1. Introduction

2.1 Proposal

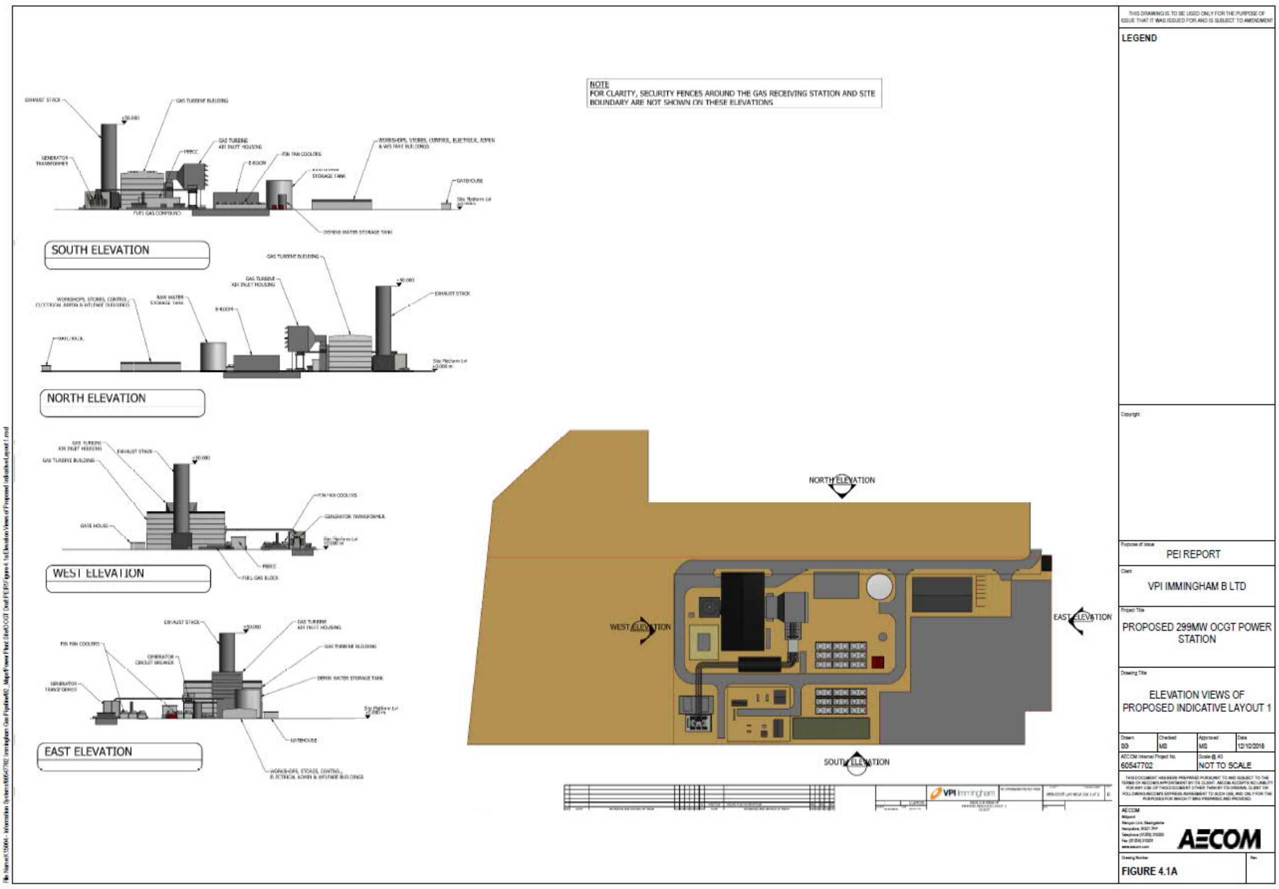
2.2 Infrastructure

The proposal is for the creation of an Open Cycle Gas Turbine (OCGT) facility off Rosper Road, at South Killingholme, Immingham. The proposed development will replace land which is currently undeveloped, and therefore will increase surface water runoff through an increase impermeable area.

The Site for the proposal is approximately 2.6 hectares (Ha), and is currently undeveloped. Land drains currently exist on the North-East and South-East boundaries of the Site. It is understood that the Site will be re-graded as part of the development.

This report is based on the indicative plant layout plans, provided at the time of writing. It has been assumed that these plans are representative of the final development of the Site. The conceptual surface water drainage strategy should be reviewed when further design details are available, however, the broad principles are provided here. An indicative location for a surface water attenuation pond has been provided, and is shown as item 12 on Figure 1.

Figure 1. Indicative Plant Layout



2. Policy Requirements

2.1 National Planning Policy Framework

The revised National Planning Policy Framework[1] (NPPF) requires that the new development should not increase flood risk both on the Site and in the area surrounding it. Surface water runoff should therefore not exceed the volumes already generated by the existing Site and betterment should be provided where possible.

