8 AIR QUALITY

Introduction

8.1 This section of the EIS deals with the air emissions from the proposed site. Particular attention is given to dust generation and deposition.

8.2 Irish Gypsum Ltd's existing operations are covered by an Integrated Pollution Prevention Control (IPPC) Licence (No. 688) issued by the Environmental Protection Agency. The emission limits as currently set by the EPA will be applied to this proposal.

Description of the Receiving Environment

Ambient PM_{10}, $PM_{2.5}$ and Dust Deposition Standards

8.3 Air quality significance criteria are assessed on the basis of compliance with the appropriate standards or limit values. The applicable PM_{10} standard in Ireland is contained within the Air Quality Standards Regulations 2002, which incorporates EU Directives 1999/30/EC and 2000/69/EC (see Table 8.1).

8.4 The European Commission sponsored report "Second Position Paper on Particulate Matter" (Final, Dec. 2004), prepared by the CAFE sub-group Working Group on Particulate Matter, recommended that the principal metric for assessing exposure to particulates should be $PM_{2.5}$ rather than PM_{10} after 2010. The report also suggested that the annual average should be in the range 12 – 20 $\mu g/m^3$. These indicative limit values were to be reviewed in the light of further information on health and environmental effects, technical feasibility etc.

8.5 Following on from this report, proposed Directive COM(2005) 447 on Ambient Air Quality and Cleaner Air for Europe (21/09/2005) has recently outlined proposals to revise and combine several existing Ambient Air Quality Standards including setting a new ambient standard for $PM_{2.5}$. The proposed approach is to establish a concentration cap of 25 $\mu g/m^3$, as an annual average (to be attained by 2010), coupled with a non-binding target to reduce human exposure generally to $PM_{2.5}$ between 2010 and 2020. This exposure reduction target is currently proposed at 20% of the average exposure indicator (AEI). The AEI is based on measurements taken in urban background locations averaged over a three year period.

8.6 In relation to dust deposition, the criteria to be met by this development are the immission levels laid out in the TA-Luft, for dust deposition (non-hazardous dust)[1]. The maximum permissible immission level for dust deposition is 350 $mg/m^2/day$ averaged over a one year period at any receptors outside the site boundary (see Table 8.1). However, in line with the recent recommendations outlined by the Department of the Environment, Health & Local Government[2], the maximum permissible levels have been applied at the site boundary in this study.

Methodology

8.7 The air dispersion modelling input data consisted of information on the physical environment, design details from all emission sources on-site and a full year of meteorological data. Using this input data the model predicted ambient ground level concentrations and deposition rates beyond the site boundary for each hour of the modelled meteorological year. The model post-processed the data to identify the location and maximum of the worst-case ground level concentration. This worst-case concentration and deposition rate was then added to the background concentration

and deposition rate to give the worst-case predicted environmental concentration (PEC) and deposition flux. The PEC was then compared with the relevant ambient air quality standard to assess the significance of the releases from the site.

Dispersion Modelling Methodology

8.8 In order to assess the dust deposition flux, PM_{10} concentration and $PM_{2.5}$ concentration at the site boundary and at sensitive locations beyond the site boundary associated with the proposed activities, dust deposition, PM_{10} concentration and $PM_{2.5}$ concentration modelling was undertaken. Modelling using the United States Environmental Protection Agency (USEPA) new generation dispersion model AERMOD[3] was used as recommended by the USEPA[4]. The model is a steady-state Gaussian plume model used to assess pollutant concentrations associated with industrial sources. The model has been designated the regulatory model by the USEPA for modelling emissions from industrial sources in both flat and rolling terrain[4]. The AERMET PRO meteorological pre-processor[5] was used to generate hourly boundary layer parameters for use by AERMOD. Dust generation rates were calculated from factors derived from empirical assessment and detailed in the USEPA database entitled "Compilation of Air Pollution Emission Factors", Volume 2, AP-42 (1986, updated periodically)[6]. The emission factors have been presented in Appendix 8.

Process Emissions

8.9 Opencast mining activities may typically emit dust. Dust is characterised as encompassing particulate matter with a particle size of between 1 and 75 microns (1-75µm). Deposition typically occurs in close proximity to each site and potential impacts generally occur within 500 metres of the dust generating activity as dust particles fall out of suspension in the air. Larger particles deposit closer to the generating source and deposition rates will decrease with distance from the source. Sensitivity to dust depends on the duration of the dust deposition, the dust generating activity, and the nature of the deposit. Therefore, a higher tolerance of dust deposition is likely to be shown if only short periods of dust deposition are expected and the dust generating activity is either expected to stop or move on.

8.10 The potential for dust to be emitted will depend on the type of activity being carried out in conjunction with environmental factors including levels of rainfall, wind speed and wind direction. This report identifies and quantifies the dust sources and remedial action necessary to minimise dust exposure for this project.

Meteorological Data

8.11 Meteorological conditions significantly affect the level of dust emissions and subsequent deposition downwind of the source. The most significant meteorological elements affecting dust deposition are rainfall and wind-speed. High levels of moisture either retained in soil or as a result of rainfall help suppress the generation of dust due to the cohesive nature of water between dust particles. Rain also assists in removing dust from the atmosphere through washout. Wind can lift particles up into the air and transport the dust downwind as well as drying out the surface. The worst dust deposition conditions typically occur therefore during dry conditions with strong winds.

8.12 Rainfall & wind speed data collated over a thirty-year period (1961-90) at Clones Meteorological Station has been reviewed to identify typical rainfall and wind patterns for each month of the year (see Table 8.2). Where rainfall is greater than 0.2mm per day, no dust is assumed generated due to the effects of rain. On average approximately 218 days have rainfall greater than 0.2mm (see Table 8.2).

8.13 The AERMOD air dispersion model requires hourly meteorological data in a specific format as a model input. Meteorological data for the region of Knocknacran was obtained using the MM5 mesoscale meteorological model[7] over the period 2001 - 2005 which was converted to AERMOD-ready data by Lakes Environmental,

Background Sources of Dust

8.14 The sources of dust arising from the facility will contribute to background levels of dust. Dust is present naturally in the air from a number of sources including weathering of minerals, and pick-up across open land and dust generated from fires.

8.15 A UK National Survey carried out by the former Warren Springs Laboratory survey has identified typical deposition rates for different areas of building density from rural sites to city and industrial areas[8]. The area around the facility is rural in nature and would apply to the rural classification in the survey. A typical deposition rate of 50 - 70 mg/m^2/day was identified for areas similar to the townland of Knocknacran. The background levels identified by the WSL survey are therefore approximately a fifth of the criteria set out in the TA Luft and guideline document for planning authorities[1-2].

8.16 Existing dust deposition measurements are conducted on-site at four locations. Results for 2005 are shown in Table 8.3. At all four locations results are generally below the TA Luft limit value of 350 mg/m^2/day although at one location (MS1) the annual average is slightly above this value.

Background Sources of PM_{10} & $PM_{2.5}$

8.17 Background PM_{10} concentrations have been estimated at 12 µg/m^3 in the townland of Knocknacran based on the current levels encountered at Phoenix Park (12 µg/m^3 in 2005)[9] and Lough Navar, Co. Fermanagh (annual average of 10 µg/m^3 in 2004)[10] and acknowledging the remote nature of the facility. The background concentration accounts for all non-traffic and industry derived emissions (e.g. natural sources, sulphates, nitrates etc.).

8.18 The background $PM_{2.5}$ has been derived from the background PM_{10} fraction using a ratio of 0.60 (European Comission (2004) "Second Position Paper on Particulate Matter – Final"). A conservative estimate of the $PM_{2.5}/PM_{10}$ ratio of 0.60 is recommended by this publication based on a review of an extensive dataset throughout Europe over the last ten years. The background concentration accounts for all non-traffic and industry derived emissions (e.g. natural sources, sulphates, nitrates etc.).

Characteristics of the Proposed Development

Site Operation

8.19 The proposed extraction site comprises an estimated gypsum reserve of 5,000,000 tonnes with an estimated 11,000,000 m^3 of overburden which will be simultaneously extracted and stored on-site for later use or reinstatement. The extraction rate will be approximately 500,000 tonnes of gypsum per annum in tandem with 800,000 m^3 of overburden.

8.20 The proposed life of the opencast mine extension is 10 years with the extraction undertaken in 14 phases. The various phases, time spans and volumes/tonnages are outlined in Table 8.4. Each phase will vary in time from 0.1 year to 1.4 years although the extraction rate of 500,000 tonnes/annum will remain constant. In order to estimate the impact of the excavation over the lifetime of the quarry various phases have been assessed in detail. Phase 1, Phase 6 and Phase 14 have been assessed below and will give a good indication of the impact of the operation of the facility over the lifetime of the excavation on the surrounding environment.

8.21 In terms of the detailed operation of the mine, blasting in conjunction with rock breakers will be used to release and break-up the rock. Suitable excavators will then excavate and load the material onto dumper trucks, which will transport the material to the primary crusher. The primary crusher reduces the run-of-mine rock to less than 300mm, known as minus 300 mm. The minus 300mm rock is delivered to a vibrating grizzly feeder. Material less than 75mm passes through the grizzly feeder and the oversize is directed to the secondary crusher. The secondary crusher reduces the

oversize material (between 75 and 300mm) to less than 75mm. After crushing the material will be conveyed to a homogeniser and from there to storage prior to transport off-site.

8.22 On a daily basis, it is estimated there will be approximately 120 no. truck movements in and out of the site per day, yielding approximately 1,667 tonnes of gypsum from the site each day (corresponding to 10,000 tonnes per week and 500,000 tonnes over the 12-month (50 week) period). The proposed hours of operation are: Monday to Saturday 8:00 am to 8:00 pm; Sunday - closed.

8.23 The following operations are likely dust generating sources or activities at the existing facility:

1) Movement of empty trucks along paved haul roads
2) Movement of empty trucks along unpaved haul roads
3) Stripping of overburden
4) Loading & movement of overburden to dump areas
5) Blasting & rock breaking
6) Extraction of material
7) Loading of material
8) Movement of full trucks along unpaved haul roads
9) Movement of full trucks along paved haul roads
10) Primary & secondary crushing, screening, conveyor transfer
11) Unloading of overburden at dump areas
12) Wind erosion at dump areas and exposed quarry surface

Dust Generation Rates

8.24 Dust generation rates depend on the site activity, particle size, the moisture content of the material and weather conditions. Dust emissions are dramatically reduced where rainfall has occurred due to the cohesion created between dust particles and water and the removal of suspended dust from the air. It is typical to assume no dust is generated under "wet day" conditions where rainfall greater than 0.2mm has fallen. Information collected from Clones Meteorological Station (1961-1990) identified that typically 218 days per annum are "wet" (see Table 8.3).

8.25 Large particle sizes (greater than 75 microns) fall rapidly out of atmospheric suspension and are subsequently deposited in close proximity to the source. Particle sizes of less than 75 microns are of interest as they can remain airborne for greater distances and give rise to the potential dust nuisance at the sensitive receptors. This size range would broadly be described as silt. Emission rates are normally predicted on a site-specific particle size distribution for each dust emission source. In the absence of such information, the particle size distribution outlined in AP-42 Appendix B.2.2 for Category 3 (mechanically generated aggregate)[6] has been used and is outline in Table 8.5. The moisture content of gypsum has been estimated at 3%, which is based on a literature review.

Activities included in Dispersion Modelling

8.26 Dust deposition levels have been predicted at the site boundary and also at the nearest sensitive locations beyond the site boundary. PM_{10} and $PM_{2.5}$ concentrations have been predicted at the nearest sensitive locations beyond the site boundary. The modelling has investigated the potential deposition and concentrations of dust, PM_{10} and $PM_{2.5}$ for the activities outlined above.

8.27 Any assumptions, along with source input information used in the dispersion modelling have been reproduced in Appendix 8.

Meteorological Data

8.28 The weather conditions identified for the region of Knocknacran was obtained using the MM5 mesoscale meteorological model[7] over the period 2001 - 2005 which was converted to AERMOD-ready data by Lakes Environmental and used in the dispersion

modelling of the various activities associated with the mine. Weather data, including precipitation rates, for the years 2001-2005 was used to identify the dust deposition levels, PM_{10} concentration and $PM_{2.5}$ concentration.

8.29 Some assumptions have been used in these calculations, as indicated in Appendix 8. The beneficial effects of any vegetation screens or other control measures have not been taken into account in the dispersion modelling. Where assumptions have been used, these are pessimistic in nature and are likely to therefore give an over-estimate of dust deposition rates and PM_{10} concentrations.

Sensitive Locations

8.30 Dust deposition typically occurs in close proximity to the dust-generating source. Only a small number of sensitive locations are present which can be affected by dust deposition. The proposed location of the facility is in an area with a low population density and the nearest sensitive locations beyond the site boundary are in general greater than 100m from the extraction of material.

