



Viridis 178 Ltd

# Viridis Swansea Capacity Mechanism Development

Surface Water Management Plan



November 2015

Amec Foster Wheeler Environment  
& Infrastructure UK Limited



## Report for

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## Document revisions

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# Contents

<b>1.</b>	<b>Introduction</b>	<b>4</b>
1.1	Background and site context	4
	Purpose of the report	4
	Structure of this report	4
1.2	Sources of data and information	4
<b>2.</b>	<b>Site description, development proposal and planning context</b>	<b>5</b>
2.1	Site description	5
	The site	5
	Topography	5
	Hydrology and drainage	5
	Geology, hydrogeology and soils	5
2.2	Development proposals	5
<b>3.</b>	<b>Flood risk appraisal</b>	<b>7</b>
3.1	Summary of potential sources	7
<b>4.</b>	<b>Surface water management strategy</b>	<b>9</b>
4.1	Development of drainage strategy	9
	Planning Policy	9
	Compatibility of SuDS with site conditions	9
	Surface Water run-off calculations	9
	Attenuation requirements	10
4.2	Selecting the appropriate SUDS strategy	11
	Requirements of the drainage system	11
	The SUDS hierarchy	11
4.3	The proposed SUDS solution	12
4.4	Discharge location	12
<b>5.</b>	<b>Summary</b>	<b>13</b>
5.1	Flood risks and mitigation	13
5.2	Surface water management	13
5.3	Recommendations	13

---

Table 3.1	Summary of Potential Flood Risks	10
Table 4.1	Input data for determining greenfield run off rates	12
Table 4.2	Greenfield run off rates (IoH 124)	12

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Figure 1.1	Site location	After page 6
Figure 3.1	TAN 15 Development and Flood Risk Development Advice Map	9
Figure 4.1	SuDS Hierarchy	13

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Appendix A	Natural Resources Wales consultation
Appendix B	Development plan
Appendix C	Windes calculations



# 1. Introduction

## 1.1 Background and site context

Amec Foster Wheeler Environment & Infrastructure UK Ltd was commissioned by Viridis 178 Ltd to carry out a Surface Water Management Plan on land at the outskirts of Swansea, off Titanium Road (National Grid Reference SS606963), hereafter referred to as 'the Site'. The development proposal is for a new gas powered electricity generation compound.

### Purpose of the report

The purpose of this report is to determine a feasible Surface Water Management plan for the Site by considering all available sources of information. The Surface Water Management plan should meet the requirements of the Technical Advice Note (TAN) 15: Development and Flood Risk (2004).

### Structure of this report

The report is structured as follows:

- ▶ Section 2 - Site Description: Existing conditions and development proposals;
- ▶ Section 3 - Flood Risk Appraisal: this provides a brief initial assessment and a summary of the various sources of flood risk to the Site;
- ▶ Section 4 - Surface Water Management Strategy: this section details the surface water drainage strategy and provides details of any mitigation required to limit surface water run-off; and
- ▶ Section 5 - Conclusions and Recommendations: this Section summarises the report findings and presents the conclusions and recommendations.

The figures along with supporting documents are presented at the end of the report in the form of appendices. In total there are three appendices, as follows:

- ▶ Appendix A presents the Natural Resources Wales consultation;
- ▶ Appendix B contains the Development Plan; and
- ▶ Appendix C contains the Windes Drainage Calculations.

## 1.2 Sources of data and information

- ▶ National Planning Policy Framework (2012);
- ▶ Technical Advice Note (TAN) 15: Development and Flood Risk (2004); and
- ▶ Welsh Government website <http://data.wales.gov.uk/apps/floodmapping/>'Development and Flood Risk map'.

## 2. Site description, development proposal and planning context

### 2.1 Site description

#### The site

The Site is centred at Grid Reference SS 606963 about 1 km north of the village of Waunarlyydd and about 5 km west of the centre of Swansea (Figure 1.1). The application boundary covers an area of 0.57 ha and is located south of an existing Western Power Distribution sub-station and west of a Short Term Operating Reserve (STOR) generation compound. The Site is located 70 m from the Afon Lian to the north and is surrounded by open agricultural land of poor quality to the south and west. The field within which the Site is located is bounded by mature trees and hedges. The site is accessed via the existing access road to the Western Power owned and operated substation from Titanium Road.

#### Topography

Topographic elevations across the Site range from 17.1 mAOD at the northern end of the Site to 17.7 mAOD at the southernmost point of the Site. The Site slopes gently to the north towards the Afon Lian.

#### Hydrology and drainage

The Site is currently 100% greenfield. The northern boundary of the Site is bounded by a 1m high bank (Site level is top of bank) which drops off to an overgrown area of bushes and marshy vegetation beyond which lies the existing WPD sub-station. There are no waterbodies within the proposed Site boundary. The Afon Lian is located 70m to the north of the Site adjacent to the existing WPD sub-station. The river has a catchment area of 30.95 km<sup>2</sup> at its closest point to the Site according to the FEH CD-ROM (v3).

#### Geology, hydrogeology and soils

The BGS<sup>1</sup> online 'Geology of Britain' mapping indicates that the Site is underlain by the Grovesend Formation - Mudstone, Siltstone And Sandstone. These rocks were formed from rivers depositing mainly sand and gravel material in channels to form river terrace deposits, with fine silt and clay from overbank floods forming floodplain alluvium, and some bogs depositing peat; includes estuarine and coastal plain deposits. The superficial deposits recorded on the Site are classified as alluvium. The LANDIS soils database<sup>2</sup> indicates that the soil on the Site is classified as "*loamy and clayey floodplain soils*".

### 2.2 Development proposals

The proposed development is for a gas-fuelled capacity mechanism embedded power plant, which would comprise a series of gas-powered generators operating on a short term basis to meet peak capacity in the electricity distribution network i.e. they are a supplementary form of power which provide back-up supplies during potential black-out periods or when demand outstrips supply (Appendix B).

