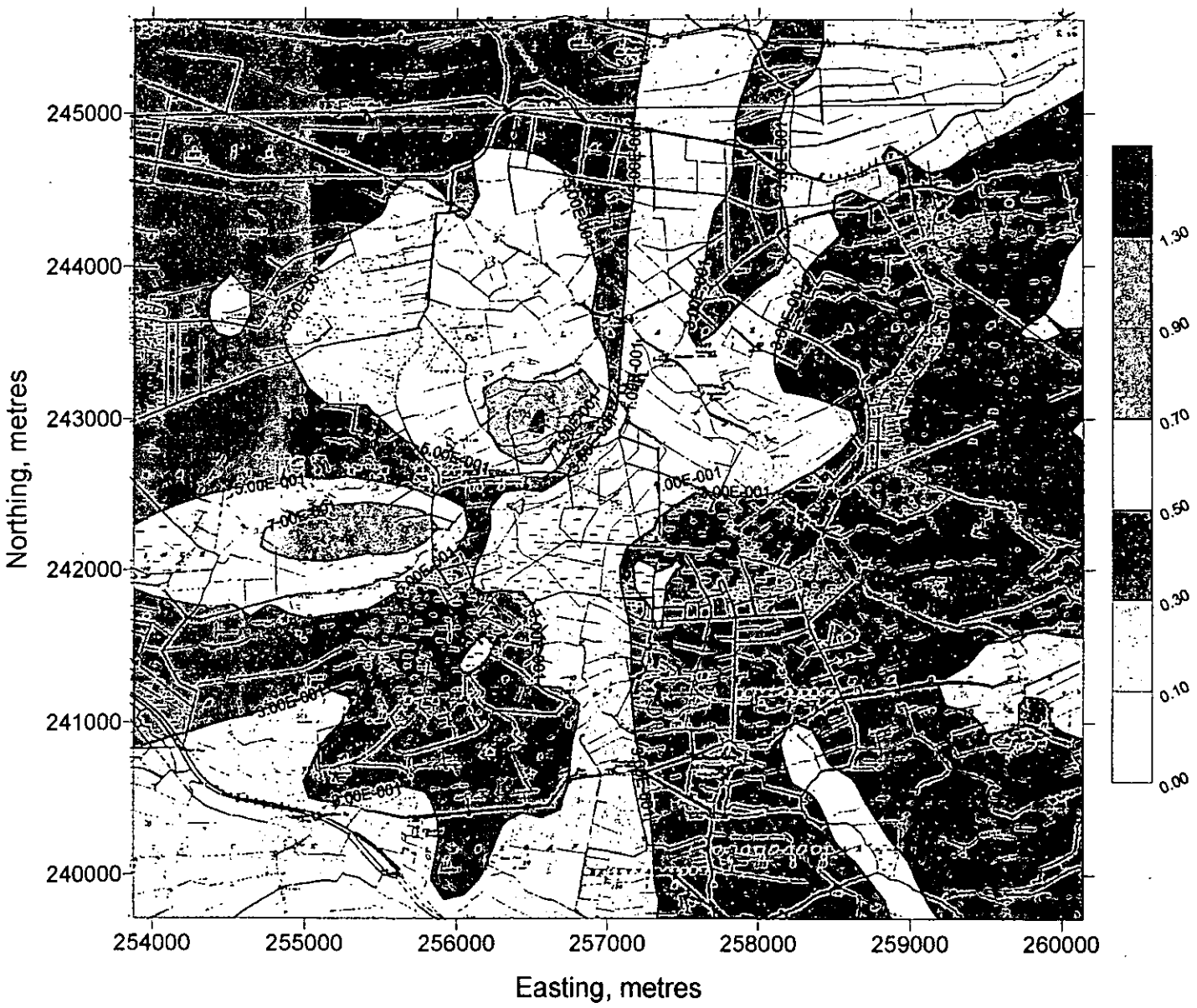
LANSDOWN CEMENT WORKS KILLASKILLEN, CO. MEATH	
APPENDIX 3.5.2 : ADDENDUM 1	
TITLE: ISOPLETH SHOWING 1-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS OF CO EMITTED FROM THE CEMENT KILN	
Drawing N°	4



Concentration units: $\mu g/m^3$

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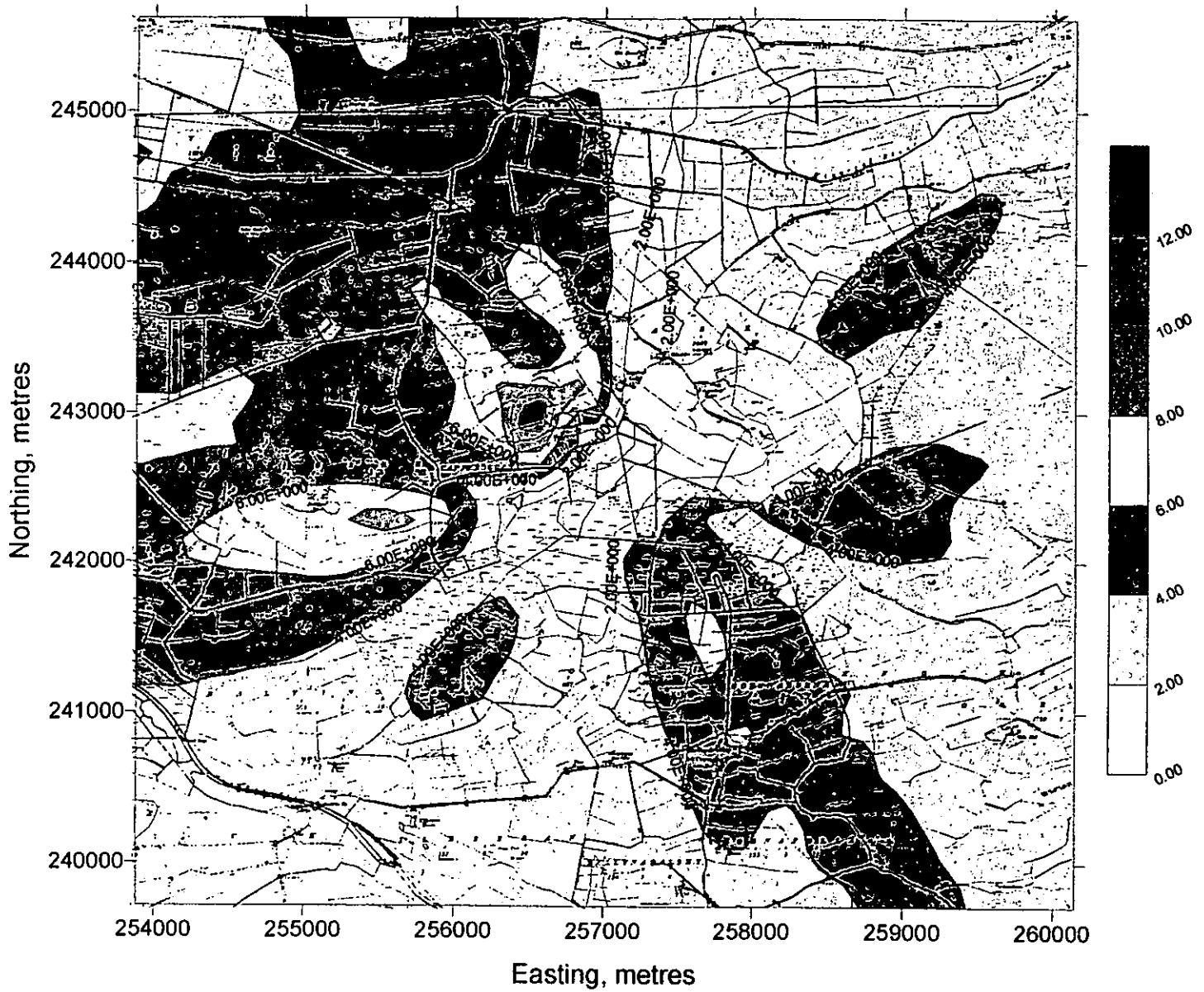
LANSDOWN CEMENT WORKS KILLASKILLEN, CO. MEATH
APPENDIX 3.5.2 : ADDENDUM 1
TITLE: **ISOPLETH SHOWING 24-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS OF PARTICULATE MATTER AND PM_{10} EMITTED FROM THE CEMENT KILN**
Drawing N° 5



Concentration units: $\mu g/m^3$

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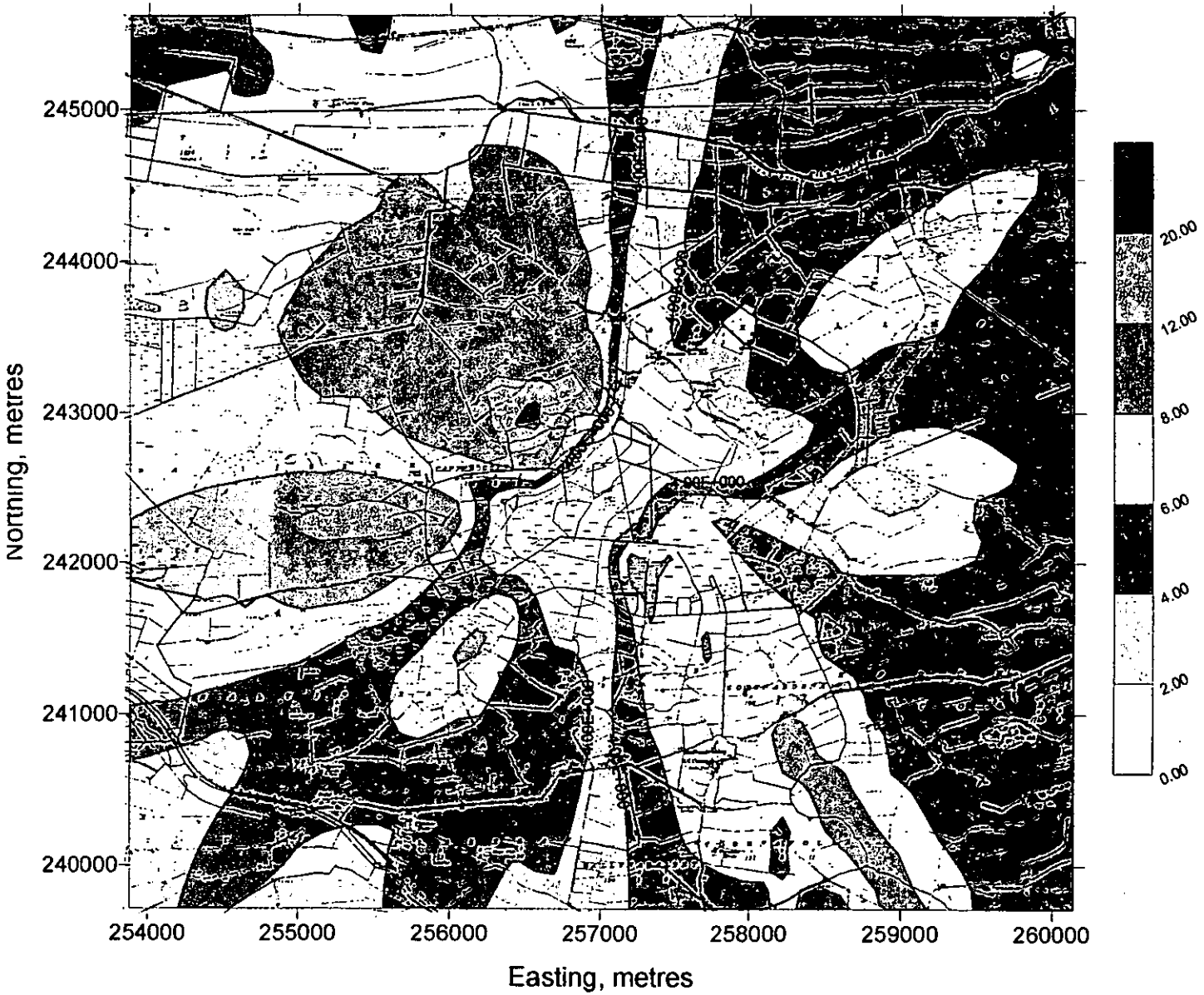
LANSDOWN CEMENT WORKS KILLASKILLEN, CO. MEATH
APPENDIX 3.5.2 : ADDENDUM 1
TITLE: **ISOPLETH SHOWING 24-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS OF SO_2 EMITTED FROM THE CEMENT KILN**
Drawing N° **6**



Concentration units: $\mu g/m^3$

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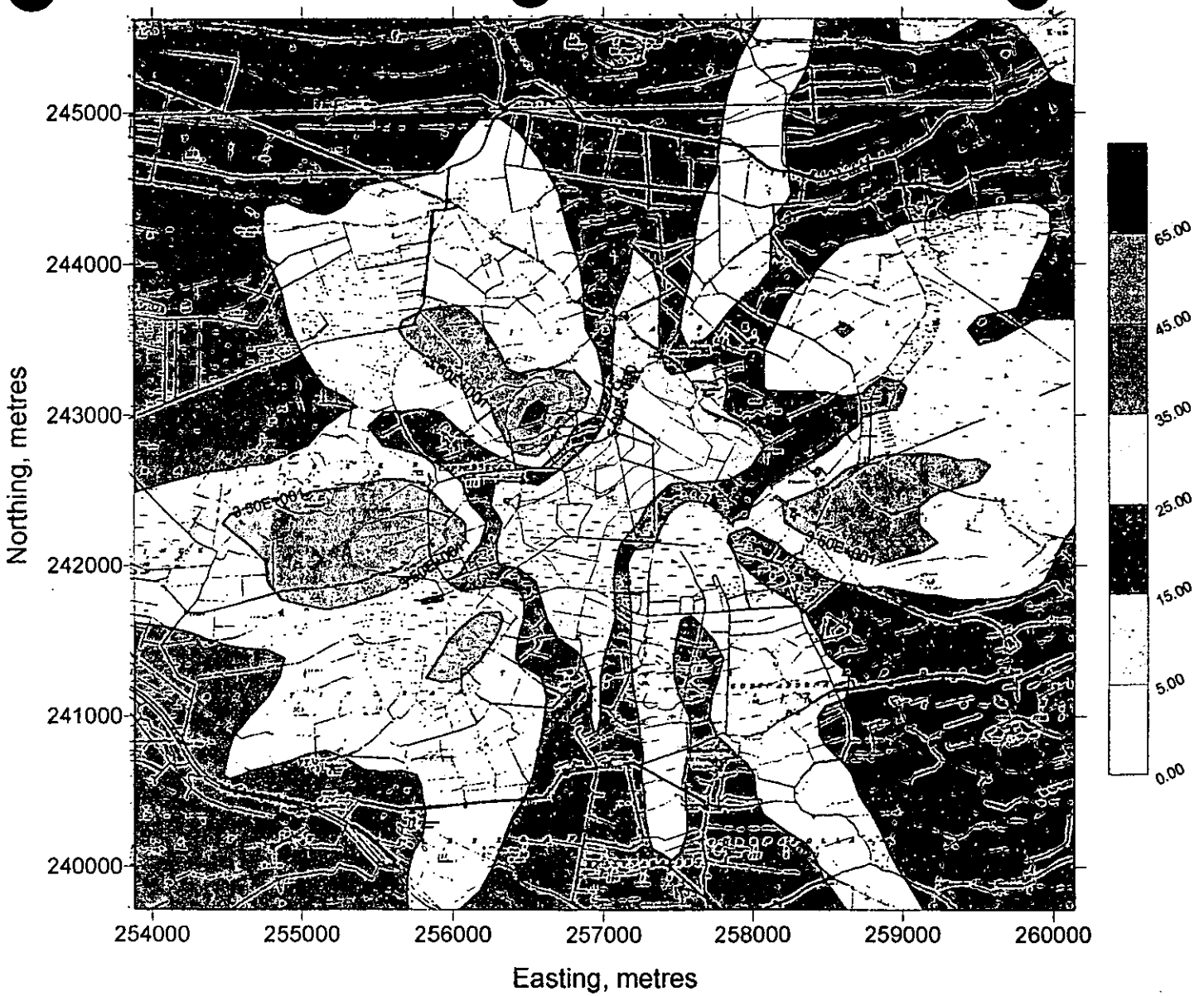
APPENDIX 3.5.2 : ADDENDUM 1

TITLE:
ISOPLETH SHOWING 24-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS OF NO_2 EMITTED FROM THE CEMENT KILN

Drawing N° 7



Concentration units: $\mu g/m^3$

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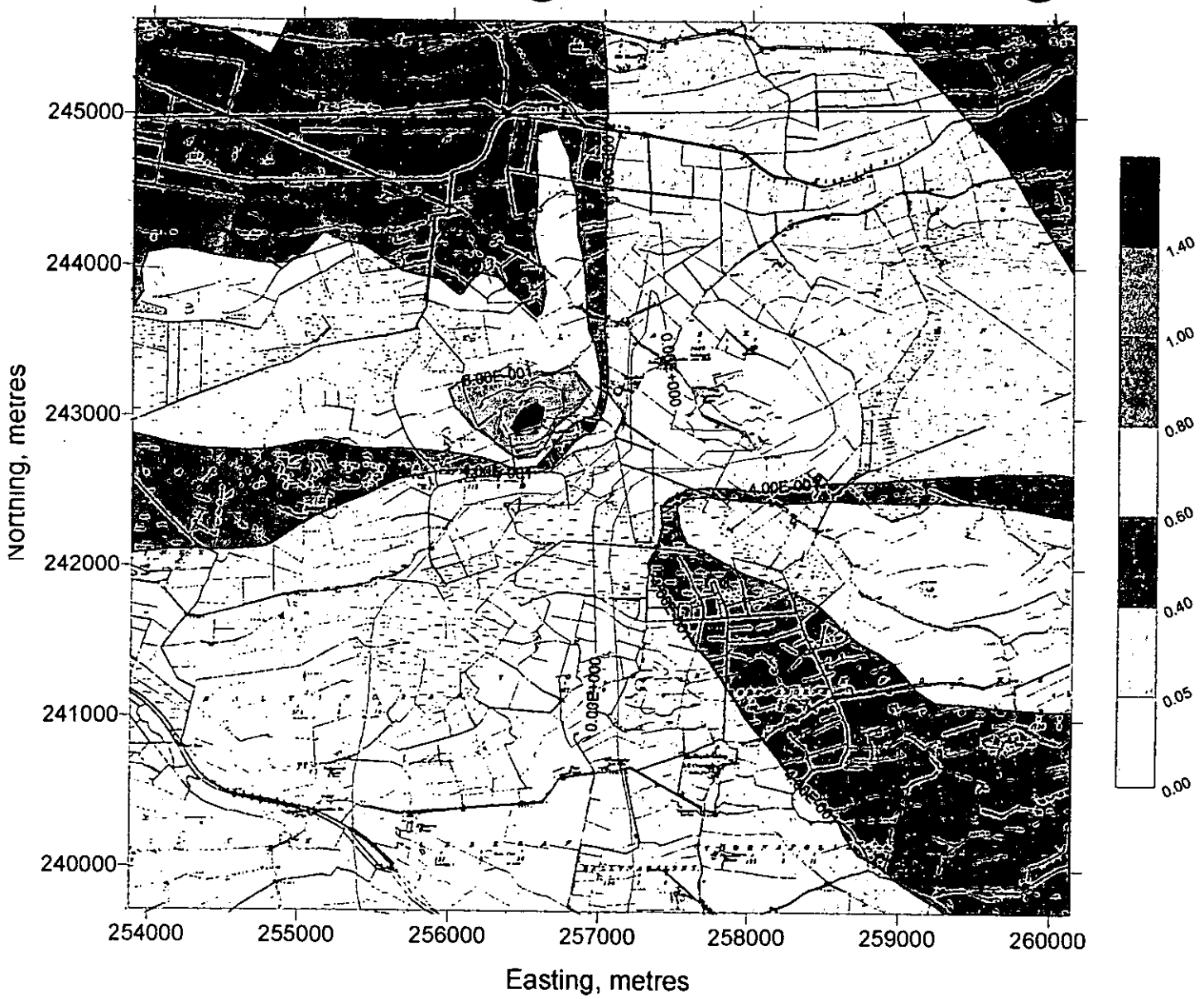
APPENDIX 3.5.2 : ADDENDUM 1

TITLE:
ISOPLETH SHOWING 8-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS OF CO EMITTED FROM THE CEMENT KILN

Drawing Nº 8



Concentration units: $\mu g/m^3$

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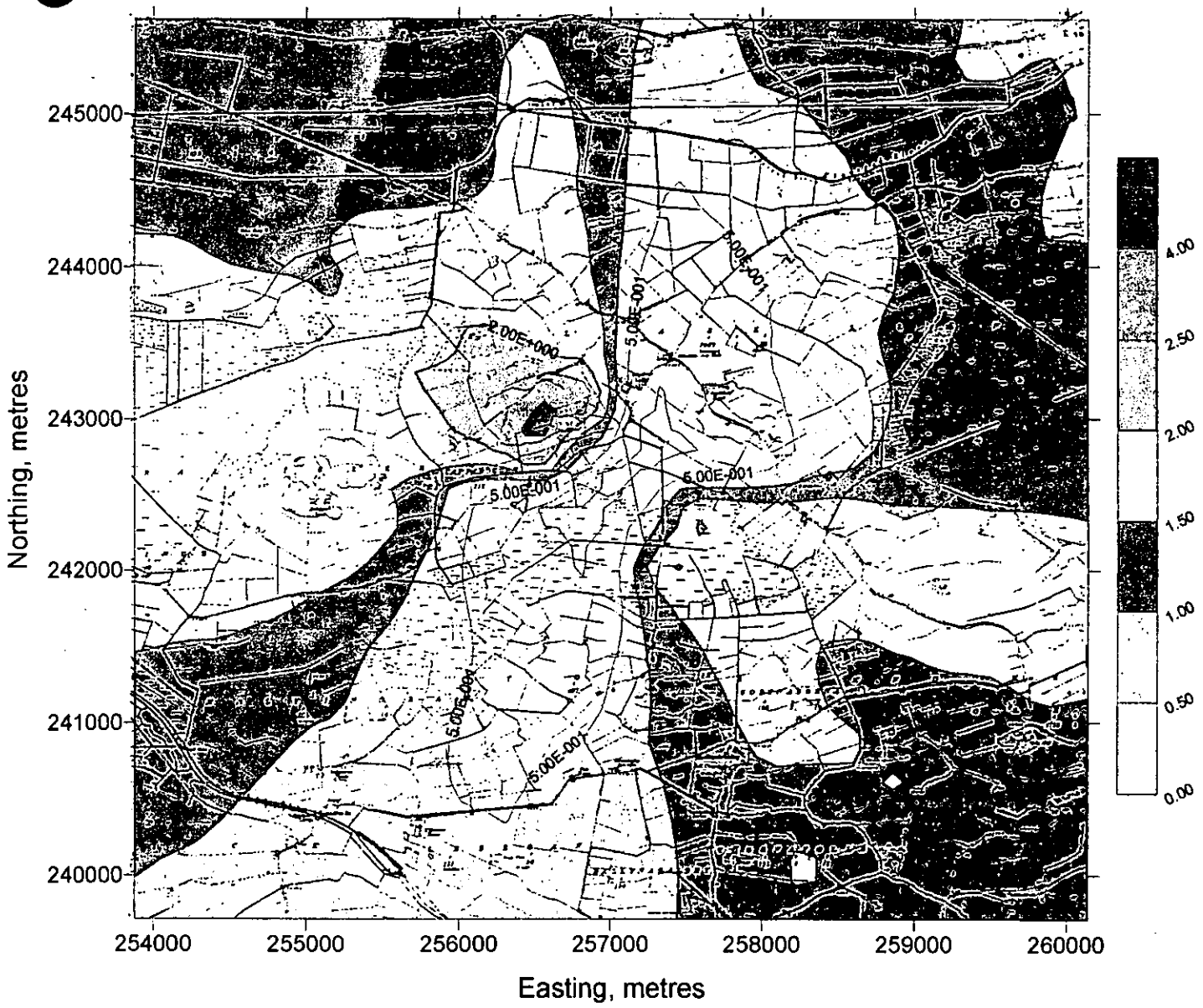
APPENDIX 3.5.2 : ADDENDUM 1