8.31 Generally, the potential for severe dust impacts is greatest within 100m of dust generating activities, though residual impacts can occur for distances beyond 100m. The nearest residential receptors would, therefore, be considered low sensitivity locations in comparison to a high sensitivity location such as a hospital, high density residential, school or crèche.

Predicted Impact of the Proposal

8.32 The combined on-site activities at the mine, overburden removal, blasting & rock breaking, extraction of gypsum, loading of gypsum onto trucks, movement along unpaved haul roads, overburden stockpiling and movement along unpaved roads, crushing & screening and movement on paved haul roads has been explicitly modelled using AERMOD using a full year of meteorological data representative of the region.

Phase 1

8.33 The assessment for Phase 1 involved air dispersion modelling of the highest possible level of site activities over a one year period based on the extraction rates and volume/tonnage outline in Table 8.4. Phase 1 will entail the extraction of 375,000 tonnes of gypsum and a volume of 547,900 m^3 of overburden over a period of 0.8 years. Although Phase 1 will be less than one year, modelling for a full year allows a direct comparison with the annual limit values.

8.34 The emissions from the combined operational processes lead to a peak dust deposition level averaged over the full year of 27.7 mg/m^2/day at the boundary of the proposed mine (see Table 8.4). Based on a background deposition rate of 70 mg/m^2/day in the region of the facility, the combined dust deposition level including the proposed mine extension peaks at 97.7 mg/m^2/day which is 28% of the T.A. Luft Limit Value of 350 mg/m^2/day).

8.35 Predicted PM_{10} concentrations are significantly lower than the ambient air quality standards at the nearest residential receptors (see Table 8.6). The predicted 24-hour and annual concentrations (excluding background) at the worst-case receptors near the facility peak at 4.4 and 0.5 $\mu g/m^3$ respectively. Based on a background PM_{10} concentration of 12 $\mu g/m^3$ in the region of the facility, the combined 24-hour and annual PM_{10} concentrations including the proposed quarry extension peaks at 16.5 and 12.5 $\mu g/m^3$ respectively. These predicted levels equate to at most 33% of their respective National and EU Limit Values.

8.36 Predicted $PM_{2.5}$ concentrations at the nearest residential receptors are significantly lower than the proposed concentration cap of 25 $\mu g/m^3$ which is likely to be in place after 2010 (see Table 8.6). The predicted annual concentration (excluding

background) at the receptors north of the proposed quarry peaks at 0.1 µg/m^3. Based on a background $PM_{2.5}$ concentration of 7.2 µg/m^3 in the region of the facility, the annual $PM_{2.5}$ concentration including the proposed quarry operations peaks at 7.3 µg/m^3. This peak level equates to 29% of the proposed annual concentration cap for $PM_{2.5}$.

Phase 6

8.37 The assessment for Phase 6 involved air dispersion modelling of the highest possible level of site activities over a one year period based on the extraction rates and volume/tonnage outline in Table 8.4. Phase 6 will entail the extraction of 437,500 tonnes of gypsum and a volume of 837,615 m^3 of overburden over a period of 0.9 years. Although Phase 6 will be less than one year, modelling for a full year allows a direct comparison with the annual limit values.

8.38 The emissions from the combined operational processes lead to a peak dust deposition level averaged over the full year of 34.1 mg/m^2/day at the boundary of the proposed mine (see Table 8.6). Based on a background deposition rate of 70 mg/m^2/day in the region of the facility, the combined dust deposition level including the proposed quarry extension peaks at 104.1 mg/m^2/day which is 30% of the T.A. Luft Limit Value of 350 mg/m^2/day.

8.39 Predicted PM_{10} concentrations are significantly lower than the ambient air quality standards at the nearest residential receptors (see Table 8.6). The predicted 24-hour and annual concentrations (excluding background) at the worst-case receptors near the facility peak at 6.7 and 1.2 µg/m^3 respectively. Based on a background PM_{10} concentration of 12 µg/m^3 in the region, the combined 24-hour and annual PM_{10} concentrations including the proposed quarry extension peaks at 18.7 and 13.2 µg/m^3 respectively. These predicted levels equate to at most 37% of their respective National and EU Limit Values.

8.40 Predicted $PM_{2.5}$ concentrations at the nearest residential receptors are significantly lower than the proposed concentration cap of 25 µg/m^3 which is likely to be in place after 2010 (see Table 8.6). The predicted annual concentration (excluding background) at the worst-case receptors near the facility peaks at 0.4 µg/m^3. Based on a background $PM_{2.5}$ concentration of 7.2 µg/m^3 in the region, the annual $PM_{2.5}$ concentration including the proposed quarry extension peaks at 7.6 µg/m^3. This peak level equates to 30% of the proposed annual concentration cap for $PM_{2.5}$.

Phase 14

8.41 The assessment for Phase 14 involved air dispersion modelling of the highest possible level of site activities over a one year period based on the extraction rates and volume/tonnage outline in Table 8.4. Phase 14 will entail the extraction of 275,000 tonnes of gypsum and a volume of 935,308 m^3 of overburden over a period of 0.5 years. Although Phase 14 will be less than one year, modelling for a full year allows a direct comparison with the annual limit values.

8.42 The emissions from the combined operational processes lead to a peak dust deposition level averaged over the full year of 55.6 mg/m^2/day at the boundary of the proposed opencast mine (see Table 8.6). Based on a background deposition rate of 70 mg/m^2/day in the region, the combined dust deposition level including the quarry extension peaks at 125.6 mg/m^2/day which is 36% of the T.A. Luft Limit Value of 350 mg/m^2/day.

8.43 Predicted PM_{10} concentrations are significantly lower than the ambient air quality standards at the nearest residential receptors (see Table 8.6). The predicted 24-hour and annual concentrations (excluding background) at the worst-case receptors near the facility peak at 9.8 and 4.3 µg/m^3 respectively. Based on a background PM_{10} concentration of 12 µg/m^3 in the region, the combined 24-hour and annual PM_{10} concentrations including the proposed quarry extension peaks at 21.8 and 16.3 µg/m^3

respectively. These predicted levels equate to at most 44% of their respective National and EU Limit Values.

8.44 Predicted $PM_{2.5}$ concentrations at the nearest residential receptors are significantly lower than the proposed concentration cap of 25 $\mu g/m^3$ which is likely to be in place after 2010 (see Table 8.6). The predicted annual concentration (excluding background) at the worst-case receptors near the facility peaks at 1.7 $\mu g/m^3$. Based on a background $PM_{2.5}$ concentration of 7.2 $\mu g/m^3$ in the region, the annual $PM_{2.5}$ concentration including the proposed quarry extension peaks at 8.9 $\mu g/m^3$. This peak level equates to 36% of the proposed annual concentration cap for $PM_{2.5}$.

Mitigation Measures

8.45 The modelling has found that dust nuisance as a result of the operation of the gypsum quarry facility is unlikely based due to implementation of the following mitigation measures:

- Water tanker will be in use on-site during dry weather
- Speed restriction of 40 km/hr on all unpaved roads will apply
- Drill rig will have dust collection system
- Primary and secondary crusher will be enclosed
- Conveyor belt will be enclosed and will have a dust suppression system
- A wheel wash is in use at the site exit.

8.46 Thus additional mitigating measures are not necessary. However, during very dry spells when the surface moisture content may drop, some additional mitigating measures particularly on haul roads will be implemented. These will include the spraying of haul roads during periods of dry weather and ensuring vehicles containing dusty material are sheeted at all times where practicable. On-site vehicles will also have upward pointed exhausts wherever practicable to prevent disturbing ground lying dust.

Forecasting Methods

8.47 The air quality assessment has been carried out following procedures described in the publications by the EPA[11,12] and using the methodology outlined in the guidance documents published by the USEPA[3-5].

REFERENCES

(1) German VDI (2002) Technical Guidelines on Air Quality Control – TA Luft
(2) DOELG (2004) Quarries and Ancillary Activities, Guidelines for Planning Authorities
(3) USEPA (2004) AERMOD Description of Model Formulation
(4) USEPA (2005) Guidelines on Air Quality Models, Appendix W to Part 51, 40 CFR Ch.1
(5) USEPA (2004) User's Guide to the AERMOD Meteorological Preprocessor (AERMET)
(6) USEPA (1986) Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition (periodically updated)
(7) NCAR (1995) A Description of the Fifth Generation Penn State/NCAR Mesoscale Model (MM5)
(8) Warren Springs Laboratory (1997) UK National Dust Deposition Survey
(9) Environmental Protection Agency (2006) Air Quality Monitoring Report 2005
(10) UK Air Quality Monitoring Archive Website (2004) http://www.airquality.co.uk
(11) EPA (2002) Guidelines On Information To Be Contained in Environmental Impact Statements
(12) EPA (2003) Advice Notes On Current Practice (In The Preparation Of Environmental Impact Statements)

Pollutant	Standard	Limit Type	Value
Dust deposition (non-hazardous dust)	TA-Luft as interpreted by DOEHLG (2004)	Annual limit value at the boundary of the site	350 mg/m^2/day Total Dust
PM_{10}	EU Directive 1999/30/EC	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50 $\mu g/m^3$
		Annual limit for protection of human health	40 $\mu g/m^3$
$PM_{2.5}$	Proposed Directive COM(2005) 447 on "Ambient Air Quality and Cleaner Air for Europe"	Annual concentration cap for protection of human health	25 $\mu g/m^3$

Table 8.1 Air Quality Standards for Dust Deposition, PM_{10} & $PM_{2.5}$

Clones Meteorological Station													
monthly and annual mean and extreme values													
1961-1990													
RAINFALL *(mm)*													
mean monthly total	90.7	67.5	77.2	56.4	67.4	67.7	60.4	85.0	83.1	96.7	85.5	90.6	928.4
greatest daily total	27.1	27.1	33.5	24.9	26.9	30.4	37.5	45.6	27.6	76.8	34.8	35.1	76.8
mean no. of days with >= 0.2mm	21	16	19	16	17	17	17	19	18	20	19	20	218
mean no. of days with >= 1.0mm	16	12	14	12	13	12	12	14	14	15	14	15	164
mean no. of days with >= 5.0mm	7	5	6	4	5	5	4	6	6	6	6	7	66
WIND *(knots)*													
mean monthly speed	8.8	8.6	10.1	8.5	8.0	7.2	6.9	6.9	7.5	8.5	8.5	8.4	8.4
max. gust	83	81	73	63	60	57	53	55	87	68	71	75	87
max. mean 10-minute speed	54	51	45	40	35	36	32	37	50	40	42	47	54
mean no. of days with gales	1.2	0.8	0.9	0.2	0.2	0.1	0.0	0.0	0.2	0.3	0.3	0.5	4.8

Table 8.2 Rainfall and Wind Speed Seasonal Averages at Clones (1961 –1990)

Monitoring Station	March	April	May	June	July	August	September	October	November	December	Average
MS2	8	50	35	48	11	14	2	58	86	5	32
MS3	10	25	25	44	57	1145	19	69	-	20	157
MS4	14	203	222	418	6	570	446	178	174	20	225
MS1	209	11	27	60	76	3714	42	37	56	8	424

Table 8.3 Dust Deposition Monitoring Results for Knocknacran Quarry in 2005 (mg/m^2/day).

Phase Number	Gypsum		Overburden		Gypsum Extracted After Year
	Tonnage	Cumulative Tonnage	Volume (m^3)	Cumulative Volume (m^3)	
1	375,000	375,000	547,900	547,900	0.8
2	870,000	1,245,000	390,146	938,046	2.5
3	437,500	1,682,500	837,615	1,775,661	3.4
4	437,500	2,120,000	837,615	2,613,275	4.2
5	437,500	2,557,500	837,615	3,450,890	5.1
6	437,500	2,995,000	837,615	4,288,504	6.0
7	95,000	3,090,000	591,090	4,879,594	6.2
8	60,000	3,150,000	785,221	5,664,815	6.3
9	690,000	3,840,000	856,752	6,521,567	7.7
10	60,000	3,900,000	785,221	7,306,788	7.8
11	275,000	4,175,000	935,308	8,242,096	8.4
12	275,000	4,450,000	935,308	9,177,404	8.9
13	275,000	4,725,000	935,308	10,112,711	8.5
14	275,000	5,000,000	935,308	11,048,019	10.0

Table 8.4 Volumes and tonnage of gypsum and overburden.

Particle Size, µm[(1)]	Cumulative %	Minimum Value	Maximum Value	Standard Deviation
1.0	4			
2.0	11			
2.5	15	3	35	7
3.0	18			
4.0	25			
5.0	30			
6.0	34	15	65	13
10.0	51	23	81	14

(1) Values calculated from data reported at 2.5, 6.0 and 10.0 µm.

