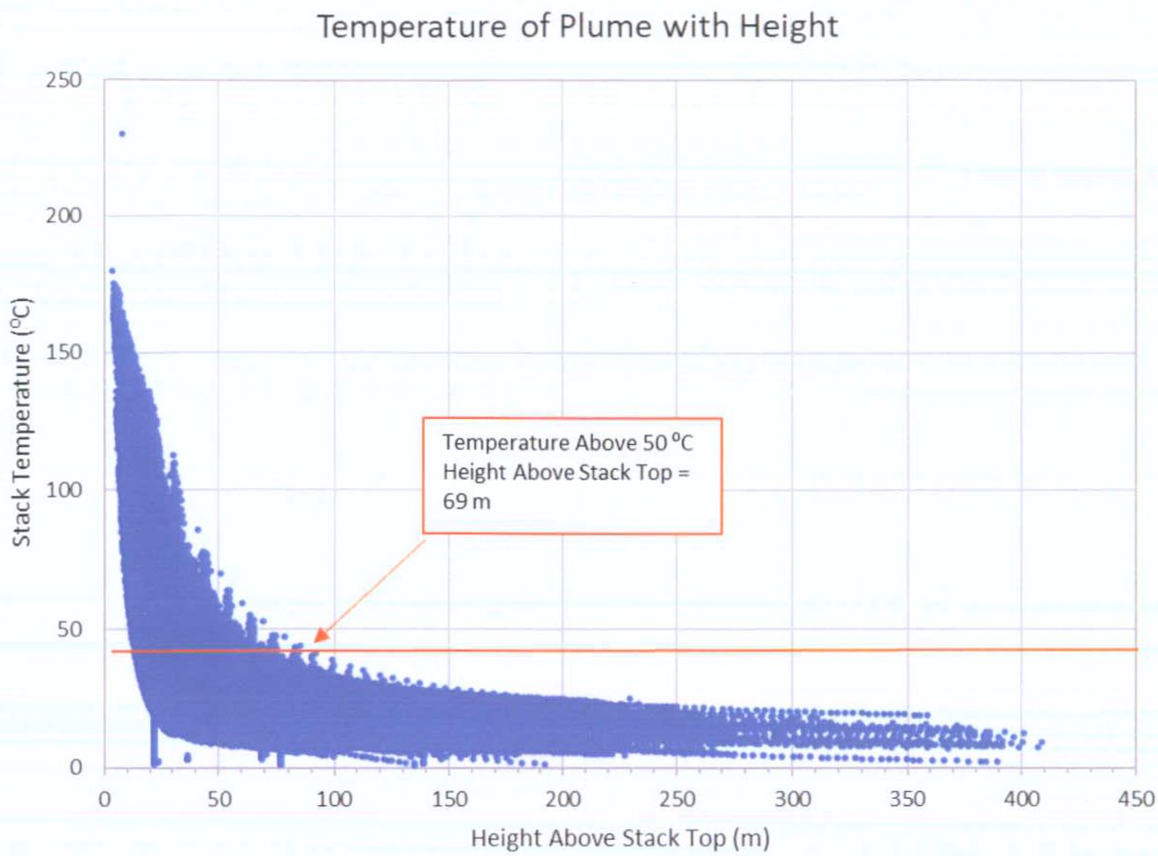


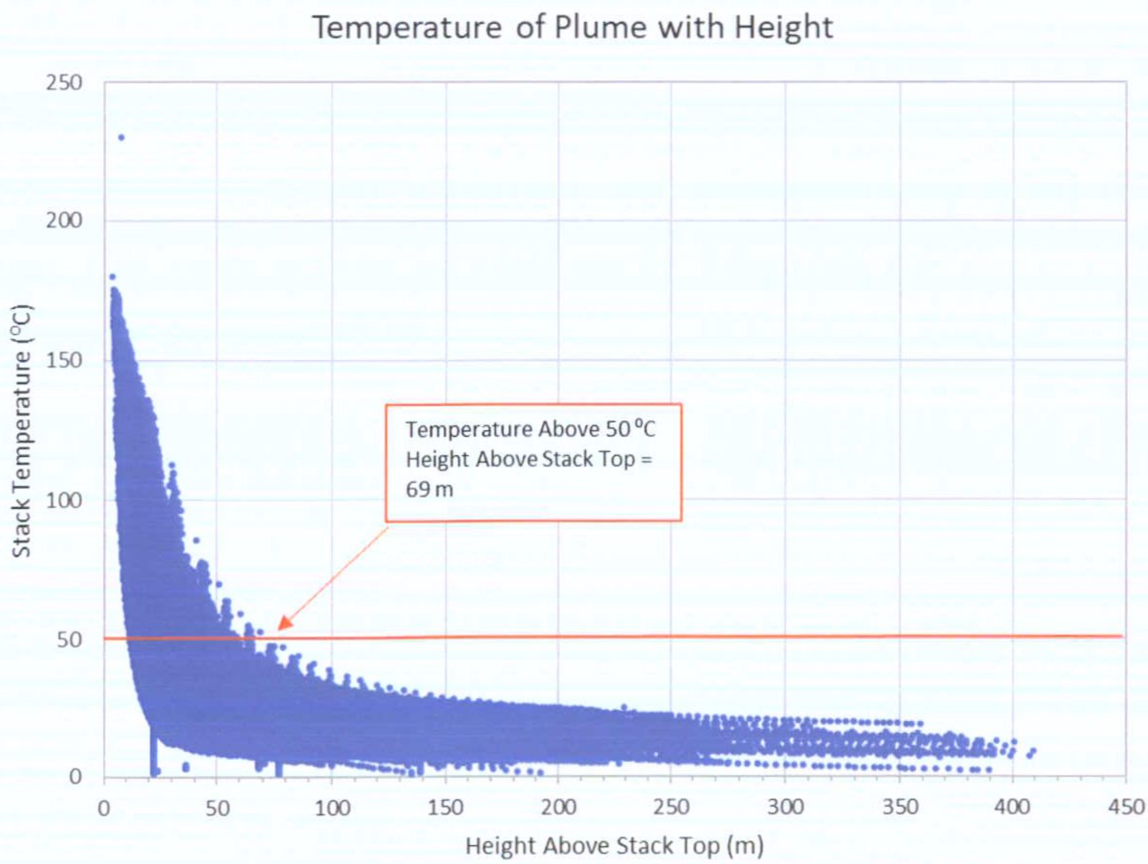


Figure 4 Temperature Of The Plume (°C) With Distance From Stack Top

The results confirm that the plume will be below 50°C within 69 m of the stack top (93 m above ground level) for every hour over the year for the stack including all meteorological conditions including pressure/temperature inversions.

Vertical Velocity / Plume Interactions

High vertical velocities are also relevant when considering aviation/plume interactions. The Australian Civil Aviation Safety Authority[(2)] consider that the critical level for vertical velocity is 6.1 m/s. Thus, modelling has been undertaken to understand the vertical velocity of the plume with distance from the stack.

Cambridge Environmental Research Consultants (CERC), the developers of the EPA approved AMDS-5 model, were contacted to determine whether vertical velocity could be derived indirectly from the travel time of the plume with distance from the stack. CERC confirmed that the vertical velocity (in m/s) could be derived from an analysis of the plume centreline height (in metres) and the plume travel time (in seconds). The vertical velocity has been calculated for every hour of the year using Dublin Airport 2019-2021. The results are outlined below in Figure 5 and Figure 6 for the worst case year of 2020.

