APPENDIX C:
AIR QUALITY TECHNICAL NOTE
DAMHEAD CREEK 2 CCGT POWER STATION
SECTION 36 CONSENT VARIATION
ENVIRONMENTAL INFORMATION REPORT
Air Quality Technical Note
May 2015
<table>
<thead>
<tr>
<th>Rev</th>
<th>Date</th>
<th>Details</th>
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<th>Reviewed by</th>
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</thead>
<tbody>
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</table>
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ANNEX C1: ISOPLETHS
1. INTRODUCTION

This Technical Note supplements the Environmental Information Report for the DHC2 Section 36(c) Variation application for a Combined Cycle Gas Turbine power station from 1,200 MW up to 1,800 MW electrical output capacity and describes the dispersion modelling and assessment of point source emission of oxides of nitrogen (NOx) from the proposed operational development.

The stack height originally proposed and consented for the original 1,000 MW scheme was 75 m and these were retained for the 1,200 MW scheme that was granted (following a Section 36 Consent variation application) in July 2014. This stack height has therefore been used as a starting point for the proposed 1,800 MW scheme. However, the detailed design of the proposed 1,800 MW scheme has not been finalised at this stage and there are several plant configurations and layouts under consideration, as outlined in the EIR. Consequently, the final stack heights may vary to ensure adequate dispersion of pollutants so as to not give rise to significant air quality effects at identified residential, amenity and ecological receptors.

For the purposes of the Section 36 Consent variation application therefore, stack heights up to a maximum of 95 m have been presented for the visual impact assessment as a worst case. However this assessment of air quality impacts presents the worst-case impacts predicted from the different plant configurations, which are based on 75 m stack heights. The final stack heights will be determined and agreed with the regulators – in particular the Environment Agency and Natural England – at the detailed design stage in order to demonstrate acceptable air quality impacts at the identified receptors.

The full suite of pollutants from the operational development will be assessed as part of the Environmental Permit application, however at this stage of the development and in agreement with the Environment Agency, emissions of nitrogen oxides (NOx) are considered to be the determining factor in definition of appropriate stack height for the proposed development, and is the focus of this assessment.

The anticipated impacts on air quality, resulting from the operational emissions, have been assessed through detailed dispersion modelling of emissions to determine the likely worst-case Process Contributions and Predicted Environmental Concentrations to enable comparison of these results with national Air Quality Strategy standards and objectives for human health and ecological protection. An assessment of the nitrogen deposition effects on the ecological receptors has also been undertaken. The assessment follows the Environment Agency’s H1 Environmental Risk Assessment methodology (Annex F), and additional significance criteria defined in agreement with Natural England.

Emissions have been assessed in conjunction with those from Scottish Power’s existing Damhead Creek power station (DHC1) in order to determine the combined air impacts from the proposed plant, as both power stations will be operated and regulated under a single Environmental Permit as one installation.
The results of the impact assessment have been compared with the predicted impacts from the currently consented 1,200 MW scheme to appraise the effects of the proposed scheme changes.
2. BASELINE ASSESSMENT

2.1 Sensitive Receptors

The nearest residential receptors to the application site (as reported in the 2009 ES, Scottish Power) are Eshcol Road, located approximately 1 km to the west and Benuncle Farm and White Hall Farm, located approximately 1.1 km to the north-west and north respectively. Additional receptors have been identified for the assessment of the proposed 1,800 MW scheme, in order to ensure that the worst case impacts at all sensitive human receptors have been identified. These include Abbots Court (approximately 1.7 km west), Burnt House Cottage (800 m west), Burnt House Farm (900 m south-west), Sturdee Cottage (1.8 km west) and North Street Farm (approximately 500 m north). An additional amenity receptor of a playing field will also be considered and reported in the air quality assessment to be submitted with the Environmental Permit variation application.

The nearest ecological receptor to the application site is Medway Estuary and Marshes Site of Special Scientific Interest (SSSI), Special Protection Area (SPA) and Ramsar site. The closest part of this site is located to the east of the application site. The area is designated for its intertidal habitats, including saltmarsh, mudflats and grazing marsh. The area holds international importance for populations of wintering and passage birds, and breeding birds, as well as the assemblage of plant species.

Additional designated habitat sites are located within the statutory screening distance of the application site, for which the impacts will be assessed as part of the Environmental Permit application. However the proximity of the Medway Estuary and Marshes SSSI means it will experience by far the highest contributions from the proposed development and therefore is the focus of this assessment.

2.2 Air Quality Standards

The national Air Quality Strategy (AQS) defines air quality objectives for several of the most commonly emitted pollutants from industrial point sources. These objectives must be achieved on a national scale by a set date – typically this was set at 2010, and thereafter. These so-called “criteria pollutants” include nitrogen dioxide (NO₂) that will be emitted from the proposed development. The objectives can be regarded as legislative limits that cannot be exceeded.