Table 8.5 Category 3 Mechanically Generated Aggregate Taken From AP-42[(6)]

Pollutant	Phase1 Predicted Deposition and Concentration[1]		Phase 6 Predicted Deposition and Concentration[1]		Phase 14 Predicted Deposition and Concentration[1]		Limit Value
	Excl. Bkg	*Incl. Bkg*[2]	*Excl. Bkg*	*Incl. Bkg*[2]	*Excl. Bkg*	*Incl. Bkg*[2]	
Dust Deposition (Site Boundary)	27.7	97.7	34.1	104.1	55.6	125.6	350
PM_{10} - Annual Average (Nearest Residential Receptor)	0.48	12.5	1.2	13.2	4.3	16.3	40
PM_{10} - Maximum 24-hr (90^{th}%ile) (Nearest Residential Receptor)	4.4	16.4	6.7	18.7	9.8	21.8	50
$PM_{2.5}$ - Annual Average (Nearest Residential Receptor)	0.1	7.3	0.4	7.6	1.7	8.9	25

(1) Units: dust deposition - $mg/m^2/day$; PM_{10} / $PM_{2.5}$ - $\mu g/m^3$.
(2) Includes the background concentrations: dust deposition = 70 $mg/m^2/day$; PM_{10} = 12 $\mu g/m^3$; $PM_{2.5}$ = 7.2 $\mu g/m^3$.

Table 8.6 Modelled Dust Deposition Level And PM_{10} / $PM_{2.5}$ Concentration Resulting From The Proposed Gypsum Quarry.

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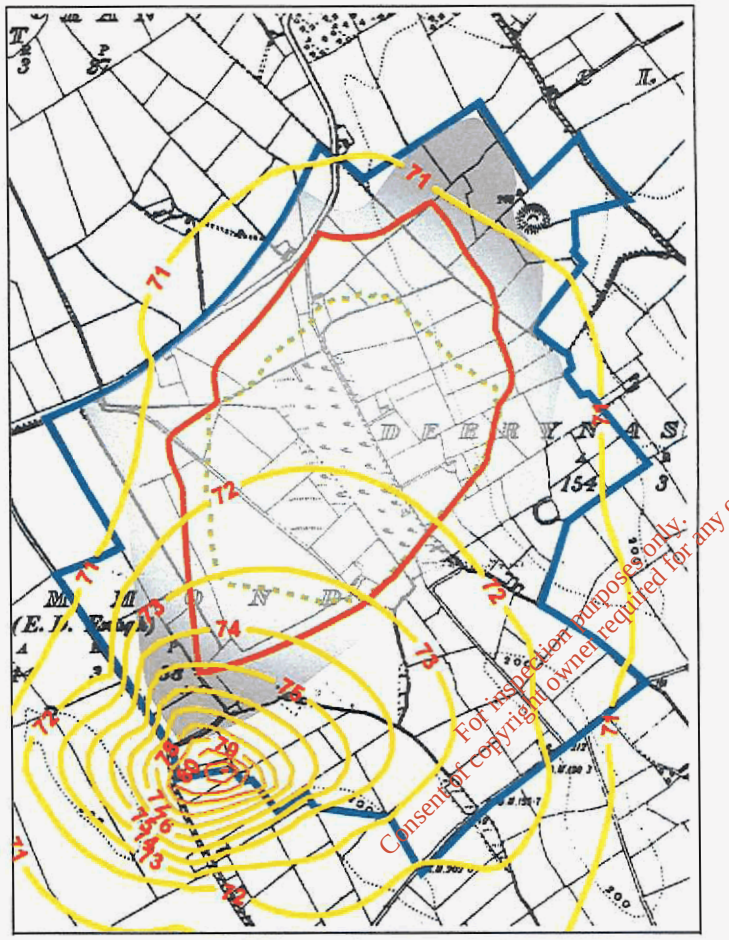

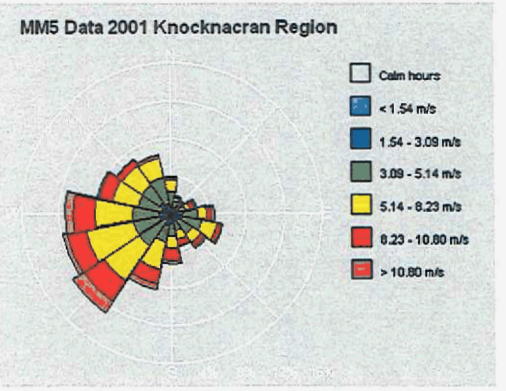

Scale 1 : 15,000 approx

Project	Knocknacran Air Quality Assessment
Reference	06_3164AR01
Figure 8.1	Predicted Phase One Annual Average Dust Deposition (mg/m²/day)

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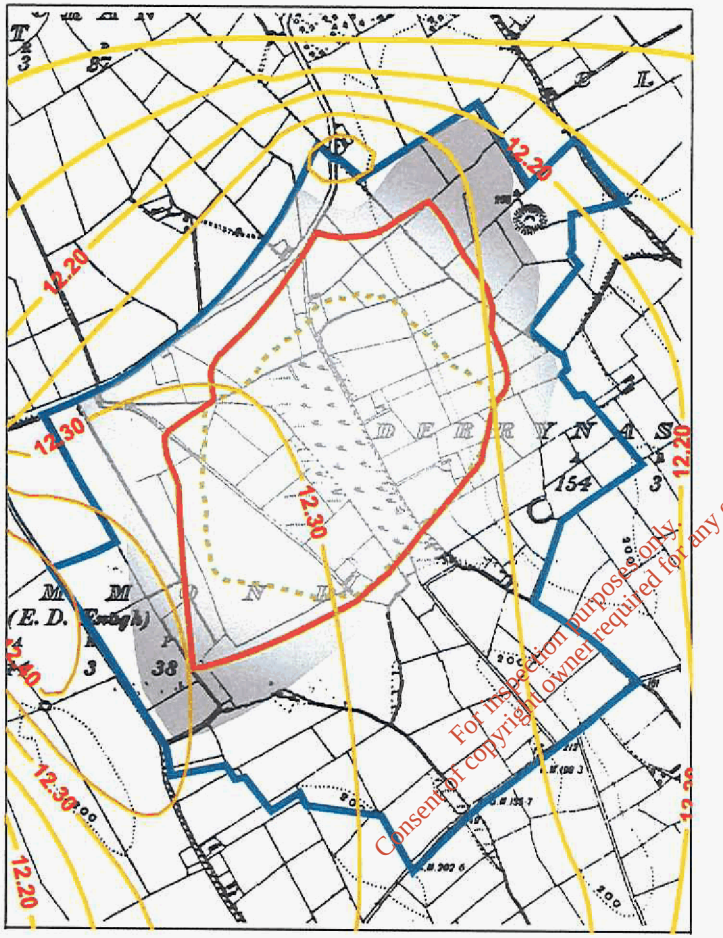

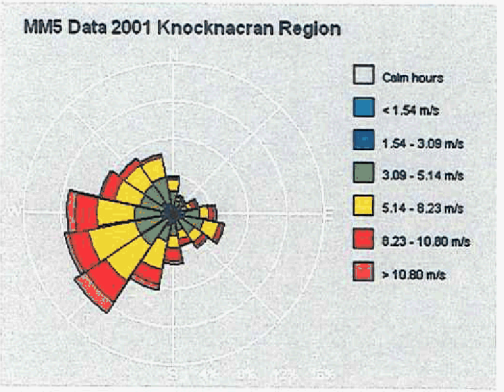

Scale 1 : 15,000 approx

Project	Knocknacran Air Quality Assessment
Reference	06_3164AR01
Figure 8.2	Predicted Phase One Annual Average PM_{10} Concentration ($\mu g/m^3$)

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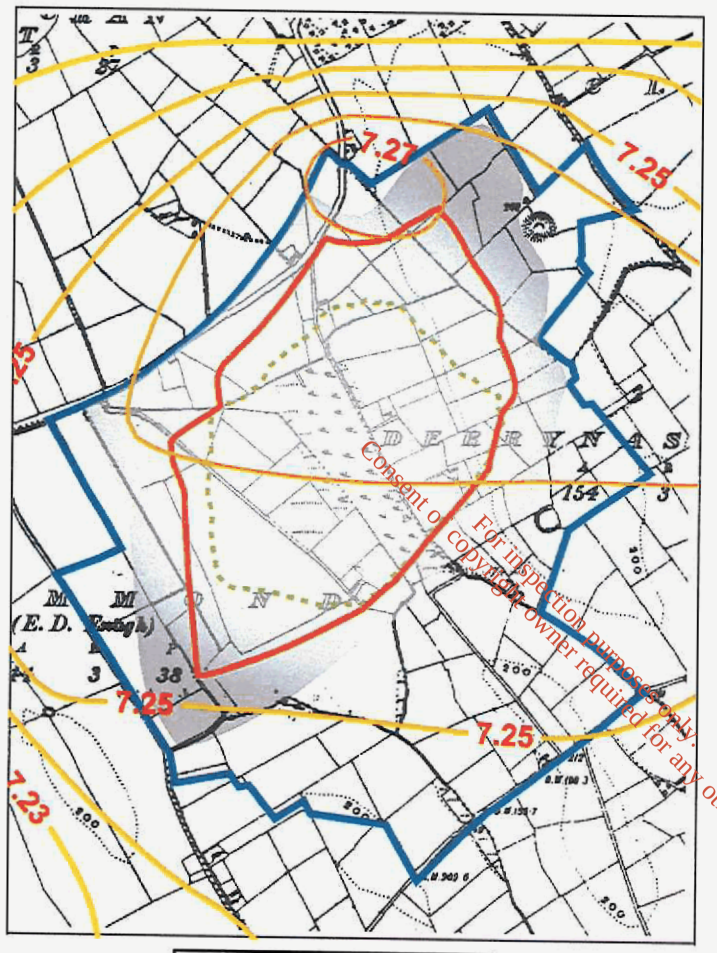

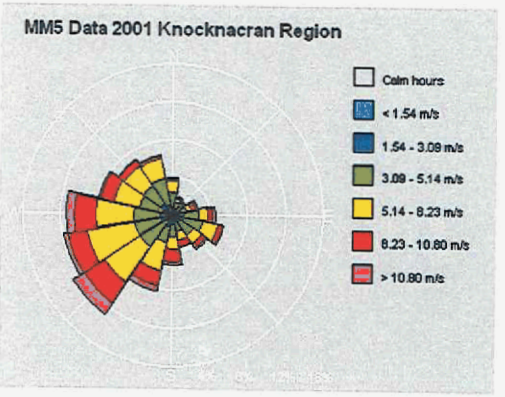

Scale 1 : 15,000 approx

Project	Knocknacran Air Quality Assessment
Reference	06_3164AR01
Figure 8.3	Predicted Phase One Annual Average $PM_{2.5}$ Concentration ($\mu g/m^3$)

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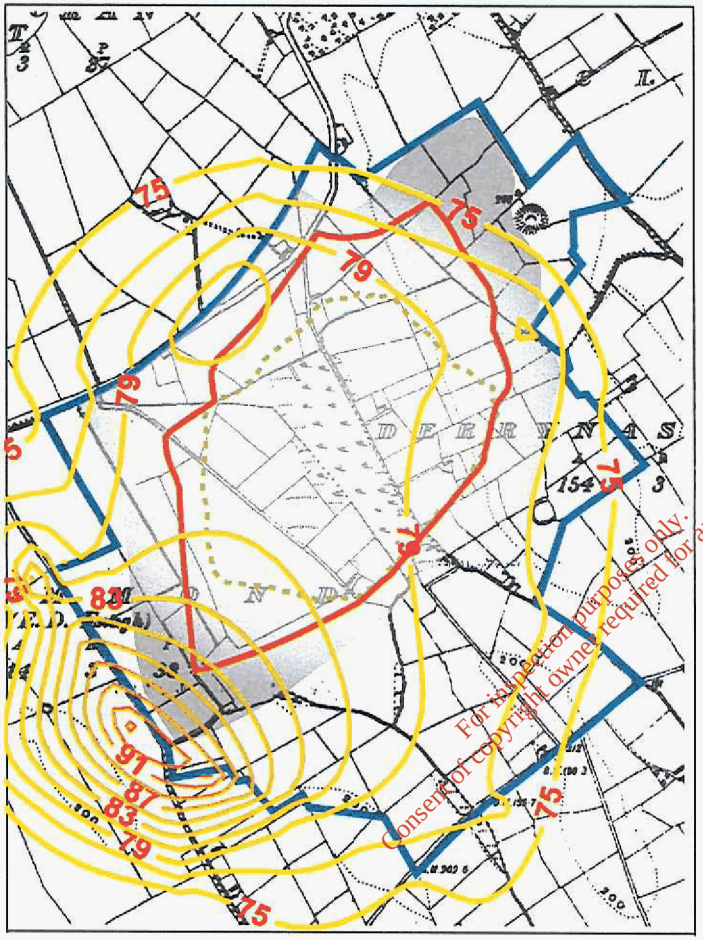