TITLE:
ISOPLETH SHOWING 99-PERCENTILE OF 24-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS OF PARTICULATE MATTER AND PM_{10} EMITTED FROM THE CEMENT KILN

Drawing N° 9



Concentration units: $\mu g/m^3$

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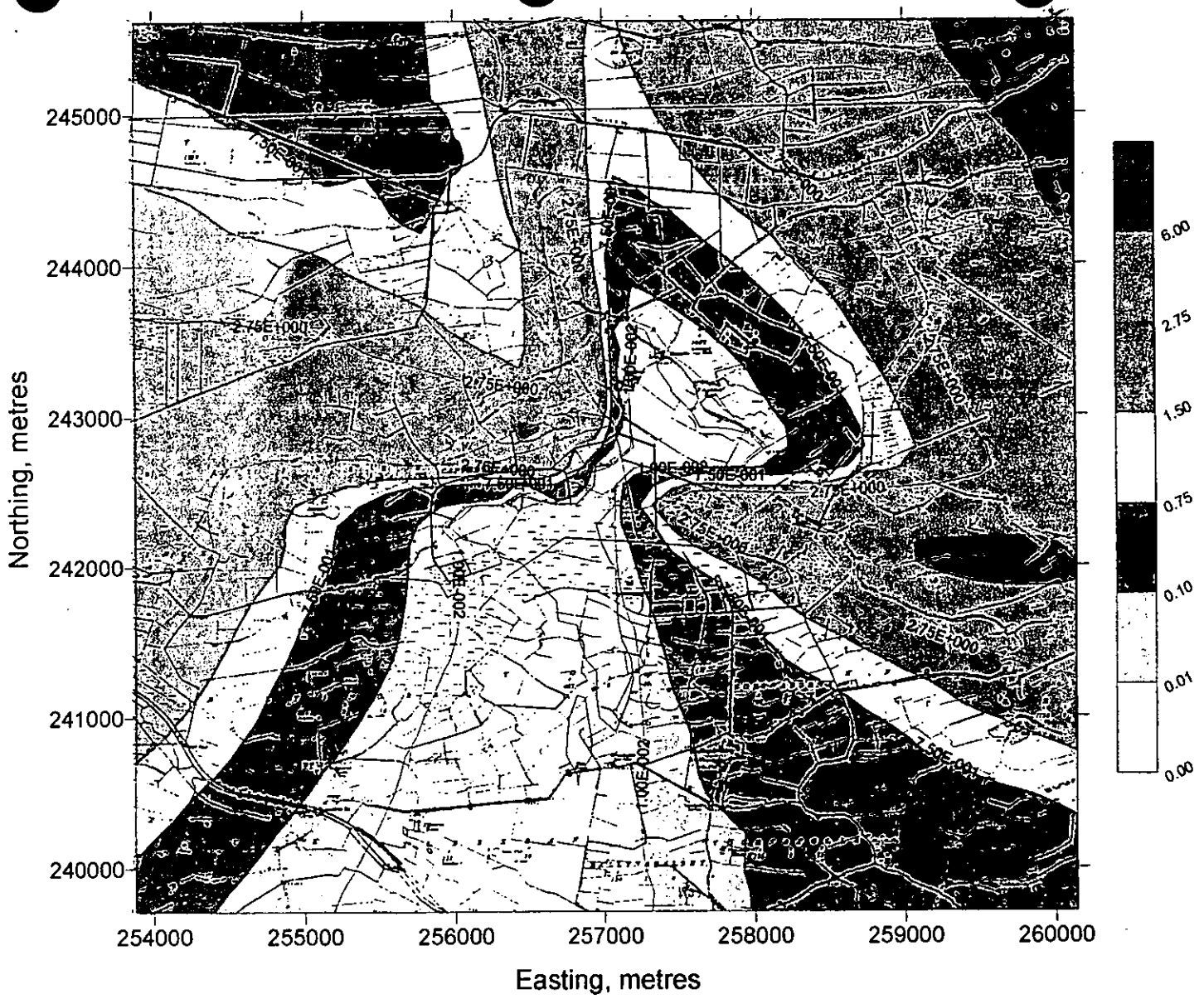
APPENDIX 3.5.2 : ADDENDUM 1

TITLE:
ISOPLETH SHOWING 98-PERCENTILE OF 24-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS OF SO_2 EMITTED FROM THE CEMENT KILN

Drawing N° 10



Concentration units: $\mu g/m^3$

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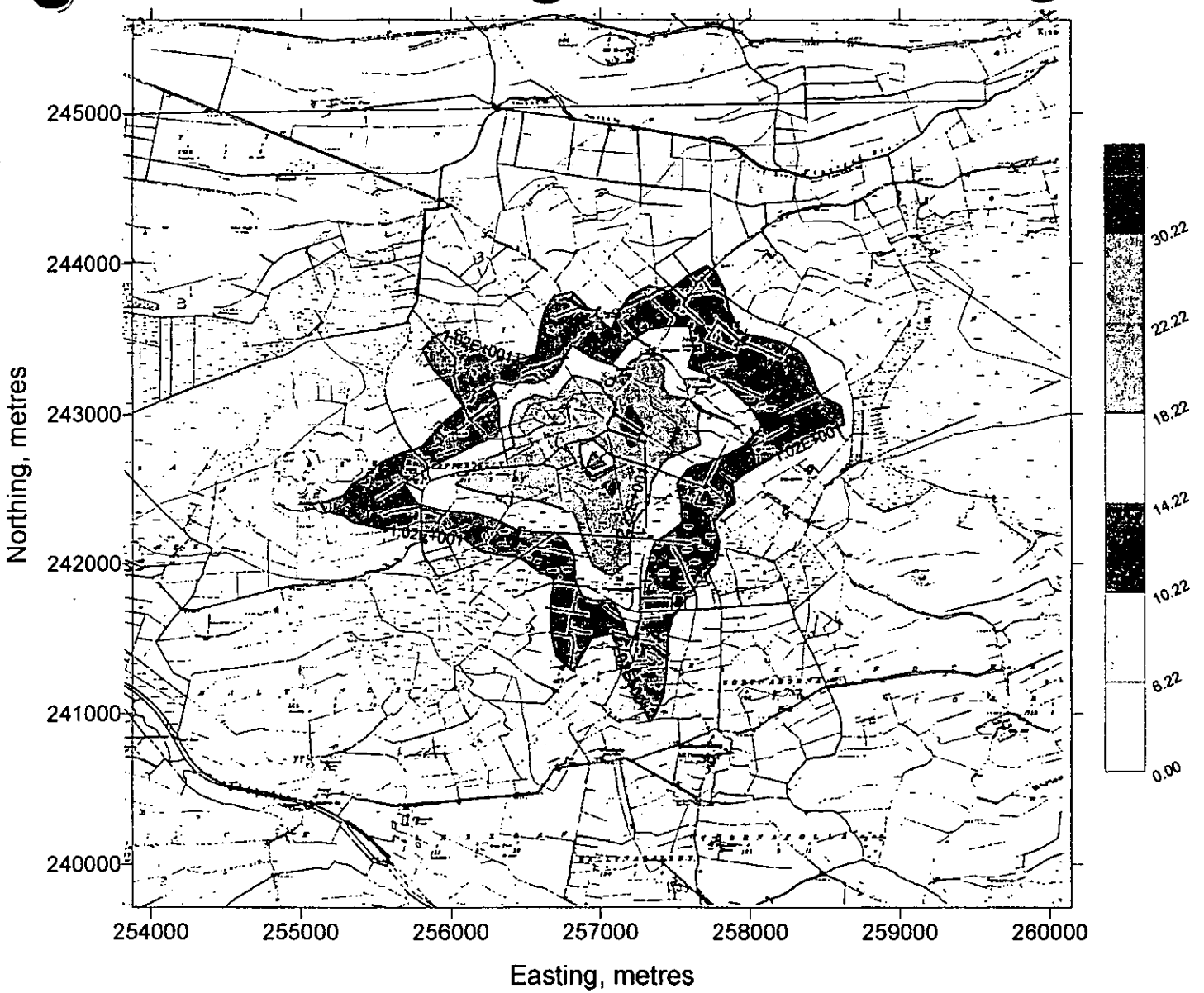
APPENDIX 3.5.2 : ADDENDUM 1

TITLE:
ISOPLETH SHOWING 98-PERCENTILE OF 24-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS OF NO_2 EMITTED FROM THE CEMENT KILN

Drawing N° 11



Concentration units: $\mu g/m^3$

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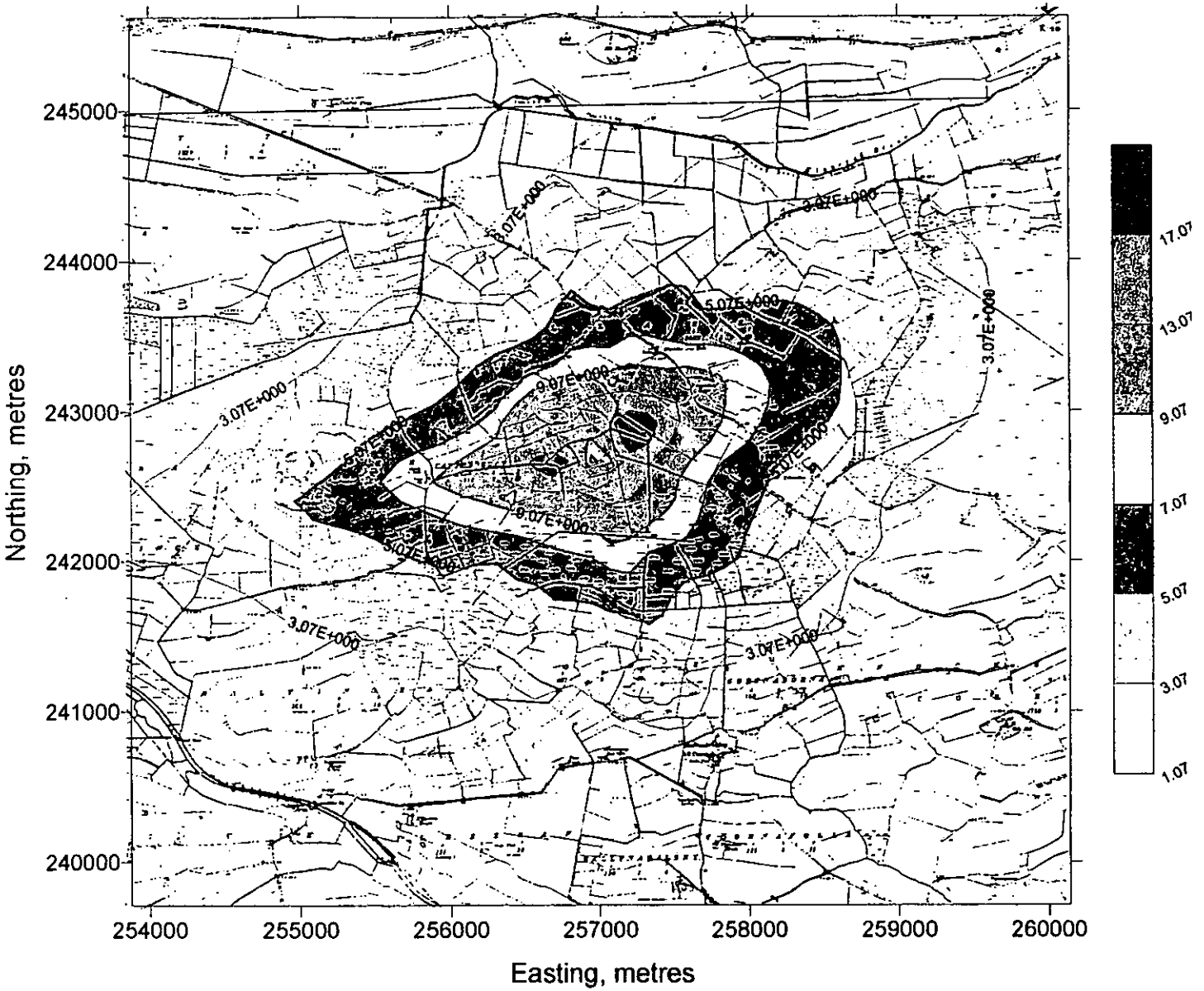
APPENDIX 3.5.2 : ADDENDUM 1

TITLE:
ISOPLETH SHOWING 24-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS OF PARTICULATE MATTER AND PM_{10} EMITTED FROM THE ENTIRE CEMENT PLANT AT MAXIMUM POTENTIAL EMISSION RATES

Drawing Nº 12



Concentration units: $\mu g/m^3$

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TITLE:
ISOPLETH SHOWING 99-PERCENTILE OF 24-HOUR AVERAGE GROUND LEVEL CONCENTRATIONS OF PARTICULATE MATTER AND PM_{10} EMITTED FROM THE ENTIRE CEMENT PLANT AT MAXIMUM EMISSIONS RATES

Drawing Nº 13

APPENDIX
3.6
NOISE AND VIBRATION

ENVIRONMENTAL IMPACT STATEMENT

SECTION 3.6: NOISE AND VIBRATION

APPENDIX 3.6.I

AMBIENT NOISE SURVEY
AT THE SITE OF THE PROPOSED DEVELOPMENT

CONTENTS

1.0 SCOPE

2.0 REGIONAL ENVIRONMENTAL SETTING

3.0 RECEPTORS

4.0 SURVEY PROTOCOL

4.1 CHOICE OF MEASUREMENT POSITIONS

4.2 INSTRUMENTATION AND METHODOLOGY

4.3 SURVEY IMPLEMENTATION

5.0 SURVEY RESULTS

6.0 EVALUATION OF RESULTS

1.0 Scope

This report presents the results of a baseline survey of environmental noise levels at 15 locations in the vicinity of the proposed site of an industrial development at Lansdown, Killaskillen, Co Meath. The development includes a limestone and a shale quarry as well as a cement manufacturing plant. The monitoring was conducted at each location during daytime and night-time monitoring intervals.

2.0 Regional environmental setting

The site of the proposed development is located in the townland of Killaskillen, approximately 3 km from Kinegad. Information on the environmental setting of the site was obtained from several sources including Ordnance Survey of Ireland Composite Maps.

The site is located in a predominantly rural location, with the village of Ballinabrackey located approximately 1.5 km south of the nearest site boundary and Kinegad lying approximately 3km to the north east of the nearest site boundary. The location of the site is well removed from substantial industrial developments. The main Dublin – Galway road, the N6, passes the site approximately 0.5km north of the site boundary; there are plans to extend the M4 Motorway to incorporate a bypass of Kinegad in the next 3 years, and the proposed route of the new Motorway passes closer to the nearest site boundary than the existing roadway. A substantial residential development is located at Kinegad. Approximately 120 residences are located in scattered developments within a radius of 2km of the site boundaries.

3.0 Receptors

The nearest noise sensitive receptors are located at distances of 100m and 175m from the nearest edge of the limestone quarry. Other occupied residences are located more than 400m from the nearest boundary of the limestone quarry. The shale quarry is more than 150m from residential properties to the west of the site, more than 200m from properties to the south and in excess of 350m from the nearest residences in other directions. The nearest residences to the plant buildings are located at least 450m away from the nearest plant building.

The existing noise environment was characterised by a series of measurements completed at the boundaries of the site of the development and at a number of noise sensitive locations in the vicinity of the plant.

Measurements were completed at 15 locations in the vicinity of the site. The location of the receptors chosen for the monitoring programme and their locations with respect to potential noise sources are summarised in the following sections, and the locations are marked as N1 to N15 on a separate map.

Location N1

The first sampling point chosen is located on the site of the proposed development near Lansdown Lodge. This measurement point is approximately 300m from Killaskillen crossroads and was chosen for this reason to assess the existing noise levels on the site at a reasonable distance from the nearest roadway.

Location N2

The second sampling point is located at the site boundary at a point close to Killaskillen House which is just across the road from the measurement point. The proposed limestone quarry site is not directly visible from this location since a 5m screening bund will be constructed along this boundary.

Location N3

The third sampling point is located beside one of the two closest residences to the quarry boundaries at Lansdown Gate Lodge at Killaskillen Cross Roads. The proposed quarry sites are directly visible from this location. Again, 5m screening bunds north and south of the existing roadway will block the views of the quarries in this location.

Location N4

The monitoring point at N4 is located at the corner of the northern boundary of the limestone quarry site beside the roadway which separates this part of the site from the shale quarry site. A residence is situated just outside the site boundary on the other side of the road.

Locations N5, N6

The monitoring points at N5 and N6 are located on the western site boundary at points close to residences on the roadside by the site boundary. N5 is the monitoring point closest to the receptor which is nearest to the cement manufacturing plant buildings.

Locations N7, N8

The monitoring points at N7 and N8 are located on the northern part of the site where the shale quarry will be sited. N7 is located at the northern site boundary beside the

Kinegad river and was chosen to assess existing contributions to ambient noise levels in the area from traffic on the busy Dublin – Galway road just 500m north of this point. N8 was positioned south of N7, about half way between N4 and N7 on the western edge of the proposed shale quarry.

Location N9

The monitoring point at N9 is located on the side of the access road leading from Kinegad to the plant beside a cluster of residences about 700m from Kinegad. A cluster of 15 residences are situated on the roadside in this area.

Location N10

The monitoring point at N10 is located at the crossroads where the road leading to the site of the proposed development joins the main Dublin – Kinegad road.

Locations N11, N12

The monitoring point at N11 is located in the village of Ballinabrackey across the road from the Roman Catholic Church. N12 is located on the roadside at a point approximately 500m north of Ballinabrackey Post Office.

Location N13

The monitoring point at N13 is located on the southern site boundary at a point close to where the cement manufacturing plant will be located, and approximately 1600m north west of Ballinabrackey village.

Location N14

The monitoring point at N14 is located on the side of the road at Baltinoran Bridge.

Location N15

The monitoring point at N15 is located on the roadside beside a cluster of residences on the road leading from Killaskillen crossroads towards Ballinabrackey village.

A summary description of the location of each monitoring point is presented in Table 1 together with the distance from the monitoring location to the nearest quarry boundary and plant building.

Table 1 Monitoring locations for noise survey in the vicinity of the site of the proposed development

MONITORING LOCATION	DESCRIPTION	DISTANCE FROM NEAREST QUARRY BOUNDARY, m	DISTANCE FROM NEAREST PLANT BUILDING, m
N1	ON SITE ADJACENT TO LANSDOWN LODGE	NA	NA
N2	SITE BOUNDARY ADJACENT TO ROADSIDE BESIDE KILLASKILLEN HOUSE	30	500
N3	SITE BOUNDARY AT KILLASKILLEN CROSSROADS	100	500
N4	SITE INTERNAL BOUNDARY BETWEEN SHALE QUARRY AND REMAINDER OF LAND HOLDING	700	800
N5	WESTERN SITE BOUNDARY ADJACENT TO RESIDENCES	1100	900
N6	WESTERN SITE BOUNDARY ADJACENT TO RESIDENCES	700	900
N7	NORTHERN SITE BOUNDARY BESIDE KINEGAD RIVER	500	1750
N8	WESTERN SITE BOUNDARY ADJACENT TO RESIDENCES	200	1000
N9	AT SIDE OF COUNTY ROAD LEADING IN TO BOGLANDS, NEAR CLUSTER OF RESIDENCES	1900	3000
N10	AT THE JUNCTION OF THE DUBLIN ROAD AND THE ROAD LEADING UP TO THE SITE	2700	3500
N11	BALLINABRACKEY VILLAGE	1600	1750
N12	BALLINABRACKEY VILLAGE	1500	1350
N13	SOUTHERN SITE BOUNDARY	200	200
N14	BALTINORAN BRIDGE	2000	2500
N15	BESIDE A CLUSTER OF RESIDENCES SOUTH EAST OF SITE	900	1200

4.0 Survey Protocol

4.1 Choice of measurement positions

The locations chosen for the survey include measurements at site boundaries at points close to potentially significant noise sources and also community locations in the vicinity of the site. The purpose of choosing a broad range of receptor locations was to provide a comprehensive evaluation of the existing noise environment at various locations which might be affected by the proposed development.

The sampling point chosen for locating the measuring instruments was chosen according to the guidelines in ISO 1996 Acoustics - Description and Measurement of Environmental Noise. In all cases, the instruments were located in the location most sensitive to noise from the proposed development site. Due care was taken to minimise potential interferences from wind generated noises from trees etc during the course of the measurement programme.

4.2 Instrumentation and methodology

The measurements were made according to the requirements of ISO 1996: Acoustics - Description and Measurement of Environmental Noise. The measurements were made using an Envi Integrating Sound Level Meter and Statistical Analysis System and a Cirrus 703A integrating sound level meter. The instrument was calibrated at 94 dB every day prior to use using a Cirrus Sound Level Calibrator. The microphone was mounted on an outdoor microphone stand which in turn was mounted on a tripod at 1.3m above ground level. This instrument is a Type 1 instrument in accordance with IEC 651 regulations. The Time Weighting used was Fast and the Frequency Weighting was A-weighted as per IEC 651.

4.3 Survey implementation

The survey was conducted by TMS Environment Ltd personnel during the period 26th May to 16th June 1998. The measurement parameters included meteorological observations and records of prevailing conditions at the time of the survey - temperature, relative humidity, atmospheric pressure and wind speed were all measured throughout the survey period.

The main measurement parameter was the equivalent continuous A-Weighted Sound Pressure Level, $L_{Aeq,\ T}$, over one hour measurement intervals for the duration of the day time survey; night-time measurements were performed over 15 minute intervals in accordance with normal practice. Measurements at some locations were completed over a period of 6 – 8 hours during the day. A statistical analysis of the measurement results was also completed so that the percentile levels, $L_{AN,\ T}$, for N = 95%, 90% and 10% over one-hour and 15-minute measurement intervals were also recorded. The percentile levels represent the noise level in dB(A) exceeded for N% of the measurement time.