In addition, the AQS defines Critical Levels for the protection of vegetation and ecosystems for NOₓ. The AQS objectives and Critical Levels relevant to the emissions from the proposed development are shown in Table 2.1.
Table 2.1: AQS Objectives and Critical Levels

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Air Quality Objective (µg/m³)</th>
<th>Averaging Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen dioxide (NO₂)</td>
<td>200</td>
<td>1 hour 99.79th percentile</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>Annual average</td>
</tr>
<tr>
<td>Oxides of nitrogen (NOₓ)</td>
<td>30</td>
<td>Annual average (V)</td>
</tr>
<tr>
<td></td>
<td>75</td>
<td>Daily average (V)</td>
</tr>
</tbody>
</table>

Notes: (V) Critical Level for the protection of vegetation and ecosystems. Other standards are for the protection of human health.

For most statutory Habitat sites there are also site-specific critical loads for nutrient nitrogen and acidity deposition, which have been determined for the protection of specific features within the Habitat site. The main Habitat type present within the Medway Estuary and Marshes SSSI is Saltmarsh, with a critical load of 20-30 kg N/ha/yr¹.

2.3 Background Concentrations (BC)

The application site is not located within an Air Quality Management Area (AQMA), although there are three AQMAs designated for NO₂ (DEFRA, 2014) within 7 km of the application site, located approximately 5 – 7 km to the south and south-west. Given the prevailing wind direction (originating from the south-west), it is considered unlikely that the emissions from the proposed 1,800 MW scheme would contribute to exceedances within these AQMAs, which are principally designated as a result of the contribution from traffic emissions, and the AQMAs therefore have not been included at this stage of the assessment, however the impact on these areas will be addressed within the Environmental Permit application.

The ambient air quality detailed in the 2009 Environmental Statement (ES) was based on monitoring data for the period 2001 – 2005, and is therefore considered to no longer be representative of ambient concentrations in 2015, particularly considering the closure of the Kingsnorth Power Station in 2012. New ambient air monitoring data has therefore been obtained for this assessment.

Medway Council operate a number of background automatic air quality monitoring sites in the UK and the results are available from the Council website. The nearest monitoring station to the application site is at a rural background location in Lower Stoke (referred to as Rochester in the 2009 ES) (NGR 583100, 176200), approximately 3.9 km north-east of the application site. An urban background monitoring station is located at Chatham Luton (NGR 577100, 166650), approximately 7.4 km south-west from the application site.

These monitoring stations have been in operation for a number of years and data will include contributions from the existing DHC1, although at a relatively low or insignificant level based on the distance between DHC1 and the monitoring station; certainly the effect of any emissions from DHC1 on the Chatham Luton monitoring station is

¹ APIS website (www.apis.ac.uk)
expected to be negligible. Results for the years 2009 to 2013 are shown in Table 2.2. It is recognised that the ambient concentrations have decreased from those reported in the 2009 ES, and it is considered that this is due to year-on-year improvements in NOx emissions from a modernising UK car fleet, and also potentially due to the cessation of activities of the Kingsnorth Power Station.

The 2009 ES included NO2 monitoring data for diffusion tubes within the Medway Council area, however as all but two of these monitoring sites are located at road/kerbside monitoring locations, they are not considered to be representative of background concentrations in the vicinity, and therefore have not been updated for this appraisal. Two of the diffusion tubes are identified as being at urban background location, however they are co-located with the automatic monitoring stations detailed above, and therefore it is considered more relevant to use the information from the automatic monitoring sites.

Table 2.2: Ambient Air Quality Records – NO2 and NOx (µg/m³)

<table>
<thead>
<tr>
<th>Year</th>
<th>Lower Stoke</th>
<th>Chatham Luton</th>
<th>Lower Stoke</th>
<th>Chatham Luton</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NO₂ Annual</td>
<td>NOₓ Annual</td>
<td>NO₂ Annual</td>
<td>NOₓ Annual</td>
</tr>
<tr>
<td>2009</td>
<td>18</td>
<td>-</td>
<td>24</td>
<td>-</td>
</tr>
<tr>
<td>2010</td>
<td>25*</td>
<td>-</td>
<td>24**</td>
<td>-</td>
</tr>
<tr>
<td>2011</td>
<td>19</td>
<td>-</td>
<td>30</td>
<td>-</td>
</tr>
<tr>
<td>2012</td>
<td>18</td>
<td>-</td>
<td>24</td>
<td>-</td>
</tr>
<tr>
<td>2013</td>
<td>14</td>
<td>19</td>
<td>24.6</td>
<td>35</td>
</tr>
<tr>
<td>Air Quality Standard</td>
<td>40</td>
<td>30</td>
<td>40</td>
<td>30</td>
</tr>
</tbody>
</table>

* Data capture only 44% due to cabin replacement therefore not representative of annual concentrations
** Data capture 73% due to technical communication problems following cabin replacement

The concentrations of NO₂ and NOₓ for the DHC2 location have also been obtained from the Defra background pollutant database, as shown in Table 2.3, in which pollutant concentrations are averaged over 1 km² grids across the UK and projected for future compliance purposes. Data for NO₂ and NOₓ is available for 2015 (from 2011 base mapping).