Site construction, laying of underground services and preparation of the foundations and slabs for the generators would take roughly three months, with a further three to four months required for the delivery and installation of the generators.

The power plant would not be continuously manned, with maintenance visits likely to occur a few times each week. The Site would be surrounded by a 2.4m high metal security fence and within this fence would be a

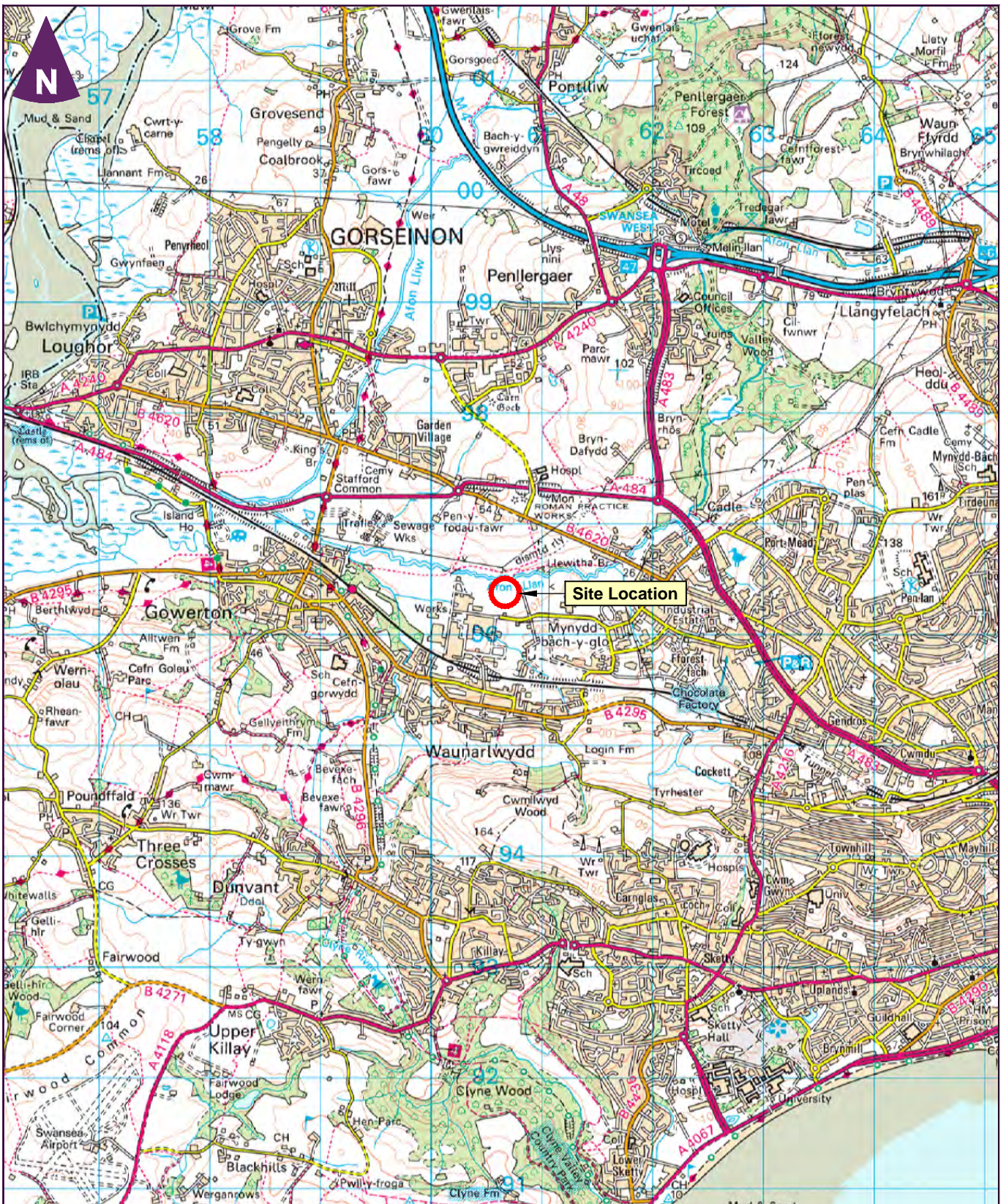
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<sup>1</sup> See: <http://www.bgs.ac.uk/data/mapViewers/home.html>

<sup>2</sup> See: <http://www.landis.org.uk/services/soilscapes.cfm>



4m high acoustic fenced compound to minimise noise arising from operation of the plant. The planning application for the generation compound is for a 25 year long lease.