5.0 Survey results

The measurement results are reported for each series of daytime measurements in Tables 2 - 6. Results of the night-time measurements are presented in Table 7.

Table 2 Baseline environmental noise survey at Lansdown

MONITORING LOCATION	SURVEY DATE TIME INTERVAL	$L_{AEQ, 1\ HR}$ dB(A)	$L_{A95, 1\ HR}$ dB(A)	$L_{A90, 1\ HR}$ dB(A)	$L_{A10, 1\ HR}$ dB(A)
N1	26TH May 1998				
	09:40 – 10:30	70.2	NM	44.6	57.6
	11:30 – 12:30	58.8	NM	42.3	48.6
	12:35 – 13:35	45.8	NM	41.3	48.6
	13:40 – 14:40	46.6	NM	42.5	48.4
	14:50 – 15:50	47.2	NM	43.3	49.9
	15:50 – 16:50	44.8	NM	40.2	47.3
	16:50 – 17:50	44.6	NM	40.3	47.5
N2	26TH May 1998				
	09:50 – 10:50	47.8	39.3	40.6	50.3
	10:55 – 11:55	47.1	40.2	41.3	49.4
	11:55 – 12:55	47.4	39.3	40.6	48.9
	13:00 – 14:00	47.4	39.4	40.6	50.0
	14:00 – 15:00	48.6	40.5	41.4	49.8
	15:00 – 16:00	46.2	39.1	39.9	48.7
	16:00 – 17:00	46.0	33.7	35.6	48.6
	17:00 – 18:00	46.7	33.5	34.6	46.5

NOTE

[1] Wind speed < 2.51 m/sec; Temperature 11°C; 68.7% Relative Humidity

[2] Light rain fell between 10:00 and 11:00 am and again for about 10 minutes between 13:00 and 14:00

[3] Drilling machinery near the site contributed to elevated noise levels; this machinery stopped operating at ca 16:40.

[4] NM = not measured

Table 3 Baseline environmental noise survey at Lansdown

MONITORING LOCATION	SURVEY DATE TIME INTERVAL	$L_{AEQ, 1\ HR}$ dB(A)	$L_{A95, 1\ HR}$ DB(A)	$L_{A90, 1\ HR}$ dB(A)	$L_{A10, 1\ HR}$ dB(A)
N3	27TH May 1998				
	09:40 – 10:40	49.6	NM	45.0	52.2
	10:40 – 11:40	51.0	NM	44.8	42.6
	11:45 – 12:45	49.2	NM	44.7	51.0
	12:50 – 13:50	49.5	NM	45.3	51.5
N4	27TH May 1998				
	09:30 – 10:30	47.2	39.2	40.3	48.7
	10:30 – 11:30	45.8	38.5	39.5	48.0
	11:30 – 12:30	52.6	33.1	34.1	47.7
	12:35 – 13:35	42.3	32.4	33.4	44.4
	13:35 – 14:35	43.4	31.3	32.1	44.1
	14:35 – 15:35	55.9	33.1	33.9	48.9
	15:40 – 16:40	46.2	33.2	34.2	45.9
	16:40 – 17:40	50.0	31.4	32.3	46.9

NOTE

[1] Wind speed 2.2 – 4.5 m/sec; Temperature 11.5°C; Relative Humidity, 3°C Dew Point

[2] Traffic was a significant contributor to ambient noise in both locations and particularly at N3

[3] NM = not measured

Table 4 Baseline environmental noise survey at Lansdown

MONITORING LOCATION	SURVEY DATE TIME INTERVAL	$L_{AEQ, 1\ HR}$ dB(A)	$L_{A95, 1\ HR}$ dB(A)	$L_{A90, 1\ HR}$ dB(A)	$L_{A10, 1\ HR}$ dB(A)
N7	9th June 1998				
	10:45 – 11:45	43.2	31.4	32.1	47.3
	11:45 – 12:40	42.0	32.1	32.9	44.6
	12:45 – 13:45	46.6	37.1	38.2	49.7
	13:45 – 14:45	48.4	40.9	41.5	51.4
	14:45 – 15:45	43.8	38.5	39.3	45.9
	15:45 – 16:45	47.1	41.2	42.1	49.2
	16:45 – 17:45	48.3	41.2	42.3	49.4
N9	11th June 1998				
	10:00 – 11:00	49.3	38.0	38.8	47.0
	11:00 – 12:00	45.0	37.0	37.8	45.3
	12:00 – 13:00	50.5	38.8	39.6	47.3
	13:00 – 14:00	47.8	38.4	39.3	48.8
	14:00 – 15:00	51.4	36.4	37.2	44.7
	15:00 – 16:00	48.1	37.7	38.8	49.0
	16:00 – 17:00	52.6	38.4	39.4	51.8

NOTE

[1] 9th June 1998: mixed - dry and some rain; Temperature 16°C
11th June 1998: dry; Temperature 11°C

[2] Agricultural machinery and passing traffic contributed to measured noise levels on both dates

[4] NM = not measured

Table 5 Baseline environmental noise survey at Lansdown

MONITORING LOCATION	SURVEY DATE TIME INTERVAL	$L_{AEQ, 1\ HR}$ dB(A)	$L_{A95, 1\ HR}$ dB(A)	$L_{A90, 1\ HR}$ dB(A)	$L_{A10, 1\ HR}$ dB(A)
N11	16th June 1998				
	10:35 – 11:35	43.8	30.4	30.8	45.1
	11:35 – 12:35	42.5	30.6	30.3	43.9
	12:35 – 13:35	64.4	36.2	39.8	68.3
	13:45 – 14:45	51.5	30.5	32.2	49.1
	14:45 – 15:45	49.8	31.3	32.7	50.0
	15:45 – 16:45	50.0	30.6	30.7	50.6
	16:45 – 17:45	52.6	33.8	35.6	53.5

NOTE

[1] Wind speed < 2 m/sec; Temperature 20°C

[2] Agricultural machinery and passing traffic contributed to measured noise levels

Table 6 Baseline environmental noise survey at Lansdown

MONITORING LOCATION	SURVEY DATE TIME INTERVAL	$L_{AEQ,\ 1\ HR}$ dB(A)	$L_{A95,\ 1\ HR}$ dB(A)	$L_{A90,\ 1\ HR}$ dB(A)	$L_{A10,\ 1\ HR}$ dB(A)
N5	8th June 1998 14:30 – 15:30	46.8	NM	39.8	50.0
N6	8th June 1998 14:40 – 15:40	42.6	34.7	35.7	44.5
N8	11th June 1998 12:50 – 13;50	45.8	NM	39.3	46.4
N10	11th June 1998 14:20 – 15:20	61.7	NM	52.6	65.0
N12	8th June 1998 16:20 – 17:20	49.4	41.8	42.9	52.2
N13	10th June 1998 15:30 - 16:30	48.0	41.7	42.3	50.6
N14	16th June 1998 18:00 – 19:00	54.5	NM	39.8	47.9
N15	10th June 1998 16:35 – 17:35	44.5	37.4	37.9	47.0

NOTE

[1] Wind speed < 2 m/sec; Temperature 11 - 16°C

[2] Agricultural machinery and passing traffic contributed to elevated noise levels at N8 and particularly at N10

[3] NM = not measured

Table 7 Baseline environmental noise survey at Lansdown

MONITORING LOCATION	SURVEY DATE TIME INTERVAL	$L_{AEQ, 15\ min}$ dB(A)	$L_{A95, 15\ min}$ dB(A)	$L_{A90, 15\ min}$ dB(A)	$L_{A10, 15\ min}$ dB(A)
	27th May 1998				
N1	23:25 – 23:40	38.5	27.3	27.4	34.0
N2	12:04 – 12:19	49.4	27.7	27.3	42.5
N3	23:45 – 24:00	49.7	27.5	28.2	49.3
N4	12:21 – 12:36	40.9	27.3	27.4	33.9
	10th June 1998				
N5	12:32 – 12:47	41.3	29.8	30.4	36.2
N6	12:10 – 12:25	34.9	29.3	29.7	35.7
N7	23:49 – 12:04	38.3	31.4	32.2	39.4
N8	23:30 – 23:45	37.8	33.6	34.1	39.7
N9	2:48 – 3:03	38.8	30.6	31.7	41.3
N10	3:07 – 3:22	51.3	29.1	30.0	53.5
N11	1:39 – 1:54	38.7	28.6	29.3	41.8
N12	1:19 – 1:34	38.4	31.7	32.4	40.7
N13	2:21 – 2:36	36.6	31.7	32.3	37.9
N14	12:57 – 1:12	42.7	27.4	27.6	36.1
N15	2:02 – 2:17	31.9	27.8	27.4	32.4

NOTE

[1] Wind speed < 4 m/sec; Temperature 6 - 7°C

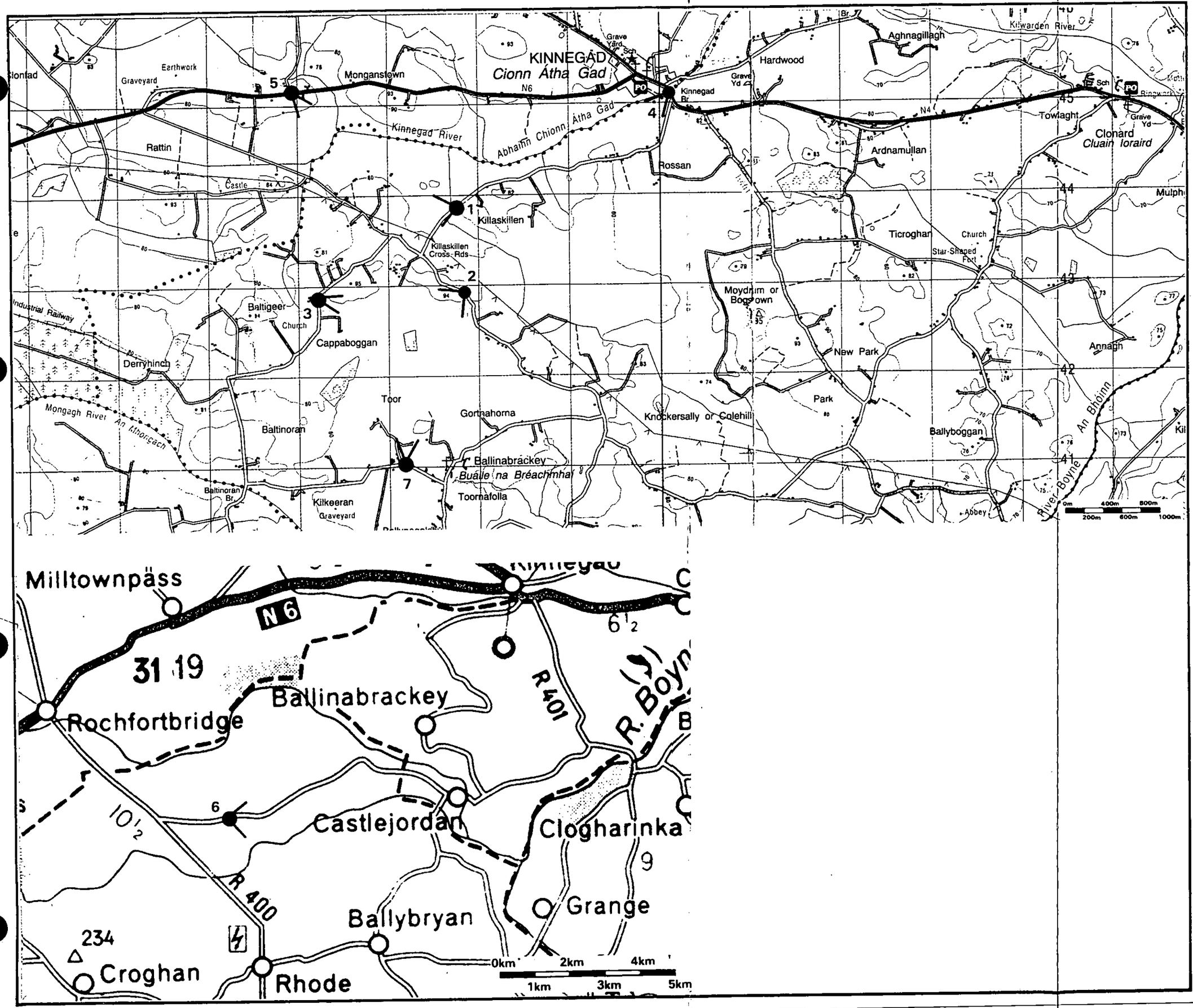
[2] Occasional passing traffic contributed to noise level at N1 – N4, N6 – N11, N14, N15

6.0 Evaluation of results

A comprehensive baseline survey of environmental noise levels at 15 locations in the vicinity of the proposed development site at Lansdown has been completed. The survey was completed prior to commencement of any works on the site, although some drilling was underway on the north eastern part of the site during part of the survey. The results have been reported in Tables 2 - 7. A comprehensive evaluation of existing noise levels at the site has been completed.

The results of the survey clearly indicated that the dominant influence on the noise climate in the area is traffic with some contributions from agricultural machinery. The existing noise environment is typical of similar locations in that there are external influences such as local and distant traffic on the noise environment. The proposed development is to take place on a relatively large site, and a substantial buffer zone is to be incorporated between the nearest residences and the site of the proposed quarries and cement manufacturing plant. The potential impact of the proposed development on community noise levels in the vicinity of the plant is considered in the Environmental Impact Statement for the development.

APPENDIX
3.7
LANDSCAPE AND VISUAL



KEY

6 PHOTOMONTAGE VIEWPOINT

N

LAGAN CEMENT LIMITED
ROSEMOUNT BUSINESS PARK
BALLYCOOLIN ROAD, DUBLIN 11
TEL: 01820 1070 FAX: 01820 1901

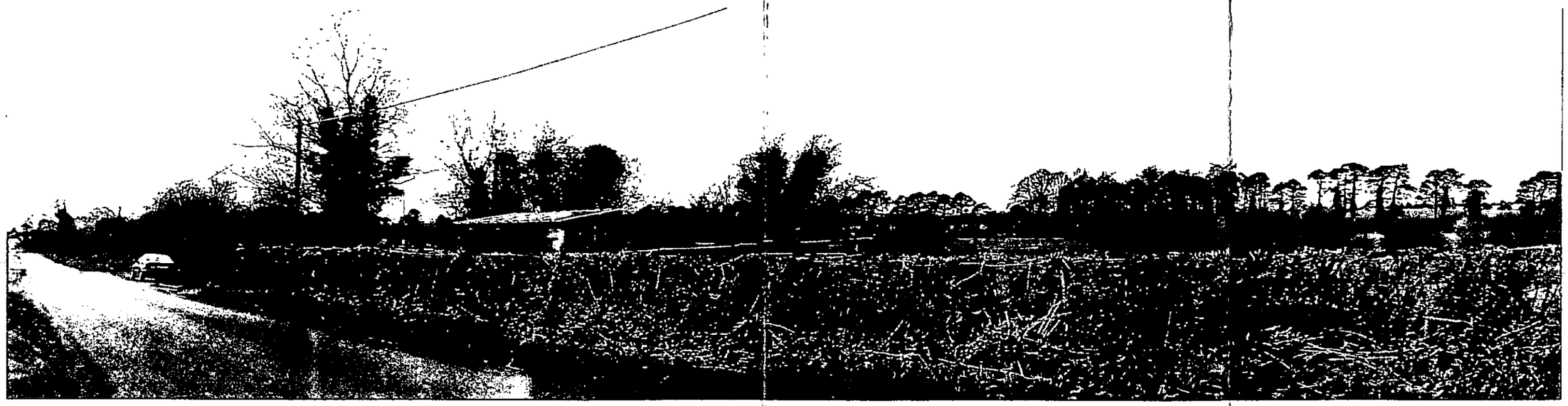
LANSDOWN CEMENT WORKS
KILLASKILLEN, CO. MEATH

APPENDIX Nº 3.7

TITLE:

PHOTOMONTAGE LOCATION PLAN

Nº 1



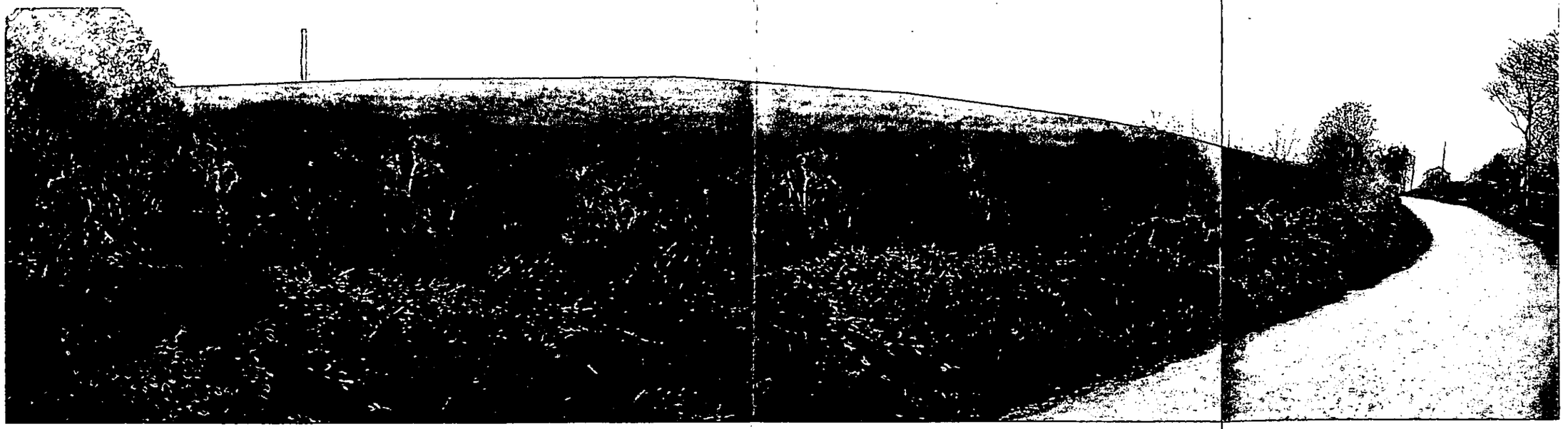
Existing view from Kinnegad to Killaskillen road by eastern site boundary.

Photomontage showing screening bunds and boundary planting.

Nb. This photomontage should only be used as a guide

LAGAN CEMENT LIMITED ROSEMOUNT BUSINESS PARK BALLYCOOLIN ROAD, DUBLIN 11 TEL: 01820 1070 FAX: 01820 1901	APPENDIX 3.7
LANSDOWN CEMENT WORKS KILLASKILLEN, CO. MEATH	TITLE: PHOTOMONTAGE VIEW Nº 1
	Nº 2.1

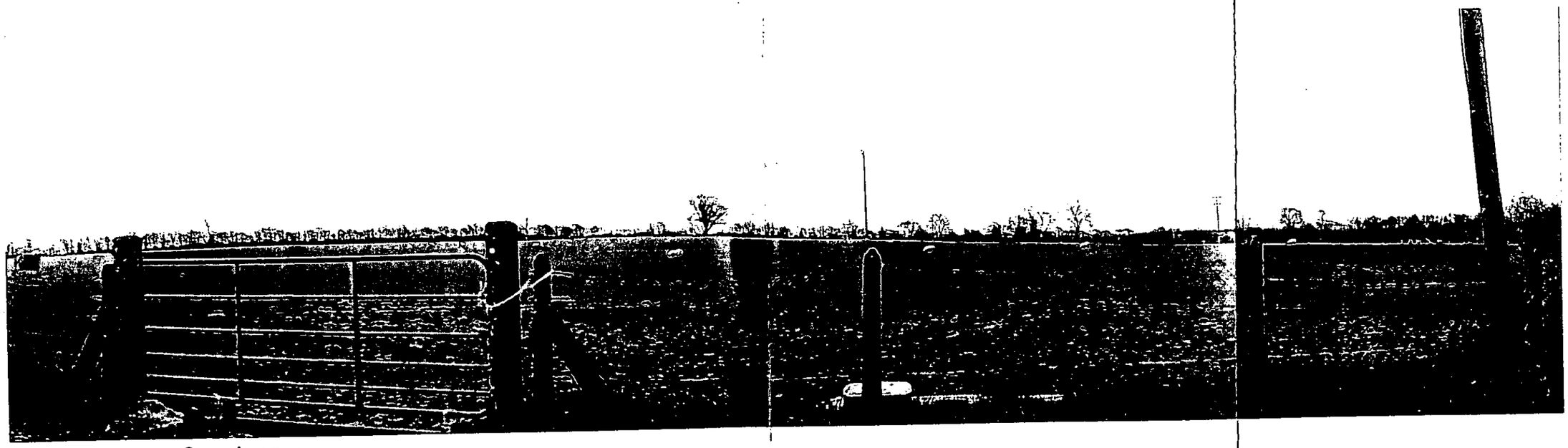
Existing view from Killaskillen to Ballinabrackey Road



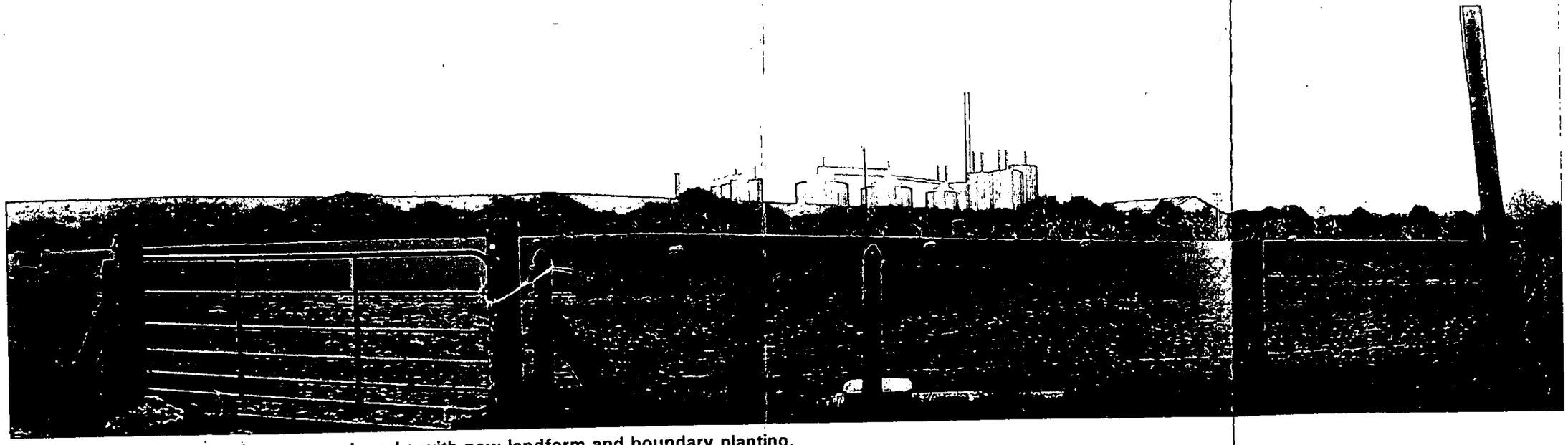
Photomontage view showing screen bund to limestone quarry

Nb. This photomontage should only be used as a guide

LAGAN CEMENT LIMITED ROSEMOUNT BUSINESS PARK BALLYCOOLIN ROAD, DUBLIN 11 TEL: 01820 1070 FAX: 01820 1901	**APPENDIX 3.7**
LANSDOWN CEMENT WORKS KILLASKILLEN, CO. MEATH	TITLE: **PHOTOMONTAGE VIEW Nº 2**
	Nº 2.2



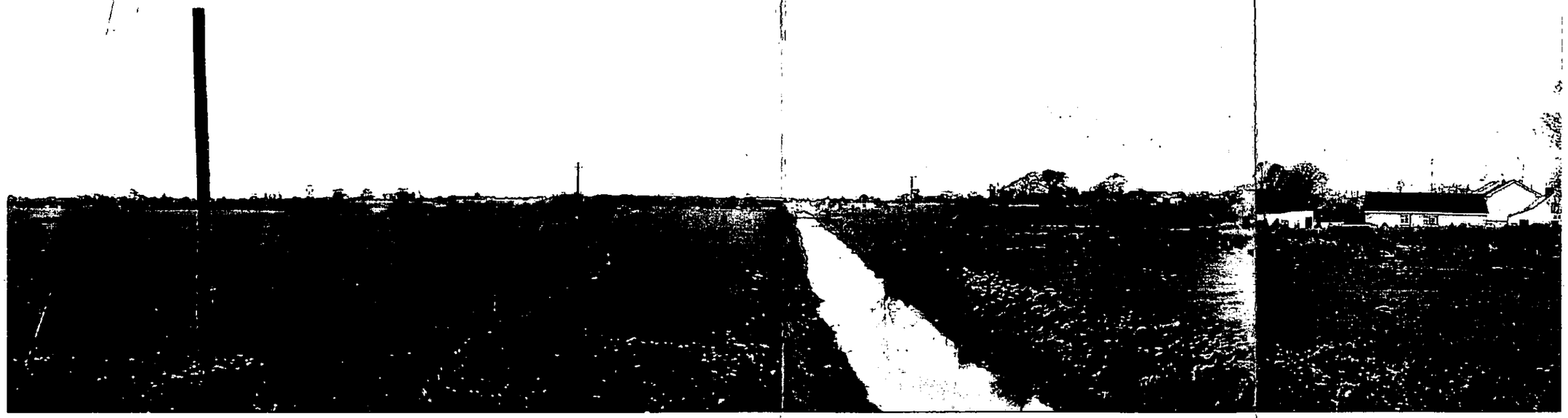
Existing view from Cappaboggan.