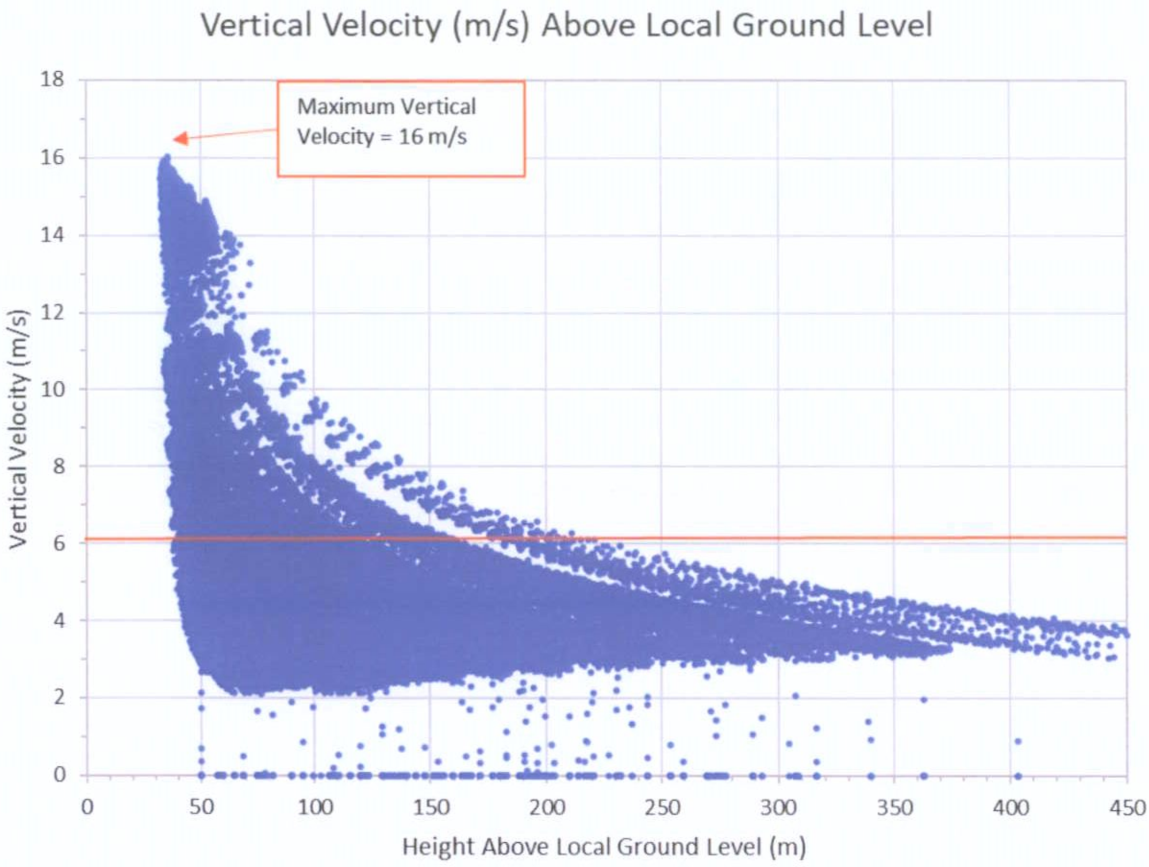


Figure 5 Vertical Velocity Of The Plume (m/s) With Distance Above Ground Level

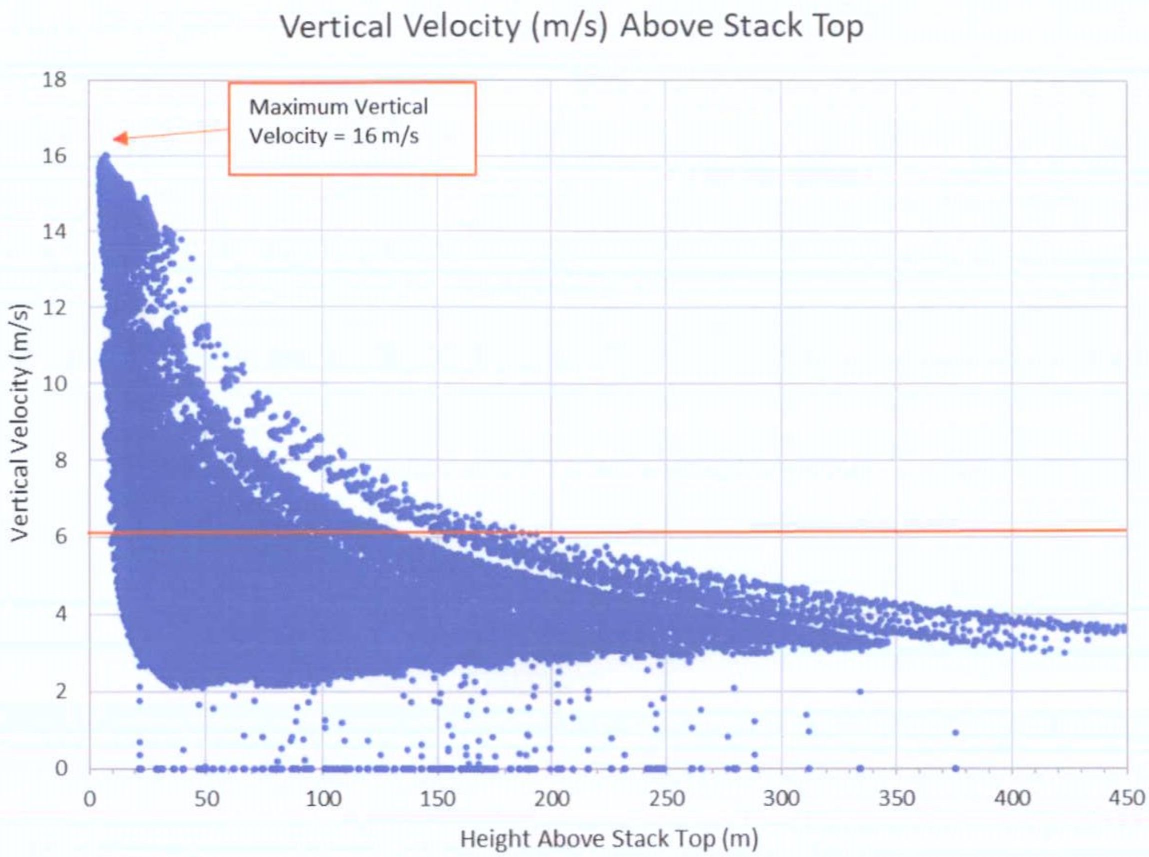


Figure 6 Vertical Velocity Of The Plume (m/s) With Distance From Stack Top

The results confirm that the velocity of the plume will be below 6.1 m/s within 182 m of the stack top (215 m above ground level) of the stack including all meteorological conditions including pressure/temperature inversions.

SUMMARY

Thus, in summary the results of the analysis are as follows.

- Oxygen Content – within <1 m metre of the stack top the oxygen concentration will increase above the 12% risk level for oxygen.
- Temperature – the temperature of the plume will drop to less than 50°C within 69 metres of the stack top.
- Vertical Velocity – the critical vertical velocity of 6.1 m/s will not be exceeded within 182 metres from the stack top.

Thus, the maximum extent of the risk zone of the plume (distance from stack top) for each parameter is shown below based on three full years of meteorological data covering all meteorological conditions including pressure/temperature inversions:

- Risk Zone for Oxygen – <1 m metres
- Risk Zone for Temperature – 69 metres
- Risk Zone for Vertical Velocity – 182 metres

REFERENCES

(1) MITRE (2012) Expanded Model for Determining the Effects of Vertical Pumes on Aviation Safety)
(2) CASA (2019) Guidelines For Conducting Plume Rise Assessments AC139-05(v3.0) January 2019

APPENDIX TO SECTION 10

NOISE & VIBRATION

APPENDIX 10.1

Glossary of acoustic terminology

APPENDIX 10.1 - GLOSSARY OF ACOUSTIC TERMINOLOGY

ambient noise	The totally encompassing sound in a given situation at a given time, usually composed of sound from many sources, near and far.
background noise	The steady existing noise level present without contribution from any intermittent sources. The A-weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90 per cent of a given time interval, T ($L_{AF90,T}$).