Key

 Site location

Green Frog Energy Group  
Planning Support



Figure 1.1  
Site location

0 km  3 km

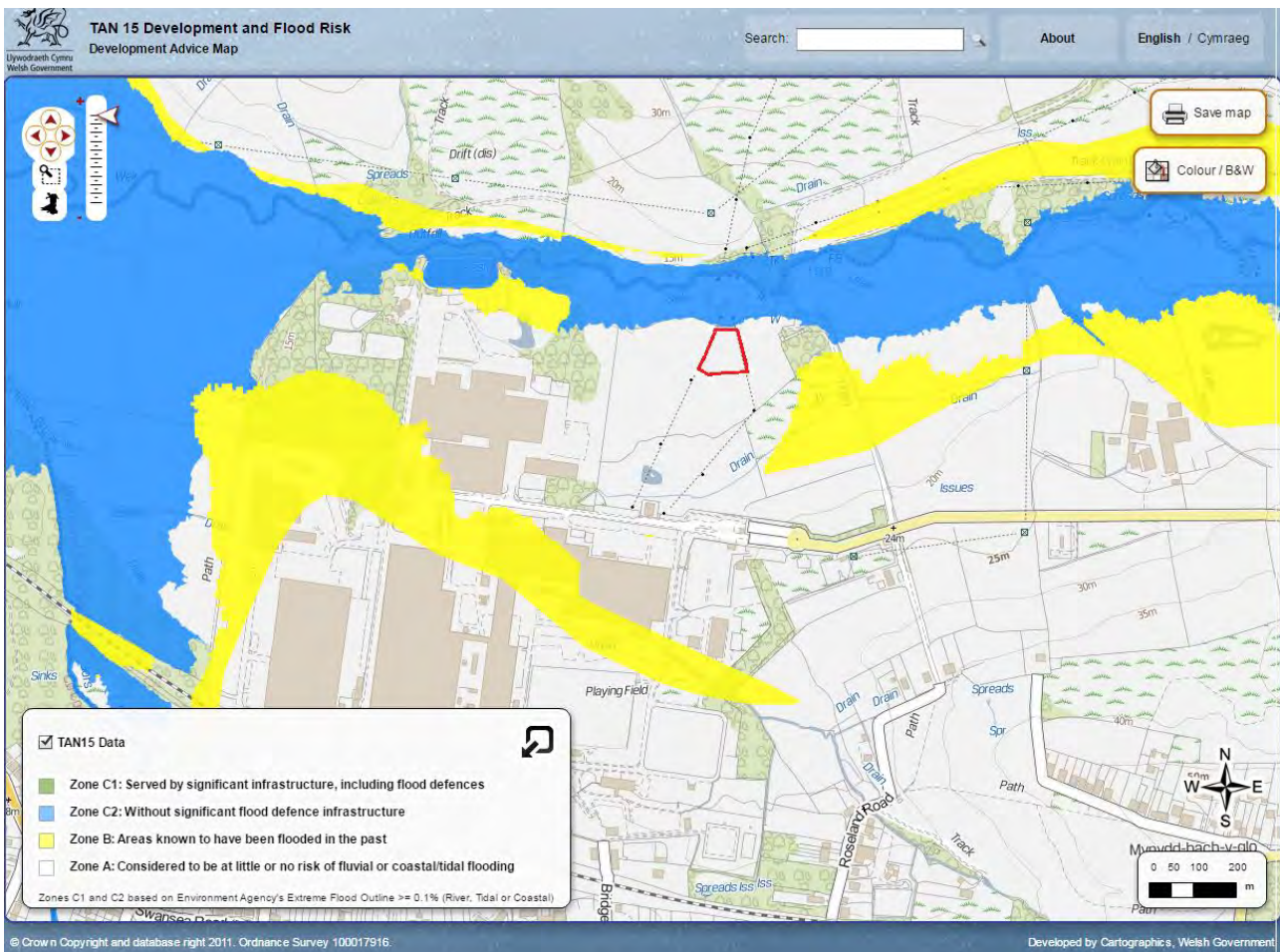
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## 3. Flood risk appraisal

### 3.1 Summary of potential sources

The TAN 15 Development Advice flood map is shown in Figure 3.1. It can be seen that the Site (shown in red outline) lies entirely in Flood Zone A. Areas of Flood Zone C2 can be seen along the Afon Llan, on land to the north of the Site. Table 3.1 summarises the flood risk across the Site from various potential sources of flooding - these are then discussed in the following sections. A Flood Risk Assessment (FRA) is not required for this Site as it is situated in Flood Zone A. This has been confirmed by NRW (see Appendix A).

Figure 3.1 TAN 15 development and flood risk development advice map



Source: <http://data.wales.gov.uk/apps/floodmapping/>. Redline boundary indicates Site location.

Table 3.1 Summary of potential flood risks

Source of Flooding	Risk Posed	Notes
<b>Fluvial</b>	Low Risk	The Site where development is proposed is located in Flood Zone A. There are low lying areas around the northern boundary which may become boggy during wet weather; however water pooling will not occur due to the sloping nature of the land. There is a 1m vertical freeboard between the lowest levels on the Site and the nearby Flood Zone C of the Afon Llan.
<b>Fluvial</b>	Low Risk	
<b>Tidal</b>	No Risk	There is no risk of tidal flooding to the Site.
<b>Groundwater</b>	Low Risk	No records of groundwater flooding have been identified. Given the geology (and non-aquifer classification), groundwater flood risk would be expected to be limited.
<b>Groundwater</b>	Low Risk	
<b>Surface run-off/ run-on and surface water drainage</b>	Low Risk	The topographic survey indicates there are no areas on Site where surface water could accumulate and cause flooding. The proposed area of impermeable surfaces on Site will increase as a result of the development. A surface water management strategy is being developed to ensure this is managed and attenuated via SuDS so as not to increase downstream flood risk.
	Low Risk	
<b>Artificial</b>	No risk	There are no artificial water bodies, or flood defences that pose a risk of flooding to the Site

## 4. Surface water management strategy

This section discusses the outline strategy for managing run-off from the developed Site in a sustainable manner, in accordance with the TAN 15 guidelines and NRW requirements. Overall requirements for attenuation storage are given, together with an outline strategy for how these requirements could be met within the Site.

### 4.1 Development of drainage strategy

#### Planning Policy

National planning guidance, in the form of TAN 15, requires that the surface water arrangements for any development site should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates prior to the proposed development (unless specific off-site arrangements are made and result in the same net effect). Where possible rainfall should be retained on-site and allowed to infiltrate into the ground within the Site. Usually run-off volumes will have to be stored during a storm and released slowly afterwards to meet the discharge rate requirement.

TAN 15 further advises that planning authorities should promote the use of Sustainable Drainage Systems (SuDS) in the management of surface water run-off from new developments. Thus there is a presumption for the use of SuDS in any development, unless it can be demonstrated that systems of this type are not feasible.