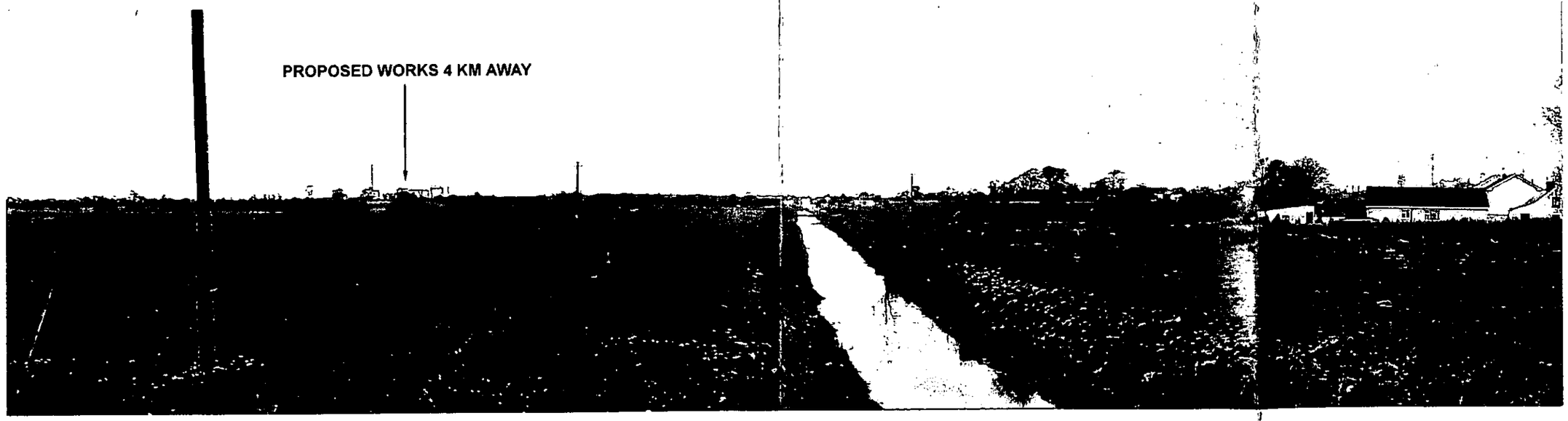
Photomontage view showing proposed works with new landform and boundary planting.

Nb. This photomontage should only be used as a guide

LAGAN CEMENT LIMITED ROSEMOUNT BUSINESS PARK BALLYCOOLIN ROAD, DUBLIN 11 TEL: 01820 1070 FAX: 01820 1901	APPENDIX 3.7
LANSDOWN CEMENT WORKS KILLASKILLEN, CO. MEATH	TITLE: PHOTOMONTAGE VIEW Nº 3
	Nº 2.3



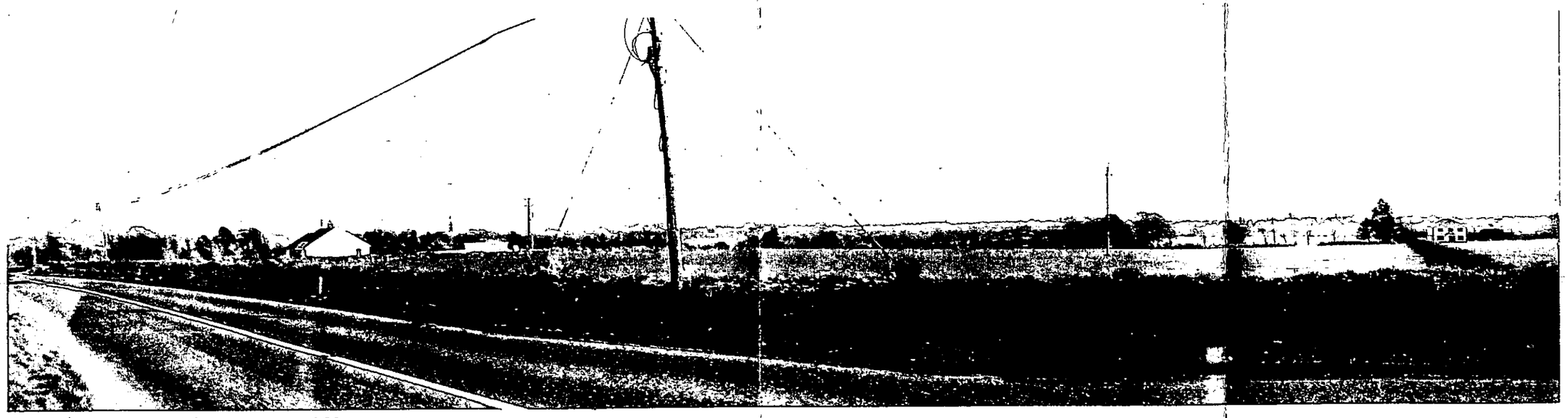
Existing view looking west from the bridge at Kinnegad.



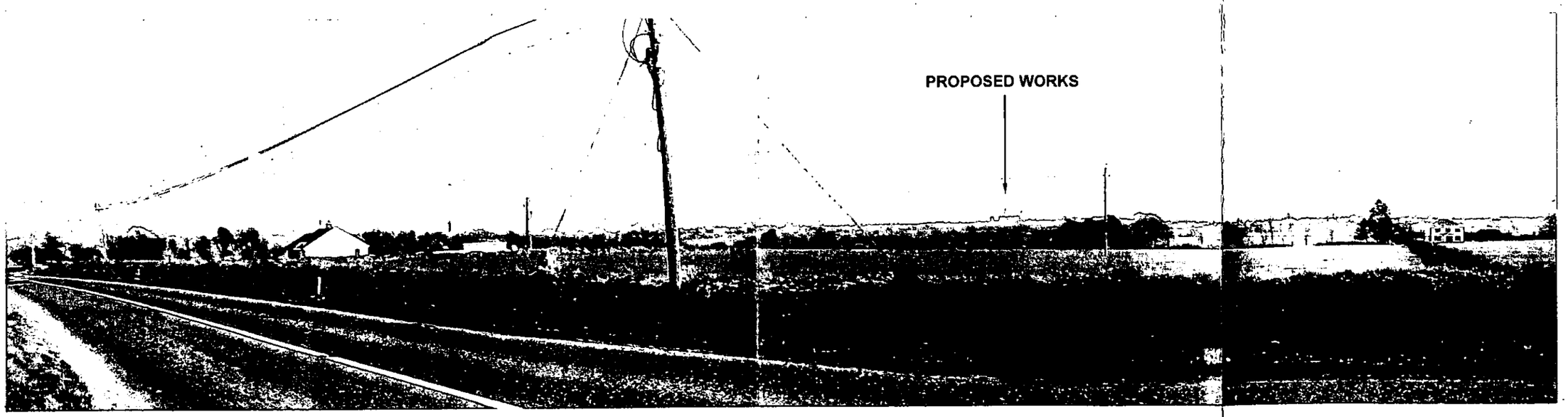
Photomontage view showing proposed works.

Nb. This photomontage should only be used as a guide

LAGAN CEMENT LIMITED ROSEMOUNT BUSINESS PARK BALLYCOOLIN ROAD, DUBLIN 11 TEL: 01820 1070 FAX: 01820 1901	APPENDIX 3.7
LANSDOWN CEMENT WORKS KILLASKILLEN, CO. MEATH	TITLE: PHOTOMONTAGE VIEW Nº 4
	Nº 2.4



Existing view from N6 1km west of Monganstown.

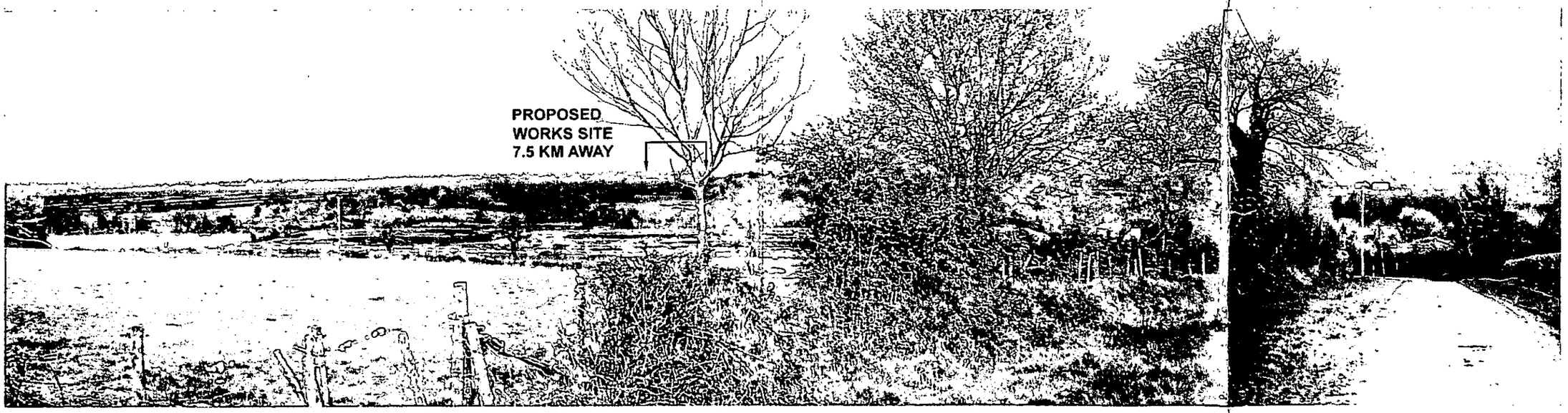


Photomontage view showing proposed works.

Nb. This photomontage should only be used as a guide

LAGAN CEMENT LIMITED ROSEMOUNT BUSINESS PARK BALLYCOOLIN ROAD, DUBLIN 11 TEL: 01820 1070 FAX: 01820 1901	APPENDIX 3.7
LANSDOWN CEMENT WORKS KILLASKILLEN, CO. MEATH	TITLE: PHOTOMONTAGE VIEW Nº 5
	Nº 2.5

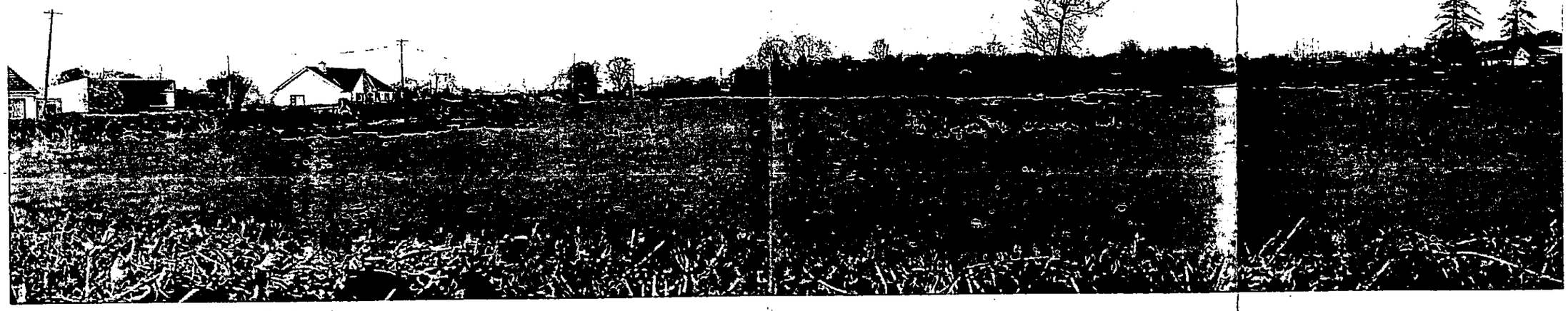
Existing view from Knockdrin Hill.



View indicating extent of proposed works.

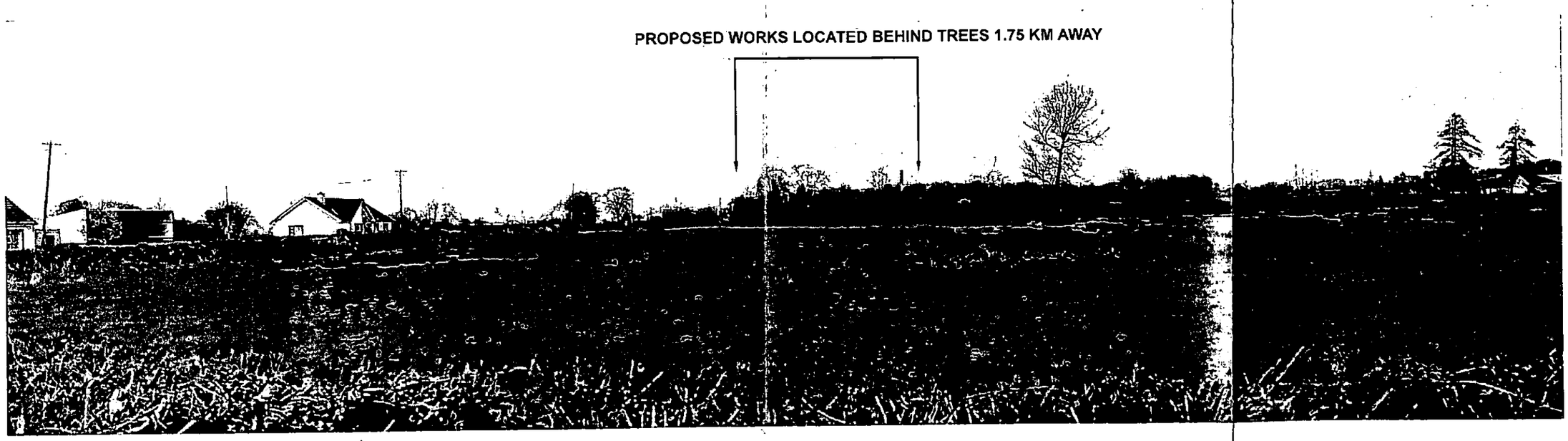
Nb. This photomontage should only be used as a guide

LAGAN CEMENT LIMITED ROSEMOUNT BUSINESS PARK BALLYCOOLIN ROAD, DUBLIN 11 TEL: 01820 1070 FAX: 01820 1901	APPENDIX 3.7
LANSDOWN CEMENT WORKS KILLASKILLEN, CO. MEATH	TITLE: PHOTOMONTAGE VIEW Nº 6
	Nº 2.6



Existing view north from Ballinabrackey.

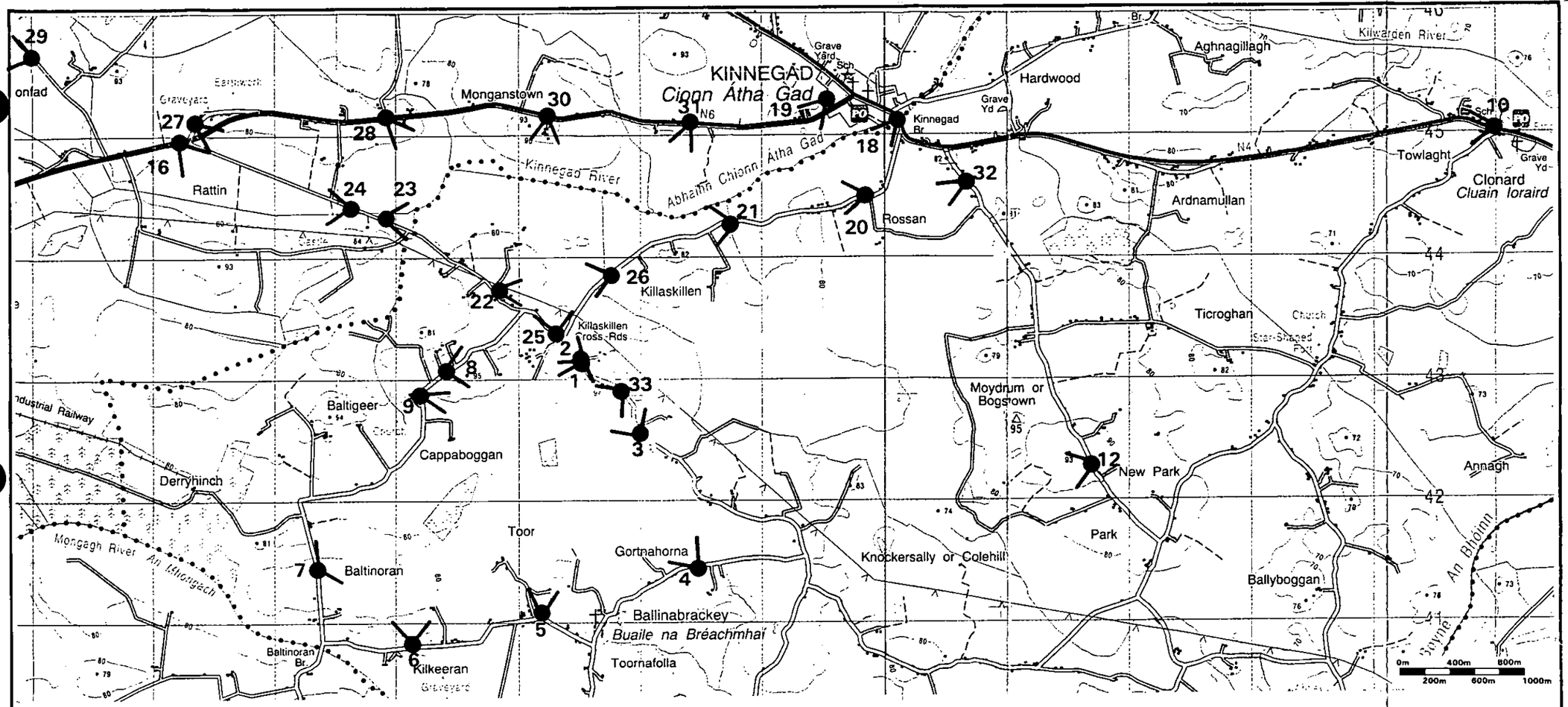
PROPOSED WORKS LOCATED BEHIND TREES 1.75 KM AWAY

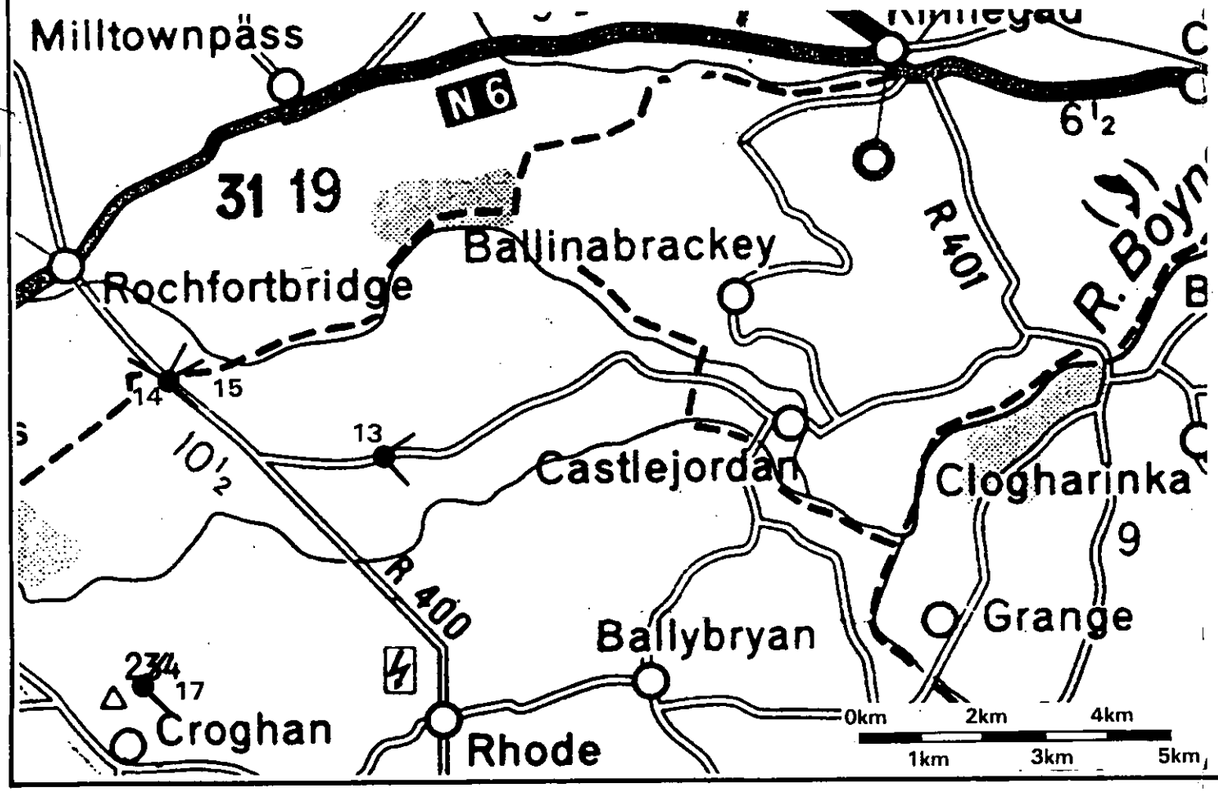


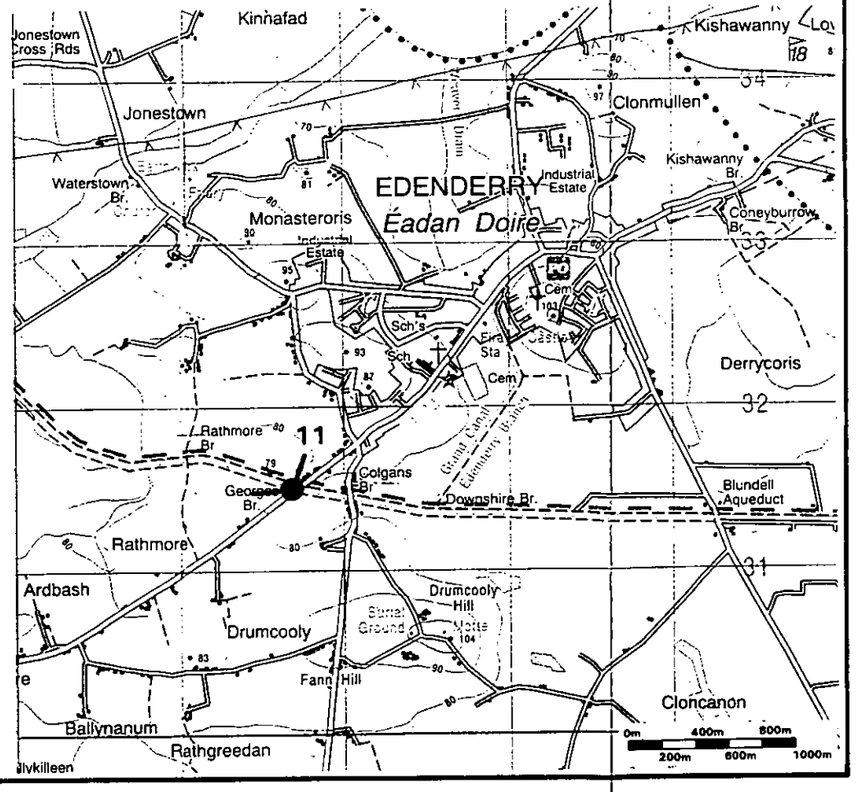
View indicating location of proposed works.