broadband	Sounds that contain energy distributed across a wide range of frequencies.
dB	Decibel - The scale in which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the RMS pressure of the sound field and the reference pressure of 20 micro-pascals (20 μPa).
dB L_{pA}	An 'A-weighted decibel' - a measure of the overall noise level of sound across the audible frequency range (20 Hz – 20 kHz) with A-frequency weighting (i.e. 'A'–weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
Hertz (Hz)	The unit of sound frequency in cycles per second.
impulsive noise	A noise that is of short duration (typically less than one second), the sound pressure level of which is significantly higher than the background.
$L_{Aeq,T}$	This is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period (T). The closer the LAeq value is to either the LAF10 or L= value indicates the relative impact of the intermittent sources and their contribution. The relative spread between the values determines the impact of intermittent sources such as traffic on the background.
L_{AFN}	The A-weighted noise level exceeded for N% of the sampling interval. Measured using the "Fast" time weighting.
L_{AFmax}	is the instantaneous slow time weighted maximum sound level measured during the sample period (usually referred to in relation to construction noise levels).
$L_{Ar,T}$	The Rated Noise Level, equal to the LAeq during a specified time interval (T), plus specified adjustments for tonal character and impulsiveness of the sound.
L_{AF90}	Refers to those A-weighted noise levels in the lower 90 percentile of the sampling interval; it is the level which is exceeded for 90% of the measurement period. It will therefore exclude the intermittent features of traffic and is used to estimate a background level. Measured using the "Fast" time weighting.
$L_{AT(DW)}$	equivalent continuous downwind sound pressure level.
$L_{fT(DW)}$	equivalent continuous downwind octave-band sound pressure level.
L_{day}	Lday is the average noise level during the day time period of 07:00hrs to 19:00hrs