Table 2.3: Defra Background Air Quality Mapping

<table>
<thead>
<tr>
<th>Location</th>
<th>NO₂ (µg/m³)</th>
<th>NOₓ (µg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NGR 581500, 172500</td>
<td>16.2</td>
<td>23.0</td>
</tr>
<tr>
<td>(2011 baseline projected to 2015, Defra)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The above demonstrates that NO₂ levels in the area are well within the AQS objective for annual mean NO₂ and the Critical Level for NOₓ.
The APIS website states that the background nitrogen deposition in the area is between 12.04–16.94 kg N/ha/yr, with an average of 14.69 kg N/ha/yr. The background deposition is therefore approximately 73% of the lower end of the critical load range defined for the Medway Estuary SSSI. This is discussed in more detail in Section 3.2.
3. **ASSESSMENT CRITERIA**

The assessment of process contributions (PC) has been made in accordance with the methodology outlined in the Environment Agency’s H1 Environmental Risk Assessment methodology - Annex F, and additional assessment criteria defined in agreement with Natural England for impacts on the Medway Estuary SSSI.

3.1 **Human Health Impacts**

According to H1, the total pollutant emission is defined as having an insignificant impact where:

- $PC \leq 1\%$ of the AQS or Critical Level for long term releases;
- $PC \leq 10\%$ of the AQS or Critical Level for short term releases.

Where a release is not screened as insignificant, the impact assessment must consider the contribution from the proposed development to the ambient air background pollutant levels. The PC from the proposed development must be added to an appropriate background concentration (BC) to give the predicted environmental concentrations (PEC). It is the PEC that is then compared with the appropriate AQS objective or Critical Level to ensure that air quality is not being significantly affected. Where an AQS objective or Critical Level is predicted to be exceeded, the proposal is unlikely to be considered acceptable and further mitigation may be required.

It is unrepresentative to add the worst-case short term PC to the worst-case short term BC, since it is highly unlikely that the two events will coincide. The H1 methodology suggests that the estimated the short-term BC is assumed to be twice the annual average concentration, rather than the short-term concentration over the equivalent averaging period. It has been agreed with the Environment Agency on other projects that the use of twice the annual average background concentration is overly conservative when assessing the daily mean NO$_x$, therefore a value of 1.5 times the background has been used.

3.2 **Impacts on Medway Estuary and Marshes SSSI**

Although there are established Critical Levels for NOx concentrations in relation to vegetation, these are intentionally generic and not calibrated to the sensitivity of different habitats. Research indicates that NOx Critical Levels (whether long-term i.e. annual or short-term i.e. 24-hr) are not particularly relevant to habitats such as saltmarsh. A study undertaken for Countryside Council for Wales$^2$ (now Natural Resources Wales) reviewed the effects of atmospheric nitrogen deposition on saltmarsh, including the relative importance of NO$_x$ concentrations (as distinct from nitrogen deposition rates). The review concluded that “… the robustness of the salt marsh nutrient system might suggest that the application of the critical load limits [as opposed to critical level] may afford sufficient protection … it seems likely that the cumulative effects of these short term impacts [of elevated NO$_x$] would, in general, be

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adequately covered by the application of the critical load approach”. This would support the view that, given the regular inundation experienced, nitrogen inputs to the substrate are likely to have a greater influence on the structure and composition of this habitat than the concentration of nitrogen in the atmosphere.

In addition, it is reasonable to consider that the short-term (24 hr) mean for NOx is of less importance than the annual mean. Vegetation exposed to levels of NOx above the Critical Level will be more likely to recover from that exposure if the exceedence is for a short duration. Authors from the Centre for Ecology and Hydrology in a recent publication on nitrogen, NOx concentrations and vegetation, states that “UN/ECE Working Group on Effects strongly recommended the use of the annual mean value, as the long-term effects of NOx are thought to be more significant than the short-term effects”3.