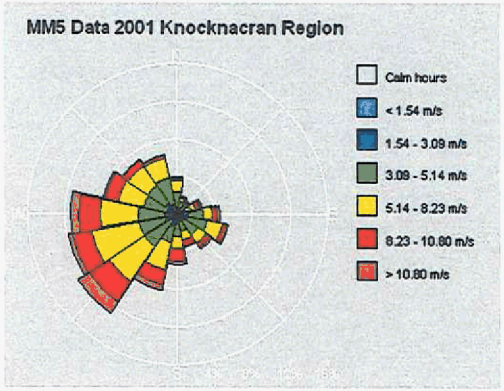

Scale 1 : 15,000 approx

Project
Knocknacran Air Quality Assessment

Reference
06_3164AR01

Figure 8.4
Predicted Phase Six Annual Average Dust Deposition (mg/m²/day)

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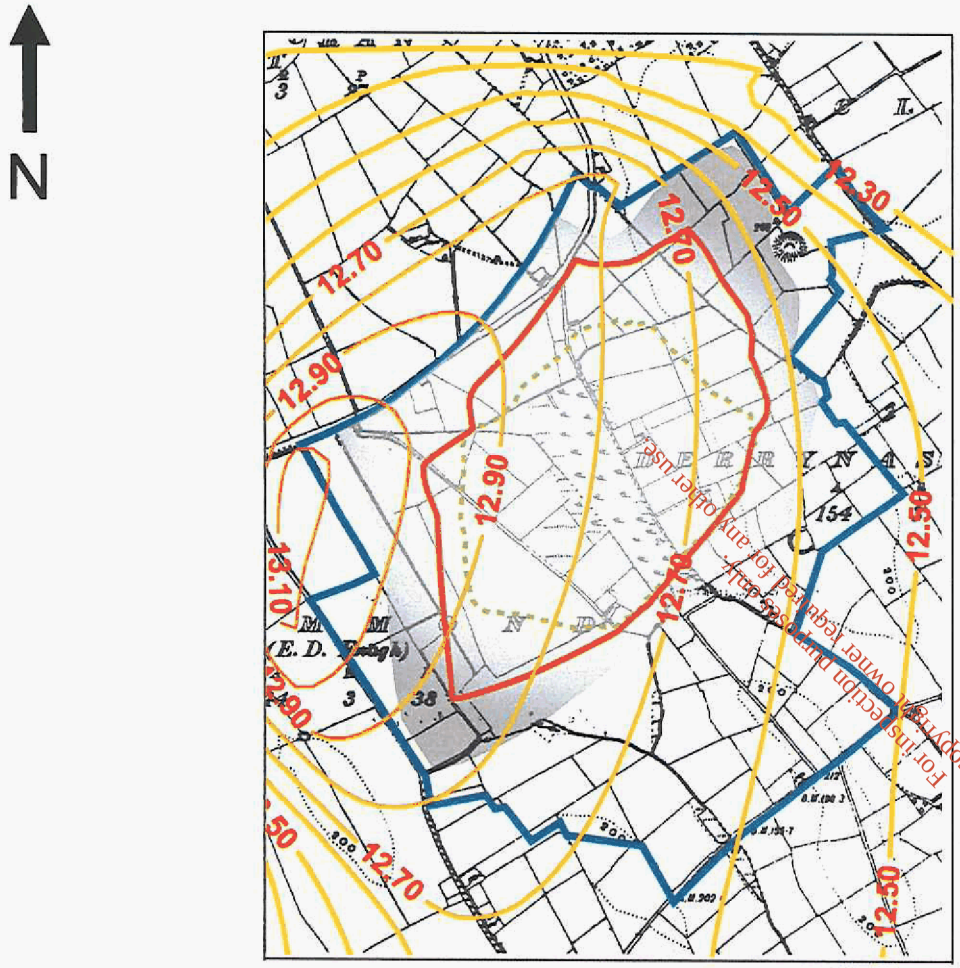

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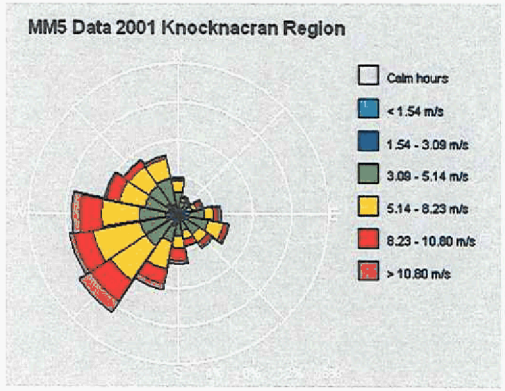

Project
Knocknacran Air Quality Assessment

Reference
06_3164AR01

Figure 8.5
Predicted Phase Six Annual Average PM_{10} Concentration ($\mu g/m^3$)

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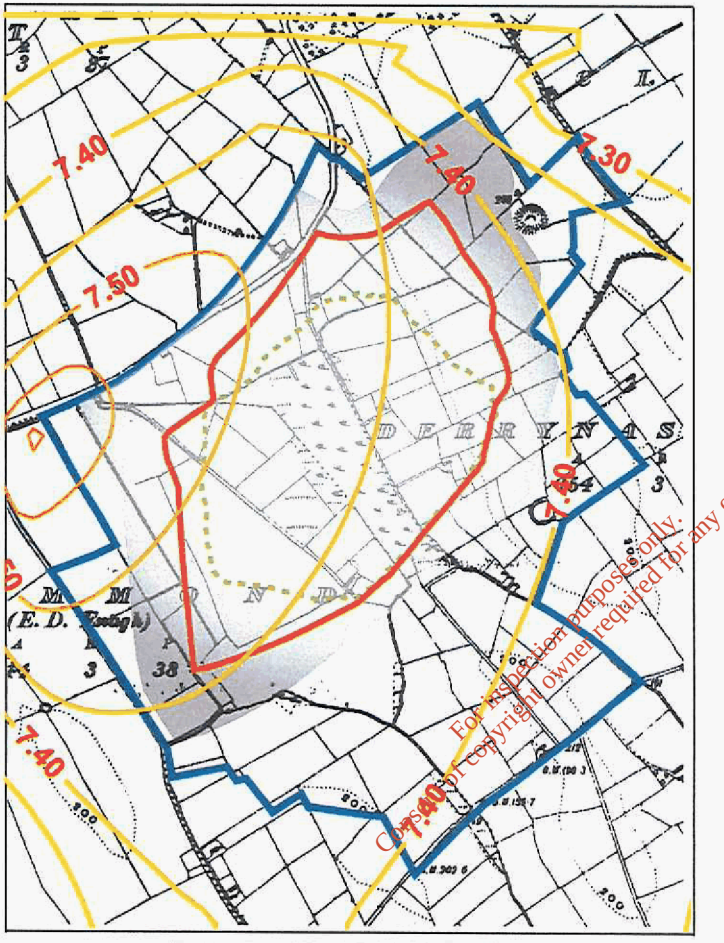

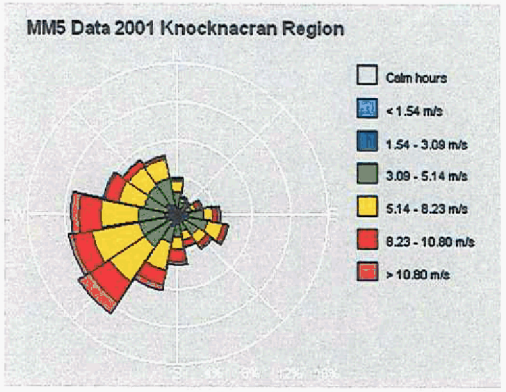

Scale 1 : 15,000 approx

Project
Knocknacran Air Quality Assessment

Reference
06_3164AR01

Figure 8.6
Predicted Phase Six Annual Average $PM_{2.5}$ Concentration ($\mu g/m^3$)

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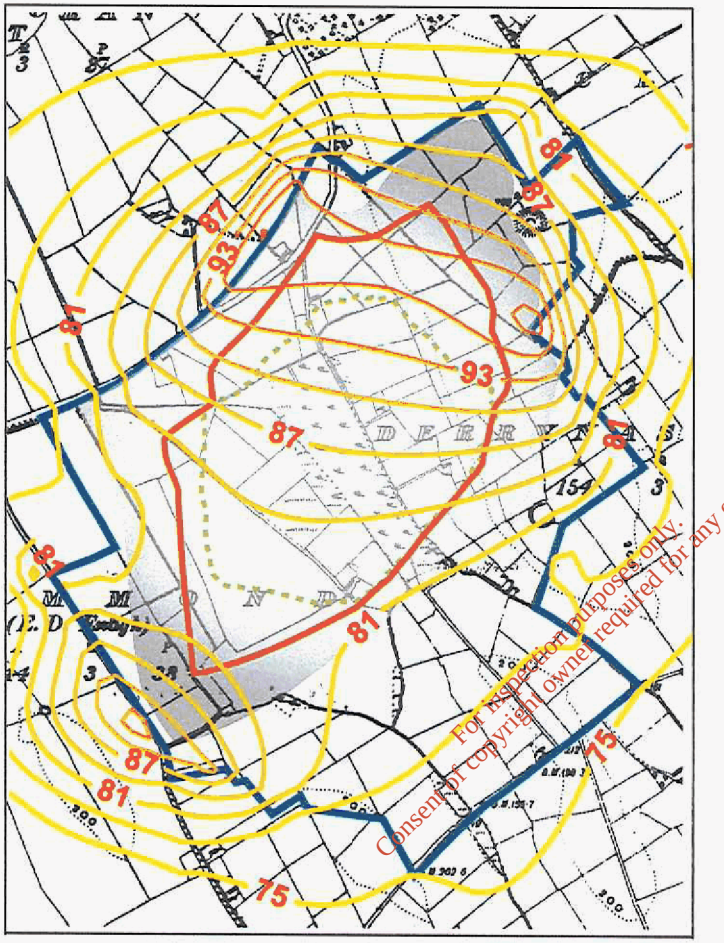

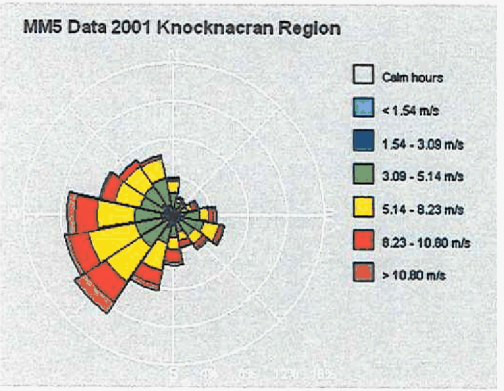

Scale 1 : 15,000 approx

Project	Knocknacran Air Quality Assessment
Reference	06_3164AR01
Figure 8.7	Predicted Phase 14 Annual Average Dust Deposition (mg/m²/day)

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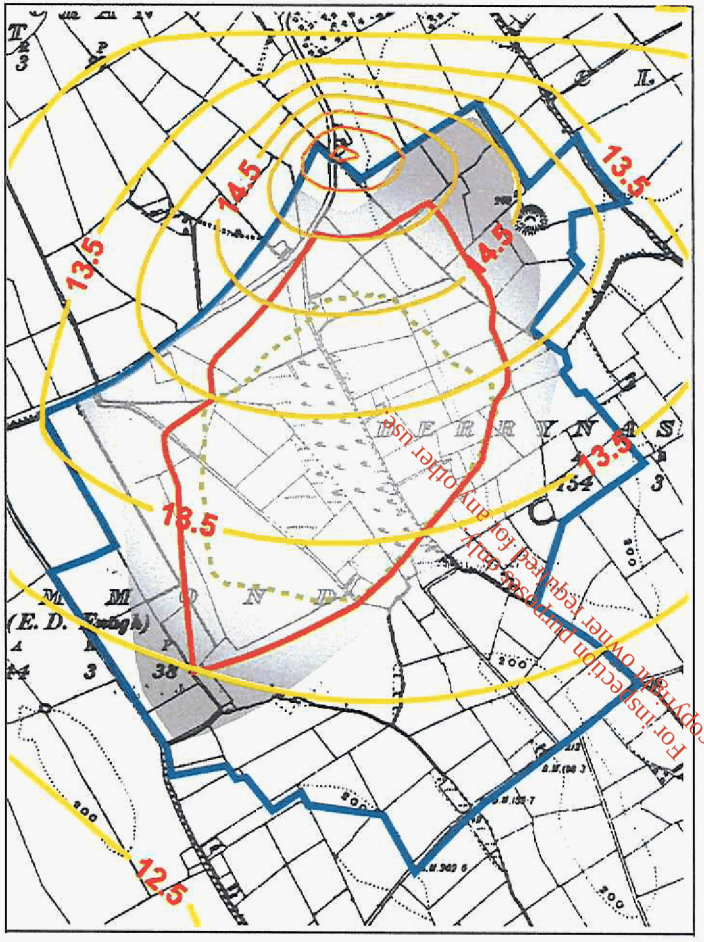