#### Compatibility of SuDS with site conditions

Generally speaking, SuDS techniques that promote infiltration of surface water are preferred over those which promote attenuation before discharge to a watercourse. In this case, the low permeability of the underlying superficial deposits, and the likely shallow depth to groundwater in the underlying alluvium, suggests that infiltration-based drainage techniques are unlikely to be suitable at this Site. As a consequence, the surface water management strategy will concentrate on the provision of attenuation storage within the Site to ensure run-off from the site remains at greenfield rates. Environment Agency guidance<sup>3</sup> states that where the volumetric criterion of maintaining the overall level of infiltration at the Site cannot practicably be achieved, the limiting discharge for any return period up to the 1 % AEP event shall not be greater than the mean annual greenfield peak runoff rate (referred to as  $Q_{bar}^4$ ). Minimum limits of discharge from flow attenuation devices may be set to 5 l/s as a compromise between attenuating to a satisfactorily low flow rate and to prevent blockages within the attenuation system.

#### Surface Water run-off calculations

The Site is currently 100% greenfield, with an area of 5,700 m<sup>2</sup> (0.57 ha). The proposed development will result 100% of the development area being developed, i.e. 0.57 ha. Greenfield rates have been determined using IOH 124 method<sup>4</sup>, using the calculation below.

$$Q_{bar\ rural} = 0.00108 \times Area^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$$

As recommended for sites of less than 50ha, the rate was calculated for a 50ha site area, and then scaled to the area of the site. The FSR<sup>5</sup> growth curve was then applied, as recommended in the CIRIA SuDS manual<sup>6</sup> (CIRIA 2007) in order to determine the rate associated with the 1% AEP event. A greenfield runoff rate of 16.19 l/s/ha or 9.2 l/s was calculated for the 1% AEP event (see Table 4.2).

<sup>3</sup> Environment Agency, Report SC 030219 Rainfall runoff management for developments

<sup>4</sup> Institute of Hydrology, Report 124 Flood Estimation for Small Catchments

<sup>5</sup> Institute of Hydrology (1975) Flood Studies Report

<sup>6</sup> Construction Industry Research Institute (CIRIA), Sustainable Drainage (SuDS) Manual, 2007

Table 4.1 Input data for determining greenfield run off rates

Parameter	Input Value	Comment
<b>Total area</b>	0.57 ha	Total development Site area
<b>Area</b>	0.57 ha	Approximate Site area which will be impermeable under proposed development, used in calculation of greenfield rate
<b>SAAR<sup>1</sup></b>	1364 mm/yr	Annual average rainfall, from FEH CD Rom for the period 1961 – 1990 at NGR SS 60150 97300
<b>Region</b>	9	From Flood Studies Report, as given in WinDes software, to determine the relevant growth curve.
<b>Soil type</b>	3	Winter Rainfall Acceptance Potential (WRAP) maps give the soil type for the location as 3 with a corresponding soil index of 0.37. This soil type is described as “clayey, or loamy over clayey soils, impermeable at shallow depth” which correlates with the Cranfield Soil and Agrifood Institute Landis Soilscales viewer <sup>7</sup> which describe the Site soils as loamy and clayey floodplain soils with naturally high groundwater. As described in Section 2, BGS survey maps of the Site indicate that the superficial geology is alluvium.

Table 4.2 Greenfield run off rates (IoH 124)

% AEP	Greenfield runoff (l/s/ha)	Greenfield runoff (l/s)
<b>Qbar</b>	7.4	4.2
<b>5</b>	9.0	5.1
<b>10</b>	10.5	6.0
<b>30</b>	13.0	7.4
<b>100</b>	16.2	9.0

The limiting rate of discharge from the Site should be set at 5 l/s<sup>3</sup> if infiltration is not proposed as an attenuation method.

### Attenuation requirements

Standard industry software WinDes (v12.6.1) was used to estimate the volume of storage required to attenuate runoff to 5 l/s for all events up to the 100 year event with a 10% allowance for climate change, as per the NPPF Planning Practice Guidance. A 10% factor was applied to current day rainfall estimates to allow for climate change to 2055. The intended lifetime of the generator site does not exceed 2055. Calculations have been undertaken assuming an impermeable area of 0.57 ha (100% of the total Site area). Results from WinDes are provided in Appendix B. The results indicate that, for the 1% AEP plus climate change (10%) rainfall event, a storage volume of approximately 380m<sup>3</sup> would be required to provide attenuation storage for the Site. The critical storm was the 720 minute 1% AEP plus climate change (10%) storm.

<sup>7</sup> <http://www.landis.org.uk/soilscales/>

## 4.2 Selecting the appropriate SUDS strategy

### Requirements of the drainage system

The drainage system is required to limit the peak discharge rate from the Site to 5 l/s for all events up to the 1% AEP (1 in 100 years) rainfall event, including a 10% allowance for climate change. In order to achieve this flow restriction it is necessary to include attenuation in the system.

The drainage strategy for managing surface water needs to be based on the Management Train as outlined in 'The SuDS Manual' (Ciria C697). This ensures that surface water is managed at source and as the water is conveyed through the Site, each sequential technique is designed to reduce the intensity of flow and to enhance the quality of flow by removing pollutants. The most suitable techniques for use across the Site can be ascertained by undertaking a SuDS Assessment. A high level assessment has been made by considering the SuDS hierarchy and choosing suitable techniques in line with the main objectives of Quantity (Flood Reduction), Quality (Pollution Reduction) and Amenity/Biodiversity (Landscape and Wildlife Benefit).

### The SUDS hierarchy

The SuDS Hierarchy is illustrated in Figure 4.1. This table rates each type of technique in terms of its overall sustainability.