Nb. This photomontage should only be used as a guide

LAGAN CEMENT LIMITED ROSEMOUNT BUSINESS PARK BALLYCOOLIN ROAD, DUBLIN 11 TEL: 01820 1070 FAX: 01820 1901	APPENDIX 3.7
LANSDOWN CEMENT WORKS KILLASKILLEN, CO. MEATH	TITLE: PHOTOMONTAGE VIEW Nº 7
	Nº 2.7







KEY

6 FIELD SURVEY PHOTO VIEWPOINT

N

LAGAN CEMENT LIMITED
ROSEMOUNT BUSINESS PARK
BALLYCOOLIN ROAD, DUBLIN 11
TEL: 01820 1070 FAX: 01820 1901

LANSDOWN CEMENT WORKS
KILLASKILLEN, CO. MEATH

APPENDIX Nº 3.7

TITLE:

FIELD SURVEY PHOTO LOCATION PLAN

Nº 3

DIRECTION OF VIEW SW DATE 31.3.98 VIEWPOINT 1

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them.

Small winding country road fully enclosed by grassed banks and/or maintained hedgerows. Occasional mature hedgerow trees.

HISTORICAL AND ECOLOGICAL ASSOCIATIONS
Are any of the following present?

Hamlets	Irregular fields	(Narrow lanes)	Ancient woods	Railways
Villages	(Mixed hedges)	(Hedge banks)	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	(Hedgerow oaks)	Scrub	(Regular fields)
Fords	Walled fields	Old pollards	(Rough grass)	(Thorn hedges)
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?

Roadside banks / trees.

AESTHETIC FACTORS CHECKLIST Indicate those factors that apply:

SCALE:	☑ intimate	☑ small	☐ large	☐ vast
ENCLOSURE:	☐ tight	☑ enclosed	☐ open	☐ exposed
DIVERSITY:	☐ uniform	☑ simple	☐ diverse	☐ complex
BALANCE:	☐ harmonious	☑ balanced	☐ discordant	☐ chaotic
MOVEMENT:	☐ dead	☑ calm	☐ busy	☐ frantic
TEXTURE:	☐ smooth	☑ textured	☐ rough	☐ v. rough
COLOUR:	☐ monochrome	☑ muted	☐ colourful	☐ garish
FORM:	☐ straight	☐ angular	☑ curved	☐ sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.

The eye is drawn along the road with few detractors.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?

Revitalise hedgerow / tree planting.

DIRECTION OF VIEW NW DATE 31.3.98 VIEWPOINT 2

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them.

Small winding country road enclosed by banks and hedging. Occasional mature hedgerow trees. Hedgerow poorly maintained and overgrown on one side

HISTORICAL AND ECOLOGICAL ASSOCIATIONS
Are any of the following present?

Hamlets	Irregular fields	(Narrow lanes)	Ancient woods	Railways
Villages	(Mixed hedges)	(Hedge banks)	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	(Hedgerow oaks)	(Scrub)	Regular fields
Fords	Walled fields	Old pollards	(Rough grass)	Thorn hedges
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?

Hedgerow banks and trees

AESTHETIC FACTORS CHECKLIST Indicate those factors that apply:

SCALE:	☑ intimate	☑ small	☐ large	☐ vast
ENCLOSURE:	☐ tight	☑ enclosed	☐ open	☐ exposed
DIVERSITY:	☐ uniform	☑ simple	☐ diverse	☐ complex
BALANCE:	☐ harmonious	☑ balanced	☐ discordant	☐ chaotic
MOVEMENT:	☐ dead	☑ calm	☐ busy	☐ frantic
TEXTURE:	☐ smooth	☑ textured	☐ rough	☐ v. rough
COLOUR:	☐ monochrome	☑ muted	☐ colourful	☐ garish
FORM:	☐ straight	☑ angular	☑ curved	☐ sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.

Hedgerow and banks direct the eye along the road. Negelected hedgerow detracts slightly in contrast to better maintained versions nearby.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?

Hedgerow management.

DIRECTION OF VIEW NNW DATE 31.3.98 VIEWPOINT 3

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them.

V. gently rolling pasture field adjoining small county road. Field enclosed by mature hedgerow trees and maintained roadside hedging.

HISTORICAL AND ECOLOGICAL ASSOCIATIONS

Are any of the following present?

Hamlets	(Irregular fields)	(Narrow lanes)	Ancient woods	Railways
Villages	(Mixed hedges)	(Hedge banks)	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	(Hedgerow oaks)	Scrub	Regular fields
Fords	Walled fields	Old pollards	(Rough grass)	(Thorn hedges)
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?

Pasture / mature hedgerow trees.

AESTHETIC FACTORS CHECKLIST Indicate those factors that apply:

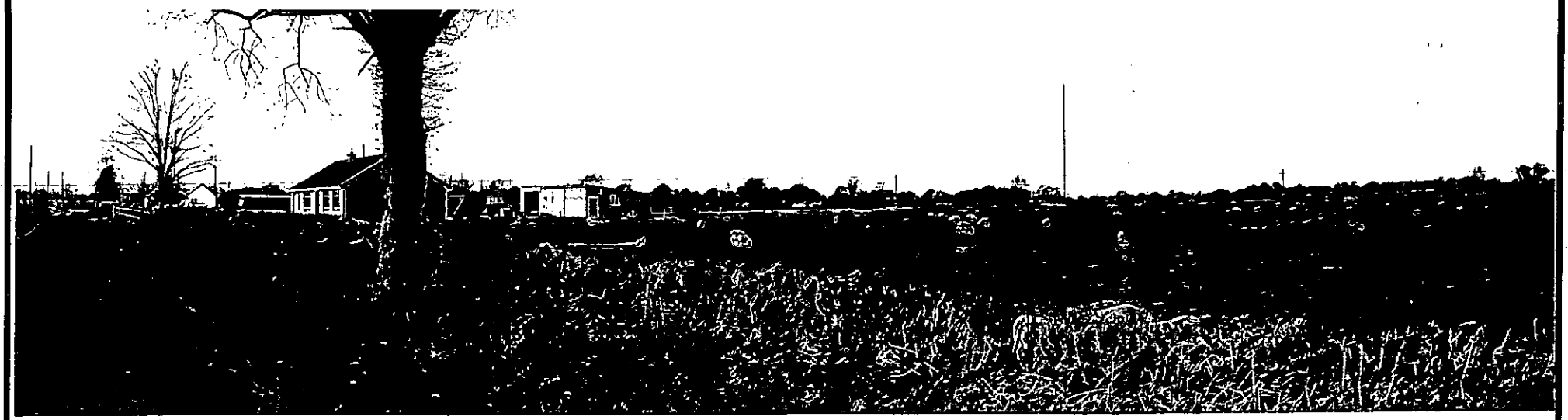
SCALE:	☐ intimate	☐ small	☑ large	☐ vast
ENCLOSURE:	☐ tight	☑ enclosed	☐ open	☐ exposed
DIVERSITY:	☐ uniform	☑ simple	☐ diverse	☐ complex
BALANCE:	☐ harmonious	☑ balanced	☐ discordant	☐ chaotic
MOVEMENT:	☐ dead	☑ calm	☐ busy	☐ frantic
TEXTURE:	☐ smooth	☑ textured	☐ rough	☐ v. rough
COLOUR:	☐ monochrome	☑ muted	☐ colourful	☐ garish
FORM:	☐ straight	☐ angular	☑ curved	☐ sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.

The v. gentle undulations combined with mature hedgerow trees make views very localised. There are few focal points.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?

Revitalise hedging / trees.



DIRECTION OF VIEW NW DATE 31.3.98 VIEWPOINT 4

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. Open, generally flat pasture partially enclosed by hedgerows and hedgerow remnants. Hedging and trees combine in the middle distance to create the impression of woodland. Single storey farm buildings adjoin pasture and country lane.

HISTORICAL AND ECOLOGICAL ASSOCIATIONS
Are any of the following present?

Hamlets	Irregular fields	Narrow lanes	Ancient woods	Railways
Villages	Mixed hedges	Hedge banks	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	Hedgerow oaks	Scrub	Regular fields
Fords	Walled fields	Old pollards	Rough grass	Thorn hedges
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?
pasture / farm buildings / hedgerow trees.

AESTHETIC FACTORS
CHECKLIST Indicate those factors that apply:

SCALE:	☐	intimate	☐	small	☑	large	☐	vast
ENCLOSURE:	☐	tight	☐	enclosed	☐	open	☑	exposed
DIVERSITY:	☐	uniform	☑	simple	☐	diverse	☐	complex
BALANCE:	☐	harmonious	☑	balanced	☐	discordant	☐	chaotic
MOVEMENT:	☐	dead	☑	calm	☐	busy	☐	frantic
TEXTURE:	☐	smooth	☑	textured	☐	rough	☐	v. rough
COLOUR:	☐	monochrome	☑	muted	☐	colourful	☐	garish
FORM:	☑	straight	☐	angular	☐	curved	☐	sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.
Simple rural elements with no significant features.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?
Re-instalise hedging / trees / woodland.

DIRECTION OF VIEW N DATE 31.3.98 VIEWPOINT 5

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. v. gently rolling partially enclosed pasture. Occasional mature isolated trees within mature hedging combine to give effect of woodland groups. Localised single storey housing in small groups.

HISTORICAL AND ECOLOGICAL ASSOCIATIONS
Are any of the following present?

(Hamlets)	(Irregular fields)	(Narrow lanes)	Ancient woods	Railways
Villages	(Mixed hedges)	(Hedge banks)	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	Hedgerow oaks	Scrub	Regular fields
Fords	Walled fields	Old pollards	(Rough grass)	Thorn hedges
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?

Hedgerow trees / pasture

AESTHETIC FACTORS
CHECKLIST Indicate those factors that apply:

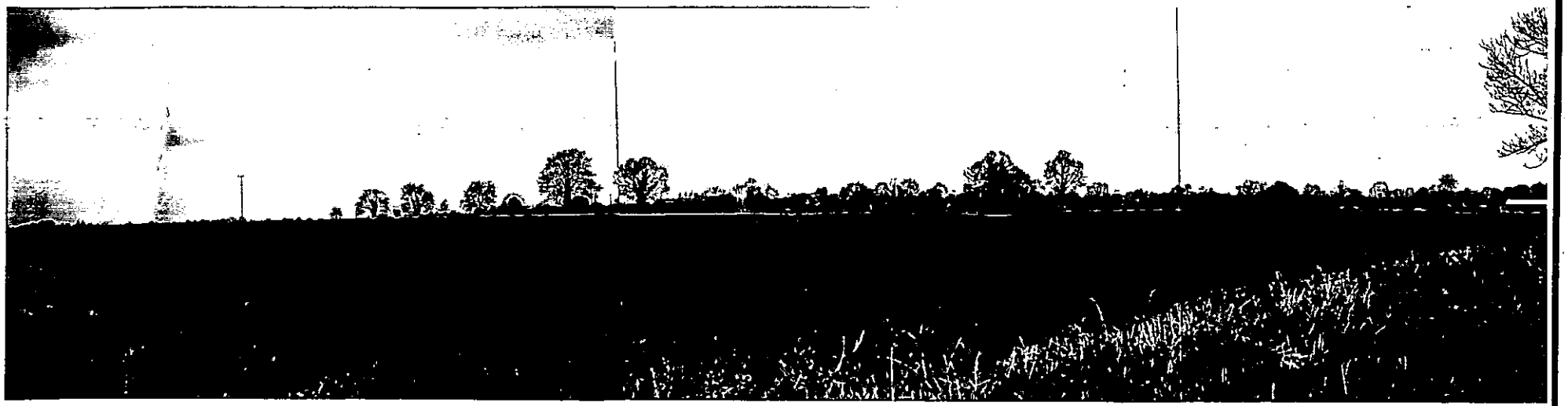
SCALE:	☐ intimate	☑ small	☐ large	☐ vast
ENCLOSURE:	☐ tight	☐ enclosed	☑ open	☐ exposed
DIVERSITY:	☐ uniform	☑ simple	☐ diverse	☐ complex
BALANCE:	☐ harmonious	☑ balanced	☑ discordant	☐ chaotic
MOVEMENT:	☐ dead	☑ calm	☐ busy	☐ frantic
TEXTURE:	☐ smooth	☑ textured	☐ rough	☐ v. rough
COLOUR:	☐ monochrome	☑ muted	☐ colourful	☐ garish
FORM:	☑ straight	☐ angular	☐ curved	☐ sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.

Vegetation lacks identity and strength of form.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?

Remove isolated trees and reinforce field hedgerow patterns.



DIRECTION OF VIEW NNE DATE 31.3.98 VIEWPOINT 6

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. Gently rolling arable farmland on local hillside. Skyline formed by mature hedging and hedgerow trees. Roadside hedgerow largely absent.

HISTORICAL AND ECOLOGICAL ASSOCIATIONS
Are any of the following present?

Hamlets	Irregular fields	Narrow lanes	Ancient woods	Railways
Villages	Mixed hedges	Hedge banks	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	Hedgerow oaks	Scrub	Regular fields
Fords	Walled fields	Old pollards	Rough grass	Thorn hedges
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?

Arable field / trees.

AESTHETIC FACTORS
CHECKLIST Indicate those factors that apply:

SCALE:	☐ intimate	☐ small	☑ large	☐ vast
ENCLOSURE:	☐ tight	☐ enclosed	☑ open	☑ exposed
DIVERSITY:	☐ uniform	☑ simple	☐ diverse	☐ complex
BALANCE:	☐ harmonious	☑ balanced	☐ discordant	☐ chaotic
MOVEMENT:	☐ dead	☑ calm	☐ busy	☐ frantic
TEXTURE:	☑ smooth	☐ textured	☐ rough	☐ v. rough
COLOUR:	☑ monochrome	☐ muted	☐ colourful	☐ garish
FORM:	☐ straight	☐ angular	☑ curved	☐ sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.

Open expanse of field. Skyline mature trees draw the eye.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?

Strengthen hedgerow / tree / woodland character.

DIRECTION OF VIEW NW DATE 31·3·98 VIEWPOINT 7

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. Gently rolling farmland with occasional isolated farmhouses enclosed by mature hedging and trees. Low lying heath adjoins farmland to the south east.

HISTORICAL AND ECOLOGICAL ASSOCIATIONS
Are any of the following present?

Hamlets	(Irregular fields)	(Narrow lanes)	Ancient woods	Railways
Villages	(Mixed hedges)	(Hedge banks)	Parkland	Dykes
Commons	Field ponds	Bracken	(Heathland)	Plantations
Historic sites	Ridge and furrow	Hedgerow oaks	(Scrub)	Regular fields
Fords	Walled fields	Old pollards	(Rough grass)	Thorn hedges
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?

Rolling landform combined with hedges.

AESTHETIC FACTORS

CHECKLIST Indicate those factors that apply:

SCALE:	☐ intimate	☐ small	☑ large	☐ vast
ENCLOSURE:	☐ tight	☐ enclosed	☑ open	☐ exposed
DIVERSITY:	☐ uniform	☐ simple	☑ diverse	☐ complex
BALANCE:	☐ harmonious	☑ balanced	☐ discordant	☐ chaotic
MOVEMENT:	☐ dead	☑ calm	☐ busy	☐ frantic
TEXTURE:	☐ smooth	☑ textured	☐ rough	☐ v. rough
COLOUR:	☐ monochrome	☐ muted	☑ colourful	☐ garish
FORM:	☐ straight	☐ angular	☑ curved	☐ sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.

Pleasant mixture of landform, farmland and heathland providing interest and colour.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?

NA.

DIRECTION OF VIEW DATE 31.3.98 VIEWPOINT 8

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. Gently rolling arable and pasture farmland with occasional isolated farmhouses. Narrow country lanes and extensive mature hedgerows.

HISTORICAL AND ECOLOGICAL ASSOCIATIONS

Are any of the following present?

Hamlets	Irregular fields	Narrow lanes	Ancient woods	Railways
Villages	Mixed hedges	Hedge banks	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	Hedgerow oaks	Scrub	Regular fields
Fords	Walled fields	Old pollards	Rough grass	Thorn hedges
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?

See description

AESTHETIC FACTORS

CHECKLIST Indicate those factors that apply:

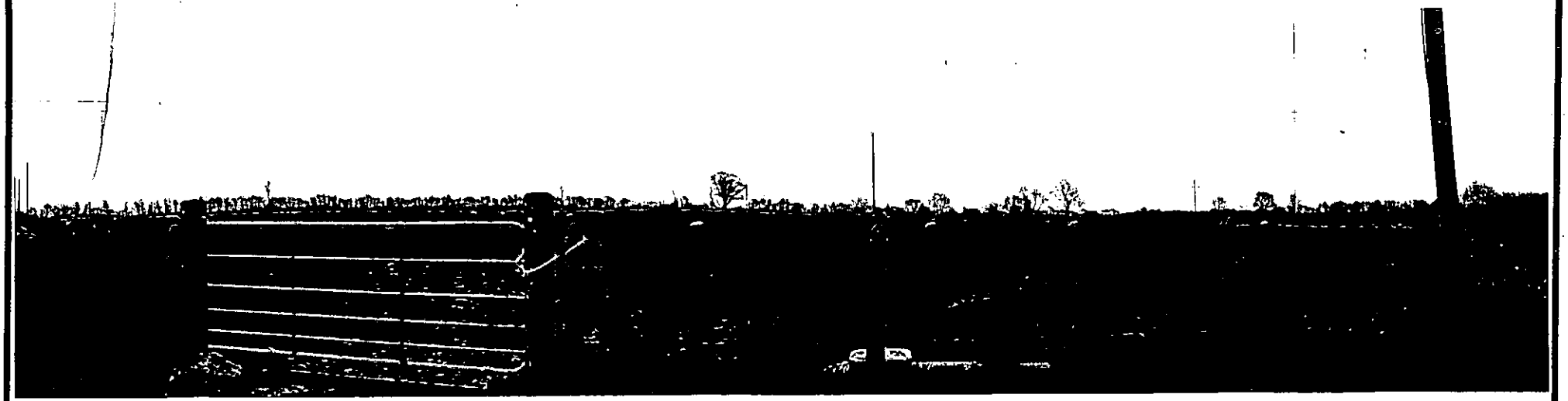
SCALE:	☐ intimate	☐ small	☑ large	☐ vast
ENCLOSURE:	☐ tight	☐ enclosed	☑ open	☐ exposed
DIVERSITY:	☐ uniform	☑ simple	☐ diverse	☐ complex
BALANCE:	☐ harmonious	☑ balanced	☐ discordant	☐ chaotic
MOVEMENT:	☐ dead	☑ calm	☐ busy	☐ frantic
TEXTURE:	☐ smooth	☑ textured	☐ rough	☐ v. rough
COLOUR:	☐ monochrome	☑ muted	☐ colourful	☐ garish
FORM:	☐ straight	☐ angular	☑ curved	☐ sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.

Homogenous scene with few attractors/detractors. No visual focus. Trees largely only in hedgerows so lack visual strength compared to woodland.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?

Definable woodland groups.



DIRECTION OF VIEW E DATE 31.3.98 VIEWPOINT 9

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. Local scale small hill with single larger field (pasture). mature hedgerow forms the skyline with occasional trees. Mixed conifer/ deciduous hedgerow trees in the far distance beyond the lower hill slopes.

HISTORICAL AND ECOLOGICAL ASSOCIATIONS

Are any of the following present?

Hamlets	Irregular fields	(Narrow lanes)	Ancient woods	Railways
Villages	(Mixed hedges)	Hedge banks	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	Hedgerow oaks	Scrub	Regular fields
Fords	Walled fields	Old pollards	Rough grass	(Thorn hedges)
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape? Landform

AESTHETIC FACTORS

CHECKLIST Indicate those factors that apply:

SCALE:	☐ intimate	☑ small	☐ large	☐ vast
ENCLOSURE:	☐ tight	☑ enclosed	☐ open	☐ exposed
DIVERSITY:	☐ uniform	☑ simple	☐ diverse	☐ complex
BALANCE:	☐ harmonious	☑ balanced	☐ discordant	☐ chaotic
MOVEMENT:	☐ dead	☑ calm	☐ busy	☐ frantic
TEXTURE:	☑ smooth	☐ textured	☐ rough	☐ v. rough
COLOUR:	☑ monochrome	☐ muted	☐ colourful	☐ garish
FORM:	☐ straight	☐ angular	☑ curved	☐ sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.