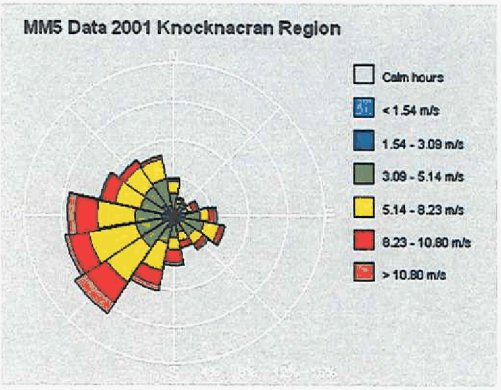

Scale 1 : 15,000 approx

Project
Knocknacran Air Quality Assessment

Reference
06_3164AR01

Figure 8.8
Predicted Phase 14 Annual Average PM_{10} Concentration ($\mu g/m^3$)

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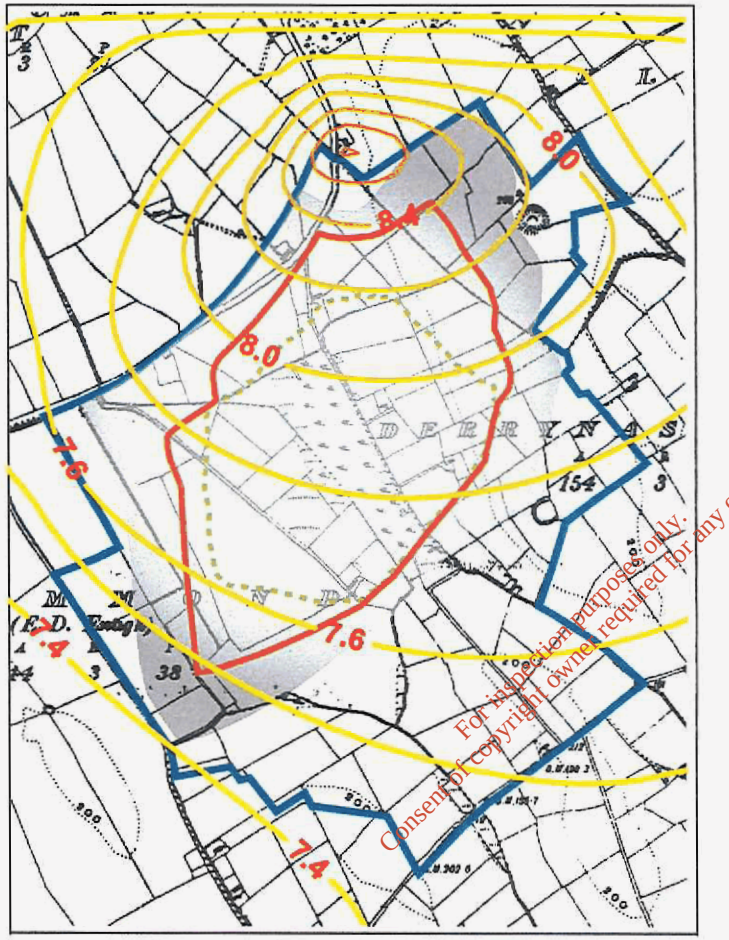

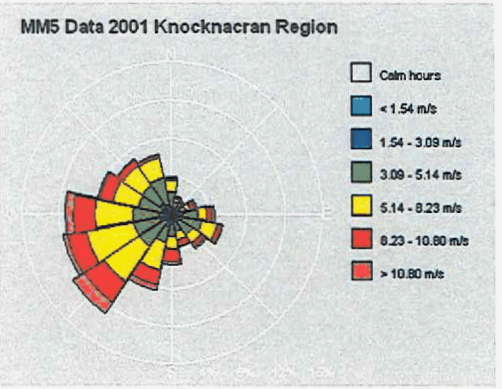

Scale 1 : 15,000 approx

Project	Knocknacran Air Quality Assessment
Reference	06_3164AR01
Figure 8.9	Predicted Phase 14 Annual Average $PM_{2.5}$ Concentration ($\mu g/m^3$)

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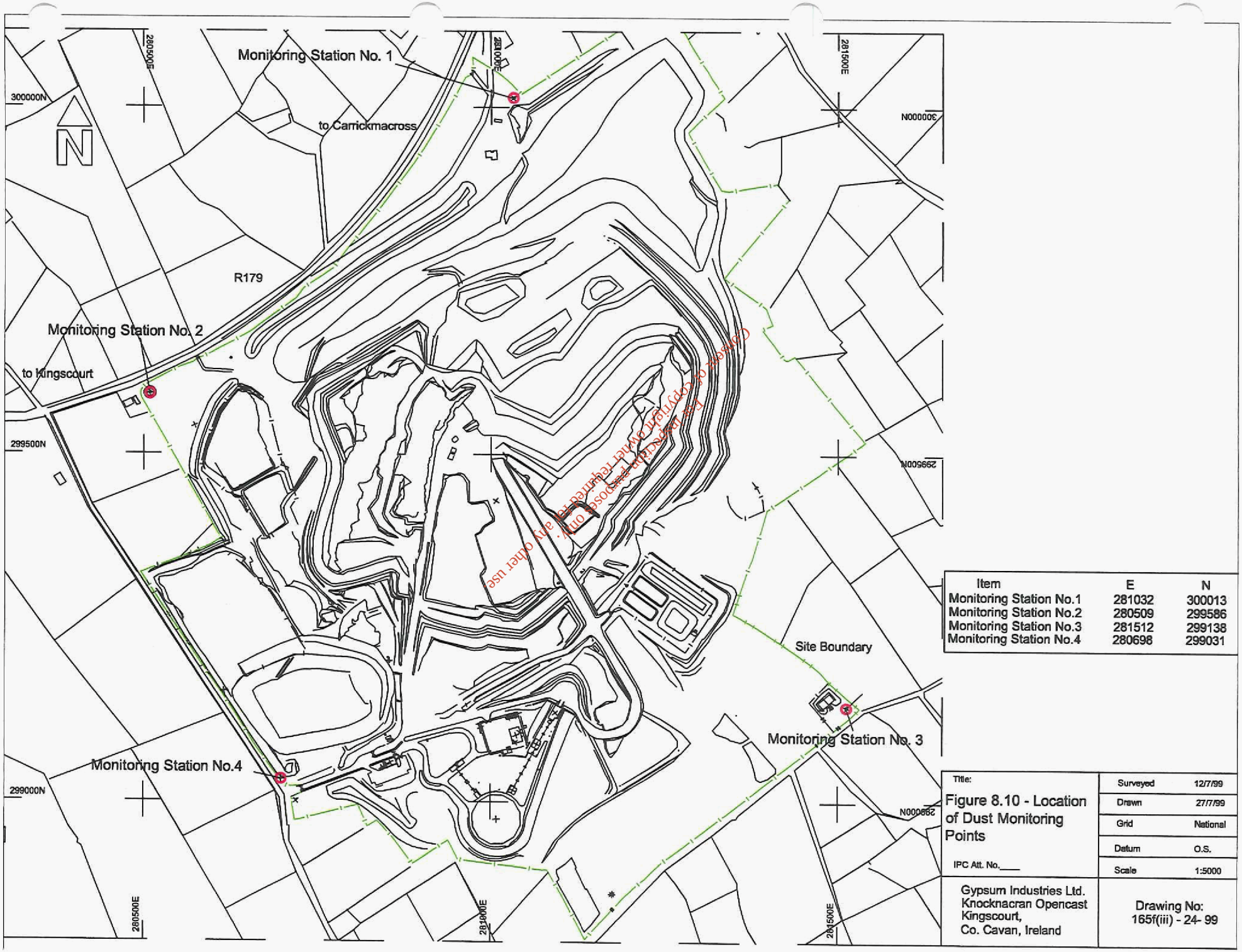


9 TRAFFIC

Introduction

9.1 This chapter of the Environmental Impact Statement (EIS) has been prepared to assess the impact of the proposed development on the 'traffic' environment.

9.2 Traffic flows associated with the proposed development site and the surrounding highway network have been established through traffic surveys conducted in 2003. This section of the EIS was completed in 2006 and the information from the 2003 surveys remain valid

9.3 Computer analysis has been carried out to determine the effects of the traffic to and from the proposed development site on the surrounding road network. These results have been assessed to determine if the existing road network and site access will adequately accommodate the traffic volumes generated by this proposal.

Receiving Environment

9.4 The site currently consists of an opencast mine which operates on a six day week basis. Operating hours within the site are normally 0800 to 2000 hours. These hours include production from the pit and also overburden stripping. The underground mine operates on a two shift basis, 6 days per week. Shift timings are up to 10 hours each. Truck movements to and from the processing site normally take place between the hours of 0500 to 2400. This situation will continue for this proposal.

9.5 The existing opencast mine site is currently accessed off the R179, between Kingscourt and Carrickmacross, via a secondary road. The R179 is a regional road, generally a 7 metre wide carriageway with varying verge widths on either side, running from Kingscourt, through Carrickmacross to Cullaville. Direct access into the existing Irish Gypsum Ltd. opencast mine site is positioned approximately 0.6km southeast of the R179. The local secondary road which links the companys operations at Knocknacran to the R179 has in part been upgraded to accommodate traffic associated with mining operations.

9.6 Although the road network in the vicinity of the site is relatively lightly trafficked during the AM and PM peak hours, there is a high percentage of HGV traffic in the area. This is due, not only to the HGV traffic generated by the Irish Gypsum Ltd, but also existing HGV movements on the R179 road travelling between Kingscourt and Carrickmacross.

9.7 Traffic flow information has been extracted from a previously approved Traffic Impact Assessment for this site with manual traffic surveys conducted in 2003 in order to establish flow levels. Surveys indicate that the AM peak hour period occurs between 7:30 – 08:30 hours and the PM peak period occurring between 06:45 – 17:45 hours.

9.8 The traffic information available has been modelled to represent present and future traffic patterns. Survey information available from the National Roads Authority has been considered in order to establish local growth rates. Information is available for two locations in the vicinity of the development site, on the N2 north of Castleblaney and on the N2 south of Ardee. A summary of the growth rates at these locations is included in Table 9.1 below:

Table 9.1: Traffic Growth Rates

Year	*N2 – North of Castleblaney*	*N2 – south of Ardee*
2005-2006	4.6%	-
2004-2005	6.2%	-1.8%
2003-2004	5.5%	-11.8%
2002-2003	0.4%	-8.3%
2001-2002	4.2%	-2.8%
2000-2001	5.3%	-9.1%
1999-2000	4.8%	7.0%
1998-1999	5.9%	8.4%
1997-1998	6.3%	-

9.9 The information presented above suggests that traffic growth rates are not consistent across the county with a significant reduction in vehicular trips noted by the N2 – south of Ardee counter. This is in all likelihood attributable to the redistribution of traffic rather than a reductions in trips.

9.10 The Draft Development Plan 2006-2012 for the Monaghan County Council area indicates that traffic flows on the N2 are projected to increase by approximately 49% by the year 2019. This represents an annual growth rate of approximately 3.1%. In order to achieve a fair growth rate for the region a 3.1% increase on the highway network surrounding the Knocknacran site is assumed. It is suggested that this provides a robust assessment as a national road is likely to be subject to a higher growth rate than a regional road.

9.11 Existing and proposed traffic flows for the highway network under consideration are included in Appendix 9.

Proposed Development

9.12 The proposed development is essentially an extension to the existing opencast mine.

9.13 Vehicular access for the development will remain as existing, via the secondary road, accessed off the R179.

9.14 The proposed extension to the opencast mine area will not result in an increase in productivity at the site, although productivity may fluctuate in line with future market demand. As such the proposed extension itself will not result in an increase in extraction rates above those currently experienced at the existing site. This report does however, for the purpose of robustness, consider the increase in site traffic in line with the traffic growth rates applied for the region.

Traffic Generation and Highway Impact

9.15 As stated, productivity at the site will not increase due to the proposed development, but may incur minor fluctuations responding to changes in market demand. For the purpose of this assessment the 2003 traffic data on the surrounding road network has been increased by 3.1% per annum to give an estimate for the assessment year, 2008. Similarly, traffic flows were increased by 3.1% per annum to reflect future years traffic growth for the design years of 2018 and 2023. It is standard practice to consider junction

analysis 10 years after the proposed year of opening for existing junctions and 15 years after the proposed year of opening for new or improved junctions.

9.16 Existing and proposed traffic flow diagrams are included in Appendix 9 of this EIS.

9.17 Analysis was carried out on the existing site access junction, and the R179 / secondary road junction adjacent to the site access for the year 2018 using the computer programme PICADY. This software package predicts capacities, queues and delays at priority traffic junctions.