As such, a material effect on the saltmarsh is considered unlikely to occur from predicted levels that are close to or marginally exceed the daily Critical Level. For saltmarsh, the UK Air Pollution Information System provides a Critical Load range of 20-30 kg/N/ha/yr and nitrogen inputs have been experimentally demonstrated at this level to have an effect on overall species composition of saltmarsh. However, the Critical Loads on APIS are relatively generic for each habitat type and cover a wide deposition rate range. They do not (and are not intended to) take into consideration other influences to which the habitat on a specific given site may be exposed. Moreover, it is important to note that the experimental studies which underlie conclusions regarding the sensitivity of saltmarsh to nitrogen deposition have “… neither used very realistic N doses nor input methods i.e. they have relied on a single large application more representative of agricultural discharge”4, which is far in excess of anything that would be deposited from atmosphere.

It is therefore concluded that for these particular sites, nitrogen inputs from air are not as important as nitrogen effects from other sources because the effect of any deposition of nitrogen from atmosphere is likely to be dominated by much greater inputs from marine or agricultural sources. This is reflected on APIS itself, which states regarding saltmarsh that “Overall, N deposition [from atmosphere] is likely to be of low importance for these systems as the inputs are probably significantly below the large nutrient loadings from river and tidal inputs4. Moreover, the nature of intertidal saltmarsh in the Medway means that there is flushing from tidal incursion twice per day. This is likely to further reduce the role of nitrogen from atmosphere in controlling botanical composition.

It has been agreed with Natural England that the stack heights should be set to ensure compliance for the PEC with the annual average NOx critical level (of 30 μg/m³) and to ensure that the predicted nitrogen deposition at the SSSI is below 100% of the lowest minimum critical load of any habitat within the SSSI (identified through APIS to be saltmarsh with a critical load of 20 – 30 kg N/ha/yr). It has been further agreed that with regards to the daily mean NOx critical level of 75 μg/m³ – while an important indicator –

4 UK Air Pollution Information System website [accessed 21/04/15]: http://www.apis.ac.uk/node/968
it is less important for this type of habitat and that marginal exceedances of the 100% of the daily mean may be considered and accepted by Natural England, to be agreed on a case by case basis subject to the justification and rationale that is presented for that exceedance.
4. EMISSION PARAMETERS

4.1 Operational Scenarios

The 1,200 MW scheme comprised a multi-shaft combined cycle with two gas turbine (GT) units, each with a heat recovery steam generator (HRSG) which would serve a single steam turbine (STG).

The design of the proposed increased capacity power station has not been finalised at this stage and therefore three plant configurations and layouts are under consideration, as outlined in the EIR, with up to three gas turbine units and an electrical output capacity of up to 1,800 MW. The most conservative scheme with reference to potential air impact, based on mass emission rate and efflux conditions, is a three unit single shaft scheme of capacity up to 1,800 MW comprising three GT units, each with an HRSG and STG. This scenario has been reported in this assessment as it represents the worst case air quality impact of the three potential options. The other two options have similarly been modelled and the predicted impacts are comparable or slightly lower than those presented here.

4.2 Emission Parameters

The flue gases from each GT module will be discharged to a dedicated stack and will meet the emission limits set in the Industrial Emissions Directive (IED) for oxides of nitrogen NOₓ, to a maximum of 50 mg/Nm³ when gas turbine outputs are above 70%.

Other release parameters, such as the discharge flow rate and temperature, are based on design specifications provided by plant vendors. The stack diameter has been set to achieve an optimum efflux velocity of 20 m/s, based on vendor advice.

For the assessment of peak short term (hourly mean impacts) and peak daily mean impacts, it has been assumed that continuous emissions occur at peak load from both DHC1 and DHC2 power stations, as will be required for the Environmental Permit application.

For the assessment of annual mean impacts, it has been assumed that both DHC1 and DHC2 generating stations will operate at the predicted average load factors from present day to 2033. That is, that the plant will run at 100% load for a reduced proportion of the year. Load Factors of 85% for DHC2 and around 65% for DHC1 have been assumed for the purpose of the assessment. This is to provide a realistic assessment of impacts for long term operation, rather than presenting an unrealistic worst case assuming 100% operation of both plants concurrently.

The relevant stack and emission parameters for the existing and proposed plant are provided in Table 4.1.
### Table 4.1: Modelled Emission Parameters

<table>
<thead>
<tr>
<th>Model Scenario</th>
<th>Efflux velocity (m/s)</th>
<th>Stack Diameter m</th>
<th>Temp °C</th>
<th>Peak NO\textsubscript{x} release rate (g/s)</th>
<th>Annual NO\textsubscript{x} release rate (g/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A9 / A10 / A11 (DHC2 1,800 MW)</td>
<td>20</td>
<td>8.4</td>
<td>77.5</td>
<td>41.6</td>
<td>35.4</td>
</tr>
<tr>
<td>A1 / A2 (DHC1)</td>
<td>22</td>
<td>6.2</td>
<td>120</td>
<td>32.0\textsuperscript{1}</td>
<td>20.8\textsuperscript{1}</td>
</tr>
</tbody>
</table>

1. Based on current Environmental Permit Emission Limit Value
2. Factored for realistic annual mean loads: 85% DHC2, 65% DHC1

### 4.3 Stack Height

Vendors have advised that a maximum stack height-to-diameter ratio of 13:1 for a self-supporting steel stack should be considered. A stack with a greater height to diameter ratio would require a reinforced concrete structure, which would increase costs considerably and increase the visual impacts of the plant.