V. simple scene, few if any, attractors/ detractors.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?

More cohesive tree groupings.

DIRECTION OF VIEW W DATE 1·4·98 VIEWPOINT 10

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them.

Generally flat pasture farmland with localised minor (historic?) earthworks adjoining N4. Extensive field hedgerows with occasional mature trees.

HISTORICAL AND ECOLOGICAL ASSOCIATIONS
Are any of the following present?

Hamlets	(Irregular fields)	Narrow lanes	Ancient woods	Railways
(Villages)	(Mixed hedges)	(Hedge banks)	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
? Historic sites	Ridge and furrow	(Hedgerow oaks)	Scrub	Regular fields
Fords	Walled fields	Old pollards	(Rough grass)	(Thorn hedges)
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?

Mature hedgerows + trees.

AESTHETIC FACTORS
CHECKLIST Indicate those factors that apply:

SCALE:	☐ intimate	☐ small	☑ large	☐ vast
ENCLOSURE:	☐ tight	☐ enclosed	☑ open	☐ exposed
DIVERSITY:	☐ uniform	☑ simple	☐ diverse	☐ complex
BALANCE:	☐ harmonious	☑ balanced	☐ discordant	☐ chaotic
MOVEMENT:	☐ dead	☐ calm	☑ busy (N4)	☐ frantic
TEXTURE:	☐ smooth	☑ textured	☐ rough	☐ v. rough
COLOUR:	☐ monochrome	☑ muted	☐ colourful	☐ garish
FORM:	☐ straight	☑ angular	☐ curved	☐ sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.

Simple, generally homogenous landscape without any marked features.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?

Woodland groups, maintained hedging.

DIRECTION OF VIEW N DATE 31·3·98 VIEWPOINT 11

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. Slightly overgrown canal running through gently undulating farmland and woodland. Generally open landscape with extensive views through hedgerow gaps. Minor construction works in foreground.

HISTORICAL AND ECOLOGICAL ASSOCIATIONS
Are any of the following present?

Hamlets	Irregular fields	Narrow lanes	Ancient woods	Railways
Villages	Mixed hedges	Hedge banks	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	Hedgerow oaks	Scrub	Regular fields
Fords	Walled fields	Old pollards	Rough grass	Thorn hedges
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?
Canal and woodland.

AESTHETIC FACTORS
CHECKLIST Indicate those factors that apply:

SCALE:	☐ intimate	☐ small	☑ large	☐ vast
ENCLOSURE:	☐ tight	☐ enclosed	☑ open	☐ exposed
DIVERSITY:	☐ uniform	☐ simple	☑ diverse	☐ complex
BALANCE:	☐ harmonious	☑ balanced	☐ discordant	☐ chaotic
MOVEMENT:	☐ dead	☑ calm	☐ busy	☐ frantic
TEXTURE:	☐ smooth	☑ textured	☐ rough	☐ v. rough
COLOUR:	☐ monochrome	☐ muted	☑ colourful	☐ garish
FORM:	☑ straight	☐ angular	☑ curved	☐ sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.
Canal provides strong visual focus away from farmland.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?
Strengthen hedgerows and define heathland / pasture boots.

DIRECTION OF VIEW W DATE 1.4.98 VIEWPOINT 12

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. View over local high ground. Foreground comprises large scale, generally flat open arable field leading to occasional mature hedgerows. Middle/far distance low in the horizon and obscured by mist.

HISTORICAL AND ECOLOGICAL ASSOCIATIONS
Are any of the following present?

(Hamlets)	Irregular fields	(Narrow lanes)	Ancient woods	Railways
Villages	(Mixed hedges)	(Hedge banks)	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	Hedgerow oaks	Scrub	Regular fields
Fords	Walled fields	Old pollards	Rough grass	(Thorn hedges)
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape? Arable field.

AESTHETIC FACTORS
CHECKLIST Indicate those factors that apply:

SCALE:	☐ intimate	☐ small	☑ large	☐ vast
ENCLOSURE:	☐ tight	☐ enclosed	☑ open	☐ exposed
DIVERSITY:	☐ uniform	☑ simple	☐ diverse	☐ complex
BALANCE:	☐ harmonious	☐ balanced	☑ discordant	☐ chaotic
MOVEMENT:	☐ dead	☑ calm	☐ busy	☐ frantic
TEXTURE:	☑ smooth	☐ textured	☐ rough	☐ v. rough
COLOUR:	☑ monochrome	☐ muted	☐ colourful	☐ garish
FORM:	☐ straight	☑ angular	☐ curved	☐ sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.

Dull scene with little interest. Scale of agriculture discordant.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?
Add visual interest, copse/woodland. Maintain hedges.

DIRECTION OF VIEW NE DATE 31.3.98 VIEWPOINT 13

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. Extensive view from local hillside over generally flat, mixed farmland / peat extraction / heathland and woodland.

HISTORICAL AND ECOLOGICAL ASSOCIATIONS
Are any of the following present?

Hamlets	Irregular fields	Narrow lanes	Ancient woods	Railways
Villages	Mixed hedges	Hedge banks	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	Hedgerow oaks	Scrub	Regular fields
Fords	Walled fields	Old pollards	Rough grass	Thorn hedges
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape? Generally flat landform and farmland.

AESTHETIC FACTORS
CHECKLIST Indicate those factors that apply:

SCALE:	☐ intimate	☐ small	☐ large	☑ vast
ENCLOSURE:	☐ tight	☐ enclosed	☑ open	☐ exposed
DIVERSITY:	☐ uniform	☐ simple	☑ diverse	☐ complex
BALANCE:	☐ harmonious	☑ balanced	☐ discordant	☐ chaotic
MOVEMENT:	☐ dead	☑ calm	☐ busy	☐ frantic
TEXTURE:	☐ smooth	☑ textured	☐ rough	☐ v. rough
COLOUR:	☐ monochrome	☐ muted	☑ colourful	☐ garish
FORM:	☐ straight	☐ angular	☑ curved	☐ sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.
Generally balanced mixture of managed landscape offsetts the flat landform. No particular focus.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?

DIRECTION OF VIEW NNE DATE 31·3·98 VIEWPOINT 14

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. View out over extensive former heathland plain, now partially grassed. Road in foreground elevated above adjoining landscape. Conifer block in middle distance.

HISTORICAL AND ECOLOGICAL ASSOCIATIONS
Are any of the following present?

Hamlets	Irregular fields	Narrow lanes	Ancient woods	Railways
Villages	Mixed hedges	Hedge banks	Parkland	Dykes
Commons	Field ponds	Bracken	(Heathland)	Plantations
Historic sites	Ridge and furrow	Hedgerow oaks	Scrub	Regular fields
Fords	Walled fields	Old pollards	Rough grass	Thorn hedges
Canals		(Straight roads)	Meres	

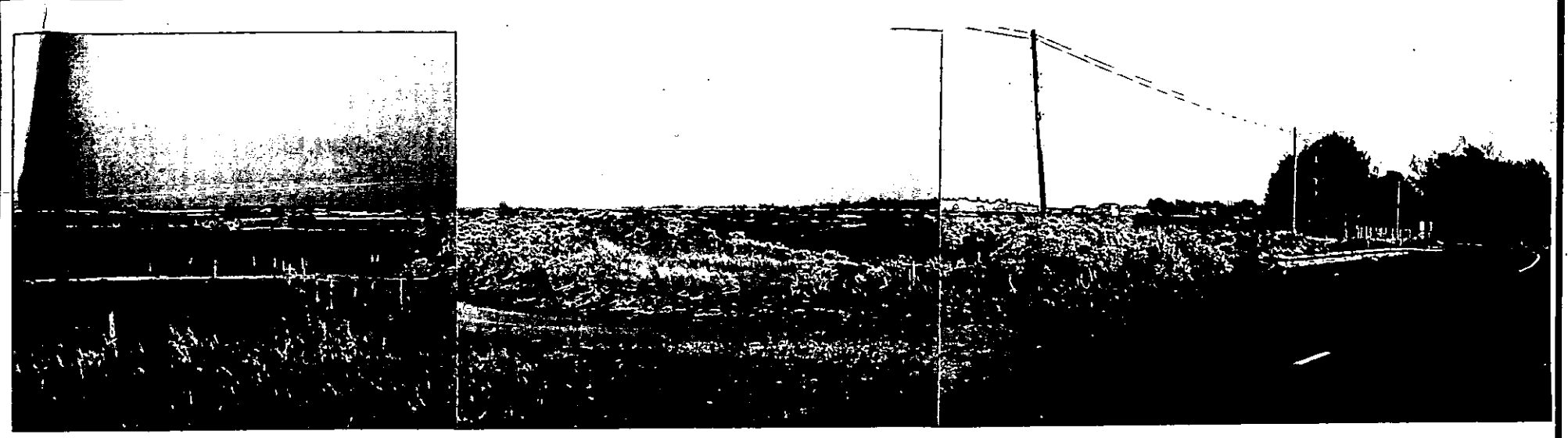
LANDSCAPE ELEMENTS Which are the dominant elements in the landcape? Conifer block, heathland/grassland

AESTHETIC FACTORS CHECKLIST Indicate those factors that apply:

SCALE:	☐ intimate	☐ small	☐ large	☑ vast
ENCLOSURE:	☐ tight	☐ enclosed	☐ open	☑ exposed
DIVERSITY:	☐ uniform	☑ simple	☐ diverse	☐ complex
BALANCE:	☐ harmonious	☐ balanced	☑ discordant	☐ chaotic
MOVEMENT:	☐ dead	☑ calm	☐ busy	☐ frantic
TEXTURE:	☑ smooth	☑ textured	☐ rough	☐ v. rough
COLOUR:	☐ monochrome	☐ muted	☑ colourful	☐ garish
FORM:	☑ straight	☐ angular	☐ curved	☐ sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.
Conifer block detracts. Heathland/scrub in middle distance like an island within managed grassland.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?
Re-introduce heathland. Remove conifer block



DIRECTION OF VIEW E DATE 31.3.98 VIEWPOINT 15

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. View out over extensive former heathland plain, now partially grassed/extracted. Remnant heathland adjoining drain/river now includ rough grass/gorse. Local small hill in middle distance.

HISTORICAL AND ECOLOGICAL ASSOCIATIONS
Are any of the following present?

Hamlets	Irregular fields	Narrow lanes	Ancient woods	Railways
Villages	Mixed hedges	Hedge banks	Parkland	Dykes
Commons	Field ponds	Bracken	(Heathland)	Plantations
Historic sites	Ridge and furrow	Hedgerow oaks	(Scrub)	Regular fields
Fords	Walled fields	Old pollards	(Rough grass)	Thorn hedges
Canals		(Straight roads)	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?
Heathland/scrub/grassland.

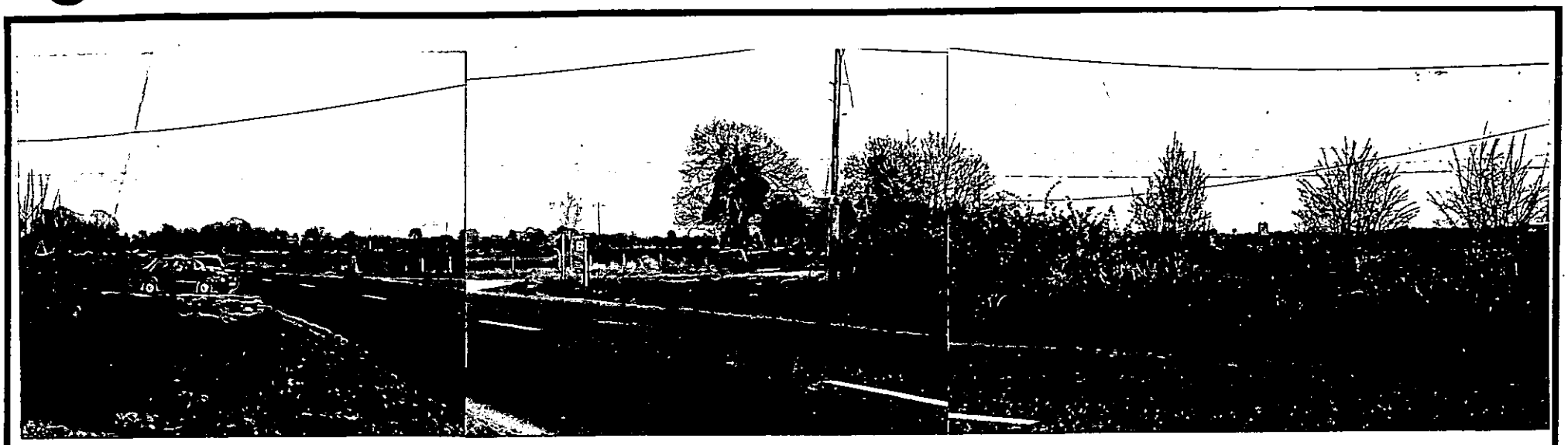
AESTHETIC FACTORS CHECKLIST Indicate those factors that apply:

SCALE:	☐ intimate	☐ small	☐ large	☑ vast
ENCLOSURE:	☐ tight	☐ enclosed	☐ open	☑ exposed
DIVERSITY:	☐ uniform	☑ simple	☐ diverse	☐ complex
BALANCE:	☐ harmonious	☐ balanced	☑ discordant	☐ chaotic
MOVEMENT:	☐ dead	☑ calm	☐ busy	☐ frantic
TEXTURE:	☐ smooth	☑ textured	☑ rough	☐ v. rough
COLOUR:	☐ monochrome	☐ muted	☑ colourful	☐ garish
FORM:	☑ straight	☐ angular	☐ curved	☐ sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.

Rough ground detracts, at odds with surroundings. Grassland (managed) also out of place.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?
Re-introduce heathland. Remove rough ground.



DIRECTION OF VIEW DATE 31.3.98 VIEWPOINT 16

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. Generally flat, mixed arable and pasture farmland with localised gentle undulations. Main road (N6) in foreground with view down straight country lane. Mixed field sizes and hedges. Some extensive views. Ruined castle remains in middle distance.

HISTORICAL AND ECOLOGICAL ASSOCIATIONS
Are any of the following present?

Hamlets	(Irregular fields)	(Narrow lanes)	Ancient woods	Railways
Villages	(Mixed hedges)	(Hedge banks)	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
(Historic sites)	Ridge and furrow	(Hedgerow oaks)	Scrub	Regular fields
Fords	Walled fields	Old pollards	~~Rough grass~~	Thorn hedges
Canals		(Straight roads)	Meres	

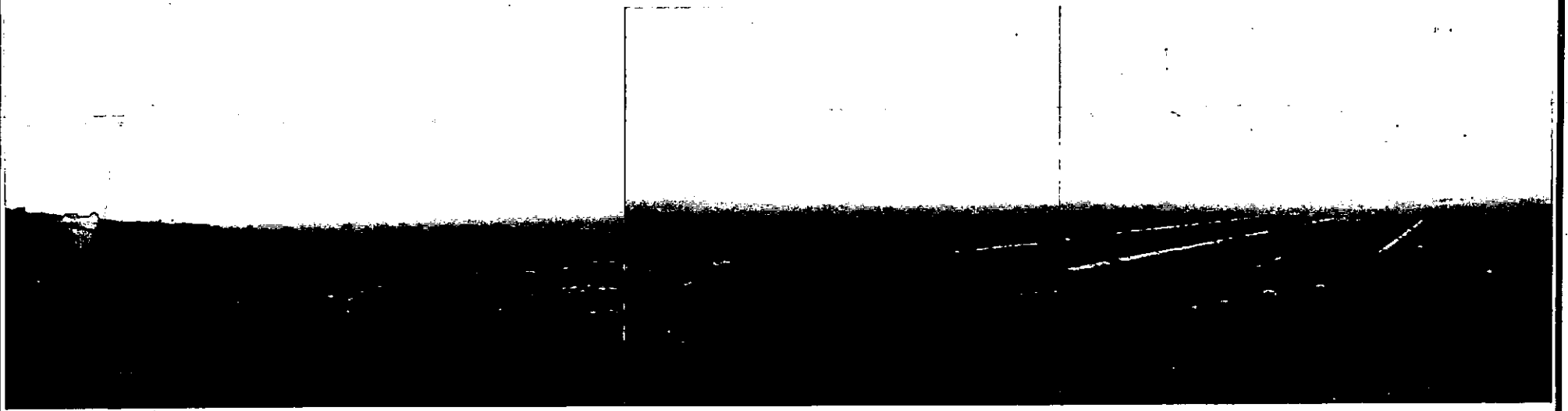
LANDSCAPE ELEMENTS Which are the dominant elements in the landcape? Mature hedgerow trees, roads.

AESTHETIC FACTORS
CHECKLIST Indicate those factors that apply:

SCALE:	☐ intimate	☐ small	☑ large	☐ vast
ENCLOSURE:	☐ tight	☐ enclosed	☑ open	☐ exposed
DIVERSITY:	☐ uniform	☐ simple	☑ diverse	☐ complex
BALANCE:	☐ harmonious	☐ balanced	☑ discordant	☐ chaotic
MOVEMENT:	☐ dead	☐ calm	☑ busy	☐ frantic
TEXTURE:	☐ smooth	☑ textured	☐ rough	☐ v. rough
COLOUR:	☐ monochrome	☐ muted	☑ colourful	☐ garish
FORM:	☑ straight	☐ angular	☑ curved	☐ sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.
Unmanaged roadside hedges/verges detract. Tree 'avenue' alongside straight country roads attracts. Power lines clutter and detract

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?
Maintain/re-introduce hedges.



DIRECTION OF VIEW NE DATE 1.4.98 VIEWPOINT 17

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. View from local hillside overlooking pasture farmland (hillsides), heath/grassland (lower slopes) and extensive peat extraction. Twin cooling towers of Coolcor power station break the skyline. Low hill in distance obscured by mist.

HISTORICAL AND ECOLOGICAL ASSOCIATIONS

Are any of the following present?

Hamlets	Irregular fields	Narrow lanes	Ancient woods	Railways
Villages	Mixed hedges	Hedge banks	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	Hedgerow oaks	Scrub	Regular fields
Fords	Walled fields	Old pollards	Rough grass	Thorn hedges
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape? Hillslopes / peat extraction

AESTHETIC FACTORS

CHECKLIST Indicate those factors that apply:

SCALE:	☐ intimate	☐ small	☐ large	☑ vast
ENCLOSURE:	☐ tight	☐ enclosed	☐ open	☑ exposed
DIVERSITY:	☐ uniform	☐ simple	☑ diverse	☐ complex
BALANCE:	☐ harmonious	☐ balanced	☑ discordant	☐ chaotic
MOVEMENT:	☐ dead	☑ calm	☐ busy	☐ frantic
TEXTURE:	☐ smooth	☑ textured	☐ rough	☐ v. rough
COLOUR:	☐ monochrome	☐ muted	☑ colourful	☐ garish
FORM:	☑ straight	☑ angular	☐ curved	☐ sinuous

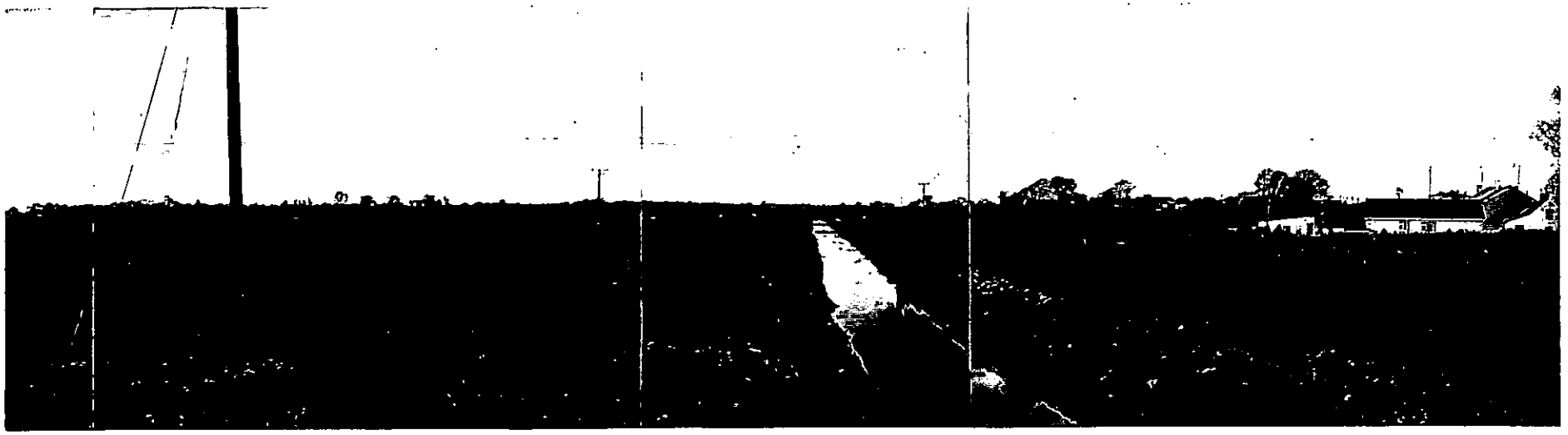
AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.

Contrast of managed hillside farming with remnant heath and peat extraction. Cooling towers draw the eye.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?

Reintroduce heathland.

2 SW



DIRECTION OF VIEW WSW DATE 31/3/98 VIEWPOINT 18

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them.

View from bridge over Kimegad River, along engineered channel. View up the flat floored valley, tree cover sparse in this section. Site to left in this view, 4 km away

HISTORICAL AND ECOLOGICAL ASSOCIATIONS

Are any of the following present?

Hamlets ✓	Irregular fields	Narrow lanes	Ancient woods	Railways
Villages ✓	Mixed hedges	Hedge banks	Parkland	Dykes ✓
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	Hedgerow oaks	Scrub	Regular fields ✓
Fords	Walled fields	Old pollards	Rough grass	Thorn hedges
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?