9.18 The results of the junction analysis are summarised in Tables 9.2 and 9.3 below.

Table 9.2: Summary of PICADY Modelling – Site Access Junction

		RFC	Q
2018 AM	B-C	0.000	0.0
	B-A	0.062	0.1
	C-AB	0.000	0.0
2018 PM	B-C	0.006	0.0
	B-A	0.080	0.1
	C-AB	0.000	0.0

Arm A – To the R179
Arm B – Site Access
Arm C –To Ardee

Table 9.3: Summary of PICADY Modelling for R179 Junction

		RFC	Q
2018 AM	B-CD	0.031	0.0
	B-A	0.051	0.1
	AB-CD	0.013	0.0
	D-AB	0.023	0.0
	D-C	0.010	0.0
	CD-AB	0.047	0.1
2018 PM	B-CD	0.036	0.0
	B-A	0.116	0.1
	AB-CD	0.017	0.0
	D-AB	0.011	0.0
	D-C	0.000	0.0
	CD-AB	0.016	0.0

Arm A – To Carrickmacross via the R179
Arm B – To Ardee
Arm C –To Kingscourt via the R179
Arm D–To Shercock

9.19 When the Ratio of Flow to Capacity (RFC) exceeds 1.0 the flow arriving at the junction will be greater than the capacity available for a particular movement, hence queuing will become a problem and delays will be imminent. It is perceived that queuing may occur at junctions with maximum RFC values greater than 0.850.

9.20 The results show a maximum RFC value of 0.116 for vehicles crossing the R179 junction during the PM peak hour for the design year 2018. As such it is envisaged that the existing junctions associated with the development will experience marginal impact, even if productivity at the site should increase in line with traffic growth levels for the region.

Mitigation Measures

9.21 Productivity will not increase due to the extension of the opencast mine, but will fluctuate in line with market demand within the industry. The entire existing base traffic has been increased for future traffic growth to provide a robust assessment of the level of impact on traffic flows.

9.22 Recognised computer software has been used to carry out an assessment of the site access junction and adjoining junction at the R179, which shows that they will not be unduly affected by the future traffic flows to and from the development site.

9.23 The country road off the R179 on which the site is accessed has previously been widened and improved to accommodate mine related traffic.

9.24 Given that the development will not lead to significant increases in traffic volumes such as HGVs, LGVs or private cars, entering or leaving the site, this proposed development will not therefore have an adverse impact on the existing traffic environment within the locality. Therefore no specific mitigation measures in relation to traffic are required.

9.25 An environmental assessment of noise levels and air quality has not been carried out to assess the impact of the proposed development which includes for traffic generation on these aspects of the environment. These are included in Chapters 8 and 10 respectively.

10 Noise and Vibration

Introduction

10.1 This Chapter of the EIS assesses the impact of the proposed extension to the opencast mine on noise/vibration emissions to the local environment.

10.2 Irish Gypsum Ltd's existing operations are covered by an Integrated Pollution Prevention Control (IPPC) Licence (No. 688) issued by the Environmental Protection Agency. The emission limits as currently set by the EPA will be applied to this proposal.

Receiving Environment

Ambient Noise

10.3 The existing ambient noise environment has been monitored once a month at each of three locations in the vicinity of the existing opencast mine since operations commenced. Ambient noise is defined as the totally encompassing sound in a given situation usually being composed of sound from many sources near and far. The specific noise is defined as a component of the ambient noise which can be specifically identified by acoustic means and may be associated with a specific source. A summary of the results of the noise monitoring over the time interval, 08:00 to 17:00 hours during May 2006 is shown in Table 10.1. This data covers the hours in which the opencast mine is normally operated.

Table 10.1: Summary of environmental noise monitoring, May 2006, mean values and standard deviations.

Location		$L_{(Aeq, 1 h.)}$	$L_{(A90, 1 h.)}$
MS1	mean	51.2 dBA	43.1 dBA
	st. dev.	1.8 dBA	3.8 dBA
MS2	mean	60.8 dBA	49.1 dBA
	st. dev.	1.3 dBA	4.4 dBA
MS3	mean	51.7 dBA	47.2 dBA
	st. dev.	2.8 dBA	4.2 dBA

10.4 The noise environment at Monitoring Station 2 (MS2) is dominated by road traffic noise. Previous attended measurements show that in the absence of road traffic noise, the specific noise due to the existing opencast mine was a $L_{Aeq,15min}$ level of 43dBA. Road traffic noise, also makes a significant contribution to the ambient noise at Monitoring Station 1 (MS1).

Blast Vibration

10.5 Blasting produces shock waves which are transmitted through the ground.

10.6 A blast vibration limit of 7.5 mm/sec peak particle velocity was set by Monaghan County Council when Knocknacran Opencast mine was opened in 1989. This limit was retained by the Environmental Protection Agency when the site received an Integrated Pollution Prevention and Control Licence (Reg No. 688) in 2002. All overground blasts are monitored at a minimum of three locations.

10.7 Over 600 production blasts were taken since the opencast mine started. 95% of these blasts were below 3.3 mm/sec peak particle velocity. All of the blasts were below 7.5 mm/sec peak particle velocity.

Air Overpressure

10.8 Blasting also produces shock waves which are transmitted through the air as noise. Blast noise is characterised by containing a large proportion of its energy with a frequency of less than 20Hz. This is below the normal hearing range of the human ear and is called air overpressure rather than noise. Air overpressure may cause a slight rattling of windows or doors, similar to a gust of wind. Consequently, it is often mistaken for ground vibration.

10.9 An air overpressure limit of 125dB was set by Monaghan County Council when Knocknacran Opencast mine was opened in 1989. This limit was retained by the Environmental Protection Agency when the site received an Integrated Pollution Prevention and Control Licence (Reg No. 688) in 2002.

10.10 95% of all blasts resulted in air overpressure readings of less than 116 dB. All air overpressure readings were within the limit of 125 dB.

Characteristics of the Proposal

Noise

10.11 The area for opencast mining will be extended as shown in Figures 1.2a and 1.2b. This also shows the extent of the proposed earth works, which will consist of a 5 metre high berm. Extraction of rock will continue as at present in the opencast mine by drilling and blasting. The opencast mine will continue to be worked in two benches. The rock will be transported by dump truck to the existing primary crusher. The fragmented rock will be transported by conveyor to the existing secondary crusher, which is enclosed, and from here to the homogeniser, which is also enclosed. Material is then taken from the homogeniser by an enclosed conveyor to a loading area. The material is then transported by road either to the factory in Kingscourt or to cement producers.

Blast Vibration & Air Overpressure

10.12 It is planned to use the extension of the opencast mine to augment production from the underground mine. It is therefore expected that blasting from the opencast mine will take place less frequently than is currently the case.

10.13 Blasting will take place closer to neighbouring properties to the north, west and south of the opencast mine.

Potential Impact

Noise

10.14 Noise from the proposed activity could have a potential for noise disturbance to residents in the vicinity of the existing mine, see paragraphs 10.20 and 10.21 for the predicted impact of noise.

Blast Vibration & Air Overpressure

10.15 The vibration due to blasting can impact on the structure of houses and on human reaction, see paragraphs 10.22 and 10.23 for the predicted impact of vibration due to the proposed development.

10.16 British Standard 7385:1993 quotes guide values for cosmetic damage for residential or light commercial-type buildings as follows:-

15 mm/sec at dominant frequency of 4 Hz increasing to 20 mm/sec at 15Hz and increasing to 50 mm/sec for frequencies of 40 Hz and above.

10.17 British Standard 6472:1992 *Evaluation of human exposure to vibration in buildings* quotes guidance values for human response to vibration. The level quoted when blasting up to 3 times per day is as follows:-

A limit of 8.5 mm/sec for the vertical vibration component, for 90% of all blasts.

10.18 The U.S. Bureau of Mines concludes in report R.I. 8485 *"Structural Response and Damage produced by Air blast from Surface Mining"* that, based on a minimal possibility of the most superficial type of damage in residential-type structures, a level of 133dB (measured with a 2Hz high pass instrument) represents a safe maximum air overpressure level.

10.19 The amelioration of potential impacts results in a predicted impact, which incorporates mitigation measures and design criteria. These are detailed in paragraphs 10.9 through to 10.12.

Predicted Impact

Noise

10.20 The predicted impact of the proposed development will be very similar to the current noise impact, attributable to the existing development. The noise due to the transportation of rock by dump truck from the floor of the existing open cast mine to the primary crushers will be the same. The existing opencast mine operation meets the noise conditions of Planning Permission Reg. Ref: PL 18/5/67892 and Condition 8.2 of IPPC Licence No. 688.

10.21 The main source of noise, as at present, will be due to the surface processing facilities such as the secondary crusher, which is enclosed, and to a much lesser extent to the homogeniser which is also enclosed. There will be no additional plant or facilities installed. The predicted noise level at the nearest house, which is located approximately 450 metres to the south west of these buildings, is 35dBA. This will be well below the noise limits for both daytime and nighttime set in the current planning permission. The environmental noise impact will therefore be negligible.

Blast Vibration & Air Overpressure

10.22 Limits of vibration or minimal probability of the most superficial type of cosmetic damage are set at Peak Particle Velocities of 12.5 millimetres per second. This limit is very conservative for modern constructions. The risk of structural damage or of cosmetic damage is, therefore, very slight.

10.23 It is proposed to retain the existing vibration limits, as set by the Environmental Protection Agency, of 7.5 mm/sec peak particle velocity and 125dB air overpressure as measured at the nearest noise sensitive location. The limits are contained in Condition 8.3 of the Company's IPPC Licence No. 688.

Remedial or Reductive Measures

Blast Vibration

10.24 The vibration from a blast is a function of the maximum amount of explosives per time delay detonator and the distance from the blast to the closest noise sensitive location.

10.25 A number of remedial measures will be used to minimise blast vibration. These include:

(i) No blasting will take place closer that 150 m from any noise sensitive location

(ii) Each blast will be designed to use the maximum number of multi-second time delays in the sequential detonation of blasts in order to minimise the amount of explosive per time delay

(iii) If necessary, blast hole diameter will be reduced from 104 mm to 89 mm in order to minimise the amount of explosive per time delay

(iv) If necessary, bench height may be reduced in order to minimise the amount of explosive per time delay.

Air Overpressure

10.26 Air overpressure is a function of blast design, however, the transmission of the pressure wave is dependant on prevailing weather conditions including wind speed and direction, temperature and pressure gradients, and cloud cover. Air overpressure will be minimised by correct blast design using the remedial measures outlined above.

Mitigation Measures

Noise

10.27 Plant and equipment will conform to noise emission limits set out in Statutory Instrument No. 20 of 1998 European Communities (Construction Plant and Equipment) (Permissible Noise Levels) Regulations 1988. The 5 m high earth berms will provide acoustic screening when drilling for the first bench. The opencast mine face will provide acoustic screening for the loading of rock into the dump trucks. For the working of the second bench the face of the first bench worked out, together with the 5 m high earth berms will provide substantial acoustic screening.

Blast vibration and Air Overpressure

10.28 It is planned to use the extension of the opencast mine to augment production from the underground mine. It is therefore expected that blasting from the opencast mine will take place less frequently than is currently the case.

Monitoring

Noise

10.29 The current noise monitoring programme will be continued to be carried out as outlined in Table 10.1.

Vibration and Air Overpressure

10.30 The vibration due to all blasts will be monitored, however the location of these monitoring sites may differ from the existing monitoring locations. Vibration will be measured as peak particle velocity (ppv) in three mutually orthogonal directions at each location.

10.31 The existing opencast mine and the underground mine are covered by an IPPC Licence issued by the Environmental Protection Agency. The emission limits as currently set by the EPA will be applied to this proposal. Full monitoring of noise and vibration emissions will continue and records submitted to the EPA as required by the IPPC Licence.

11 Cultural Heritage

Introduction

11.1 This Chapter of the Environmental Impact Statement addresses the potential impacts of the proposed development on Cultural Heritage elements of the environment. Sites of known archaeological significance are highlighted and described. The historical context of the landscape is outlined and as far as possible, its evolution and its development are traced from the early historic period until recent times.

11.2 All the relevant and current legislation as well as the current statutory requirements are considered.

11.3 The assessment is based on an examination of Ordnance Survey maps, records and publications of the Archaeological Survey of Ireland and the National Museum of Ireland, together with primary and secondary documentation and archive material from various institutions. A field inspection was also carried out within the study area.

Planning considerations.