Based on the original modelling carried out for the 2009 ES, an initial stack height of 75 m has been considered and assessed but as outlined in Section 1, the final stack heights will be determined and agreed with the regulators – in particular the Environment Agency and Natural England – at the detailed design stage in order to demonstrate acceptable air quality impacts at the identified receptors. For the purposes of the Section 36 Consent variation therefore, stack heights up to a maximum of 95 m have been presented for the landscape and visual impact assessment as a worst case, although the results from 75 m high stacks are presented in this assessment.
5. DETAILED DISPERSION MODELLING

5.1 Model Description

Detailed dispersion modelling of the likely emissions to air has been undertaken utilising AERMOD (version 14134), in order to assess the environmental impact of emissions to air from the Proposed Development.

AERMOD is an advanced Gaussian plume dispersion model that incorporates the principles of dispersion in convective and stable planetary boundary layers (defined by the Monin-Obukhov length), plume rise and buoyancy, plume penetration into elevated inversions, treatment of vertical wind, turbulence and temperature profiles and treatment of simple and complex terrain. AERMOD also incorporates the PRIME downwash algorithm for treatment of emissions entrained in the deviated wind-field created in the wake of buildings close to the source. The model uses hourly sequential meteorological data to enable a realistic assessment of dispersion from point sources to be conducted for weather conditions that are directly applicable to the site.

AERMOD is approved for use by the Environment Agency for regulatory purposes. The use of AERMOD over other dispersion models, such as ADMS, is considered appropriate in this case for consistency with the previous ES and therefore for comparison with the impacts predicted for the 1,200 MW scheme.

5.2 Treatment of NO\textsubscript{x} Emissions

Emissions have been modelled for the release scenario detailed in Section 4 above, at the emission parameters shown in Table 4.1.

Emissions of nitrogen oxides (NO\textsubscript{x}) from industrial point sources are typically dominated by nitric oxide (NO), with emissions from combustion sources typically in the ratio of NO to NO\textsubscript{2} of 9:1. However, it is nitrogen dioxide that has specified AQS objectives due to its potential impact on human health. In the ambient air, NO is oxidised to NO\textsubscript{2} by the ozone present, and the rate of oxidation is dependent on the relative concentrations of NO\textsubscript{x} and ozone in the ambient air. Concentrations of ozone in the atmosphere are affected by a number of factors including background hydrocarbon and NO\textsubscript{x} levels, and diurnal and seasonal atmospheric changes.

The 2009 ES used a rate of conversion of nitric oxide to NO\textsubscript{2} estimated from an empirical relationship based on measurements made in various power station plumes. However, this approach may underestimate the rate of conversion because of uncertainty regarding ozone concentrations in the local environment. This approach also cannot be used for comparison with the Critical Levels for the protection of ecological receptors that are based on the total NO\textsubscript{x} concentration.

The Environment Agency technical guidance for a conservative assessment assumes that 70% of emitted NO\textsubscript{x} is oxidised to NO\textsubscript{2} in the long term and 35% of the emitted NO\textsubscript{x} is converted to NO\textsubscript{2} in the local vicinity of the site in the short-term.

Emissions of total NO\textsubscript{x} expressed as NO\textsubscript{2} have been modelled in the assessment and the predicted ground level concentrations factored to take account of the above
Environment Agency recommendations for NO\textsubscript{x} conversion, with due consideration of the conservative nature of this assumption.

### 5.3 Modelled Domain

The dispersion modelling has been carried out using a grid extending 2 km from the proposed site with grid points at 80 m intervals. Specific receptor locations at the nearest identified residential properties to the proposed development have also been included in the model.

A conservative approach to impacts at habitat receptors has been carried out, with the potential impacts at statutory and non-statutory ecological receptors and wildlife sites being considered at the worst affected ecological receptor based on the isopleths taken from the dispersion modelling. A full impact assessment of all required ecological sites will be included within the Environmental Permit application.

### 5.4 Meteorology

The dispersion of emissions from a point source is largely dependent on atmospheric stability and turbulent mixing in the atmosphere, which in turn are dependent on wind speed and direction, ambient temperature, cloud cover and the friction created by buildings and local terrain.

Actual measured hourly-sequential meteorological data is available for input into dispersion models, and it is important to select data as representative as possible for the site that is modelled. This is usually achieved by selecting a meteorological station as close to the site as possible, although other stations may be used if the local terrain and conditions vary considerably, or if the station does not provide sufficient data.