2.2 Environment Agency

The EA advisory comments set out the following recommendations:

- **Runoff Rates** – Peak discharge rates from a site will not increase as a result of a proposed development, up to a 1% Annual Exceedance Probability (AEP) storm event including climate change. The Environment Agency expects all applicants to strive to achieve greenfield runoff rates to reduce the impact of the development on the surface water drainage infrastructure, unless it is demonstrated that this is not practicable;
- **Storage Volumes** - Storage volume for all storm events up to a 1% AEP, including an allowance for climate change, can be provided on site. The site will not flood from surface water during events up to a 1% AEP, including an allowance for climate change, or surface water flooding will be safely contained on site up to this event, ensuring that surface water runoff will not increase flood risk to the development or third parties;
- **Sustainable Drainage Techniques** - SuDS such as green roofs, ponds, swales and permeable pavements should be used. The SuDS hierarchy should be followed; and
- **Residual Risk** - The residual risk of flooding can be managed and contained safely on site should any drainage features fail or during an extreme storm event. The location, depth and flow routes of any over ground flooding should be clearly shown on a plan.

2.3 North Lincolnshire Council Sustainable Drainage (SuDs) Guidance

North Lincolnshire Council (NLC) has created a SuDS guidance document[2] which stipulates the expectations of NLC for designers and developers in regards to the use of SuDS. This guidance document has been produced based on best practice guidelines from the CIRIA SuDS Manual[3].

The document details the requirements for SuDS, appropriate design processes and discusses various types of SuDS. Specific NLC requirements for drainage projects are also detailed with a checklist given for the required steps to be taken for the adoption of SuDS.

2.4 Building Standards Regulations

The Building Standards Regulations 2000 Part H[4] requires that surface water runoff be preferentially discharged first to soakaways, then to surface watercourses and finally to sewers.

[1] Revised National Planning Policy Framework, Published 24th July 2018. Available at: https://www.gov.uk/government/collections/revised-national-planning-policy-framework
[2] North Lincolnshire Council (2017) SuDS and Flood Risk Guidance Document Rev I April 2017
[3] CIRIA (2015) The SuDS Manual C753
[4] Office of the Deputy Prime Minister (2002) The Building Regulations 2000, Drainage and Water Disposal (Approved Document H)

2.5 Surface Water Management

Existing Surface Water Runoff

The revised National Planning Policy Framework (NPPF) requires that new developments should not increase flood risk on the site or in the surrounding area. Therefore surface water runoff rates leaving the site should not exceed the existing undeveloped runoff rate.

The greenfield runoff rate for the Site has been calculated using based on the IoH124 runoff calculation method from the HR Wallingford online calculator based on co-ordinates (OSNGR) 516495, 417675. The Site area of 2.6 Ha has been used within these calculations. Table 1 summarises the greenfield runoff rates for a variety of rainfall events.

Table 1: Greenfield Runoff Rates

Return Period	Runoff Rate (l/s)
QBAR	10.81
1 in 1 year	9.4
1 in 30 years	26.48
1 in 100 years	38.48

Proposed Surface Water Runoff Rates

The development of the scheme will increase the runoff rate, due to the increase in impermeable areas. These anticipated surface runoff rates, assuming no attenuation, have been calculated using the rational method:

$$Q = 2.78 \times CIA$$

Where Q = runoff rate (l/s)

C = runoff coefficient (0.9 used to represent hard standing)

I = Rainfall intensity (mm/hr)

A = Site Area (Ha)

As the majority of the proposed development is hard standing, an assumed runoff coefficient of 0.9 has been used for the calculations.

Table 2. Post development runoff rates (no attenuation)

Return Period	Total Site (2.6 Ha) Runoff (l/s)								
	15 mins	30 mins	1hr	2hr	3 hr	5 hr	12 hr	24 hr	48 hr
2 (50%)	172	113	71	50	40	29	16	10	6
5 (20%)	303	197	123	79	60	41	21	13	7
10 (10%)	396	258	162	100	74	50	25	15	8
30 (3.3%)	541	357	225	134	97	65	32	18	10

50 (2%)	611	405	255	150	109	72	35	20	11
100 (1%)	706	472	299	172	124	82	40	23	13
100 + 20% CC	847	566	359	206	149	98	48	28	16
100 + 40% CC	944	661	419	241	174	115	56	32	19

Surface Water Attenuation

In order to prevent increases in flood risk downstream, in accordance with the NPPF, EA, NLC and North East Lindsey IDB requirements, surface water discharge from the proposed development should be restricted to the greenfield runoff rate. Surface water attenuation will therefore be required, as included in the proposed Site layout (Figure 1), to ensure greenfield runoff rates are not exceeded.