11.4 The cultural heritage of Co. Monaghan has been considered in the Monaghan County Development Plan 2003 and the Draft County Development Plan 2006-2012. The Draft Development Plan sets out '*an overall strategy for the proper planning and sustainable development of an area*' and specifies that the county and town plans must '*be consistent, in so far as possible, with national plans, policies and strategies which relate to proper planning and sustainable development*' (p. 4). It also specified that the plans should incorporate a range of objectives, including '*The conservation and protection of the environment, including the archaeological and natural heritage*' (Objective (iii), p. 4). Objectives (v) and (vi) also relate directly or indirectly to the cultural heritage of the county. Objective (v) involves '*The protection of the character of the landscape, including the preservation of views and prospects, and the amenities of places and features of natural beauty*'. Objective (vi) covers '*The protection of structures of architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest.*'

11.5 Chapter 4 of the Draft Development Plan deals specifically with guidelines formulated to protect and enhance the natural and built heritage of the county. The policies outlined in this chapter are based on four principles which recognize the non-renewability of much of Monaghan's natural and cultural heritage (p. 45, Section 4.0). The Council states that '*The 'polluter pays' principle and the 'precautionary approach' principle are central to any planning policies that deal with the environment and heritage*'. The long-term well-being of the county requires the management of environment and heritage resources '*to the highest standard*'. It is also recognized that '*The conservation and enhancement of biodiversity, natural heritage, landscape, the built environment and archaeology should be promoted as important elements of the long term economic growth and development of the County*' (ibid.).

Recorded Monuments within the study area.

11.6 Two Recorded Monuments (RMP Nos MO034-001 and MO031-008) lie within the general study area (Figure 11.1) Both of these monuments are ringforts and consist of stone and earthen banks and external ditches which enclose subcircular areas measuring approximately 30m across. While ringfort RMP No. MO034-001 lies within the Company's property boundary, and lies approximately 30-35m from the present edge of mining activity, ringfort RMP No. MO031-088 lies within a field which is separated from the north-eastern spoil dump by an established and extant field boundary. This ringfort is also within the landholding of the applicant.

11.7 Ringforts are understood to be the Irish version of 'a common European settlement pattern' of dispersed individual farmsteads which was prevalent in the first millennium A.D. Although the exact period to which ringforts date is uncertain, it is thought that most examples were constructed or were in use between the start of the 4th to the end of the 9th centuries A.D. Relatively few of these monuments have been excavated, but in cases where excavation has been carried out, the foundations of a range of buildings have been identified within their banks. Systems of curvilinear fields and enclosures have also been identified in association with ringforts, many of which survive only as cropmarks or as subterranean features. The nature of these structures and of the material associated with them have led excavators to conclude that ringforts were generally farmsteads 'which would have enclosed a single farming family and their retainers' (ibid.). In some areas, ringforts were also sporadically used or occupied at different periods into the 19th century

Historical, Archaeological and Folklore Background

11.8 Historical and placename evidence suggest that a large proportion of the townlands of Derrynascobe, Derrynaglah, and Knocknacran were originally covered by oak woods that extended in an approximately north-south strip across this part of the parish of Magheracloone. This parish was part of the wider barony of Donaghmoyne which comprises much of the area of the early medieval territory of Farney. The townlands of the study area, with their rounded drumlin landscape, have been the site of human settlement and activity for many millennia. The possible barrow in Knocknacran East townland to the north of the study area indicates probable prehistoric human activity in the area. While most of the artefacts purchased by the National Museum from Major J. E. Shirley in 1965 are unprovenanced, it is possible that one or more of them may have come from within or adjacent to the townlands of the study area. They include a range of material dating from the prehistoric to the medieval periods and illustrate the rich archaeological heritage of the wider area.

11.9 The primary evidence of past human settlement within and adjacent to the study area dates from the early medieval period, by which time the drumlins of the study area were linked together by networks of ringforts. These monuments (as noted above) are regarded as one of the primary settlement forms of the fourth to ninth centuries A.D., and as settlement and farm centres were often surrounded by associated networks of small 'petal-shaped' fields. It is possible that the both of the ringforts (RMP No. MO034-001 and RMP No. MO031-088) which sit within the Company's property boundary of the study area were originally set within similar field systems.

11.10 Although these sites may have fallen out of use within a century or two of their establishment, they continued to exercise a large influence over the imaginations of local people. Throughout much of Monaghan, such sites were protected from change and interference as they were believed to be places in which the fairies or other dangerous supernatural forces dwelt. For that reason, people frequently avoided ringforts as contact with supernatural forces could have negative consequences (such as illness, injury or kidnapping) for ordinary people. The fact that fairies on occasion favoured particular individuals, and that ringforts were believed to be places of contact with the power of the "Otherworld" meant, however, that they were occasionally sought out by people seeking access to lost loved ones, hunting fairy treasure or in quest of adventure. While stories of lights seen at night and noises emanating from forts had obvious cautionary overtones, they may also have reflected the use of forts for illicit purposes or for covert meetings by those wishing to flout social or legal conventions.

11.11 The geographical proximity of both RMP No. MO034-001 and RMP No. MO031-088 suggests some direct connections between the occupants of both forts in the early medieval period. The relative density of ringforts in the area perhaps presaged the relatively high densities of occupants throughout this rural area in subsequent centuries. The inclusion of Drummond within lands listed as part of the 'tearmann' or sanctuary of Magheracloone indicates that this townland and the area to the west may

have originally have been farmed by, or on behalf of, the clerics of St. Molua's church at Camaghy. Ringforts were locked into wider social landscapes that mirrored the hierarchical relationships of early medieval Irish society, and their location and inhabitation often reflected the strategic occupation of wider landscapes by kin-groups and their vassals. In this context, it is of interest that although a variety of septs and families controlled the barony at different periods, the MacMahon family were the dominant power in the area in the middle ages. It is thus likely that the ringforts of the study area were occupied by ancestors of the extended kin and client networks of the MacMahons.

11.12 However, with the establishment of the Essex estate in the early 17th century, the political power of the MacMahons was broken, and by the mid 19th century, the surname was relatively rare among the tenants of the study area. Like much of the rest of south Ulster, the barony of Farney was included in the system of confiscations and grants following the rebellion of the 1590s and associated with the early 17th-century plantation of English and Scottish tenants under predominantly English undertakers. The situation of Farney at this time was, however, somewhat different to that of other Ulster territories, as it was granted in the 1590s to Robert Devereux, Second Earl of Essex prior to his ill-fated campaign against the Ulster lords. Despite the trial and execution of Essex, the lands of Farney remained in the hands of the Devereux family and its heirs until the 20th century. When the last of the male line died, the Essex estate passed by marriage into the possession of the Shirley family and their relatives the Marquesses of Bath. The townlands of Drummond, Enagh, Derrynascobe, Derrynaglah and Knocknacran East lay within the holdings of the Shirley family, whose primary seat was later established at Lough Fea several kilometres to the northeast. The Shirleys survived the reduction of income caused by the hardship and suffering of the Famine of the 1840s and maintained their holdings (with some alterations) into the 20th century.

11.13 The overall configuration of the site area appears to have remained relatively constant over much of the 19th century, with the exception of the subdivision of some of the larger field areas. The primary changes to the study area during the later 19th/early 20th centuries was the apparent demise of the relatively large number of cottages and farms which lay within its boundaries. In light of the fact that the Famine had a considerable effect on this part of Monaghan, which was heavily populated in the pre-Famine decades, it is possible that a number of the cottage occupants died or emigrated in the bleak years following 1847. It is, however, possible that the removal of the cottages reflected broader post-famine economic and social changes and reflected policies of land improvement or the non-renewal of short leases in heavily settled areas by the administrators of the Shirley estate. In addition to the role of the present opencast mine in the erasure of traces of such sites, it is likely that a portion of the cottages fell into ruin or were dismantled and ploughed out as their tenants moved away.

Cartographic and aerial photographic background (Figure 11.1).

11.14 The available cartographic and aerial photographic evidence largely supports the information contained within the historical and archaeological sections of this report. In addition to the two ringforts which lie within and adjacent to the study area, eleven cottages or small structures were cartographically identified at or near the site margins. In most instances, these sites are absent from the aerial photograph, although subterranean traces may yet survive in some cases. Of these, 5 lie within the northern and western site areas where the proposed development will be concentrated.

Site inspection.

11.15 Field inspection confirmed the existence of both Recorded Monuments (ringforts MO031-088 and MO034-001) within the existing property boundary of Irish Gypsum Ltd. Both monuments are considerably overgrown, and, in the case of MO034-001, vegetation growth has been so vigorous that the interior is almost entirely

impenetrable. With the exception of the erection of a modern field fence along the course of the potential external ditch of MO034-001, and activity associated with a makeshift camp within the interior of MO031-088, neither monument shows significant signs of modern disturbance.

11.16 No further features of archaeological, historical or cultural significance were noted within the inspected areas of the Company's lands.

Potential Impact of the Development

Impact on Recorded Monuments.

11.17 Recorded Monument MO034-001 lies within the eastern boundary of the Company's landholding. The proposed extension will not encroach on this site. The existing edge of ground disturbance activity is approximately 30m from the western edge of the ringfort. Any associated field systems or enclosures to the west or northwest of the fort will already have been removed by previous mining activities. Nonetheless, the site itself, and the remaining area which surrounds it are considered to be of archaeological interest.

11.18 Recorded Monument MO031-088 (ringfort) lies at the extreme northeastern edge of the Company's landholding. Again the proposed extent of mining activity will not come within 30 metres of this site, but the site itself is considered of archaeological interest.

Impact on Protected Structures.

11.19 No Protected Structures (as listed within the Schedules of the Monaghan County Development Plan 2006-2012) lie within or adjacent to the area of proposed development.

Potential impact on unidentified archaeological remains.

11.20 As mentioned above, it is possible that previously unidentified subterranean features associated with the ringfort (RMP No. MO031-088) may lie within and adjacent to the northeastern boundary of the site, however the mitigation measures detailed below, will ensure that the proposed development will not impact on this feature.

Impact on identified structures and on features of historical interest.

11.21 Comparison of cartographic and aerial photographic sources indicated that a number of probable houses or cottages (Figure 11.1) may have stood within or close to the proposed mine expansion area. These sites and their locations were probably the post medieval dwellings and farms of local people and they may not, in some instances, have survived 19th-century social changes. In light of the relative poverty of many local people during the 18th and early 19th centuries, it is possible that these sites may have been characterised by a scarcity of material culture and relatively impermanent building techniques.

11.22 The current study has indicated the settlement of the wider area for several millennia, and unrecognised archaeological remains associated with such activity may be present within the area of proposed expansion.

Hedgerows and field boundaries.

11.23 With the exception of the hedgerows that comprise the existing site boundaries, significant lengths of hedgerow survive in only one area within the Company's landholding. The area in question lies immediately to the northeast of Recorded Monument MO034-001 and subdivides this corner of the site into four small rectilinear fields. None of the field boundaries in this area constitute townland boundaries. Examination of the 1835 First Edition Six Inch map suggests that these boundaries date to the later 19th or early 20th centuries. They are outside the extent of this proposal and will therefore remain undisturbed.

Mitigation Measures

Recorded Monuments Nos. MO034-001 and MO031-088.

11.24 No works of any kind will take place at the site of either of these Recorded Monuments.

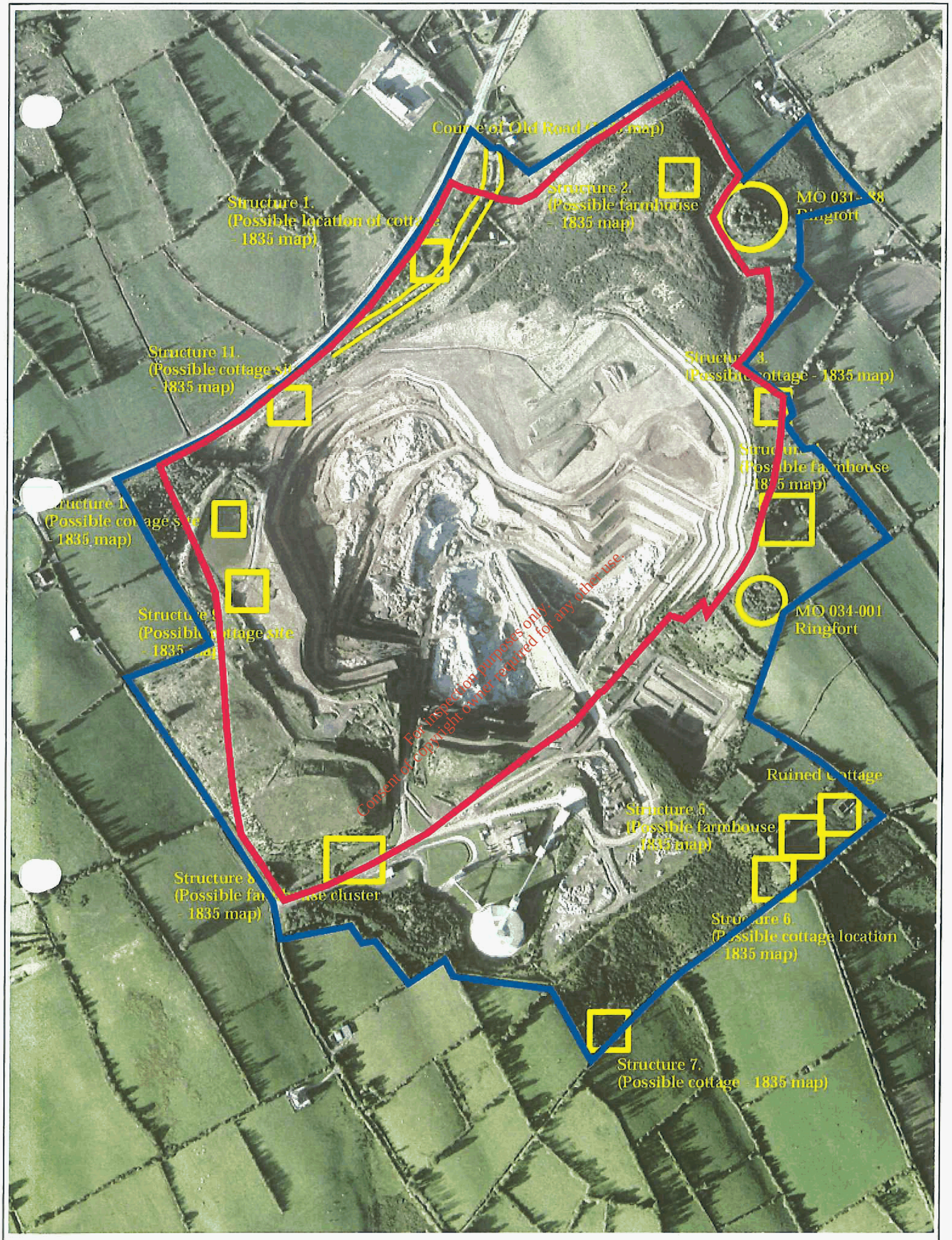
11.25 A buffer zone of 30m extending from the visible outer edge of both Recorded Monuments will be established within which no overburden removal or mining will take place.