The meteorological site that was selected for the assessment was Southend Airport, located approximately 17 km north of the proposed development, at a flat airfield in the built up area of Southend-on-Sea.

The modelling for this assessment has utilised meteorological data for the period 2008-2012, with 2011 providing the worst-case results for annual average impacts, and 2008 generally providing the worst-case results for short term impacts. The wind rose for Southend Airport for 2011 is provided in Figure 5.1.
5.5 Building and Terrain Effects

The dispersion of emissions from sources can be significantly affected by the presence of buildings or structures near to the emissions point. The wind field can become entrained into the wake of buildings, which causes the wind to be directed to ground level more rapidly than in the absence of a building. If an emission is entrained into this deviated wind field, this can give rise to elevated ground-level concentrations. Building effects are typically considered where a structure of height greater than 40% of the stack height is situated within 8-10 stack heights of the emissions source.

The building parameters defined for dispersion model purposes are shown in Table 5.1 and visual representation provided in Figure 5.2, based on initial concept design layouts for the 3 unit CCGT.

Table 5.1: Modelled Building Parameters

<table>
<thead>
<tr>
<th>Building</th>
<th>Height</th>
<th>Length (m)</th>
<th>Width (m)</th>
<th>Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHC1 ACC</td>
<td>40</td>
<td>73</td>
<td>73</td>
<td>176</td>
</tr>
<tr>
<td>DHC1 HRSG</td>
<td>36</td>
<td>33</td>
<td>50</td>
<td>176</td>
</tr>
<tr>
<td>DHC2 ACC</td>
<td>46.5</td>
<td>122</td>
<td>85</td>
<td>176</td>
</tr>
<tr>
<td>DHC2 HRSG 1</td>
<td>41</td>
<td>33</td>
<td>34</td>
<td>176</td>
</tr>
<tr>
<td>DHC2 HRSG 2</td>
<td>41</td>
<td>33</td>
<td>34</td>
<td>176</td>
</tr>
<tr>
<td>DHC2 HRSG 3</td>
<td>41</td>
<td>33</td>
<td>34</td>
<td>176</td>
</tr>
</tbody>
</table>
Notes: 1 The angle between the building length and grid north, ACC = Air Cooled Condenser, HRSG = HRSG enclosure

Figure 5.2: Visualisation of buildings representation in the dispersion model

This concept layout is indicative and has been used for the purposes of the dispersion modelling, recognising that the orientation of buildings may change at the detailed design stage. This layout is a hybrid between option (2) and option (3) as detailed in the EIR, with stack locations around the centre of both potential layout options. The results are not expected to vary significantly between the final layout but will be repeated when final capacity, configuration and layout has been determined. Nevertheless, conservative building heights have been used in the assessment. A final assessment of the effects of buildings on dispersion will be undertaken for the Environmental Permit Variation application once the building layouts and dimensions have been determined.

The application site is situated in an area of flat terrain with low level vegetation. Surface roughness for the area has therefore been assumed at 0.3 m, which is representative of agricultural land. It is also in line with previous modelling carried out for the site.

Site-specific terrain data has not been used in the model, as typically terrain data will only have a marked effect on predicted concentrations where hills with gradient of more than 1 in 10 are present in the vicinity of the source, which is not the case at this site.
6. PREDICTED RESULTS

6.1 Conservative Assumptions

The worst-case PC and PEC from the alternative plant configurations within the application have been compared with the appropriate air quality objectives to identify whether the contribution from the proposed development could result in the AQS objectives or Critical Level being exceeded, or where there is a significant risk of the objectives being exceeded.

The model used to generate the worst-case results, reported below, contained the following conservative assumptions:

- Maximum of 1,800 MW output;
- Emissions at IED emission limit values, when average emissions are likely to be below these values;
- Stack heights of 75 m;
- Peak emissions from DHC1 and DHC2 occurring simultaneously;
- Long term average emissions based on maximum likely utilisation (Load Factor) for the two power stations;
- Assumption that 70% of NOₓ emissions are converted to NO₂ in the stack vicinity in the long term and 35% conversion in the short term for human health impacts;
- Worst case meteorological data for averaging period; and,
- Inclusion of buildings within the model.

The model files have been used to generate isopleth diagrams (Annex C1) showing the predicted maximum ground level concentrations of pollutants at grid points around the installation. This modelling output has confirmed that the maximum ground level concentrations occur beyond the site boundary, and therefore worst case impacts have been taken directly from the model output.

It is recognised that the maximum predicted impacts presented in the 2009 ES occurred some 2.2 km from the proposed development, where the current model maximum impacts occur less than 1 km from the proposed development. This is likely to be associated with the slower NO to NO₂ conversion rate assumed in the plume in the 2009 assessment. Whilst this means that direct comparison with predicted data is not possible, the current model is considered to be more conservative, as a higher conversion rate for NO to NO₂ has been used.