Figure 4.1 SUDS Hierarchy

<b>Most Sustainable</b>	<b>SUDS technique</b>	<b>Flood Reduction</b>	<b>Pollution Reduction</b>	<b>Landscape &amp; Wildlife Benefit</b>
	<b>Living roofs</b>	✓	✓	✓
	<b>Basins and ponds</b> - Constructed wetlands - Balancing ponds - Detention basins - Retention ponds	✓	✓	✓
	<b>Filter strips and swales</b>	✓	✓	✓
	<b>Infiltration devices</b> - soakaways - infiltration trenches and basins	✓	✓	✓
	<b>Permeable surfaces and filter drains</b> - gravelled areas - solid paving blocks - porous paviers	✓	✓	
	<b>Tanked systems</b> - over-sized pipes/tanks - storms cells	✓		
	<b>Least Sustainable</b>			

Source: SUDS: A Practical Guide, Environment Agency Development Control Thames Region, 2006.

Techniques such as permeable surfaces offer source control by managing flow intensity entering the system, although they do not promote any wildlife benefit. Tanked systems are typically located underground and as such they offer no landscape, wildlife or pollution control benefit. Therefore, these systems are only to be used once all other sustainable techniques have been assessed and considered unsuitable.

SuDS techniques that promote infiltration of surface water are preferred over those which promote attenuation before discharge to a watercourse. As identified in Section 3, the Site is underlain by the Grovesend solid geology. Overall, the geology at the Site is not particularly permeable; therefore, SuDS techniques which primarily utilise infiltration are not suitable at this Site.

As infiltration rates across the Site are considered poor, on-Site attenuation should be the primary means of surface water management. However, if the results of any future infiltration testing indicate that infiltration could be utilised as part of the drainage system, then the total attenuation volume will be reduced. As the Site is not located in a groundwater Source Protection Zone (SPZ), there would be no reason from a groundwater pollution perspective as to why the run-off generated on - Site could not be infiltrated into the ground, providing a risk assessment has been carried out to ascertain the potential levels of pollution. In particular, any car parking areas along the access track would need to be assessed to identify the need for an oil separator or suitable SuDS technique.

### 4.3 The proposed SUDS solution

The proposed Development Plan (Appendix B) includes areas between the tarmacked access and generators that can provide attenuation storage, without the need for any sub-surface tank system. The ground cover between the tarmacked access and the generators will be gravel. This area (which covers approximately 50% of the total area of the site) can therefore be used as a gravel-filled SuDS basin, providing the required attenuation volume for the whole Site. The gravel will enable access to the generators. In order to achieve the required attenuation volume of 380m<sup>3</sup>, the SuDS basin would require a depth of 0.44m assuming a gravel porosity of 30%. The SuDS basin will have a maximum discharge rate of 5 l/s. The outfall of the SuDS basin should be closed off in the event of a pollution incident<sup>8</sup>. Spill kits should be available on Site, and the generators should be bunded as required to contain any oil coolant spillages.

### 4.4 Discharge location

It has been assumed that infiltration will not be possible, due to the anticipated low permeability of the underlying alluvium and shallow depth to groundwater. Surface water will be discharged at controlled rates to a nearby watercourse via a pipe or drainage ditch. The details of the new pipe or ditch and details of flow control will need to be determined at the detailed design stage.

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<sup>8</sup> Environment Agency, PPG3 Pollution Prevention Guidelines

## 5. Summary

### 5.1 Flood risks and mitigation

The development area within the Site and the access routes to it are not located in a fluvial flood risk area and therefore safe access and egress can be maintained at times when nearby watercourses are in flood. Flood risk has been considered from all sources. The proposed development is not at risk of tidal flooding or fluvial flooding. Whilst a watercourse flows 70m to the north of the Site which has a floodplain near to the Site, there is a 1m vertical freeboard between the lowest Site levels and edge of Flood zone C. The impact of the development on run-off has been assessed, and recommendations provided for SuDS that will prevent any increase in downstream flood risk.

### 5.2 Surface water management

Section 4 has recommended potential options to ensure that surface water generated as a result of the development is managed and controlled to a discharge rate of 5 l/s or 8.8 l/s/ha during the 1% AEP plus climate change (10%) rainfall event. A required storage volume of 380 m<sup>3</sup> has been calculated in order to attenuate excess runoff from the development. The required attenuation volume can be provided by infilling 50% of the Site to a depth of 0.44m with gravel of a porosity of at least 30%. This gravelled area will act as a SuDS basin which will discharge at a rate of 5 l/s. The outfall should be controlled either by a weir or hydrobrake into a ditch or pipe discharging to the Afon Lian.

The outline SuDS detailed in Section 4 should be developed further as the development design progresses. Agreement on detailed design should be made with the adopting authority. Under the Flood and Water Management Act (FWMA), 2010 this will typically be the Lead Local Flood Authority (LLFA). Under the Act, the LLFA is termed the 'SuDS Approving Body' (SAB) and should be consulted as the final designs are developed to ensure a final design suitable for implementation and adoption is constructed.

### 5.3 Recommendations

- ▶ The attenuation based SuDS have been sized on the basis that they will be the only element. Although the Site geology has a low infiltration rate, source control measures could still be used in parts of the Site so it may be possible to reduce the volume of attenuation storage as part of the final design;
- ▶ Infiltration techniques for excess runoff attenuation can only be implemented provided that infiltration testing can demonstrate that there is sufficient permeability and headroom above the water table; and
- ▶ It is recommended that the discharge of runoff to the Afon Lian is treated on Site to ensure that no contaminants from the generators enter the nearby watercourse.