Possible 19th century cottage remains.

11.26 The Company will ensure that archaeological monitoring of groundworks will be carried out. Should any archaeological features or deposits be uncovered during the monitoring programme, all ground works will cease so that the extent and nature of the archaeological deposits may be evaluated. Following such an evaluation, further monitoring, archaeological testing, preservation in situ or preservation by record will be undertaken.

Hedgerows and field boundaries.

11.27 Particular care will be paid during groundworks at the site edges to avoid negatively impacting upon the hedgerows that form the existing site boundaries.



Knocknacran Mine Extn. EIS

Fig 11.1: Historical context

(Based on OS First Edition (1835) maps - sheet no's: 30, 31, 33 & 34)

12 LANDSCAPE

Receiving Environment

12.1 The visual assessment was carried out in October 2006 on a day when visibility was good, and the largely deciduous vegetation, which surrounds the site, was loosing its leaf rendering visibility into the site possible. Information regarding the site and surrounds was gathered from Ordnance Survey maps, aerial photography and from on-site observations.

12.2 The methodology used to assess the impacts of the development on the landscape are based on the guidelines of the Environmental Protection Agency. The assessment is made with regard to the vulnerability of the landscape to change and to the location of visual receptors relative to the proposed development. The assessment has regard to - and the methodology is based on - the EPA Guidelines on the information to be contained in Environmental Impact Statements, 2002 and EPA Advice Notes on Current Practice (in the preparation of Environmental Impact Statements), 2003.

12.3 Landscape has two separate but closely related aspects. The first is **visual impact** *i.e.* the extent to which new development can be seen in the landscape. In considering visual impact, various aspects and stages are considered in detail including, excavation stage impact, impact on completion of excavation and longer-term established impact.

12.4 The second aspect of landscape is **impact on landscape character**, *i.e.* responses that are felt towards the landscape. This draws on the appearance of the land, including aspect, land-use, topography, vegetative cover, built environment, etc. and their interaction to create specific patterns and landscape units distinctive to particular localities.

12.5 It is important to note that just because a development - or part of a development - may be visible within the landscape; this does not necessarily determine that the development will have an adverse impact on the character of an area. Rather the manner in which a development 'fits' within an existing setting is the principal consideration in the assessment.

12.6 The terminology used throughout the assessment can be defined as follows;

Imperceptible impact.
An impact capable of measurement but without noticeable consequences

Slight Impact.
An impact which causes noticeable changes in the character of the environment without affecting its sensitivities.

Moderate Impact.
An impact that alters the character of the environment in a manner that is consistent with existing and emerging trends

Significant Impact.
An impact which by its character magnitude duration or intensity alters a sensitive aspect of the environment

Profound Impact.
An impact which obliterates sensitive characteristics.

12.7 In addition impacts, which may be rated as positive, neutral or negative, are also considered in terms of duration as set out in the EPA Guidelines ranging from:

temporary (lasting for one year or less),
short-term (lasting one to seven years),
medium-term (lasting seven to fifteen years),
long-term (lasting fifteen to sixty years), and
permanent (lasting over sixty years).

Site Context

12.8 The Irish Gypsum Ltd. site at Knocknacran is located approximately 4.5km south-east of Carrickmacross and a similar distance north-east of Kingscourt, Co. Cavan at an elevation of 45 metres (minimum) to 70 metres (maximum) above Ordnance Datum (Malin Head). The site is accessed from a local road via the R179 regional road linking Kingscourt to Carrickmacross.

12.9 The proposed quarry extension will take up to 10 years to complete, and shall be undertaken on a staged basis. All stages shall be undertaken in the same manner that is the stripping of overburden followed by the removal of gypsum. See drawing 4904-300 to see the extent of overburden stripping, and the extension of gypsum extraction.

Stage 1 (Yrs 1-3.5)
The quarry shall extend toward its northern boundary

Stage 2 (Yrs 3.5-6)
Following the extraction of the gypsum on the northern quarry face, the quarry shall extend toward its eastern boundary

Stage 3 (Yrs 6-10)
This final stage of works sees the quarry extend on the western boundary.

12.10 The landscape character of the site is typical of that in Monaghan/Cavan; gently undulating landform, primarily in pasture, with field sizes averaging approximately 2 – 3 hectares (5 – 7.5 acres) sub-divided by hedgerows.

12.11 There are a number of residential properties and agricultural buildings surrounding the site, the majority of these are located along the local road, which frames the western boundary of the site, and the local road, which forms the eastern boundary of the site. It should be noted that only those on the western boundary shall be affected visually by the extension of the quarry.

Characteristics of the proposal

12.12 The proposal will comprise the following elements, which shall be undertaken in the following order:

The stripping / removal of overburden; and
The removal of gypsum.

12.13 This process shall be undertaken over a 10-year period, beginning on the northern boundary followed by the western and finishing on the eastern boundary. All works shall be undertaken beneath the existing finished ground level. No storage of overburden shall take place above the existing finished ground levels surrounding the site. A major characteristic of the proposal is that the overburden that is striped from the northern, western and eastern boundaries is placed into the quarry base and thereby raise the level of the quarry floor. This proposal will aid in the long-term goal of filling in the extraction quarry and returning the land to a status equal to that of the surrounding countryside.

Potential Impact

Operational Phase

12.14 The visual impact to the surrounding landscape due to the operational phase of the quarry extension shall be slight to moderate impacts, to the northern western and eastern boundaries, due to the removal of overburden and to the northern and eastern boundaries this coupled with the removal of existing tree / shrub planting. This slight to moderate impact shall diminish to imperceptible impacts upon maturation of the remedial tree and shrub planting to the northern western and eastern boundaries.

Remedial or Reductive Measures

Pre Operational Phase

12.15 Landscape proposals will be prepared for the boundary areas adjacent to the proposed quarry extension and carried out by a competent landscape contractor. The proposed additional screen planting will be achieved through established landscape planting techniques i.e. bare root trees, transplants and shrubs which adapt easily to disturbed ground conditions.

12.16 The following landscape works will be carried out during the planting season (October-March) closest to the granting of permission.

12.17 Provision of tree and shrub planting along proposed internal roads assisting in the visual integration of the roads. These measures will be carried out to the western, eastern and northern boundaries and result in the establishment of a 'green' barrier between the neighbouring road network and the existing quarry. These proposals will comprise of evergreen and deciduous tree and shrub planting and in doing so create a native / naturalised boundary to the site.

12.18 The most significant impact of these proposals will be to the western boundary from the neighbouring the road the cut face of the quarry is clearly visual, the proposed boundary treatment as highlighted in drawing 4904-301 and 4904-302 (Appendix 12) will prevent users of the local road from viewing the cut face of the site. See Plate 12.2.1 and 12.3.1 for photomontages of remedial planting to western boundary.

12.19 The eastern boundary planting will enhance an already green belt and aid in the creation of a 'green' visual barrier into the site for the local road. See drawing 4904-301 and 4904-302 (Appendix 12).

12.20 The northern boundary of the site will be heavily planted with evergreen and deciduous tree and shrub planting, and in doing so reinforce and maintain an already green barrier between the R179 and the site. See drawing 4904-301 and 4904-302 (Appendix 12).

12.21 A competent landscape contractor will carry out aftercare and maintenance of the landscape works for an eighteen-month period.

Predicted Impact

12.22 In landscape terms the proposed development will impact in varying degrees on three inter-related aspects, namely (1) the perceived character of the area, (2) impact on residential areas and surrounding roads (views) and (3) recreational amenity.

Operational Phase - Impact on Landscape Character

12.23 A slight impact will on the landscape character will occur as a result of the proposed quarry extension. This slight impact is a result of the removal of overburden to the

northern eastern and western boundaries, along with the removal of a quantity of existing tree and shrub planting to the northern and eastern boundaries. The proposed tree and shrub planting as indicated in drawing 4904-301 and 4904-302 (Appendix 12) will upon maturation eliminated the impact of the operational works.

Operational Phase - Impact on Surrounding Residential Areas

12.24 There will be a short-term impact to the residential dwellings to the western boundary. This impact will diminish as the remedial planting works on the western boundary mature, and in doing so prevent visibility into the site. Upon maturation the predicted impact shall be positive as indicated in plate 12.2.1 and 12.3.1. These plates show how the existing views of the quarry shall be reduced by the remedial planting that shall be undertaken for these extension works. This remedial planting coupled with the reduction of the ridge height (background Plate 12.1) shall have a positive impact on views from the surrounding residential dwellings on the western boundary.

12.25 The residential dwellings to the eastern boundary will experience a short-term impact, as the green barrier that exists between these dwellings and quarry is reduced due to the extension of the quarry and the removal of the overburden. However as is clearly indicated in drawing 4904-302 this impact shall be short term as the remedial planting matures and obscures long term views into the quarry site.

Impact on Surrounding Roads

12.26 As a result of the extension, there will be a short-term visual impact for passing traffic on the northern boundary road. This short-term impact shall decline with the maturation of the remedial planting to the northern boundary.

12.27 To the western boundary the impact will be short term and of a positive nature. Presently there are clear views into the site from this area (see plate 12.2 and 12.3) The impact of remedial planting coupled with the lowering of the ridge height of the existing quarry will have a positive visual impact for the western boundary. See plate 12.2.1 and 12.3.1.

12.28 There will be some medium impact on the adjoining roads due to added heavy goods vehicles being employed to cater for the additional works relating to the extension of the quarry. This impact shall decline after year 10.

Impact on Recreational Amenity

12.29 There will be no impact to the recreational amenity of the surrounding lands.

Monitoring

Construction Phase

12.30 The site boundary vegetation will be retained and reinforced where possible. Maintenance of proposed planting will be an integral part of the on-going site management. No other monitoring regarding landscaping will be required.

Summary

12.31 The proposed extension to the Irish Gypsum Ltd. site at Knocknacran will give rise to no additional visual impact to the landscape character of the area. Given the adjoining topography and the form of the quarry as it drops below the general ground level of the area, only views from west boundary road shall be altered by the quarry extension, (See Plate No, 12.2, 12.2.1, 12.3, 12.3.1). The manner to which these views will be altered will be a positive one as the extension works lowers the ridge levels. There may be some medium impact on the adjoining roads due to added heavy goods vehicles being employed to cater for the additional works relating to the extension of the quarry. To the North and South there will be no visual impacts to the surrounding landscape and residential dwellings.

12.32 Mitigation measures will be incorporated into the scheme by way of extensive boundary planting to the northern, eastern and western boundaries, as indicated in drawing 4904-301 and 4904-302 (Appendix 12). The results of such planting can be viewed in plate 12.2.1 and 12.3.1. The following are proposed:

Woodland Planting
(Planted @ 1/1.5mtrs ctrs)
15% Crataegus monogyna, b/r, 1+2, 60-90cm
15% Corylus avellana, b/r, 2+2, 90-120cm
10% Sambucus nigra, b/r, 2+2, 90-120cm
25% Fraxinus excelsior, b/r, 2+2, 90-120cm
15% Betula pendula, b/r, 2+2, 90-120cm
15% Quercus robur, b/r, 1+2, 60-90cm
5% Euonymus europaeus, b/r, 1+2, 60-90cm