6.2 Predicted Results - Human Health Impacts

The results of the assessment of PCs against AQS are shown in Table 6.1.
The results indicate that the proposed development is unlikely to result in or contribute to an exceedance of the annual average NO\textsubscript{2} AQS at any off-site location, with a PC of 3.3 µg/m\textsuperscript{3} or 8% of the AQS, and a PEC at 49% of the AQS.

The predicted maximum hourly average PC is 29 µg/m\textsuperscript{3} or 14% of the AQS, and the PEC represents 31% of the hourly average AQS (both reported as the 99.79\textsuperscript{th} percentile) and therefore the emissions from the proposed development are considered unlikely to result in or contribute to an exceedance of the short-term AQS.

The predicted results for the 2009 ES gave the maximum predicted annual average process contribution of 0.4 µg/m\textsuperscript{3} at a location 2.2 km north-east of the site, representing 1% of the AQS. As shown in the isopleths in Annex C1, the maximum predicted short-term and long-term process contributions for the proposed 1,800 MW scheme, using more conservative modelling assumptions, occurs less than 1 km from the site, which accounts in part for the higher concentrations.

Whilst the process contributions are higher for the proposed 1,800 MW scheme than for the 1,200 MW scheme, there is not considered to be a risk to compliance with the AQS objectives at human health receptors associated with the revised scheme.

6.3 Impacts on Medway Estuary and Marshes SSSI

As discussed in Section 2.1, the assessment of impacts on ecological receptors has focussed on the Medway Estuary and Marshes SSSI as that is the receptor that will experience the highest impact as a result of emissions from the proposed development.

The 2009 ES considered impacts of NO\textsubscript{x} on the SSSI, reporting an annual mean predicted concentration of 0.15 µg/m\textsuperscript{3}, 0.5% of the Critical Level.

As discussed above, the maximum predicted impacts from this more conservative model occur closer to the site than predicted for the 2009 ES model, likely to be due to the oxidation rate assumptions used in the 2009 assessment. The proposed 1,800 MW scheme, with more conservative modelling and assessment, results in a maximum annual average PC of 4.7 µg/m\textsuperscript{3} and the PEC is within the annual mean Critical Level, at 79%. Therefore the worst-case impact from the proposed 1,800 MW scheme is not predicted to exceed the Critical Level at the worst-affected location within the SSSI.

The nitrogen deposition loading from process contributions predicted for the 1,200 MW scheme was reported at 0.28 kg N/ha/yr. The nitrogen deposition loading from process contributions predicted for the proposed 1,800 MW scheme is predicted to be 0.575 kg N/ha/yr, less than 10% of the critical load range for the most sensitive species, saltmarsh, with a Critical Load range of 20-30 kg N/ha/yr. The background nitrogen deposition for the Habitat site has been taken from APIS to be an average of 14.69 kg N/ha/yr, and therefore the process contribution in combination with the background deposition is 15.21 kg N/ha/yr, or 76% of the minimum critical load. The critical load is therefore not predicted to be exceeded as a result of the emissions from the proposed 1,800 MW scheme.

As described in Section 3.2, discussions between the applicant and Natural England agreed that, whilst the daily mean NO\textsubscript{x} Critical Level of 75 µg/m\textsuperscript{3} is an important indicator, it is less important for the types of habitat present within the SSSI, than the
annual mean NOₓ Critical Level of 30 µg/m³, as a result of tidal influences and nutrient loadings from river and tidal inputs to the substrate.

Therefore while the applicant will seek to achieve compliance with 100% of the daily mean Critical Level at the SSSI, marginal exceedances of the 100% of the daily mean may be considered and accepted by Natural England, to be agreed on a case by case basis subject to the justification and rationale that is presented for that exceedance.

Based on 75 m stack heights, as a worst case scenario for the assessment of air quality impacts, the predicted daily mean NOₓ concentration at the SSSI is 110% of the daily mean Critical Level. The daily mean Critical Level was not assessed in the 2009 ES.