L_{night}	Lnight is the average noise level during the night-time period of 23:00hrs to 07:00hrs.
low frequency noise	LFN - noise which is dominated by frequency components towards the lower end of the frequency spectrum.
noise	Any sound, that has the potential to cause disturbance, discomfort or psychological stress to a person exposed to it, or any sound that could cause actual physiological harm to a person exposed to it, or physical damage to any structure exposed to it, is known as noise.
noise sensitive location	NSL – Any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or other area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels.
octave band	A frequency interval, the upper limit of which is twice that of the lower limit. For example, the 1,000Hz octave band contains acoustical energy between 707Hz and 1,414Hz. The centre frequencies used for the designation of octave bands are defined in ISO and ANSI standards.
rating level	See LAr,T.
sound power level	The logarithmic measure of sound power in comparison to a referenced sound intensity level of one picowatt (1pW) per m2 where: $$Lw = 10 Log \frac{P}{P_0} \text{ dB}$$ Where: p is the rms value of sound power in pascals; and P_0 is 1 pW.
sound pressure level	The sound pressure level at a point is defined as: $$Lp = 20 Log \frac{P}{P_0} \text{ dB}$$
specific noise level	A component of the ambient noise which can be specifically identified by acoustical means and may be associated with a specific source. In BS 4142, there is a more precise definition as follows: 'the equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific noise source over a given reference time interval (LAeq, T)'.
tonal	Sounds which cover a range of only a few Hz which contains a clearly audible tone i.e. distinguishable, discrete or continuous noise (whine, hiss, screech, or hum etc.) are referred to as being 'tonal'.
1/3 octave analysis	Frequency analysis of sound such that the frequency spectrum is subdivided into bands of one–third of an octave each.

APPENDIX 10.2

Noise modelling details & assumptions

APPENDIX 10.2 - NOISE MODELLING DETAILS & ASSUMPTIONS

Noise Model

A 3D computer-based prediction model has been prepared in order to quantify the noise level associated with the proposed building. This section discusses the methodology behind the noise modelling process.

DGMR iNoise

Proprietary noise calculation software has been used for the purposes of this modelling exercise. The selected software, DGMR iNoise, calculates noise levels in accordance with *ISO 9613: Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation, 1996*.

DGMR iNoise is a proprietary noise calculation package for computing noise levels in the vicinity of noise sources. iNoise calculates noise levels in different ways depending on the selected prediction standard. In general, however, the resultant noise level is calculated taking into account a range of factors affecting the propagation of sound, including:

- the magnitude of the noise source in terms of A weighted sound power levels (LWA);
- the distance between the source and receiver;
- the presence of obstacles such as screens or barriers in the propagation path;
- the presence of reflecting surfaces;
- the hardness of the ground between the source and receiver;
- Attenuation due to atmospheric absorption; and
- Meteorological effects such as wind gradient, temperature gradient and humidity (these have significant impact at distances greater than approximately 400m).

Brief Description of ISO9613-2: 1996

ISO9613-2:1996 calculates the noise level based on each of the factors discussed previously. However, the effect of meteorological conditions is significantly simplified by calculating the average downwind sound pressure level, L_{AT}(DW), for the following conditions:

- wind direction at an angle of ±45° to the direction connecting the centre of the dominant sound source and the centre of the specified receiver region with the wind blowing from source to receiver, and;

- wind speed between approximately 1ms-1 and 5ms-1, measured at a height of 3m to 11m above the ground.

The equations and calculations also hold for average propagation under a well-developed moderate ground based temperature inversion, such as commonly occurs on clear calm nights.The basic formula for calculating L_{AT}(DW) from any point source at any receiver location is given by:

$$L_{fT}(DW) = LW + Dc - A \qquad \textbf{Eqn. A}$$

Where:

L_{fT}(DW) is an octave band centre frequency component of L_{AT}(DW) in dB relative to $2x10^{-5}$Pa;

L_W is the octave band sound power of the point source;

D_c is the directivity correction for the point source;

A is the octave band attenuation that occurs during propagation, namely attenuation due to geometric divergence, atmospheric absorption, ground effect, barriers and miscellaneous other effects.

The estimated accuracy associated with this methodology is shown in Table 10.A2.1 below:

Table 10.A2.1 No text of specified style in document.**.A2.1 Atmospheric Attenuation Assumed for Noise Calculations (dB per km)**

Height, h*	Distance, d†	
	0 < d < 100m	100m < d < 1,000m
0<h<5m	±3dB	±3dB
5m<h<30m	±1dB	±3dB

* h is the mean height of the source and receiver. † d is the mean distance between the source and receiver.
N.B. These estimates have been made from situations where there are no effects due to reflections or attenuation due to screening.

Input Data and Assumptions

The noise model has been constructed using data from various source as follows:

Site Layout The general site layout has been obtained from the drawings forwarded by Kavanagh Tuite.