Broad flat river valley — Houses at edge of Kimegad

Wood pole power line — Traffic on bridge behind

River channel

AESTHETIC FACTORS

CHECKLIST Indicate those factors that apply:

SCALE:	☐ intimate	☐ small	☒ large	☐ vast
ENCLOSURE:	☐ tight	☐ enclosed	☒ open	☐ exposed
DIVERSITY:	☐ uniform	☒ simple	☐ diverse	☐ complex
BALANCE:	☐ harmonious	☒ balanced	☐ discordant	☐ chaotic
MOVEMENT:	☐ dead	☒ calm	☐ busy	☐ frantic
TEXTURE:	☐ smooth	☒ textured	☐ rough	☐ v. rough
COLOUR:	☐ monochrome	☒ muted	☐ colourful	☐ garish
FORM:	☒ straight	☐ angular	☐ curved	☐ sinuous

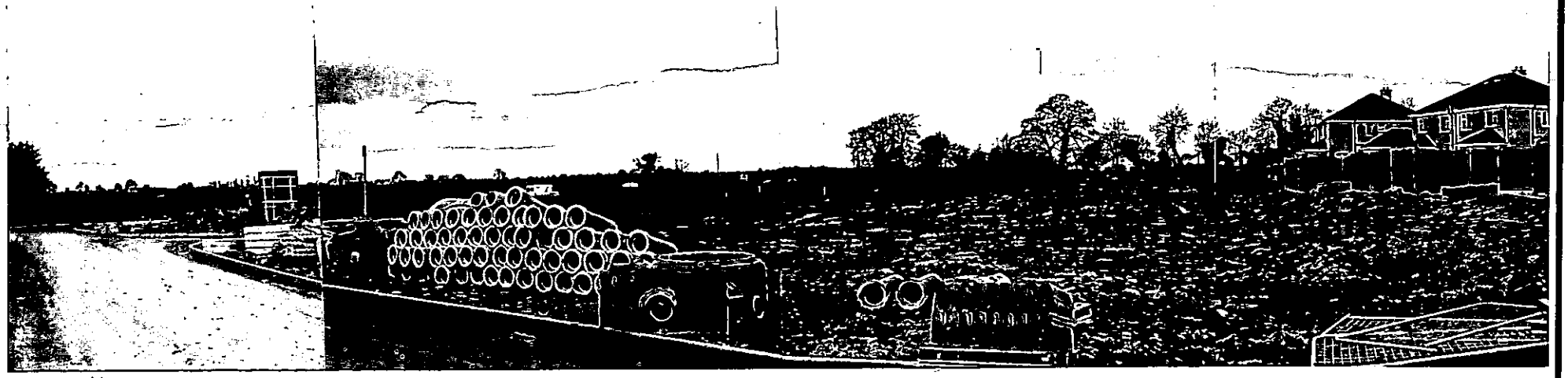
AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.

Open prospect along Kimegad River, which draws the eye into the distance. Discordant elements (Road signs, Hoardings etc.) visible at edges of view.

Heavy traffic passes close behind viewpoint on N4

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area? Site not visible, but large earthworks may show in distance - profile to be carefully considered.

4 S



DIRECTION OF VIEW SW DATE 31/3/98 VIEWPOINT 19

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. View from within 'Heathfield' - new development in Kimesgad. (Field in front will be built on). From slightly raised ground above river valley to south. Site 3km away to SW, on L.H. side in this view

HISTORICAL AND ECOLOGICAL ASSOCIATIONS
Are any of the following present?

Hamlets	Irregular fields	Narrow lanes	Ancient woods	Railways
Villages	Mixed hedges ✓	Hedge banks	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	Hedgerow oaks ✓	Scrub	Regular fields
Fords	Walled fields	Old pollards	Rough grass	Thorn hedges
Canals		Straight roads	Mores	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?

level ground awaiting development - site infrastructure in foreground. Prominent dark tree belt on site boundary. New fences and houses a stark contrast.

AESTHETIC FACTORS

CHECKLIST Indicate those factors that apply:

SCALE:	☐ intimate	☒ small	☐ large	☐ vast
ENCLOSURE:	☐ tight	☒ enclosed	☐ open	☐ exposed
DIVERSITY:	☐ uniform	☐ simple	☒ diverse	☐ complex
BALANCE:	☐ harmonious	☐ balanced	☒ discordant	☐ chaotic
MOVEMENT:	☐ dead	☐ calm	☒ busy	☐ frantic
TEXTURE:	☐ smooth	☐ textured	☒ rough	☐ v. rough
COLOUR:	☐ monochrome	☒ muted	☐ colourful	☐ garish
FORM:	☐ straight	☒ angular	☐ curved	☐ sinuous

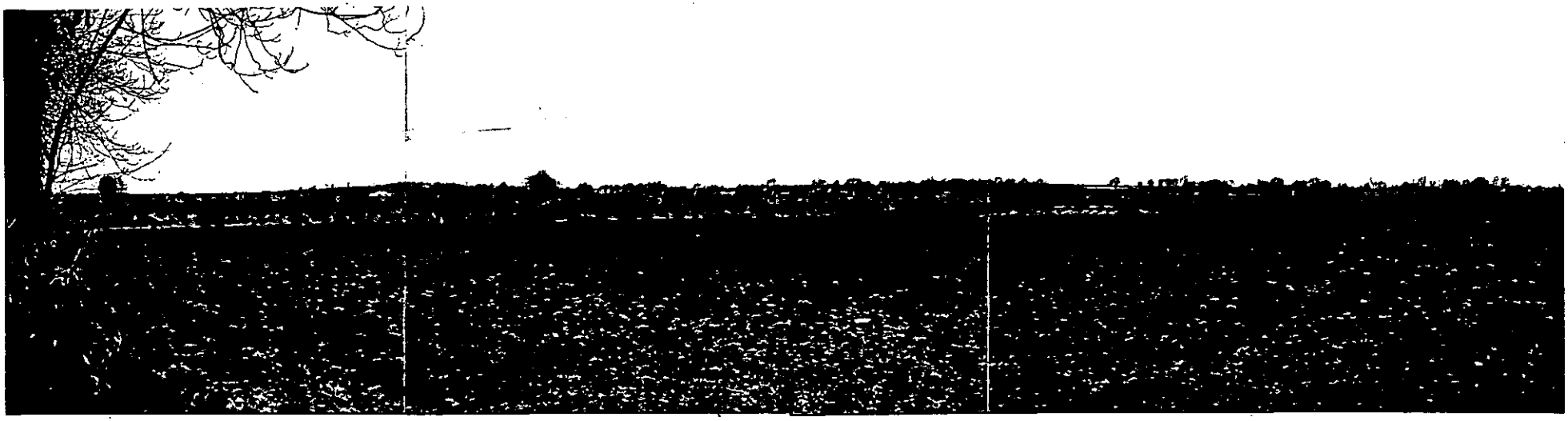
AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.

Site enclosed by houses or trees. More open view to SW behind low hedge. (In time views out towards site from upper windows when site is developed).

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?

siting / design / colour of any large structures visible from here.

5 WNW



DIRECTION OF VIEW WNW DATE 31/3/98 VIEWPOINT 20

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. View across open arable field towards Hill House + ridge on which N6 runs. Access road would cross behind white barn (left).

HISTORICAL AND ECOLOGICAL ASSOCIATIONS

Are any of the following present?

Hamlets	Irregular fields	Narrow lanes	Ancient woods	Railways
Villages	Mixed hedges	Hedge banks ✓	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	Hedgerow ~~oaks~~ trees ✓	Scrub	Regular fields ✓
Fords	Walled fields	Old pollards	Rough grass	Thorn hedges
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape? Open expanse in fore/middle ground of arable and pasture. Low hedges + banks give little enclosure Tree covered ridge forms skyline.

AESTHETIC FACTORS

CHECKLIST Indicate those factors that apply:

SCALE:	☐ intimate	☐ small	☒ large	☐ vast
ENCLOSURE:	☐ tight	☐ enclosed	☒ open	☐ exposed
DIVERSITY:	☐ uniform	☒ simple	☐ diverse	☐ complex
BALANCE:	☐ harmonious	☒ balanced	☐ discordant	☐ chaotic
MOVEMENT:	☐ dead	☒ calm	☐ busy	☐ frantic
TEXTURE:	☒ smooth	☐ textured	☐ rough	☐ v. rough
COLOUR:	☐ monochrome	☒ muted	☐ colourful	☐ garish
FORM:	☒ straight	☐ angular	☐ curved	☐ sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.

View dominated by open flat valley giving distant views - contrast to areas N and S.

Traffic on N4 audible in distance

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?

Care in road design to avoid insympathetic banks etc.

6 W

DIRECTION OF VIEW W DATE 31/3/98 VIEWPOINT 21

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. View along the Kinnegad - Ballinabracken road. Open river valley directly ahead, higher ridge with tree cover to left. Centre of site 2km distant in centre of view

HISTORICAL AND ECOLOGICAL ASSOCIATIONS
Are any of the following present?

Hamlets	Irregular fields	Narrow lanes ✓	Ancient woods	Railways
Villages	Mixed hedges	Hedge banks	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	Hedgerow oaks (ash) ✓	Scrub	Regular fields
Fords	Walled fields	Old pollards	Rough grass ✓	Thorn hedges
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?
Flat pasture and arable fields. Hedgerow trees (Ash) Ridge on which NG runs is distant horizon.

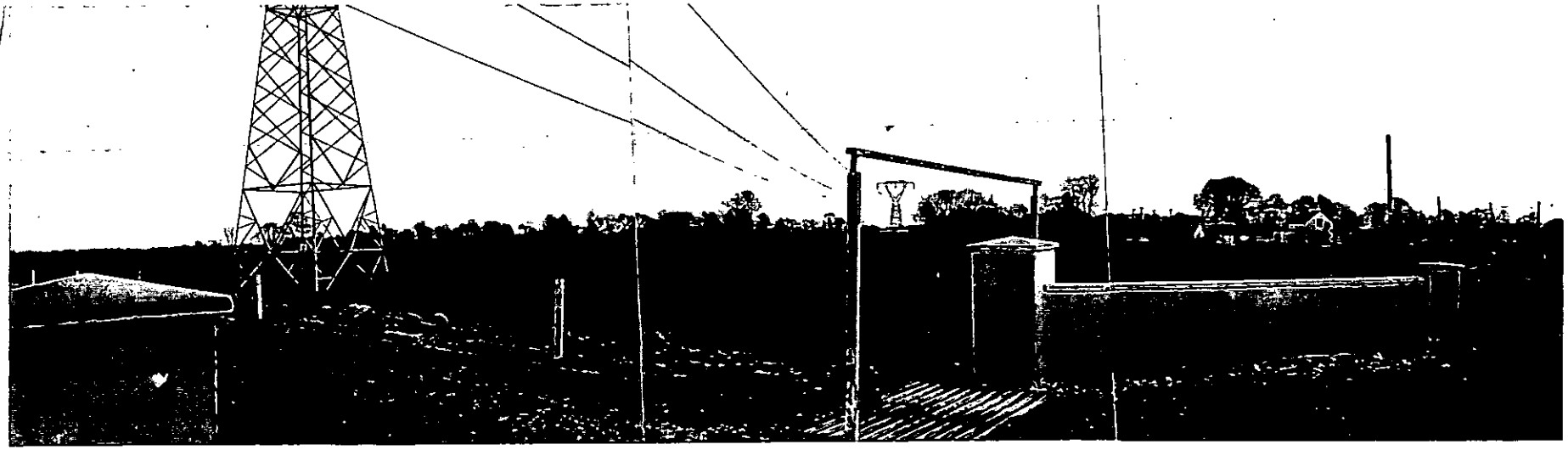
AESTHETIC FACTORS CHECKLIST Indicate those factors that apply:

SCALE:	☐	intimate	■	small	☐	large	☐	vast
ENCLOSURE:	☐	tight	☐	enclosed	■	open	☐	exposed
DIVERSITY:	☐	uniform	■	simple	☐	diverse	☐	complex
BALANCE:	☐	harmonious	■	balanced	☐	discordant	☐	chaotic
MOVEMENT:	☐	dead	■	calm	☐	busy	☐	frantic
TEXTURE:	☐	smooth	■	textured	☐	rough	☐	v. rough
COLOUR:	☐	monochrome	■	muted	☐	colourful	☐	garish
FORM:	☐	straight	☐	angular	■	curved	☐	sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.
Vane and open vista along Kinnegad River lead the eye to distant ridge. Wood pole and cable a discordant element.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?
Screen banks / planting if road crosses valley

58 L



DIRECTION OF VIEW E DATE 31/3/98 VIEWPOINT 22

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. View towards centre of site from west of Killaskillen. Farm entrance prominent in foreground. Power line crosses middle of site. Boundary tree screen will remain.

HISTORICAL AND ECOLOGICAL ASSOCIATIONS
Are any of the following present?

Hamlets ✓	Irregular fields	Narrow lanes ✓	Ancient woods	Railways
Villages	Mixed hedges	Hedge banks	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	Hedgerow ~~oaks~~ trees ✓	Scrub	Regular fields ✓
Fords	Walled fields	Old pollards	Rough grass	Thorn hedges
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape? Flat field on top of low ridge. Walls, gate posts of farm entrance. Overhead line and pylon.

AESTHETIC FACTORS

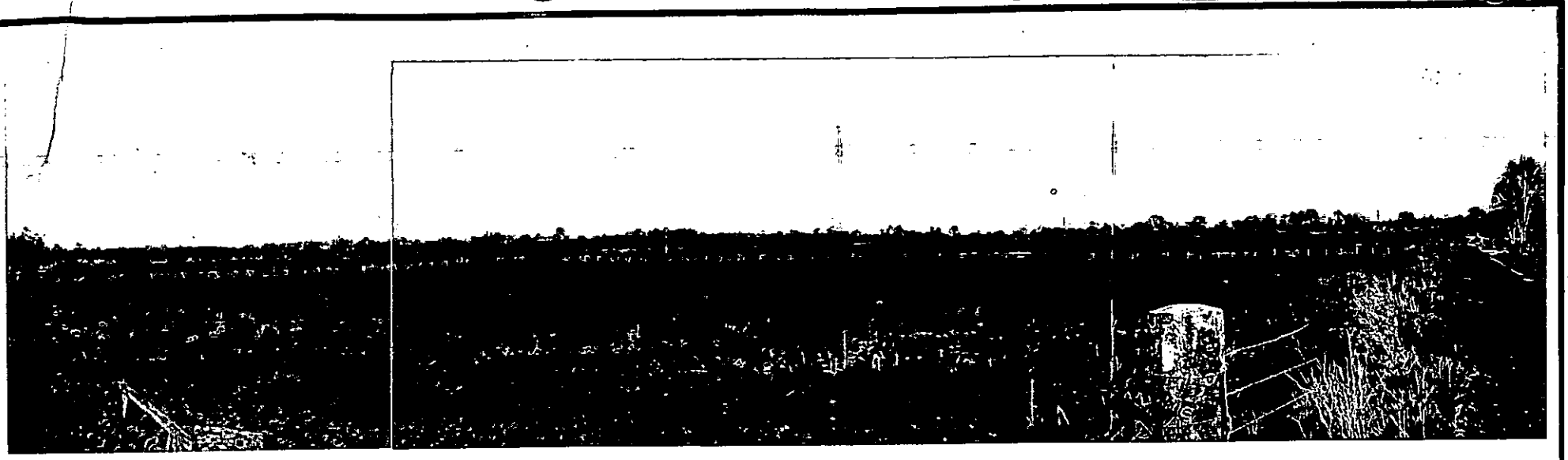
CHECKLIST Indicate those factors that apply:

SCALE:	☐	intimate	☒	small	☐	large	☐	vast
ENCLOSURE:	☐	tight	☒	enclosed	☐	open	☐	exposed
DIVERSITY:	☐	uniform	☐	simple	☒	diverse	☐	complex
BALANCE:	☐	harmonious	☐	balanced	☒	discordant	☐	chaotic
MOVEMENT:	☐	dead	☒	calm	☐	busy	☐	frantic
TEXTURE:	☐	smooth	☒	textured	☐	rough	☐	v. rough
COLOUR:	☐	monochrome	☐	muted	☒	colourful	☐	garish
FORM:	☐	straight	☒	angular	☐	curved	☐	sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.
Discordant scene dominated by man made objects and structures. Natural features subservient.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?
Preservation of boundary trees. Design of screen and storage mounds.

11.



DIRECTION OF VIEW E DATE 31/3/98 VIEWPOINT 23

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. View east down Kinnegad River valley towards Hill House. (River between metal fence posts on L). Shale quarry 1½ km away in centre of view. Plant site out of view to R. Gentle undulations to east and north.

HISTORICAL AND ECOLOGICAL ASSOCIATIONS

Are any of the following present?

Hamlets	Irregular fields	Narrow lanes	Ancient woods	Railways
Villages	Mixed hedges	Hedge banks	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	Hedgerow oaks	Scrub	Regular fields
Fords	Walled fields	Old pollards	Rough grass ✓	Thorn hedges
Canals		Straight roads ✓	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?

Flat fields with wire fence or thin hedge boundaries. Hedgerow trees – Pine and birch prominent.

AESTHETIC FACTORS

CHECKLIST Indicate those factors that apply:

SCALE:	☐	intimate	☐	small	☒	large	☐ vast
ENCLOSURE:	☐	tight	☐	enclosed	☒	open	☐ exposed
DIVERSITY:	☐	uniform	☒	simple	☐	diverse	☐ complex
BALANCE:	☐	harmonious	☒	balanced	☐	discordant	☐ chaotic
MOVEMENT:	☒	dead	☐	calm	☐	busy	☐ frantic
TEXTURE:	☐	smooth	☒	textured	☐	rough	☐ v. rough
COLOUR:	☒	monochrome	☐	muted	☐	colourful	☐ garish
FORM:	☒	straight	☐	angular	☐	curved	☐ sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.

Open view along river flood-plain. Horizon limited by trees 1 – 3 km distant. Occasional houses + farms visible.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?

Tops of major mounds may be visible – relate to landform.

12

DIRECTION OF VIEW W DATE 31/3/93 VIEWPOINT 24

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. View west along Kinneyed River. Rattin castle on left. Open fields along river valley with few trees or hedges. Site behind viewer. 1½ km away

HISTORICAL AND ECOLOGICAL ASSOCIATIONS
Are any of the following present?

Hamlets	Irregular fields	Narrow lanes	Ancient woods	Railways
Villages	Mixed hedges	Hedge banks	Parkland	Dykes ✓
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites ✓	Ridge and furrow	Hedgerow oaks	Scrub	Regular fields
Fords	Walled fields	Old pollards	Rough grass	Thorn hedges
Canals		Straight roads ✓	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?
Open river flood-plain. Straight lines of river channel and road

AESTHETIC FACTORS CHECKLIST Indicate those factors that apply:

SCALE:	☐	intimate	☐	small	☒	large	☐ vast
ENCLOSURE:	☐	tight	☐	enclosed	☒	open	☐ exposed
DIVERSITY:	☐	uniform	☒	simple	☐	diverse	☐ complex
BALANCE:	☐	harmonious	☒	balanced	☐	discordant	☐ chaotic
MOVEMENT:	☐	dead	☒	calm	☐	busy	☐ frantic
TEXTURE:	☐	smooth	☒	textured	☐	rough	☐ v. rough
COLOUR:	☐	monochrome	☒	muted	☐	colourful	☐ garish
FORM:	☒	straight	☐	angular	☐	curved	☐ sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.
Open view to west with few foreground features. castle and pylon prominent features in middle distance.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?
Site not visible.

15.

DIRECTION OF VIEW N. DATE 31/3/98 VIEWPOINT 25

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them.

View north into site from n. of & Lansdown Lodge. Bunded materials store will be behind hedge, Shale quarry 300m to north. Small undulations in local relief.

HISTORICAL AND ECOLOGICAL ASSOCIATIONS
Are any of the following present?

Hamlets	Irregular fields	Narrow lanes ✓	Ancient woods	Railways
Villages	Mixed hedges	Hedge banks ✓	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	Hedgerow ~~oaks~~ trees ✓	Scrub	Regular fields
Fords	Walled fields	Old pollards	Rough grass	Thorn hedges
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?

Arable field, hedgerow + tree belts. Trees on skyline.

AESTHETIC FACTORS

CHECKLIST Indicate those factors that apply:

SCALE:	☐	intimate	■	small	☐	large	☐	vast
ENCLOSURE:	☐	tight	■	enclosed	☐	open	☐	exposed
DIVERSITY:	☐	uniform	☐	simple	■	diverse	☐	complex
BALANCE:	☐	harmonious	■	balanced	☐	discordant	☐	chaotic
MOVEMENT:	☐	dead	■	calm	☐	busy	☐	frantic
TEXTURE:	☐	smooth	■	textured	☐	rough	☐	v. rough
COLOUR:	☐	monochrome	■	muted	☐	colourful	☐	garish
FORM:	☐	straight	☐	angular	■	curved	☐	sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.

Silhouetted trees visually prominent. Dark pines contrast with green field.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?

Design of outer bund faces to avoid excessive dominance.

16

DIRECTION OF VIEW W DATE 31/3/98 VIEWPOINT 26

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. View west from eastern site boundary. Pines on right are in centre of shale quarry. Main works site is left of road 1½ km away. Hedges + trees dominate the view

HISTORICAL AND ECOLOGICAL ASSOCIATIONS
Are any of the following present?

Hamlets	Irregular fields	Narrow lanes	Ancient woods	Railways
Villages	Mixed hedges ✓	Hedge banks ✓	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	Hedgerow ~~oaks~~ trees ✓	Scrub	Regular fields
Fords	Walled fields	Old pollards	Rough grass	Thorn hedges
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?

Pines, trees (Ash, Beech) with dense ivy. Foreground hedge.

AESTHETIC FACTORS

CHECKLIST Indicate those factors that apply:

SCALE:	☐	intimate	☒	small	☐	large	☐	vast
ENCLOSURE:	☐	tight	☒	enclosed	☐	open	☐	exposed
DIVERSITY:	☐	uniform	☐	simple	☒	diverse	☐	complex
BALANCE:	☐	harmonious	☒	balanced	☐	discordant	☐	chaotic
MOVEMENT:	☐	dead	☒	calm	☐	busy	☐	frantic
TEXTURE:	☐	smooth	☒	textured	☐	rough	☐	v. rough
COLOUR:	☐	monochrome	☐	muted	☒	colourful	☐	garish
FORM:	☒	straight	☐	angular	☐	curved	☐	sinuous

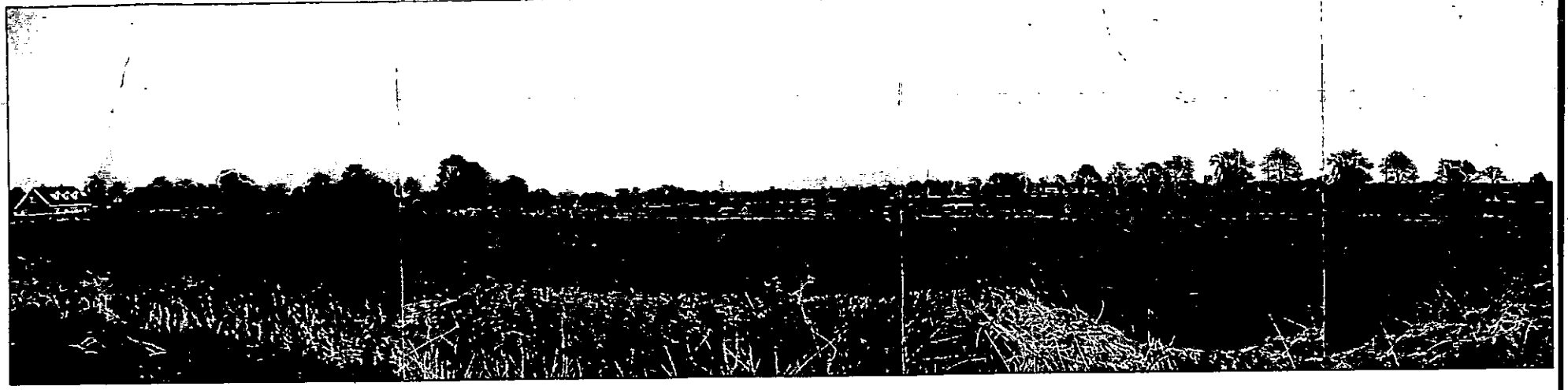
AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.