As described above, the final configuration and capacity of the power station has not yet been confirmed and this will affect the final stack heights – as may the final sensitivity analysis on the model input parameters such as surface roughness. On this basis therefore, the final stack height may vary within the stated range (75-95 m) to further mitigate the effects as necessary in maintaining the position outlined above regarding compliance with the critical levels and critical loads at the SSSI, with any marginal exceedance of the daily mean NOₓ critical level only subject to Natural England agreement.
### Table 6.1: Maximum Predicted Offsite Ground Level Concentrations – Potential Human Health Impacts

<table>
<thead>
<tr>
<th>Sources</th>
<th>Pollutant</th>
<th>Measured as</th>
<th>AQS (µg/m³)</th>
<th>PC (µg/m³)</th>
<th>PC/AQS %</th>
<th>BC¹(µg/m³)</th>
<th>PEC (µg/m³)</th>
<th>PEC/AQS %</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHC2 1,800 MW, and DHC1</td>
<td>NOₓ (as NO₂)</td>
<td>Annual Average</td>
<td>40</td>
<td>3.3</td>
<td>8%</td>
<td>16.2</td>
<td>19.5</td>
<td>49%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hourly mean (99.8th %ile)</td>
<td>200</td>
<td>28.6</td>
<td>14%</td>
<td>32.5</td>
<td>61.1</td>
<td>31%</td>
</tr>
<tr>
<td>2009 ES: DHC 1,200 MW, DHC1</td>
<td>NOₓ (as NO₂)</td>
<td>Annual Average</td>
<td>40</td>
<td>0.4</td>
<td>1%</td>
<td>(16.2)</td>
<td>(16.6)</td>
<td>(42%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hourly mean (99.8th %ile)</td>
<td>200</td>
<td>10.3</td>
<td>5%</td>
<td>(32.5)</td>
<td>(42.8)</td>
<td>(21%)</td>
</tr>
</tbody>
</table>

**PC** = Process Contribution, **BC** = Background Concentration, **PEC** = Predicted Environmental Concentration, **AQS** = Air Quality Strategy objective or EAL

(1) Assuming twice the annual average ambient concentration as a worst case for short-term impacts.

(2) Values in parenthesis not previous reported, based on current background concentrations.

### Table 6.2: Maximum Predicted Ground Level Concentrations – Potential Impacts at Medway Estuary and Marshes SSSI

<table>
<thead>
<tr>
<th>Sources</th>
<th>Pollutant</th>
<th>Measured as</th>
<th>CL (µg/m³)</th>
<th>PC (µg/m³)</th>
<th>PC/CL %</th>
<th>BC¹(µg/m³)</th>
<th>PEC (µg/m³)</th>
<th>PEC/CL %</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHC2 1,800 MW, and DHC1</td>
<td>NOₓ</td>
<td>Annual Average</td>
<td>30</td>
<td>4.7</td>
<td>16%</td>
<td>19.0</td>
<td>23.7</td>
<td>79%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Daily average</td>
<td>75</td>
<td>53.8</td>
<td>72%</td>
<td>28.5</td>
<td>82.3</td>
<td>110%</td>
</tr>
<tr>
<td>2009 ES: DHC 1,200 MW, DHC1</td>
<td>NOₓ</td>
<td>Annual Average</td>
<td>30</td>
<td>0.15</td>
<td>0.5%</td>
<td>(19.0)</td>
<td>19.2</td>
<td>64%</td>
</tr>
</tbody>
</table>

**PC** = Process Contribution, **BC** = Background Concentration, **PEC** = Predicted Environmental Concentration, **CL** = Critical Level for the protection of vegetation and ecosystems

(1) Assuming twice the annual average ambient concentration as a worst case for short-term impacts.

(2) Values in parenthesis not previous reported, based on current background concentrations.
7. CONCLUSIONS

Dispersion modelling of emissions from DHC1 and DHC2 has been carried out to determine the likely worst-case impacts on air quality for the protecting human health and ecosystems. The short-term impacts assume maximum operation of both plants at the stipulated emissions limits, and conservative NOx to NO2 conversion of 35%. Long term impacts assume realistic maximum annual plant utilisation and operation at emission limits, with conservative NOx to NO2 conversion of 70%, in line with Environment Agency guidance.

The final configuration and capacity of the power station has not yet been confirmed and this will affect the final stack heights used, as may the final sensitivity analysis on the model input parameters such as surface roughness. Therefore, the final stack height may vary within the stated range (75-95 m), however for the purposes of worst-case assessment of air quality impacts in this report, the stack height for each proposed GT has been assumed to be 75 m.

The assessment of emissions from the proposed 1,800 MW scheme in combination with emissions from the DHC1 has shown that the process contributions are unlikely to result in or contribute to an exceedance of the short-term or long-term AQS objectives for the protection of human health.

The process contribution is not predicted to result in exceedance of the annual mean NOx critical level or minimum critical load for the adjacent SSSI although a marginal exceedance of the daily mean NOx critical level is predicted for 75 m stacks. However, the applicant is committed to further mitigation of effects as necessary in order to maintain the position outlined regarding compliance with the critical levels and critical loads at the SSSI, with any marginal exceedance of the daily mean NOx critical level only subject to agreement with the relevant regulators.
ANNEX C1: ISOPLETHS
Figure C1: Annual Mean NOx process contributions (µg/m³) – 75 m Stacks
Figure C2: Daily Mean NOₓ process contributions (µg/m³) – 75 m Stacks