Local Area The location of noise sensitive locations has been obtained from a combination of site drawings provided by Kavanagh Tuite Architects and others obtained from Ordinance Survey Ireland (OSI).

Heights The heights of buildings on site have been obtained from site drawings forwarded by Kavanagh Tuite Architects. Off-site buildings have been assumed to be 8m high with the exception of industrial buildings where a default height of 15m has been assumed.

Contours Site ground contours/heights have been obtained from site drawings forwarded by Kavanagh Tuite Architects where available.

The final critical aspect of the noise model development is the inclusion of the various plant noise sources. Details are presented in the following section.

Source Sound Power Data

The noise modelling competed indicates the following values in relation to various items of plant associated with the overall site development. Plant items will be selected in order to achieve the stated noise levels and or appropriate attenuation will be incorporated into the design of the plant in order that the plant noise emission levels are achieved on site (including any system regenerated noise).

Table 10.A2.2 No text of specified style in document.**.A2.2 Sound Power Levels Utilised in Noise Model**

Item	Sound Power Level, LWA (dB) at Octave-band Centre Frequency, (Hz)									dB(A)
	31.5	63	125	250	500	1000	2000	4000	8000	
Inlet Filter Face	115	110	99	91	85	88	89	93	90	98
Inlet Duct	113	104	89	79	76	79	89	85	67	92
Inlet Transition Duct	120	111	96	85	85	86	81	75	47	91
Inlet Plenum	90	92	89	91	90	91	100	91	79	102
Gas Turbine Enclosure	112	114	108	97	91	90	92	90	84	99
GT Enclosure Vent Fans	57	70	88	86	89	89	89	93	88	97
Exhaust Diffuser with Barrier Wall	106	113	97	93	87	85	86	89	76	95
Generator Enclosure	113	117	114	101	96	92	90	82	79	102
Fin Fan Coolers	56	69	93	92	97	100	91	86	86	102
Liquid Fuel Module (Liq Fuel Only)	115	119	116	103	98	94	92	84	81	104
Fuel Oil Pump (Liq Fuel only)	80	81	82	84	84	87	84	80	74	91
Demin Water Pump – (Liquid Fuel Only)	80	81	82	84	84	87	84	80	74	91
Fuel Gas Separator Skid (Gas Fuel Only)	47	51	60	65	69	79	91	92	86	96
Fuel Gas Performance Heater Skid (Gas Fuel Only)	43	48	57	61	65	75	87	88	82	92
Silencer Duct Stage 1	127	118	103	92	92	93	88	82	54	98
Silencer Duct Stage 2	88	92	87	83	89	93	89	83	53	96
Stack with Shroud	119	100	67	48	47	53	60	70	42	81
Stack outlet	88	89	81	83	87	86	81	88	78	92
Air Compressor	83	87	88	89	90	88	86	82	76	93
Admin Building HVAC	41	57	67	71	74	73	71	68	58	78
Warehouse Louvre (each of 2)	41	57	67	71	74	73	71	68	58	78
Warehouse Exhaust (each of 2)	41	57	67	71	74	73	71	68	58	78
Aux Trafo	48	59	74	83	85	91	83	73	59	92
Step-up Transformer	48	59	74	83	85	91	83	73	59	92

Noise Barrier

The design in corporates a noise barrier of 12 m height at the north east part of the main gast turbine area, as in the figure below:

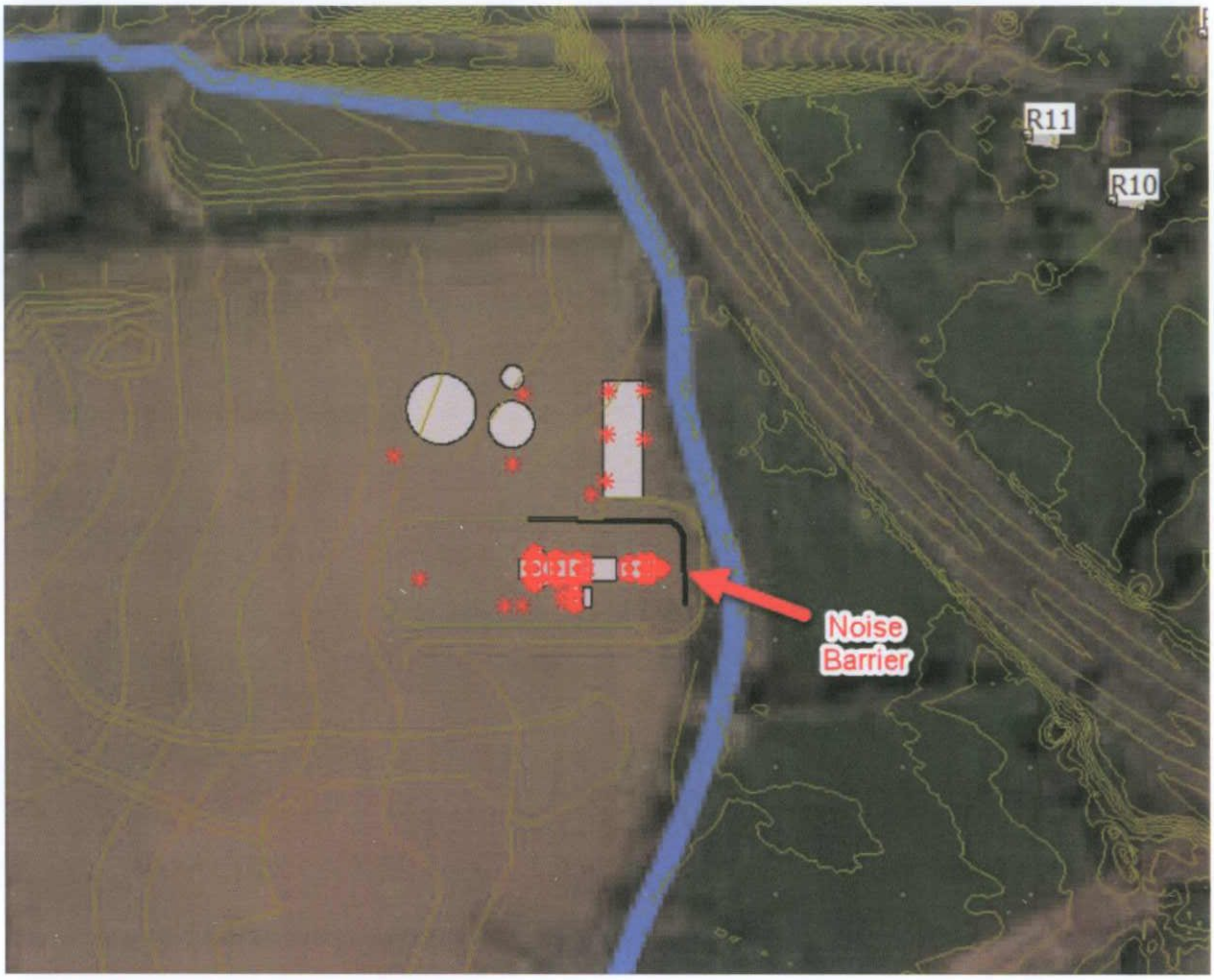


Figure 10.A2.1 Noise Barrier

The noise barrier has the following acoustic properties:

Table 10.A2.3 No text of specified style in document.**.A2.3 Sound Reduction**

SRI dB at Octave Band Centre Frequencies (Hz)								
31.5	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
8	**15**	**20**	**25**	**39**	**48**	**50**	**50**	**50**

Table 10.A2.3 No text of specified style in document.**.A2.4 Acoustic Absorption on side facing gas turbine**

Acoustic Absorption at Octave Band Centre Frequencies (Hz)								
31.5	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
0.5	**0.5**	**0.84**	**1.0**	**1.0**	**1.0**	**1.0**	**0.97**	**0.97**

APPENDIX 10.3

Noise model parameters

APPENDIX 10.3 – NOISE MODEL PARAMETERS

Prediction calculations for noise emissions have been conducted in accordance with *ISO 9613: Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation, 1996*. The following are the main aspects that have been considered in terms of the noise predictions presented in this instance.

Directivity Factor: The directivity factor (D) allows for an adjustment to be made where the sound radiated in the direction of interest is higher than that for which the sound power level is specified. In this case the sound power level is measures in a down wind direction, corresponding to the worst case propagation conditions and needs no further adjustment.

Ground Effect: Ground effect is the result of sound reflected by the ground interfering with the sound propagating directly from source to receiver. The prediction of ground effects is inherently complex and depend on source height receiver height propagation height between the source and receiver and the ground conditions. The ground conditions are described according to a variable defined as G, which varies between 0.0 for hard ground (including paving, ice concrete) and 1.0 for soft ground (includes ground covered by grass trees or other vegetation) Our predictions have been carried out using various source height specific to each plant item, a receiver heights of 1.6m for single storey properties and 4m for double. An assumed ground factor of G = 1.0 has been applied off site. Noise contours presented in the assessment have been predicted to a height of 4m in all instances. For construction noise predictions have been made at a level of 1.6m as these activities will not occur at night.

Geometrical Divergence This term relates to the spherical spreading in the free-field from a point sound source resulting in attenuation depending on distance according to the following equation:

$$A_{geo} = 20 \times \log(\text{distance from source in meters}) + 11$$

Atmospheric Absorption Sound propagation through the atmosphere is attenuated by the conversion of the sound energy into heat. This attenuation is dependent on the temperature and relative humidity of the air through which the sound is travelling and is frequency dependent with increasing attenuation towards higher frequencies. In these predictions a temperature of 10°C and a relative humidity of 70% have been used, which give relativity low levels of atmosphere attenuation and corresponding worst case noise predictions.

Table 10.A.3.1 No text of specified style in document.**.A3.1 Atmospheric Attenuation Assumed for Noise Calculations (dB per km)**

Temp (°C)	% Humidity	Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1k	2k	4k	8k
10	70	0.12	0.41	1.04	1.92	3.66	9.70	33.06	118.4

Barrier Attenuation The effect of any barrier between the noise source and the receiver position is that noise will be reduced according to the relative heights of the source, receiver and barrier and the frequency spectrum of the noise.

APPENDIX TO SECTION 11

LANDSCAPE & VISUAL IMPACT

KILSHANE

Method Statement - Photo-montage production.

1. Photographs are taken from locations as advised by client with a full frame SLR digital camera and prime lens. The photographs are taken horizontally with a survey level attached to the camera. The photographic positions are marked (for later surveying), the height of the camera and the focal length of the image recorded.

2. In each photograph, a minimum of 3no. visible fixed points are marked for surveying. These are control points for model alignment within the photograph. All surveying is carried out by a qualified topographical surveyor using Total Station / GPS devices.

3. The photographic positions and the control points are geographically surveyed and this survey is tied in to the site topographical survey supplied by the Architect / client.

4. The buildings are accurately modelled in 3D cad software from cad drawings supplied by the Architect. Material finishes are applied to the 3D model and scene element are place like trees and planting to represent the proposed landscaping.