Shed with red roof a visual focus (colour, form) Pines against rising ground and sky are attractive feature. Overhead cable a discordant element.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?

Design of screen bunds + planting around shale quarry.

19.



DIRECTION OF VIEW ESE DATE 31/3/98 VIEWPOINT 27

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. View ESE from old road route – N6 cuts diagonally through field pattern. Land falls gently to river. More tree cover on higher ground. Plant site 3½ km away to southeast.

HISTORICAL AND ECOLOGICAL ASSOCIATIONS

Are any of the following present?

Hamlets ✓	Irregular fields	Narrow lanes ✓	Ancient woods	Railways
Villages	Mixed hedges	Hedge banks	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites ✓	Ridge and furrow	Hedgerow oaks trees ✓	Scrub	Regular fields ✓
Fords	Walled fields	Old pollards	Rough grass	Thorn hedges ✓
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?

Arable + pasture fields
Hedgerow trees + roadside trees.

AESTHETIC FACTORS

CHECKLIST Indicate those factors that apply:

SCALE:	☐	intimate	☒	small	☐	large	☐	vast
ENCLOSURE:	☐	tight	☐	enclosed	☒	open	☐	exposed
DIVERSITY:	☐	uniform	☒	simple	☐	diverse	☐	complex
BALANCE:	☐	harmonious	☒	balanced	☐	discordant	☐	chaotic
MOVEMENT:	☐	dead	☐	calm	☒	busy	☐	frantic
TEXTURE:	☐	smooth	☒	textured	☐	rough	☐	v. rough
COLOUR:	☐	monochrome	☒	muted	☐	colourful	☐	garish
FORM:	☒	straight	☐	angular	☐	curved	☐	sinuous

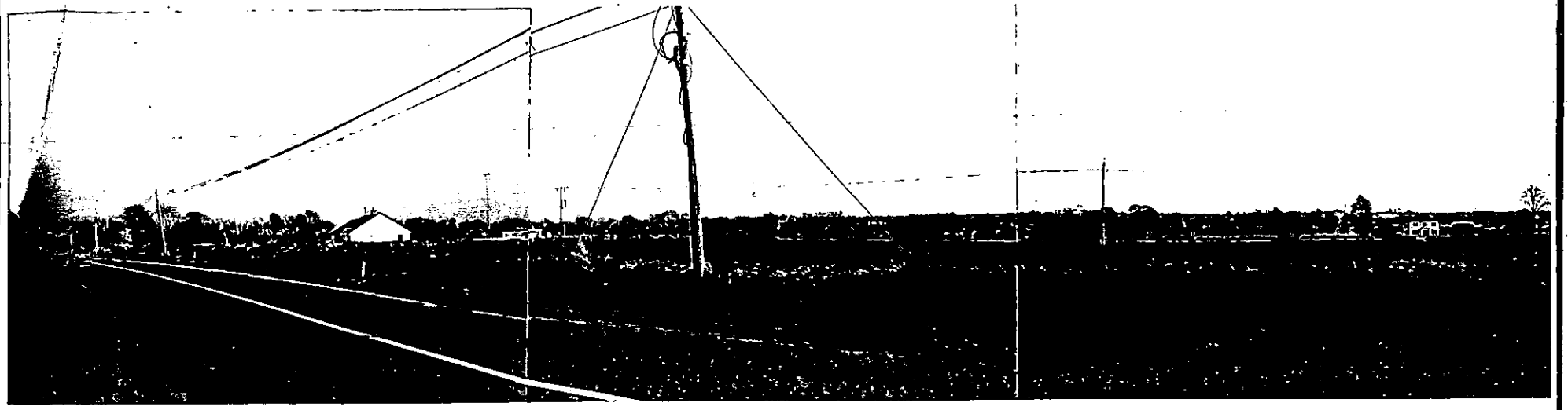
AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.

View down to Kimeyed River framed by trees to L and R. Rattin castle a visual focus on ridge to south. Traffic on N6 passes through centre of view (between fences)

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?

Colour and form of tall structures which may be visible.

21



DIRECTION OF VIEW SE DATE 31/3/99 VIEWPOINT 28

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. View SE from NG towards site. slightly elevated above river plain. View to horizon about 4 km away. Plant site c. 3 km distant, tall structures likely to be visible

HISTORICAL AND ECOLOGICAL ASSOCIATIONS
Are any of the following present?

Hamlets	Irregular fields	Narrow lanes	Ancient woods	Railways
Villages	Mixed hedges	Hedge banks ✓	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	Hedgerow oaks	Scrub	Regular fields
Fords	Walled fields	Old pollards	Rough grass	Thorn hedges
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?
Road and verges (moving traffic). Arable and pasture fields. Poles and overhead wires.

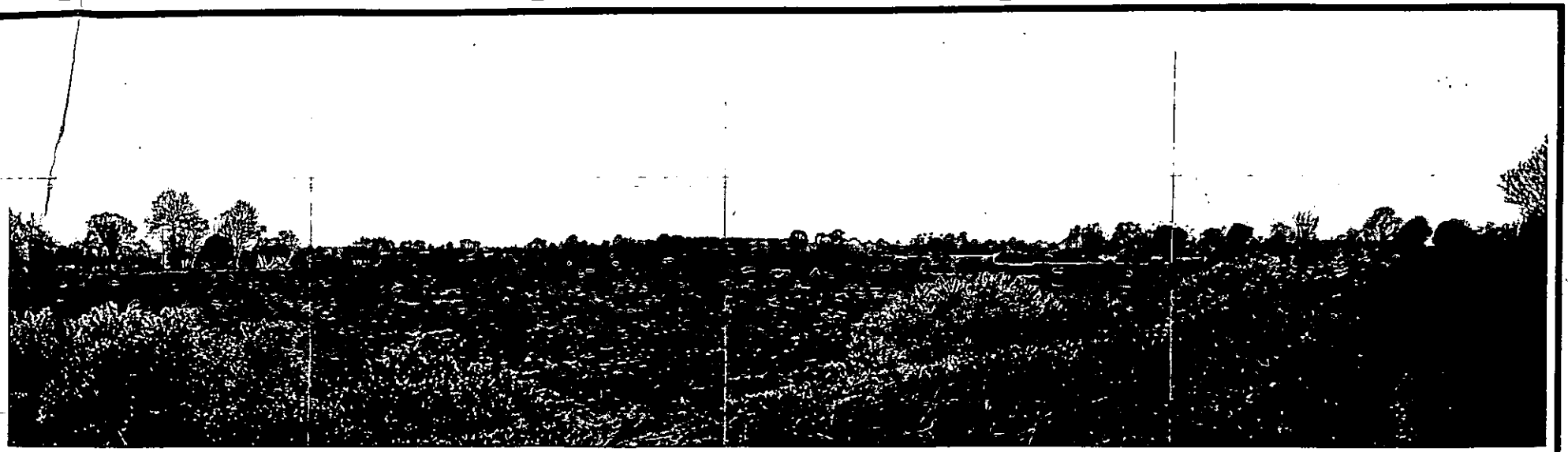
AESTHETIC FACTORS CHECKLIST Indicate those factors that apply:

SCALE:	☐	intimate	☒	small	☐	large	☐ vast
ENCLOSURE:	☐	tight	☐	enclosed	☒	open	☐ exposed
DIVERSITY:	☐	uniform	☒	simple	☐	diverse	☐ complex
BALANCE:	☐	harmonious	☐	balanced	☒	discordant	☐ chaotic
MOVEMENT:	☐	dead	☐	calm	☒	busy	☐ frantic
TEXTURE:	☐	smooth	☒	textured	☐	rough	☐ v. rough
COLOUR:	☐	monochrome	☒	muted	☐	colourful	☐ garish
FORM:	☒	straight	☐	angular	☐	curved	☐ sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.
Roadside view dominated by foreground traffic. Human influence strong (houses, roads, power lines)

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?
Tall structures may be visible but not quarry sites

24 V



DIRECTION OF VIEW W DATE 31/3/98 VIEWPOINT 29

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them.

View over unmanaged rough grazing land. Dark mass of conifer plantation forms skyline in centre. Site behind viewpoint 5km away.

HISTORICAL AND ECOLOGICAL ASSOCIATIONS
Are any of the following present?

Hamlets	Irregular fields	Narrow lanes	Ancient woods	Railways
Villages	Mixed hedges	Hedge banks	Parkland	Dykes
Commons ✓3	Field ponds	Bracken	Heathland	Plantations ✓
Historic sites	Ridge and furrow	Hedgerow oaks	Scrub	Regular fields
Fords	Walled fields	Old pollards	Rough grass ✓	Thorn hedges
Canals		Straight roads ✓	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?

Rough grass + gorse, tree groups and lines

AESTHETIC FACTORS CHECKLIST Indicate those factors that apply:

SCALE:	☐	intimate	☐	small	☒	large	☐ vast
ENCLOSURE:	☐	tight	☐	enclosed	☒	open	☐ exposed
DIVERSITY:	☐	uniform	☒	simple	☐	diverse	☐ complex
BALANCE:	☐	harmonious	☒	balanced	☐	discordant	☐ chaotic
MOVEMENT:	☐	dead	☒	calm	☐	busy	☐ frantic
TEXTURE:	☐	smooth	☐	textured	☒	rough	☐ v. rough
COLOUR:	☐	monochrome	☐	muted	☒	colourful	☐ garish
FORM:	☒	straight	☐	angular	☐	curved	☐ sinuous

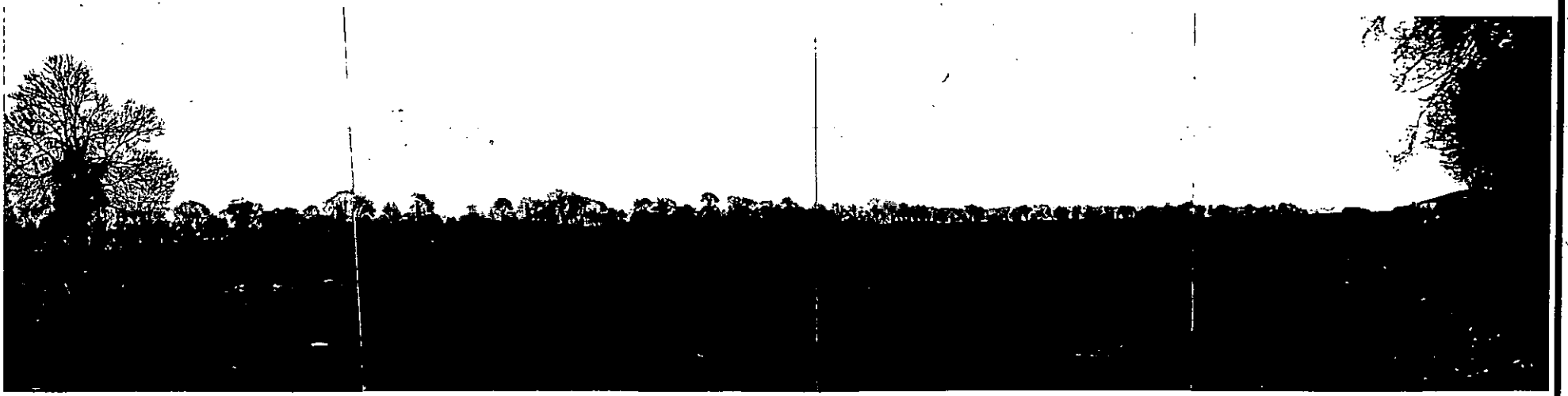
AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.

Bright colour from gorse flowers enlivens foreground. Tree tracery composes well with misty sky and ground texture.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?

Site not visible.

27 S



DIRECTION OF VIEW S DATE 1/4/98 VIEWPOINT 30

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. View south from east side of Hill House on NG. Dark mass of trees around house overshadow to right. Site beyond tree belt and river valley, 2km to south.

HISTORICAL AND ECOLOGICAL ASSOCIATIONS
Are any of the following present?

Hamlets	Irregular fields	Narrow lanes	Ancient woods	Railways
Villages	Mixed hedges	Hedge banks	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	Hedgerow ~~oaks~~ trees ✓	Scrub	Regular fields
Fords	Walled fields	Old pollards	Rough grass	Thornhedges
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?

Grass ley / pasture field
Boundary tree belt.

AESTHETIC FACTORS CHECKLIST Indicate those factors that apply:

SCALE:	☐	intimate	☒	small	☐	large	☐	vast
ENCLOSURE:	☐	tight	☒	enclosed	☐	open	☐	exposed
DIVERSITY:	☐	uniform	☒	simple	☐	diverse	☐	complex
BALANCE:	☐	harmonious	☒	balanced	☐	discordant	☐	chaotic
MOVEMENT:	☐	dead	☒	calm	☐	busy	☐	frantic
TEXTURE:	☐	smooth	☒	textured	☐	rough	☐	v. rough
COLOUR:	☐	monochrome	☒	muted	☐	colourful	☐	garish
FORM:	☒	straight	☐	angular	☐	curved	☐	sinuous

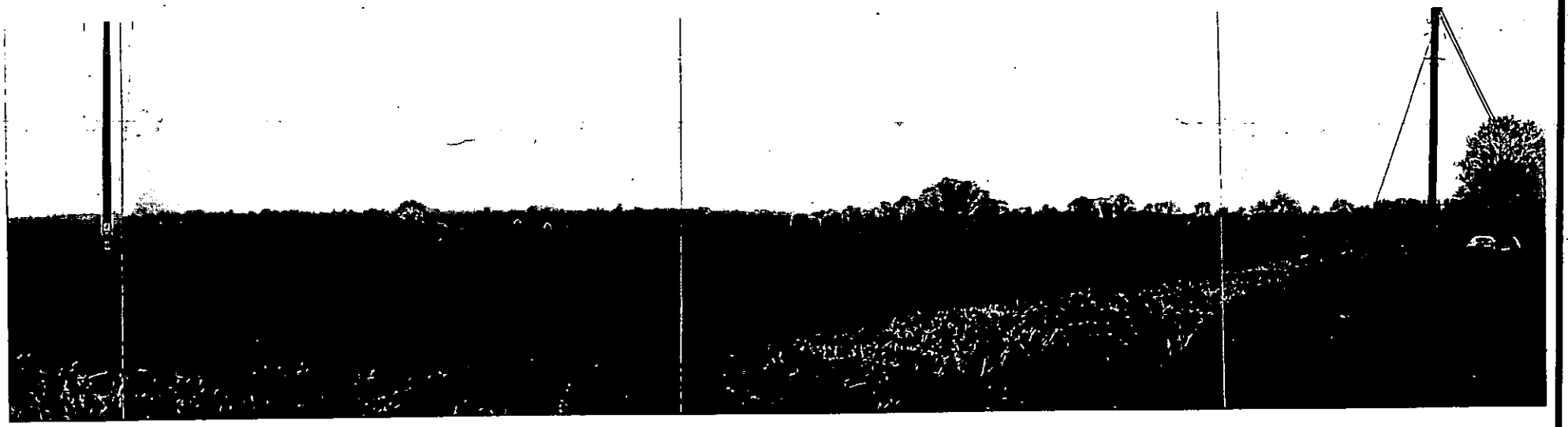
AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.

Simple view into enclosed field. Filtered view out towards ridge beyond river valley. Overhanging trees on Hill House boundary are oppressive.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?

Only tallest structures visible. Road connection may be nearby

28. SSW



DIRECTION OF VIEW SSW DATE 1-4-98 VIEWPOINT 31

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. slightly elevated view from NG across Kinnegad River valley. Few trees in valley, more on ridges to N and S. Site in centre of view, 2km to south. Tall structures likely to be visible.

HISTORICAL AND ECOLOGICAL ASSOCIATIONS
Are any of the following present?

Hamlets	Irregular fields	Narrow lanes	Ancient woods	Railways
Villages	Mixed hedges ✓	Hedge banks	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	Hedgerow oaks	Scrub	Regular fields
Fords	Walled fields	Old pollards	Rough grass	Thorn hedges
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?
Open farmland
Tree groups and lines

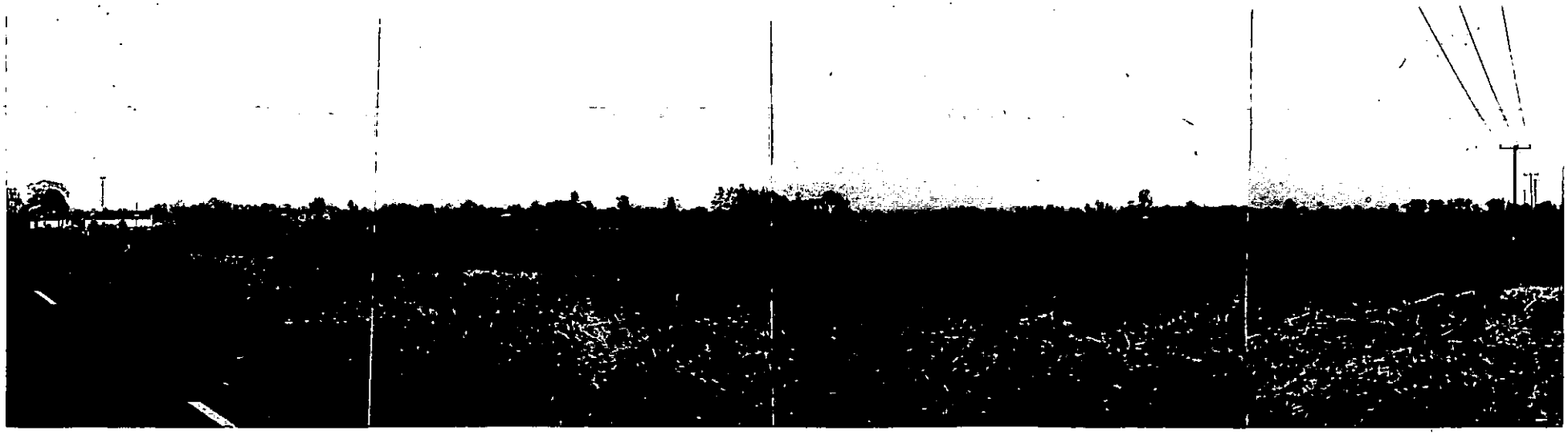
AESTHETIC FACTORS
CHECKLIST Indicate those factors that apply:

SCALE:	☐	intimate	☐	small	☒	large	☐	vast
ENCLOSURE:	☐	tight	☐	enclosed	☒	open	☐	exposed
DIVERSITY:	☐	uniform	☒	simple	☐	diverse	☐	complex
BALANCE:	☐	harmonious	☒	balanced	☐	discordant	☐	chaotic
MOVEMENT:	☐	dead	☒	calm	☐	busy	☐	frantic
TEXTURE:	☐	smooth	☒	textured	☐	rough	☐	v. rough
COLOUR:	☐	monochrome	☒	muted	☐	colourful	☐	garish
FORM:	☐	straight	☐	angular	☒	curved	☐	sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.
Gently flowing lines of middle distance landform
Traffic on NG just behind viewer is a distraction.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?
Care in form and height of bunds and mounds.

33 W



DIRECTION OF VIEW W DATE 1-4-98 VIEWPOINT 32

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them.

Flat field in foreground bounded by low hedges. Tree cover limits views to <1km generally. Site 4km away in centre of view – only tallest structures likely to be visible. View W. from R401 SE of Kinnegad.

HISTORICAL AND ECOLOGICAL ASSOCIATIONS

Are any of the following present?

Hamlets	Irregular fields	Narrow lanes	Ancient woods	Railways
Villages	Mixed hedges	Hedge banks ✓	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	Hedgerow oaks	Scrub	Regular fields
Fords	Walled fields	Old pollards	Rough grass	Thorn hedges
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?

Flat farmland, Tree belts and groups in middle distance.

AESTHETIC FACTORS CHECKLIST Indicate those factors that apply:

SCALE:	☐	intimate	☒	small	☐	large	☐	vast
ENCLOSURE:	☐	tight	☐	enclosed	☒	open	☐	exposed
DIVERSITY:	☐	uniform	☒	simple	☐	diverse	☐	complex
BALANCE:	☐	harmonious	☒	balanced	☐	discordant	☐	chaotic
MOVEMENT:	☐	dead	☒	calm	☐	busy	☐	frantic
TEXTURE:	☐	smooth	☒	textured	☐	rough	☐	v. rough
COLOUR:	☐	monochrome	☒	muted	☐	colourful	☐	garish
FORM:	☒	straight	☐	angular	☐	curved	☐	sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.

A flat landscape in which trees form enclosure – some tall groups of mature conifers are prominent

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?

Site not visible, but tallest structures may be.

DIRECTION OF VIEW SW DATE 31.3.98 VIEWPOINT 33

BRIEF DESCRIPTION Describe the main elements and features of the landscape, and the way in which they are organised and the relationship of the site to them. Small winding country road partially enclosed by grassed banks and hedgerows. Occasional mature hedgerow trees. Field access via break in bank with view over generally flat pasture field to mature trees and hedges forming field boundarie

HISTORICAL AND ECOLOGICAL ASSOCIATIONS
Are any of the following present?

Hamlets	Irregular fields	(Narrow lanes)	Ancient woods	Railways
Villages	(Mixed hedges)	(Hedge banks)	Parkland	Dykes
Commons	Field ponds	Bracken	Heathland	Plantations
Historic sites	Ridge and furrow	(Hedgerow oaks)	Scrub	(Regular fields)
Fords	Walled fields	Old pollards	(Rough grass)	(Thorn hedges)
Canals		Straight roads	Meres	

LANDSCAPE ELEMENTS Which are the dominant elements in the landcape?
Roadside banks / trees.

AESTHETIC FACTORS
CHECKLIST Indicate those factors that apply:

SCALE:	☐ intimate	☑ small	☑ large	☐ vast
ENCLOSURE:	☐ tight	☑ enclosed	☑ open	☐ exposed
DIVERSITY:	☐ uniform	☑ simple	☐ diverse	☐ complex
BALANCE:	☐ harmonious	☑ balanced	☐ discordant	☐ chaotic
MOVEMENT:	☐ dead	☑ calm	☐ busy	☐ frantic
TEXTURE:	☐ smooth	☑ textured	☐ rough	☐ v. rough
COLOUR:	☐ monochrome	☑ muted	☐ colourful	☐ garish
FORM:	☐ straight	☐ angular	☑ curved	☐ sinuous

AESTHETICS Describe the above, including any other special aesthetic factors, attractors, detractors, genius loci and visual travel.
The eye is drawn along the road with few detractors.

GUIDELINES What measures might be appropriate on site to strengthen or improve the landscape character of the area?
Re introduce bank hedging.