# Appendix A

## Natural Resources Wales consultation

Dr Richard Breakspear  
Amec Foster Wheeler  
155 Aztec West,  
Park Avenue,  
Almondsbury  
Bristol  
BS32 4UB

Ein cyf / Our ref: SH/2015/118375/01  
Eich cyf / Your ref: 37121 FRA

14 April 2015

Dear Dr Breakspear

**PRE – APPLICATION ENQUIRY: PROPOSED CONSTRUCTION OF A GAS FUELLED CAPACITY MECHANISM EMBEDDED POWER PLANT ON LAND CURRENTLY SET TO PASTURE. SCHEME TO INCLUDE GENERATOR UNITS, ASSOCIATED CONTROL PLANT AND WELFARE UNIT, PLUS AREAS OF HARDSTANDING.**

Thank you for consulting Cyfoeth Naturiol Cymru / Natural Resources Wales, in relation to the above proposal, which we received on 1 April 2015.

**Please note that these comments do not set a precedent for our response to any formal application for planning permission or other legal consent. Such applications shall be assessed on the information submitted and regulations of relevance at that time. The details contained in this letter are based on the information available to date.**

#### **Environmental Permit Requirements**

Proposal would require a permit from NRW under Environmental Permitting (England and Wales) Regulations 2010 (as amended) as a Part A(1) activity as the aggregated term input will exceed 50 MWth. The EPR Permit will cover emissions to the environment including noise. We are aware that some pre-application discussions have taken place with the applicant for a permit application to be made.

It should be noted that before commissioning the Permit would not cover noise and other construction activities. Please be aware that other permission may be required from NRW for such activities as the discharge of water from the site during construction.

**We would advise that parallel tracking of the Environmental Permit and Planning Application takes place.**

Natural Resources Wales/Cyfoeth Naturiol Cymru  
Maes Newydd, Llandarcy, Neath Port Talbot, SA10 6JQ.  
Llinell gwasanaethau cwsmeriaid / Customer services line: 0300 065 3000  
[www.cyfoethnaturiolcymru.gov.uk](http://www.cyfoethnaturiolcymru.gov.uk) / [www.naturalresourceswales.gov.uk](http://www.naturalresourceswales.gov.uk)

Croesewir gohebiaeth yn y Gymraeg a'r Saesneg  
Correspondence welcomed in Welsh and English

### **Protected Sites and Air Quality**

For all SSSI within at least 2 km, and all SAC/SPA/Ramsar within 10km, of the proposed plant, we require the following information:

- Concentrations of NO<sub>x</sub> (and SO<sub>2</sub> if present in emissions) emitted by the proposed plant compared to critical levels for sensitive habitats at the above sites.
- Information with regard to Critical Levels can be found on the APIS website at: [http://www.apis.ac.uk/overview/issues/overview\\_Cloadslevels.htm#\\_Toc279788054](http://www.apis.ac.uk/overview/issues/overview_Cloadslevels.htm#_Toc279788054).
- We also advise that proposed plant emissions (Process Contribution/PC) should be compared as a percentage of the relevant critical level as well being compared to the PC added to the background (PEC), to give percentage figures.
- Levels of nutrient Nitrogen deposition and Acid deposition derived from the proposed plant (PC) should also be compared to site relevant critical loads for the above sites. These are available on the APIS website (<http://www.apis.ac.uk/srcl>) and should be similarly compared to the PC and PEC for each feature's most sensitive critical load value, to give percentage values.
- Instructions on how to carry out these calculations for acid deposition are available on the APIS website: <http://www.apis.ac.uk/critical-load-function-tool> ) and in Environment Agency AQ TAG Paper 06 for nutrient Nitrogen deposition. Please note that in relation to a Peaking Power facility (or similar) which operates sporadically, the assessment must be done as a worst case scenario i.e. the maximum number of hours that the plant will be able to operate, over a year.

### **Habitats Regulations Assessment**

NRW would also draw to your attention that a Habitats Regulations Assessment (HRA) will need to be recorded by the Planning Authority.

The HRA should test the likely significant effects of the development for all relevant receptor SAC, SPA and Ramsar sites, in light of impact pathways from the development itself (for example aerial emissions). These effects should be tested alone and if no likely significant effects concluded for a particular impact pathway on a site(s) alone, in-combination effects should then be tested for those parameters, according to any residual effects from this development and other relevant plans/projects.

Guidance is available for competent authorities in recording HRA's (Assessing Projects Under The Habitats Directive - Guidance For Competent Authorities, CCW, 2011) and this may aid the applicant in providing information to the competent authority, in terms of main guiding principles of the HRA process.

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Croesewir gohebiaeth yn y Gymraeg a'r Saesneg  
Correspondence welcomed in Welsh and English

### **Surface Water Disposal**

The site is located within zone A, as defined by the development advice maps referred to under TAN 15 Development and Flood Risk (July 2004). Our Flood Map information, which is updated on a quarterly basis, indicates the site to be outside of the current flood zones. As the site is located in zone A, we can confirm that a flood consequences assessment will not be required for the development.

We also note from the information provided that surface water from the site will be attenuated prior to discharging to the Afon Llan. In the first instance, we would advise that all SUDs techniques are explored and implemented where possible prior to discharging to a watercourse. If it can be demonstrated that infiltration techniques are not suitable on the site, the proposed discharge rate into the Afon Llan will need to be reviewed by our Hydrology team.

### **Foul Water Disposal**

We note that the development proposes a cesspit. We would object to the use of a sealed cesspit at this location as the site is within a sewered area, with a gravity foul pipe passing along the boundary of the proposed development. We would require further details as to why connection to the foul sewer is not proposed.

### **Pollution Prevention**

Due to the proximity of the proposed development to the Afon Llan we would advise that a detailed Construction Management Plan (CMP) and Pollution Prevention Plan (PPP) are produced prior to commencement of work on the site.

Our local Natural Resource Management (NRM) team would be happy to discuss these matters. The primary focus of these plans is to minimise the clearance of land, reduce risk of erosion and prevent silt contaminated water from leaving site. For further information, please feel free to contact Chris Palmer (Environment Officer) at: [Chris.Palmer@cyfoethnaturiolcymru.gov.uk](mailto:Chris.Palmer@cyfoethnaturiolcymru.gov.uk)

I hope these comments are of assistance. If you have any queries regarding the above, please feel free to contact the Llandarcy office.