Storage volume calculations have been undertaken for the critical storm duration of the design return period storm event based on an allowable discharge of 10.81 l/s, equal to the Q-bar greenfield runoff rate. The total impermeable area on the proposed site is 1 hectare.

The storage volume estimate has been made using the quick storage estimate tool within the Micro drainage 2016.1 Source Control Program; results are shown in Table 3. FSR rainfall estimated hydrographs were used to undertake this analysis. A conservative assumption of zero infiltration has been made, in the absence of permeability data for the Site.

Table 3. Storage Volumes

Rainfall Event	Min Storage (m^3)	Max Storage (m^3)
1% AEP + 40% Climate Change	487	671

These volumes are estimates, and detailed surface water modelling would be required as part of a detailed design phase to better assess storage volumes.

This surface water attenuation has been proposed at the southern extent of the proposed development. As discharge via infiltration is likely to be unviable, it is proposed that all surface water be discharged to the land drain to the south-east of the Site. Discharge should be at the greenfield runoff rate. This will be subject to confirmation that sufficient capacity is available and receiving discharging consent from North East Lindsey IDB. Confirmation should also be sought that the discharge rate is sufficient to prevent an increased risk of siltation within the drain and allow for continued operation without the need for increased maintenance.

Surface water is to be collected on site and conveyed to the storage area (comprising a storage pond or underground attenuation tank etc.) via the use of drainage ditches/swales where possible.

2.6 Sustainable Drainage Systems

In line with EA advisory recommendations, CIRIA SuDS manual best practice guidelines and local planning policy sustainable drainage systems should be used as a preferential option. A summary of sustainable drainage systems is given in Table 4, this is not an exhaustive list and other options will also be considered. The SuDS management train will be taken into account during detailed drainage design with an aim of capturing surface water as close to the source as possible.

Table 4. Sustainable Drainage Systems

Technique	Description	Restrictions of use
Storage Pond	Storage ponds can be used to attenuate overland runoff and slowly release it into a watercourse or sewer. These systems do not offer water quality benefits unless additional water quality measures are added such as filters or sedimentation volume.	Storage ponds may require substantial earthworks and thus incur high costs during the construction phase. Additionally, large ponds which store water above ground level may be classified as reservoirs which are subject to a range of legislative requirements. Land take requirements for storage ponds are likely to be substantial.
Permeable Paving	Permeable paving allows rainwater to infiltrate through a hard-standing surface to underlying soil or drainage infrastructure. From which it may infiltrate or be directed to a local watercourse or sewer.	Permeable pavements may be restricted by the presence of basements or groundwater levels as well as high imposed loads.
Rainwater Harvesting	Rainwater from roofs and hard surfaces can be stored and used for non-potable purposes. This can provide a reduction of surface water runoff through control at source as well as reducing the demand on the water supply system. In the case of the proposed development harvested rainwater could be used to supplement cooling water supplies.	Rainwater harvesting is dependent on a consistent supply of rainwater which cannot be ensured. As such it will be used as a supplement to conventional water supply only.
Below Ground Attenuation	Below ground storage tanks will attenuate surface water flows in much the same way as surface water ponds, although with reduced land take. Storage tanks will typically require a hydro brake to ensure steady and controlled discharge.	Upfront costs are likely to be high for buried storage tanks. The maintenance regime may be onerous or involve heightened health and safety risks due to enclosed spaces.