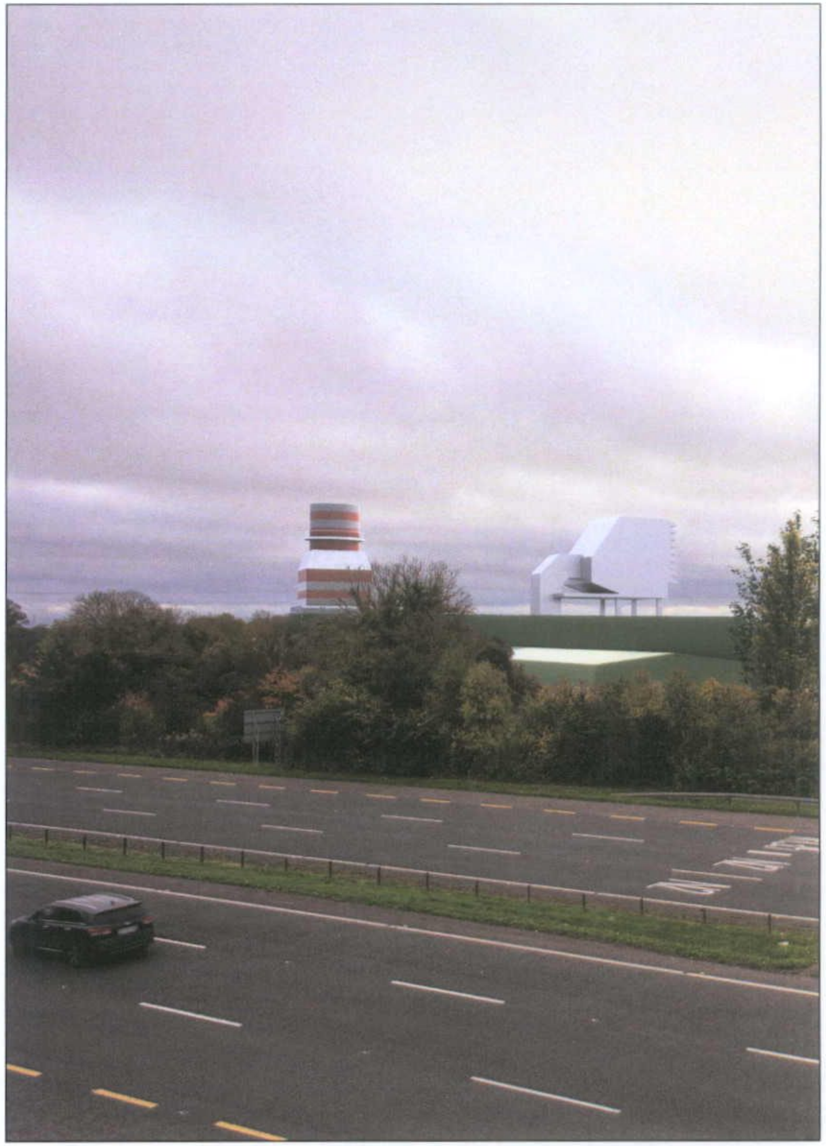
5. Virtual 3D cameras are positioned according to the survey co-ordinates and the focal length is set to match the photograph. Pitch and rotation are adjusted using the survey control points to align the virtual camera to the photograph. Lighting is set to match the time of day the photograph is taken.

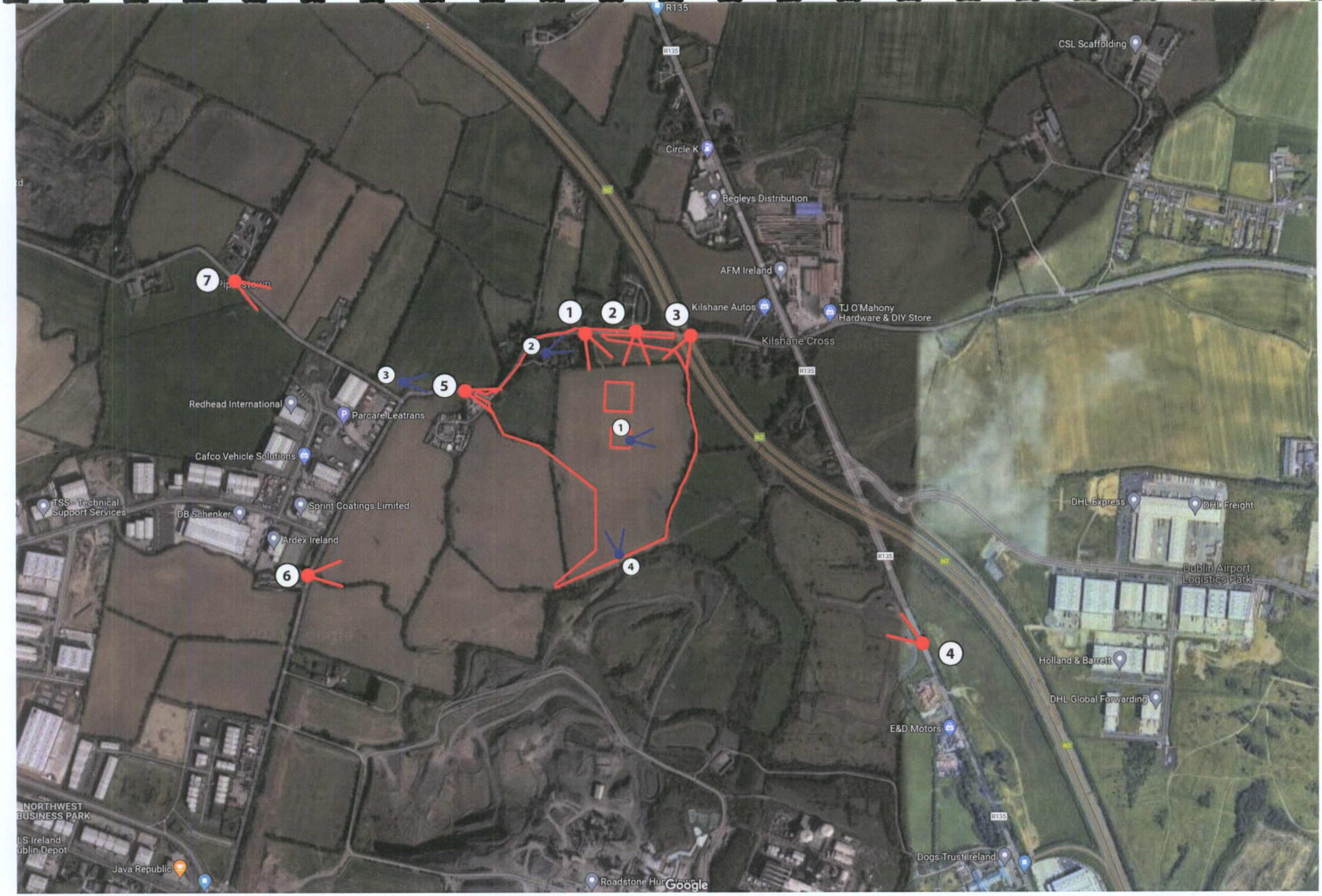
6. The proposed development is output from the 3D software using this camera and the image is then blended with the original photograph to give an accurate image of what the proposed development will look like in its proposed setting.