Yours sincerely

**Aled Roderick**  
**Development Planning Advisor /**  
**Ymgynghorydd Cynllunio Datblygu**

Natural Resources Wales/Cyfoeth Naturiol Cymru  
Maes Newydd, Llandarcy, Neath Port Talbot, SA10 6JQ.  
Llinell gwasanaethau cwsmeriaid / Customer services line: 0300 065 3000  
[www.cyfoethnaturiolcymru.gov.uk](http://www.cyfoethnaturiolcymru.gov.uk) / [www.naturalresourceswales.gov.uk](http://www.naturalresourceswales.gov.uk)

Croesewir gohebiaeth yn y Gymraeg a'r Saesneg  
Correspondence welcomed in Welsh and English

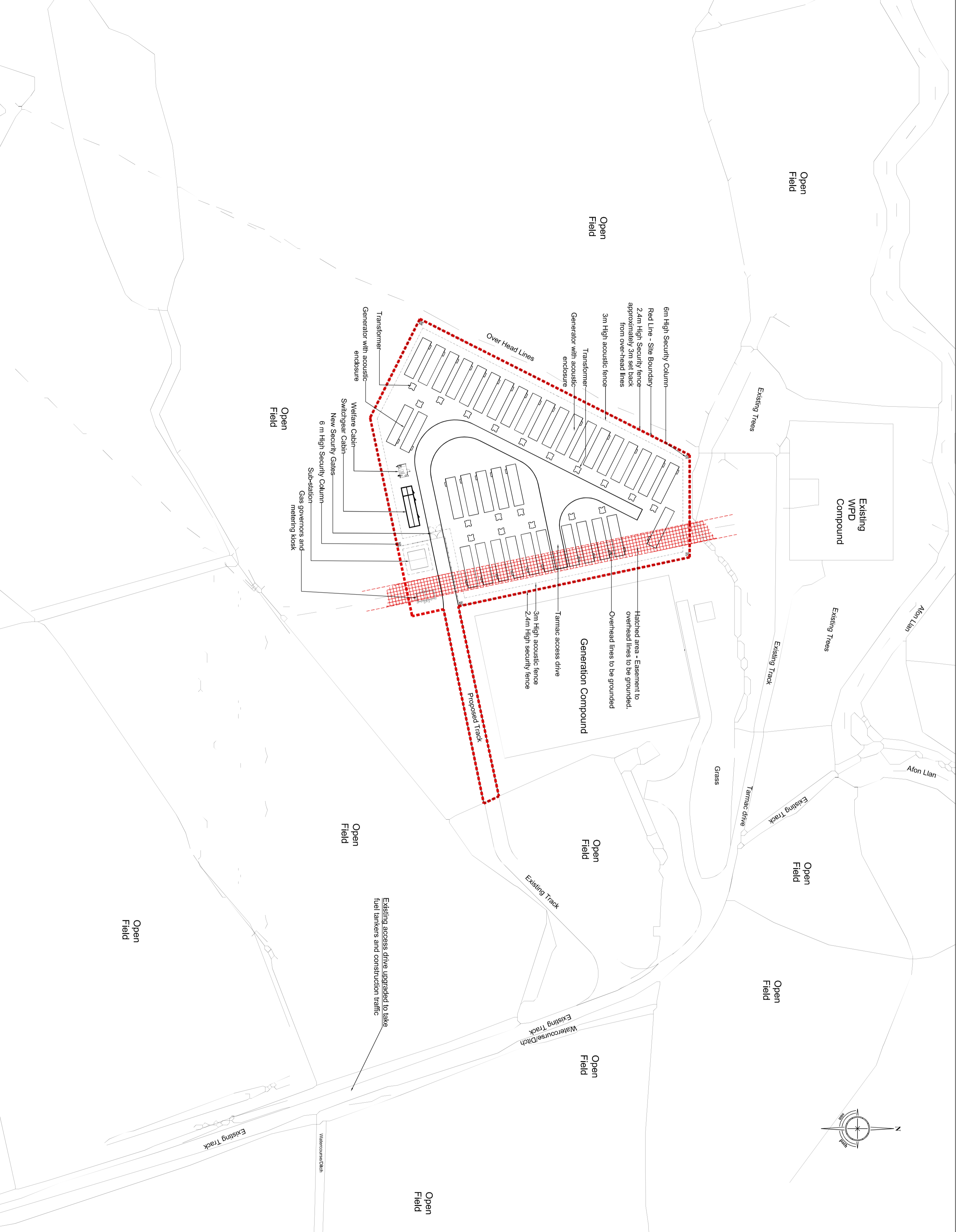
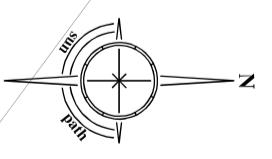


# Appendix B

## Development plan

Scale 1:1000

REVISIONS	Rev.	Date	By



Planning

ALL DIMENSIONS TO BE CHECKED ON SITE  
WORK TO REQUIRED DIMENSIONS ONLY  
AT ONCE BEFORE PROCEEDING  
COPYRIGHT ACT APPLIES



Project Title:  
Generation Compound  
Titanium Road  
Suttonia  
SAS 45F

Drawing Title:  
**Proposed Plan**

Scale: 1:500 @ A1 Date: March 2015  
Drawn: SJ Checked: DS  
Drawing No: 230/004 Rev:

Plot date: 19-Mar-15



# Appendix C

## Windes calculations

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
15 min Summer	0.378	0.378	3.1	0.0	3.1	143.7	O K
30 min Summer	0.461	0.461	3.4	0.0	3.4	175.0	O K
60 min Summer	0.556	0.556	3.7	0.0	3.7	211.4	O K
120 min Summer	0.662	0.662	4.1	0.0	4.1	251.7	O K
180 min Summer	0.725	0.725	4.3	0.0	4.3	275.7	Flood Risk
240 min Summer	0.768	0.768	4.4	0.0	4.4	291.8	Flood Risk
360 min Summer	0.819	0.819	4.5	0.0	4.5	311.4	Flood Risk
480 min Summer	0.846	0.846	4.6	0.0	4.6	321.5	Flood Risk
600 min Summer	0.862	0.862	4.6	0.0	4.6	327.5	Flood Risk
720 min Summer	0.874	0.874	4.7	0.0	4.7	332.1	Flood Risk
960 min Summer	0.875	0.875	4.7	0.0	4.7	332.7	Flood Risk
1440 min Summer	0.864	0.864	4.6	0.0	4.6	328.2	Flood Risk
2160 min Summer	0.828	0.828	4.5	0.0	4.5	314.8	Flood Risk
2880 min Summer	0.788	0.788	4.4	0.0	4.4	299.5	Flood Risk
4320 min Summer	0.720	0.720	4.2	0.0	4.2	273.6	Flood Risk
5760 min Summer	0.657	0.657	4.0	0.0	4.0	249.6	O K
7200 min Summer	0.600	0.600	3.9	0.0	3.9	228.2	O K
8640 min Summer	0.550	0.550	3.7	0.0	3.7	209.0	O K
10080 min Summer	0.505	0.505	3.6	0.0	3.6	191.9	O K
15 min Winter	0.424	0.424	3.3	0.0	3.3	161.0	O K
30 min Winter	0.517	0.517	3.6	0.0	3.6	196.3	O K
60 min Winter	0.625	0.625	3.9	0.0	3.9	237.4	O K
120 min Winter	0.746	0.746	4.3	0.0	4.3	283.4	Flood Risk

Storm Event	Rain (mm/hr)	Overflow Volume (m <sup>3</sup> )	Time-Peak (mins)
15 min Summer	136.403	0.0	19
30 min Summer	83.838	0.0	34
60 min Summer	51.529	0.0	64
120 min Summer	31.672	0.0	122
180 min Summer	23.824	0.0	182
240 min Summer	19.466	0.0	242
360 min Summer	14.643	0.0	360
480 min Summer	11.965	0.0	478
600 min Summer	10.229	0.0	526
720 min Summer	9.000	0.0	592
960 min Summer	7.259	0.0	714
1440 min Summer	5.362	0.0	982
2160 min Summer	3.960	0.0	1404
2880 min Summer	3.194	0.0	1816
4320 min Summer	2.383	0.0	2636
5760 min Summer	1.935	0.0	3408
7200 min Summer	1.647	0.0	4176
8640 min Summer	1.443	0.0	4928
10080 min Summer	1.291	0.0	5656
15 min Winter	136.403	0.0	19
30 min Winter	83.838	0.0	33
60 min Winter	51.529	0.0	62
120 min Winter	31.672	0.0	120

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
180 min Winter	0.819	0.819	4.5	0.0	4.5	311.1	Flood Risk
240 min Winter	0.869	0.869	4.7	0.0	4.7	330.1	Flood Risk
360 min Winter	0.932	0.932	4.8	0.0	4.8	354.2	Flood Risk
480 min Winter	0.968	0.968	4.9	0.0	4.9	367.9	Flood Risk
600 min Winter	0.988	0.988	5.0	0.0	5.0	375.6	Flood Risk
720 min Winter	0.999	0.999	5.0	0.0	5.0	379.5	Flood Risk
960 min Winter	0.997	0.997	5.0	0.0	5.0	378.9	Flood Risk
1440 min Winter	0.977	0.977	4.9	0.0	4.9	371.2	Flood Risk
2160 min Winter	0.921	0.921	4.8	0.0	4.8	349.9	Flood Risk
2880 min Winter	0.858	0.858	4.6	0.0	4.6	325.9	Flood Risk
4320 min Winter	0.750	0.750	4.3	0.0	4.3	284.9	Flood Risk
5760 min Winter	0.655	0.655	4.0	0.0	4.0	249.0	O K
7200 min Winter	0.575	0.575	3.8	0.0	3.8	218.6	O K
8640 min Winter	0.507	0.507	3.6	0.0	3.6	192.7	O K
10080 min Winter	0.449	0.449	3.3	0.0	3.3	170.6	O K
Storm Event	Rain (mm/hr)	Overflow Volume (m <sup>3</sup> )	Time-Peak (mins)				
180 min Winter	23.824	0.0	178				
240 min Winter	19.466	0.0	236				
360 min Winter	14.643	0.0	350				
480 min Winter	11.965	0.0	462				
600 min Winter	10.229	0.0	568				
720 min Winter	9.000	0.0	666				
960 min Winter	7.259	0.0	752				
1440 min Winter	5.362	0.0	1066				
2160 min Winter	3.960	0.0	1516				
2880 min Winter	3.194	0.0	1960				
4320 min Winter	2.383	0.0	2808				
5760 min Winter	1.935	0.0	3624				
7200 min Winter	1.647	0.0	4392				
8640 min Winter	1.443	0.0	5184				
10080 min Winter	1.291	0.0	5944				

Northumbria House  
Regent Centre  
Gosforth NE3 3PX



Date 15/05/2015 16:24  
File 37121-TimetGreeF...

Designed by richard.c...  
Checked by

Micro Drainage

Source Control W.12.6.1

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
Site Location	GB 260150 197300 SS 60150 97300
C (1km)	-0.027
D1 (1km)	0.422
D2 (1km)	0.377
D3 (1km)	0.401
E (1km)	0.288
F (1km)	2.522
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+10

Time / Area Diagram

Total Area (ha) 0.570

**Time   Area**  
**(mins) (ha)**

0-4 0.570