Annex 1 Figures

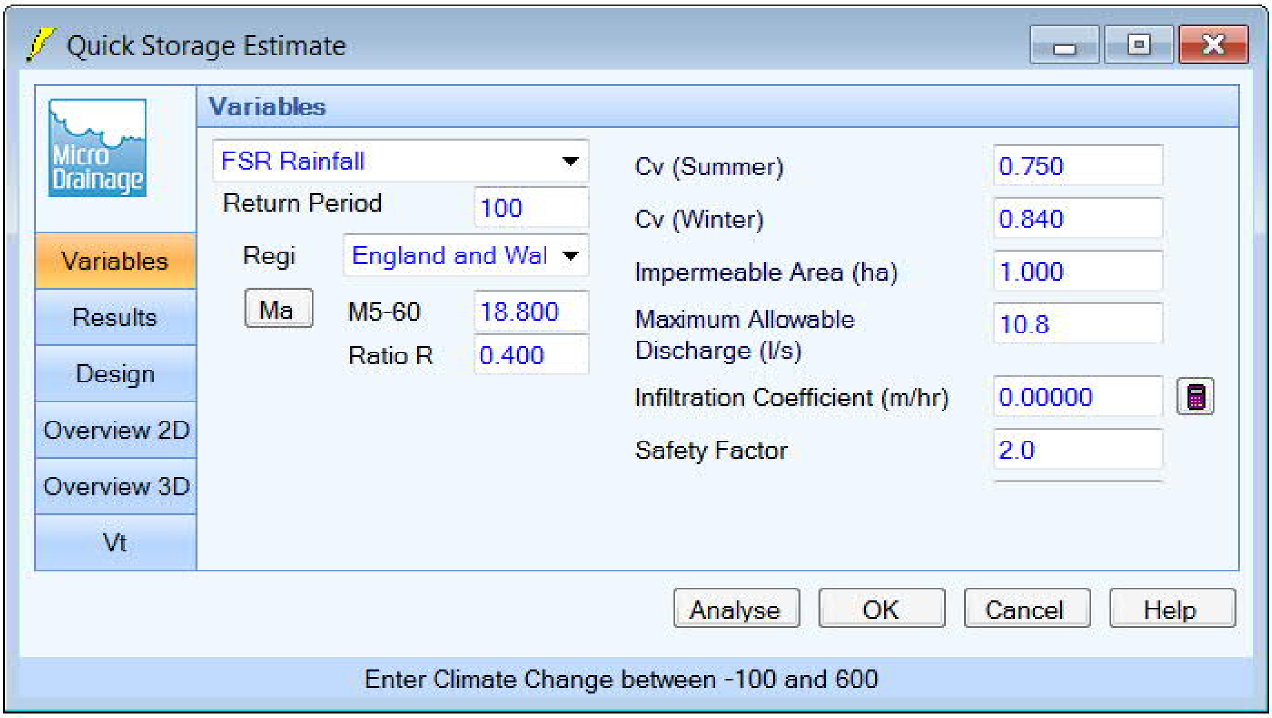


Figure A1 Microdrainage Source Control Quick Storage Estimate Input

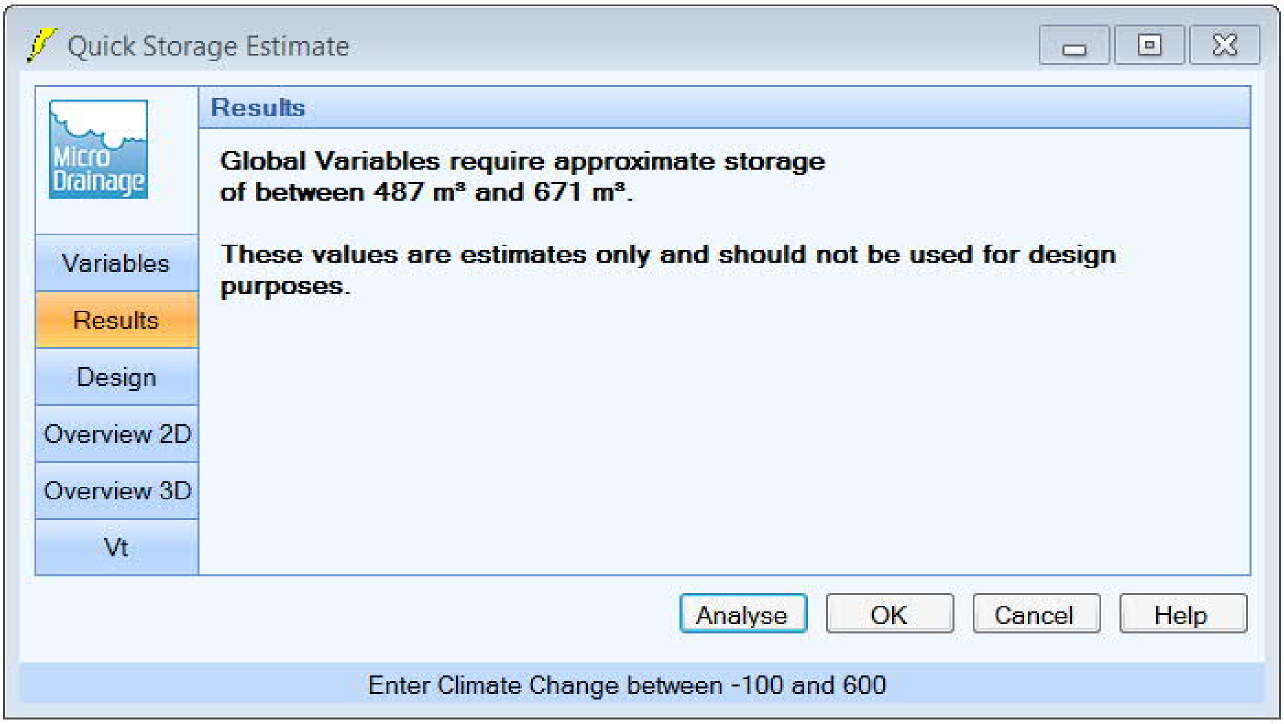


Figure A2. Microdrainage Source Control Quick Storage Estimate Output