7. In the event of the development not being visible, the roof line of the development will be outlined in red if re-quested.

8. The document contains:

   a) Site location map with view locations plotted.
   b) Photo-montage sheet with existing or proposed conditions.
   c) Reference information including field of view/focal length, range to site / development, date of photograph.




R135
CSL Scaffolding
Circle K
Begleys Distribution
AFM Ireland
Kilshane Autos
TJ O'Mahony
Hardware & DIY Store...
Kilshane Cross
1
2
3
4
5
6
7
Redhead International
Parcare Leatrans
Cafco Vehicle Solutions
TSS - Technical
Support Services
DB Schenker
Sprint Coatings Limited
Ardex Ireland
DHL Express
DHL Freight
Dublin Airport
Logistics Park
Holland & Barrett
DHL Global Forwarding
E&D Motors
NORTHWEST
BUSINESS PARK
Java Republic
Dogs Trust Ireland
Google

Location	Date	Field of view	35mm equivalent	Distance to site	Camera model
View 1 Existing	05/11/21	74°	24mm	24m	Canon EOS 5DS

digital dimensions
architectural visualisation

Location	Date	Field of view	35mm equivalent	Distance to site	Camera model
View 1 Proposed (yr1)	05/11/21	74°	24mm	24m	Canon EOS 5DS

Showing planting @ year1

digital dimensions
architectural visualisation

Location	Date	Field of view	35mm equivalent	Distance to site	Camera model
View 1 Proposed (yr5)	05/11/21	74°	24mm	24m	Canon EOS 5DS

Showing planting @ year5

digital dimensions
architectural visualisation

Location	Date	Field of view	35mm equivalent	Distance to site	Camera model
View 1 Proposed (yr10)	05/11/21	74°	24mm	24m	Canon EOS 5DS

Showing planting @ year10

digital dimensions
architectural visualisation

Location	Date	Field of view	35mm equivalent	Distance to site	Camera model
View 2 Existing	05/11/21	74°	24mm	32m	Canon EOS 5DS

digital dimensions
architectural visualisation

Location	Date	Field of view	35mm equivalent	Distance to site	Camera model
View 2 Proposed (yr1)	05/11/21	74°	24mm	32m	Canon EOS 5DS

Showing planting @ year1

digital dimensions
architectural visualisation

Location	Date	Field of view	35mm equivalent	Distance to site	Camera model
View 2 Proposed (yr5)	05/11/21	74°	24mm	32m	Canon EOS 5DS

Showing planting @ year5

digital dimensions
architectural visualisation

Location	Date	Field of view	35mm equivalent	Distance to site	Camera model
View 2 Proposed (yr10)	05/11/21	74°	24mm	32m	Canon EOS 5DS

Showing planting @ year10

digital dimensions
architectural visualisation

Location	Date	Field of view	35mm equivalent	Distance to site	Camera model
View 3 Existing	05/11/21	74°	24mm	78m	Canon EOS 5DS

digital dimensions
architectural visualisation

Location	Date	Field of view	35mm equivalent	Distance to site	Camera model
View 3 Proposed (yr1)	05/11/21	74°	24mm	78m	Canon EOS 5DS

Showing planting @ year1

digital dimensions
architectural visualisation

Location	Date	Field of view	35mm equivalent	Distance to site	Camera model
View 3 Proposed (yr5)	05/11/21	74°	24mm	78m	Canon EOS 5DS

Showing planting @ year5

digital dimensions
architectural visualisation

Location	Date	Field of view	35mm equivalent	Distance to site	Camera model
View 3 Proposed (yr10)	05/11/21	74°	24mm	78m	Canon EOS 5DS

Showing planting @ year10

digital dimensions
architectural visualisation

Location	Date	Field of view	35mm equivalent	Distance to site	Camera model
View 4 Existing	05/11/21	74°	24mm	586m	Canon EOS 5DS

digital dimensions
architectural visualisation